

VIII STUDENTSKA ASTRONOMSKA RADIONICA
Departman za fiziku, Prirodno-matematički fakultet, Novi Sad

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Sudbina međuzvezdane prašine u galaksijama posle zvezdorodne faze

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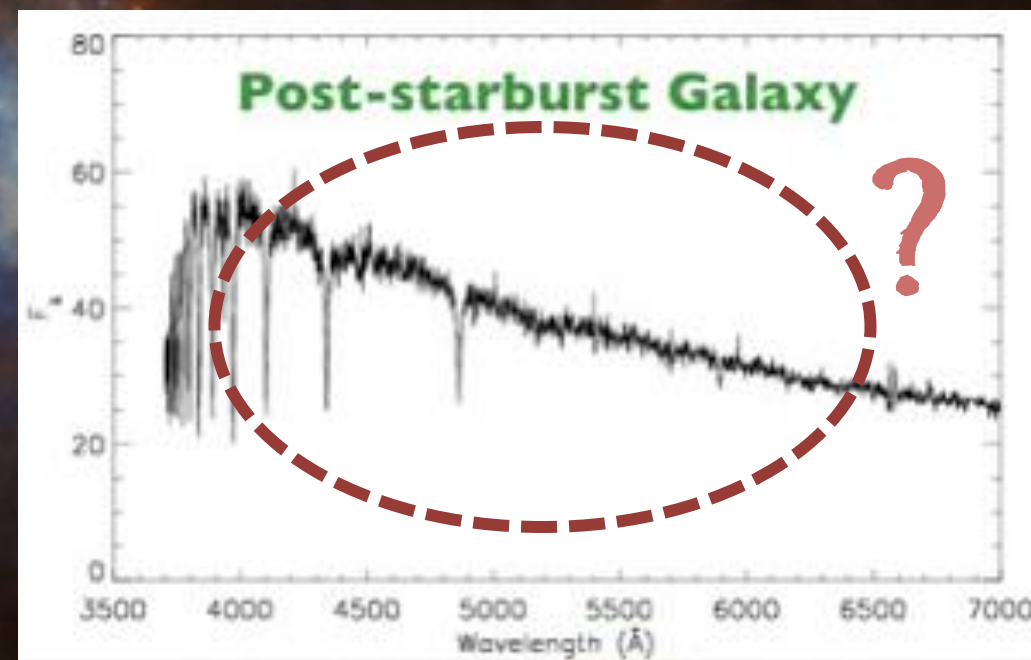
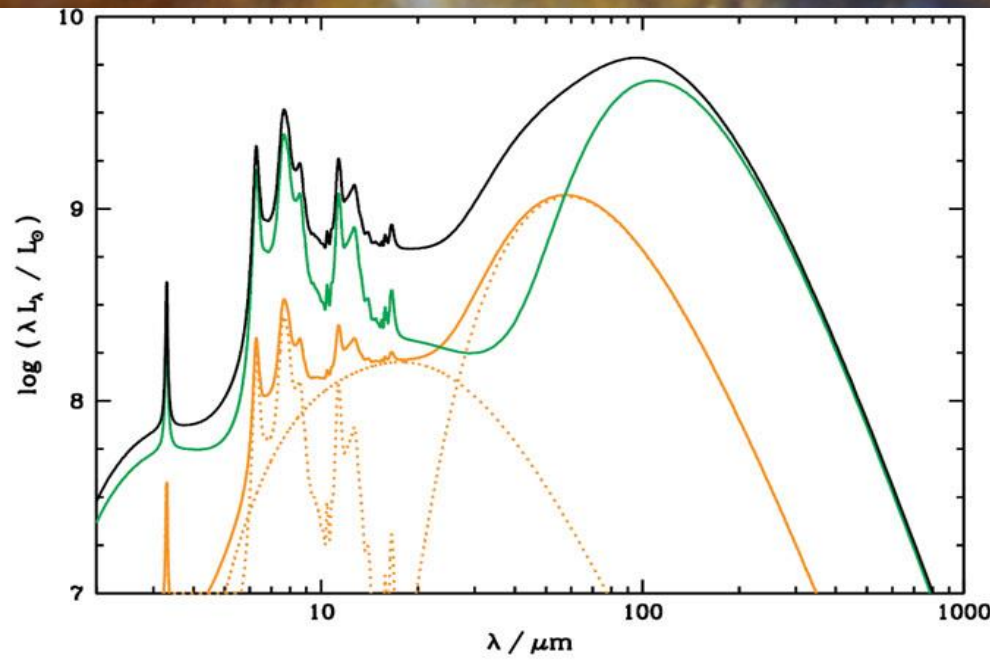
Max Planck Institute for
Astronomy
Heidelberg, Germany

Kratak pregled

- **Motivacija** – posmatranja ukazuju na **odsustvo prašine!**
- **Cilj** – simulirati **evoluciju zrna prašine** (kreacija i destrukcija)
- **Osnovni pojmovi**
 - SFR/SFRH, (post-)starburst, quenching (gašenje) i quiescence (mirno doba)
 - SSP, IMF, metaličnost, AGB
 - prašina, thermal sputtering, cooling function, SN uništavanje
- **Rezultati :)**
- **Budući rad**

Motivacija

- Očekivano prisustvo prašine:
- Emisija u IR (model)
- Apsorbpcija u vidljivom (posmatranja)

