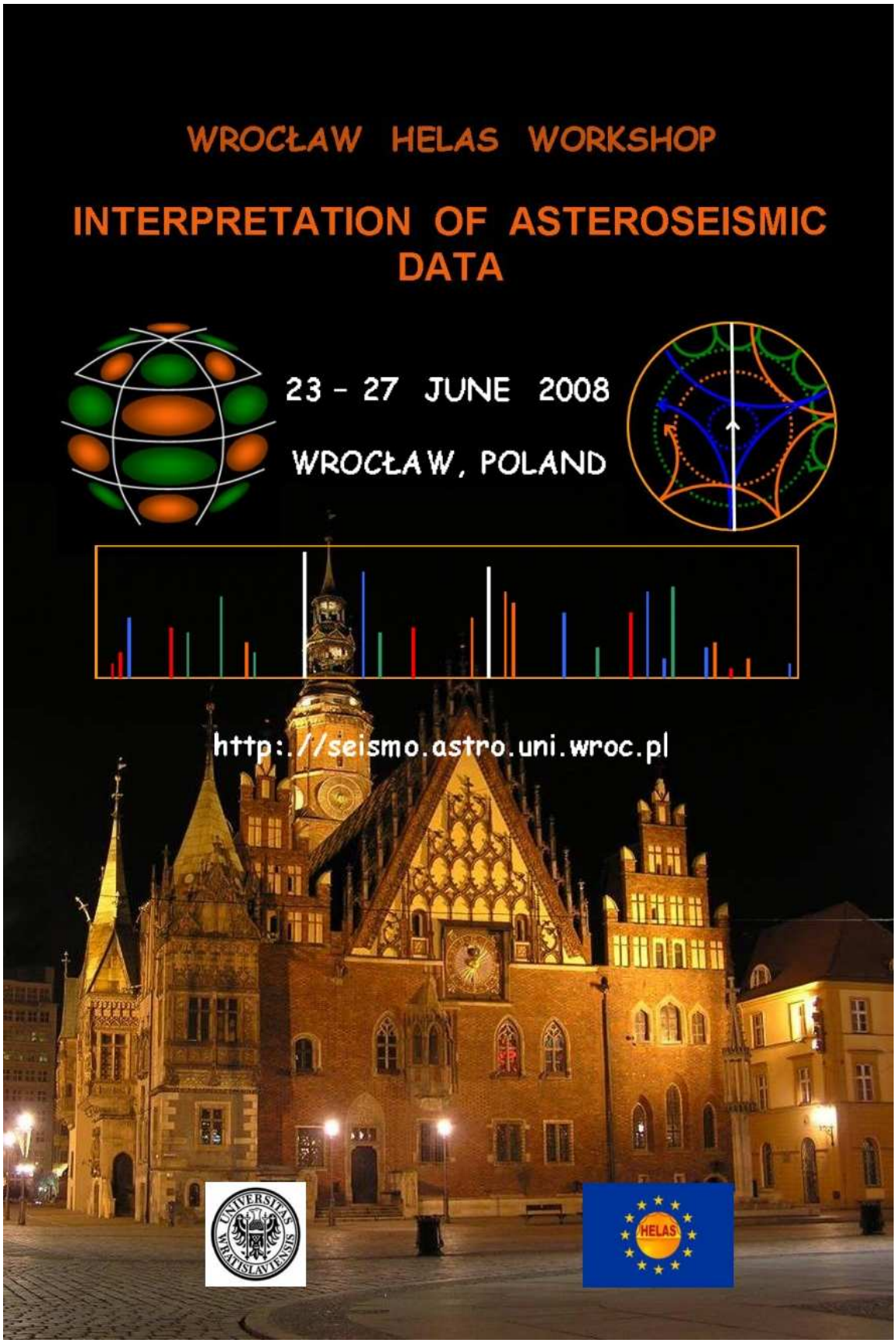

Program and abstract book

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Program

June 22, Sunday

18:00 – 20:00 Registration

June 23, Monday

Session 0: **Introduction** Chair: J. Daszyńska-Daszkiewicz

8:00 – 9:00 Registration and setting up posters
9:00 – 9:15 Welcome and opening the workshop by vice-rector of Wrocław University, prof. Krzysztof Nawotka
9:15 – 9:35 **Oskar von der Lühe** — *Introduction of the HELAS project (invited)*
9:35 – 10:15 **Marc-Antoine Dupret** — Introductory talk: *Problems and prospects in stellar physics (invited)*
10:15 – 11:00 — coffee break

Session 1A: **DATA: ground-based observations** Chair: J. Daszyńska-Daszkiewicz

11:00 – 11:30 **S. Oliveira Kepler** — *Photometric observations of pulsating stars (invited)*
11:30 – 12:00 **Conny Aerts** — *Spectroscopic observations of pulsating stars (invited)*
12:00 – 12:15 **Sonja Schuh** — *Multi-wavelength photometric variation of PG 1605+072*
12:15 – 12:30 **Wojciech Dimitrov** — *Radial-velocity observations of pulsating stars with a new Poznań Spectroscopic Telescope*
12:30 – 14:00 — lunch

Session 1A: **DATA: ground-based observations** – cont'd Chair: W. Dziembowski

14:00 – 14:30 **Igor Soszyński** — *Detecting pulsating variables from massive surveys (invited)*
14:30 – 14:45 **Torsten Böhm** — *Discovery of non-radial pulsations in the spectroscopic binary Herbig Ae star RS Cha*
14:45 – 15:00 **Katrien Kolenberg** — *A different approach to analyzing the Blazhko effect: the VSAA applied to RR Lyr*
15:00 – 15:15 **Mike Breger** — *Towards mode selection in δ Scuti stars: regularities in the observed frequency spacing*
15:15 – 16:00 — coffee break, poster session

Session 1B: **DATA: space missions** Chair: W. Dziembowski

16:00 – 16:30 **David Guenther** — *MOST and the search for p-modes in Sun-like stars (invited)*
16:30 – 17:00 **Eric Michel** — *Asteroseismic results from CoRoT (invited)*
17:00 – 17:15 **Jaymie Matthews** — *MOST asteroseismology across the HR Diagram*
17:15 – 17:30 **Juan Gutiérrez-Soto** — *First results on the Be stars observed with the COROT satellite*
20:00 – 23:00 — Welcome reception on the boat cruising the Odra River

June 24, Tuesday

Session 2A: **MODES: extracting eigenmode frequencies** Chair: M. Breger

9:00 – 9:30 **Mikołaj Jerzykiewicz** — *Extracting oscillation frequencies from sparse spectra: Fourier analysis (invited)*
9:30 – 9:45 **Geza Kovács** — *Application of the Trend Filtering Algorithm in searching for multiperiodic signals*
9:45 – 10:00 **Sotirios Tsantilas** — *VSAA: A method of tracing variable frequencies in time series analysis*
10:00 – 10:30 **Brendon Brewer** — *Extracting oscillation frequencies from dense spectra: A Bayesian approach (invited)*
10:30 – 10:45 **Othman Benomar** — *An application of the Bayesian inference in a solar-like pulsator: HD 49933*
10:45 – 11:00 **Neil Tarrant** — *Analysis of sun-like oscillations in Red Giant stars*
11:00 – 11:30 — coffee break, poster session

Session 2B: **MODES: mode identification** Chair: M. Breger

11:30 – 12:00 **Gerald Handler** — *Pulsational mode identification from multi-colour photometry (invited)*
12:00 – 12:30 **John Telting** — *Constraints on angular numbers of pulsation modes from spectroscopy (invited)*
12:30 – 12:45 **Karen Pollard** — *Spectroscopic observations and mode-identification of a sample of non-radially pulsating stars*
12:45 – 13:00 **Barbara Castanheira** — *Spectroscopic mode identification of the δ Scuti stars 4 CVn and EE Cam*

13:00 – 14:30 — lunch

Session 3A: **STARS: convection** Chair: A. Noels

14:30 – 15:00 **Reza Samadi** — *Stochastic excitation of oscillation modes in the HR diagram (invited)*
15:00 – 15:30 **Guenter Houdek** — *Pulsation-convection interaction: the effect of convection on mode stability (invited)*
15:30 – 15:45 **Stéphane Mathis** — *Stochastic waves excitation in rotating stars*
15:45 – 16:00 **Radosław Smolec** — *Double-mode Cepheid models – revisited*
16:00 – 17:00 — coffee break, poster session

Session 3B: **STARS: opacity driving, levitation, opacity data** Chair: A. Noels

17:00 – 17:30 **Nicolas Grevesse** — *Photospheric solar chemical composition (invited)*
17:30 – 18:00 **Josefina Montalbán** — *Input from opacity data in computation of pulsation instability (invited)*

June 25, Wednesday

Session 3B: **STARS: opacity driving, levitation, opacity data** – cont'd
Chair: M.-J. Goupil

9:00 – 9:30	**Stéphane Charpinet** — *The potential of hot B subdwarf pulsators for testing diffusion and other competing process in stars (invited)*
9:30 – 10:00	**Gilles Fontaine** — *Degenerate pulsators (invited)*
10:00 – 10:15	**Ronny Lutz** — *Long-term photometric monitoring of the hybrid subdwarf B pulsator HS 0702+6043*
10:15 – 10:30	**Suzanna Randall** — *Mode identification in rapidly pulsating subdwarf B stars from monochromatic amplitude and phase variations*
10:30 – 11:00	— conference photo in the Szczytnicki Park
11:00 – 12:00	— poster session, coffee break
12:00 – 13:30	— lunch
13:30 – 14:00	— transport to the Wrocław Market Square
14:00 – 17:00	— city tour
20:00 – 23:00	— conference dinner

June 26, Thursday

Session 3C: **STARS: effects of rotation on the stellar structure and pulsation**
Chair: R. Garrido

9:00 – 9:30 **Jean-Paul Zahn** — *Effects of rotation on stellar structure: rotation induced mixing (invited)*
9:30 – 10:00 **Umin Lee** — *Pulsation in rapidly rotating stars (invited)*
10:00 – 10:15 **Stéphane Mathis** — *Waves transport in differentially rotating stellar radiation zones*
10:15 – 10:30 **Francois Lignières** — *The asymptotic structure of the p-modes frequency spectrum in rapidly rotating stars*
10:30 – 11:00 — coffee break, poster session

Session 3D: **STARS: effects of magnetic field on stellar pulsation**
Chair: R. Garrido

11:00 - 11:30 **Hiromoto Shibahashi** — *Theory of roAp stars (invited)*
11:30 – 12:00 **Oleg Kochukhov** — *Pulsation in the atmosphere of roAp stars (invited)*
12:00 – 12:15 **Isa Brandão** — *Interferometric and seismic constraints on the roAp star α Cir*
12:15 – 12:30 **Joana Sousa** — *On the understanding of pulsations in the atmosphere of magnetic stars*

12:30 – 14:00 — lunch

Session 3E: **STARS: oscillations and stellar models** Chair: M.-J. Goupil

14:00 – 14:30 **Simon Jeffery** — *The impact of asteroseismology on the theory of stellar evolution (invited)*
14:30 – 15:00 **Alosha Pamyatnykh** — *Examples of seismic modelling (invited)*
15:00 – 16:15 — coffee break, poster session
16:15 – 16:30 **Konstanze Zwintz** — *Asteroseismology of pre-main sequence stars*
16:30 – 16:45 **Marcella Di Criscienzo** — *The use of the rotating evolutionary models for the seismic interpretation of two pulsating PMS stars in NGC 6530*
16:45 – 17:00 **Valérie Van Grootel** — *Internal rotation profile from asteroseismology for two sdB pulsators residing in close binary systems*

June 27, Friday

Session 4: **FUTURE ASTEROSEISMIC PROJECTS** Chair: W. Dziembowski

9:00 – 9:25	**Jørgen Christensen-Dalsgaard** — *Kepler (invited)*
9:25 – 9:50	**Werner W. Weiss** — *BRITE-Constellation (invited)*
9:50 – 10:15	**Conny Aerts** — *PLATO: PLAnetary Transits and Oscillations of stars (invited)*
10:15 – 11:00	— coffee break, poster session
11:00 – 11:25	**Eric Fossat** — *Asteroseismic possibilities at Concordia, Antarctica (invited)*
11:25 – 11:50	**Frank Grundahl** — *SONG – writing the verses (invited)*
11:50 – 12:20	**Joyce Guzik** — CLOSING TALK
12:20 – 14:00	— lunch

Session 0: **Introduction**
Time: Monday, June 23, 9:15 – 9:35
Type of talk: Invited

Introduction of the HELAS project

Oskar von der Lühe

Kiepenheuer-Institut für Sonnenphysik, Freiburg, Germany

Session 0: **Introduction**
Time: Monday, June 23, 9:35 – 10:15
Type of talk: Invited

Introductory talk: problems and prospects in stellar physics

Marc-Antoine Dupret

Paris-Meudon Observatory, France

Main difficulties and uncertainties in stellar physics originate in the modelling of convection, microscopic and macroscopic transport mechanisms and rotation. I consider each of them, giving a particular attention to the possible probing of these physical processes by asteroseismology.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 11:00 – 11:30
Type of talk: Invited

Photometric observations of pulsating stars (ground based)

S.O. Kepler

Instituto de Fisica da UFRGS, Porto Alegre, RS, Brazil

The study of pulsating stars through photometric observations, specially time series photometry, has grown from visual, to single channel photometry, double and triple channel photometry and finally CCD photometry. The continuous measurement of the pulsating star, simultaneous with accurate sky measurements and several comparison stars has allowed a huge increase in the S/N, and the possible correction of thin cloud and atmospheric variability, which can occur at timescales of minutes, due to g-modes on the Earth atmosphere. It has also been crucial to be able to use comparisons stars up to a few arcminutes from the pulsating star, to be able to select comparisons brighter than the target star, decreasing the noise introduced in the differential photometry due to noise in the comparisons.

