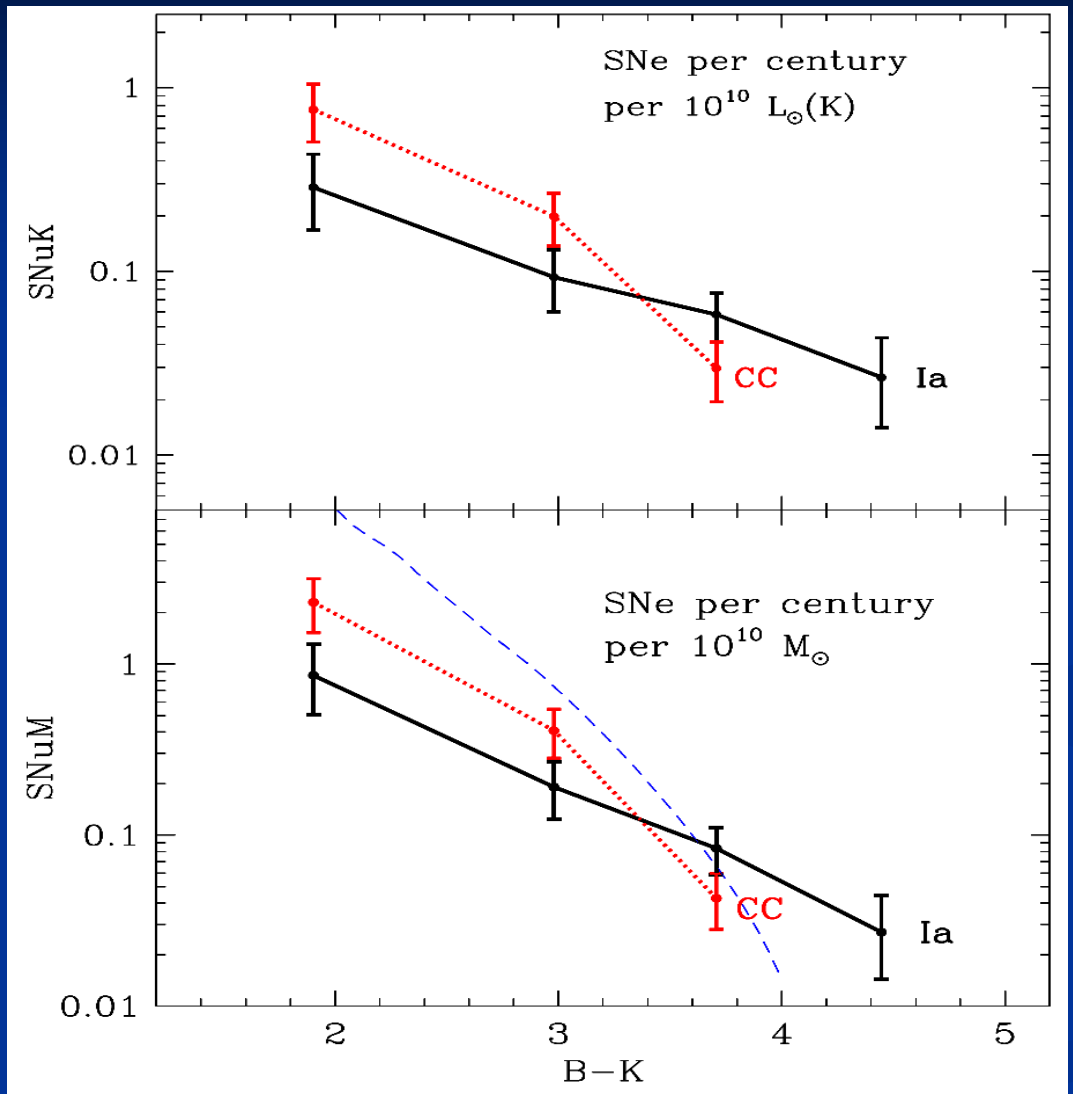
The Type Ia Supernova Rate

Evan Scannapieco
KITP, UC Santa Barbara

Ia Rate Per Unit Stellar Mass



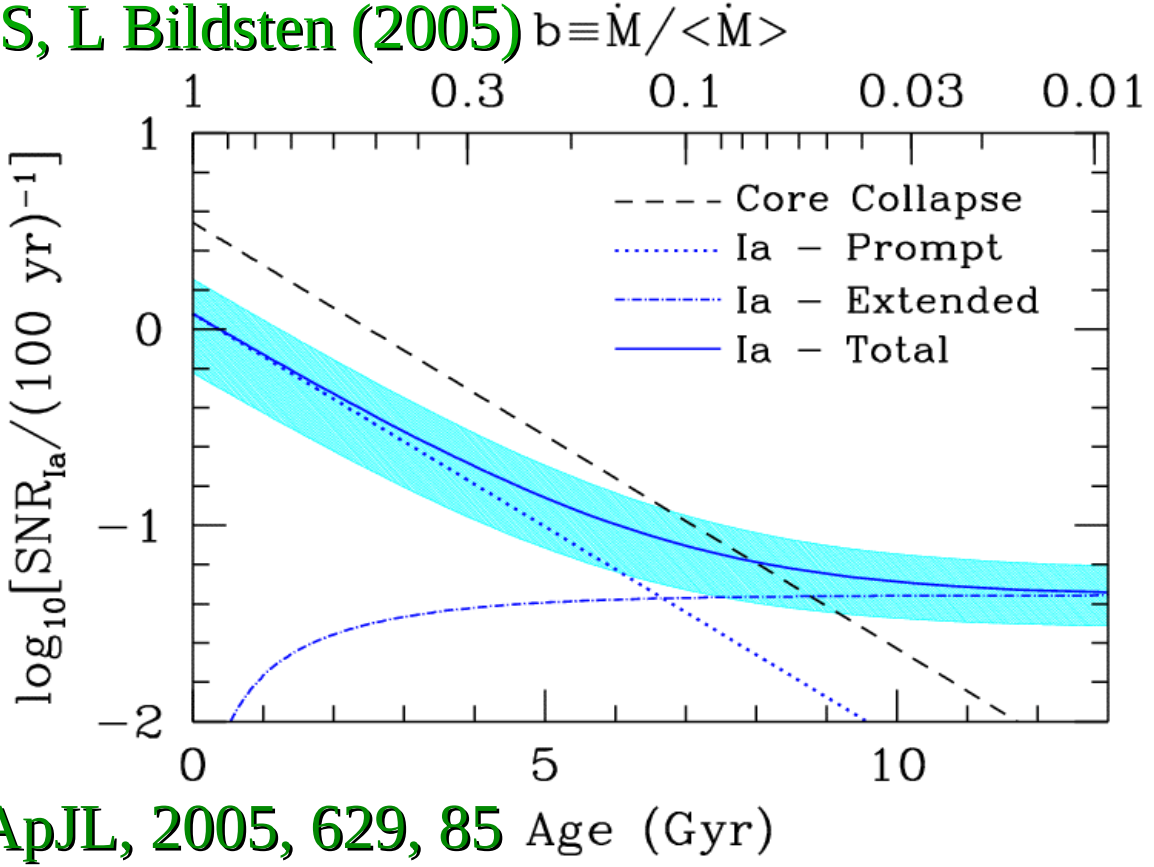
- 2MASS K magnitudes were used to determine the stellar mass
- previous work was in using B, rather than K, to measure the rate
- Data can be "fit" with a simple law of one term that depends on the mass and another that is 40% of the core collapse rate (type II)

F. Mannucci M. Della Valle, N. Panagia, E. Cappellaro, G. Cresci, R. Maiolino, A. Petrosian, M. Turatto (2005)

Two Component Fit

$$\text{Ia rate} = \# \times Mass + \# \times SFR$$

ES, L Bildsten (2005)



