Report of the 1st SpaceInn Workshop 4.1

March 11-13, 2014

Tenerife, Spain

"Peak-bagging in Helio- and Astero-seismology"

SpaceInn Grant Agreement no: 312844
SOC: Dr. A. Eff-Darwich (Ull-IAC), Dr. R.A. García (SAp, CEA-Saclay), and Dr. P.L. Pallé (IAC-ULL)
Workshop Website: http://www.iac.es/congreso/spaceinn-wp41/

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Exploitation of space science and exploration data

Scientific Rationale:

The SpaceInn activities aim to enhance use of the existing and incoming data collected from space-based and ground-based helio- and asteroseismic instruments. The activities are organized in terms of the following topics: data access, scientific expertise, and coordination actions.

The Workshop “Peak-bagging for Helio- and Asteroseismology” was devoted to some key issues already stated in the “Global Helioseismology” 4.1 work package. In particular, how to obtain a new solar activity proxy directly from helioseismic observations, to develop a well documented and robust peak-bagging open access tools, and to assess the optimal use of different instrumentations observing the Sun at the same time, and how to combine different mode data sets. Moreover, reviews and progress on solar and stellar inversions as well as other related parallel topics discussions, took place in a very pleasant environment.

The final goal of this Workshop was to bring together experienced scientists on these specific domains to really contribute towards the final procurement of the main deliverables.

The topics discussed in the various sessions comprised:

- Sensitivity of helioseismic observations to solar activity degree: a new photometric solar activity proxy
- Towards a better understanding of the peak-bagging techniques
- How to optimize the combined used of many contemporaneous helioseismic observations from different instruments
- Sensitivity of current solar inversion techniques to different sets of modes and the physical meaning of the associated uncertainties.

Figure 1: Group photo of the Workshop participants

Scientific Program

The Workshop was organized into a total of 6 half-day sessions (morning & afternoon) from Tuesday to Thursday (11th-13th March, 2014).

Each of the sessions began with an introductory talk about the topics to be discussed, pointing out the challenges and open questions to be considered

Daily schedule

09:00 - 11:00 Review talk and discussions

11:00 - 11:30 coffee break

11:30 - 13:30 discussions

13:30 lunch

15:30 - 17:30 Review talk and discussions

17:30 - 18:00 coffee break

18:00 - 19:30 discussions

20:15 - dinner

Tuesday March 11, 2014

08:45 Welcome and "Tour de Table"

(All participants present themselves and indicate the field they are working in)

Session #1. Low-degree peak-bagging techniques (feedback to and from asteroseismology)

Session Leader: Jerome Ballot (IRAP)

- The different strategies (global fittings, by even-odd groups, etc) at different freq. ranges
- The different minimization techniques
- The length of the temporal series effect on the derived parameters
- The uncertainties on the parameters and their physical meaning
- Current limitations and foreseen progress

Short presentations by: Hans Kjeldsen and Enrico Corsaro

Session #2. On numerical solar inversions and the properties of the mode sets

Session Leader: Maria Pia di Mauro (INAF)

- Redundant information on frequency data sets
- Complementary information on frequency data sets
- Observational requirements (characteristics of the modes) for a minimum meaningful inversion of stellar interiors
- Short presentations by: Hannah Schunker, Antonio Eff-Darwich, and Paul G. Beck

Wednesday March 12, 2014

Session #3: "Implementation of a solar activity proxy from helioseismic observations"

Session Leader: Rafael A. García (CEA-Saclay)

The derivation of solar activity proxies from Helioseismic observations.

- From the photometric and velocity time series.
  - GOLF & VIRGO
- From temporal behavior of solar eigenfrequencies

- Differentiate information depending on:

Agreement and definition of the associated deliverable: the **S**tandard **P**hotometric **H**elioseismic **A**ctivity pro**X**y (SPHAX)

Short presentation by: Martin Nielsen

Session #4. Mid- and High-degree peak bagging techniques

Session Leader: Sylvain Korzennik (CfA)

- The different strategies at different freq. ranges
- The different minimization techniques
- The length of the temporal series effect on the derived parameters
- The uncertainties on the parameters
- Current limitations and foreseen progress

=> Conceptual scheme of the peak-bagging tool to be delivered

Short presentations by: Markus Roth and David Salabert

Thursday March 13, 2014

Session #5. Optimal exploitation of different simultaneous / contemporaneous data sets

Session Leader: Anne-Marie Broomhall (U. Warwich)

- Different solar physical magnitudes (flux, radial velocity, etc.)
- Different intrinsic noise sources and systematics
- Challenge to derive a standard procedure to optimize the combined use of all data sets

=> Definition and contents of the associated deliverable

Session #6. Summary of the Workshop and wrap-up

Chairman: Antonio Eff-Darwich (ULL/IAC)

Definition of the tasks to be performed (deliverables), responsibilities (who) and temporal planning.

