Supernova rate statistics in nearby galaxies from integral-field spectroscopy data

ready to submit

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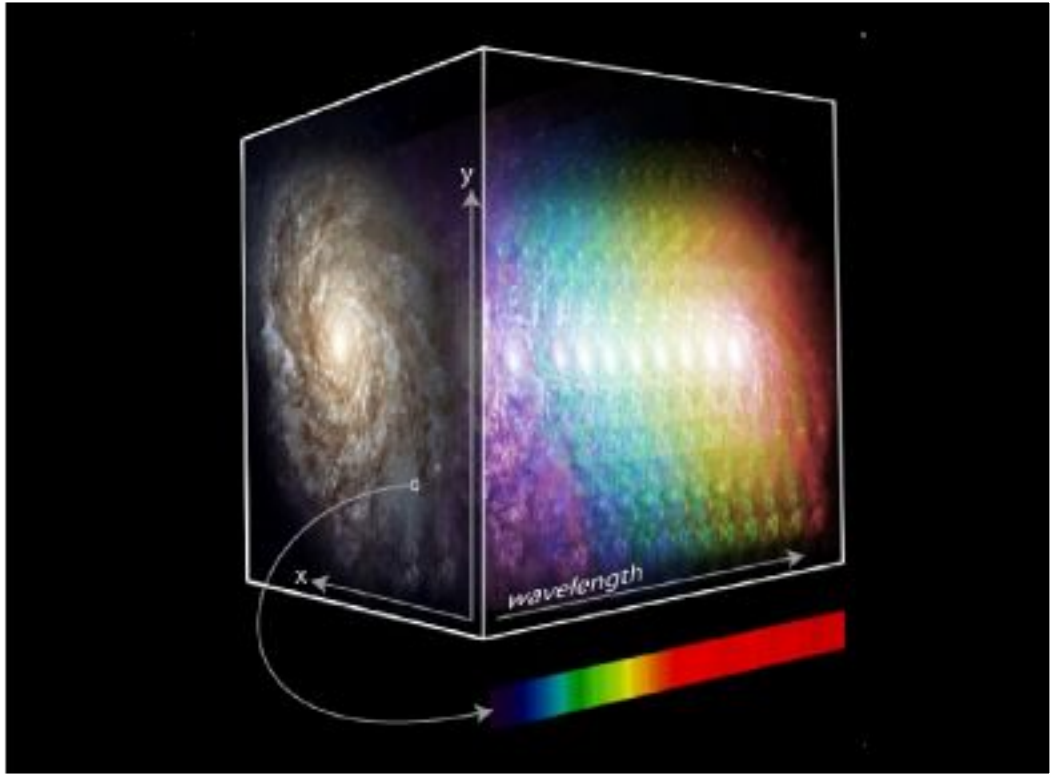
Galaxies, those annoying objects around our beautiful supernovae

NGC 4414 - NASA

Integral field spectroscopy data

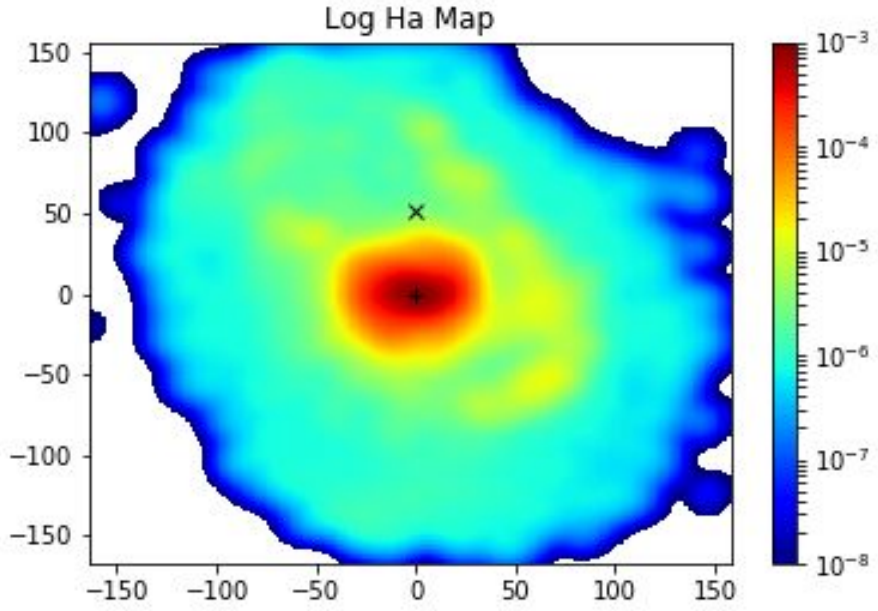
- AMUSING
- 134 supernovae host galaxies
  - 86 type Ia
  - 37 type II
  - 11 type Ic



