Interacting dark matter and modified holographic Ricci dark energy induce a relaxed Chaplygin gas

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We investigate a model of interacting dark matter and dark energy given by a modified holographic Ricci cutoff in a spatially flat Friedmann-Robertson-Walker (FRW) space-time. We consider a nonlinear interaction consisting of a significant rational function of the total energy density and its first derivative homogeneous of degree one and show that the effective one-fluid obeys the equation of state of a relaxed Chaplygin gas. So that, the universe is dominated by pressureless dark matter at early times and undergoes an accelerated expansion in the far future driven by a strong negative pressure. We apply the χ^{2}-statistical method to the observational Hubble data and the Union2 compilation of SNe Ia for constraining the cosmological parameters and analyze the feasibility of the modified holographic Ricci cutoff. By using the new Om diagnostic method, we find that the effective model differs substantially from the Λ--CDM one, because it gets the accelerated expansion faster than the Λ--CDM model. Finally, a new model with a third component decoupled from the interacting dark sector is presented for studying bounds on the dark energy at early times.

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