TACHYON-DOMINATED COSMOLOGY: STATUS UPDATE

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A Friedmann-Robertson-Walker spacetime with contents dominated by a gas of tachyonic particles undergoes expansion with inflection (cosmic jerk) and acceleration similar, but not identical, to that of dark-energy-dominated models. The testing of such a tachyonic model against observation, as an alternative to the standard model, is under way. Fitting the model to redshift and distance data for several thousand Type Ia supernove yields values for such quantities as the Hubble parameter and the age of the universe again similar, but not identical, to standard-model results. Testing the model via features of the cosmic microwave background, and other observations, is in progress at this time.

I. Yes, there is such a thing (Martin & Redmount, arXiv: 1904.07316, Starke & Redmount, arXiv: 1905.13557)
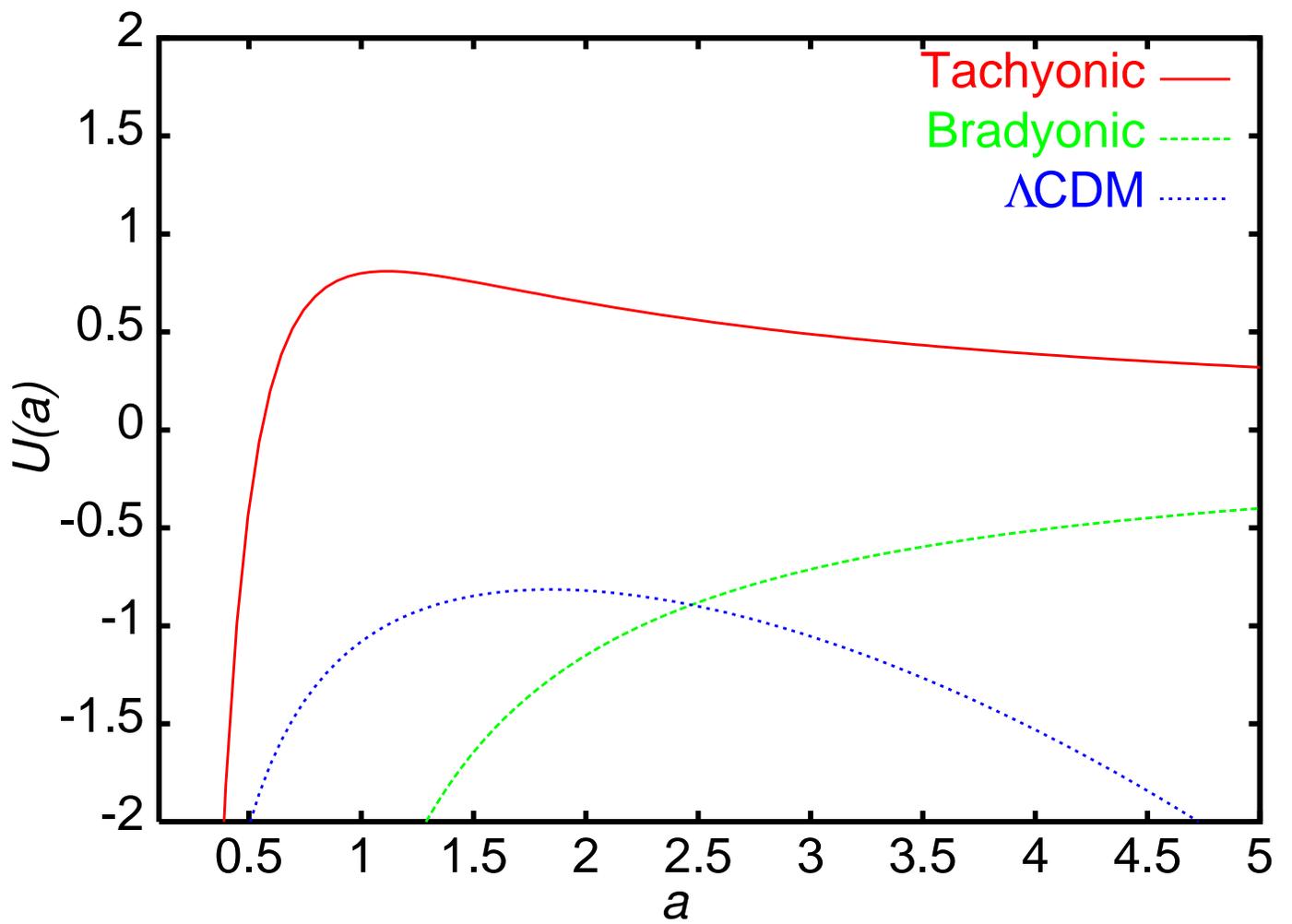
II. Tachyonic equation of state

