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Self-similar analytical model of the plasma expansion in a magnetic field

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The study of hot plasma expansion in a magnetic field is of interest for many astrophysical applications. In order to observe this process in laboratory, an experiment is proposed in which an ultrashort laser pulse produces a high-temperature plasma by irradiation of a small target. In this paper an analytical model is proposed for an expanding plasma cloud in an external dipole or homogeneous magnetic field. The model is based on the self-similar solution of a similar problem which deals with sudden expansion of spherical plasma into a vacuum without ambient magnetic field. The expansion characteristics of the plasma and deceleration caused by the magnetic field are examined analytically. The results obtained can be used in treating experimental and simulation data, and many phenomena of astrophysical and laboratory significance.

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