Probability Maps

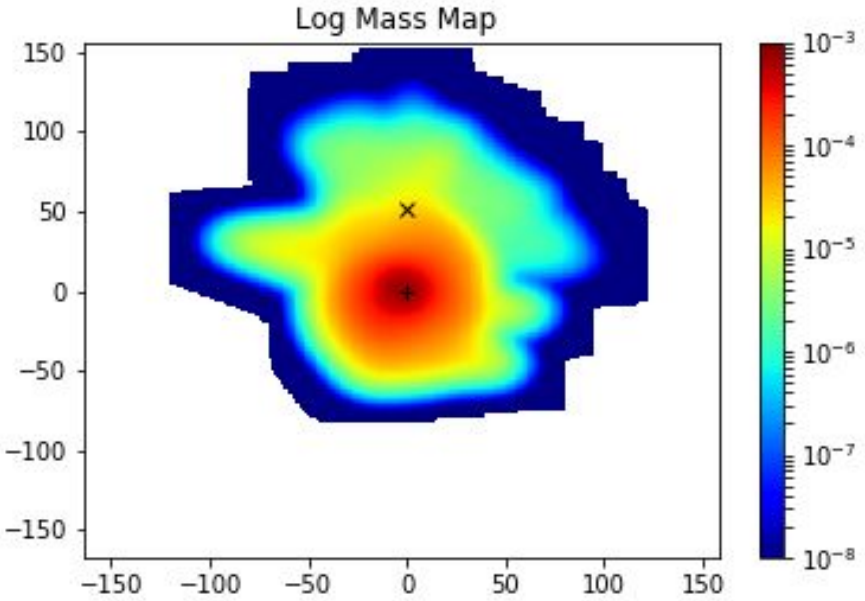
SN events tracers

- H-alpha



SN events tracers

- H-alpha
- Mass



SN events tracers

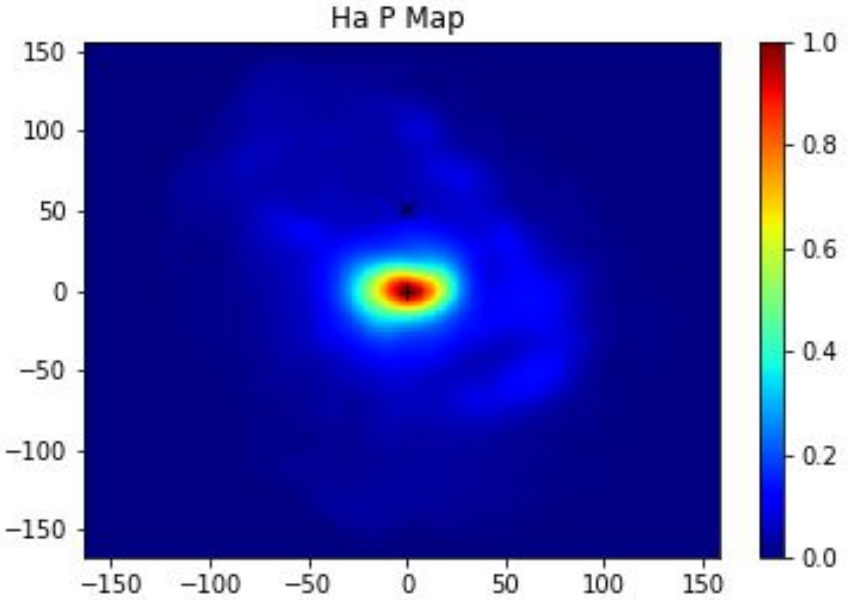
- H-alpha
- Mass
- Delay Time Distribution model

