

Pulsations in Intermediate-mass, Massive and/or Multiple Stars

18-22 January 2021 – Workshop report

[Event website](#)

Summary

“Pulsations in Intermediate-mass, Massive and/or Multiple Stars” was a week-long international workshop, originally planned at the University of Surrey for Easter 2020 and moved online in January 2021. It was organised by Dr Giovanni Mirouh, Dr Robert Izzard, Mr. David Hendriks (University of Surrey) and Dr Andrea Miglio (University of Birmingham).

The workshop was designed to pioneer the potential of asteroseismology in the analysis of binary stars, made timely by the wealth of data delivered by recent space missions like Corot, Kepler, TESS and BRITE. To that end, we connected experts from both asteroseismology and binary-star evolution – two communities whose interactions are sadly too often limited – to forge new approaches and techniques that are still missing today.

The meeting brought together 32 attendees from numerous groups in the UK, continental Europe, and Japan. Talks covered a wide range of topics: observations and models of binary stars, underlying physical processes, and novel methods such as machine learning. Talks ranged from general introductions to these topics, to precise examples of cutting-edge studies, along with generous discussion time to push the arguments further.

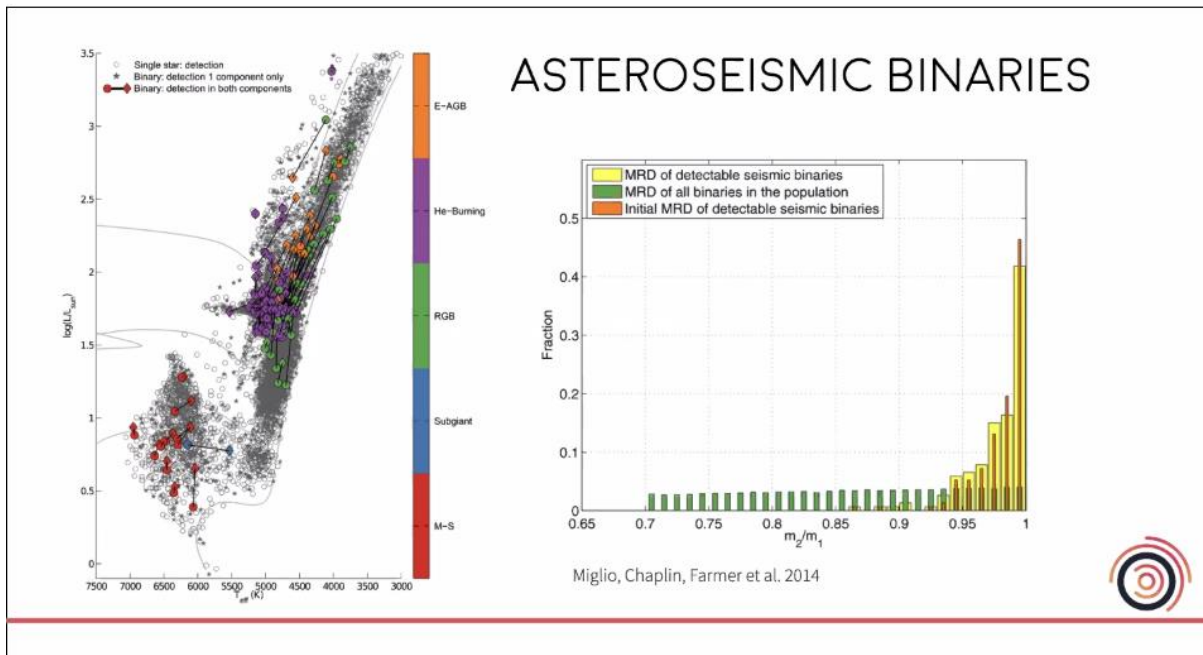
Workshop Aims

Over the last two decades, asteroseismology has become the main tool to probe the deep layers of stars, allowing astronomers to derive fundamental parameters and describe internal rotation profiles and structural quantities for thousands of stars. However, these techniques were developed for single stars, while half of the stars in the local Universe are in binary systems. Stars in those systems can interact (through tides, mass transfers or mergers), thus making the description of their structure and evolution much more complex.

