Constraints on interacting dynamical dark energy

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$$T_{\mu\nu} = \frac{-2}{\sqrt{-g}} \frac{\delta S_X}{\delta g^{\mu\nu}} = (\rho + p) U_\mu U_\nu + p g_{\mu\nu}$$

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$$\nabla_\mu T^\mu_\nu = \nabla_\mu \sum_i (T_i)^\mu_\nu = 0$$

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$$\nabla_\mu T^\mu_0 = 0 \Rightarrow \dot{\rho} = -3\frac{\dot{a}}{a}(1+w)\rho$$

observables:

$$H \equiv \frac{\dot{a}}{a}\ ,\ q \equiv -\frac{\ddot{a}}{aH^2}\ ,\ j \equiv \frac{\dddot{a}}{aH^3}$$

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Friedmann equations

$$\sum_{i=1}^{4} \Omega_i = 1$$

$$q = \frac{1}{2}(1 + 3\sum_{i=1}^{4} w_i \Omega_i)$$

$$\left(\rho_{curv} \equiv \frac{-3k}{8\pi G a^2}\right)$$

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$$j = 1 + \frac{9}{2} w_{DE}(1 + w_{DE})\Omega_{DE} \ ; \Omega_{rad} \simeq 10^{-3}\Omega_{mat}$$

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DE- matter (baryonic and/or dark)
DE- radiation
DE-DE

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same as for $\dot{w}_{DE} = Q_{DE} = 0$

Main result:

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NB: general result, based only on Friedmann equations, $\nabla_\mu T^\mu_\nu = 0$ and $p_i = w_i \rho_i$

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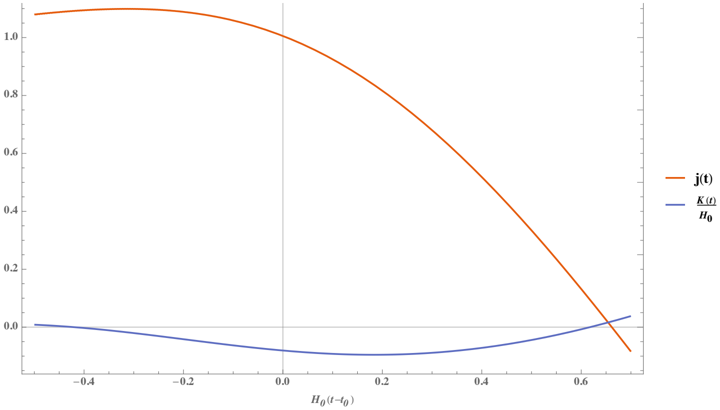
independent of $j \neq 1$
interesting case: $j = 1$ but $K \neq 0$


1.0
0.8
0.6
0.4
0.2
0.0
−0.4
−0.2
0.0
0.2
0.4
0.6
H0 (t−t0)
j(t)
K(t)
H0

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1

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2. constraint on the parametrizations for $w_{DE}(t)$ and $Q_{DE}(t)$
$$\left(\begin{array}{c} w_{DE} = w_0 + w_a(1-a) \\ Q_{DE} = \gamma H \rho_{DE} \end{array} \right)$$