DBI models for the unification of dark matter and dark energy

Work in collaboration with L.Chimento and R.Lazkoz.
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  - Dark matter and dark energy are not detected directly, their nature is still under investigation.
  - The problem would be simplified if they were two manifestations of the same fluid.

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- $\phi(a) \to p(a)\,,\ \rho(a)$.

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The background happens to mimick that induced by the joint contribution of a Chaplygin gas and a cosmological constant.

Novelty: behavior realized with a single fluid!

Linear Perturbations

In synchronous gauge

$$\delta' = -(1+w)\left(\theta + \frac{h'}{2}\right) - 3\mathcal{H}(c_s^2 - w)\delta \qquad \theta' = -\mathcal{H}(1-3c_s^2)\theta + \frac{c_s^2}{1+w}k^2\delta$$

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    - High energy modes $\left(k^2/\mathcal{H} \gg 1\right)$: Perturbation decreases asymptotically: $\lim_{t\to+\infty} \delta \approx 0$, becomes negligible as Universe becomes dominated by vacuum energy.

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Friedman equation

$$\frac{H^2}{H_0^2} = \sqrt{\Omega_f^2 + \Omega_c^2(1+z)^6} + \Omega_\Lambda + \Omega_r(1+z)^4$$

$\sim \Omega_m$ high energy regime

with $\Omega_f = \frac{1}{3H_0^2 f_0}$, $\Omega_\Lambda = \frac{f_0 V_0 - 1}{3H_0^2 f_0}$, $\Omega_r = \frac{\rho_{r0}}{3H_0^2}$ and $\Omega_c = \frac{c}{\sqrt{f_0} 3H_0^2}$.

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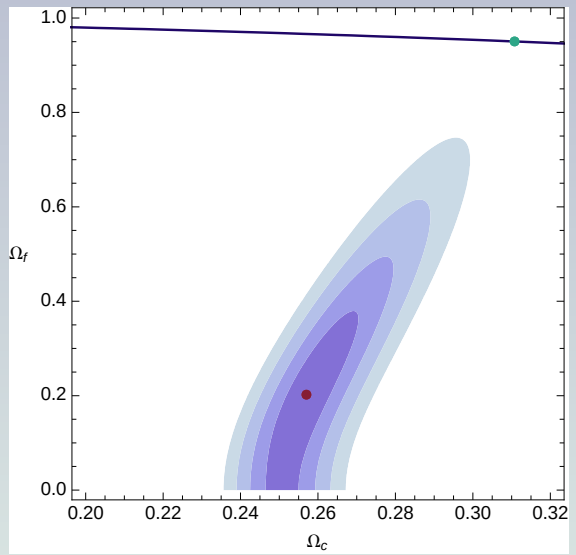

Contour plot with ESSENCE sample. Best values:

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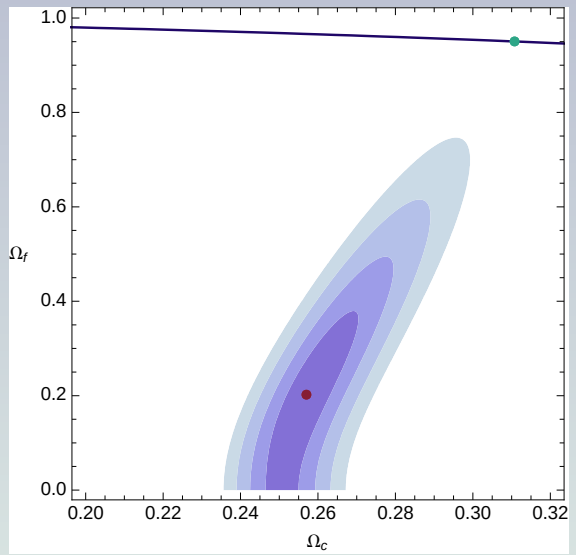

