Effects of radiative losses on jet propagation and interaction with an ambient medium

Alexander Pelka[1], Alessandra Ravasio[1], Alexandra Diziere[1], Alessandra Benuzzi-Mounaix[1], Michel Koenig[1], Takao Ide[2], Taichi Morita[2], Yasuhiro Kuramitsu[2], Youichi Sakawa[2], Sergey Pikuz Jr.[3], and Erik Blackman[4]

[1]LULI, Ecole Polytechnique, CNRS, CEA, UPMC, Route de Saclay, F-91128 Palaiseau, France
[2]Institute of Laser Engineering, Osaka University, Suita, Osaka 565-0871 Japan
[3]Joint Institute for High Temperatures RAS, 13-2 Izhorskaya st., Moscow, 125412 Russia
[4]Department of Physics and Astronomy , University of Rochester, Rochester, NY, 14627-0171, USA

March 22, 2012

Abstract

In astrophysics, supersonic collimated outflows from gravitating sources are a common occurrence. Despite large amounts of data collected from observing these objects there are still many open questions on both jet launching and propagation. The jet structure has been the subject of several simulations, observations and theories and is thought to be best described as a multicomponent structure, composed of a dense central region surrounded by a thin cocoon, therefore being highly complex. In this context, the possibility to simulate the jet formation using high power lasers bears large potential. A number of

previous experiments have proven successful in developing optimized target geometries for creating jets and investigating various stages of their evolution. In earlier work we focused on testing the jet propagation in an ambient medium. Here we present recent studies dedicated to the investigation of collimating effects. We will consider different processes presumed to play a role in the collimation mechanism. In particular we will discuss the consequences of radiative losses in the jet evolution both with and without ambient medium and the influence of inhomogeneous environments, such as surrounding outflows of different density and composition and quasi-stationary gas flows. Using an ensemble of optical and X-ray diagnostics we can access both the thin outer part of the jet and the denser core, thus achieving an extensive measurement of the jet characteristics.