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COVER ILLUSTRATION: Jaymie Matthews with the MOST satellite before launch

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## Contents

**Editorial** 5

**ENEAS: the European Network of Excellence in AsteroSeismology**

*by C. Aerts*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and Goal of ENEAS</td>
<td>6</td>
</tr>
<tr>
<td>Management of ENEAS</td>
<td>7</td>
</tr>
<tr>
<td>Collaboration over the internet</td>
<td>8</td>
</tr>
<tr>
<td>ENEAS-RTN</td>
<td>8</td>
</tr>
<tr>
<td>Call for participation</td>
<td>9</td>
</tr>
</tbody>
</table>

**The ENEAS Portal**

*by E. Solano*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>10</td>
</tr>
<tr>
<td>The system</td>
<td>10</td>
</tr>
<tr>
<td>Functionalities</td>
<td>11</td>
</tr>
</tbody>
</table>

**The public outreach programme of ENEAS**

*by D.W. Kurtz, K. Kolenberg, Z. Kollath and T. Teixeira*

<table>
<thead>
<tr>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don Kurtz</td>
<td>13</td>
</tr>
<tr>
<td>A press release:</td>
<td>14</td>
</tr>
<tr>
<td>Don Kurtz:</td>
<td>15</td>
</tr>
<tr>
<td>Zoltan Kollath:</td>
<td>15</td>
</tr>
<tr>
<td>Katrien Kolenberg:</td>
<td>17</td>
</tr>
<tr>
<td>Teresa Teixeira:</td>
<td>17</td>
</tr>
<tr>
<td>All of us</td>
<td>19</td>
</tr>
</tbody>
</table>

**Follow-up observations of the DSCT V350 Peg**

*by J. Vidal-Sániz, E. García-Melendo, P. Lampens, P. Van Cauteren and P. Wils*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>20</td>
</tr>
<tr>
<td>The data</td>
<td>21</td>
</tr>
<tr>
<td>Analysis and conclusion</td>
<td>21</td>
</tr>
</tbody>
</table>

**A Hare and Hound in a BAG: Asteroseismology of $\beta$ Cephei stars**

*by Thoul et al., BAG*

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>26</td>
</tr>
</tbody>
</table>
Photometry of Be stars in the vicinity of COROT primary targets for asteroseismology
by J. Gutiérrez-Soto, J. Fabregat, J. Suso, A.M. Hubert, M. Floquet and R. Garrido
Introduction .................................. 30
Observations and data analysis .................. 31
Notes on individual stars ......................... 32
Conclusions .................................... 35

The MOST and COROT prime target fields: A target inventory
and K. Zwintz
Introduction .................................. 37
Target inventory ................................ 40

VISAT – VIenna Selection of Astronomical Targets
Introduction .................................. 44
Catalogues ...................................... 45
Query forms .................................... 47
Object Search ................................... 47
Parameter Search ................................ 48
Field Search ................................... 48
Space mission masks ............................. 48
COROT mask ................................... 48
MOST mask ..................................... 49
Editorial

We live in exciting times for asteroseismology, both on the ground and in space. On Monday, June 30th in the late afternoon, the Canadian MOST satellite was successfully launched. It should be sending asteroseismological data immediately after successful tests of the instruments during the verification phase which is scheduled for the next weeks. On Earth, the small-telescope networks are very successful. Furthermore, the huge data bases of HIPPARCOS, MACHO, OGLE etc. continue to reveal one scientific gem after another. These developments and the growth in asteroseismology have led to the establishment of our own society: ENEAS, the European Network of Excellence in Asteroseismology. We already commented on this in the last editorial.

So this editorial is not surprisingly another upbeat one. Parallel to the rapid progress in the field of asteroseismology, our 'Communications in Asteroseismology' has taken another jump forward. Two years ago we merged with the Delta Scuti Star Newsletter and obtained professional printing support from the Austrian Academy of Sciences. This year we have been asked by ENEAS to be their official publication medium. Of course we gladly accepted! This volume of the Communications contains a number of ENEAS articles.

Citations to articles in the Communications are counted by NASA’s Astrophysics Data System (ADS), which now has assigned us the official abbreviation "CoAst" to our publication. We request that this name be used in all references to the articles in our journal.

Michel Breger
Editor
ENEAS: the European Network of Excellence in AsteroSeismology

C. Aerts
http://www.eneas.info

Abstract
In this contribution we briefly introduce the history of the European Network of Excellence in AsteroSeismology, its goals and some concrete action items that have been defined. We invite all interested scientists to take part in our initiative, to make use of the facilities of the network and to propose suggestions for its future activities and structure.

History and Goal of ENEAS
The European Network of Excellence in AsteroSeismology (ENAEAS) was created on 11 October 2002 during a kick-off meeting held in Leuven (Belgium). This kick-off meeting was the result of the need felt by several astronomers in leading institutes in asteroseismology to develop an efficient exchange programme and to create closer collaborations across Europe in this research field. This need became evident during the numerous meetings of the European consortia of the future asteroseismic space missions planned for launch within a couple of years from now.

We need not convince the readers of this journal that asteroseismology is one of the major important science topics in astrophysics in the coming decade. Very substantial investments are being made in Europe to ensure observations of stellar oscillations of unforeseen quality. It concerns both upgraded ground-based instruments and asteroseismic space missions, COROT and Eddington, planned for launch between 2005 and 2008. Besides these European missions, NASA’s WIRE satellite was recently put back into operation and the Canadian MOST mission was just launched successfully (see elsewhere this volume).
MOST is the first dedicated seismic space mission. It will provide photometric time series from space for bright stars other than the Sun with unprecedented precision. It is clear that we have an exciting time ahead of us in this research domain.

A successful seismic study is necessarily multidisciplinary, as it involves many different steps, from instrument calibration over state-of-the-art data treatment to theoretical physical modelling of the oscillation frequencies. ENEAS is set up to meet the needs of combining and exchanging the different expertises of its participating institutes in these different areas, of training PhD students and of both training and exchanging post-doctoral researchers. Several well-working initiatives already exist in Europe, mainly working groups concentrated around a specific future space mission. It is one of ENEAS' prime goals to provide an efficient coordination between these existing initiatives in order to achieve an effective integration of expertise. This will guarantee the most fruitful exploitation of the new upcoming data. ENEAS will also be a testbed for the development of efficient collaboration across the internet, involving a vast range of procedures and skills, as well as extensive common use of a broad variety of data. Furthermore, procedures will be incorporated for the joint training of students, which is an essential part of our project.

Management of ENEAS

During the ENEAS kick-off meeting, a plan was prepared to install a management structure for the network through a call for candidates and an election procedure. These positions have been filled. The network is led by a coordinator, three co-coordinators and a team of eleven managers. Each of the managers is responsible for particular topics of ENEAS. The current management team was installed for two years (period 2003 - 2004) and consists of:

- Coordinator: Conny Aerts (Belgium)
- Co-coordinators: Annie Baglin (France), Jørgen Christensen-Dalsgaard (Denmark), Don Kurtz (UK)
- Managers: Marie-Jo Goupil (France), Guenter Houdek (UK), Hans Kjeldsen (Denmark), Don Kurtz (UK), Yveline Lebreton (France), Carla Maceroni (Italy), Arlette Noels (Belgium), Alex Schwarzenberg-Czerny (Poland), Petr Skoda (Czech Republic), Enrique Solano (Spain), Mike Thompson (UK).

Meanwhile, 256 scientists from 43 institutes have joined ENEAS. In each of these 43 institutes one contact person was appointed. This person is responsible for a good interface between the ENEAS management team and each of the
participating institutes. The contact persons can be found on the ENEAS web page. The purpose of this web page is described below and its practical implementation and accessibility is discussed in another paper in this volume.

Collaboration over the internet

ENEAS presents unique challenges in terms of the establishment of efficient collaboration between the widely dispersed groups, with overlapping and complementary expertise. Although much will be accomplished through the exchange of scientists at all levels within the network, full use will be made of the possibilities of collaboration over the internet. An important part of the project will be to test and utilize techniques for such collaboration. A specific team of five ENEAS managers has been assigned the task to define and implement appropriate aspects of internet collaboration, which range from information provision to active and efficient data mining and specialised software usage, including internet teaching.