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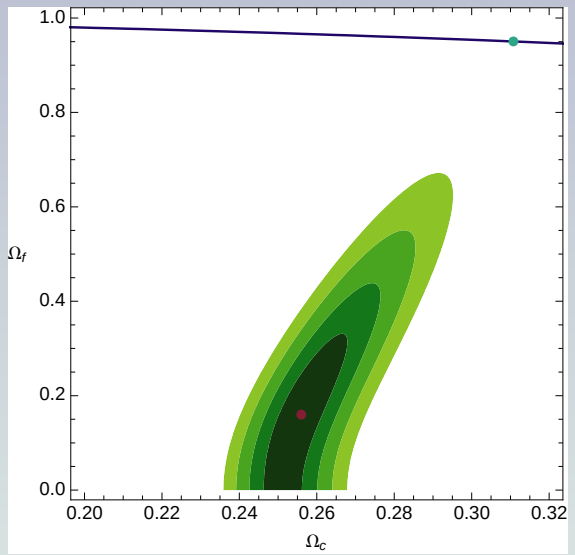

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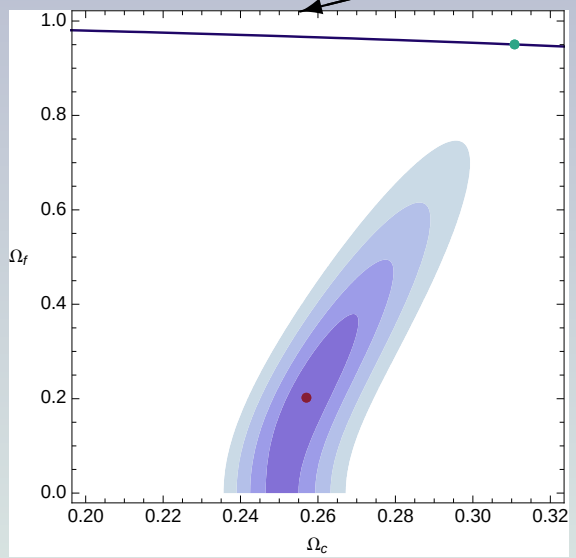

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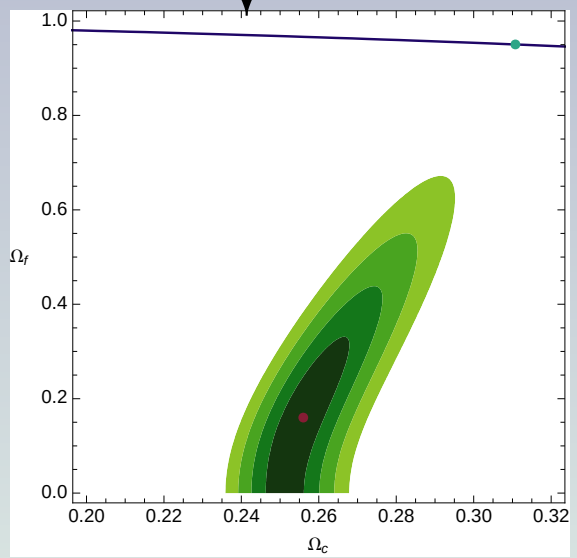

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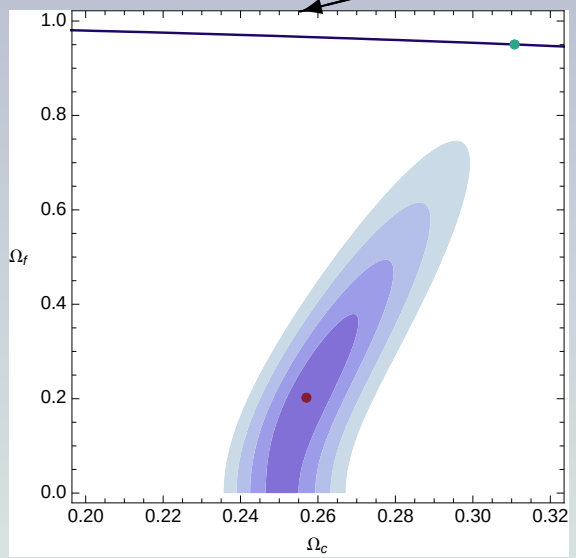