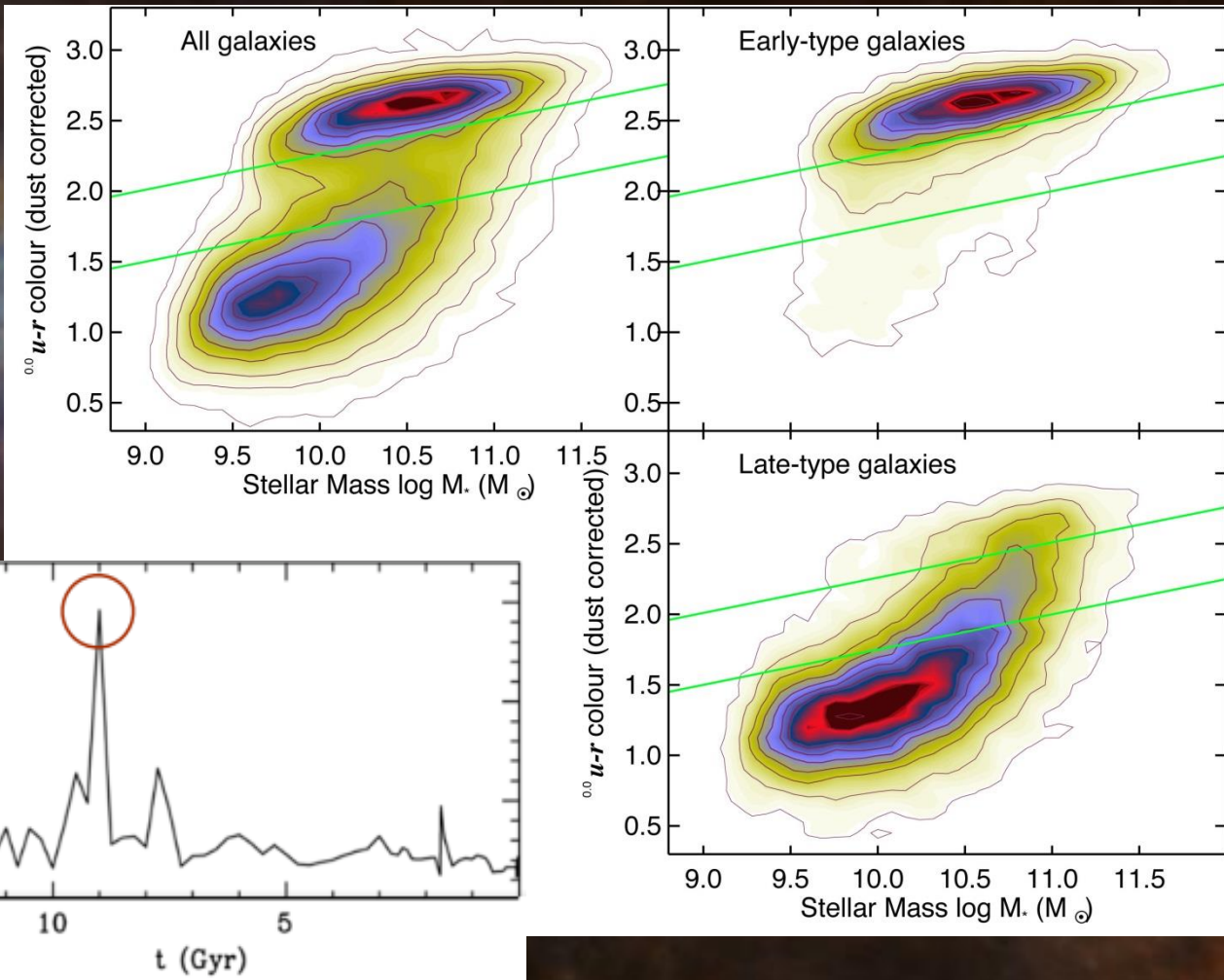


CILJ

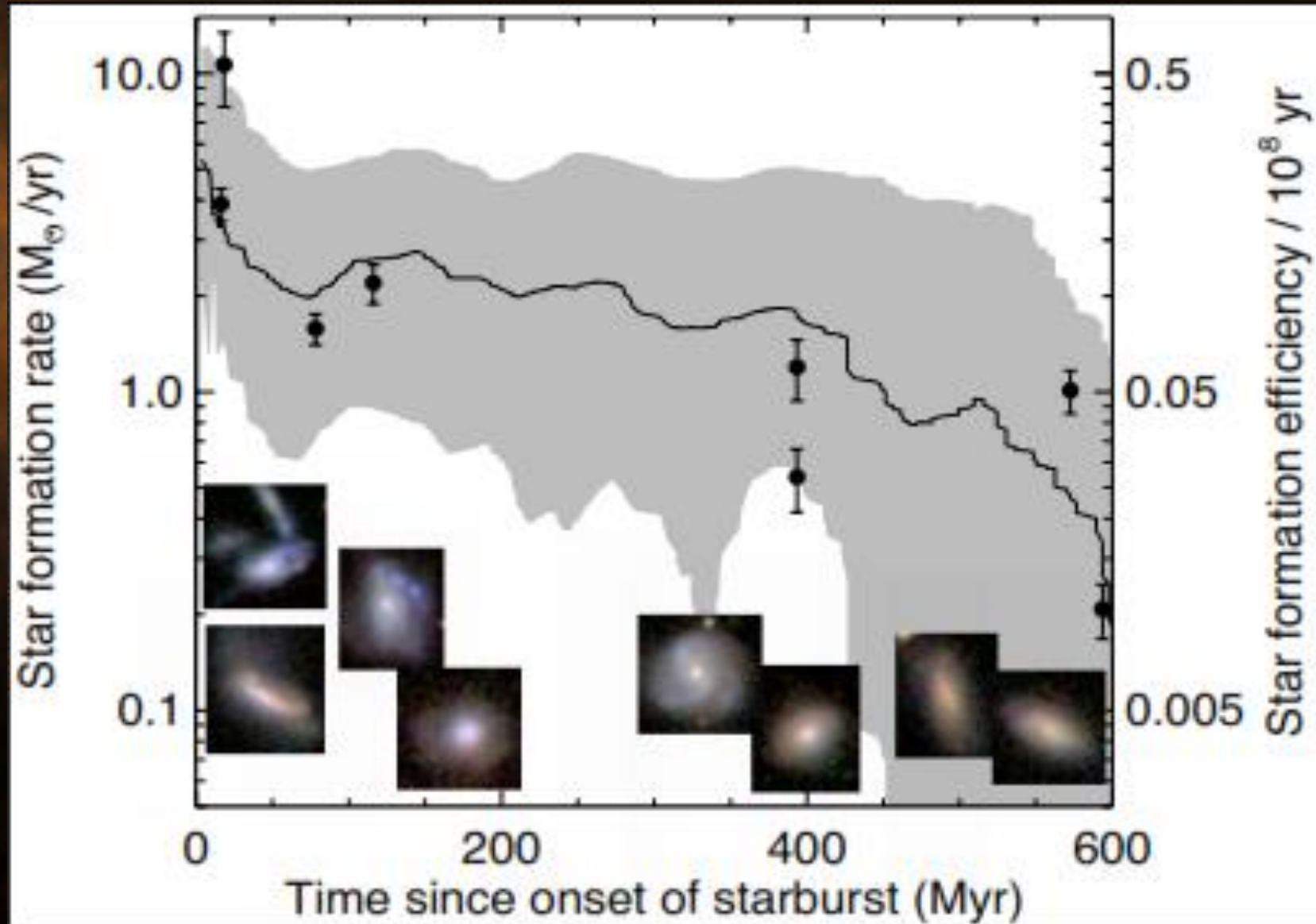
OBJASNITI NESLAGANJE
POMOĆU MODELA

skoro SAV MZM u zvezde = starburst

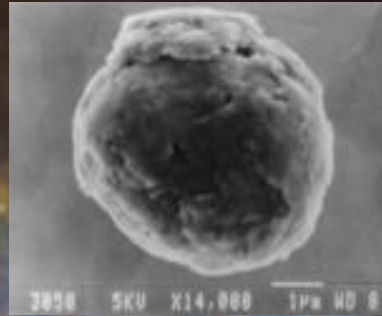
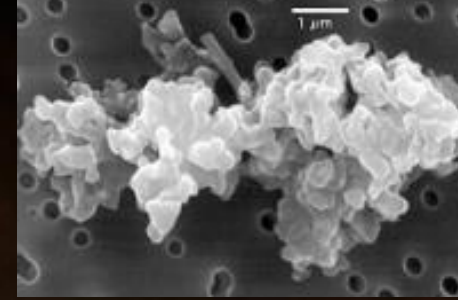
- Starburst:
 - Iznenadan
 - Neodrživ
 - Dodaje $>15\%$ zvezdane mase
 - Retko se dešava