A first aspect of these activities will be the establishment and maintenance of a central ENEAS web page. This will provide information on the ENEAS participants, new job openings at the ENEAS institutes, announcements of meetings of interest to ENEAS participants, general presentation of ENEAS activities for the broad community of physicists, on-line documentation, tools for outreach and public lecturing, etc.

A second crucial aspect will be the establishment of Europe-wide high-level (internet) courses on asteroseismology, benefitting from the broad range of expertise of the staff present in the network. Efficient ways to store and exchange data through the internet will be developed, including observations of stellar oscillations, “classical” observations of stellar properties, software for the different analysis methods, theoretical models, etc. in such a way that they can be used efficiently and on-line throughout the network. We stress that on-line catalogues of analysis algorithms with short descriptions and contact persons will be made available as a valuable and rather new tool to allow easy communication between instrumentalists, observers and theoreticians.

ENEAS-RTN

The first task taken up by the management team was to seek funding for ENEAS. Two major ENEAS goals are to achieve integration of expertise across Europe and to train young scientists. These goals perfectly fulfill the criteria of a Marie-Curie Research Training Network in the sixth framework programme of the European Union. An application for such a training network was submitted on 1 April 2003 (not a joke..). We called it the European Network of Excellence
in AsteroSeismology Research Training Network, with acronym ENEAS-RTN. Twenty eight ENEAS institutes, i.e. those that have the capacity and are prepared to provide training to young scientists, take part in ENEAS-RTN. The complete application text of ENEAS-RTN can be found on the ENEAS web page.

In specifying the core research activities of ENEAS-RTN we have considered what should be done to be ready to interpret the forthcoming data from the ground and from space and to improve significantly our knowledge of the physics inside the stars. This has resulted in the definition of three research themes in which training will be provided:

1. ENEAS-RTN theme 1: Models and Inversions.
2. ENEAS-RTN theme 2: Ground-based observing strategies and new observations. Exploration of existing data.
3. ENEAS-RTN theme 3: Analysis of data from the large future space databases. Data analysis methods and error analysis.

The work plan of ENEAS-RTN consists of the creation of exchange visit positions with a duration of three months and one-year positions at the ENEAS institutes. These will be filled by open calls to the community. Besides these exchanges we plan the organisation of tutorials and workshops in each of the three themes.

**Call for participation**

We repeat that ENEAS will play the role of a coordinating and integrating facility with respect to the already existing and well-working initiatives concentrated on particular space missions and ground-based networks. It will also set up additional initiatives that are independent of the character of these specific missions and networks if needed. We invite everyone who is interested in participating in our network to consult the ENEAS web page (http://www.eneas.info) and/or to contact an ENEAS manager for further information.
The ENEAS Portal

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Abstract

ENEAS (European Network of Excellence in Asteroseismology) is formed by more than 250 scientists from 40+ institutes. In order to optimize the communication among the ENEAS members as well as to centralize the project-related information and documentation it is necessary to build the ENEAS portal. In this paper, the main resources and services available from the portal are described.

Introduction

ENEAS has a twofold goal. It will serve as an integration and coordination mechanism of the expertise and capacities in the field of Asteroseismology across Europe. Also it will constitute the framework where young scientists will be trained and prepared to work with the ultra-high accuracy, high-temporal resolution data coming from the space missions COROT and EDDINGTON. The intrinsic nature of ENEAS makes the communication among the different participating institutes a critical issue. Networking was seen as the optimum method for the establishment of an efficient collaboration among the widely dispersed groups and the development and maintenance of a portal connecting all ENEAS activities a crucial task in this framework.

The system

The ENEAS portal is based on Postnuke, a community, collaborative, content management system. Content management systems (CMSs) are aiming at reducing development time and optimize the manpower required to manage the contents of a portal, what makes it extremely adequate for ENEAS. Postnuke allows to work within a structured environment and rapidly deliver contents such
as articles, links, news, dynamic headlines, frequently asked questions, chat, community and file management among others. One of the big advantages of Postnuke is its modular design, which makes it possible to extend the capabilities of the system by including specific modules chosen among the great number of extra modules available. The second reason why Postnuke was chosen over similar products was the importance that the developers give to security as can be seen from the granularity of the permission set. Postnuke is based on PHP and MySQL and it is a free, open-source software.

One of the potential problems of the ENEAS portal is the management of the HTML pages. In "classical" portals managed by a webmaster this problem does not exist. However, for the ENEAS portal where the information management will not be centralised in a single person but every manager will be responsible for all the activities within his/her section, the need of having some knowledge on how to handle HTML pages may constitute a major drawback. The impact of the HTML editing can be minimized by using phpWiki, an extra-module integrated into Postnuke. Wiki is a software that allows users to freely create and edit web page content using any web browser in a very easy way. Wiki supports hyperlinks and has a simple text syntax for creating new pages and crosslinks between internal pages making it ideal for the collaborative development of documentation or any other kind of content.

A second example of extra module is the Upload module, integrated in to the system to provide the ability to upload/download files (documents, images, ...) to the server.

Functionalities

The amount of information available through the ENEAS portal is given by the user’s profile. Non-registered users, that is, any person accessing the ENEAS URLs (http://www.eneas.info; http://eneas.info) will have access only to limited contents: general information on the project, the list of centres participating in ENEAS, the list of Frequently Asked Questions and the ENEAS e-mail address (eneas@eneas.info). In order to have access to the full contents of the portal, it is necessary to register. The user himself can register using a login and a password. Once the registry has been completed and checked by the ENEAS portal administrator in order to guarantee the data accuracy, the user is provided with an "user profile". As of today, there are two types of profiles: the "ENEAS user" and the "ENEAS manager". Both profiles are allowed to read all the contents of the portal but the managers are also allowed to modify the contents of the sections they are responsible for. It is important to stress that the permission scheme in Postnuke is granularized what allows to create, if necessary, any number of different profiles with different access permissions.
The ENEAS portal as seen by a registered user is shown in Figure 1. The page is structured in three column blocks. In the left column, three sections are displayed: a) ENEAS Information, the only block available to non-registered users, b) Internal Information containing project-related documentation, the ENEAS mailing list and the tools to upload/download files, c) Areas of activity, resembling the ENEAS work package structure. From this block it is possible to have access to the ENEAS database, the data mining tools, the internet courses, software packages for the different analysis methods in a way that they can be efficiently used through the network and tools and documentation for outreach and public lecturing.

In the central column, the news of interest for the ENEAS community is posted by the responsible of the different sections. Finally, the right column displays information on job openings at the ENEAS institutes, announcements of meetings of interest as well as ENEAS-related papers. The five most recent ones are displayed as dynamic headlines.
The public outreach programme of ENEAS

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Everyone is fascinated with astronomy. Opportunities for astronomers to explain their work to the public with popular books, public talks, media interviews, television and radio programmes and internet sites are unlimited with very satisfying public response to all of our efforts. Recognising this, the directors of the European Network of Excellence in Asteroseismology, ENEAS, have created ENEAS-Outreach to help all of the more than 250 scientists in ENEAS bring the marvels of asteroseismology to the public. We, the four authors of this paper, are the board of directors of ENEAS-Outreach. Our purpose here is to call for input from members of the group, and to make available the outreach work of our colleagues for everyone’s use. Public outreach is rewarding, but time-consuming. Our job as directors is to gather and create outreach material, and make that available to the entire group. It is not possible for only a few people who are interested in public outreach to give public talks, media interviews and presentations, and create internet sites in all the local languages of our member countries. What we in ENEAS-Outreach are doing is to create materials in our “connecting” language, English, that can then be adapted for local use all over Europe. These materials will be made available on the ENEAS website. To illustrate some of the possibilities, we explain here some our individual activities in public outreach.

Don Kurtz:

I have recently created a Powerpoint presentation for a public talk now called “Songs of the Stars: the real music of the spheres”. Much of the material I have used has come from ENEAS members after a first public request by me. Fascinating presentations were sent to me by Mike Thompson, Yvonne Elsworth, Conny Aerts, Mario Monteiro, Katrien Kolenberg and Patricia Lampens. Sound
files of stellar frequency spectra boosted into the audible range were provided by Zoltan Kollath, Gunter Houdek and Conny Aerts, and movies of non-radial pulsation modes were provided by Rich Townsend. It is clear that ENEAS has many members who are very active in public outreach and have already produced a rich source of material for the rest of ENEAS to use. Sylvie Vauclair has recently published a popular book, _La Chanson du Soleil_ (The Song of the Sun), that has won the Orsay 2002 Scientific Book prize.