On 4m class telescopes, and prime focus on 2m class telescopes, we can routinely achieve 1 mmag up to 19th mag stars, allowing the study of distant stars and possibly different populations.

To be able to measure multiple periods present in non-radially pulsating stars, it is necessary to observe the star for several beat periods, and multi-site campaigns, starting with the Whole Earth Telescope, followed by the Delta Scuti Network and GONG, for example, has allowed such long observations. On the data analysis side, corrections of the observations times to the barycenter of the solar system became necessary to join long data sets, and Monte Carlo simulations of the time series allowed an efficient way to estimate the detection limits for time series with gaps and multiperiodic, where the noise distribution is not Poissonic.

The discovery of many pulsation modes in nonradially pulsating stars, as δ Scuti, roAp, the Sun and white dwarf stars, has allowed seismological studies measuring accurately several internal properties of these pulsating stars, and even their time rates-of-change.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 11:30 – 12:00
Type of talk: Invited

Spectroscopic observations of pulsating stars

Conny Aerts[1,2]

[1]*Institute of Astronomy, University of Leuven, Belgium,* [2]*Department of Astrophysics, Radboud University Nijmegen, the Netherlands*

During the past three decades, astronomers have been gathering extensive time series of high-precision spectroscopy of pulsating stars. In contrast to one-shot spectra, which provide the fundamental parameters, the projected rotational velocity and the abundances of the stars, time-resolved spectroscopy offers a much broader variety of opportunities for asteroseismology. The most important applications encompass the determination of the radial-velocity amplitudes and phases of the modes, the detection of modes that are invisible in photometry, the identification of the azimuthal order of the non-radial modes through specialised methodology (talk Telting), the unravelling of pulsational and orbital motions, and, since a few years, the detection of solar-like oscillations in various types of stars. By means of a few case studies of time-resolved spectroscopy, we illustrate the input that spectroscopic time series can provide for asteroseismic modelling, for various types of pulsators. We end with some future prospects of how this input can be improved and pushed beyond present achievements in the near future.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 12:00 – 12:15
Type of talk: Contributed

Multi-wavelength photometric variation of PG 1605+072

Sonja Schuh

Institut für Astrophysik, Universität Göttingen, Germany

In a large coordinated attempt to further our understanding of the p-mode pulsating sdB star PG1605+072, the Multi-Site Spectroscopic Telescope (MSST) collaboration has obtained simultaneous time-resolved spectroscopic and photometric observations. The photometry was extended by additional WET data which increased the time base. This contribution presents the analysis of the MSST photometric light curve, including the four-colour BUSCA data from which chromatic amplitudes have been derived, as well as supplementary FUV light curves from two different epochs. These results will have the potential to complement the interpretation of the published spectroscopic information.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 12:15 – 12:30
Type of talk: Contributed

Radial-velocity observations of pulsating stars with a new Poznań Spectroscopic Telescope

Wojciech Dimitrov

Adam Mickiewicz University, Poland

We present results of radial velocity measurements of classical cepheids, δ Scuti and β Cephei stars. The spectra were obtained with Poznan Spectroscopic Telescope (PST). The telescope has been operating since August 2007. The PST is equipped with two 40cm diameter mirrors of Newtonian focus, connected by an optic fiber with an echelle spectrograph. The PST's design aimed at the best cooperation with the spectrograph as well as limiting light looses. It allows us to measure radial velocity of stars as faint as 11.5 magnitudes. The peltier-liquid cooled CCD camera covers 64 echelle orders with spectral range from 4480 to 9250 Å. The dispersion of the obtained radial velocity measurements is on the level of 150 m/s. Echelle spectra reduction and RV measurements are performed with Image Reduction and Analysis Facility (IRAF). We have achived sufficient phase coverage for 28 And, γ Peg, Polaris and V440 Per. Further data acquirement for other pulsating stars is currently held.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 14:00 – 14:30
Type of talk: Invited

Detecting pulsating variables from massive surveys

Igor Soszyński

Warsaw University Astronomical Observatory, Warsaw, Poland

The Optical Gravitational Lensing Experiment (OGLE) regularly observes ∼150 million stars in the Magellanic Clouds and Galactic Bulge searching for gravitational microlensing events. Since 2001, when the third phase of the OGLE survey started, about 10^{11} individual high precision photometric points have been collected. This huge database provides us with an ideal material for selecting and studying hundreds of thousands of variable stars, which will be the basis of the OGLE-III Catalog of Variable Stars. Here, we report preliminary results of this analysis, describing the samples of Cepheids, RR Lyrae stars, delta Scuti stars and Long Period Variables detected in the Large and Small Magellanic Clouds. The catalog contains the largest and the most complete list of variable stars in the Magellanic Clouds that has ever been published. We present a statistical analysis of these stellar populations and discuss individual objects of particular interest. We also describe the plans for future expansion of the OGLE project.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 14:30 – 14:45
Type of talk: Contributed

Discovery of non-radial pulsations on the spectroscopic binary Herbig Ae star RS Cha

Torsten Böhm[1], Wolfgang Zima[2], Claude Catala[3], Evelyne Alecian[4], Karen Pollard[5], Duncan Wright[5]

[1]*Observatoire Midi-Pyrénées - CNRS, France,* [2]*Instituut voor Sterrenkunde, Leuven, Belgium,* [3]*LESIA, OBSPM, Paris, France,* [4]*Royal Military College, Kingston, Canada,* [5]*University of Canterbury, Christchurch, New Zealand*

The spectroscopic binary Herbig Ae star RS Cha was monitored in quasi-continuous observations during 14 observing nights (2006) at the 1m Mt John (New Zeeland) telescope with the Hercules high-resolution echelle spectrograph. For the first time we discovered by direct observational means using high resolution echelle spectroscopy non radial oscillations in a Herbig Ae star. A preliminary mode identification was performed yielding strong constraints on upcoming asterosismological models.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 14:45 – 15:00
Type of talk: Contributed

A different approach to analyzing the Blazhko effect: the VSAA applied to RR Lyr

Katrien Kolenberg[1], Sotirios Tsantilas[2]

[1]*Institute of Astronomy, University of Vienna, Austria,* [2]*Department of Physics, University of Athens, Greece*

The mysterious amplitude and phase modulation seen in many RR Lyrae stars has puzzled astrophysicists for more than a century now. The most commonly quoted hypotheses to explain the phenomenon involve nonradial modes, through either resonances or magnetic fields. However, their reality is still being questioned. If an unknown physical mechanism in the star causes the radial mode to change its properties over time, and there are no other pulsation modes involved, classical Fourier techniques may give misleading results. The VSAA (Variable Sine Algorithmic Analysis) is based on the idea of a single sine function with variable coefficients. Powered by the Simplex algorithm, it decodes a signal in the most simple and accurate manner -especially in cases of a single acting mechanism-, providing an output of time-dependent frequency and amplitude. Because of its ability to describe a quasi-periodic time series, we used the method for analyzing the Blazhko effect. Assuming the effect consists of the modulation of a single pulsation mode, we applied the VSAA to an extensive data set of RR Lyr, one of the best studied Blazhko stars. The results show how the amplitude and period of the modulation have changed over the past decades.

Session 1A: **DATA: ground-based observations**
Time: Monday, June 23, 15:00 – 15:15
Type of talk: Contributed

Towards mode selection in δ Scuti stars: regularities in the observed frequency spacing

Michel Breger, Patrick Lenz, Alexey Pamyatnykh

Institute of Astronomy, University of Vienna, Austria

Only some of the theoretically predicted nonradial pulsation modes are actually seen in δ Scuti stars. The large number of frequencies detected in recent photometric studies of selected δ Scuti stars allow us to look for regularities in the frequency spacing of modes and to relate the results to mode identifications.

Statistical analyses of several δ Scuti stars (FG Vir, 44 Tau, BL Cam and others) show that the observed frequencies are not distributed at random, but that the excited nonradial modes cluster around the frequencies of the radial modes over many radial orders. For the typical low-order p-modes, the peaks in the observed frequency pattern differ from those of the asymptotic case by a factor of approximately two, since the excited ℓ = 1 modes are also found near the radial modes.

The observed regularities can be explained by modes trapped in the stellar envelope, for which the amplitude growth rates are higher. This mode selection mechanism was already proposed in 1990 by Dziembowski and Krolikowska. New pulsation model calculations for the observed stars confirm the observed regularities.

Finally, applications of these findings to interpret future results from satellite missions are discussed.

Session 1B: **DATA: space missions**
Time: Monday, June 23, 16:00 – 16:30
Type of talk: Invited

MOST and the search for p-modes in Sun-like stars

David Guenther

Saint Mary's University, Canada

The first Sun-like star targeted by MOST was Procyon. This bright star with well determined parameters and convincing evidence for the existence of p-modes from groundbased observations was expected to be an easy object for us. To our surprise (and to the surprise of many experts) we were unable to identify any p-modes.

We returned to Procyon twice. Based on the results from the latest run, with noise levels reduced by a factor of two over previous runs, we are now ready to comment on the nature of Proycon and its oscillation spectrum. I will review what we have learned from observing Sun-like stars with MOST and describe some of the strategies we have developed to deal with the sparse and apparently noisy oscillation spectra. I will also discuss how recent simulations of stellar convection touch on the problem.

Session 1B: **DATA: space missions**
Time: Monday, June 23, 16:30 – 17:00
Type of talk: Invited

Asteroseismic results from CoRoT

Eric Michel

Observatoire de Paris – LESIA, France

About 6 months after the first CoRoT data delivery, we will comment the data exploitation progress for different types of stars. We will consider first results to illustrate how these data of unprecedented quality shed a new light on the field of stellar seismology.

Session 1B: **DATA: space missions**
Time: Monday, June 23, 17:00 – 17:15
Type of talk: Contributed

MOST asteroseismology across the HR Diagram

Jaymie Matthews

University of British Columbia, Canada

As CoRoT data flows and results begin to appear, and with Kepler on the horizon (soon to be above the horizon), the MOST experience can offer useful lessons on the analysis and interpretation of many types of asteroseismic targets. I will touch on the hot and cool ends of the HR diagram: SPBe stars and red giants. In the mid-range, the internal magnetic fields of roAp stars, hybrid pulsators, and of course, Procyon, and a discussion of the behaviour of its convection zone and how that ties in with p-mode lifetimes and detectability in luminosity and radial velocity.

Session 1B: **DATA: space missions**
Time: Monday, June 23, 17:15 – 17:30
Type of talk: Contributed

First results on the Be stars observed with the COROT satellite

J. Gutiérrez-Soto and the COROT Be Team

Observatoire de Paris-Meudon, France

In this talk I will present an overview of the analysis of all the Be stars observed with the COROT satellite. Be stars are very fast-rotating B-type stars which may pulsate as β Cephei or SPB stars. COROT has already observed 5 bright Be stars in the seismology fields and several tens fainter ones in the exoplanet fields with an unprecedented quality and from 20 to 150 days. Multiple frequencies are detected in the majority of the stars. Pulsations, outbursts, beating phenomenon, possible transient modes, rotation, amplitude variability, etc. have been found in their light curves. In order to complement this study, ground-based spectroscopic data have been analysed for the stars located in the seismology fields.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 9:00 – 9:30
Type of talk: Invited

Extracting oscillation frequencies from sparse spectra: Fourier analysis

Mikołaj Jerzykiewicz

Astronomical Institute of the University of Wrocław, Poland

I will explain properties of spectral window of time-series data. Emphasis will be on data obtained at a single geographic longitude, but ground-based multi-longitude campaigns and space missions such as HIPPARCOS and MOST will not be entirely neglected. I will then discuss the procedure of pre-whitening. Finally, I will consider the basic assumption underlying periodogram analysis.

