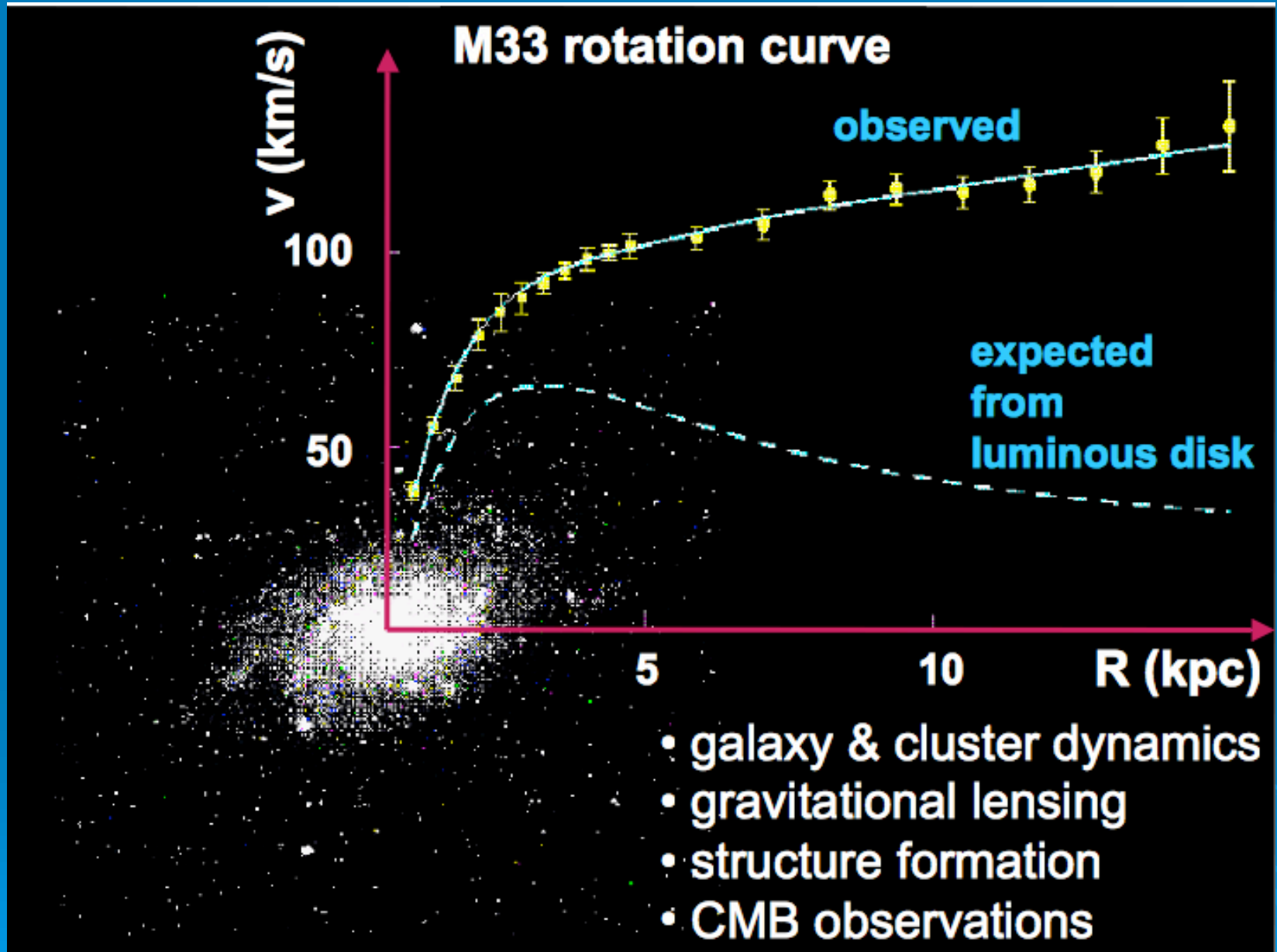


Standard Big Bang

- Not adequate
 - Four plus Problems
 - Missing mass
 - New Standard Candle
 - Horizon
 - Exotic particles
 - Age