I had begun giving the talk “Songs of the Stars: the real music of the spheres” under the title “asteroseismology: the real music of the spheres” but quickly discovered that the big word “asteroseismology” in the title is scary to the public and cuts audience sizes. I have gathered material from internet sites, from members of ENEAS, and from other astronomers, as well as using my own to create this talk. Here is a press release written by Paula Opfer, a professional in public relations and marketing, from Australia where the talk was given in Perth, Melbourne and Sydney in conjunction with the IAU General Assembly in Sydney in July 2003. It is interesting and instructive for us scientists to see how PR people handle our subject.

A press release:

_Fancy a little night music?_

_Did you know that the stars ‘sing’? Professor Don Kurtz from the Centre for Astrophysics, University of Central Lancashire, UK, promises to let us in on the musical secrets of our Universe during his FREE talk. Held at 2 PM, Sunday, 20 July, 2003, at the Astro Expo, Exhibition Hall 5, of The Sydney Exhibition Centre at Darling Harbour, as part of The Australian Festival of Astronomy.

So Top 40 hits and dance tracks aren’t doing it for you anymore? To hear the true sounds of the Universe, says Professor Don Kurtz, world-authority on asteroseismology, tune your ears a little higher. It seems that those stars so far above us are actually ‘singing’.

Find that hard to believe?

_During his free talk at Astro Expo on Sunday July 20 2003 at 2pm, Professor Kurtz will explain exactly how this heavenly symphony is composed. Beginning with its first listeners, the ancient Greeks..._

_The ancient Greeks believed that the planets and stars were embedded in crystal spheres that hummed as they spun around the heavens, making what they called ‘the music of the spheres’. Pythagoras thought that the orbits of the planets had harmonic relationships. Unfortunately, Johannes Kepler was so enamoured of Pythagoras’s idea that, in the early 1600s, he..._
spent years trying to discover harmonic relationships among the planets, but ended up proving otherwise. The ‘music of the spheres’ was put on the backburner...

Then, in the 1970s, scientists began discovering that the sun and other stars actually do ‘sing’ – ringing from sound waves in them that cause them to vibrate, get hotter and cooler, brighter and dimmer, bigger and smaller, and change shape. These sound waves cannot get out of the star into the vacuum of space, so we do not ‘hear’ them directly. But scientists can detect the sounds that are there.

The detection process is what is now known as asteroseismology – the seismology (vibrations) of the stars. Using this method, scientists can ‘look’ beneath the surfaces of the stars, right into the unearthly maelstrom of the giant nuclear reactors that make up their cores.

Professor Kurtz promises to share the sounds of the stars (including an amazing group of the strangest stars in the sky, discovered by Kurtz himself) with his audience.

Britney Spears, eat your heart out.

Don Kurtz:

With ENEAS-Outreach all members of ENEAS are free to use the material for this presentation, to adapt it to be given in their own languages, to personalise it for their own research specialty, and to provide feedback to ENEAS-Outreach so that we can continue to improve and increase the material available to us all. Some of the very best material has been produced by Zoltan Kollath. I find his “Cepheid Horn” particularly entrances audiences.

Zoltan Kollath:

Parallels in sciences and the arts can help a lot to demonstrate the nature of physical processes in stars for a general public. Mathematical and physical similarities between pulsating stars and musical instruments have been discussed by Buchler et al. (1997). A “Cepheid Horn” they developed has the overtone response of a Cepheid, rather than the purely harmonic response of a musical instrument and can be used to show the overtone structure of stellar oscillations. I have created several animations to illustrate the similarities of musical instruments and stellar physics that will be available on the ENEAS web site, and can be found in DWK’s “Songs of the Stars: the real music of the spheres”. I have created an electronic music file of Bach’s Choral prelude “Ich ruf” zu dir, Herr Jesu Christ” as it sounds with the overtone response of the Cepheid Horn.
It is slightly dissonant, as is to be expected, but very pleasing to listen to. Audiences are captivated by it. It is accompanied by an animation of a pulsating Cepheid with the Cepheid horn rotating to be seen from different aspects.

My animations are used for many different audiences: from school children to physics teachers and amateur astronomers; they have also appeared in television science programmes in Hungary. Virtual musical instruments based on the physics of the stars and observations can be used to orchestrate any piece of music - with that we reach the borderline of science and art. You can talk about physics and at the same time entertain the audience. Such musical experiments were aired in a radio broadcast and were used as a background music for a TV programme on Konkoly Observatory. The other way around is true, too: Astronomers are as fascinated by this science/art boundary as is the public.

A 5-minute-long animation titled “The Music of the Stars” was on continuous display for more than a year at the “Dreamers of Dreams: Hungarians of World Renown” exhibition at the “Millenníris Park Exhibition and Events Center” complex that was built during 2000/2001 to commemorate the 1000th anniversary of the founding of the Hungarian state. During the August 2003 JENAM meeting I will give a public talk entitled “The Music of Cosmos”.

My animations, sound files and astro-musical creations will be made available to ENEAS members for public outreach all across Europe.
Katrien Kolenberg:

Often when people ask me what my work is about, I use the metaphor of a peeled mandarin, to illustrate how one can imagine nonradial sectoral pulsation. A rainbow, a passing ambulance, a stone thrown into water . . . there are enough phenomena in daily life that can be directly related to the work we are doing, and can be used to make it clear to whomever is interested, adults or children. And sometimes a little drawing also helps.

I have been interested in illustrating astronomy through art since my teenage years as an amateur astronomer. After my studies, my popularisation activities focused more and more on stellar astronomy. Just like some of my colleagues, I gave lectures for the interested public. My predilection for handmade things was enjoyed to the full when designing poster and cover illustrations for some conferences and symposia, e.g., for IAU Symposium 191, IAU Coll. 176, the 53rd Dutch Astronomical Conference, and several posters for events organized by the local amateur astronomy group. When some of my colleagues in Louvain finished their PhDs, I was asked to design the covers for their theses, displaying an “artistic and colourful impression” of the work they were presenting. I created the logo for the Institute for Astronomy of Louvain (Belgium) and, finally, designed the logo for ENEAS that can be seen on this report and all ENEAS documents.

For ENEAS-outreach my presentations are available for others to use the artwork (with acknowledgement). Time permitting, on special request I am prepared to liven up astronomers’ presentations by designing, e.g., an appropriate background for a PowerPoint presentation. I can also design logos and illustrations for posters and covers. I hope that from this example we will find amongst ENEAS members others with creative hobbies that can make our science more accessible to the public and give greater pleasure to everyone, astronomers included!

Teresa Teixeira:

The asteroseismology group at the Department of Physics and Astronomy of the Aarhus University (Denmark) has for the past year been involved in a range of public outreach activities, many of them involving schools. Because of the specificity of the main subject of our research, asteroseismology, our outreach and education activities do not solely concentrate on that subject, but rather include it in a more general background of Stellar Astrophysics.

1. Activities with and for schools

(i) We have organized visits of 1st-year high-school classes (16-year-olds) to spend a day at the department. The students are introduced to the subject of the Sun, solar structure and activity in an informal lecture given by one of the
The public outreach programme of ENEAS

Researchers in the group. After the lecture, the students have the opportunity to work on computer-based exercises prepared by members of our group, using typically data from satellites (e.g. SoHO). To work on these exercises they are assisted by members of the group and/or PhD students. That allows them to ask and answer questions from researchers, and to challenge and to be challenged! During the visit, and weather allowing, the students are also given the opportunity to make their own continuum and H-α observations of the Sun.

(ii) In collaboration with high-school teachers, we will now be working on preparing more advanced exercises using astronomical observations to illustrate concepts taught in physics in the 2nd and 3rd years in high-school (17- to 19-year-olds). Some of the techniques and concepts from asteroseismology will be used in such exercises.

(iii) We have hosted visits of individual students from the basic school (13- to 15-year-olds), where they have the opportunity to spend two or three days with one of the researchers in the group, learning about the research carried out in the group through discussions and relevant exercises.