skoro SAV MZM u zvezde = starburst



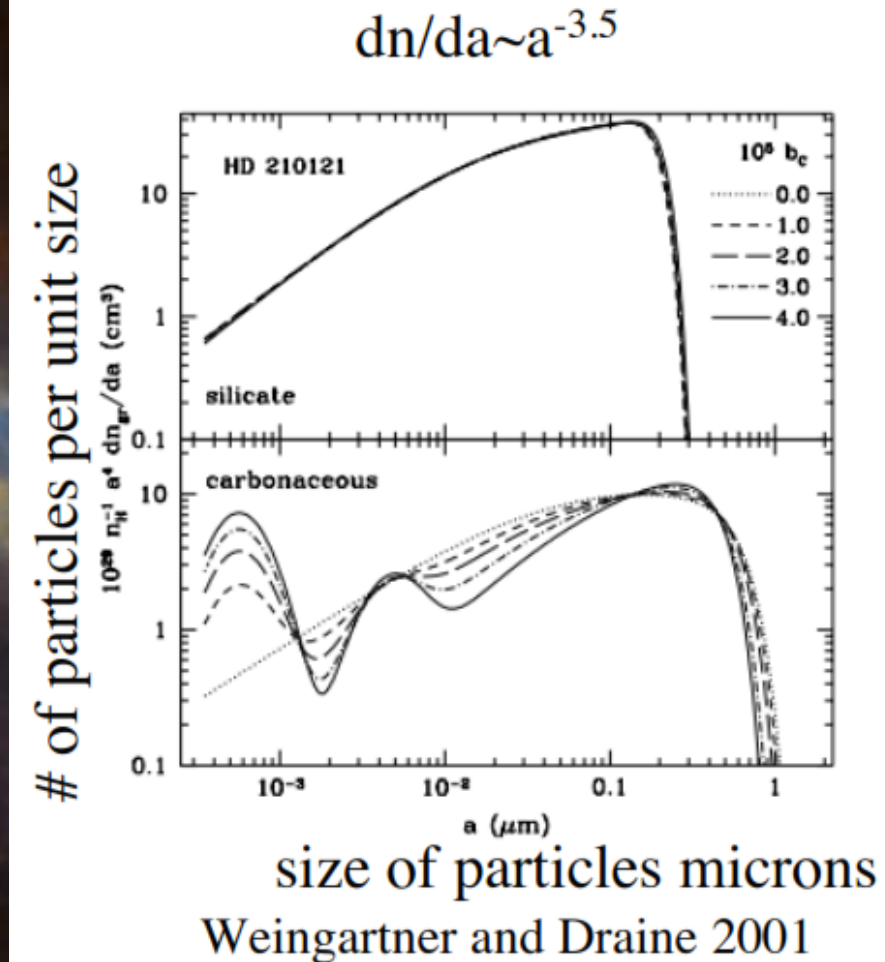
Prašina



- Razlikujemo više vrsta:
 - Gvožđevitu
 - Silikatsku
 - Ugljeničnu....
- Nastaje pri evoluciji AGB i SN*
- Uništava se u SN šokovima i termalnim cepakanjem

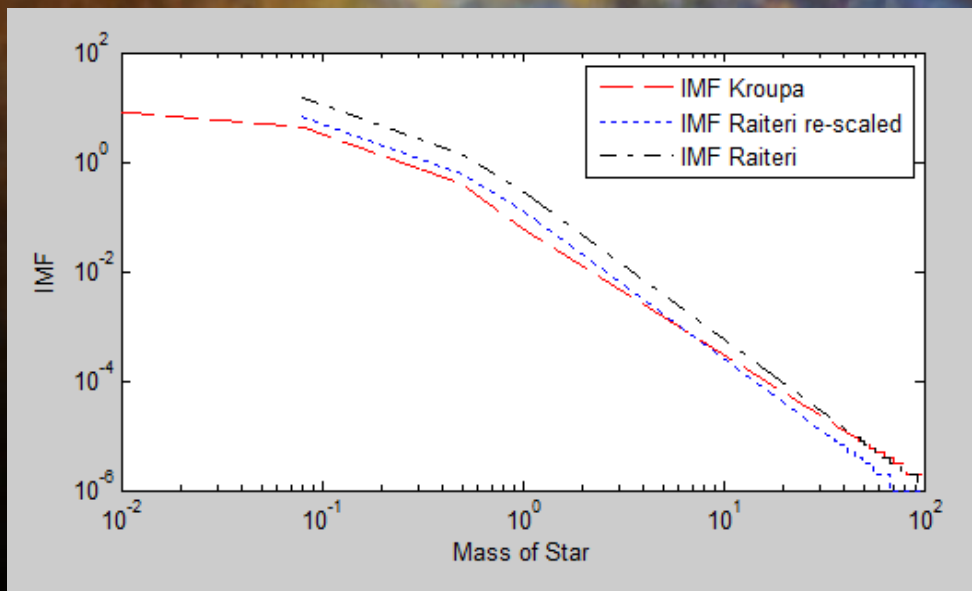
$$\dot{M}_i^{dust}(t) = \dot{M}_i^d(t) + \dot{M}_i^{destruction}(t)$$

$$\dot{M}_i^{destruction}(t) = -\frac{M_i^{dust}(t)}{\tau_{dest,sp}} - \frac{M_i^{dust}(t)}{\tau_{dest,SN Ia}}$$

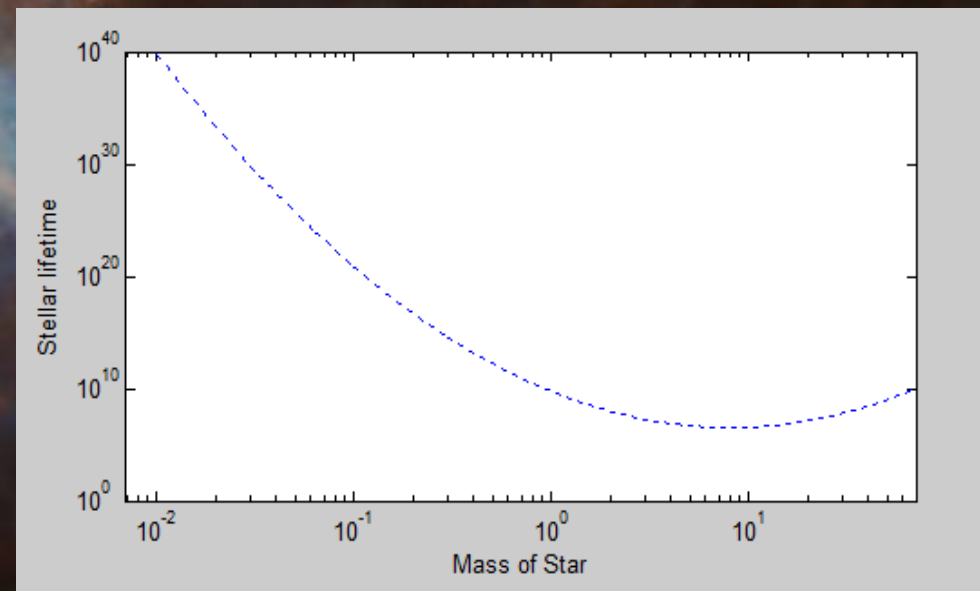


Modeliranje SSP

- Zvezde iste metaličnosti nastale u istom trenutku
- Initial Mass Function
- Vreme života zvezde