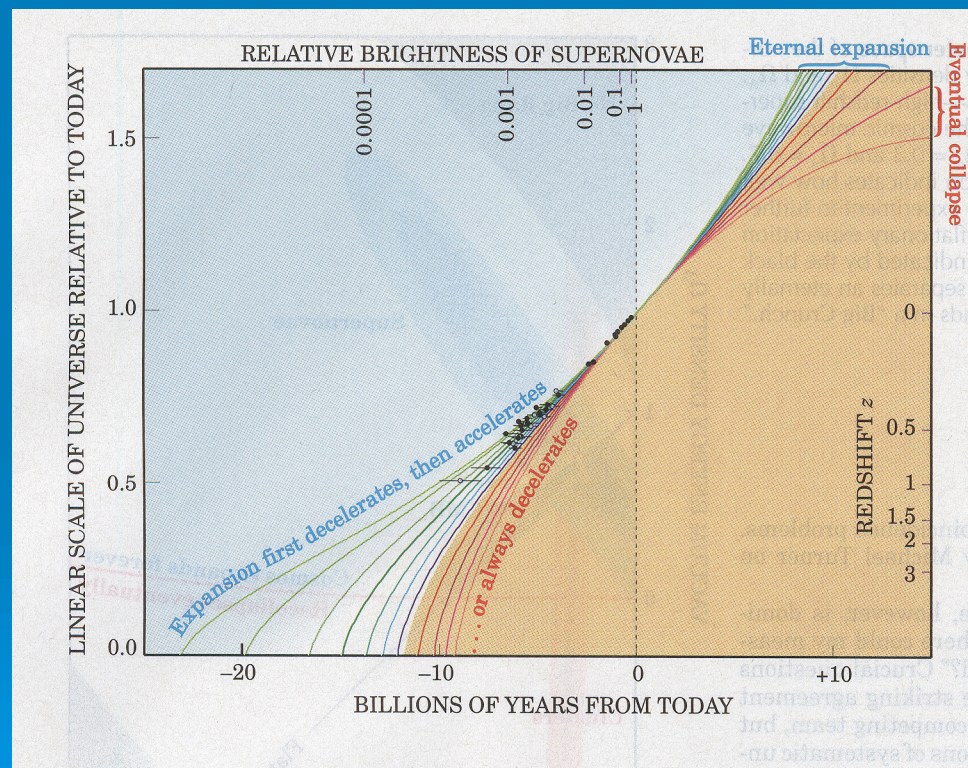
Missing Mass

- Goes back to Einstein
 - He wanted a collapsing universe
- Luminous matter $\Omega_{Lum} \approx 0.01$
- Galaxies $\Omega_{Gal} \approx 0.1$
- Clusters of galaxies $\Omega_{clus} \approx 0.2$

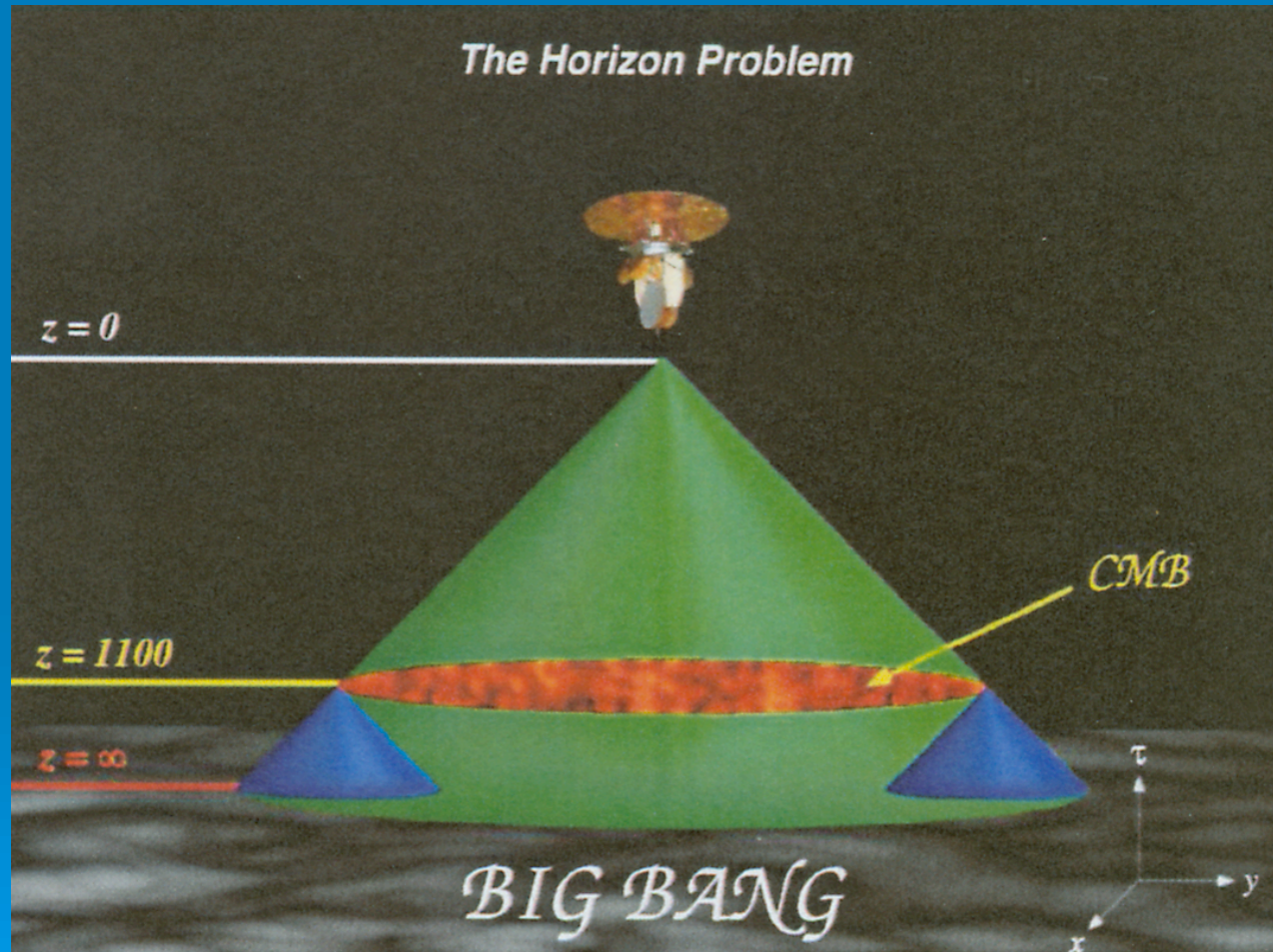


New Standard Candle

➤ Recalibration of Type 1a Supernovae



Horizon Problem



The Horizon Problem

Uniform!
 $\Delta T/T \sim 10^{-5}$



The Age Problem

- Some Globular Clusters are 12 billion years old.
 - Best age for the universe from expansion is 8.9 billion years old

Two Solutions

- Inflation
 - Implied by particle physics
- A Cosmological Constant