Short presentations by: Markus Roth and Thierry Appourchaux

Oral Presentations:

All oral presentations of the Workshop can be found via the central web site of the meeting:

http://www.spaceinn.eu/events/peak-bagging-in-helio-and-asteroseismology/

List of Participants:

Thierry Appourchaux	Institut d'Astrophysique Spatiale (IAS)
Jerome Ballot	Inst. Recherche Astrophysique & Planetologie (IRAP)
Sebastià Barceló Forteza	Instituto de Astrofísica de Canarias (IAC)
Paul Beck	Comisariat de l'Energie Atomique. (CEA-Saclay)
Anne-Marie Broomhall	University of Warwick
Enrico Corsaro	Instituut voor Sterrenkunde (IvS)
Maria Pia di Mauro	Istituto di Astrofisica e Planetologia Spaziali (INAF-IAPS)
Antonio Eff-Darwich	Universidad La Laguna (ULL) Instituto de Astrofísica de Canarias (IAC)
Rafael García	Comisariat de l'Energie Atomique. (CEA-Saclay)
Bernard Gelly	THEMIS INSU-CNRS/CNR
Hans Kjeldsen	Stellar Astrophysics Centre (SAC)
Sylvan Korzennik	Harvard-Smithsonian Center for Astrophysics (CfA)
James Kuszlewicz	University of Birmingham
Mikkel Lund	Stellar Astrophysics Centre (SAC)
Jose Melero	Universidad de La Laguna (ULL)
Martin Nielsen	Max Planck Institute for Solar System Research
Pere L. Pallé	Instituto de Astrofisica de Canarias (IAC)
Clara Régulo	Universidad La Laguna (ULL) Instituto de Astrofísica de Canarias (IAC)

Teodoro Roca Cortés	Universidad La Laguna (ULL) Instituto de Astrofísica de Canarias (IAC)
Markus Roth	Kiepenheuer-Institut für Sonnenphysik (KIS)
David Salabert	Comisariat de l'Energie Atomique. (CEA-Saclay)
Hannah Schunker	Max Planck Institute for Solar System Research
Andrea Triviño Hage	Instituto de Astrofísica de Canarias (IAC)

Conclusions of the meeting:

During this meeting and to answer to the scientific objectives of the WP 4.1: "Global helioseismology" we have established 8 well identified subpackages with a coordinator for each one. Reports on the advance of the scientific objectives will be given at the end of the year 2014. They will be discussed next year during the second Global Helio- and Astero-seismology working group meeting that will be held during the period January-February 2015. The location of the conference will be decided along the year, but Dr. M. Roth has kindly volunteer to organize it in Germany.

List of working sub-packages and actions:

1. Statistical analysis of combined BISON + GOLF + HMI to search for low-frequency signals
    - COORDINATOR: Anne Marie Broomhall
    - PARTICIPANT INSTITUTIONS: UoW, IAS, CEA, CFA, IAC, UoB
2. Use of Collapsograms/Overlapogrammes (technics to enhance low signal-to-noise ratio modes, Salabert et al. 2009) combining HMI, MDI & GONG (alone or with GOLF, BiSON, and/or VIRGO)
    - COORDINATOR: David Salabert
    - PARTICIPANT INSTITUTIONS: CEA, IAS, UoW, IAC, INSU-CNRS
3. Explore statistical methods based on joint probability to extract "more precisely" l<4 modes
    - COORDINATOR: Anne Marie Broomhall
    - PARTICIPANT INSTITUTIONS: UoW, IAS, CEA, IAC, UoP, SAC, MPI, UoB
4. To develop new tools to extract global seismic parameters of HMI and AIA aboard the NASA mission SDO

- Standard analysis of low-degree modes
    i. COORDINATOR: UoB
    ii. PARTICIPANT INSTITUTIONS: IAS, CEA, IAC, UoW, UoB
- Medium- and High-degree modes: Standalone fitting code
    i. COORDINATOR: Sylvain Korzennik
    ii. PARTICIPANT INSTITUTIONS: CFA, CEA, IAC, UoB, MPI

5. To support these analysis we propose to:
    - To make available SolarFLAG simulations in the SPACEINN Portal
    - To make available any other data set used to test the new methodologies
        i. COORDINATOR: Jerôme Ballot
        ii. PARTICIPANT INSTITUTIONS: IRAP, CEA, IAC, UoB, MPI, SAC, INAF, UoW, UoP
6. Generate the SPHAX index using GOLF and VIRGO in a regular cadence
    - There will be placed on the web and linked to the SpaceInn portal
        i. COORDINATOR: Rafael A. García
        ii. PARTICIPANT INSTITUTIONS: CEA, IAC, CFA
7. To compare the rising phases of solar Schwabe cycles 22, 23 and the current cycle 24:
    - Necessity to wait till summer 2015 for final comparison
        i. COORDINATOR: David Salabert
        ii. PARTICIPANT INSTITUTIONS: CEA, IAC, IRAP, IAS, UoB, UoW, MPI
8. All the tools and time series used to generate the different deliverables will be placed in a repository in the SpaceInn portal properly documented following a standard protocol (TBD) according to WP 6.
        i. COORDINATOR: Jerôme Ballot
        ii. PARTICIPANT INSTITUTIONS: IRAP, CEA, IAS, IAC, UoB, MPI, SAC