Division G Working Group: Ap and Related Stars

Annual Report 2021-22

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Introduction

The purpose of the Working Group on Ap and Related Stars (ApWG) is to promote and facilitate research about stars in the spectral type range from mid-B to early F that exhibit surface chemical peculiarities and related phenomena. To this effect, the ApWG publishes a newsletter and distributes it to its members and the ApWG members actively contribute to the organization of international scientific meetings. The Ap and related stars represents an active field of research, which takes full advantage of the new opportunities opened by the unprecedented data delivered by the space- and ground-based instruments that came into operations in the past few years. Some of the resulting scientific highlights are presented in this report.

Scientific Highlights

Over the past year in excess of 50 research papers have been published by members of the ApWG. Here we present only a short selection of some of the scientific highlights during the past year.

Takahashi & Langer (2021) introduced a new approach to modelling of stellar evolution where the interplay between magnetic field, rotation, mass loss, and evolutionary changes of the internal structure of stars is treated self-consistently. The Lorentz force produces torsional Alfvén waves propagating through the star, which impose near-rigid rotation within the Alfvén timescale. Models with different initial rotational velocities and magnetic fields can reproduce the main observed properties of Ap/Bp stars.

Exploiting the high-precision and high-cadence of the Transiting Exoplanet Survey Satellite (TESS), Kochukhov et al. (2021) presented photometric data of 64 Mercury-Manganese (HgMn) stars observed by the TESS and determines the incidence of rotational modulation and pulsations among HgMn stars. About 84 per cent of the targets show rotational variability with amplitudes of 0.1-3 mmag. This indicates that presence of spots on HgMn-star surfaces is ubiquitous. Several HgMn stars is also identified as multiperiodic g-mode pulsators or show tidally induced variations and eclipses.

In addition to the HgMn stars, Holdsworth et al. (2021) utilised the TESS data to search for high-frequency pulsations in stars with effective temperatures greater than 6000 K with the aim of identifying and studying new members of the rapidly oscillating Ap (roAp) stars. The opportunities presented by TESS allow for an almost unbiased search for class members like never before. The work found 12 new members and provided a homogeneous study of all 56 stars observed during Cycle 1, identifying 60% of the stars to host multi-periodic pulsations, providing a rich resource for future exploitation.

Leto et al. (2021) presented the analysis of incoherent non-thermal radio emission from a sample of magnetic stars of spectral types ranging from early-B to early-A. The paper challenges a well-established scenario in which the electrons producing the radio emission originate in current sheets formed in the outer magnetospheric regions where the wind opens the magnetic field lines. The paper discusses more realistic models of the radio emission and suggests a scaling relationship between the radio luminosity and the induced electric voltage,

which holds for a diverse group of stellar types including magnetic main-sequence stars and ultracool dwarf stars and even the planet Jupiter.

Working Group Members Swetlana Hubrig and Markus Schöller have had a book published on the *Magnetic Fields in O, B, and A Stars.* The book gives a comprehensive review of recent achievements in the measurements of stellar magnetic fields in O, B, and A stars, including those in chemically peculiar stars and an overview of the underlying physics for the interpretation of measurements.

A spectral atlas based on low-resolution spectra from LAMOST has been compiled by Stefan Hümmerich. It covers the chemically peculiar stars of the upper main sequence, including the Am, Ap, HgMn, He-peculiar and λ Bootis stars. The atlas can be accessed from Richard O. Gray's MKCLASS website, http://www.appstate.edu/~grayro/mkclass/.

A peculiar Newsletter

A peculiar Newsletter (ApN), the electronic newsletter of the ApWG, is the product of this group that is most valued by its members. Its contents include lists of recent publications in the field of Ap and related stars and announcements of interest for the scientific community working in that field (including conference announcements, job ads, and obituaries). It also serves as a forum for discussions among members of this community. In summary, since its foundation in 1978 (on paper, at the time), it has been an essential channel of communication and of reference for the scientists interested in Ap and related stars. The ApN is hosted on a server at the Leibniz Institute for Astrophysics Potsdam (https://apn.aip.de/), under the lead of the Editor, Dr Silva Järvinen.

Scientific meetings

The COVID-19 pandemic has severely curtailed scientific meetings, with many cancelled or postponed. Others have migrated to an online format, including *"OBA Stars: Variability and Magnetic Fields"* in April 2021 organized by several members of the ApWG. Topics covered by the online conference included, the origin of magnetic fields in convective and non-convective stars, methods of magnetic field measurements, stars with strong and weak magnetic fields, magnetic fields in Herbig Ae/Be stars, the results from large surveys and recent and current space missions, atomic and molecular data for stellar physics, and observations versus theory. Online presentations can be found at https://zenodo.org/communities/stars-2021/.

References

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