$$R(t) = \int_0^{\infty} \phi(\tau)\ \Psi(t-\tau)\ d\tau$$

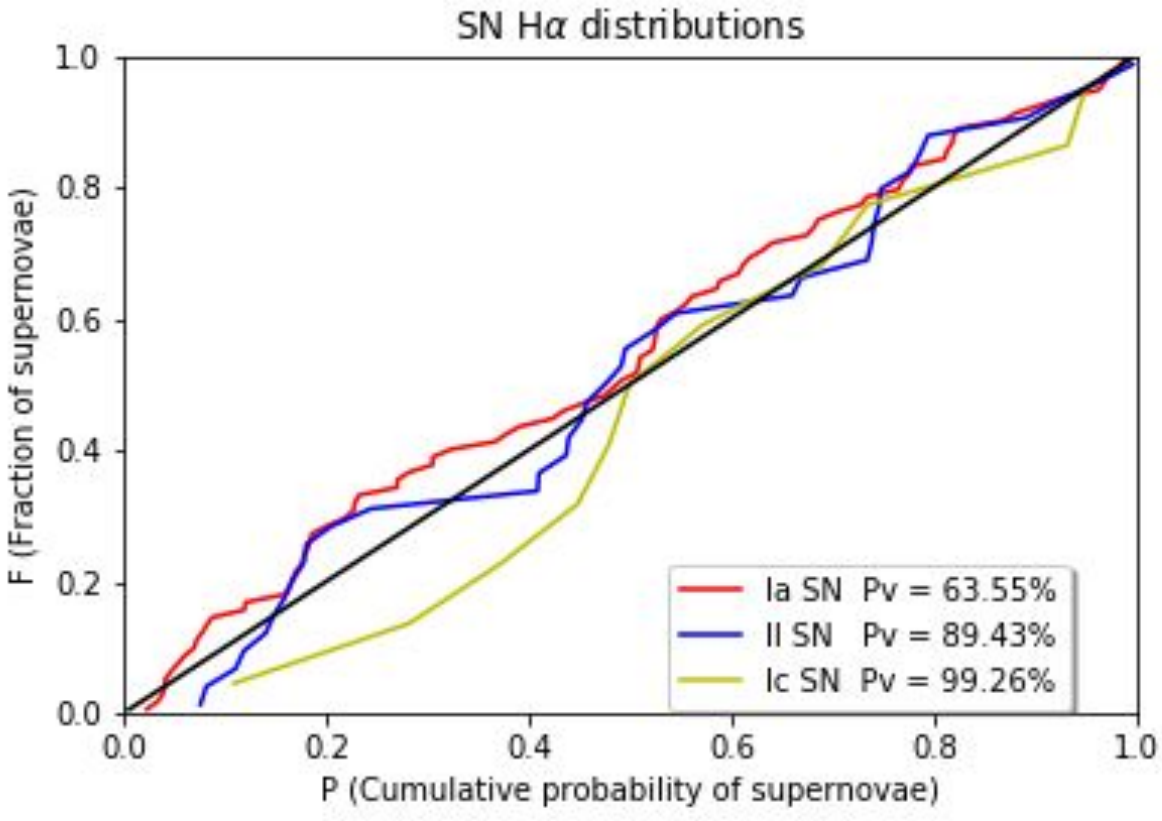
Statistical analysis

- Cumulative probability of the supernova (P)
- Fraction of SNe (F)
- We expect a linear correlation

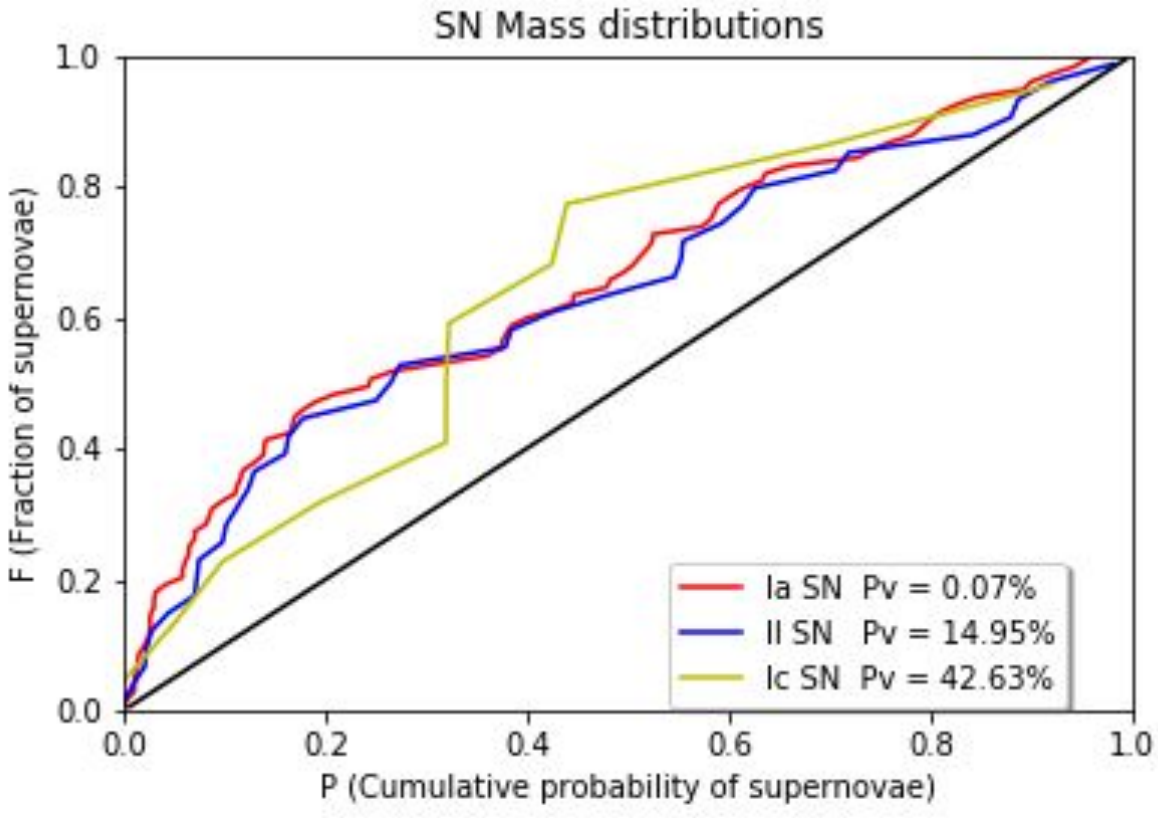
$$P_i = \sum_{p_j < p_i} p_j$$



Ha results


SN Hα distributions
F (Fraction of supernovae)
P (Cumulative probability of supernovae)
0.0
0.2
0.4
0.6
0.8
1.0
Ia SN Pv = 63.55%
II SN Pv = 89.43%
Ic SN Pv = 99.26%