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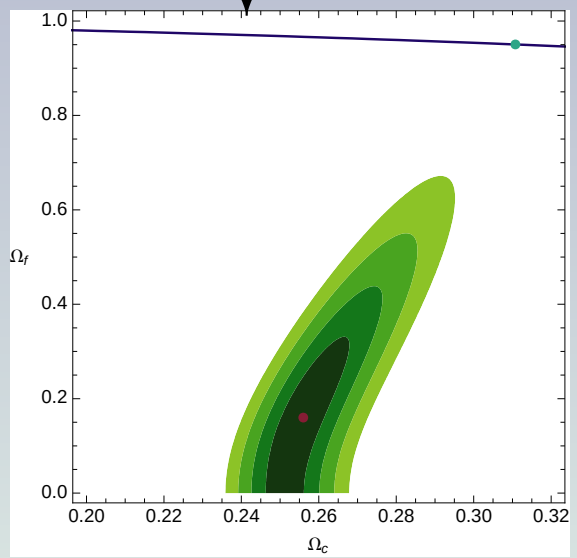

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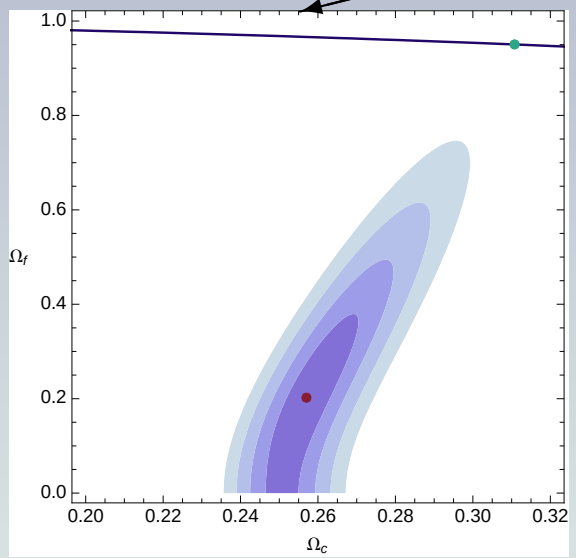

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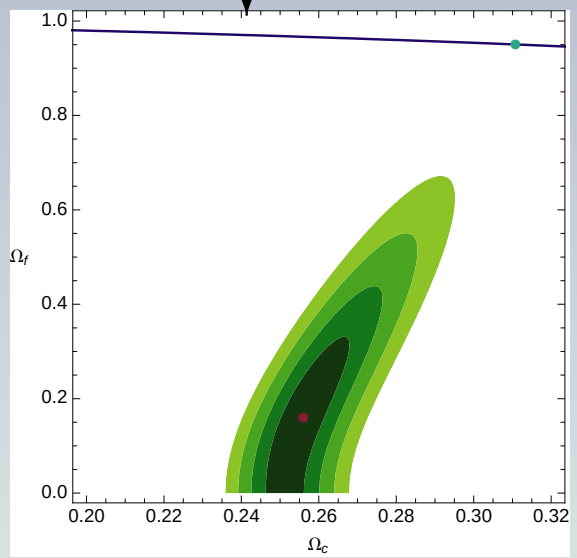

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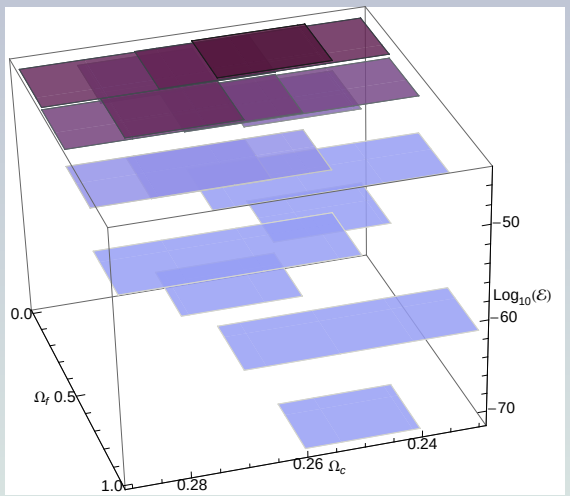