Throughout the talk, I will try to give credit to the pioneers of the subject.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 9:30 – 9:45
Type of talk: Contributed

Application of the Trend Filtering Algorithm in searching for multiperiodic signals

Géza Kovács[1], Gaspar Bakos[2]

[1]*Konkoly Observatory, Hungary,* [2]*Harvard-Smithsonian Center for Astrophysics, U.S.A.*

During the past few years the Trend Filtering Algorithm (TFA) has been proved to be a very important utility in filtering out time-dependent systematic effects in photometric databases for extrasolar planetary transit search. Here we present the extension of the method to multiperiodic signals and show the high efficiency of the signal detection over the direct frequency analysis on the original database derived by today's standard methods (e.g., aperture photometry). We also consider the iterative reconstruction of the signal that involves the proper extraction of the systematics. The method is demonstrated on the database of a field observed by the HATNet project. We present several examples on multiperiodic variables with (sub)mmag amplitudes.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 9:45 – 10:00
Type of talk: Contributed

VSAA: A method of tracing variable frequencies in time series analysis

Sotirios Tsantilas, Helen Livaniou-Rovithis

University of Athens, Greece

In this work we discuss a new method of time series analysis. This new method — Variable Sine Algorithmic Analysis, (VSAA) — is based on a single sine function with variable coefficients and it is powered by the simplex algorithm. It can be applied to almost every type of time series, e.g. to pulsating stars, sunspot activity, recurrent novae, pulsars, or even in the number of stocks traded daily, heartbeat and cases of auricular fibrillation, providing a very accurate and simple analysis. Especially in cases of phenomena demonstrating variable frequencies but triggered by a single mechanism — where Fourier Transform and Wavelet Analysis fail to describe practically and efficiently — provides a straightforward solution. Applications are given to synthetic and real data.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 10:00 – 10:30
Type of talk: Invited

Extracting oscillation frequencies from dense spectra: A Bayesian approach

Brendon Brewer

The University of Sydney, Australia

In asteroseismology, we often wish to extract the oscillation frequencies of a star from time series data. This is usually done by computing the power spectrum or by using an iterative fitting process such as CLEAN. While these methods are often very useful, there has recently been interest in trying to improve upon them. In this talk, I will introduce the concepts of Bayesian Inference and discuss the conditions under which the power spectrum and CLEAN may not extract all of the information in the data. The alternative, a fully Bayesian treatment, is computationally feasible for many data sets and provides dealiasing and uncertainties in all of the estimated frequencies, and always uses all of the information in the data. I will also discuss recent work towards developing a method that does not rely on the assumption that the signal from each mode is purely sinusoidal.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 10:30 – 10:45
Type of talk: Contributed

An application of the Bayesian inference on a solar-like pulsator: HD 49933

Othman Benomar

IAS/CNRS, France

The amount of collected data by space-borne instruments (like CoRoT and Kepler) is being to increase drastically and it will be helpful to have automated process to provide a maximum of information from these data. Only a few attempts have been made in this way (see for ex. Brewer and Bedding, 2007). We propose to use Markov Chain Monte Carlo (MCMC) with Metropolis-Hasting based algorithm to infer the main stellar oscillations parameters from a power spectrum, in the case of solar-like pulsators. Given a number of nodal modes under a frequency range, the algorithm is able to give the best set of parameters (large separation, frequencies, line-width, amplitudes, splitting) corresponding to a chosen input model. We applied this algorithm to the spectrum of one of the first CoRoT targets, HD 49933.

Session 2A: **MODES: extracting eigenmode frequencies**
Time: Tuesday, June 24, 10:45 – 11:00
Type of talk: Contributed

Analysis of sun-like oscillations in Red Giant stars

Neil J. Tarrant

University of Birmingham, U.K.

Sun-like oscillations, excited stochastically by convective noise, have now been observed in a number of red giant stars. The large amplitudes and long periods of these modes, relative to those seen in the Sun, make these oscillations attractive prospects for observation. However the low Q-factor of these modes, and issues relating to a steeply rising background at low frequencies, present some interesting challenges for identifying modes and determining the related asteroseismic parameters.

In my talk I report on a probability based technique for mode identification. I also discuss steps taken to ensure the robustness of best-fitting mode parameters given by a 'peak-bagging' analysis of red giant mode peaks. I will show results from a number of giants, extracted from multi-year observations with the SMEI instrument.

Session 2B: **MODES: mode identification**
Time: Tuesday, June 24, 11:30 – 12:00
Type of talk: Invited

Pulsational mode identification from multi-colour photometry

Gerald Handler

Institut für Astronomie, Universität Wien

I will review the basic principles of mode identification by means of multi-colour photometry. Some applications, successful and unsuccessful, of this technique will be shown, with an emphasis on how to select the most efficient filter passbands for different types of pulsating stars. The practical limitations of the method will be discussed, for both ground-based and space observations.

Session 2B: **MODES: mode identification**
Time: Tuesday, June 24, 12:00 – 12:30
Type of talk: Invited

Constraints on angular numbers of pulsation modes from spectroscopy

John Telting

Nordic Optical Telescope

Asteroseismology relies on accurate mode identification. High-resolution spectroscopy allows to detect such crucial information as the pulsational degree ℓ, the azimuthal number m, and pulsation amplitudes, directly from time-series of observations. The advantage of high-resolution spectroscopy over standard photometric techniques is that not only pulsational temperature variations can be detected, but also the pulsational velocity field, yielding valuable extra information.

In this paper I review the mode-identification methods that have been developed over the last decades, with emphasis on the application to hot stars.

Session 2B: **MODES: mode identification**
Time: Tuesday, June 24, 12:30 – 12:45
Type of talk: Contributed

Spectroscopic observations and mode-identification of a sample of non-radially pulsating stars

Karen Pollard

Department of Physics and Astronomy, University of Canterbury, New Zealand

We have obtained high-resolution spectroscopic data with the highly stable and precise HERCULES spectrograph on the 1.0-m telescope at the Mt John University Observatory in Tekapo, New Zealand. We have developed a new technique utilising cross correlation of stellar spectra with scaled delta function templates to obtain high signal-to-noise spectral line profiles for analysis. Using these profiles and employing the Fourier Parameter Fit method, we have been able to place constraints on the degree and azimuthal order of the non-radial pulsation modes in a sample of non-radially pulsating stars, including some β Cephei and γ Dor stars.

Session 2B: **MODES: mode identification**
Time: Tuesday, June 24, 12:45 – 13:00
Type of talk: Contributed

Spectroscopic mode identification of the δ Scuti stars 4 CVn and EE Cam

Barbara Castanheira[1], M. Breger[1], P. Beck[1], A. Elmasli[2]

[1]*University of Vienna, Austria,* [2]*Ankara University, Turkey*

δ Scuti stars constitute a class of pulsators located on and above the main sequence, that have both gravity (interior) and pressure (surface) modes, with periods between 0.02 and 0.25 days. A better understanding of this class of pulsators places important constraints on stellar models, including a satisfactory description of the physical processes in the stellar interior (e.g. convection). We observed the two δ Scuti stars 4 CVn and EE Cam for more than 30 nights, through time-series high-resolution spectroscopy, using the 2.1m telescope at McDonald Observatory. Quasi-simultaneous time-series high-accuracy photometry was obtained with the Vienna Automatic Photometric Telescopes in Arizona to determine the present modes. 4 CVn is a cool and evolved δ Scuti star, showing a strong amplitude variability, while EE Cam belongs to the region of transition between high amplitude (HADS) and the normal δ Scuti stars. In the present work, we will report our first results of mode identification for these important stars, using the Fourier Parameter Fit Method (Zima 2006), which compares the amplitude and phases observed across the line profiles with those of the theoretical models.

Session 3A: **STARS: convection**
Time: Tuesday, June 24, 14:30 – 15:00
Type of talk: Invited

Stochastic excitation of oscillation modes in the HR diagram

R. Samadi[1] , K. Belkacem[1], M.-J. Goupil[1], H.G. Ludwig[2], M.-A. Dupret[1]

[1]*Observatoire de Paris, LESIA, Meudon, France,* [2]*Observatoire de Paris, GEPI, Meudon, France*

For more than ten years, solar-like oscillations have now been detected and frequencies measured for a growing number of stars with various characteristics ($e.g.$ different evolutionary stage, effective temperature, gravity, metal abundance...).

Excitation of such oscillations is attributed to turbulent convection and takes place in the uppermost part of the convective enveloppe. Since the pioner work of Goldreich & Keely (1977), more sophisticated theoretical models of stochastic excitation were developped, which differ to each other both by the way turbulent convection is modelled and by the assumed sources of excitation. We review here these different models and their underlying approximations and assumptions.

We next show that computed mode excitation rates crucially depend on the way turbulent convection is described but also on the stratification and metal abundance of the upper layers of the star. In turn we will show how the seismic measurements collected so far allow us to infer properties of turbulent convection in stars.

Session 3A: **STARS: convection**
Time: Tuesday, June 24, 15:00 – 15:30
Type of talk: Invited

Pulsation-convection interaction: the effect of convection on mode stability

Guenter Houdek

University of Cambridge, U.K.

In this presentation I shall review the current state of mode physics in classical pulsators and in stars with solar-like oscillations. Particular emphasis will be given on the location of the classical instability strip and on the properties of solar-like oscillations in red giant stars.

Session 3A: **STARS: convection**
Time: Tuesday, June 24, 15:30 – 15:45
Type of talk: Contributed

Stochastic waves excitation in rotating stars

Stèphane Mathis[1], Kevin Belkacem[2], Marie-Jo Goupil[2]

[1]*CEA/DSM/IRFU/Service d'Astrophysique, France,* [2]*LESIA, Observatoire de Paris-CNRS-Université Paris Diderot, France*

Wave propagation, excitation and associated transport are modified by the Coriolis and the centrifugal accelerations in rotating stars. In this work, we focus on the influence of the Coriolis acceleration on the wave volumetric stochastic excitation in convective zones of rotating stars. First, we present the complete formalism which has been derived and we discuss the different terms which appear due to the Coriolis acceleration. Then, we present a first application to high-frequency gravity mode excitation rates and we discuss the peculiar behavior due to rotation. Next, we discuss the other possible applications of this work such as inertial and gravito-inertial wave excitation. Consequences on the wave transport in rotating stars are finally discussed.

Session 3A: **STARS: convection**
Time: Tuesday, June 24, 15:45 – 16:00
Type of talk: Contributed

Double-mode Cepheid models — revisited

Radosław Smolec

Copernicus Astronomical Center, PAS

For many years modeling of double-mode pulsation of classical pulsators was challenging problem. Inclusion of turbulent convection into pulsation hydrocodes finally led to stable double-mode behaviour. However, it was never analysed, which factor of turbulent convection is crucial. We show that the double-mode behaviour results from incorrect assumptions adopted in some of the pulsation hydrocodes, namely from the neglect of buoyant forces in convectively stable layers. This leads to extreme, artificial overshooting and consequently strong eddy-viscous damping in deep, convectively stable layers of the model. Resulting, differential reduction of fundamental and first overtone amplitudes favours the occurrence of double-mode pulsation. If buoyant forces are taken into account no stable double-mode behaviour is found.

We argue that better description of non-local turbulent convection and its coupling with stellar pulsation is necessary. The problem of modeling double-mode pulsation in classical pulsators remains open.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Tuesday, June 24, 17:00 – 17:30
Type of talk: Invited

Photospheric solar chemical composition

Nicolas Grevesse

Centre Spatial de Liège and Institut d'Astrophysique et de Géophysique University of Liège, Belgium

We shall review our current knowledge of the solar chemical composition based on the recent significant downward revision of the solar photospheric abundances of the most abundant metals by M. Asplund, N. Grevesse, A.J. Sauval and coworkers. We shall discuss the various implications of these new results not only for the sun but for the many types of stars that are studied by asteroseismology.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Tuesday, June 24, 17:30 – 18:00
Type of talk: Invited

Input from opacity data in computation of pulsation instability

Josefina Montalbán

Université de Liège, Belgium

The κ-mechanism is responsible for driving of pulsation modes in several types of variable stars along the HR diagram. The precise ($T_{\rm eff} - L$) domain where these pulsators are located and their oscillation periods are highly dependent on the value of opacity and on its variation inside the star. Furthermore, stellar opacity can also play an important role in the properties of stellar oscillations which are not excited by the k-mechanism. In this contribution we analyze the sensitivity of the stellar pulsation instability to the opacity tables (OP/OPAL), to the chemical composition of the stellar matter, and to the action of transport processes which could change the distribution of chemical elements inside the stars.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Wednesday, June 25, 9:00 – 9:30
Type of talk: Invited

The potential of hot B subdwarf pulsators for testing diffusion and other competing process in stars

Stéphane Charpinet

Observatoire Midi-Pyrenées, France

The hot and compact B subdwarf (sdB) stars harbor two classes of nonradial pulsators: the rapid p-mode EC14026-type pulsators discovered in 1997 and the slow g-mode pulsators known as the V1093 Her variables found in 2003. The oscillations in these stars are singular in that the driving mechanism, a classical kappa effect triggered by the Z-bump, a region where partial ionisation of heavy elements from the iron group significantly increases the gas opacity, is truely effective only through local abundance enhancements of such elements (in particular of iron itself) caused by microscopic diffusion. They are the only pulsating stars, among those currently known across the HR diagram, that show oscillations so tightly linked to these diffusive phenomena. In this contribution, I will review our present understanding of the various components that drive pulsations in sdB stars and I will outline the (so far) unique potential of these stars to become laboratories where diffusion and other competing process may be tested.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Wednesday, June 25, 9:30 – 10:00
Type of talk: Invited

Degenerate pulsators

Gilles Fontaine, Pierre Brassard

Université de Montréal, Canada

We briefly review the basic properties of the three distinct families of isolated pulsating white dwarfs. These are the GW Vir stars (He/C/O-atmosphere stars with $T_{\rm eff}$ $\sim$ 120,000 K), the V777 Her stars (He-atmosphere, $T_{\rm eff}$ $\sim$ 25,000 K), and the ZZ Ceti stars (H-atmosphere, $T_{\rm eff}$ $\sim$ 12,000 K), all showing multiperiodic luminosity variations caused by low-order and low-degree g-mode instabilities. We discuss, in particular, the excitation physics in these stars, with emphasis on the common properties. In the light of the recent and unexpected discovery of a new type of white dwarfs, those with atmospheres dominated by carbon and found only in a narrow range of effective temperature from 18,000 K to 23,000 K, we also review the asteroseismological potential of these objects. This sets the table for a discussion of the recent exciting discovery of the first pulsating C-atmosphere white dwarf, SDSS J142625.71+575218.3.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Wednesday, June 25, 10:00 – 10:15
Type of talk: Contributed

Long-term photometric monitoring of the hybrid subdwarf B pulsator HS 0702+6043

Ronny Lutz

Institut für Astrophysik, Universität Göttingen, Germany

Pulsating subdwarf B stars oscillate in short-period p-modes or long-period g-modes. HS 0702+6043 is one of the three objects known to show characteristics of both types and hence is classified as hybrid pulsator. We briefly present our analysis of the g-mode domain of this star, then focus on first results from long-term photometric monitoring in particular of the p-mode oscillations. We will present a high-resolution frequency spectrum, and report on our efforts to construct a multi-season O–C diagram. In addition to the standard (although nontrivial) exercise in asteroseismology to probe the instantaneous inner structure of a star, measured changes in the pulsation frequencies as derived from an O–C diagram can be compared to theoretical evolutionary timescales. Within the EXOTIME program, we also use this same data to search for planetary companions around extreme horizontal branch objects ("asteroseismic planets"). For two of our sample targets, HS 0702+6043 and HS 2201+2610 (V 391 Peg), we have gathered time-resolved spectroscopic data, complementing the photometric analysis.