Mass results



SN events tracers

- H-alpha
- Mass
- Delay Time Distribution model
  - Ia DTD model

$$\mathrm{DTD_{Ia}}\,(t) \;=\; \begin{cases} 0 & if \quad t < \Delta \\ \\ \phi_{Ia} \cdot t^{-\alpha} & if \quad \Delta \leq t \end{cases}$$

SN events tracers

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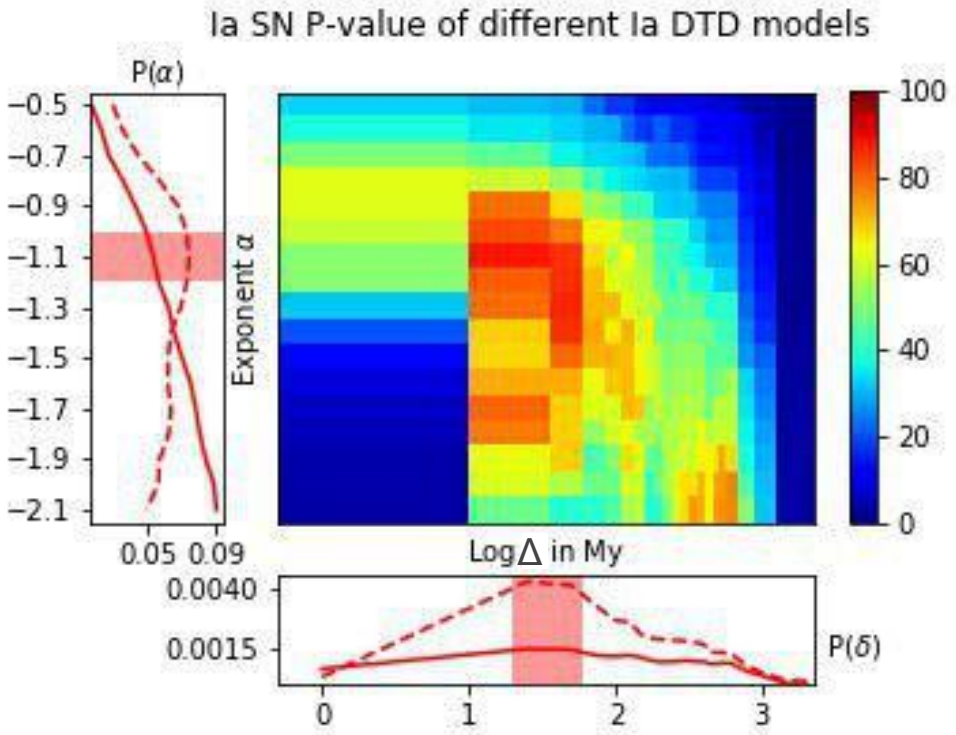
$$\mathrm{DTD_{Ia}}(t) = \begin{cases} 0 & if \quad t < \Delta \\ \phi_{Ia} \cdot t^{-\alpha} & if \quad \Delta \leq t \end{cases}$$