    A. Equation of state:

$$P = \frac{1}{3}(\rho + \mu c^2 n)$$

$$\Rightarrow \qquad \rho(a) = \frac{(\rho_0 + \mathcal{M}_0)a_0^4}{a^4} - \frac{\mathcal{M}_0 a_0^3}{a^3}$$

B. Friedmann equation "potential energies"
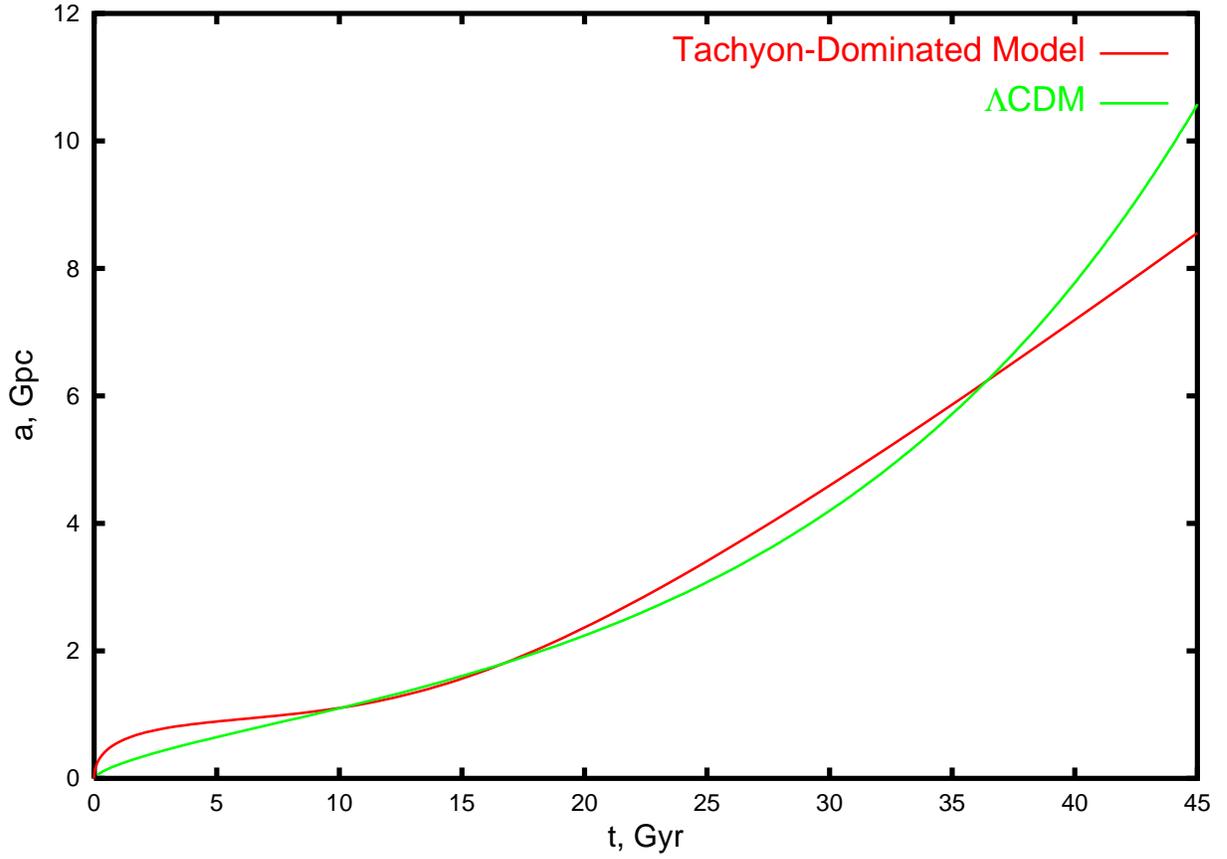
$$U(a) = -\frac{8\pi G \rho a^2}{3c^4}$$