Session 3B: **STARS: opacity driving, levitation, opacity data**
Time: Wednesday, June 25, 10:15 – 10:30
Type of talk: Contributed

Mode identification in rapidly pulsating subdwarf B stars from monochromatic amplitude and phase variations

S.K. Randall[1], V. Van Grootel[2], G. Fontaine[3], P. Brassard[3], S. Charpinet,[2]

[1]*ESO Garching,* [2]*Observatoire Midi-Pyrénées,* [3]*Université de Montréal*

Over the last years, rapidly pulsating subdwarf B stars have become one of the success stories of asteroseismology. Not only are the adiabatic and non-adiabatic pulsation properties thought to be understood qualitatively, but quantitative asteroseismic solutions have been achieved for an ever-growing number of these objects. Independent constraints on mode identification have been proposed notably on the basis of line-profile variations and multi-colour photometry, however they are often limited by the intrinsic faintness of the targets, low pulsational amplitudes, and the short periods observed. We recently obtained low resolution time-series spectroscopy for the rapid sdB pulsator PG 1047+003 using the unique HIT-MS mode on FORS2 at the VLT. The aim is to partially identify the main pulsation modes using the monochromatic amplitude and phase variations in an extension of the popular multi-colour method, additionally incorporating radial velocity changes. We will present first results and discuss the implications for both the asteroseismic solution previously proposed for the target and the application of this technique to other pulsators.

Session 3C: **STARS: effects of rotation the stellar structure and pulsation**
Time: Thursday, June 26, 9:00 – 9:30
Type of talk: Invited

Effects of rotation on stellar structure: rotation induced mixing

Jean-Paul Zahn

Observatoire de Paris, France

Standard models of stellar structure are unable to account for various observational facts, such as the appearance at the surface of chemical elements that have been produced in the nuclear core. Thus there is now a large consensus that some 'extra mixing' must occur in the radiation zones. In massive stars, this mixing is achieved mainly through the shear-turbulence generated by the differential rotation, which itself results from the transport of angular momentum by a large-scale circulation that is induced either by structural adjustments accompanying the evolution or by the applied torques (stellar wind, accretion, tides). These processes are now being implemented in stellar evolution codes, and they provide a much better agreement with the observations.

Session 3C: **STARS: effects of rotation the stellar structure and pulsation**
Time: Thursday, June 26, 9:30 – 10:00
Type of talk: Invited

Pulsation in rapidly rotating stars

Umin Lee

Tohoku University, Japan

Recent detection of low frequency oscillations in rapidly rotating Be stars by MOST and COROT have made promising astero-seismological studies of the stars. Because of rapid rotation, unstable g-modes and r-modes appear, when observed in the inertial frame, in separate groups of frequencies $\sim m\Omega$ for different values of m, where m is the azimuthal wavenumber and Ω is the angular frequency of rotation. Since rapid rotation tends to suppress retrograde g-modes more strongly than progarde g-modes, it is rather easy to assign m and ℓ values to the observed frequencies of the modes, although there exist some controversies. In this talk, I will discuss pulsational stability of low frequency g-modes and r-modes and their possible role in angular momentum transfer in the stellar interior.

Session 3C: **STARS: effects of rotation the stellar structure and pulsation**
Time: Thursday, June 26, 10:00 – 10:15
Type of talk: Contributed

Waves transport in differentially rotating stellar radiation zones

Stèphane Mathis

CEA/DSM/IRFU/Service d'Astrophysique, France

Low-frequency internal gravity waves transport is an essential mechanism for the rotational mixing in stellar radiation zones. On the other hand, it has been shown that for such waves the Coriolis acceleration has to be taken into account. It has been recently undertaken, but only in the 'weak differential rotation' case where the angular velocity is taken as the sum of a mean solid-body rotation, $\overline{\Omega}_s$, and of a residual shellular differential rotation, $\delta\overline{\Omega}\left(r\right)$, where $\delta\overline{\Omega}\left(r\right) << \overline{\Omega}_s$. However, stars are differentially rotating and angular momentum transport during their evolution could also create strong gradients of angular velocity. Moreover, the angular velocity of the regions of waves excitation at the borders of radiative regions depends both in radius and in latitude (for example the Tachocline in the solar case). We thus have to go beyond this first approximation in the treatment of the Coriolis acceleration. This is the goal of this work and we present here the new theoretical results which allow to treat the transport and mixing processes associated with internal gravity waves in such differentially rotating radiation zones, the angular velocity profile being taken the more general as possible. Consequences for transport of angular momentum both in the radial and in the latitudinal directions are discussed as well as the consequences for stellar evolution modelling.

Session 3C: **STARS: effects of rotation the stellar structure and pulsation**
Time: Thursday, June 26, 10:15 – 10:30
Type of talk: Contributed

The asymptotic structure of the p-modes frequency spectrum in rapidly rotating stars

Francois Lignières

Observatoire Midi-Pyrénées, France

We show that acoustic ray dynamics combined with methods from quantum chaos reveal the structure of the high frequency spectrum of rapidly rotating polytropic stars.

The spectrum is a superposition of regular frequency patterns and an irregular frequency subset respectively associated with near-integrable and chaotic phase space regions. The regular patterns are analogous albeit different from those found in the non-rotating case. The irregular subset displays clear signature of wave chaos such as statistical level repulsion. The visibility of these modes will be also discussed (Lignières & Georgeot arXiv:0803.1737, Reese et al. A&A 481 2008).

Session 3D: **STARS: effects of magnetic field on stellar pulsation**
Time: Thursday, June 26, 11:00 – 11:30
Type of talk: Invited

Stochastic excitation of oscillation modes in the HR diagram

Hiromoto Shibahashi

Department of Astronomy, University of Tokyo, Japan

Many issues have arisen with the increase of observations of roAp stars. To solve them, the influence of magnetic fields and chemical peculiarity must be taken into account. I will discuss the wave propagation in a stratified plane atmosphere with magnetic fields as fundamental basics.

Session 3D: **STARS: effects of magnetic field on stellar pulsation**
Time: Thursday, June 26, 11:30 – 12:00
Type of talk: Invited

Pulsation in the atmosphere of roAp stars

Oleg Kochukhov

Uppsala University, Sweden

Possibility to obtain high-resolution time-resolved spectra of roAp stars at large telescopes has led to a major breakthrough in our understanding of magnetoacoustic pulsations in these interesting objects. New observations have allowed to uncover a number of intricate relations between stellar oscillations, magnetic field, and chemical inhomogeneities. Unusual pulsational characteristics of roAp stars arise from an interplay between short vertical length of pulsation waves and extreme chemical stratification. Here I review results of recent studies which utilize these unique properties of magnetic A stars to map 3D pulsation geometry using a combination of Doppler imaging, vertical pulsation tomography, interpretation of line profile variation, and ultraprecise space photometry. I also describe attempts to interpret theoretically the complex observational picture of roAp pulsations.

Session 3D: **STARS: effects of magnetic field on stellar pulsation**
Time: Thursday, June 26, 12:00 – 12:15
Type of talk: Contributed

Interferometric and seismic constraints on the roAp star α Cir

I.M. Brandão[1], H. Bruntt[2], M.S. Cunha[1], D.W. Kurtz[3] et al.

[1]*Centro de Astrofísica da Universidade do Porto, Portugal,* [2]*School of Physics, University of Sydney, Australia* [3]*Centre for Astrophysics, University of Central Lancashire, U.K.*

We present new constraints on the rapidly oscillating Ap star α Cir, derived from a combination of interferometric and photometric data obtained with the Sydney University Stellar Interferometer (SUSI) and the WIRE satellite. The highlights of our study are:

(1) the determination, for the first time, of the angular diameter of a rapidly oscillating Ap star;

(2) an independent determination of the effective temperature of α Cir, which is found to be lower than the values previously estimated;

(3) two additional oscillation frequencies, which provide a new determination of the large separation of the star.

Based on this new information, we have computed non-magnetic and magnetic models for α Cir. We show that the value of the large separation derived from the new data agrees well with that derived from theoretical models. Moreover, we also show how the magnetic field may explain the two main anomalies seen in the oscillation spectrum, and how those provide constraints on the magnetic field topology and magnitude.

Session 3D: **STARS: effects of magnetic field on stellar pulsation**
Time: Thursday, June 26, 12:15 – 12:30
Type of talk: Contributed

On the understanding of pulsations in the atmosphere of magnetic stars

Joana Sousa, Margarida Cunha

Centro de Astrofisica da Universidade do Porto, Portugal

Exciting discoveries concerning the behavior of rapidly oscillating Ap (roAp) stars, such as the indication of a co-existence of standing and running waves in their atmospheric layers, have recently been made through the analysis of high-resolution spectroscopic data. Such data holds unique information about the structure and dynamics of the peculiar atmospheres of these stars. Having this in mind we developed a toy model for the atmosphere of roAp stars with the purpose of understanding the general trends seen in the atmospheric pulsation data acquired with high-resolution spectroscopy. In our analysis we consider an isothermal atmosphere in a plane parallel approximation. In addition, we assume that the region considered is magnetically dominated and, consequently, that the magnetoacoustic wave has decoupled into its acoustic and magnetic components. Starting from the equations for the displacement parallel and perpendicular to the direction of the magnetic field and using the analytical solutions for the velocity components appropriate to this model, we determine the expression for the velocity component parallel to the line of sight averaged over the visible stellar disk, for a general position of the observer. Fitting the latter to a function of the form Acos(σt+phase), with σ the oscillation frequency and t the time, we derive the amplitude A and the phase for our model as function of height in the atmosphere. The results are compared to the general trends of the phase and amplitude derived from the spectroscopic data. Such comparison allows as to link the observed behavior to the physical and geometric quantities that are involved in the problem.

Session 3D: **STARS: oscillations and stellar models**
Time: Thursday, June 26, 14:00 – 14:30
Type of talk: Invited

The impact of asteroseismology on the theory of stellar evolution

Simon Jeffery

Armagh Observatory, U.K.

Observable oscillations occur in stars across the Hertzsprung-Russell diagram, with periods ranging from tens of seconds in white dwarfs, to hundreds of days in red giants. Even the simplest radial oscillation can provide direct measurements of a star's fundamental properties, notably its mean density and radius. Thus the study of stellar pulsations has provided fundamental tests of the stellar evolution theory for almost a century, connecting, for example, Type I Cepheids with their main-sequence progenitors. The discovery that many stars oscillate in more than one mode has led to the possibility of new information about the density distribution in stellar interiors. In particular, the location of boundaries between layers of different composition critically affects both the stability and frequencies of natural modes in many classes of evolved star. This talk will summarize recent progress in understanding the structure and evolution of highly evolved stars from asteroseismology, including subdwarf B stars, PG1159 variables, and white dwarfs. It will highlight the impact of pulsation studies on understanding very luminous stars, including Wolf-Rayet, extreme helium and other hydrogen-deficient stars. It will introduce some of the outstanding problems in stellar evolution theory that can be solved using the methods of asteroseismology.

Session 3D: **STARS: oscillations and stellar models**
Time: Thursday, June 26, 14:30 – 15:00
Type of talk: Invited

Examples of seismic modelling

A.A. Pamyatnykh

Nicolaus Copernicus Astronomical Center, Warsaw, Poland

The studies I talk about have been performed in Wojtek Dziembowski's group in Warsaw and in Mike Breger's group in Vienna. I will discuss four examples of seismic modelling of main-sequence pulsators: ν Eridani, 12 Lacertae, FG Virginis and 44 Tauri. ν Eri and 12 Lac are hybrid stars showing both β Cephei type and SPB type pulsations which seem to be very important to test stellar opacity. Moreover, the oscillation spectra of both stars allow to estimate the interior rotation rate. FG Vir is the main sequence star in the middle of the δ Scuti domain with more than 65 independent frequencies have been detected. 44 Tau is an evolved δ Scuti star with extremely slow rotation (about 1–5 km/s), which simplifies the interpretation of the observed oscillation spectrum.

Session 3D: **STARS: oscillations and stellar models**
Time: Thursday, June 26, 16:15 – 16:30
Type of talk: Contributed

Asteroseismology of pre-main sequence stars

Konstanze Zwintz[1], David Guenther[2]

[1]*Institute of Astronomy, University of Vienna, Austria,* [2]*Dep. of Astronomy and Physics, St. Mary's University, Halifax, Canada*

Pre-main sequence stars (PMS) that gain their energy from gravitational contraction cross the instability region on their way to the main sequence and can become pulsationally unstable. A and F type PMS pulsators differ from their more evolved counterparts of same effective temperature, luminosity and mass - i.e., the classical δ Scuti stars - in their interior structure. PMS stars lack regions of already processed nuclear material and seem to be unaffected by strong rotation gradients that could complicate their inner regions.