Ia DTD results

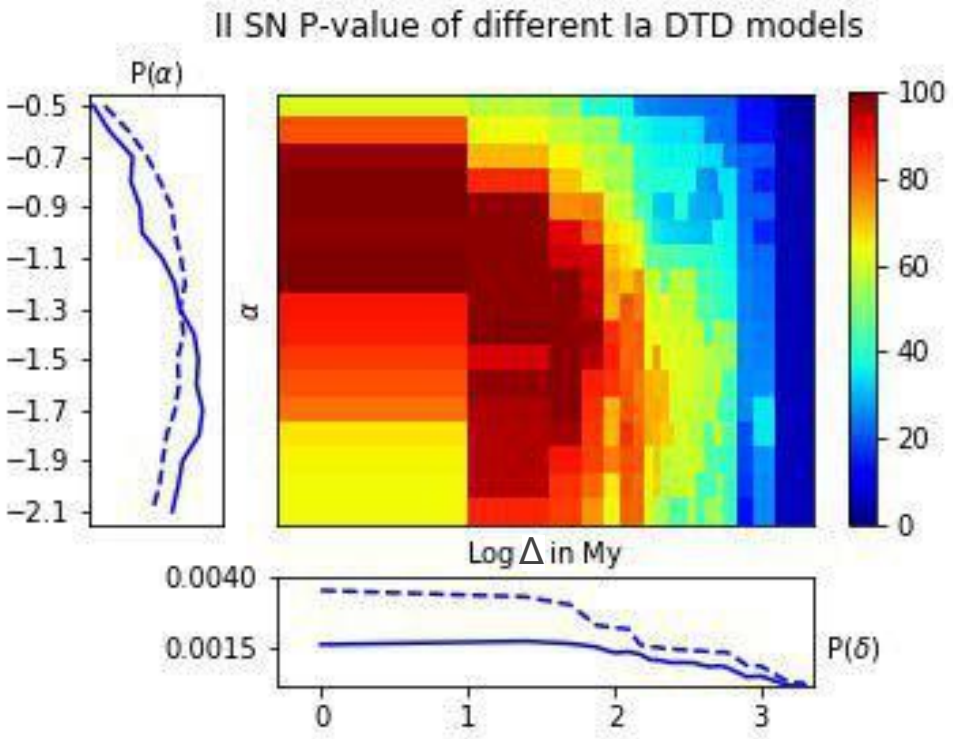
type Ia SNe

Best Fit: α=1.15 and Δ=75 My



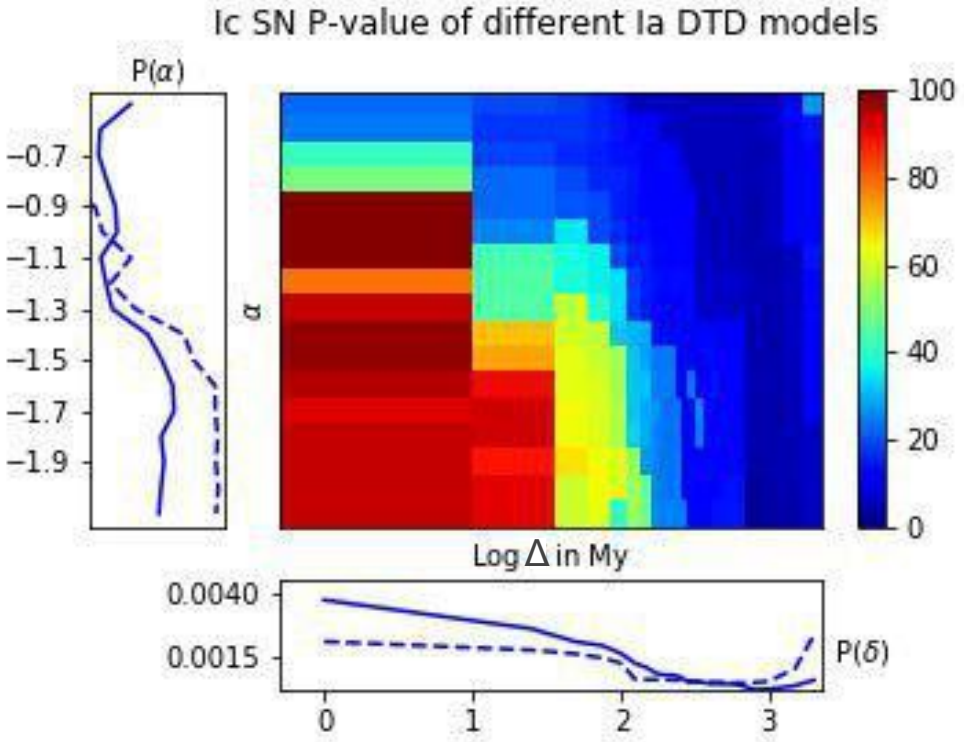
Ia DTD results

type II SNe



Ia DTD results

type Ic SNe



SN events tracers

- H-alpha
- Mass
- Delay Time Distribution model
  - Ia DTD model
  - CC Gaussian DTD model

$$\mathrm{DTD_{CC}}(t) = \phi_{cc} \cdot e^{-t^2/2\sigma^2}$$

SN events tracers

- H-alpha
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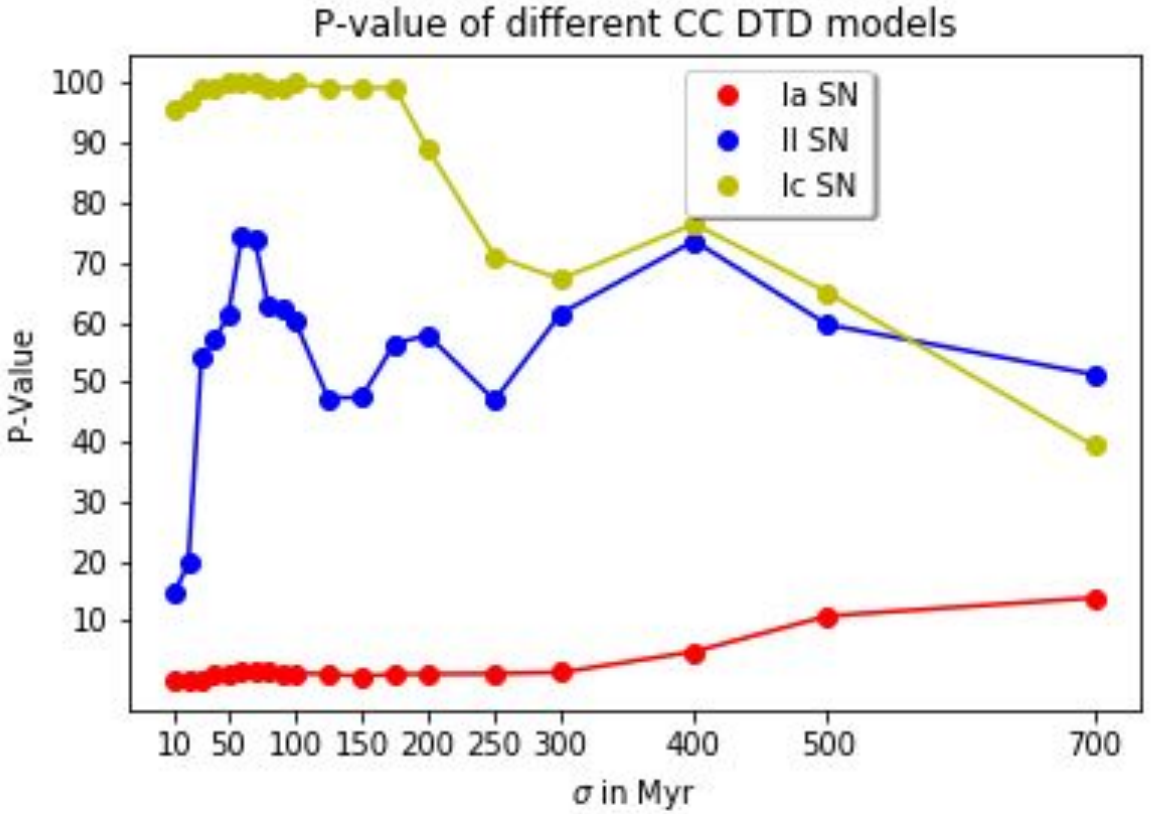
  - CC Gaussian DTD model