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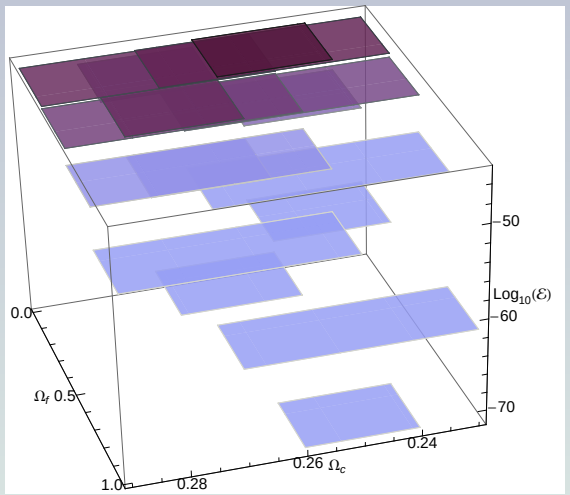

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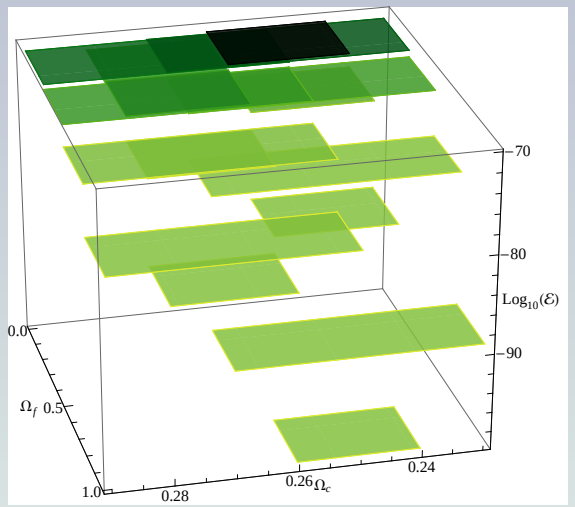

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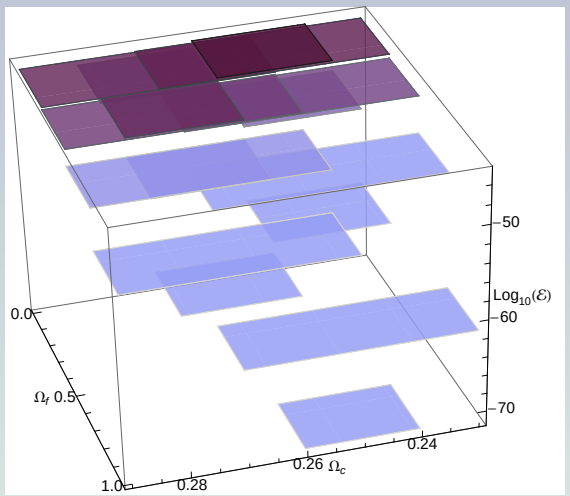

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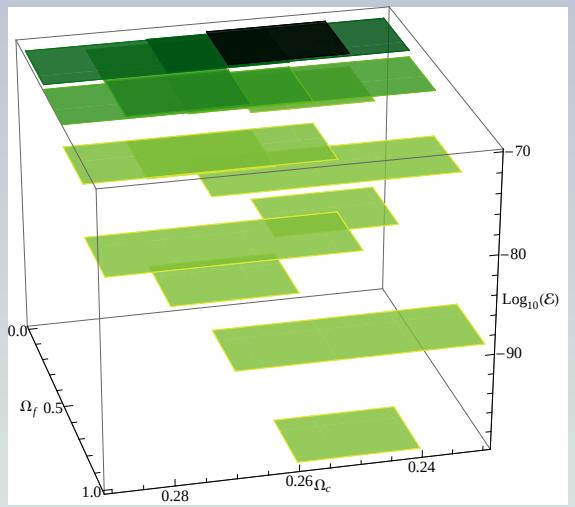

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- Redshift dependence of the effective equation of state parameter.