ZAVISI OD MASE ZVEZDE



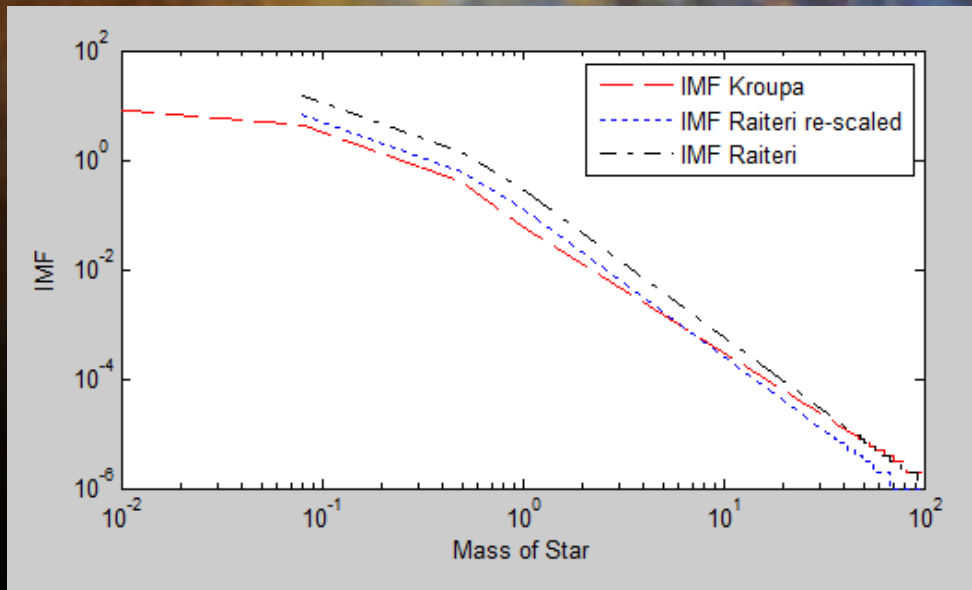
ZAVISI OD MASE ZVEZDE I METALIČNOSTI



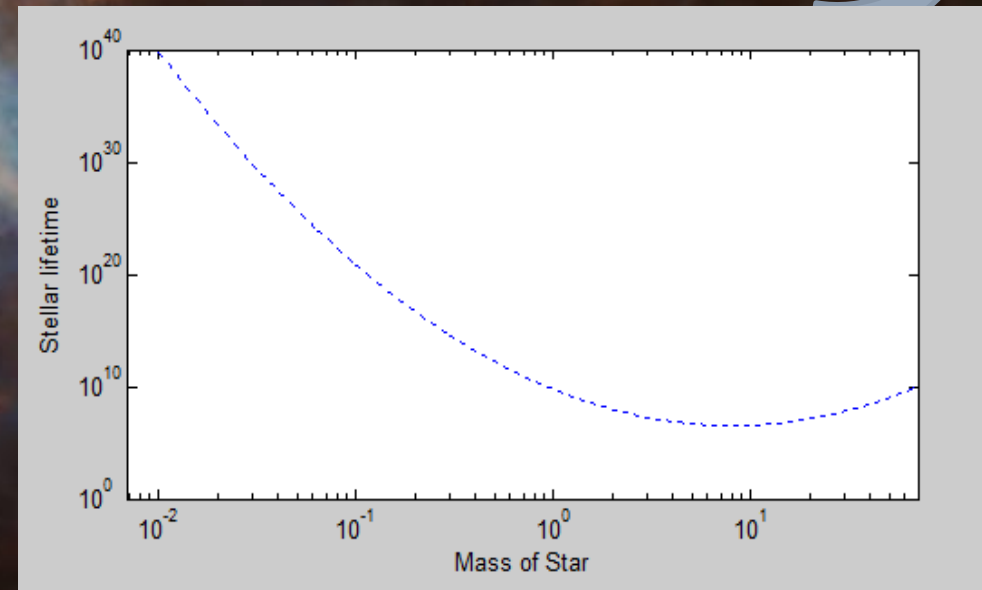
Modeliranje SSP

različita masa
~
različito vreme

- Zvezde iste metaličnosti nastale u istom trenutku
- Initial Mass Function
- Vreme života zvezde