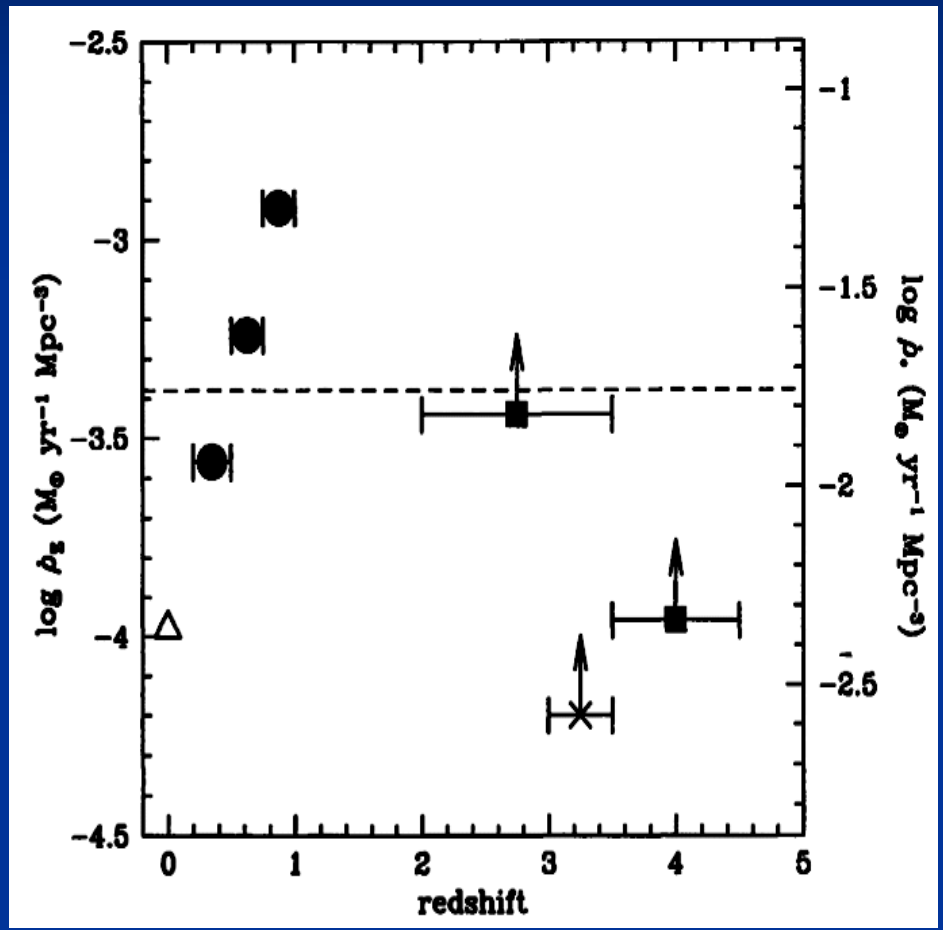
ApJL, 2005, 629, 85

Prompt dominate if b < 0.1

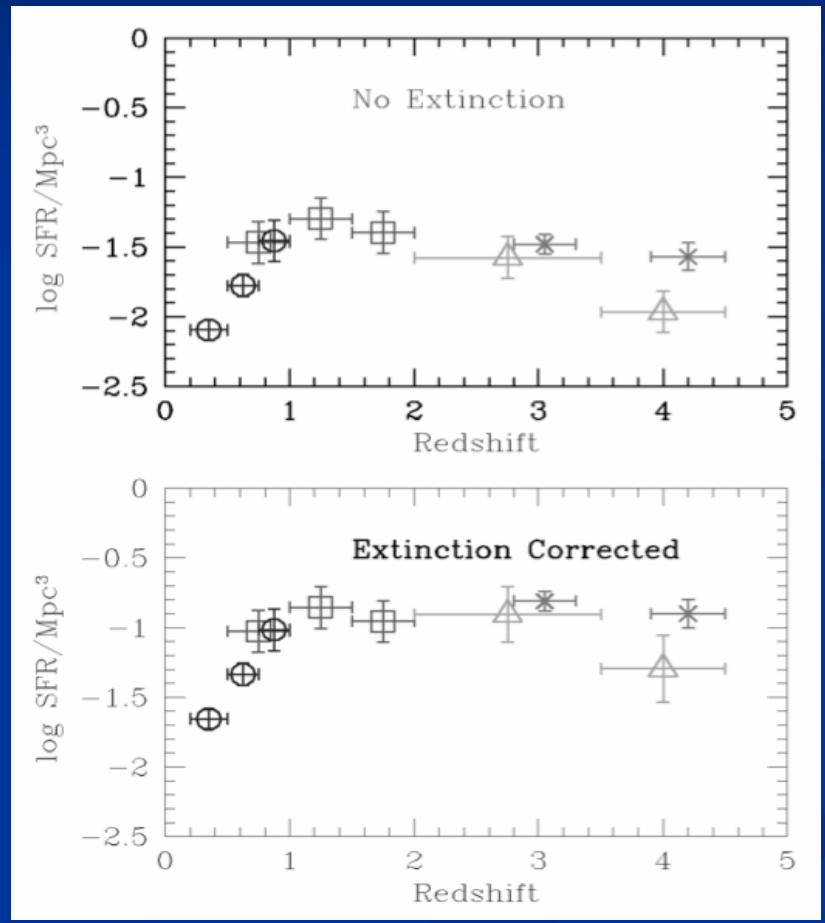
Prompt ALWAYS dominate integral (Metals)