Several attempts to model pulsations in PMS stars have been successful already. We will show latest results of PMS star seismology using data obtained by the MOST space telescope as well as from ground, also illustrating the potential to derive the evolutionary phase of a pulsating star from asteroseismology.

Session 3D: **STARS: oscillations and stellar models**
Time: Thursday, June 26, 16:30 – 16:45
Type of talk: Contributed

The use of the rotating evolutionary models for the seismic interpretation of two pulsating PMS stars in NGC 6530

M. Di Criscienzo[1], P. Ventura[1], F. D'Antona[1], M. Marconi[2], V. Ripepi[2], A. Ruoppo[2]

[1]*INAF-OAR,* [2]*INAF-OAC*

We applied the ATON code to the computation of detailed grids of standard (non–rotating) and rotating Pre–Main Sequence (PMS) models and computed their adiabatic oscillation spectra, with the aim of exploring the seismic properties of young stars. As, until now, only a few frequencies have been determined for about 40 PMS stars, the way of approaching the nterpretation of the oscillations is not unique.

We adopt a method similar to the matching mode method by Guenther and Brown making use, when necessary, also of our rotating evolutionary code to compute the models for PMS stars. The method is described by a preliminary application to the frequency spectrum of two PMS stars (85 and 278) in the young open cluster NGC 6530.

For the Star 85 we confirm, with self–consistent rotating models, previous interpretation of the data, attributing three close frequencies to the mode $n = 4$, $\ell = 1$ and $m = 0$, $+1$, -1. For the Star 278 we find a different fit for the frequencies, corresponding to a model within the original error box of the star, and dispute the possibility that his star has a T_{eff} much cooler that the red boundary of the radial instability strip.

Session 3D: **STARS: oscillations and stellar models**
Time: Thursday, June 26, 16:45 – 17:00
Type of talk: Contributed

Internal rotation profile from asteroseismology for two sdB pulsators residing in close binary systems

Valerie Van Grootel

Laboratoire d'Astrophysique de Toulouse-Tarbes, France

Since their discovery twelve years ago, short-period pulsating sdB stars have proved their potential for quantitative asteroseismological studies. We have recently updated our asteroseismic diagnostic tools in order to incorporate the effects of stellar rotation on pulsations, assuming various internal rotation laws. This is deemed necessary for the study of moderate ($\sim$10 hours) and fast ($\sim$2-3 hours) sdB rotators.

It was possible, with these new tools, to determine the inner rotation profile of two short-period pulsating sdB stars, Feige 48 and PG 1336$-$018. Both resides in close binary systems, with orbital periods of, respectively, 9.024 h and 2.424 h as measured from spectroscopy. For the two stars, we show that spin-orbit synchronism is reached from the surface down to 0.25 R_* and 0.55 R_*, respectively (the rotation of deeper layers cannot be inferred with the type of modes observed in short-period pulsating sdB stars). These successful inversions of inner rotation profiles could also provide new elements to test tidal friction theories in close binaries.

Session 4: **FUTURE ASTEROSEISMIC PROJECTS**
Time: Friday, June 27, 9:00 – 9:25
Type of talk: Invited

Kepler

Jørgen Christensen-Dalsgaard

Danish Asteroseismology Centre, and Department of Physics and Astronomy, University of Aarhus, Denmark

Kepler is a NASA mission, scheduled for launch in February 2009, whose principal purpose is to investigate extra-solar planetary systems, through the detection of planetary transits across their parent star. An important goal is to determine the prevalence of Earth-size planets in Earth-like orbits. The required photometric precision also makes the mission very well suited for asteroseismology, with the important purpose of characterizing the central stars in planetary systems. An extensive asteroseismic programme is planned for Kepler, organized in an international collaboration in the Kepler Asteroseismic Science Consortium (KASC). I present the mission, emphasizing the asteroseismic investigation, and discuss community participation to the target selection and the Kepler data analysis and interpretation. Further information can be found at the KASC website: http://astro.phys.au.dk/KASC.

Session 4: **FUTURE ASTEROSEISMIC PROJECTS**
Time: Friday, June 27, 9:25 – 9:50
Type of talk: Invited

BRITE-Constellation

Werner W. Weiss

Institute for Astronomy, University of Vienna, Austria

BRITE-Constellation presently consists of UniBRITE and BRITE-AUSTRIA (TUG-SAT1), two 20 cm cube nanosatellites. Each will fly a small aperture telescope with a CCD camera to perform high-precision two-color photometry of the brightest stars in the sky ($\leq$ 4th mag) continuously for up to several years. The primary science goals are studies of massive and luminous stars in our neighbourhood, representing objects which dominate the ecology of our Universe, and also evolved stars (giants) to probe the future development of our Sun. The wide field cameras (24^{o}) will also obtain data from other scientifically interesting stars to investigate their stellar structure and evolution. All of that is enabled by innovative technology currently developed in collaboration between Canada (Space Flight Laboratory of University of Toronto) and Austria (Technical University Graz). A launch of UniBRITE and BRITE-AUSTRIA in early 2009 in envisioned. An expansion proposal of the BRITE-Constellation by two additional spacecraft of same build, to be funded by the Canadian Space Agency (CSA), is currently under review.

Session 4: **FUTURE ASTEROSEISMIC PROJECTS**
Time: Friday, June 27, 9:50 – 10:15
Type of talk: Invited

Asteroseismic possibilities at Concordia, Antarctica

Eric Fossat

Université de Nice, France

The astronomical site testing campaigns at Concordia have started in November 2000, and have been pursued regularly during each summer season from 2000 to 2004. Since 2005, the station is open for winter-over life, and the site testing operations are now running all year round.

Among the obvious scientific programmes that can benefit from the unique location of this exotic site are those that require very long observing time, such as asteroseismology and/or exoplanet transits. The benefits will come from the long polar night, the large proportion of clear sky, the significant reduction of the scintillation amplitude and the very specific seeing statistics. All these parameters begin to be bracketted by more and more robust statistics. I will briefly review these results and mention the photometric and spectroscopic programmes, already running or in project.

Session 4: **FUTURE ASTEROSEISMIC PROJECTS**
Time: Friday, June 27, 11:00 – 11:25
Type of talk: Invited

PLATO: PLAnetary Transits and Oscillations of stars

Ian Roxburgh

Queen Mary, University of London, U.K.

PLATO is a short-listed candidate mission for ESA's Cosmic Vision programme; if selected it should be launched in 2017/2018. The mission addresses the question: *How do planetary systems form and evolve?* It will provide the data needed for an advance in our understanding of the formation and evolution of planets and planetary systems, including systems with Earth-like planets in the "habitable zone", and of the structure and evolution of stars.

PLATO will detect and fully characterise planetary systems by long duration (3 year), short cadence (30 sec) continuous photometric monitoring of ≈100,000 bright stars of all spectral types, using the signature of transits of planets in front of their parent stars, seismic analysis of the oscillation frequencies of the parent stars, ground based high resolution spectroscopy and interferometry, and data from Gaia. The primary targets of PLATO are therefore stars sufficiently bright ($4 \leq m_V \leq 11$) for such characterisation to be possible. In addition PLATO will also perform a more extensive survey of planetary transits in front of ≈400,000 stars down to $m_V = 14$, the limit for the detection of Earth like planets. 2 long runs of 3 years on primary target fields will be followed by a set of 4 short (3 month) runs on different target fields. Asteroseismic analysis of all the bright stars will be used to study stellar evolution; this will include stars in open clusters and population II stars.

Session 4: **FUTURE ASTEROSEISMIC PROJECTS**
Time: Friday, June 27, 11:25 – 11:50
Type of talk: Invited

SONG – writing the verses

Frank Grundahl

Danish AsteroSeismology Centre, University of Aarhus, Denmark

SONG (Stellar Observations Network Group) is a project which aims at designing and building a global network of telescopes to carry out high-precision radial-velocity studies of nearby stars (asteroseismology) and photometric follow-up of microlensing events in the galactic bulge (search for exoplanets). I will describe the status of the project which has received funding to build and test a prototype network node over the course of 2008–2011. The emphasis will be on the issues related to asteroseismology.

Time: Friday, June 27, 11:50 – 12:20
Type of talk: Invited

CLOSING TALK

Joyce Guzik

Los Alamos National Laboratory, U.S.A.

POSTERS:

(presenting person is shown in boldface)

1. **Antoci**, Nesvacil, Handler
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ABSTRACTS OF POSTERS

1. The δ Scuti star ρ Puppis — some spectroscopic results

V. Antoci, N. Nesvacil, G. Handler

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In this poster we present preliminary results of an atmospheric abundance analysis of the δ Scuti star ρ Puppis based on high resolution and high S/N spectra. The data, obtained from the ESO Science Archive, were observed with the HARPS spectrograph attached to the ESO La Silla 3.6m telescope. Additionally, the basic parameters of the star have been redetermined. A discussion of the pulsational behavior of ρ Puppis, eponymous for a whole chemically peculiar subgroup of the δ Scuti stars, is given.

2. Solar-like stars as seen by CoRoT

T. Appourchaux[1], C. Barban[2], **R.A. Garcia**[3], B. Mosser[2], and the Data Analysis Team

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CoRoT has been observing for more than a year and 4 solar-like stars have already been observed. In the present work, we will show the status of the analysis of these stars paying special attention to the problems we have found as the mode identification or the determination of the inclination angle and the global splitting.

3. Preliminary seismic modelling of the γ Dor COROT target HD 49434

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HD 49434, the first γ Dor target of the COROT mission, has been observed by the satellite during the winter 2008 long run and has been followed by an extensive ground-based photometric and spectroscopic campaign before and during the space run. This gDor, showing pulsation modes around 1 c/d and around 10 c/d, is actually an hybrid δ Sct/γ Dor pulsator.

We present here a preliminary seismic modelisation of HD 49434 using its observed stellar parameters and the ground-based identified modes. We compute stellar models with CLES (Code Liégeois d'Evolution Stellaire) and excited modes with the non-adiabatic pulsation code MAD.

4. 44 Tau: Examination of amplitude variability and combination frequencies

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The Delta Scuti Network has observed the slowly rotating δ Scuti star 44 Tau for five seasons during 2000–2006. All $\ell = 1$ modes exhibit strong annual amplitude variations, while the radial modes have constant (or nearly constant) amplitudes. We examined the probability of different amplitude modulation mechanisms to be responsible for the observed amplitude variability.

The amplitudes of the combination frequencies, $f_i + f_j$, mirror the variations of the parent modes. The relationship between the amplitudes of the combination frequencies and their parents is found to be constant ($\mu = 0.003$) for the combinations involving the radial fundamental and different $\ell = 1$ modes.

5. German Data Center for the Solar Dynamics Observatory: A model for the PLATO mission?

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The German Data Center (GDC) for the Solar Dynamics Observatory (SDO), hosted by the Max Planck Institute for Solar System Research in Germany, will provide access to SDO data for the German solar physics community. The GDC-SDO will make available all the relevant Helioseismic and Magnetic Imager (HMI) data for helioseismology and smaller selected Atmospheric Imaging Assembly (AIA) data sets. This project commenced in August 2007 and is funded by the German Aerospace Center (Deutsches zentrum fuer Luft- und Raumfahrt or DLR) until December 2012. An important component of the GDC-SDO is the Data Record Management System (DRMS), developed and distributed by the Stanford/Lockheed Joint Science Operations Center (JSOC). Additional information about the GDC-SDO can be found at http://www.mps.mpg.de/projects/seismo/GDC1/index.html. A similar structure and philosophy should be ideal for the PLATO mission, which looks for planetary transits and stellar oscillations and is being studied by ESA for an M-Mission slot in Cosmic Vision.

6. Asteroseismology of pulsating white dwarfs

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White dwarfs are the evolutionary end point of almost 98% of all stars. Their evolution is dominated by cooling; as they cool, they cross three distinct instability strips. We compared the observed modes to a fine grid of adiabatic models to determine the internal structure of 72 pulsating white dwarfs with H dominated atmosphere (DAVs or ZZ Cetis). Prior to this work there were only 12 ZZ Cetis that had been studied seismologically. Our main contribution was the inclusion of relative weights proportional to the observed amplitudes in the fits. We performed a broader search in the parameter space, using the spectrocopic determinations as a guide. By searching the

whole grid, we avoid local minima. We determined that the average hydrogen mass is $10^{-6.3\pm1.6}\ M_*$ and that the helium mass is $10^{-2,5\pm0,6}\ M_*$. We did not find evidence for accretion nor for mass loss while the stars evolve through the instability strip.

7. The potential of the GW Vir variable star PG 0122+200 as a sensitive probe of plasmon neutrino emission in pre-white dwarf stars

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This work is aimed to specifically assess the feasibility of employing the coolest known pulsating PG1159 star PG 0122+200 as a tool to place constrains on the plasmon neutrino emission rates in pre-white dwarf stars. We employ the asteroseismological model of PG 0122+200 derived by Córsico et al. (2007) employing the Miller Bertolami & Althaus's (2006) full PG1159 evolutionary sequences. We calculate PG1159 sequences with the stellar mass of our asteroseismological model but with different rates of neutrino emission (artificially enhanced or diminished) as to assess the relevance of neutrino losses on the cooling rate and to estimate their impact on the theoretical rates of period change of PG 0122+200. We found that, in spite of the relatively low total mass of our asteroseismological model (0.556 $M_\odot$) as compared with the predictions of early studies (0.59–0.66 $M_\odot$), the evolutionary change of periods alue of the neutrino production rates. This property renders the star as an appropriate target to measure the plasmon neutrino luminosity on the basis of an observed value of the rate of period change. We conclude that, once a value of the rate of period change be measured in PG 0122+200, this star could open the possibility to astronomers to place interesting constraints on the plasmon neutrino rates in the dense interior of pre-white dwarfs and, consequently, to study anomalous neutrino electromagnetic properties (a magnetic dipole moment or millicharge).