ZAVISI OD MASE ZVEZDE



ZAVISI OD MASE ZVEZDE I METALIČNOSTI

Svaka zvezda daje svoj doprinos

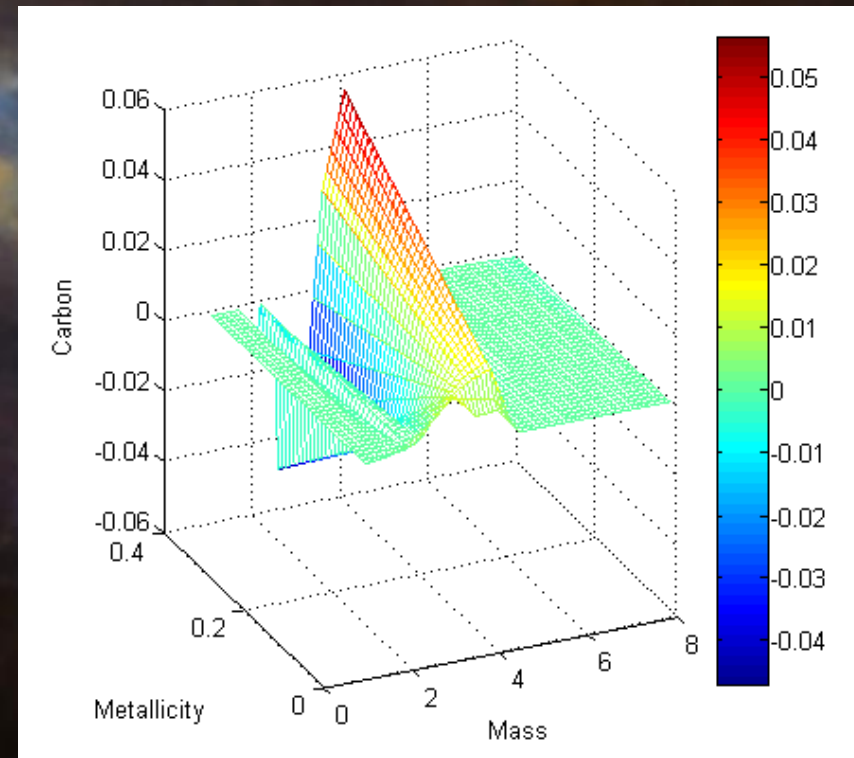
- Obogaćuje MZM metalima i povećava metaličnost *

$$M_{metal}(t) = \frac{M_{SSP}}{m_{average}} \int_{m_*(\tau_*=t)}^{m_u} \Phi(m) [m \cdot y_{TOT}(m, Z) + m_{ej}(m, Z) \cdot Z] dm$$

*(bitno za kasnije formiranje objekata, hlađenje i SN razaranje)

- Obogaćuje MZM gasom i prašinom

$$M_i^d(t) = \frac{M_{SSP}}{m_{average}} \int_{m_*(\tau_*=t)}^{m_u} \Phi(m) Y_i^d(m, Z) dm$$



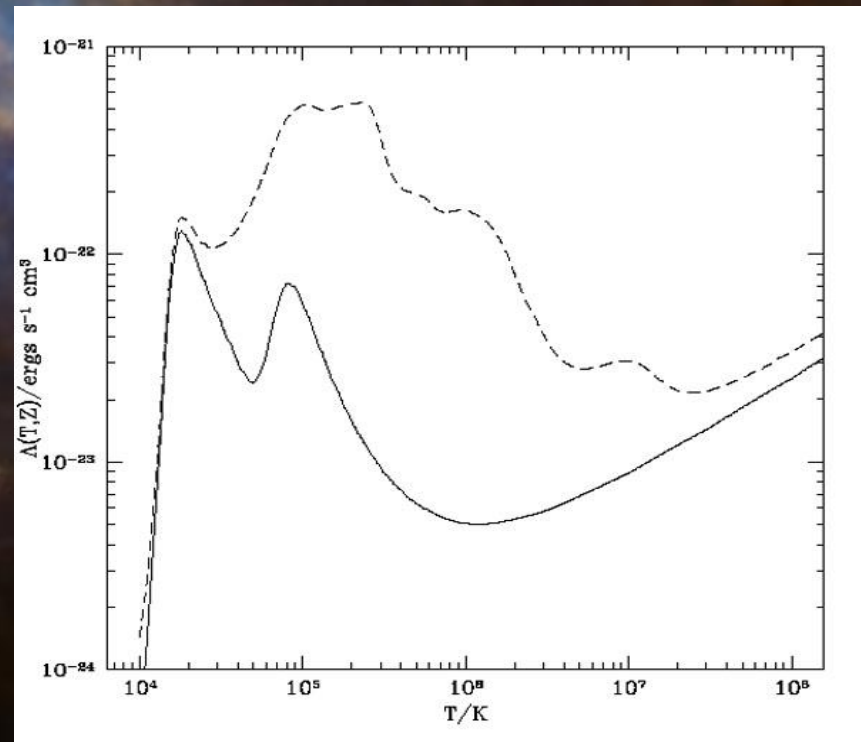
Mehanizmi uništenja - detaljnije

- **Termalno cepkanje (sputtering)** – efekat približno isti

$$\tau_{dest,sp} = 10^5 \times [1 + T[10^6 K]^{-3}] \frac{a/0.1\mu m}{n_H/cm^{-3}}$$

za Fe, Si, C itd.