SFR(t)= $M_{gas}(t)/\tau$ $\tau = 2$ Gyrs

The cosmic star formation rate



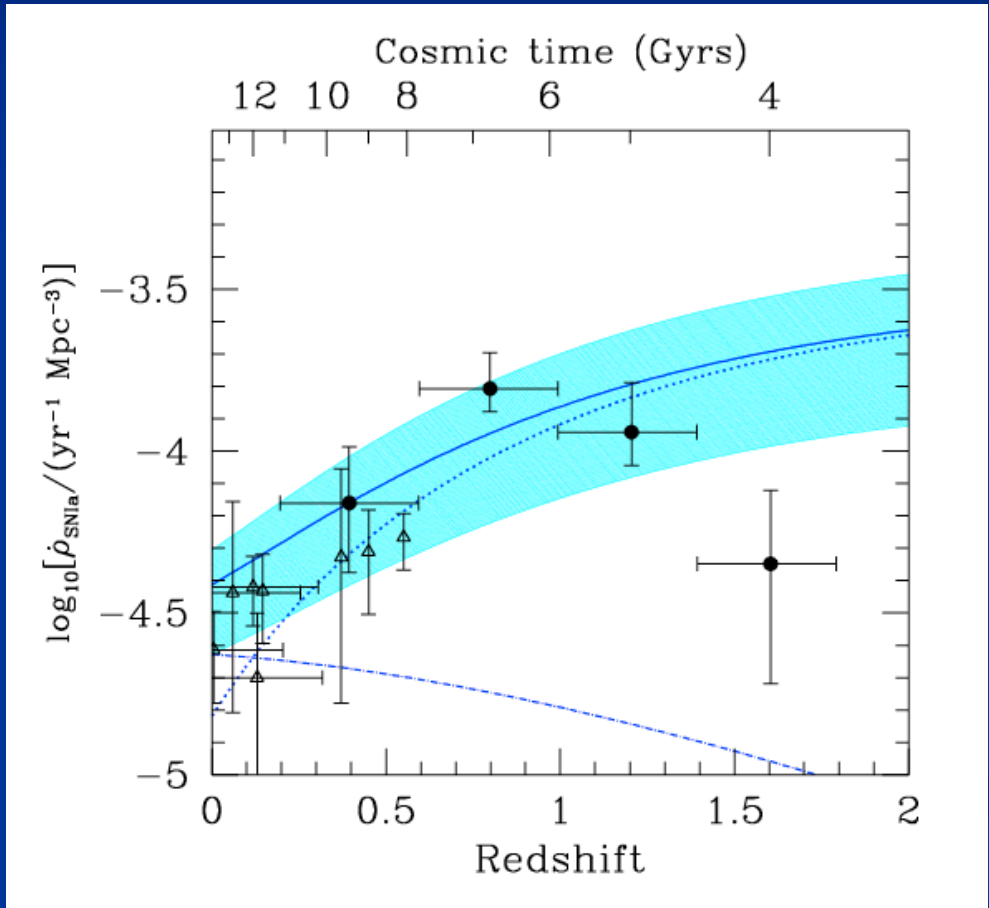
Madau et al (1996)



Steidel et al (1999)