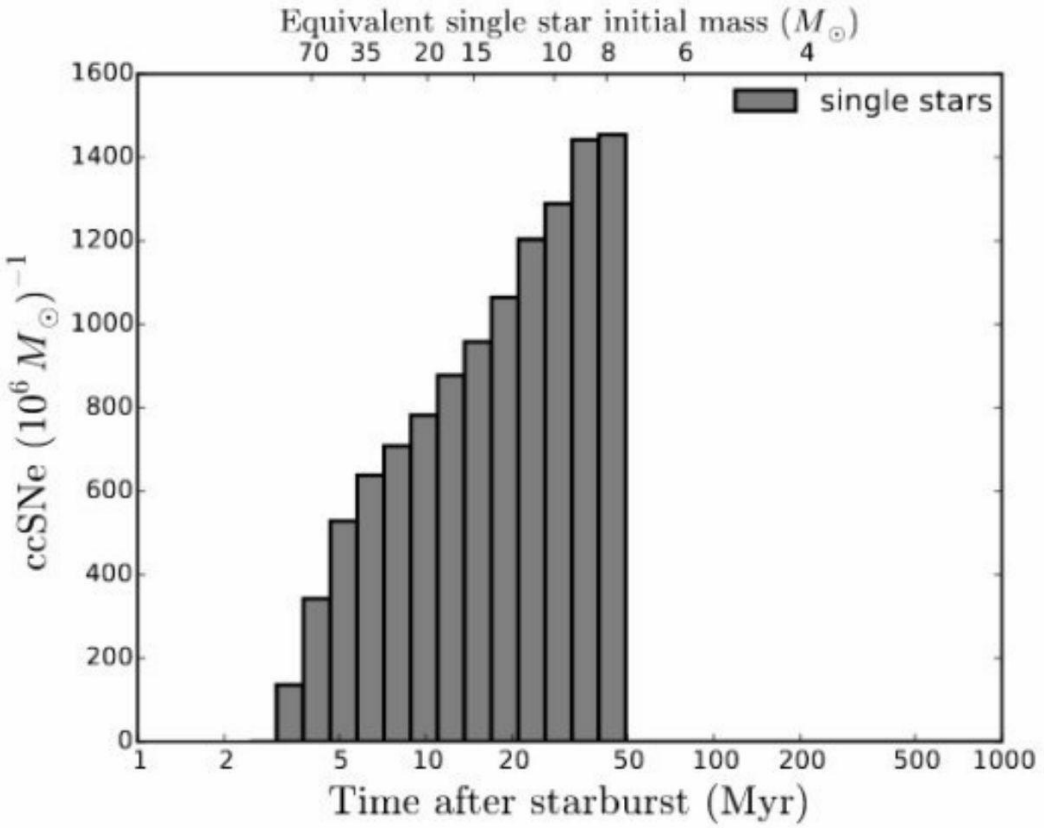
$$\mathrm{DTD_{CC}}(t) = \phi_{cc} \cdot e^{-t^2/2\sigma^2}$$

CC Gaussian DTD results



SN events tracers

- H-alpha
- Mass
- Delay Time Distribution model
  - Ia DTD model
  - CC Gaussian DTD model
  - Zapartas et. al. (2017)