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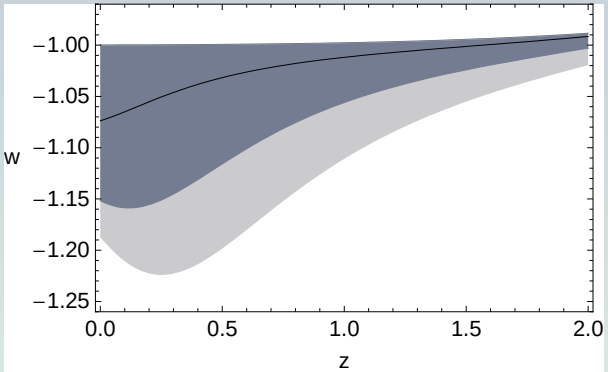

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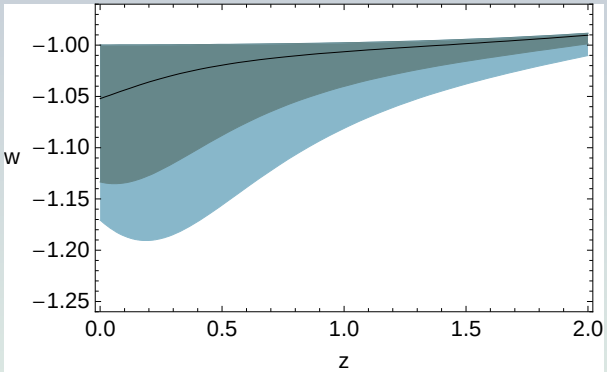

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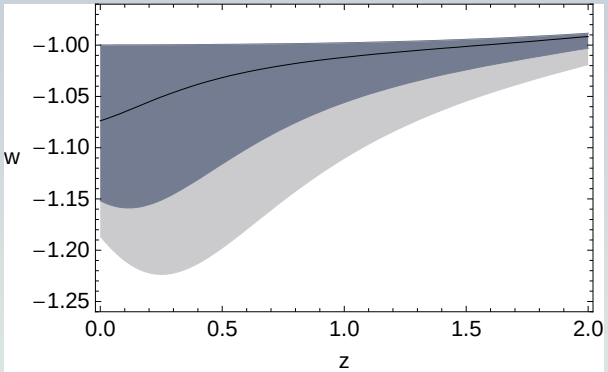
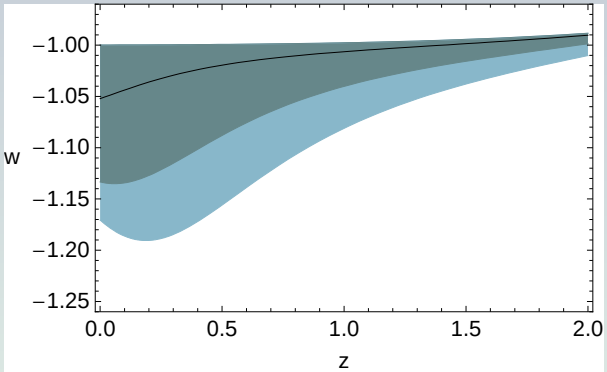
$$w(z) = \frac{\frac{2}{3}\frac{d\ln H}{dz}(1+z)-1}{1-\left(\frac{H_0}{H}\right)^2\Omega_c(1+z)^3}$$



ESSENCE dataset.



UNION dataset.

- The current observational data restricts it: $w(z) \leq -1$, with $\frac{dw(z)}{dz}|_{z=0} > 0$.

Model kinematics
Acceleration parameter

$$q(z) = \frac{3}{2}\left(1 - \frac{\Omega_c(1+z)^3}{H^2}\right) w(z) + \frac{1}{2}$$

