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Spherical Collapse of non-top-hat profiles in the presence of dark energy with arbitrary sound speed

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We study the spherical collapse of non-top-hat matter fluctuations in the presence of dark energy with arbitrary sound speed (c_s). The model is described by a system of partial differential equations solved using a pseudo-spectral method with collocation points. This method can reproduce the known analytical solutions in the linear regime with an accuracy better than 10^{-6} % and better than 10^{-2} % for the classical results of the spherical collapse model. We show the impact of nonlinear dark energy fluctuations on matter profiles and discuss some issues regarding phantom dark energy models. We also compute how dark energy sound speed affects the threshold for collapse and virialization density of halos. We confirm previous results for clustering dark energy $c_s \to 0$ and homogenous dark energy $c_s \to 1$, and extend them to arbitrary values of c_s. Finally, show how the gravitational potential and halo mass functions are impacted by c_s.

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