

Circumstellar Dynamics at High Resolution

held at Foz do Iguaçu, Paraná State, Brazil, 27 February–2 March 2012

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The workshop was jointly sponsored by ESO, the Brazilian National and São Paulo state agencies CAPES and FAPESP, and the University of São Paulo. Nearly 70 participants gathered to discuss the immediate surroundings of stars, mostly those more massive and hotter than the Sun. The venue, near the spectacular Iguazu waterfalls, and topic proved to be well chosen to attract a balanced crowd: about one third of the participants came from each of Brazil, other ESO member states and Chile, and ESO non-member states.

The dynamics of circumstellar envelopes is an active research frontier that has benefited greatly from the advent of high-resolution observational techniques in the spectral and spatial domains. The diverse and complex circumstellar environments revealed by these observational techniques are particularly evident near hot, high-mass, stars, where stellar radiation plays a large, if not crucial, role in continuously shaping the immediate environment.

Circumstellar structures have not only been resolved spatially, but also have been followed over characteristic timescales of their variation. This dynamical evolution has been modelled for discs and winds: we are now directly observing and measuring the consequence of the physical mechanisms operating within the circumstellar environments. As a result, current observing facilities, not least the ones operated by ESO, have allowed the field to progress from a static picture of the circumstellar environment towards understanding its dynamics and the physical processes dominating the dynamics.



Figure 1. The conference group photo taken against the splendid backdrop of the Iguazu Falls.

Circumstellar discs and outflows

The meeting started with two oral sessions on circumstellar discs and their outflows. The first, focused on observations, was opened by reviews on discs and their properties during various evolutionary phases by R. Oudmaijer and by introductions to, and results from, various observing techniques, such as polarimetry (presentation by A.M. Magalhães) and both amplitude and intensity interferometry (by P. Nuñez and F. Millour). A. Kaufer showed the late B supergiant Rigel to be a particularly interesting case, exhibiting a cyclically recurring large-scale circumstellar structure. In two contributions exploring the fate of circumstellar ejecta of less massive stars over longer timescales, R. de la Reza wondered why no ejection shells had yet been discovered around lithium-rich giants, and T. Ueta introduced the Herschel Planetary Nebula Survey.

The second session then concentrated on the theory addressing the observational phenomena. Magnetohydrodynamic wind models were presented in detail by A. ud-Doula, a topic picked up frequently in later contributions. One of the most interesting aspects of the current state-of-the-art disc modelling is that the Be star models have begun to

converge to a common physical basis, namely that of a geometrically thin disc in Keplerian rotation that is driven by viscosity (talks by J. Bjorkman and C. Jones). This provided a most valuable common baseline for further exploration, as was shown by D. M. Faes for an interferometric phase effect so far not considered, and by R. Halonen concerning the role of polarimetry in revealing the disc structure. X. Haubojs extended the theoretical understanding of Be star discs into the temporal domain, while A. Granada approached the issue from a different direction by investigating how Be stars fit into the current understanding of stellar evolution.

δ Sco and Be stars as laboratories for circumstellar disc physics

In July 2011, the highly eccentric binary δ Sco went through periastron passage, more than ten years after the previous one. The previous periastron event and the evolution since, summarised by A. Miroshnichenko, sparked significant interest in the object, as δ Sco seems to have started to build up a circumstellar Be star disc around that time. Therefore, the 2011 periastron passage was anticipated to clarify if and how the periastron has any connection to mass ejection and disc formation. On this occasion the disc around the primary was fully developed, so monitoring its response to the passage of the secondary was another