2. Activities for the public in general.

(i) Based on the Rømer/MONS project, we produced a short planetarium presentation for journalists and decision makers. Following the success of that presentation, we are now preparing an educational planetarium presentation aimed at high-school level and the public in general. The main topics of that presentation will be stellar structure and asteroseismology, and the study of extrasolar planets, using as “anchor” points three space missions: SoHO, Edington and Darwin. We will also prepare supporting educational material as a complement to the planetarium session, to be used in connection with school visits and public talks.

(ii) Talks at observatories and astronomy clubs, which are often attended by families.

3. Other activities.

Following reactions to press releases on asteroseismology, we have also provided sound material to a composer and to a music company who were interested in the sounds of stars for artistic purposes.

Preparing and carrying out all these activities is extremely demanding and time-consuming, but also extremely rewarding. We have learned a lot about people’s interests and expectations, about perceptions and misconceptions, and also about our successes and (many) shortcomings at presenting our subject of research. But all reactions have been extremely positive and encouraging. At the end of the day we will feel we have been successful if our (different) audiences go home feeling they have learned something new, if they will have felt some of the excitement that drives us in research, if they feel they can understand the principles behind it, if they have seen some beauty in astronomy,
in pictures, in sounds, in words, or if, like someone one day told me, if we make them dream. Then we will have reached out to our public.

All of us:

Many ENEAS members are already very active in public outreach. They know the pleasure of presenting astronomy to the public, and they know the rewards. Others who have thought about this, but have not yet become involved should think about how they, themselves might benefit. We all know how science benefits from public understanding and enthusiasm for our work, but you, the astronomer, can benefit, too. Of course, many of you are teachers and enjoy being on stage with a captive audience. The general public has a wide age range and wide background knowledge from experts to beginners, but people who attend your public lectures are enthusiastic. Their applause after a presentation is not the polite brief applause of a professional audience to a colloquium or meeting talk; it is laud, sustained, full of the pleasure they have received from your presentation – sometimes a bit embarrassingly so. Try it – you’ll like it. You can speak at schools, science festivals, to business people, to clubs . . . even on cruise ships! Most of this is all-expenses-paid, frequently for you and your partner. Once you start this you will find that a talk or two can pay for a luxury holiday. You can “sing for your supper”.

ENEA-Outreach will provide material you can adapt from English to your own language. We hope that talks polished by the work and knowledge of many ENEAS members will be presented to audiences all over Europe. We also request that you share your own material with ENEAS members through the ENEAS website. We intend that the ENEAS-Outreach part of the website will be developed to include the presentation material used for public talks. It will be developed into forms useful for schoolchildren for learning astronomy, as well as anyone searching the web for asteroseismology. With the phrase “songs of the stars” we will get some surprised visitors to our website. Once they see what is there, many of them will stay for a while to find out about asteroseismology.

Acknowledgments. We thank Paula Opfer, of The Axis Public Relations & Marketing Company, Sydney, Australia, for permission to use the press release “Fancy a little night music”.

References

Follow-up observations of the DSCT V350 Peg

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Abstract

We present all the CCD photometric observations of the δ Scuti star V350 Peg performed by us until now. The data have been acquired between 1997 July and 2002 October. A large part has been analysed and presented previously (Vidal 2002a). The new data of 2002 confirm the former conclusion that two frequencies of very similar amplitudes are excited in this star. The entire data set consists of 16191 measurements collected during 48 nights, and may be very helpful to investigate the detailed behaviour of this basically double-mode δ Scuti variable if future campaigns are held at a later stage.

Introduction

V350 Peg (HIP 115563 = HD 220564) was discovered to be a δ Scuti variable star by the Hipparcos satellite (ESA 1997). In papers by Vidal et al. (2002a,b) based on observations from 1997 mainly, the star was shown to be a multiperiodic pulsator. Two relatively close frequencies with similar amplitudes, 5.840 and 5.668 c/d, were found. These could not completely explain all the variations. The fact that two equally dominant, close frequencies were found and that non-radial modes are possibly excited made us conclude that this star is a worthwhile target for a multi-site campaign. We started a co-operation from...
3 sites on 3 different continents and began to gather new data in 2002. Regretfully, due to various problems, data from only one longitude were secured (2 sites). We present here all the CCD differential data that were used in the previous analysis (Vidal 2002a), as well as the new data obtained during the follow-up campaign.

The data

The data were collected at Monegrillo Observatory (40cm Newtonian), Esteve Duran Observatory (60cm Cassegrain and 20cm Schmidt-Cassegrain) and Beersel Hills Observatory (40cm Newtonian). Cameras used are a SX Starlight CCD camera with a Sony ICX027BL chip, an Audine camera with a Kodak KAF-0400 CCD chip, and an SBIG ST10 XME camera with Kodak KAF3200ME chip. A V filter according to Bessel’s specifications was used. Table 1 lists the telescope and equipment used by each observer and the observer’s code. Exposure times ranged from 3 to 30 seconds depending on local conditions. Image cleaning (darkframing and flatfielding) followed by aperture photometry was carried out using a software package called LAIA (Laboratory for Astronomical Image Analysis) for the frames obtained at Monegrillo and Esteve Duran observatories and the Mira AP software (Axiom Research Inc.) for the frames from Beersel Hills Observatory.

The brightness of V350 Peg was measured with respect to HIP 115545 (HD 220538), with SAO 73234 serving as check star. Nightly standard deviations of $\Delta V$ between check and comparison star ranged between 5 and 13 mmag.

In total we collected 16191 measurements during 48 different nights between 1997 and 2002. The data consist of 7131 differential photometric observations gathered during more than 175 hours on 31 nights for the 1997-98 season, 381 observations obtained during 21 hours on 4 nights in 2001 and 8679 observations gathered during 86 hours on 13 nights for the 2002 season.

Table 2 gives the format in which the data are presented, together with an identification of the comparison stars. The complete dataset (including the data used in Vidal 2002a) is now available under catalogue with reference II/242 (http://cdsweb.u-strasbg.fr/cgi-bin/qcat?II/242) from the Vizier Catalogue Service (CDS, Strasbourg).

Analysis and conclusion

It was necessary to eliminate colour differences between the various data sets in order to combine the data from the multi-site campaign. Since the variable and the check star have similar spectral types (F2 versus F0), the average difference
Table 1: Observer codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Observer</th>
<th>Observatory</th>
<th>Instrumentation</th>
</tr>
</thead>
</table>
| BHO  | Van Cauteren-Lampens    | Beersel Hills | 40cm Newtonian  
|      |                         |             | SBIG ST10 XME                    |
| EG1  | E. García-Melendo      | Estève Duran | 60cm Cassegrain  
|      |                         |             | SX Starlight                     |
| EG2  | E. García-Melendo      | Estève Duran | 60cm Cassegrain  
|      |                         |             | Audine                           |
| EG3  | E. García-Melendo      | Estève Duran | C8 Schmidt-Cassegrain  
|      |                         |             | Audine                           |
| EG4  | E. García-Melendo      | Estève Duran | C8 Schmidt-Cassegrain  
|      |                         |             | SX Starlight                     |
| JVS  | J. Vidal-Sáinz         | Monegrillo  | 40cm Newtonian  
|      |                         |             | SX Starlight                     |

Table 2: Format of the data file

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>F9.4</td>
<td>Heliocentric Julian Date - 2450000</td>
</tr>
<tr>
<td>11-16</td>
<td>F6.3</td>
<td>Instrumental $\Delta V$ in the sense variable (V350 Peg) - comparison star (HD 220538)</td>
</tr>
<tr>
<td>18-23</td>
<td>F6.3</td>
<td>Instrumental $\Delta V$ in the sense check star (SAO 73234) - comparison star (HD 220538)</td>
</tr>
<tr>
<td>25-27</td>
<td>A3</td>
<td>Observer code</td>
</tr>
</tbody>
</table>
between the check and the comparison star for each night was subtracted from
the differential data for the variable star. By using a comparison star of similar
brightness as the variable we kept the benefit of higher accuracy. The 2002 data
were then analysed with the period-search program Period98 (Sperl 1998).

