

## PWNe beyond the free expansion

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It is known that CTA will contribute to the discovery of tens or hundreds of new pulsar wind nebulae (PWNe). Many of them will be beyond the free expansion phase, thus it is necessary to study in detail what is their evolution across this phase. The current one-zone models for PWNe treat the nebulae and the supernova remnant (SNR) as an uniform system and important mismatches appear when we simulate and compare the SNR pressure outside the PWN shell with 1D hydrodynamic (HD) models during the reverberation phase where, after the arrival of the reverse shock, the shocked material of the SNR directly interacts with the PWN shell. We use TIDE, an advanced radiative code, to evaluate the impact of various parameters (properties of the supernova ejecta, inner pulsar and ambient medium) upon the extent of the reverberation phase of PWNe in properties as the starting time of the reverberation phase and how this affects the amount of the compression, and how much of this can be ascribable to the radiation processes. We also provide a new prescription for the SNR shock trajectories, updating the work already done by Truelove & McKee in 1999, with the final aim of providing a new set of semi-analytical equations to model the reverberation phase in one-zone models with 1D-HD-simulations-like accuracy.

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