SN events tracers

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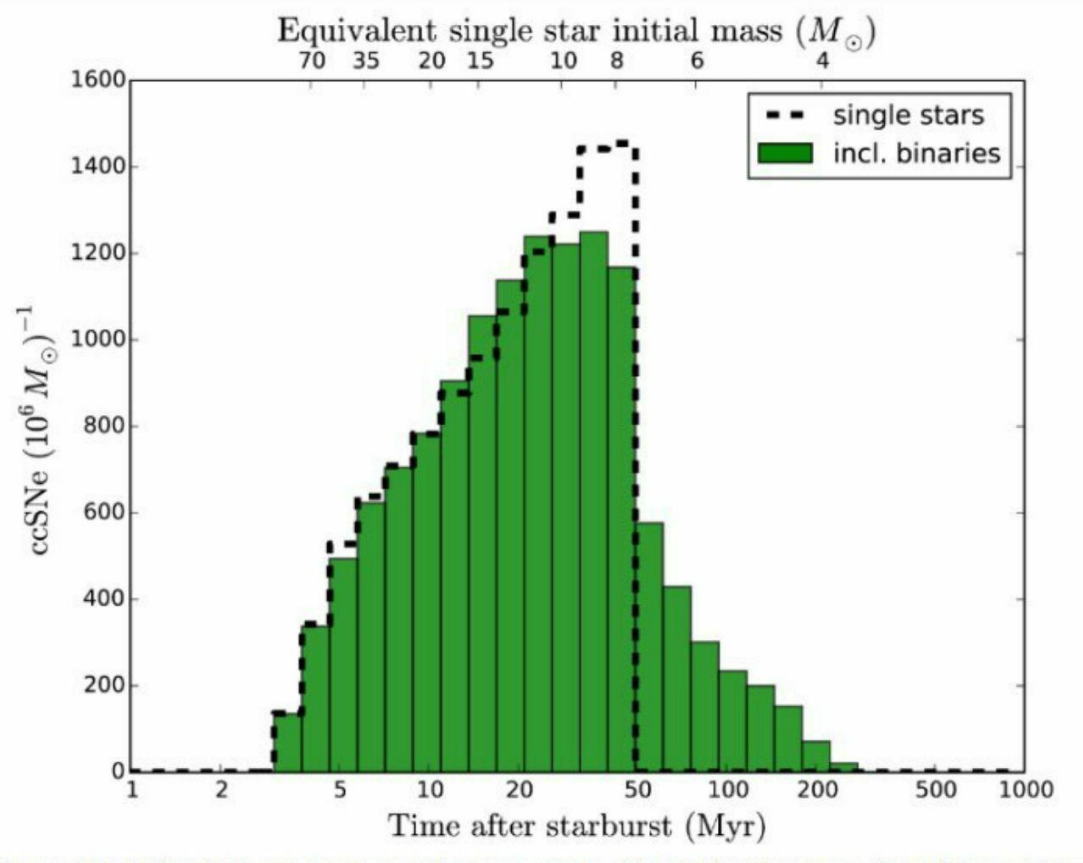
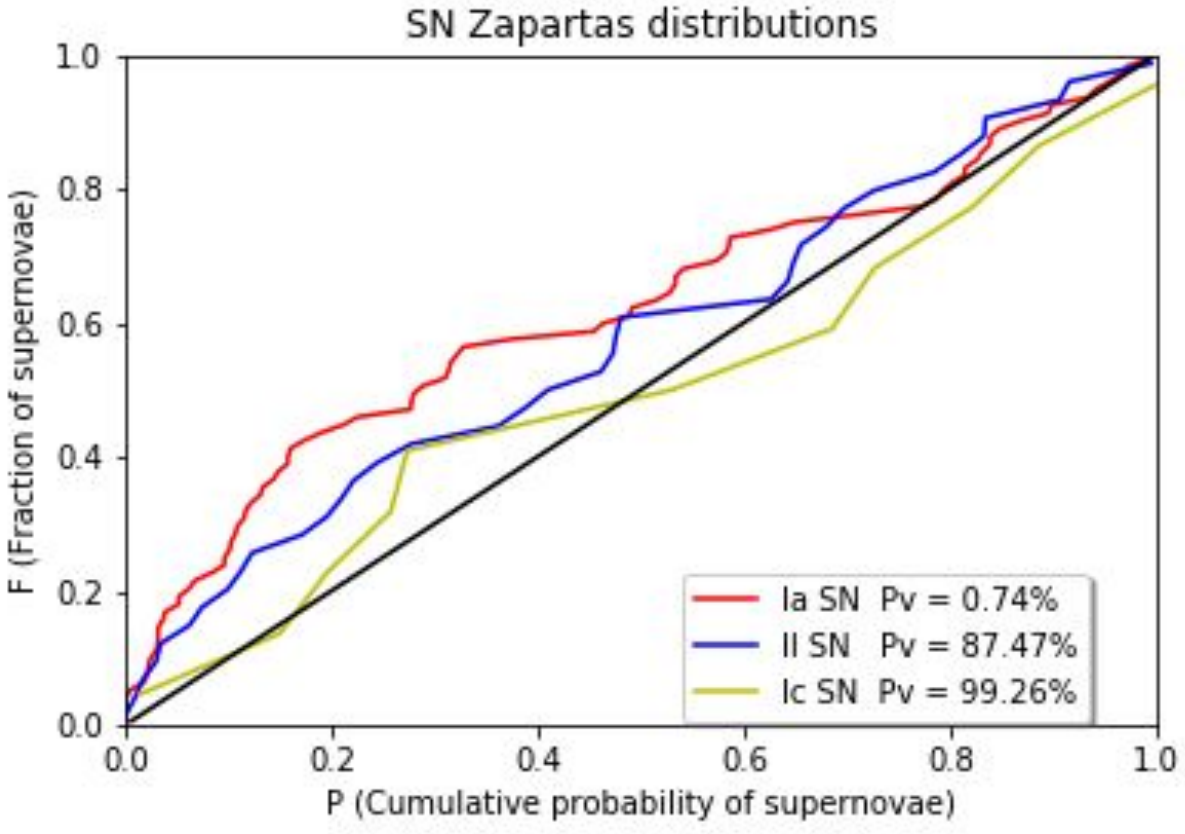
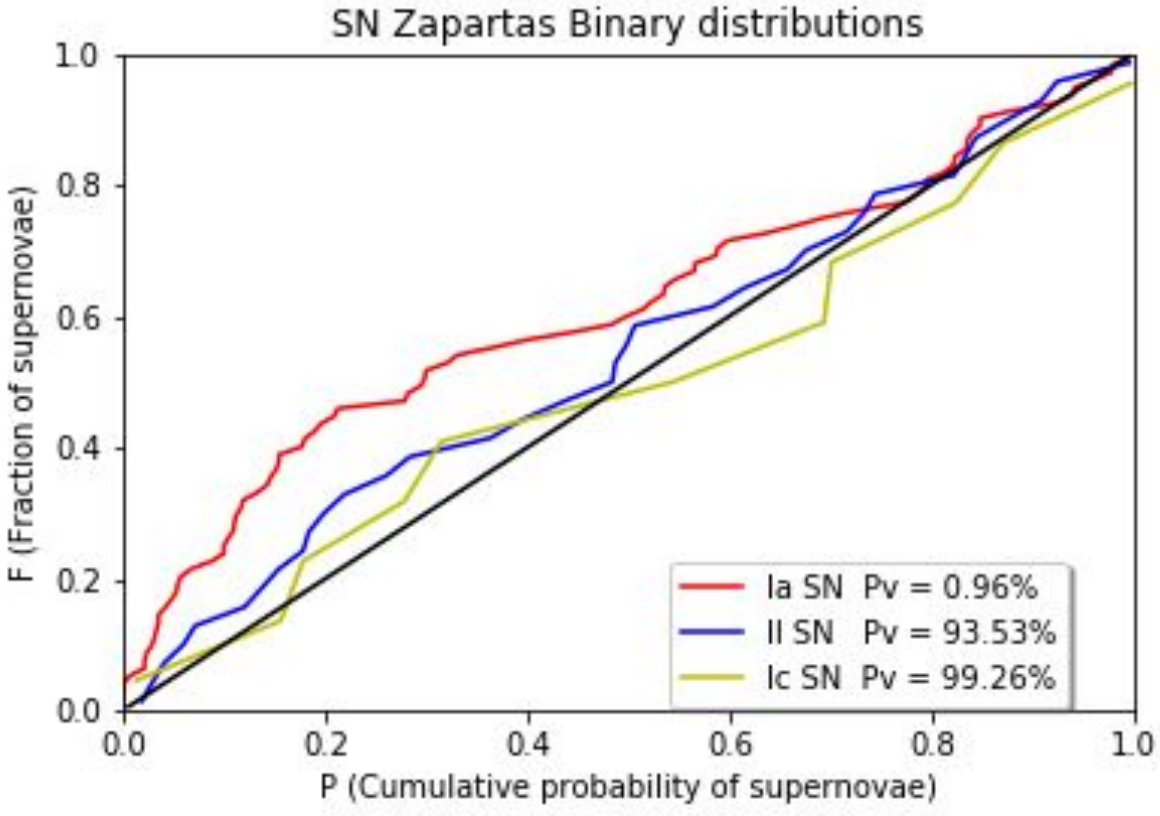


No Binary DTD results



Binary DTD results



Type II DTD comparison

DTD Model	**P-value**
Binary DTD	93.58 %
No Binary DTD	87.47 %
Best fit Gaussian DTD	74.17 %

CONCLUSIONS

New test of the DTD model using nearby galaxies

The Binary DTD is the one that give us the best fit for SN type II (93.58%)

For the Ia SN we obtain the best fit with α=1.15 and Δ=75 My

We can do the same analysis for GRB, Classical Novae or Kilonovae DTD

CONCLUSIONS

New test of the DTD model using nearby galaxies

The Zapartas Binary DTD is the one that give us the best fit for SN type II (93.58%)

For the Ia SN we obtain the best fit with α=1.15 and Δ=75 My

We can do the same analysis for GRB, Novae or Kilonovae DTD

Thank You