- Funkcija hlađenja
(za retku plazmu)
bitna za prostornu
raspodelu kasnije



Mehanizmi uništenja - detaljnije

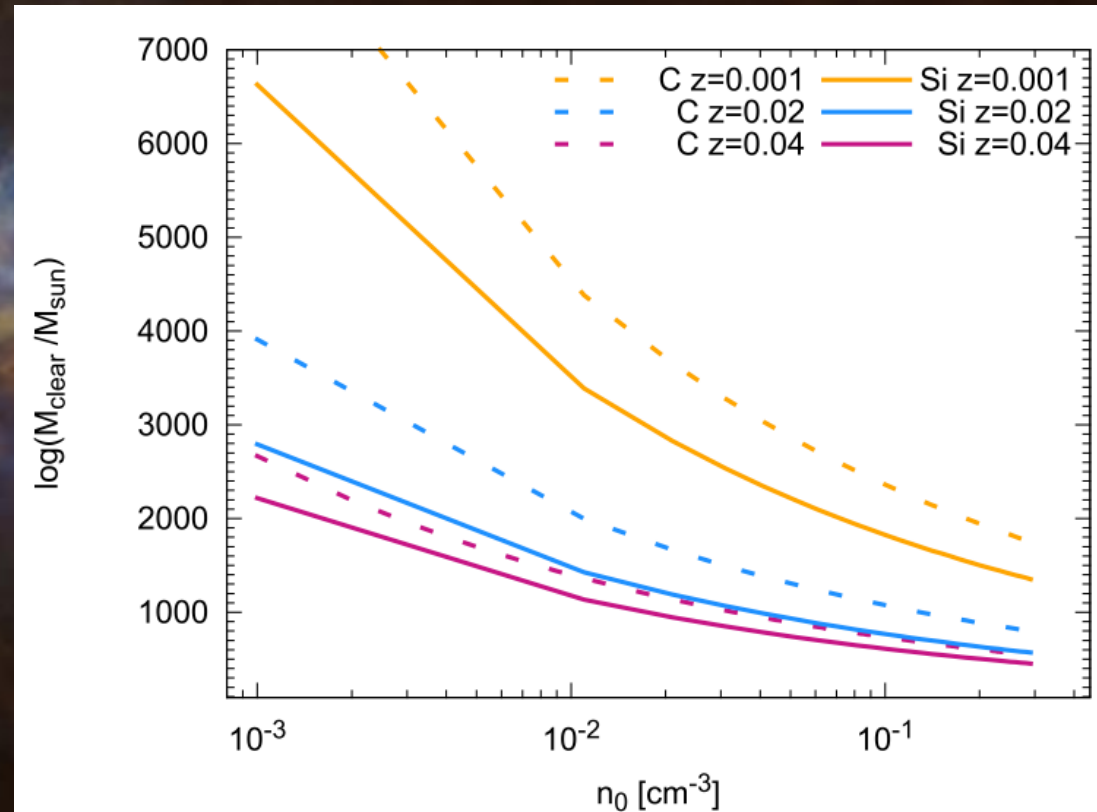
- SN uništavanje – samo za SNIa i Fe != Si != C ...

$$\tau_{dest,SNIa}^j = \frac{M_{gas}}{M_{j,cleared} f_{SN} R_{SN}}$$

$$M_{j,cleared}(n_0) = \int_{v_0}^{v_f} \epsilon_j(v_s, n_0) \left| \frac{dM_s(v_s, n_0)}{dv_s} \right| dv$$