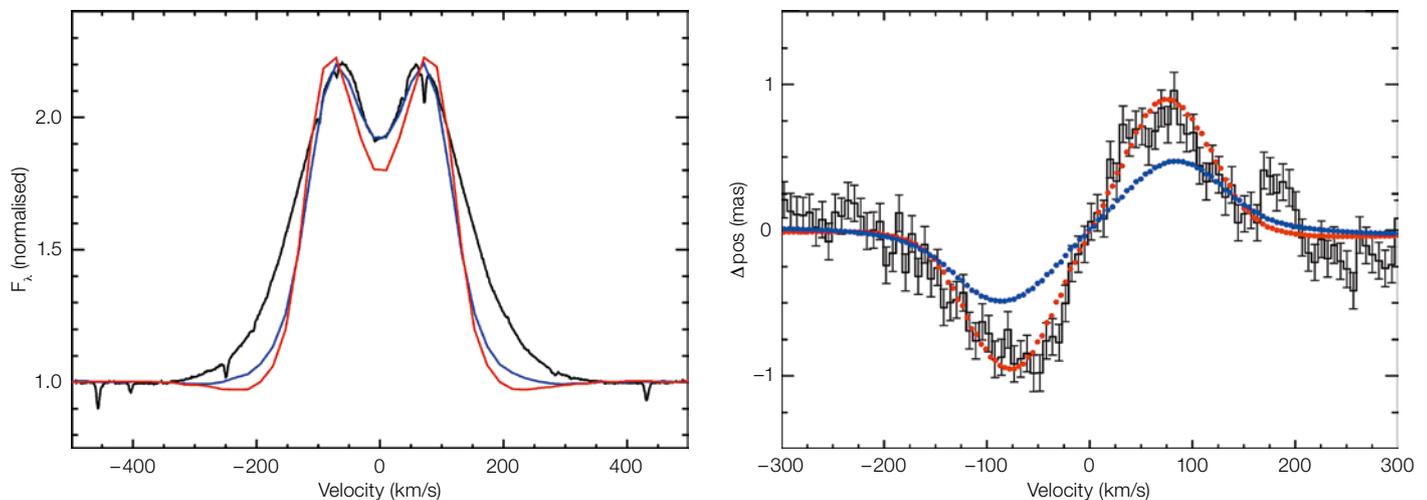


Figure 2. Spectroastrometric observations of β CMi. The data are compared to HDUST models featuring angular momentum and Keplerian rotation (blue and red respectively). The combination of high spectral resolution and sub-milliarcsecond spatial precision constrain the disc kinematics. Only the Keplerian model can simultaneously recreate the observed line profile (left) and the spectroastrometric signature (right). From Wheelwright et al. 2012, MNRAS 423, L11.

attractive opportunity in 2011. Observations of the 2011 periastron and their preliminary interpretations were presented by S. Štefl in the oral session and by some posters.

High angular observations of Be stars, at the Very Large Telescope Interferometer (VLTI) as well as other interferometric facilities, and their implications were reviewed by Ph. Stee, while the dynamical theory of Be discs in binaries was presented by A. Okazaki. Observations of the latter were shown by R. Mennickent, pointing out the existence of hundreds of peculiar double periodic binaries, in which the non-orbital photometric period, originating from a circumstellar disc, is typically longer than the orbital one by a factor of about twenty.

The presentation by H. Wheelwright, comparing observations of the disc of β CMi to kinematic models of the circumstellar velocity field, reinforced the understanding presented already in the previous sessions and by Stee: Be star discs are in Keplerian rotation. Consensus on this controversial result, growing since a meeting in Sapporo,

Japan, in 2005, is probably among the most significant achievements of this workshop, given that this issue has been debated for decades, sometimes quite controversially.

Dynamics of circumstellar material and tidal interactions in hot binaries

The δ Sco periastron found significant attention within the Be star community. But the fact that η Carina is an eccentric binary, interacting in many ways, has certainly impacted the community still more deeply. Consequently, this star and other Luminous Blue Variables (LBVs) featured prominently in this section, beginning with a review given by J. Groh on interferometric data and a contribution by Z. Abraham on radio observations. The question whether possibly all LBVs with giant eruptions might be binaries was raised by C. Martayan.

Moving away from these most extreme cases, D. Cohen, S.P. Owocki, and J. Sundqvist presented the recent developments of the theory of radiatively driven stellar winds on a broader scale, ranging from X-rays as shock diagnostics, via structural questions in general, to temporal variability. The remainder of the session was devoted to more individual topics, in particular the interferometric study of a B[e] star by M. Borges Fernandes, the circumstellar structure of a Be X-ray binary during a giant outburst by Y. Moritani and the modelling of [WCE] stars by G. Keller.