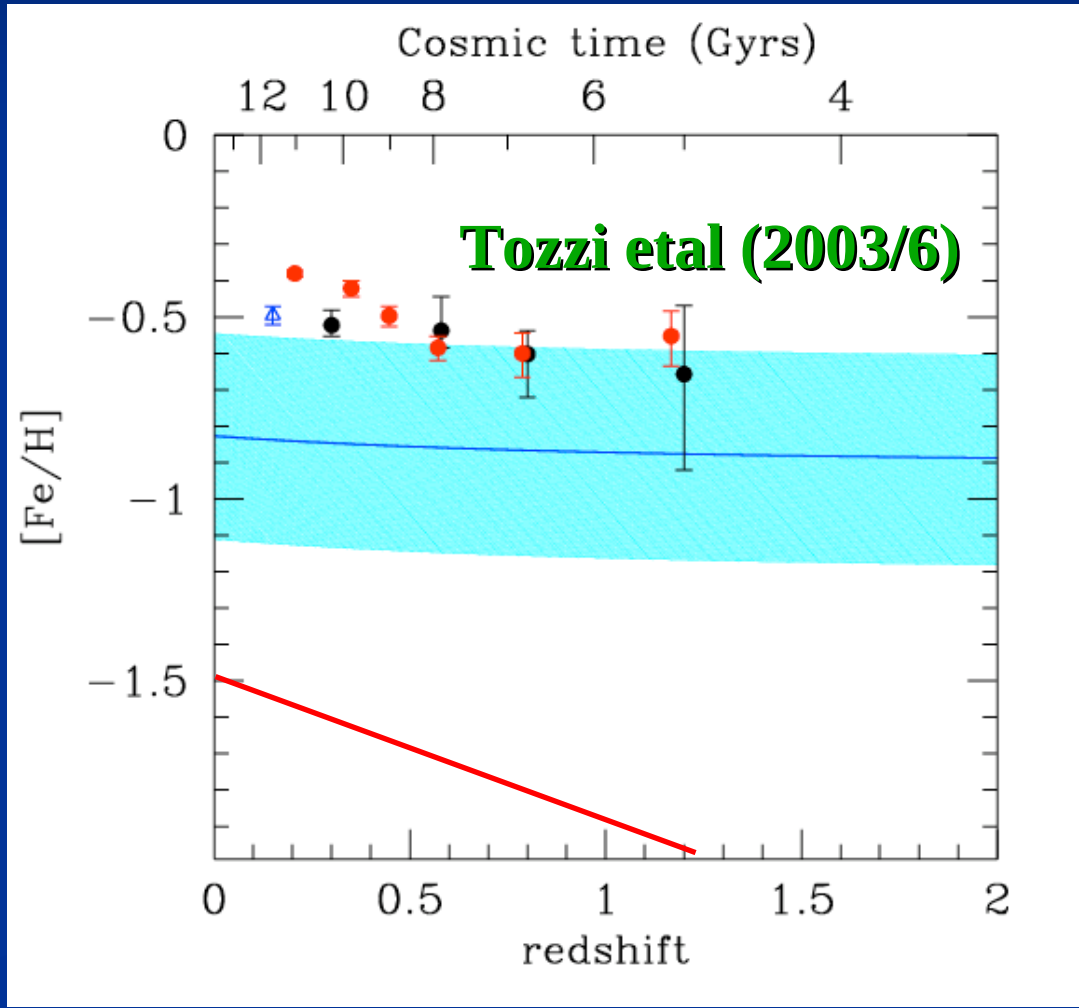
Cosmic Rate

Can’t match the high redshift point with this fit….



Cluster Enrichment

Gets high level of [Fe/H]
in clusters (see Renzini 2003)
As well as constancy with z



