3D Hydrodynamical Simulations of Nova Ejecta: Pollution of the Companion Star

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Classical novae are cataclysmic binary star systems in which matter from an unevolved star is slowly accreted by a white dwarf companion. When enough mass has been accreted the pressure at the base of its envelope becomes high enough for the ignition of hydrogen, and a thermonuclear runaway occurs. Apart from releasing a large amount of energy in various parts of the electromagnetic spectrum, the nova explosion also results in the ejection of matter, forming an expanding shell around the system. In this study we aim to investigate the evolution of this nova shell to ascertain whether or not the secondary star can be significantly polluted by the ejecta material. To model the expanding shell we use a smooth particle hydrodynamics (SPH) code. The simulation is fully 3D and includes the nova ejecta, the main sequence companion, and the white dwarf (as a gravitational potential). The initial conditions for the nova ejecta are taken from the late stages of a detailed 1D hydrodynamical-nucleosynthetic simulation of the nova outburst on the white dwarf surface. Our very preliminary results show that some matter is accreted by the companion star, as expected, however it remains to be seen if the amount accreted is significant. We also find that the impact of the shell material on the main sequence star envelope enhances mass transfer in the system, so that some ejecta is probably also re-accreted by the white dwarf itself. This will affect the next nova explosion, as the white dwarf surface composition will be altered, especially at low metallicity. We also discuss necessary improvements for our future simulations.