

## **Bubbles and SuperBubbles of massive star**

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In this project, we aim to investigate the circumstellar medium of massive stars. (see e.g.: van Marle et al. 2015). In particular, we will study the influence of the cosmic ray pressure on the evolution of bubbles surrounding massive stars and of super-bubbles surrounding massive stars clusters. The cosmic rays that are accelerated at the forward shock extract energy from the shocked ISM. This changes the evolution of the bubbles and superbubbles, making them smaller, and influences the position of the termination shock (reverse shock propagating in stellar wind). This behaviour could explain the observations of bubbles and super-bubbles that are smaller than what is expected from the ideal theoretical model.

A second part of the project will be to use our simulations of bubbles and super-bubbles as circumstellar medium for Gamma Ray Burst (GRB) progenitors. In particular, we intend to explain how the termination shock within the circumstellar medium of a GRB progenitor could get closer to the GRB progenitor. Recent works point to binary stars also as possible progenitors of GRBs (see e.g.: Vergani et al. 2017, A&A, in press). Furthermore, from GRB afterglow observations, a constant density profile of the medium surrounding the GRB is often found instead of the expected wind profile one. We will investigate, the influence of binary interaction, stellar motion, and the winds from other massive stars in the cluster; and how the environment of the progenitor may cause the termination shock to be pushed toward the GRB progenitor.

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- Organisation of COSMIDYN at the Paris Observatory in November 2017 (2000 euros) and pay for attention by members of the international community. This conference has been held twice before (IAP Dec. 2015, LUPM Dec. 2016)
  - Foreseen speakers: B.Commercon, Y. Dubois, C. Evoli, P. Girichidis, P. Hennebelle, A. Marcowith, A.J. van Marle, D. Maurin, Z. Meliani, M. Padovani, C. Pfrommer, V. Guillet)
- Contribution to attendance for one person (A.J. van Marle, APC) of the 7th International Fermi Symposium October 2017 (Garmisch-Partenkirchen, Germany) (1000 euros)
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