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Experiments with laser driven plasma jets

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Laboratory studies can address issues relevant to astrophysics[1] and in some cases improve our understanding of the physical processes that occur in astrophysical objects. So issues related to the jet propagation and collimation over considerable distance and their interactions with surrounding media have begun to be addressed these last years. Laboratory plasmas and astrophysical objects have different length, time and density scales. However, the typical velocities are the same, of a few hundred km/s and the similarity criteria[2] can be applied to scale the laboratory jets to astrophysical conditions. In this presentation, we use a method of jet formation[3] which allows to launch a very fast jet having a velocity around 400 km/s by using a relatively small laser energy, of the order of 100 J. The jet has a Mach number greater than 10, a length of a few mm, and a radius of a few tenths of mm. The interaction of these jets with a gas puff has been recently studied in an experiment carried out at the PALS laser facility. Varying gas pressure and composition, we show that the nature of interaction zone changes from a quasi adiabatic outflow to a strongly radiatively cooling jet. The use of various diagnostics, allows to relate the x-ray emission to the density map of the interaction zone. Already observed in astrophysical objets for strongly different time and space scales, these structures are interpreted in our laboratory experiment by using a semi-analytical model and 2D radiation hydrodynamic simulations. [1] B. Remington et al, Rev. Mod. Phys. 78, 755 (2007) [2] D. Ryutov et al, Phys . Plasmas 8, 1804 (2001) [3] Ph. Nicolai et al, Phys. Plasmas 13, 062701 (2007)