Division G Working Group: Ap and Related Stars

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1. 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 (Section 3), and the ApWG members actively contribute to the organization of international scientific meetings (Section 4). The Ap and related stars represents a very 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 Section 2.

2. Scientific highlights

The release of the first TESS data opened new perspectives for the study many aspects of the physics of the Ap and related stars, whose exploitation started right away. Cunha et al. (2019) analysed the photometric light curves of the Ap stars of the first two TESS sectors to show that rapidly oscillating Ap (roAp) stars are rare (~4% of all Ap stars) and that various of their observed properties challenge the theory developed to explain their pulsations. Data from the same TESS sectors were also the basis for a systematic study of δ Scuti and γ Doradus stars, which provides new constraints for the theoretical modelling of these intermediate mass A- and F-type pulsators (Antoci et al. 2019). The MOBSTER collaboration initiated a systematic effort to take advantage of the TESS data to gain insight into the evolutionary and rotational properties of the magnetic Ap and Bp stars (David-Uraz et al. 2019). It identified 58 rotationally variable A-type stars that were not previously known to be Ap stars, whose nature will need to be established through spectroscopy (Sikora et al. 2019a). It also discovered a magnetic Bp star in an eclipsing binary (Shultz et al. 2019a). No eclipsing binary containing an Ap or Bp star was known until a couple of years ago, but another probable occurrence of an Ap star in such a system was recently reported by another group (Skarka et al. 2019; based on K2 photometric data). The first roAp star in a (rather) close spectroscopic binary was also discovered by combining TESS data with ground-based photometry and spectroscopy (Holdsworth et al. 2019).

Besides these TESS-based studies, the exploitation of the results of previous space missions continued. Mombarg et al. (2019) analysed Kepler data to determine the masses, ages, and core properties of 37 γ Doradus stars. Li et al. (2019) also used Kepler observations to study the internal rotation of 82 such stars. Hey et al. (2019) discovered six new roAp stars in the Kepler long-cadence data using super-Nyquist asteroseismology.

In several of the works listed above, the derivation of the fundamental stellar parameters was based on Gaia data. These data were also exploited to locate the strongly magnetic Ap stars in the Hertzsprung-Russell diagram, with a view to studying the evolution of their magnetic fields across the main sequence (Scholz et al. 2019). The resulting catalogue includes 153 Ap stars that were found to have resolved magnetically split lines in the infrared (Chojnowski et al. 2019). Romanovskaya et al. (2019) found that the effective temperatures and radii of Ap stars determined from careful spectroscopic analyses were consistent with those obtained from interferometry. Moiseeva et al. (2019) carried out a systematic determination of the fundamental parameters of 146 chemically peculiar stars.

Major progress has been achieved in the past few years in the knowledge of the rotation of Ap stars, in large part because huge numbers of new periods could be determined from the analysis of the data from many ground-based and space-based photometric surveys. TESS promises to bring about a new big step forward, with an unprecedented number of light curves becoming available in the near future. While it is best suited to study periods shorter than ~15 d, at the other end of the period distribution, with a period of 29 yr, HD 50169 has recently become the Ap star with the longest accurately determined period (Mathys et al. 2019a). Another period longer than 10 yr that has been recently determined is that of HD 965 (16.5 yr; Mathys et al. 2019b). On the other hand, a new star whose short rotation period show secular changes over long-time scales, the Bp star HD 142990, was recently identified (Shultz et al. 2019b).

While the samples of Ap stars with known rotation periods and magnetic fields are generally inhomogeneous and incomplete, Sikora et al. (2019b) undertook a systematic study of a volume limited sample. Other recent publications reporting the results of studies of the magnetic fields of Ap and related stars include Kochukhov et al. (2019; modelling of the magnetic field topologies of two weakly magnetic Ap stars), Petit et al. (2019; survey of the magnetic properties of O-type stars), Shultz et al. (2019c; survey of the magnetic and rotation properties of early B-type stars), and Romanyuk et al. (2019; search for magnetic fields in Ap stars in the Orion OB1 association). Two spectroscopic binaries including (at least) one magnetic star were also studied in detail: HD 96446 (González et al. 2019; magnetic Bp star + β Cep star) and HD

104237 (Järvinen et al. 2019; a magnetic Herbig Ae star, the potential progenitors of an Ap star, and a magnetic T Tauri star).

Finally, as a result of a spectroscopic campaign aimed at determining the chemical abundances in 155 objects reported as uncertain in the Catalogue of Ap, HgMn and Am stars (Renson & Manfroid 2009), 62 new Am stars were identified (Catanzaro et al. 2019).

The large number of scientific highlights reported in this incomplete list (apologies to the authors who may feel that their results have been unduly overlooked) testifies of the healthy and vigorous state of research in the field of the Ap and related stars and underlines the importance of the role that the ApWG may play to give the best support to this research.

3. 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. Unfortunately, in February 2019, the server hosting the ApN developed a terminal failure. After delays due to personal and technical challenges, at the time of writing, the configuration of a new server and the deployment of the ApN on it are in progress, and the publication of the newsletter is expected to resume in a few days, under the responsibility of a new editor. As soon as it is ready, the ApWG members will be notified by email, and the link to the newsletter will be published on the IAU-hosted web page of the WG (https://www.iau.org/science/scientific_bodies/working_groups/105/).

4. Scientific meetings

Two conferences took place in 2019 that were organized in large part by members of the ApWG: *Stellar Magnetism* (London, Ontario, Canada, July 2019) and *Stars and their Variability observed from space* (Vienna, Austria, August 2019). Another meeting to the organization of which members of the ApWG actively contributed is the *TASC5/KASC12 workshop* (Cambridge, Mass., USA, July 2019).

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