8. Contributions of different effects towards the light variations in main sequence pulsators

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Nonradial stellar oscillations cause the brightness changes, which result from temperature, geometrical and pressure perturbations. The observed values of photometric amplitudes and phases are determined by a competition between those three effects whose contributions depend on stellar parameters and pulsation mode.

I discuss the importance of the individual contributions towards the light variations as a function of the spherical harmonic degree, ℓ, and mode frequency, for β Cep, SPB and δ Sct star models. All computation were performed in the framework of linear non-adiabatic theory of stellar pulsation and assuming the non-rotation approximation.

9. HARPS seismic data of the F type star HD 49933 revisited with the CoRoT data

S. Deheuvels, E. Michel, B. Mosser and CoRoT team

Observatoire de Paris, LESIA, Meudon, France

HD 49933, an F5 star on the Main Sequence, is the only solar-like pulsator, except the Sun, for which both photometric and spectrometric monitoring of the oscillations were obtained. The star was observed during the 60-day-long initial run of the space mission CoRoT (spring 2007). Previously, a 10-day-long run was conducted with the échelle spectrometer HARPS, installed at the ESO 3.6-m telescope in La Silla (Mosser et al. 2005, A&A 431, L13). Compared to the CoRoT data, these single site ground-based observations suffer from a low duty cycle (about 23%), but show a similar SNR. Therefore, we can revisit the analysis of the spectrometric time series, in the light of the recent photometric CoRoT data and explore how photometry and velocimetry observations might compare and complete.

10. Pulsating B and Be stars in the Magellanic Clouds

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The main objective of this work is to investigate the existence of B-type pulsators at low metallicities, searching for short-term periodic variability in absorption-line B and Be stars in the Magellanic Clouds. The research has been performed in a sample of 313 B and Be stars in the Small Magellanic Cloud (SMC) and 180 B and Be stars in the Large Magellanic Cloud (LMC) with fundamental parameters accurately determined from high-resolution spectroscopy.

Photometric light curves of the MACHO project have been analysed using standard Fourier techniques and linear and non-linear least squares fitting methods. The position of the pulsating stars in the HR diagram has been used to ascertain their nature and to map the instability regions in the SMC and LMC.

In the SMC, we have detected 9 absorption-line B stars showing short-period variability, two among them being multiperiodic. One star is most likely a β Cephei variable and the remaining 8 are SPB stars. The SPB instability strip in the SMC is shifted towards higher temperatures with respect to the Galaxy. In the Be star sample, 32 stars are short-period variables, 20 among them multiperiodic.

In the LMC, the work is ongoing.

11. Dipole modes of stellar oscillations

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Stellar modelling is considered as being successful to the extend that the models reproduce the observed oscillation frequencies of stars together with the global stellar parameters being in agreement with observationally obtained ranges. To identify the modes of the calculated frequencies accurately is a difficult but also an important task.

In this work we focus on dipole mode stellar oscillations which have been a challenge in classifying the modes. However, it is possible to use a classification scheme specific to these oscillations (Takata 2006). We have made use of the variables defined by Takata in order to test this new classification on realistic stellar models. The treatment takes into account the gravitational potential perturbation. Our results show that this classification scheme can be used at least for stars from main sequence through the sub-giant branch.

12. Asteroseismic models for the exoplanet host star HD 19994

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We present asteroseismic models for HD 19994, a star belonging to a binary system and also, has been found that harbors an extrasolar planet. We calcul evolutionary tracks from 1.18 $M_\odot$ to 1.40 $M_\odot$ with the Toulouse-Geneva evolution code and we chose the models closer to the observational constraints given by the previous spectroscopy studies. We developed models for four different metallicity values. Once we have chosen an specific model for the star, we perform several asteroseismic tests to see what will be the structure of the star in the different cases. In particular we calculed the large separations, the small separations and we ploted the echelle diagrams. We see that the star could be an overmetallicity main sequence star or a solar metallicity red giant brach star. In some cases, the small separtion became negative, indicating that the star develop a convective core down to its centre. This work was performed as a preparation of the observations of this star which was observed in November 2007 with the HARPS spectrograph, mounted in the 3.6 m Telescope at La Silla Observatory.

13. Radiative levitation: A likely explanation for the presence of pulsations in the unique hot O subdwarf star SDSS J1600+0748

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SDSS J1600+0748 is the only hot sdO star for which unambiguous multiperiodic luminosity variations have been reported so far. These rapid variations, with periods in the range from 60 s to 120 s, are best qualitatively explained in terms of pulsational instabilities, but the exact nature of the driving mechanism has remained a puzzle. Models with uniform metallicity are unable to excite pulsation modes in the range of interest as demonstrated most eloquently by Cristina Rodriguez-Lopez in her Ph.D. thesis at the Universidad de Vigo in 2007. We confirm her results here, but also show that the inclusion of radiative levitation in the equilibrium models changes the picture dramatically. We find indeed that p-mode pulsations with periods overlapping the observed ones in SDSS J1600+0748 can be excited in models in which radiative levitation of iron is taken into account. This process provides the needed boost to the opacity driving mechanism. We conclude that radiative levitation is a likely esential ingredient in the excitation physics at work in this unique star.

14. New multisite observations of δ Scuti stars V624 Tauri and HD 23194

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The preliminary results of 2006 STEPHI campaign are reported. The δ Scuti variables V624 Tauri (HD 23156) and HD 23194, belonging to the Pleiades cluster, were reobserved photometrically for 20 days on three continents during 2006 November-December. An overall run of 232 hours of data was collected. Eight frequencies for V624 Tauri and three frequencies for HD 23194 have been found above a 99% confidence level. These results improve those found in 1999, in the framework of STEPHI X campaign, where the two stars were observed as well. When the data of the two campaigns are merged nine and four oscillation frequencies are detected above a 99% confidence level in V624 Tauri and HD 23194 respectively. A comparison with models is also performed.

15. Pulsational tomography of the Herbig Ae star HD 104237

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LATT, Université de Toulouse, CNRS

Herbig Ae/Be stars are young pre-main sequence stars of intermediate mass (2–8 $M_\odot$). They are in their radiative phase of the contraction towards the main sequence and should therefore not possess outer convection zones generating magnetic fields via a classical dynamo mecanism. In this context, the observation of tremendous activity and stellar variability in the spectra of this group of stars remains unexplained as of today. However, there is growing evidence about an internal stellar origin responsible for the observed activity. Asteroseismology is the only tool able to probe stellar interiors. Most Herbig Ae stars are located in or close to a recently discovered pms-instability strip. Based on extensive high resolution spectroscopic monitoring of the Herbig Ae star HD 104237 we did perform a first tomographic analysis of the pulsations by analyzing how the observed pulsations vary with photospheric depth.

In addition, and preparing first asteroseismological models, we present new results concerning the fundamental stellar parameters of this star.

16. Is HD 163899 really a supergiant star?

Mélanie Godart[1], **Arlette Noels**[1], Marc-Antoine Dupret[2]

[1]*Liége University, Belgium,* [2]*Paris-Meudon Observatory, France*

According to its spectral type B2 Ib/II (Klare & Neckel 1977; Schmidt & Carruthers 1996), HD 163899 should be a supergiant star. The star presents p and g-mode pulsations (Saio et al. 2006). In such a post-main sequence star, the helium core is radiative with a very large Brunt-Väisälä frequency which produces a strong damping. The presence of excited g-modes is however possible thanks to an intermediate convective zone which prevents some g-modes from entering the radiative damping core (Saio et

al. 2006). We have investigated an alternative solution. We show that main sequence evolutionary tracks could cross the error box of HD 163899 if overshooting is taken into account. However, in that case, the spectrum of unstable modes is different from the spectrum of a supergiant star since the Brunt-Väisälä frequency is much smaller.

17. Photometric observations of southern Blazhko stars

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In the years 2004 and 2005 we gathered Johnson photometry of 7 southern Blazhko RR Lyrae stars. The data and some analyses are presented. The characteristics of the Blazhko effect in these stars are discussed with respect to the recent findings from large scale surveys.

18. Asteroseismology in the young open cluster NGC 3293

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We carried out an extensive CCD photometry campaign of the young open cluster NGC 3293 that contains eleven known β Cephei stars. None of these is singly periodic. Several objects are among the most multiperiodic of these massive pulsators, giving us strong hope to perform precision asteroseismology in an open cluster for the first time. We report preliminary mode identifications for the highest-amplitude pulsational signals.

We have also discovered many new variable stars in and around this cluster. A peculiar group of variables in NGC 3293 is located near the low-luminosity end of the β Cephei instability strip. The variability periods of these stars are too long for classical β Cephei pulsation, but too short for binarity or rotational effects, or for SPB-type pulsation. In addition, we discovered more than a dozen δ Scuti stars in the field, some of which belong to the cluster, some foreground objects and eclipsing variables.

19. Pulsation modes and combination frequencies in photometry of the ZZ Ceti star EC 14012-1446

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We report the analysis of more than 200 h of time-resolved CCD photometry of the pulsating DA white dwarf star EC 14012−1446 acquired during four observing epochs

in three different years, including a coordinated three-site campaign. A total of 19 independent frequencies in the star's light variations together with 148 combination signals up to fifth order could be detected. We infer a rotation period of 0.61 ± 0.03 d, assuming the rotationally split modes are $\ell = 1$. The pulsation modes of the star undergo amplitude and frequency variations, in the sense that modes with higher radial overtone show more pronounced variability and that amplitude changes are always accompanied by frequency variations. Most of the second-order combination frequencies detected have amplitudes that are a function of their parent mode amplitudes, but we found a few cases of possible resonantly excited modes. We point out the complications in the analysis and interpretation of data sets of pulsating white dwarfs that are affected by combination frequencies of the form $f_A + f_B - f_C$ intruding into the frequency range of the independent modes.

20. Pulsation, chemical composition and multiplicity in main-sequence A and F type stars

S. Hekker, Y. Frémat, P. Lampens, P. De Cat

Royal Observatory of Belgium

The region in the HR-diagram where the main sequence intersects the classical instability strip hosts stars exhibiting a rich variety of physical processes, such as pulsations, multiplicity and different chemical compositions. In order to investigate the inter-relationship between these phenomena, we study a significant sample of main-sequence A and F stars suspected of showing radial velocity variations. So far, we gathered spectra for approximately 65 stars which will be used for the determination of atmospheric stellar parameters and chemical abundances. Also a first indication of multiplicity and/or pulsations has been extracted from these spectra, in which case follow-up spectroscopy and differential photometry is being performed.

Here we will present an overview of the project together with our methodology and some first results.

21. Solar-like oscillations in red giants in the CoRoT exo-field

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Many red-giants are observed with the CoRoT satellite in the exo-planet-field. We report here on the discovery of solar-like oscillations in red giants brighter than V = 15 mag observed during an observing run of 150 days. We present a variety of very nice red giant power spectra showing the variation of oscillations with spectral type. We also present our first conclusions concerning the damping time of these giant oscillations, using multiple techniques.

22. Orbital period analysis of some classical Algols with pulsating component

Yasemin Kaçar[1], Faruk Soydugan[1], Esin Soydugan[1], Volkan Bakis[1], Mehmet Tüysüz[1], Tunç Şenyüz[1], Ali Donmez[1], Selcuk Bilir[2], Osman Demircan[1]

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The long-term orbital period variations of some Algol type binaries with delta scuti component (oEA), AB Cas, CT Her and TW Dra are investigated by using all published times of minima. An upward parabola is seen in all of these systems' O−C diagrams, as is expected from the evolutionary scenario of classical Algols. These variations of the orbital periods of AB Cas, CT Her and TW Dra may be a result of mass transfer from less massive component to the more massive one, which is a pulsating component of δ Scuti type. Using the parameters obtained from the O−C analysis, the mass-transfer rates are estimated for all systems under the assumption of conservative mass and angular momentum transfer. The possible period and/or amplitude variations of the pulsating components will be investigated, in a future work, since the mass is being transferred onto the pulsating components in these systems.

23. Follow-up campaign of the Blazhko star RR Lyr

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The phenomenon of amplitude and phase modulation in RR Lyrae stars has been haunting observers and theoreticians for more than a century now. Stars with changing Blazhko periods challenge the currently proposed hypotheses for the Blazhko effect. RR Lyrae, the prototype of the class, is one of the best-studied Blazhko stars but it keeps on surprising its observers.

We present the results from a photometric follow-up campaign in 2006–2007 of the star. Multicolour data were gathered from different observatories in the northern hemisphere. Our analysis focuses specifically on the period behaviour. We confirm the previously reported decrease of the modulation period.