Massive star formation out of a dynamic environment

The session on star formation began with an unusual setup. Since M. Krumholz could not be present in Iguazu, he agreed to give his talk on the theory of massive star formation via Skype on one screen, while the slides were shown on the other. This *ad hoc* teleconferencing solution worked flawlessly, and the audience was rewarded with a very interesting contribution on collapsing molecular clouds. L. Ellerbroek provided insights into an alternative scenario of the accretion history of an intermediate-mass young stellar object.

Interferometry is a major driver in this field, with baselines ranging from typical single-dish diameters (aperture masking, talk by S. Lacour) via long optical baseline interferometry like the VLTI (presentation by W.J. de Wit) to the kilometre-scale baselines in the submillimetre range that will be offered by ALMA (presentation by N. Evans).

Magnetospheres of hot stars

The observational facts about magnetically-governed environments of hot stars were introduced by E. Alecian, and complemented by R. Townsend, providing an overview of theoretical insights into the interplay between rotation, magnetic field and stellar wind. Detailed examples were presented by V. Petit and A. Carciofi; T. Rivinius argued that a sufficient num-

ber of such objects are currently known to permit statistical analysis, and possibly to postulate these objects as constituting a class of magnetic hot stars. Many of these newly found magnetic stars were provided by the MiMeS survey, summarised by G. Wade, which finds a magnetic field incidence of typically 10% in massive stars, very similar to lower-mass (but still non-convective) stars. The only striking exception are the Be stars, a class for which not a single magnetic member has been found. This result has the potential to settle another longstanding debate, namely what role, if any, magnetic fields play in the formation of discs around Be stars.

Closing talks

The final talk of the meeting was given by D. Baade, summarising the contributions,

reminding the participants of the progress made and presented at the meeting, but putting emphasis as well on the work left to be done.

A public talk by D. Baade, translated simultaneously from English into Portuguese, on ESO's Extremely Large Telescope and the quest for extraterrestrial life was attended by members of the Pólo Astronômico, a large and active group of amateur astronomers, as well as the conference participants. A Star Party, prepared by the Pólo Astronômico for after that talk unfortunately could not be held due to bad weather. The excursions to the Brazilian and Argentinean sides of the Iguazu waterfalls were as spectacular as expected for a visit to one of the new seven wonders of nature¹.

The generous sponsorship not only by ESO but also by Brazilian agencies ena-

bles us to publish printed proceedings in full colour, which will appear in the conference series of the Astronomical Society of the Pacific, edited by A. Carciofi and T. Rivinius.

Acknowledgements

We are very grateful for the enthusiastic work of both the scientific and local organising committees. The meeting benefitted greatly from the organising support of Maria Eugenia Gomez and Marketka Šteflová. We thank the Pólo Astronômico for their enthusiasm and the staff of the Rafain Palace Hotel for their assistance.

Links

¹ New seven wonders of nature: <http://www.n7w.com>

Report on the Workshop

Observing Planetary Systems II

held at ESO, Vitacura, Chile, 5–8 March 2012

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This second edition of the Observing Planetary Systems workshop was aimed at bringing together the two communities of Solar System and extra-planetary system scientists to review the recent progress made in our understanding of the formation of the Solar System and its early chemistry, and how this picture fits with our current knowledge of the formation and evolution of planetary systems in general.

Observing Planetary Systems II

An ESO workshop to bring together both communities of solar system and extra-planetary system researchers and to foster our understanding of the formation and evolution of planetary systems at large

Santiago, Chile, March 5-8, 2012

Topics and Invited Speakers

The first Myr. of planetary formation
Hilke Schlichting, UCL
Bill Dent, ESO/A&MA
Sebastian Wolf, Kiel University

Nature and orbits of planetary bodies
Dave Jewitt, UCLA
Willy Benz, Bern University
Caroline Terquem, Institut d'Astrophysique de Paris
Didier Queloz, Geneva Observatory
Alessandro Morbidelli, Nice Observatory

Planetary atmospheres and bio-markers
Tobias Owen, University of Hawaii
Eric Pallé, Instituto de Astrofísica de Canarias
Michael Gillon, Liege University

SPHERE: Future ESO planet-finders
David Mouillet, Institut de Planétologie et d'Astrophysique de Grenoble

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Web page: <http://www.eso.org/sci/meetings/2012/OPSII.html>
Conference e-mail: ops2012@eso.org

Figure 1. The workshop poster.