III. Open $(k = -1)$ tachyon-dominated model:
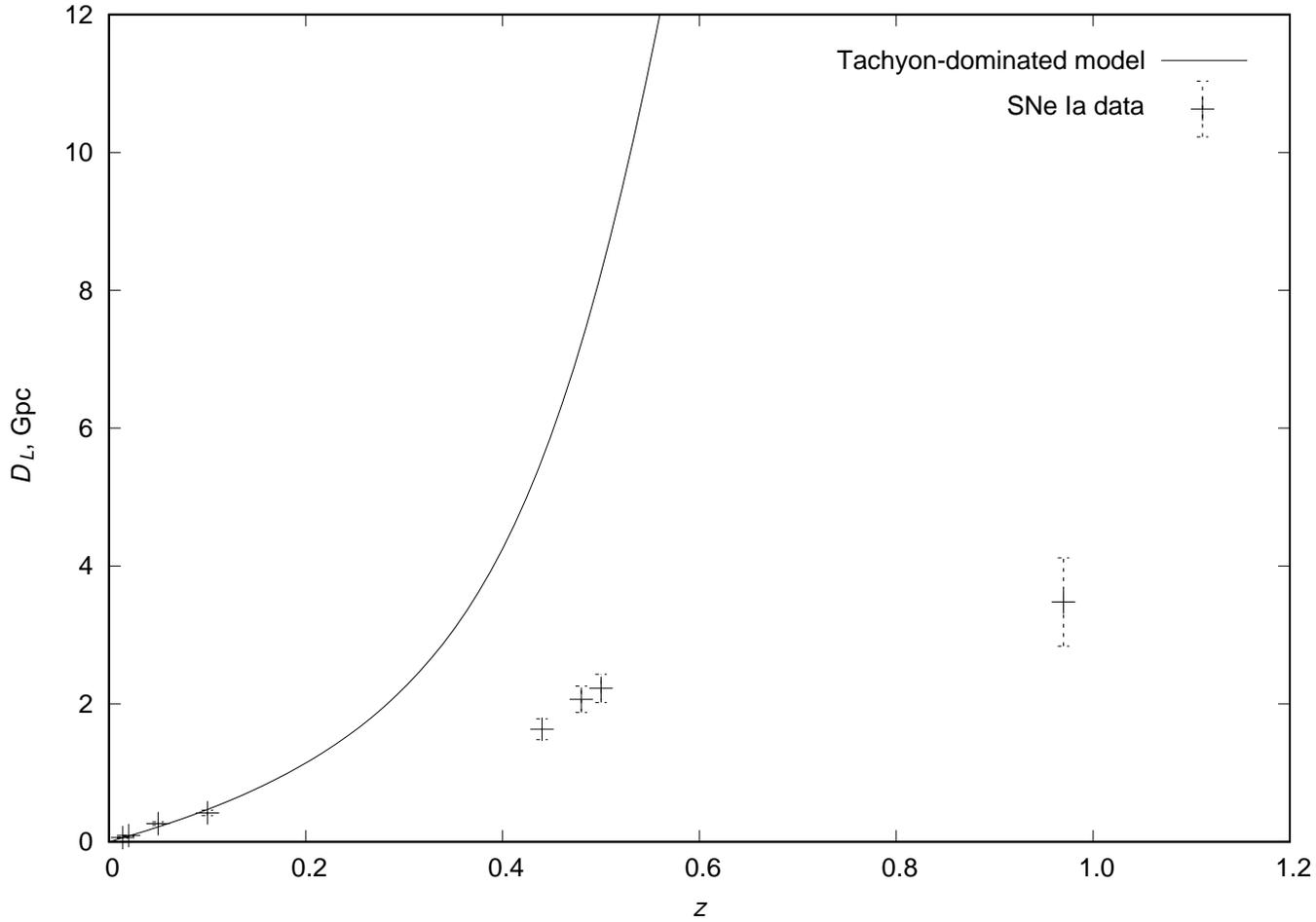
A. Evolution

$$a(\eta) = A \sinh \eta - B (\cosh \eta - 1)$$

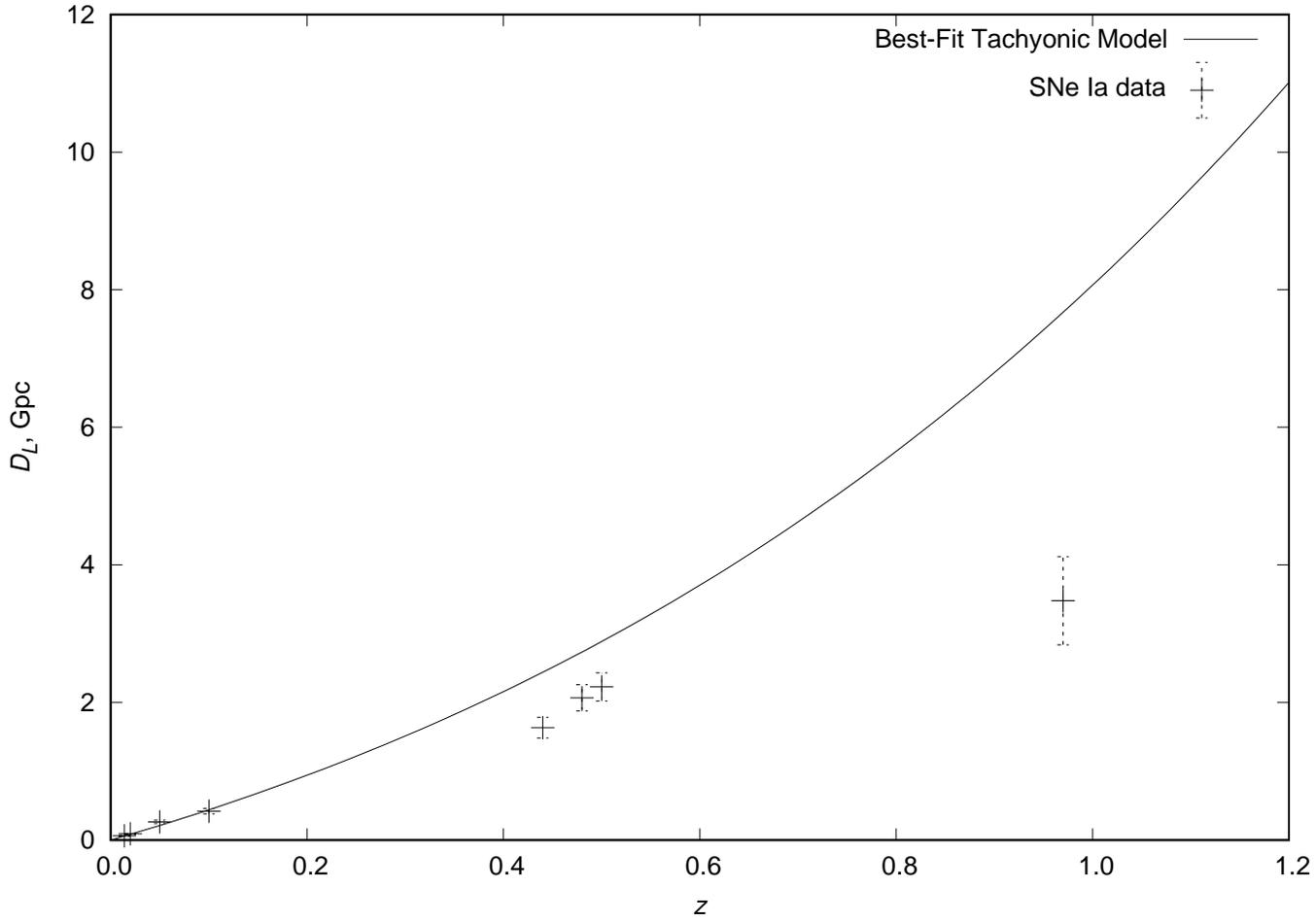$$t(\eta) = A (\cosh \eta - 1) - B(\sinh \eta - \eta)$$