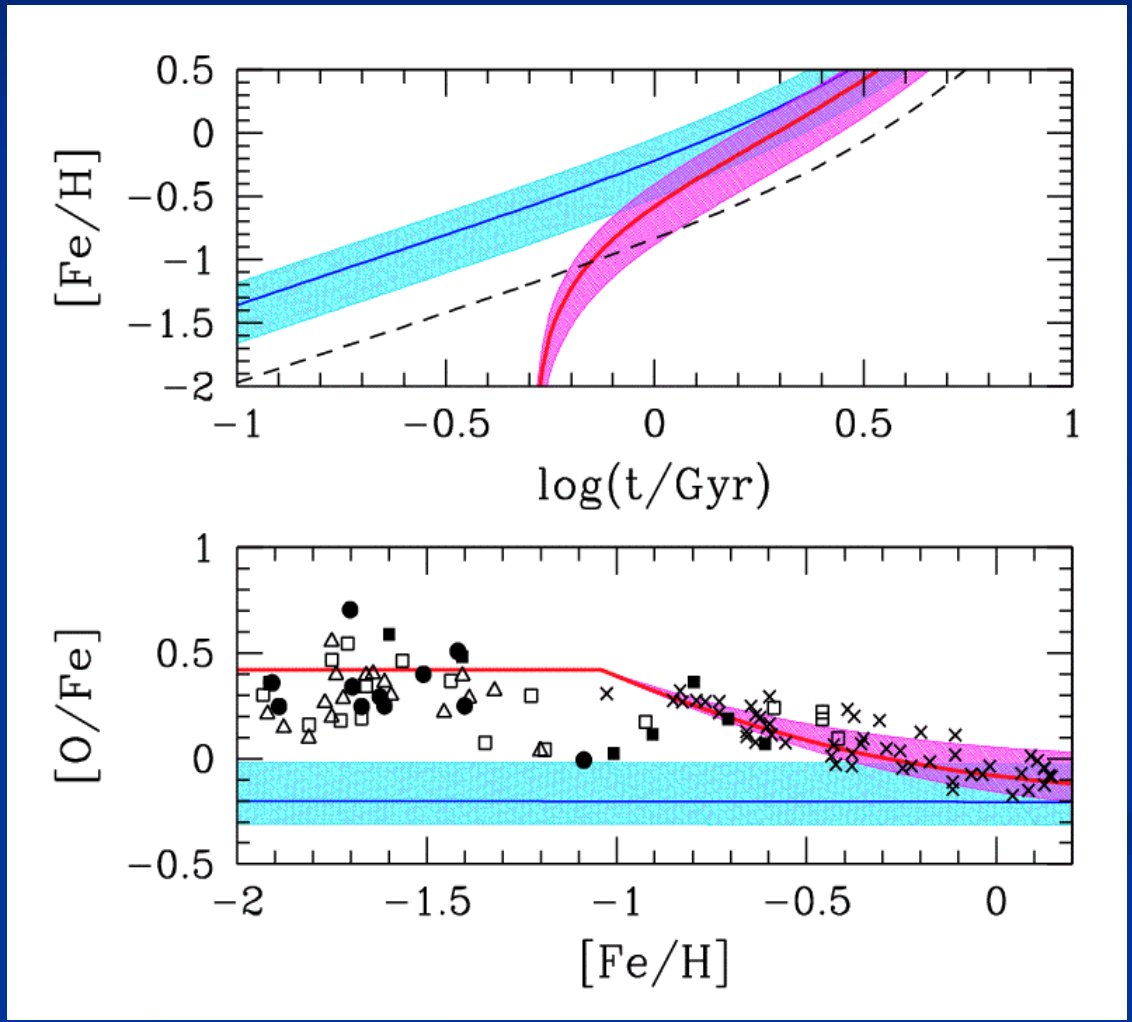
Halo Stars

$SFR(t)=M_{gas}(t)/\tau$

$\tau = 2$ Gyrs

Short delay of ~1/2 Gyr

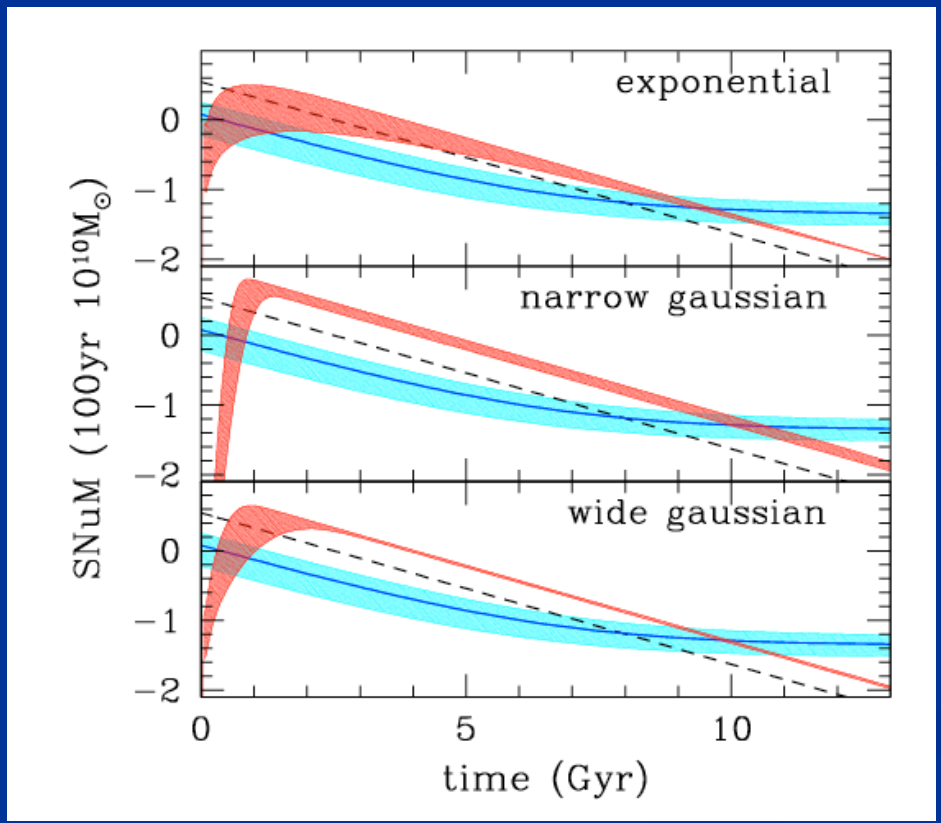
Scales with HALO SFR

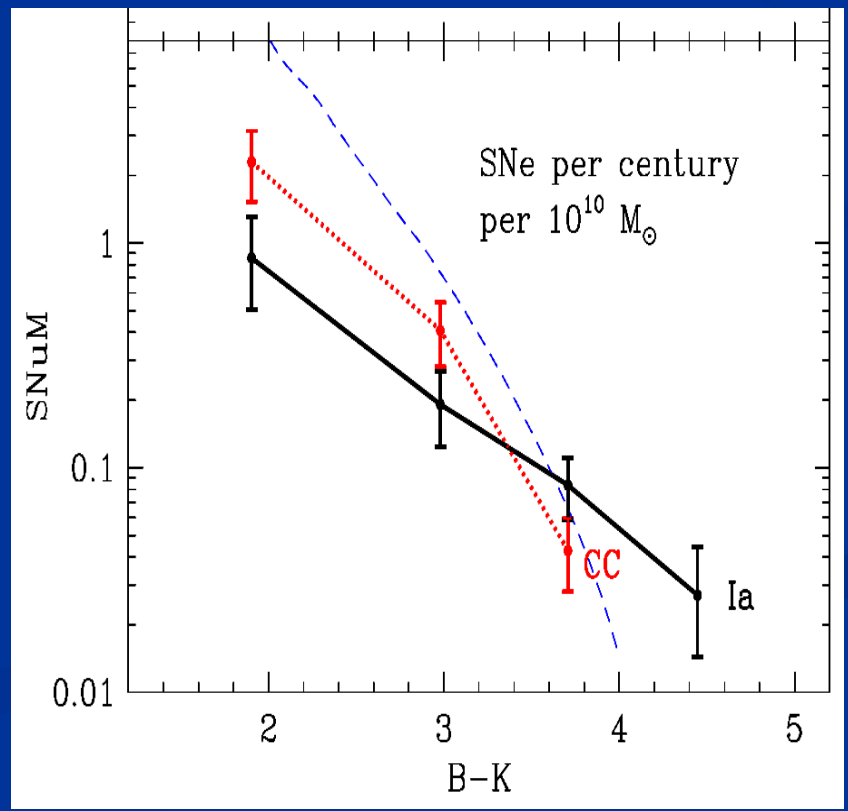


Standard single-component “Fits”

delay function

$$\mathrm{SNR_{Ia}(t)} = \int \Delta t\, \mathrm{SFR}(t - \Delta t)\Phi(\Delta t)$$





Conclusions

- Single-component models for Ia rates do not fit the local data… CHECK THE CC/Ia Ratio!
- A simple 2 component model (SFR, Stellar Mass) does work…
- Cluster iron enrichment CHECK Cluster Fe
- You do need a (short) delay…. (Alpha/Fe ratios)
- Observations constraining Ia's on small time scales (spiral arms, correlation with radio jets, etc.) are still important.

