Recent laboratory astrophysics studies of accreting magnetized white dwarfs: From VLT observations to Megajoule laser experiments

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Recent comparison between numerical simulations of accretion processes and VLT observations have shown that the standard model of high-energy radiation coming from accreting magnetized white dwarfs is not complete [1,2,3]. These astrophysical objects are ideal to study accretion processes in the high energy regime and they are an important galactic population of X-ray sources, as well as a potential progenitor of thermonuclear supernovae.

The interesting scalability properties of the radiative accretion zone [5,6] allow us to reproduce it using powerful lasers and since the first experiments, various designs have been devoted to study different aspects of accretion shock physics.

In this work, the simulation of non-linear dynamics of accretion shocks is presented. Based on scaling properties the possibility to reproduce accretion shock with laser experiments is revisited and discussed in detail. Numerical simulations of the experimental design for a megajoule-class laser are presented and the links with astrophysical modelling are discussed.

References

[1] L. Van Box Som et al., MNRAS, 473, 3158 (2018)
[2] C. Busschaert et al. Astron. Astrophys., 579, 25 (2015)
[3] J. M. Bonnet-Bidaud et al., Astron. Astrophys., 579, 24 (2015)
[4] M. Mouchet et al. Astron. Astrophys. 600, 53 (2017)
[5] E. Falize et al. Astrophys. Space Sci. (2009)
[6] E. Falize et al. Astrophys. J. (2011)