**Triennial Report 2024**

We begin by again noting, with deep sadness, the death of our Vice President Dimitri Pourbaix in November 2021.

Commission G1 covers a very broad range of topics including both observations and theoretical modelling of binary and multiple star systems. Over the last three years the most transforming contributions have come from surveys and the production of catalogues of more and more systems will well measured parameters. Not least amongst these has been the contribution from the Gaia mission. The Gaia Early Data Release 3 (DR3) in 2022 has stimulated a large number of studies related to binary and multiple stars. The catalogue contains substantial information on duplicity of the observed stars. Data are published for 813,687 non-single stars, including astrometric, spectroscopic and eclipsing binary stars. Of these 169,227 have orbital astrometric solutions, 186,905 have orbital spectroscopic solutions and 87,073 are eclipsing (Gaia Data Release 3. Astrometric binary star processing. 2023, Halbwachs J.-L., Pourbaix D., Arenou F. et al. A&A 674, A9). We note again here Dimitri Pourbaix's important contribution as the head of the Coordination Unit 4 (Object Processing) of the Gaia Data Processing and Analysis Consortium, responsible for the non-single star aspects of reduction of Gaia astrometric data.

The boom of space photometric data from Kepler and TESS has not only led to numerous studies of binary stars but has also led to discoveries of many new triple and quadruple stellar systems. Both identifications of new such systems and detailed analysis of individual triple and quadruple systems are ubiquitous in the recent astrophysical literature.

There has been significant activity on the observational side related to understanding binary properties of massive stars in different stages of their evolution. This includes recent surveys of multiplicity of Galactic Wolf-Rayet (WR) stars.

The ULLYSES project, Ultraviolet Legacy Library of Young Stars as Essential Standards, based on HST and X-Shooter observations of massive stars in the Large and Small Magellanic Clouds (even though the sample was designed to exclude known binary stars) offers an excellent sample to search for hot binary-stripped stars that are sufficiently massive to explode as SNe (Vink et al. 2023, A&A 675, A154). Binary-stripped stars, which are not wind-stripped WR stars, are suggested as progenitors of binary neutron stars that merge in gravitational wave events. The discovery of such binaries was recently reported by Drout et al. (2023, Sci 382, 1287).

Gratton et al. (2023, A&A 678, A93) recently discussed the frequency, mass ratio, and separation in binaries around B stars in the Scorpius-Centaurus association with essentially completed star formation. Using high contrast imaging samples from BEAST, SHINE, and previous surveys with evidence of companions from Gaia, the authors found evidence for 200 companions around 181 stars. A strong correlation between the mass of the primaries

and of the companions, and a scarcity of low mass stellar companions to massive stars has been reported.

Hubrig et al. (2023, MNRAS 521, 6228) surveyed high-resolution ESO HARPSpol and CFHT ESPaDOnS archival spectropolarimetric observations of O-type binary and multiple systems and revealed a large sample of such systems with potential magnetic components, pointing out that the incidence rate of magnetic fields in massive binaries has probably been greatly underestimated.

Cepheid variables are primary distance indicators in establishing the cosmic distance scale via their period - luminosity relationship. Cepheids belonging to binary systems are extremely important objects for calibrating the zero point of this relationship. Several new studies of the duplicity of Cepheids have appeared in the last three years.

Meetings related to the Commission have included, in 2023, a Kavli Summer Program in Astrophysics on "The lives, deaths and afterlives of interacting stars" organized by Selma de Mink and Stephen Justham. This brought together experts in stars and their interactions invigorating interest in the astrophysical importance of stars that interact during their lives leading to the formation of close binary systems containing compact objects, including the known stellar-mass black holes.

"3,2,1: Massive Triples, Binaries and Merges" in 2023, Leuven, brought together observers and theoreticians to understand the life cycles of massive binary and multiple systems, from formation to death with particular reference to what might be obtained from gravitational wave astronomy.

The ESO workshop "Two in a million - The interplay between binaries and star clusters" in 2023 Garching aimed to better understand the origin of black-hole merges and effects on galaxies in the early Universe.