The frequency spectrum is illustrated by Fig. 1. Two frequencies at 5.839
and 5.670 c/d, each with a semi-amplitude of about 25 millimag, are clearly
detected. Error bars (half width at half maximum) on the frequencies are on
the order of 0.008 c/d. The frequency spectrum after prewhitening, is given in
Fig. 2. The residual standard deviation of the data is 19 mmag, a reduction of
40%.

![Figure 1: Frequency spectrum of the 2002 data](image)

The frequencies found, perfectly match the previously determined values of
5.840 and 5.668 c/d (Vidal et. al. 2002a,b), meaning that these two frequencies
have remained stable since 1997. When the data were combined with the 4
nights of late 2001 (Vidal et. al. 2002a), no change of the frequency values was
found. Due to the length of the time elapsed between the observing campaigns
of 1997 and 2002, it was impossible to determine unambiguously the exact
number of cycles between the two data sets, so that a more accurate period
based on all the data can not be given.

Light curves from 2002, with the best two-frequency fit superposed, are
Follow-up observations of the DSCT V350 Peg

Figure 2: Frequency spectrum after prewhitening the two main frequencies shown in Fig. 3. There is no other significant frequency detected in the recent data. Deviations between the observations and the model curves based on the two most dominant frequencies may be possibly due to the presence of some hitherto undetected frequency (with semi-amplitude below 12 mmag), as well as to small additional zero point shifts.

Acknowledgments. J. Vidal and E. García thank Joan A. Cano and Rafael Barberá for writing the LAIA software. P. Lampens acknowledges support from the Fund for Scientific Research (FWO) - Flanders (Belgium) through project G.0178.02. The Belgian data have been acquired with equipment purchased thanks to a research fund financed by the Belgian National Lottery (1999).

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ESA 1997, The Hipparcos and Tycho Catalogues, ESA SP–1200
Vidal-Sáinz, J., Wils, P., Lampens, P. and García-Melendo, E. 2002b, CoAst 142, 52
Figure 3: $V$ light curves of V350 Peg during 2002 with a 2-frequency fit.
A Hare and Hound in a BAG: Asteroseismology of \( \beta \) Cephei stars


Belgian Asteroseismology Group

Abstract

Several members of the COROT Seismology Working Group (SWG) have performed several “hare-and-hound” exercises to prepare the data exploitation of the mission in the past few years. These exercises consist in reproducing a theoretical model on the basis of a light curve obtained from a frequency spectrum computed from an “unknown” theoretical model of a solar-like or a \( \delta \) Scuti star. Members of the BAG (Belgian Asteroseismology Group) have now shown that such an exercise in the mass range of \( \beta \) Cephei stars is extremely convincing, making these stars excellent targets for asteroseismology space missions.

Asteroseismology has recently become a very interesting way to probe the interior of stars, and hence, learn more about the physics of stellar interiors. The Sun has been extensively studied, both from the ground and from space. The pulsations of other stars are being observed from the ground, e.g., \( \alpha \) Cen (Bouchy & Carrier 2002), 16 Lac (Lehmann et al. 2001, Aerts et al. 2003a), HD129929 (Aerts et al. 2003b). One of the first satellites which will be launched to observe from space the pulsations of stars other than the Sun is the European COROT satellite. COROT will observe some 50 stars for long uninterrupted
times of about 150 days, while several other stars will be observed for shorter times.

In order to carefully choose the targets which will be observed for 150 days, the COROT SWG has undertaken a series of “hare-and-hound” exercises. In such an exercise, one group of people makes up a star within a given error box in the HR-diagram and calculates the oscillation frequencies of that star. Another group transforms the oscillation spectrum into a light curve, given the specifications of the COROT instrument. A third group analyzes the light curve and extracts frequencies. A fourth group then performs a seismic analysis of the star. These useful exercises have been going on within the COROT SWG for several months, considering each time solar-type oscillations in solar-type and δ Scuti stars.

β Cephei stars are massive main sequence stars, of about 9 to 12 solar masses. Their structure is very simple: a rather large convective core surrounded by a radiative envelope. There is no convective envelope. Their metallicity is probably not far from the solar metallicity. They can be described by few parameters: the mass M, the hydrogen mass fraction X, the metallicity Z, the core overshooting parameter $\alpha_{ov}$, and any quantity related to the evolutionary stage, such as the age. These stars are excited through the $\kappa$ mechanism in the iron opacity bump around 200,000K. They exhibit f, g and p modes of oscillation, but only the low-degree and low-order modes are excited. Furthermore, their spectrum of frequencies is rather sparse.

Recently, very interesting results have been obtained for β Cephei stars observed from the ground. For the star 16 Lac, three frequencies of well-identified modes are known with very high precision, allowing a rather precise determination of its mass and metallicity. The number of modes identified was however too low to constrain the overshooting parameter (Thoul et al. 2003). The star HD129929 was observed for 20 years, and six frequencies were obtained with high precision. The seismic analysis of that star was performed, and very strong constraints were obtained for its mass, metallicity, and overshooting parameter. In addition, since several multiplets were detected, it was possible to rule out a rigid rotation of its envelope (Aerts et al. 2003b) These encouraging results prove that it is indeed very interesting to study the pulsations of β Cephei stars in full detail.

This is why the BAG (Belgian Asteroseimology Group) decided to perform a “hare-and-hound” exercise for β Cephei stars. The major groups involved in this exercise were the “Leuven group” and the “Liège group”, but other teams were also involved. The Leuven team used the Warsaw-New Jersey evolution code and Dziembowski’s oscillation code while the Liège team used the stellar evolution code CLES (Code Liégeois d’Evolution Stellaire) and its own oscillation code MAD. The Liège group produced a star (HH1), while the
Leuven group produced another one (HH2), both within a given error box in the HR diagram (log $T_{\text{eff}} = [4.34, 4.36]$ and log $g = [3.70, 3.90]$). Each group transmitted the oscillation frequencies of their star to data analysis experts who produced a light curve using the COROT instrumental and orbital specifications. Each light curve was then transmitted to the other team who had to extract the oscillation frequencies and perform a seismic analysis of the star. It is important to point out that the models were produced and analyzed using different stellar evolution and oscillation codes.

The outcome of these two hare-and-hound exercises was presented at the 4th COROT Week in Marseille (June 2003). The details of the exercise and the figures can be found in the PowerPoint file of the presentation, on the BAG WebSite

http://www.asteroseismology.be/B_Stars.ppt

We give here only the main conclusions of the exercise. The first conclusion is that there is only one possible identification for the modes observed, due to the sparse nature of the oscillation spectrum. In both case (HH1 and HH2) all the excited modes were correctly identified. We have to stress, however, that slow rotation was assumed when determining the oscillation frequency spectra from the chosen model. This is realistic, as most well-studied $\beta$ Cephei stars indeed have low $v \sin i$ (Aerts & De Cat 2003). It is necessary to resolve the multiplets in order to know the frequencies of the axisymmetric modes. Fitting one frequency fixes the age of the model. Fitting additional frequencies gives information on the other parameters. The splittings in the multiplets give valuable information on the internal rotation law of the star. In the case of HH2, it was possible to differentiate between two models which differed only through the value of the metallicity using an $l = 5$ mode. Such modes have lower amplitudes and cannot be observed from the ground.

The results of the HH2 exercise are shown in Fig.1, where the acceptable output models are compared to the input model. As seen in this figure, through the seismic analysis we were able to get the mass of the model star with a relative accuracy of 1.5% ($\dagger$), the metallicity $Z$ with a relative accuracy of 10%, and the overshooting parameter with a relative accuracy of 10%. The least constrained parameter was the hydrogen mass fraction. Similar results were obtained for the HH1 exercise. We also compared the frequencies extracted from the light curve to the original frequencies, both for HH1 and for HH2. In both cases, the frequencies were recovered with a relative accuracy of about $10^{-4}$.

Acknowledgments. This work has been supported by the PRODEX-ESA/Contract#15448/01/NL/SFe(IC) and by the Pole d’Attraction Interuniversitaire Contract # P5/36. AT acknowledges financial support from the
Figure 1: Results of the HH2 exercise

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Aerts, C., De Cat, P. 2003, Space Science Reviews 105, 453
Phommetry of Be stars in the vicinity of COROT primary targets for asteroseismology

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\textsuperscript{2} Instituto Ciencia de los Materiales, Universitat de València
\textsuperscript{3}GEPI, Observatoire de Paris-Meudon
\textsuperscript{4}Instituto de Astrofísica de Andalucía

Abstract

We present differential photometry of Be stars close to potential COROT primary targets for asteroseismology. Several stars are found to be short period variables. We propose them to be considered as secondary targets in the COROT asteroseismology fields.