B. Distance-redshift relation

$H_0 = 71.7$ km/s/Mpc, $t_0 = 1.37 \times 10^{10}$ yr, $z_j = 0.500$; Data from Garnavich *et al, Ap. J. Lett.* **493,** p. L53 (1998).
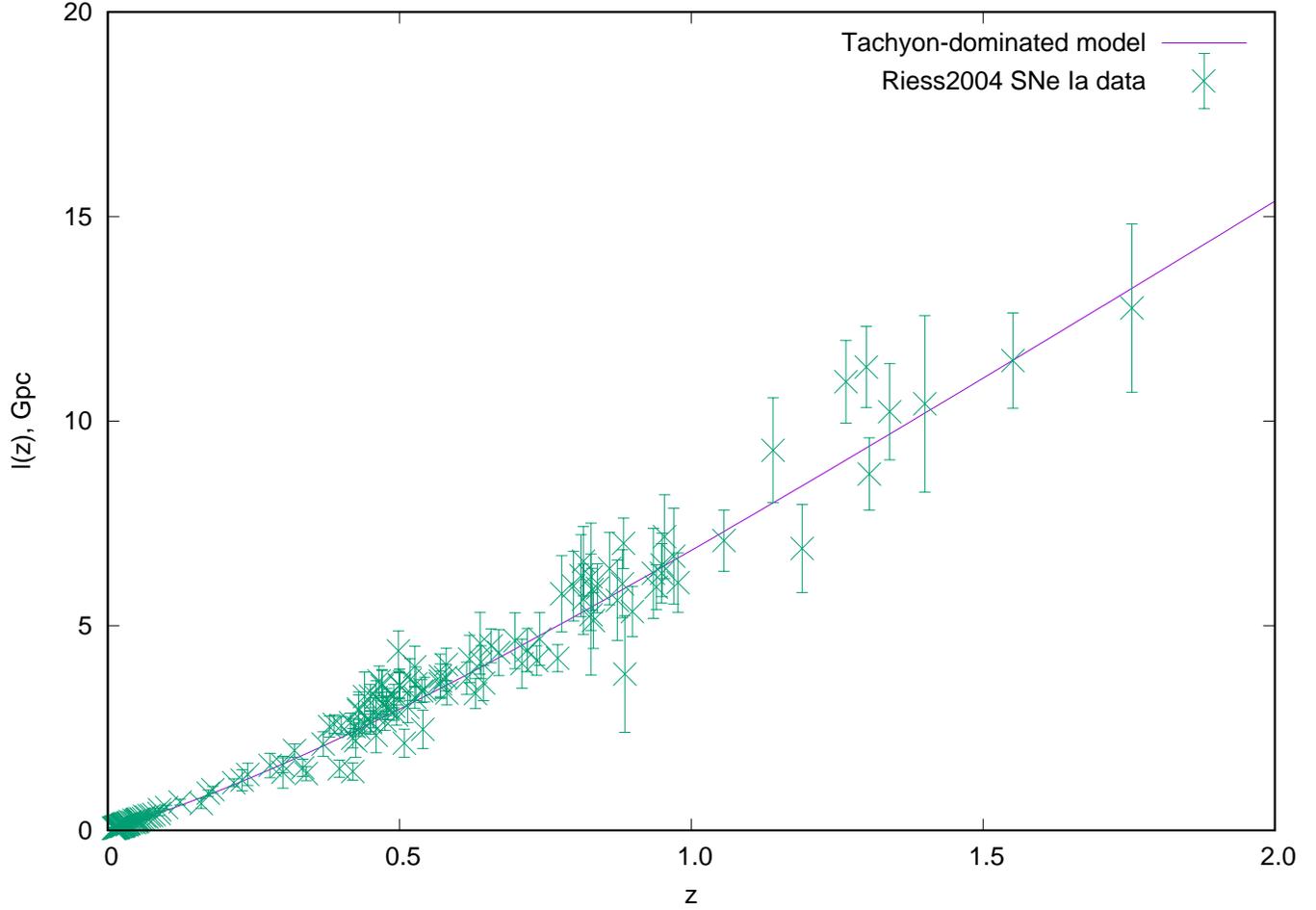
C. Model fitted to SNe Ia data:

$$H_0 = (64.8 \pm 3.9) \text{ km/s/Mpc}$$
$$t_0 = (13.5 \pm 3.0) \text{ Gyr}$$
$$z_j = 0.954 \pm 0.885$$

