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On the spherical-axial transition in supernova remnants

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In this communication we derive some first order differential equations which model   the classical and the relativistic thin layer approximations in the presence of a circumstellar medium with a density which is decreasing in the distance z from the equatorial plane. The circumstellar medium is assumed to follow a density profile with z of hyperbolic type, power law type, exponential type or Gaussian type. The first order differential equations are solved analytically, or numerically, or by a series expansion, or by Pad\'e approximant. The initial conditions are chosen in order to model the temporal evolution of SN 1987A over 23 years and others supernova remnants.

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