Introduction

The observation of classical Be stars by COROT will provide important keys to understand the physics of these objects and the nature of the Be phenomenon. In particular, the detection of photospheric multiperiodicity will confirm the presence of non radial pulsations ($nrp$) as the origin of the short term variability. COROT observations will allow the study of the beat phenomenon of $nrp$ modes and its relation with recurrent outbursts and the building of the circumstellar disc.

Our group is proposing the observation of Be stars as secondary targets for the asteroseismology fields. A sample of stars in the vicinity of the main target candidates is under study for this purpose. Hubert et al. (2001, 2003) presented the selected objects and performed a study of their short term variability using Hipparcos photometric data. We have obtained new ground based photometry with a more suitable time sampling to further characterize their variability.
Observations and data analysis

Observations were carried out at the 0.9 m telescope of the Observatorio de Sierra Nevada (Granada, Spain). The instrument used was the automatic six-channel spectrophotometer which allows simultaneous observations through the four uvby filters of the Strömgren system. Differential photometry of four Be stars in the vicinity of main targets candidates in the galactic center direction was obtained in the period 20 to 29 May 2002. Five more Be stars were observed in the anticenter direction in the period 8 to 14 January 2003. The mean accuracy of the differential photometry, measured as the rms of the comparison minus check values, is 0.010 mag. in u and 0.007 in vby.

Different observing strategies were employed in both runs. In May 2002 we observed all four stars consecutively every night. In January 2003 we devoted each clear night to follow an individual star. For the first run data we performed periodogram analysis of each star, using the Scargle (1982) and PDM (Stellingwerf 1978) techniques. Phase curves at the detected frequencies were made and visually inspected. In Figure 1 we present an example of the obtained periodograms. With the second run data, we made daily light curves which were visually inspected for consistent trends. Light curves of three stars are presented in Figure 2.

Figure 1: Scargle periodogram for the v filter data of star HD 183656
Figure 2: Light curves of stars HD 49330, HD 50209 and HD 50696. Asterisks correspond to variable minus comparison magnitude, and points to comparison minus check.

Notes on individual stars

HD 43285. A possible period of 0.454 days is proposed from the Hipparcos data. Our light curve spanning 8.5 hours does not show any variability.

HD 46380. This star is presented as short term variable from Hipparcos, although no period was found. Our data confirm this star as variable. Our time coverage prevents us from performing period searches.

HD 49330. The Hipparcos data show a periodicity of 0.283 days. Our 8.5 hours light curve presents clear variability (see Figure 2). The short time coverage does not allow us to perform period searches. However, we have made a phase curve with the Hipparcos period, which we present in Figure 3. Our data are fully compatible with the Hipparcos period determination.

HD 50209. The Hipparcos data analysis shows a period of 0.592 days, considered as uncertain. Our data show clear variability (see Figure 2). The phase curve is compatible with the Hipparcos period, although the phase coverage is incomplete.

HD 50696. There are no Hipparcos photometric data for this faint star.
Our observations show clear variability (see Figure 2).

*HD 171219*. No short term variability was found in the Hipparcos photometry. Our periodogram analysis does not show any significant peak. The star is
not variable at our detection level.

**HD 174513.** This star appears as short term variable in the Hipparcos data, although no periodicity was found. Our analysis confirms the variability with
Table 1: Summary of results

<table>
<thead>
<tr>
<th>Star</th>
<th>HIPPARCOS</th>
<th>This Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 43285</td>
<td>Periodic P=0.454 d ?</td>
<td>No variable</td>
</tr>
<tr>
<td>HD 46380</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>HD 49330</td>
<td>Periodic P=0.283 d ?</td>
<td>Periodic P=0.283 d</td>
</tr>
<tr>
<td>HD 50209</td>
<td>Periodic P=0.592 d ?</td>
<td>Variable</td>
</tr>
<tr>
<td>HD 50696</td>
<td>No data</td>
<td>Variable</td>
</tr>
<tr>
<td>HD 171219</td>
<td>No short term variability</td>
<td>No variable</td>
</tr>
<tr>
<td>HD 174513</td>
<td>Variable</td>
<td>Periodic P=0.234 d ?</td>
</tr>
<tr>
<td>HD 183656</td>
<td>Periodic P=0.652 d</td>
<td>Periodic P=0.8518 d</td>
</tr>
<tr>
<td>HD 184279</td>
<td>Periodic P=0.156 or 0.6 d ?</td>
<td>Periodic P=0.423 d ?</td>
</tr>
</tbody>
</table>

possible periods of 0.234 or 0.306 days. In Figure 4 we present phase curves with the 0.234 days period, which we consider the most likely one.

**HD 183656.** Short term variability with a period of 0.652 days was obtained from the Hipparcos photometry. This star was also found variable by Lynds (1960) who proposed a period of 0.8518 days. Our data are more compatible with the Lynds’ period (see Figure 5). However, the Hipparcos data appear very noisy when folded with the 0.8518 days period. This might indicate that the star is multiperiodic. More observations are needed to conclude on this issue.

**HD 184279.** From the analysis of the Hipparcos data, Hubert et al. (2001) proposed a period of 0.156 days, while Percy et al. (2002) found a period of 0.6 days. Both studies present their period determination as uncertain. From our data, the most likely period is 0.423 days, although this value is also uncertain. We present the composition with our period in Figure 6. In the Hipparcos data this period is not apparent, yet a period of 0.734 days appears in addition to the 0.156 days period. The 0.734 days period (f=1.346 c/d) is in fact an one day alias of our 0.423 days (f=2.36 c/d) period. We can hence confirm the short term variability and possible multiperiodicity. The determination of the actual variability characteristics would need more observational work.

**Conclusions**

Our observations confirm that stars HD 49330, HD 50209, HD 174513, HD 183656 and HD 184279 are periodic variables, with the periods given in Table 1. Stars HD 46380 and HD 50696 are also variable, although their periods are
not yet found. HD 43285 and HD 171219 appear as no variables in our data. All results are summarized in Table 1.

Acknowledgments.
This research was based on data obtained at the Observatorio de Sierra Nevada, which is operated by the Consejo Superior de Investigaciones Científicas through the Instituto de Astrofísica de Andalucía. J.F. and J.S. acknowledges financial support from the program ESP2001-4530-PE. R.G. acknowledges financial support from the program ESP2001-4528-PE. The work of J.G.-S. is supported by a grant from the Spanish “Ministerio de Educación, Cultura y Deporte”.

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Hubert, A.M. et al. 2001, 1st COROT Week, Vienna
Hubert, A.M. et al. 2003, 4th COROT Week, Marseille
The MOST and COROT prime target fields: A target inventory

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Abstract

MOST and COROT are two satellite missions dedicated to asteroseismology and the detection of exoplanets. Both satellites use CCDs as a detector and hence they do not exclusively observe their prime targets but an entire field with additional objects. It is crucial to know their astrophysical properties and to have information on the location in the CCD-fields. Therefore VISAT (Vienna Selection of Astronomical Targets, see Kallinger et al., this volume) was used to investigate the fields around the prime targets of COROT and MOST resulting in the two catalogues described in this article.

Introduction

MOST (Microvariability and Oscillation of STars) is a Canadian microsatellite performing asteroseismology of sun-like and magnetic stars as well as studying microvariability in Wolf-Rayet winds and other targets. It is a low budget mission which demonstrates that even small missions can perform high quality observations. MOST has been launched by Eurockot on June 30th, 2003, from Plesetsk, Russia, with a Proton rocket and operates at an altitude of 820 km in a polar dawn-dusk orbit. The optical system consists of a 15-cm-Maksutov telescope and a CCD camera (1024 by 1024 pixels). An array of 36 Fabry lenses in the focus of the telescope (Fig. 1) minimizes the effect of satellite jitter and provides the required photometric precision (Matthews 1998).