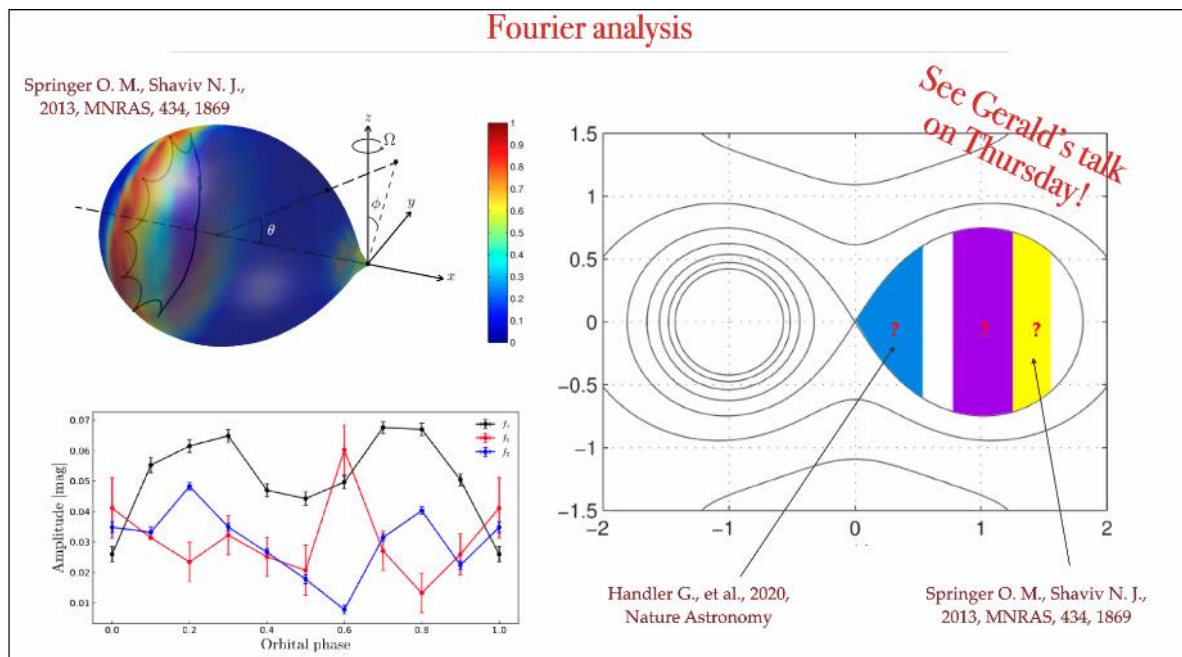
Because of this, binary systems are rarely investigated using asteroseismology, and the two respective communities rarely work together – only small samples of specific stars, such as distant eclipsing binaries, are modelled seismically. To extract more information from observations and reach a more complete understanding of the complex evolution of interacting stars, this workshop brought together the binary stars and asteroseismology communities through a mix of introductory talks, presentations focused on recent results, and extensive discussion.

Programme and Event themes

The workshop attracted 32 attendees from the UK, Europe, and Japan. A balance between seasoned researchers and early-career researchers was sought, with six graduate students and ten postdoctoral researchers. Over the week, we had 30 talks distributed over five 4h30 sessions, that were completed by discussion sessions both before and after the talks, and an online social event. Again, early-career researchers were given keynote talks and were chairing sessions.



Talks ranged from introductory reviews (observations of pulsating binaries, courtesy Andrea Miglio) ...



... to detailed modelling of specific systems (single-sided pulsations in tidally-distorted stars, courtesy Amadeusz Miszuda)

In an attempt to involve everyone and mitigate fatigue, we recorded Zoom talks and made them available online in the very afternoon as unlisted videos on YouTube. These videos were associated with a Slack workspace, which allowed for discussion and acts as a repository for related resources. These technical choices were met with enthusiasm.

Topic covered by the programme included:

- galactic archaeology and stellar populations
- rotation of pulsating stars at various evolutionary stages
- mass transfer in close binary systems
- eclipsing binaries and the oscillations they harbour
- oscillations forced by tides and associated dissipations
- machine learning and inversion techniques and applications to stellar physics
- late-stage stars such as subdwarfs, neutron stars and black holes

The detailed programme is available [here](#).

The social event, that had to be held virtually, revolved around a show-and-tell dinner. Attendees were invited to join in bringing food and drink from their place of origin (or residence) and present the cultural and/or personal significance. The event was attended by roughly half of the participants, and widely appreciated.



Smiles on every face despite the distance in the virtual social event organised by Rob Izzard

Outcomes

Feedback from attendees was very positive, with 93% of the attendees being satisfied with the workshop content. Attendees were also generally pleased with the association of live Zoom videos and durable Slack online discussions. The quick availability of videos on YouTube was especially appreciated by attendees from the Japan time zone, or working from home with children to look after, allowing them to manage their schedule and still follow the talks. This combination was implemented by one of our attendees for a [virtual conference](#) they organised in March 2021.

We expect publications to follow from the event: an email has been circulated, asking attendees to acknowledge the PIMMS workshop in papers that benefitted from the workshop discussions and

presentations.

Future plans include the organisation of a follow-up event in a couple of years, possibly making use of the amazing support at Surrey. Along with the balanced mix of early-career and well-established researchers in the group, this will ensure the continuity of collaborations.

Acknowledgements

The organisers acknowledge financial support from the Institute of Advanced Studies at the University of Surrey and the Royal Astronomical Society. We are also very grateful to Ms. Mirela Dunic and Mrs. Vicki Blamey for their help with organising the event, and Ms. Danielle Kurtin for her help with logistics.