COLLIMATION AND ACCELERATION OF POYNTING DOMINATED JETS

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The primary observational fact that emerged from studies of a large class of astrophysical objects (quasars, gamma-ray bursts, galactic X-ray sources) is the occurrence of highly collimated, relativistic outflows. According to the most popular model, these jets are driven by rotating magnetic fields anchored in the accretion disk and the central compact object. The energy is initially transferred predominantly in the form of the Poynting flux. It is well known that in Poynting dominated outflows, collimation and acceleration are intimately connected and the acceleration zone spans a large range of scales. I analyze the collimation and acceleration of an externally confined jet in the far zone and show that there are two different collimation regimes. In the first regime, the structure of the flow at any distance from the source is the same as in an appropriate equilibrium cylindrical jet. In the second regime, the pressure of the poloidal magnetic field is negligible small so that the flow could be conceived as composed from coaxial magnetic loops. In different collimation regimes, the acceleration regimes are also different. I discuss how the collimation/acceleration regimes depend on the profile of the confining pressure and also present simple scalings for the terminal Lorentz factor of the flow and the final collimation angle.