24. Follow-up spectroscopy of the planet-hosting subdwarf B pulsator HS 2201+2610

Renate Kruspe

Institute for Astrophysics, University of Göttingen

Pulsating subdwarf B stars oscillate in short-period p-modes or long-period g-modes. The sdB star HS 2201+2610 (V 391 Peg) is one of the three known hybrids, but has become famous for different reasons. ¿From its p-modes, a secular period change has recently been measured over a period of 10 years. Furthermore the O–C diagram has revealed a sinusoidal component which is explained by a planetary-mass companion. To determine the mass of the companion object, the inclination of the orbit needs to be determined. Assuming alignment of the orbital, rotational and pulsational axes, it should be possible to derive the stellar inclination from a combination of rotational

splitting in the photometric frequency spectrum and the projected rotational velocity $v \sin i$ from measured rotational broadening of spectral lines. We concentrate on the latter, which must be corrected for the broadening contribution due to pulsational radial velocities: During May and September 2007 echèlle spectra were taken with the 9m-class Hobby-Eberly-Telescope. The spectra in September were obtained in time-resolved mode and can be combined to a phase-resolved series for the main pulsation frequencies. We report on our progress on extracting pulsational radial velocities, estimating the pulsational broadening, and finally the rotational broadening.

25. Frequency analysis of the δ Scuti type pulsations in the semi-detached eclipsing binary CT Her

Patricia Lampens, Anton Strigachev et al.

Koninklijke Sterrenwacht van België

We present the results of a large, multi-site photometric campaign carried out in 2004-2007 on the Algol-type eclipsing binary system CT Her, the primary component of which is a δ Scuti-type pulsator with a main pulsation period of only 27 min. CT Her is an thus oscillating Algol-type binary (oEA star). The oEA stars are the former secondaries of evolved, semi-detached eclipsing binaries which are (still) undergoing mass transfer and form a new class of pulsators close to the main sequence (Mkrtichian et al. 2002, 2004). We collected enough data in two passbands to perform a modelling of the light curves (using PHOEBE) and detected up to 7 significant pulsation frequencies in the frequency range between 45–53 c/d in the B-residuals (independent of the adopted solution for the binary modelling). The remaining standard deviation of the more than 7000 B-residual data spread over 4 years is (only) 4.2 mmag.

26. Photometric mode identification methods in eclipsing binaries

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We present a comparison of two methods developed to identify modes of non-radial pulsations in eclipsing binary stars. The first method is the direct fitting of spherical harmonics, while the second employs the eclipsing mapping techniques. Both methods use the effective surface sampling of the eclipses and require photometric data only. The relative merits of the methods will be evaluated through tests on synthetic light curves.

27. The oEA star TW Draconis - a spectroscopic study

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We present results from a first analysis of time series of high-resolution spectra of the oEA star TW Draconis taken with the coude-echelle spectrograph at the 2-m telescope at the Thueringer Landessternwarte Tautenburg in 2007. One part of the analysis is based on radial velocity variations and includes the determination of the binary orbit and a frequency analysis of the observed pulsation modes. A second part uses the least

quares deconvolution technique to investigate the line profile variations caused by the non-linear pulsations.

28. Observational constraints on intrinsic mode amplitudes of δ Scuti pulsators

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Using the azimuthal order (m) and the inclination angle (i), as determined from spectroscopy, the combination of two-color photometry and radial velocity data allows for simultaneous extracting the spherical harmonic degrees (ℓ) and intrinsic amplitudes (ε) of pulsation modes.

We present such estimates for identified modes of two well-studied δ Scuti stars: FG Vir and 44 Tau. The correlation between observed photometric/radial velocity amplitudes and intrinsic mode amplitudes is discussed.

29. The Algol-type binary TZ Eridani: BV photometry and search for pulsations and tertiary component

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CCD photometric observations of the Algol-type eclipsing binary TZ Eri have been obtained in B and V filters during 26 nights from December 2007 to February 2008 at the Athens University observatory. The light curves are analyzed with the Wilson-Devinney program and new geometric and photometric elements are derived. A time-series analysis of the observations shows that the primary component pulsates with a frequency of 18.7 c/d, while a multiperiodic behavior is also discussed. The presence of a third light in the system is considered and our results are compared with those of the O−C analysis for a third body in the system, given by Zasche et al. (2008).

30. The ongoing campaign on the open cluster h Persei (NGC 869)

Aleksandra Majewska-Świerzbinowicz[1], Andrzej Pigulski[1], Slavek Ruciński[2]

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We have recently increased the number of known β Cephei stars in h Persei (NGC 869) to nine (Majewska-Świerzbinowicz et al. 2008) showing that the cluster is as good target for asteroseismic study as its twin, χ Persei (Saesen et al. 2008). We present the first results of Białków photometry of h Persei made in 2007 within the campaign and some preliminary results of the spectroscopy of the brightest pulsators carried out with the 2-m telescope of David Dunlap Observatory.

31. The near-contact system BF Velorum: New BVRI photometry and search for pulsations

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A photometric analysis of the short-period eclipsing binary system BF Velorum, based for the first time on complete new BVRI CCD light curves obtained by the authors, is presented. Light variations characteristic of a pulsating component in the system are evident in these light curves. The new photometric solution obtained with the Wilson-Devinney program reveals that BF Vel is a semi-detached (near-contact) system with the secondary star filling its Roche lobe. Absolute elements of the system were calculated, and the evolutionary status of its members was determined. An analysis of the pulsation in the B filter using the Period04 program was also performed.

32. A study of δ Scuti stars in open clusters NGC 1817 and NGC 7062

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Reported are spectroscopic and photometric observations of selected δ Scuti stars from two open clusters: NGC 1817 and NGC 7062. Projected rotational velocities, $v \sin i$, and radial velocities are measured, and the stellar atmospheric parameters are computed.

New single-lined spectroscopic binaries discovered in our observations are reported, and the membership of all the observed the stars to the clusters, verified.

The candidates for asteroseismic targets in NGC 1817 and NGC 7062 are discussed in more detail.

33. Nonradial modes in classical Cepheids

Paweł Moskalik[1], Zbigniew Kołaczkowski[2]

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Systematic search for multiperiodicity in the LMC Cepheids (Moskalik, Kołaczkowski & Mizerski 2004) has led to discovery of low amplitude nonradial modes in a substantial fraction of overtone pulsators. We present detailed discussion of this new type of multimode Cepheid pulsators and compare them to similar nonradial pulsators discovered among RR Lyrae stars. Finally, we show first detections of secondary nonradial modes in FU/FO double-mode Cepheids.

34. Cluster Ages Experiment (CASE): multiperiodic RR Lyrae stars in ω Centauri

Paweł Moskalik, Arkadiusz Olech

Copernicus Astronomical Centre, Warsaw, Poland

We have conducted a systematic search for multiperiodic pulsations in the RR Lyrae-type stars of the galactic globular cluster ω Cen. Secondary periodicities close to the primary pulsation frequency have been detected in 17 out of 74 studied fundamental mode (RRab) pulsators and in 35 out of 81 overtone (RRc) pulsators. Because of the observed period ratios, these newly detected periodicities must correspond to nonradial modes. Their beating with the primary radial pulsation leads to a slow amplitude and phase modulation, commonly referred to as the Blazhko effect. The incidence rate of Blazhko modulation in ω Cen RRab stars ($23 \pm 5\%$) is similar to that observed in the Galactic Bulge. In the case of ω Cen RRc stars, the incidence rate of Blazhko effect is exceptionally high ($43 \pm 6\%$), more than 3 times higher than in any other studied population (including the Galactic Bulge).

In addition to Blazhko variables, we have also identified two RR Lyr variables exhibiting first overtone/second overtone double-mode pulsations, and a triple-mode High Amplitude δ Scuti variable.

35. Main-sequence pulsating stars in the Galactic disk

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The long-term massive sky surveys are excellent sources of photometric data that might be used in the search for variable stars and their thorough investigation. We present the result of such an investigation which made use of the photometry of 21 Galactic fields observed within the OGLE-II survey. We have analysed 380 000 light curves of disk stars brighter than 17 mag in I. We have found over 9500 stars showing periodic brightness variability with periods between 0.2 and 5 days and amplitudes lower than $\sim$0.1 mag. Many of them are multiperiodic. The amplitudes and periods suggest that this sample contains mainly main-sequence pulsators, namely β Cephei, SPB, δ Scuti and γ Doradus stars with only a minor contamination by other types of variability.

Since periods and amplitdues alone are not sufficient to make unambiguous classification, we have supplemented the variability search with the UBV photometry in the OGLE-II fields collected with the 1-m telescope in Siding Spring Observatory. The two colour, (U$-$B) vs. (B$-$V), diagrams constructed using this photometry allowed us to distinguish between different types of variables, at least for the brightest stars. Independently, we used neural networks as a supplementary classification tool.

36. The pulsations of a B5 IVe star revealed by CoRoT

C. Neiner et al.

GEPI, Observatoire de Paris-Meudon, France

In this poster we will present the first results of the analysis of the CoRoT data of a B5 IVe star. This is the first Be star observed during a long run (5 months) of the asteroseismic CoRoT mission. The light curve of this B5IVe star shows clear pulsations and

even beating effects. Several frequencies are detected. Ground-based spectroscopic data have also been analyzed for this star and help to identify the pulsations modes.

37. Chemical abundances of the β Cephei star HD 167743

Ewa Niemczura

Instytut Astronomiczny, Uniwersytet Wrocławski, Poland

We present the first detailed abundance analysis of the B-type star HD 167743. Recently, HD 167743 was classified as a β Cephei pulsator by Pigulski (2005) from the analysis of the ASAS-3 database. Asteroseismology of β Cephei stars is a very promising tool to understand the structure and evolution of early B-type main-sequence stars. To perform the seismic modelling of the star, the precise knowledge of their atmospheric parameters and chemical abundances is essential. Here we present the results of a detailed NLTE abundance study of HD 167743 based on high-resolution FEROS spectra. We obtained effective temperature and surface gravity of 24500 K and 3.80 dex, respectively. The average value of the projected rotational velocity, 57 ± 6 km/s, was derived from all analysed lines. We considered the following elements: He, C, N, O, Ne, Mg, Al, Si, S and Fe. Within the error bars, the determined abundances are consistent with the solar values of Asplund et al. (2005).

38. Line profile variations for the pulsating sdB Balloon 090100001

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We have acquired time series of high resolution Echelle spectra for the brigh pulsating sdB Balloon 090100001. The time series consist of 6 nights spanning from August to December, 2006. We present the preliminary results of line profile variation analysis.

39. Prediciting amplitude variations of physical parameters from spectroscopic modelling of the pulsating sdBV Balloon 090100001

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In order to interpret our extensive spectroscopic time-series of the high amplitude sdBV pulsator Balloon 090100001 we have undertaken an extensive exercise to model the variations in effective surface temperature, gravity, velocity as well as photometry throughout the pulsational cycle for different pulsational ℓ and m's. Here we present the results of this modelling demonstrating that the amplitude ratios of temperature and gravity, as determined by classical fitting of observed spectra on model grids, can be used as reliable indicators of the pulsational degree ℓ.

40. Validity domain of a perturbative approach for the effects of rotation on asteroseismic data

Rhita-Maria Ouazzani

LESIA - Paris Observatory, France

Among the methods used to investigate the effect of rotation on oscillation frequencies of stellar pressure modes, we consider here perturbation techniques and direct numerical integrations of a two dimensional eigenvalue system — nonperturbative approach.

Knowing the accuracy of asteroseismic data provided by CoRoT, the issue is to determine whether it is sustainable to take the effect of rotation on stellar oscillations into account with a perturbative approach, or if we should adopt a nonperturbative method that could be much heavier numerically.

The aim of this study is to determine the limits — in terms of rotational angular velocity — of a perturbative approach to model the effects of rotation on both structure and oscillation frequencies.

Until now, 2D nonperturbative oscillation code has only been developed for polytropic models but not for realistic models of stars. Thus, we have used a polytropic model to compare the results of a 2D nonperturbative oscillation code provided by D. Reese, and a 1D second order perturbative one.

For models whose angular velocity of rotation is that of a δ Scuti type star, say 70–145 km s^{-1}, we find a relative frequency difference between the results of the two codes of 0.03% to 0.17%. Considering an optimistic evaluation of uncertainties on CoRoT frequency splittings mesurements — 0.2 μHz about 500 μHz: relative frequency uncertainty 0.04% — we can already conclude that the perturbative method seems to be acceptable for a 2 solar radius star up to about 100 km s^{-1} but not further. We expect to push the validity limits of this method a little further taking into account additional corrections such as near-degeneracy coupling — work in progress.

41. Non-linearity in the white dwarf, GD 154

Margit Paparó, Peter Papics

Konkoly Observatory, Hungary

Light curves, obtained on four consecutive nights at Canadian-French 3.6 m telescope, is used for the investigation of non-linearity. The three independent frequencies are regarded as a basic sign of the pulsation. The linear combinations are treated as a sign of the non-linear behaviour of the pulsation. The area under each cycle of the light curve is used to show how dominant is the non-linearity in the star. The observed and synthetic light curves of different combinations are compared.

42. Physical parameters determination of the RR Lyrae stars RU Psc, SS Psc and TU UMa

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Strömgren $uvby-\beta$ photometry of the RR Lyrae stars RU Piscium, SS Piscium and TU UMa has been acquired at the Observatorio Astronomico Nacional, Mexico in order to determine the physical parameters along the cycle of pulsation of the stars through the Fourier light curve decomposition. The physical parameters such as the absolute magnitude M_v, intrinsic color $(B-V)_0$ and metal abundance [Fe/H] have been estimated. Once the reddening has been determined, unreddened indexes have been obtained and T_e and $\log g$ determined along the cycle by comparing to the theoretical models for the determined metallicity.