COROT (COnvection, ROtation and planetary Transits) is a French-lead satellite mission with the cooperation of several, mainly European countries which is dedicated to asteroseismology and the discovery and study of exoplanets with the transit technique. Launch date is mid 2006 and COROT will perform its observations from an 800 - 900 km polar orbit. COROT is equipped
The MOST and COROT prime target fields: A target inventory

Figure 1: MOST chart of HD 183324 as produced by VISAT. The smaller circle represents the accessible area for the MOST camera for HD 183324. The target star can be positioned in one of the 36 Fabry lenses and the CCD can be rotated at an angle of 360 degrees. In inserted rectangular illustrates the CCD and the location of the Fabry lenses.

with a 27 cm telescope and two CCDs (1024 by 1024 pixels) for asteroseismology and exoplanet search each (Baglin et al. 2002). The satellite can be rotated around the optical axis by an angle of ±20 degrees (see Fig. 2).

Many interesting objects can be found in the field of view (FOV) of those satellites, as is illustrated in Fig. 3. The orientation of the CCD’s projected on the sky defines the observable targets and hence the amount of accessible science. To optimize the scientific output, information about the astrophysical properties is required and also their location in the FOV.
The present investigation is an attempt to characterize the area around the prime targets and to provide this information to the scientific community for preparing additional science programs. For this reason we analyzed the fields using the VISAT database, which contains catalogs and information, based also on private communications, specialized in different types and objects, such as δ Scuti stars, rapidly oscillating Ap (roAp) stars, etc. (see T. Kallinger et al., this volume).
The MOST and COROT prime target fields: A target inventory

<table>
<thead>
<tr>
<th>MOST targets</th>
<th>COROT targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 61421 (Procyon)</td>
<td>HD 38529</td>
</tr>
<tr>
<td>HD 121370 (η Boo)</td>
<td>HD 191765 (WR 134)</td>
</tr>
<tr>
<td>HD 10700 (τ Cet)</td>
<td>HD 192103 (WR 135)</td>
</tr>
<tr>
<td>HD 102870 (β Vir)</td>
<td>HD 17723 (WR 123)</td>
</tr>
<tr>
<td>HD 142860 (γ Ser)</td>
<td>HD 149757 (ζ Oph)</td>
</tr>
<tr>
<td>HD 99028 (ε Leo)</td>
<td>HD 114710 (β Com)</td>
</tr>
<tr>
<td>HD 224930</td>
<td>HD 22049 (ε Eri)</td>
</tr>
<tr>
<td>HD 76932</td>
<td>HD 120136 (τ Boo)</td>
</tr>
<tr>
<td>HD 201601 (γ Equ)</td>
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<td>HD 176232 (10 Aql)</td>
<td>HD 165688 (WR 110)</td>
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<td>HD 24712 (HR 1217)</td>
<td>QR Sge (WR 124)</td>
</tr>
<tr>
<td>HD 217014 (51 Peg)</td>
<td>HD 56925 (WR 007)</td>
</tr>
</tbody>
</table>

Table 1: The MOST and COROT prime targets, analyzed in this paper

Target inventory

The catalogs of the MOST and COROT field analyses contain a VISAT star chart and an object list for each prime target, which contains any entry found in the database. A list of the analyzed MOST and COROT prime target stars can be found in Tab. 1.

Fig. 1 and Fig. 2 show the star charts of the MOST and COROT mask produced by VISAT. The circle in Fig. 1 and the dumbbell-shaped figure in Fig. 2 represent the accessible area for MOST and COROT, provided that the prime target is anywhere in the photometric area of the CCD. All objects shown in this charts are stars which have entries in the VISAT database.

Fig. 3 shows an example of an object list. As a star can be found in different catalogues, multiple entries are possible. Among star identifier and coordinates, the list contains also information on the spectral type and photometric parameters extracted from SIMBAD. As the catalogs implemented in VISAT provide different spectral classifications, multiple spectral types are possible. If a star was only found in one catalogue, the spectral type entry from SIMBAD was added. Absolute luminosity (M_V) was either calculated using Hipparcos parallaxes or using the calibration given by Gray (1992).

Furthermore, HR-diagrams of the COROT fields were generated (Fig. 4). Full circles represent the datapoints with M_V, calculated with Hipparcos parallaxes, the light stars were obtained using the calibration given by Gray. A few regions for variable stars, like the instability strip and the regions for β Cephei, SBP and γ Dor stars were added in the HR-diagrams.

The complete MOST catalogues for all the prime targets presently chosen
Figure 3: Object list of the field stars around HD 183324. As one star can be found in different catalogues implemented in VISAT, multiple entries are possible. If there was only one spectral type entry found in VISAT, multiple entries were added, which was marked with (S). The photometric parameters were extracted from SIMBAD, $m_V$ was calculated using Hipparcos data (SIMBAD) or the calibration from Gray, F. D.
Figure 4: HR-diagram of the field around HD 183324. Full circles represent data calculated using Hipparcos data (extracted from SIMBAD). Lighter stars represent data which were calculated using the calibration given by Gray, F. D. The blue and red edge of the instability strip as well as some further regions where variable stars can be found are added.

for the first two years of operation can be downloaded from
http://ams.astro.univie.ac.at/space/mostinventory.pdf
and for COROT from

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**VISAT – VIenna Selection of Astronomical Targets**


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**Abstract**

**VISAT** is a tool, developed to optimize the scientific output of space missions which use panoramic detectors and hence allow to observe a variety of 'secondary' targets simultaneously, when collecting data for the primary target. The observable secondary targets depend on the orientation of the space craft and the position of the primary target within the detector field of view. **VISAT** presently provides masks, representing specifically the focal plane arrangements of the space missions COROT and MOST. **VISAT** allows to explore the scientific potential of various spacecraft orientations and furthermore can be used for planning ground-based observing runs. The advantage over other databases, like **SIMBAD**, is a simple identification of stars in the field of view according to thematic lists, like δ Scuti, Ap or roAp stars. Furthermore, it is very simple to add (or remove) new lists of stars which yet are not available via **SIMBAD** or similar public data bases. At the moment **VISAT** includes up to 39 different parameters of 93,901 stars in 40 catalogues and subcatalogues.

**Introduction**

The motivation for developing this database originate in the need to have a user friendly tool available, that allows to select possible secondary targets for space missions such as MOST ¹ (Microvariability and Oscillation of STars, successfully launched on June 30th, 2003) or COROT ² (CONvection, ROTation and planetary Transits, launch date mid 2006). The preparation of space missions or the planning of ground-based observing runs can be optimized using **VISAT**, because it allows to identify objects of special interest in a certain area of the sky, e.g. δ Scuti stars located in an area of 30 arcminutes centered on a given

¹http://www.astro.ubc.ca/MOST
²http://www.astrsp-mrs.fr/projets/corot/pagecorot.html
primary target (or some given location at the sky) or all objects brighter than 9th magnitude having right ascensions between specified boundaries. VISAT provides an overlay to the star map with a mask which characterizes the focal plane arrangement of the mentioned space experiments. We started in the year 2000 to collect catalogues of different star types (see Section ‘Catalogues’) from different sources (see Section ‘References’) and linked the star position with the type of object. The advantage over other databases, like SIMBAD, is a simple identification of stars in the field of view according to thematic lists, like δ Scuti, Ap or roAp stars. Furthermore, it is very simple to add (or remove) new lists of stars which yet are not available via SIMBAD or similar public databases. VISAT is a PostgreSQL 3 database, connected to the internet via PHP 4 scripts and is available at http://ams.astro.univie.ac.at/visat.

Catalogues

Currently VISAT provides up to 39 different parameters (coordinates, magnitudes, colors, spectral types, vsini, parallaxes, ...) of 93901 stars included in 40 catalogues and subcatalogues, listed in Tab.1. The distribution of the stars on the sky contained in VISAT is shown in Fig. 1 and illustrates that the Michigan Catalogues IV and V are the most voluminous catalogues implemented in VISAT reflecting the fact that MOST as well as COROT observe only stars which are located within a stripe centered on the celestial equator.

For each star included in VISAT at least one of the following 8 identifiers has to be known and is stored in the database: Henry Draper (HD), Bright Star Catalogue (HR), Bonner Durchmusterung (BD), General Catalogue of Variable Stars (GCVS), Smithsonian Astrophysical Observatory Star Catalogue (SAO), New General Catalogue (NGC), Guide Star Catalogue (GSC), HIPPARCOS Catalogue (HIP) number.