IV. Fitting to available SNe Ia data sets: Kramer and Redmount, in progress

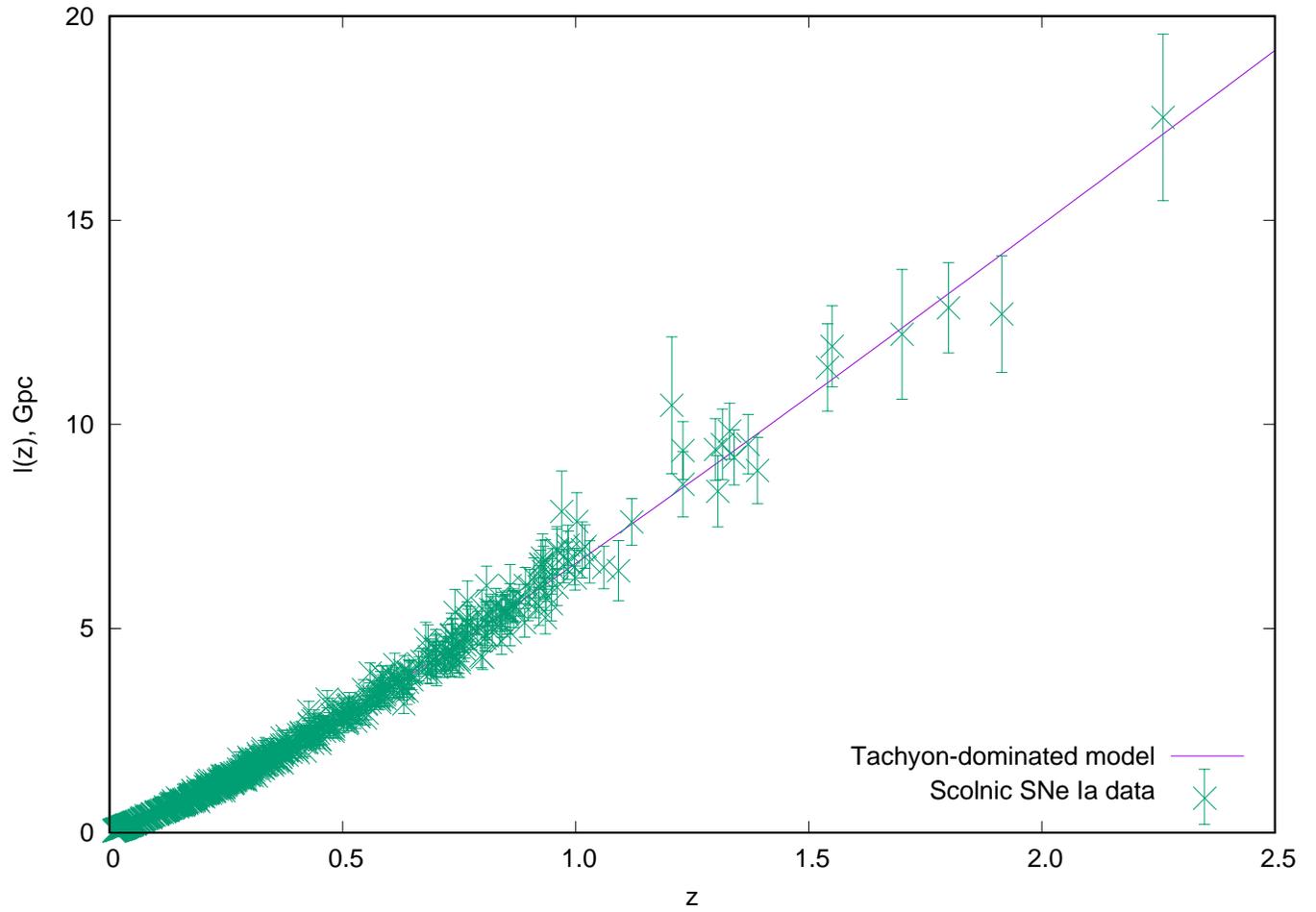A. Riess *et al,* Ap. J. (2004), 186 SNe

$$H_0 = (66.6 \pm 1.5) \text{ km/s/Mpc}$$
$$t_0 = (8.3 \pm 0.7) \text{ Gyr}$$
$$z_j = 0.10 \pm 0.06$$
$$\chi^2/\text{DOF} = 2.57$$

B. Scolnic *et al*, Ap. J. (2018), 1048 SNe

Tachyon-dominated model
Scolnic SNe Ia data

$$H_0 = (69.6 \pm 0.4) \text{ km/s/Mpc}$$
$$t_0 = (8.2 \pm 0.4) \text{ Gyr}$$
$$z_j = 0.12 \pm 0.01$$
$$\chi^2/\text{DOF} = 1.99$$