43. Distribution of β Cephei stars in the local part of Galaxy from the All Sky Automated Survey

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Over 100 β Cephei stars were recently discovered in the photometry obtained within the All Sky Automated Survey (ASAS) covering 70% of the sky (Pigulski & Pojmański, 2008, A&A 477, 917). We present the second part of the list of β Cephei stars found in the ASAS data, containing about 180 pulsators of this type.

Since the sample of β Cephei stars found in the ASAS data is quite numerous ($\sim$300 stars) and homogeneous, we discuss their distribution in the Galaxy in the context of location of spiral arms and star-forming regions. In addition, their pulsational properties (periods and amplitudes) are summarized and discussed.

44. Perturbation of structural models of sdOs

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We investigate the effects of perturbing the transition regions of the Brunt-Väisälä and Lamb frequencies of sdO models, in the mode trapping and the modes tendency to instability.

45. Spectroscopy of pulsating stars at Poznań Spectroscopic Telescope — data reduction and radial velocity measurements

Agata Rożek

Astronomical Observatory of Adam Mickiewicz University

The aim of this presentation is to introduce the radial velocity curves obtained at the new Poznan Spectroscopic Telescope. PST is a small telescope equipped with a fibre fed echelle spectrograph. The data reduction was carried out with IRAF package. With radial velocity measurement precision at a sigma level of 150 m/s we are capable of obtaining high quality velocity curves for pulsating stars. One of the first observed objects was γ Pegasi. The star is a bright B2 IV β Cephei pulsator. Our results reveal a period of 3.4 h and an amplitude of variations about 3.5 km/s. Polaris is a classical Cepheid variable. About 200 spectra during a two moth observational period have been acquired. Another analysed Cepheid variable is V440 Persei. Current measurements result in detection of a second harmonic of pulsation. The star is subject to ongoing observations in order to confirm the low amplitude, about 90 m/s, harmonic. The last featured star is a member of the δ Scuti family, named 28 Andromedae. For this star, having pulsational period of 1.66 h, radial velocity curve of σ = 0.17 km/s has been obtained.

46. Spectroscopic monitoring of the roAp star γ Equ

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We present the analysis of spectroscopic time-series observations of the roAp star γ Equ. Observations were carried out with the NES spectrograph at 6-m telescope of SAO RAS. All these data were analysed for radial velocity (RV) variations. Time-series analysis of the spectroscopic data gives four frequencies that are coincide with the photometric ones obtained with MOST mini-satellite. Phase-amplitude diagrams created for the lines of different elements/ions show that atmospheric pulsations may be represented by a superposition of the standing and running wave components, similar to other roAp stars. The relative amplitudes of the different frequencies seem to be comparable to what were found in MOST photometry (Gruberbauer et al., 2008).

47. A binary star with a δ Scuti component: EF Herculis

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Çanakkale Onsekiz Mart University, Turkey

New photometric observations of Algol type binary system EF Her were carried out in B, V and R filters during 2007 observing season. In the literature, there is no any the photometric and spectroscopic study of the system so far. Firstly, the new observations have been analyzed by using the Wilson-Dewinney code and determined the geometrical and physical parameters of the system. The mass ratio of EF Her was found about 0.21. It is clearly seen periodic oscillations in the maxima, secondary minima and also primary minima phases of the light curve due to the pulsation of the primary component. The residuals from the computed binary light curves were

analyzed with PERIOD 04 program. As a result of this, only one frequency at 10.0653 c/d was obtained. The pulsation amplitudes in B, V and R filters were determined 0.0694, 0.0512 and 0.0408 mag, respectively.

48. Seismic signature of convective and helium cores

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The study of stellar oscillations is a powerfool tool in order to better understand the stellar internal structure. In particular, the characteristic combinations of frequencies called the śmall separationsąre very sensitive to the structure of the stellar cores. We show in this poster that the $\ell = 0 - \ell = 2$ small separations can become negative in the observing frequency region during the evolution of solar-type stars. This specific behavior can be used to characterize the convective and the helium stellar cores, and to obtain constraints on the possible extent of the overshooting at the core edge.

49. Fourier analysis of gapped time-series

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In asteroseismology, gaps in the time series complicate the data analysis and hamper the precise measurement of stellar oscillation parameters, e.g. the frequencies, amplitudes, phases, and mode lifetimes. In the Fourier domain the convolution of the stellar signal with the Fourier transform of the temporal window function introduce data correlations between the different frequencies. We developed a method to derive Maximum Likelihood Estimates (MLE) of mode parameters where these data correlations are explicitly taken into account. Using simulated realisations of noisy time series with gaps, the MLE of the mode parameters of solar-like oscillations obtained with our new fitting method are more precise and less biased than the MLE determined based on the unfounded assumption of uncorrelated frequency bins.

50. Radius determination from the large frequency separation

Dennis Stello and the rest of the AsteroFLAG team

University of Sydney, Australia

We report on the recent 2nd AsteroFLAG hare-and-hound exercise aimed at determining radii of F-K stars that are on or near the main sequence. Based on the large frequency separation, obtained from simulations of 4 year data from the Kepler mission (1st AsteroFLAG exercise; astroph/08034143), we have been able to correctly determine the stellar radii. The various methods used by each independent hound all agree, which gives strong confidence that radii estimation can be performed to the 1% level on a routine basis using automatic pipeline reduction.

51. PMS δ Scuti stars in the region of Carina Nebula

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We present the results of a search for pulsating stars in the region of Carina Nebula which contains a very young population of stars and several open clusters. The search was made with the data obtained with the Wide Field Imager (WFI) on the MPG/ESO 2.2-m telescope in La Silla (Chile). In total, about 16,000 stars have been analysed using classical Fourier techniques. We found about 150 pulsating δ Scuti-type stars in this region. At least dozen of them can be members of young open clusters at the pre-main sequence (PMS) stage of evolution.

52. About the pulsational status of the ϵ Ophiuchi

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In this paper we try to determine the pulsational status of the star ϵ Ophiuchi that is located on the AGB region.

53. The driving mechanism of roAp stars: effects of metallicity

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Since their discovery, thirty years ago, the roAp stars have challenged the theoricists in many different ways: the properties of their pulsations and the position of their instability strip, for instance, still remain open issues. Today the κ-mechanism operating in the HI ionization region is considered as the most probable driving mechanism for roAp oscillations. As a result the properties of the excited modes are expected to be strongly dependent on the chemical distribution, especially in the external layers of the star. Several complex processes are expected to be involved in the definition of the chemical elements distribution in these layers: microscopic diffusion including radiative levitation, stellar winds, turbulent motions, magnetic field. Up to now theoricists tried to model the resulting complex internal structure of magnetic Ap stars in order to explain the properties of their oscillations but they always considered models with homogeneous chemical composition or with helium (and so hydrogen) stratification. No study was dedicated to the influence of the heavy elements distribution on the pulsations. However recent abundance determinations in several roAp stars seem to suggest a relation between the metallicity and the excitation mechanism. The aim of this paper is then to study the influence of metals on the excitation mechanism of roAp stars pulsations and to test if these elements could help solving some open issues related to roAp stars properties.

54. Spectroscopic solution fot the oEA star RZ Cas using the Shellspec code

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We reinvestigate the short period oEA star RZCas based on the time-series of high resolution spectra obtained in 2001 and 2006 by using a modern code for the synthesis of composite line profiles of binary systems "Shellspec" (Budaj and Richards, 2004; Budaj, Richards, Miller, 2005). Our results confirm most of the system parameters obtained by Lehmann and Mkrtichian (2008). Investigations of the Fe I 4957 Å line profile variations give different results for the 2001 and 2006 observation periods. The strong attenuation of the line profile of the primary obtained from the 2001 spectra point to a transient phase of rapid mass transfer during this period and to the existence of an accretion annulus around the primary. We found that the system was in a quiet state during the observation period in 2006 and can be modelled very well by two stars where the secondary component has a Roche geometry. Results obtained assuming such model give an ultra-high gravity darkening exponent for the secondary and show that its brightness distribution can be described by a gravity darkening law that assumes two different exponents for different star's hemispheres. The obtained ultra-high value of the gravity darkening exponent of 0.5 is in a good agreement with the results photometrically obtained by Unno et al. in 1994 and the two different exponents reflects the possible existence of two different star spots on the opposite sides of the secondary as predicted by Unno.

55. The preliminary results of the eclipsing binary system EW Boo with δ Scuti component

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In this study, we present B and V photometric and spectroscopic observations of EW Boo for the first time. The photometric observations were made in 2003, 2004, 2006 observing seasons, while a few spectra were taken during 2004 season. The light and radial velocity curves were analyzed simultaneously by using the Wilson-Dewinney code. The geometrical, physical and absolute parameters of the system were estimated. We found that the primary component of the system shows δ Scuti-type variability. The power spectrum indicates that two frequencies are significant. So, we decided that multi-periodic pulsations of the primary component of EW Boo exist. The main peak found from the frequency analysis is 48.31 c/d which agrees well with the relation between the orbital and pulsation periods and the other one is 52.37 c/d in both B and V filters. The pulsation amplitudes are about 0.035 and 0.025 mag in B and V filters, respectively.

56. Detection of line-profile variations in high-resolution VLT/UVES spectroscopy of the subdwarf B pulsator PG 1336-018 (NY Virginis)

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We present an analysis of about 400 high-resolution time-resolved VLT/UVES spectra of the eclipsing subdwarf binary system PG 1336-018, a rapidly pulsating subdwarf B primary in a short orbit with an M5 companion. We analysed the spectra of PG 1336-018 with the aim to detect the pulsational signal of the primary in line-profile variations. After removing the dominant radial-velocity component inherent to the orbital motion, we computed cross-correlation functions for each individual spectrum and assumed these to approximate the average line profile. The dominant pulsation mode is detected in the cross-correlation functions and may lead to the first spectroscopic mode identification of this star. We present our current results of the computed line diagnostics for PG 1336-018 and their interpretation.

57. Rotation and pulsation in g-mode main sequence pulsators

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The lack of well-identified modes is one of the major problems preventing an in-depth asteroseismic study of g-mode main sequence pulsators. Since several of the currently available spectroscopic mode identification techniques have been developed for, or only extensively tested on p-mode pulsations, we started an investigation to improve them for the modes observed for SPB and γ Doradus stars. A few high quality spectroscopic timeseries are being obtained for a selection of the most promising members from these groups with a large spread in projected rotational velocity that will serve as testbeds. These data will also enable us to study any observational relationship between the observed g-modes (degree ℓ, azimuthal number m and/or pulsation amplitude) and the rotation of these non-radially pulsating stars.

58. Can opacity changes help to reproduce the hybrid star pulsations?

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Hybrid stars like ν Eridani and 12 Lacertae show two different types of pulsations: (i) low-order acoustic and gravity modes of the β Cephei type with periods of about 3–6 hours, and (ii) high-order gravity modes of the SPB type with periods of about 1.5–3 days. Theoretical computations using both OPAL and OP opacity data well reproduce short period low-order pulsations of the β Cep type and show a tendency to instability of high-order gravity modes, especially for stellar models built with the OP opacities. However, instability at observed long periods has not been achieved. We test effects of artificial opacity modifications in the deep envelope on the instability of some hybrid star models. For ν Eri models, an opacity increase both in the Z opacity bump region

at temperature of about 200 000 K and in the region of the deeper opacity bump at temperature of about 2–2.5 million degrees (this bump is also mainly due to excited ions of the iron-group elements) may result in instability of the high-order gravity modes with the observed periods. The shortest observed period of 3 hours can also be excited in modified models. However, the required opacity increase seems to be quite large (up to 2 times in some stellar layers) which may be incompatible with atomic physics.

59. Stellar evolutionary models and their oscillations

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Theoretical computations of stellar evolutionary models on and close to the main sequence have been performed using new OP opacity data and new solar heavy element mixture. The results for several models of different masses were compared with those obtained by other authors with the CESAM code, and the differences are discussed. For the models considered, radial and nonradial osclliations have been computed using linear nonadiabatic code written by W.A. Dziembowski. The theoretical instability domains for the β Cephei and SPB type variables have been determined, giving special consideration to regions of the highest instability within these domains and to regions of the hybrid pulsations (both β Cep and SPB type instability).

60. FAMIAS - A userfriendly new software tool for the mode identification of photometric and spectroscopic times series

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FAMIAS (Frequency Analysis and Mode Identification for Asteroseismology) is a collection of state-of-the art software tools for the analysis of photometric and spectroscopic time-series data. It provides analysis tools required for the steps between the data reduction and the seismic modeling for κ-driven pulsation modes.

Two main sets of tools are incorporated in FAMIAS. The first allows to search for periodicities in the data using Fourier and non-linear least-squares fitting algorithms. The other allows to carry out mode identification for the detected pulsation frequencies to determine their harmonic degree, ℓ, and azimuthal order, m. For the spectroscopic mode identification, the Fourier parameter fit method and the moment method are available. The photometric mode identification is based on pre-computed grids of atmospheric parameters and non-adiabatic observables, and uses the method of amplitude ratios and phase differences in different filters.

The types of stars for which FAMIAS is applicable are all main-sequence pulsators hotter than the Sun. This i ncludes the γ Dor, roAp and δ Sct stars, the slowly pulsating B (SPB)-stars and the massive β Cep stars - basically all stars, for which empirical mode identification is required to successfully carry out asteroseismology.

In this poster, we present an overview over the different features of FAMIAS.