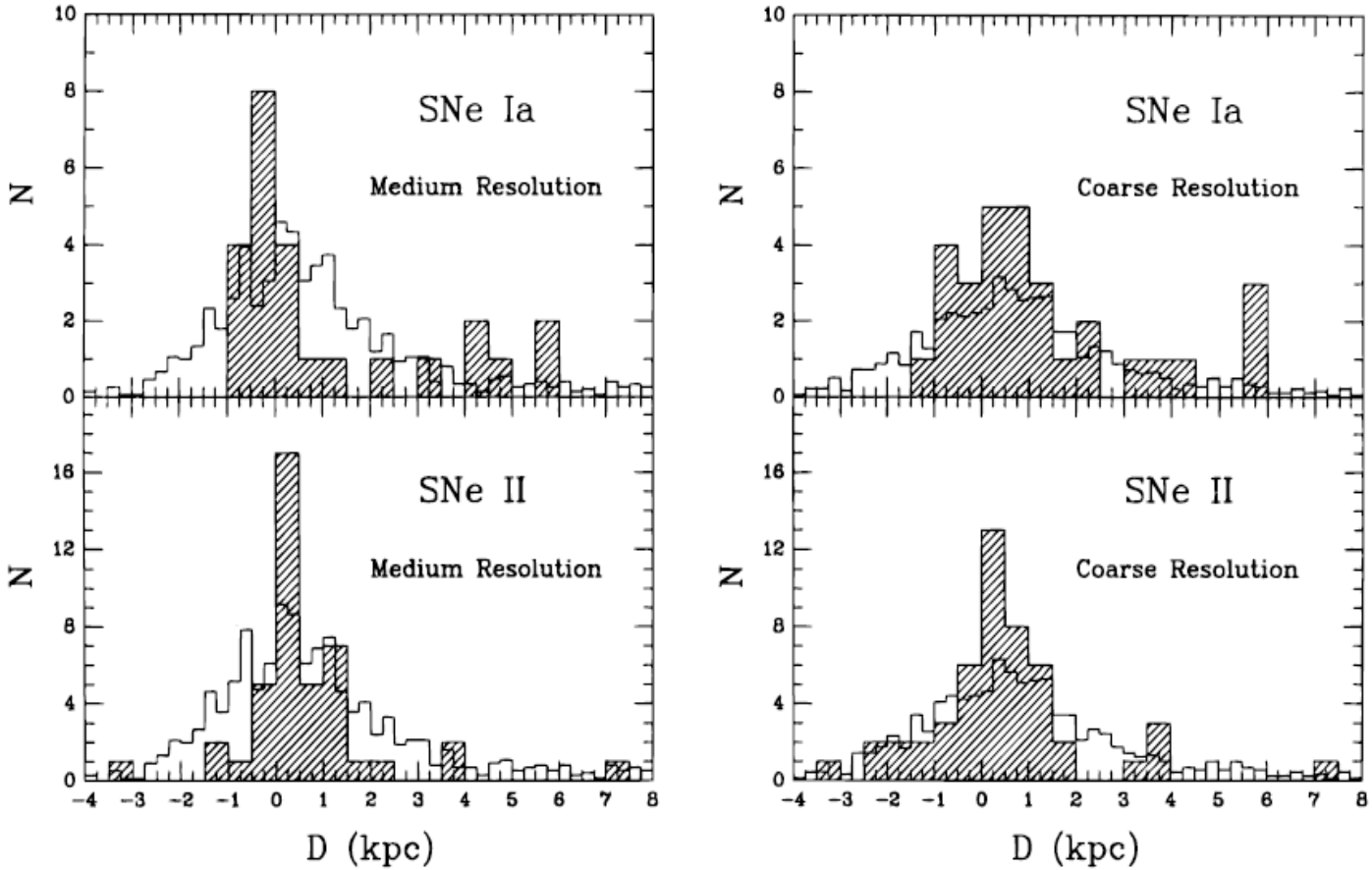


FIG. 1.—Distribution of SN offsets from spiral arms for medium and coarse resolutions. A sample of randomly generated disk objects is overplotted for comparison. Both types of SN are more tightly concentrated to the arms than a random disk population.