New users are asked to register at the login page. After logging into the database a session ID is assigned to each user, which expires 30 minutes after the last interaction within a current VISAT session. The user is then asked to login again. The login information is only used for statistics and to inform users about changes of the database.

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3http://www.postgresql.org
4http://www.php.net
5http://www.aip.de/groups/activity/CABS2
6http://cfa-www.harvard.edu/planets/catalog.html
7http://www.astro.ubc.ca/MOST
<table>
<thead>
<tr>
<th>Catalogue Type</th>
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<tr>
<td>α Cygni Type stars</td>
<td>C. Aerts, private communication</td>
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<td>W.W. Weiss, private communication</td>
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<td>B stars</td>
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<td>Be star Catalogue</td>
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<td>β Cephei stars (Cluster)</td>
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<td>β Cephei stars (LPV)</td>
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<td>β Cephei stars (Photometric)</td>
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<td>Chromospherical Active Binaries</td>
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<td>Cool Hydrogen stars</td>
<td>C.S. Jeffery et al., 1996</td>
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<tr>
<td>δ Scuti stars</td>
<td>E. Rodriguez et al., 2000</td>
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<td>DOV stars (Pul. PG1159)</td>
<td>P. Bradley, 1999</td>
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<tr>
<td>Eclipsing Binaries</td>
<td>H.K. Brancewicz &amp; T.Z. Dworak, 1980</td>
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<tr>
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<td>Extreme Helium stars</td>
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<td>γ Doradus Candidates</td>
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<td>γ Doradus stars</td>
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<td>The Hipparcos and Tycho catalogues, 1997</td>
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<tr>
<td>Hipparcos Unsolved Variable</td>
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<tr>
<td>Interacting Binary White Dwarfs</td>
<td>E. Paunzen, private communication</td>
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<td>λ Bootis stars</td>
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<td>Maia Candidates</td>
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<td>Michigan Catalogue Vol. 5</td>
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<td>ZZ Ceti stars</td>
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Table 1: Catalogues included in VISAT; exact catalogue references are given in Section ‘References’. 
Figure 1: Distribution of the VISAT stars over the sky is dominated by the Michigan Catalogues IV and V. The two ellipses represent the COROT Continuous Viewing Zones in the center direction at 6 h 50 m and in the anticenter direction at 18 h 50 m. The area between the 2 horizontal lines represents the MOST Continuous Viewing Zone spanning declinations from about -19 to +36 ° in which a selected target star will remain observable for up to 60 days without interruption.

Query forms

The VISAT webpage provides three different query possibilities: the Object Search, the Parameter Search and the Field Search.

Object Search

For the Object Search it is requested to enter one of the 8 star identifiers and all astrophysical information of the specified star available within the various catalogues implemented in VISAT will be displayed.
Parameter Search

To find all objects of one or more types in a given magnitude and/or right ascension and/or declination range the Parameter Search can be used. It is possible to choose between specific catalogues or search the whole database. The output of the Parameter Search lists all objects, matching the given criteria with their identifier, positions in equatorial coordinates (epoch 2000.0), magnitudes and catalogue names in which the objects are included. For a display of all available information within VISAT on a certain object in this list, it is necessary to click on the button next to the object name. In case of a multiple entry of one object, i.e. the object is included in different catalogues, it is listed separately for each catalog with the respective available astrophysical information.

Field Search

The Field Search allows to search for all or only specific objects located within a given radius around certain central coordinates. Similar to the output of the Parameter Search, a list of matching objects with the objects identifier, coordinates (epoch 2000.0), magnitudes, distances from the central coordinates and catalogue names is provided. Again, additional information can be retrieved, when clicking on the button next to the object name.

Space mission masks

Graphical masks were developed in order to allow an efficient selection of secondary targets for the COROT and MOST missions. The query result of the database centered on a selected primary mission target and the field of view, including the detector arrangement, is plotted as a sky map. The possibility of changing the position and orientation of the space craft allows to optimize the secondary target selection and hence the possible scientific output of an observing run. J. Oehlinger et al. (2003) describe a prime field target inventory in detail using the space mission masks.

COROT mask

First select the primary target with an Object Search on the main page of VISAT. Clicking on the COROT symbol at the right top corner on the Object Search result page leads to the COROT Secondary Target Selection page.

All objects found in the database within a radius of 3.1° centered on the primary target, are listed in the bottom field of the page. A map of the objects retrieved and the COROT field of view is displayed in a new window (see Fig. 2).
The COROT field of view consists of four single CCDs, grouped in an Asteroseismology (blue squares, marked with S) and an Exoplanet segment (green squares, marked with E). The relative positions and orientations of the respective segments depend on the coordinates of the primary target. For targets in the center direction of the Continuous Viewing Zone (CVZ), the Asteroseismology CCDs are located at the left side (higher right ascensions) of the Exoplanet CCDs and tilted about $5.7^\circ$ in counter-clockwise direction. For targets in the anticenter direction, the position and tilt angle of the Asteroseismology CCDs are opposite. As a default, the primary target is located in the center of the top CCD of the Asteroseismology segment in the case of the 'center CVZ' and at the bottom CCD in case of the 'anticenter CVZ'.

The user can define an offset of the COROT field of view to the primary target and a rotation angle (limited to $\pm 20$ degrees) by entering the necessary values on the COROT Secondary Target Selection page. The dumbell-shaped figure on the map represents the accessible area of the Asteroseismology CCDs for various values of offset and rotation, provided the primary target remains within the Asteroseismology segment of the field of view. Furthermore, a range of magnitudes for the displayed objects can be defined by the user. The numbering of objects in the map can be switched off or chosen in incremental blocks of one hundred. The map is created as a PNG\textsuperscript{8} format and can be printed or locally stored.

MOST mask

Similar to the case for COROT, the primary target is defined with an Object Search on the main page of VISAT. Clicking on the MOST symbol at the left top corner on the Object Search result page, leads to the MOST Secondary Target Selection page. All objects found in the database within a radius of 65 arcminutes, centered on the primary target, are listed in the bottom field of the page. A map of the objects found, and the MOST field of view, is displayed in a new window (see Fig. 3). The MOST field of view is given by a 1024 by 1024 pixel CCD camera and an array of 6 by 6 Fabry lenses in front of the detector. A primary target has to be placed in one of the 20 arcseconds wide lenses. The area for possible secondary targets is defined by a 250 pixel (about 13 arcminutes) wide stripe, centered on the Fabry lens, chosen for the primary target. As a default, the primary target is placed in Fabry lens number 1 (upper left corner). On the MOST Secondary Target Selection page the user can define the Fabry lens to be used and a rotation angle centered to this lens. The

\textsuperscript{8}Portable network graphic, supported by most of the newer Webbrowsers, e.g. MS Internet Explorer v4.0 and later or Netscape Navigator v4.04 and later.
Figure 2: COROT star map of HD 43318. The COROT field of view represents a 2 by 2 array of CCDs, separated into an Asteroseismology (marked with S) and an Exoplanet segment (marked with E). For targets in the center direction of the Continuous Viewing Zone the Asteroseismology segment is located at the left side (higher right ascensions) of the field of view and tilted by about 5.7° in the counterclockwise direction. For targets in the anticenter direction the position and tilt angle of the Asteroseismology segment are opposite. The dumbbell-shaped figure represents the accessible area of the Asteroseismology CCDs provided the primary target remains within the Asteroseismology part of the field of view.
Figure 3: MOST star map of HD 165688. The MOST field of view represents a 1024 by 1024 pixel CCD camera and an array of 6 by 6 Fabry lenses in front of the detector. A primary target has to be placed in one of the 20 arcseconds wide lenses. The readout area on the CCD is limited to a 250 pixel wide stripe, centered on the used Fabry lens and defines the accessible area for secondary targets (inner circle).

inner circle on the map corresponds to the accessible area for secondary targets.

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lar Atmospheres and Pulsating Stars (P14984), by the Bundesministerium für Bildung, Wissenschaft und Kultur (BMBWK) and the Bundesministerium für Verkehr, Innovation und Technologie (BMVIT) via the Austrian Space Agency (ASA).

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