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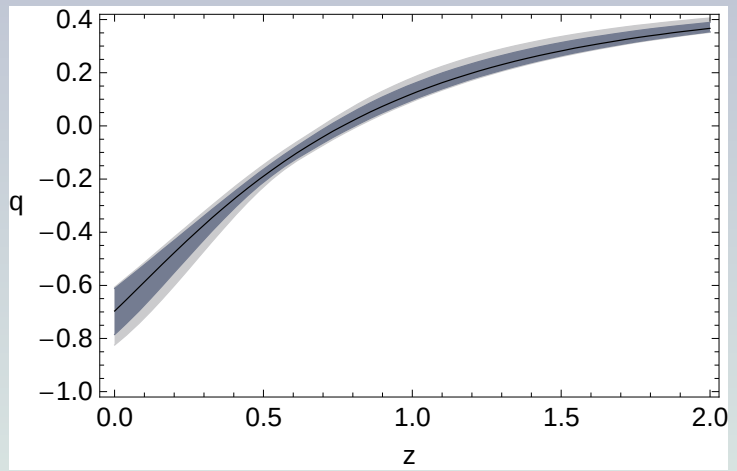
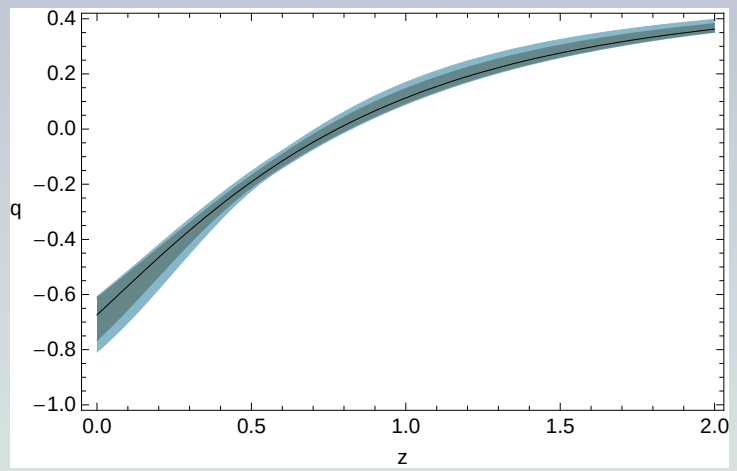


$q_{eff}(z)$ with ESSENCE sample.



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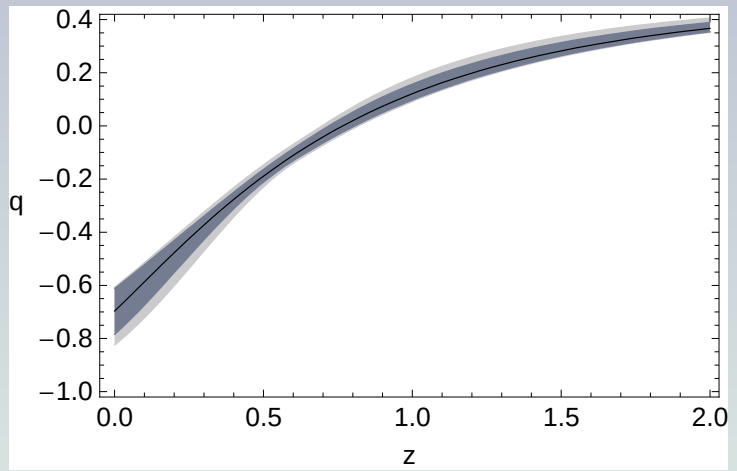

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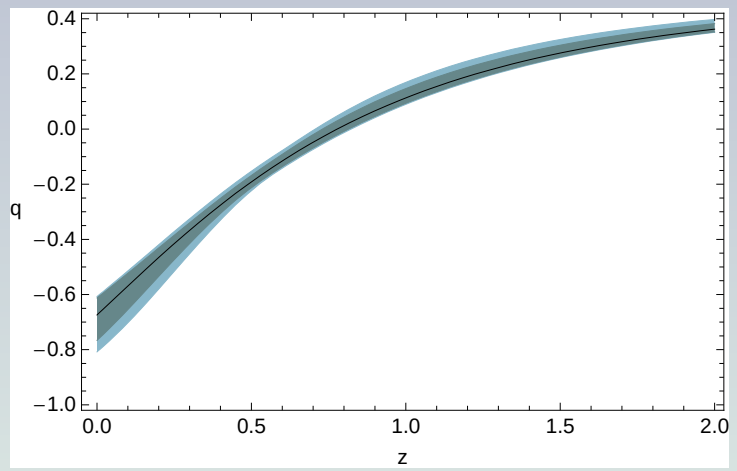

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- Strong evidence of deceleration-acceleration transition $\xrightarrow{allows}$ infer transition redshift.

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Transition redshift

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- Approximations are not good for accounting the tendency of our DBI fluid to induce a phantom stage.

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  - is better suited to observations than the Chaplygin gas.
  - present a phantom behavior without and explicit component in the model.
  - in the future can be explored to its generalization.