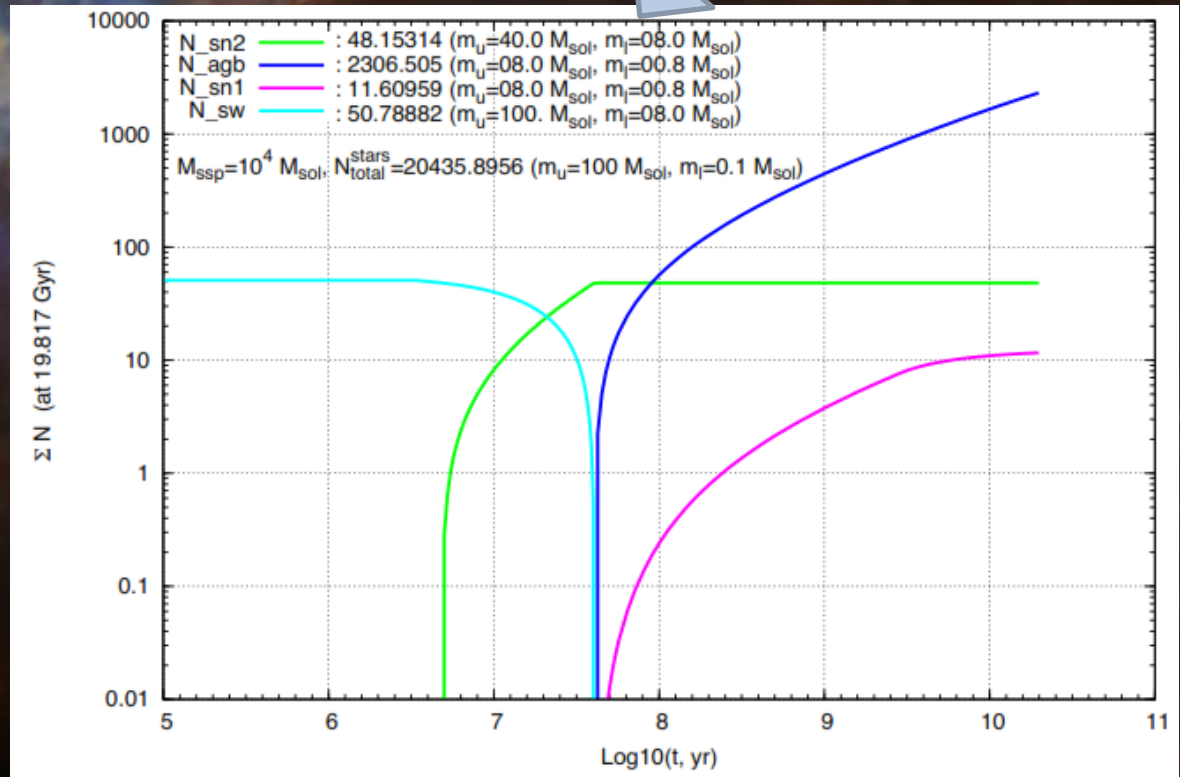
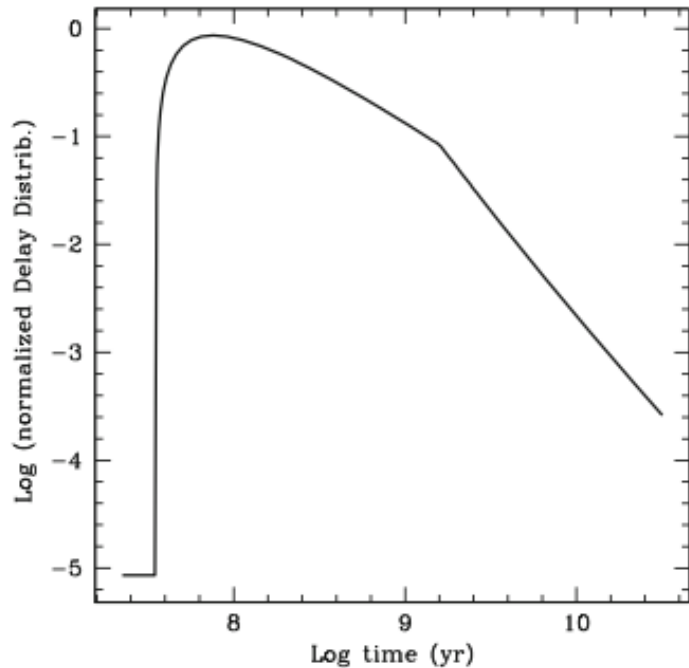
$$v_{PDS} = 413 n_0^{1/7} E_{51}^{1/14} \left(\frac{Z_*}{Z_{Sun}} \right)^{-3/14}$$

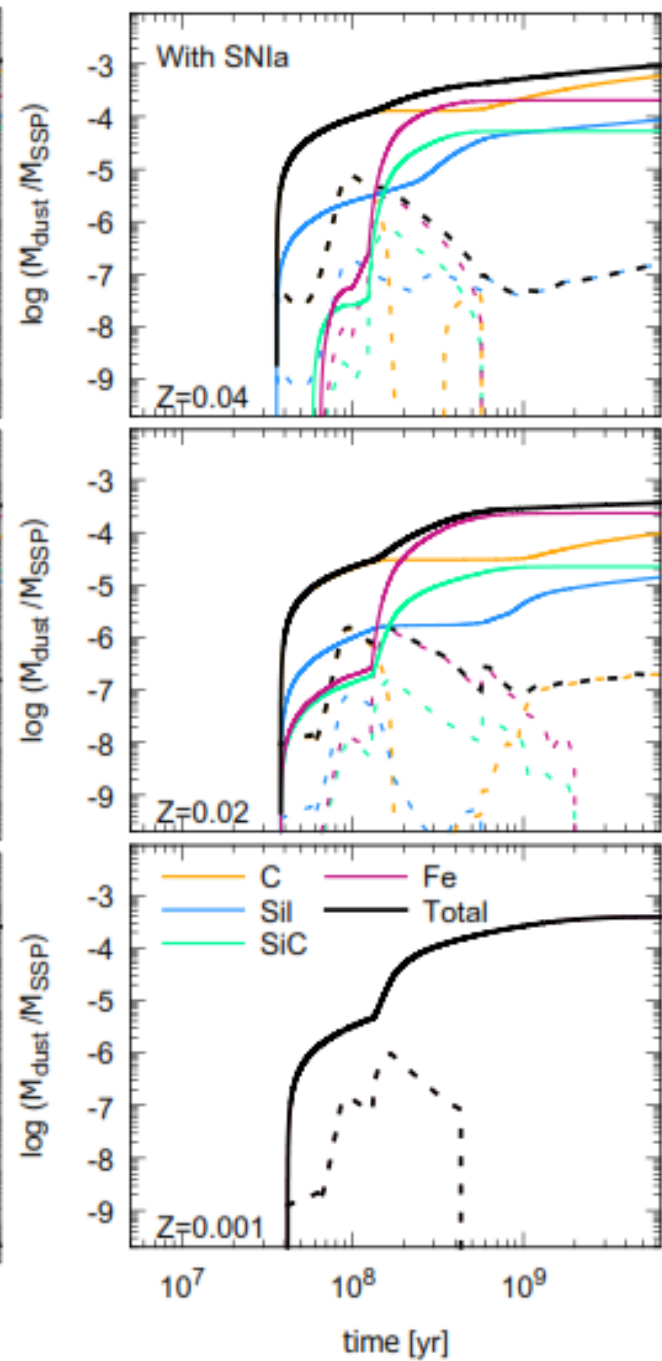
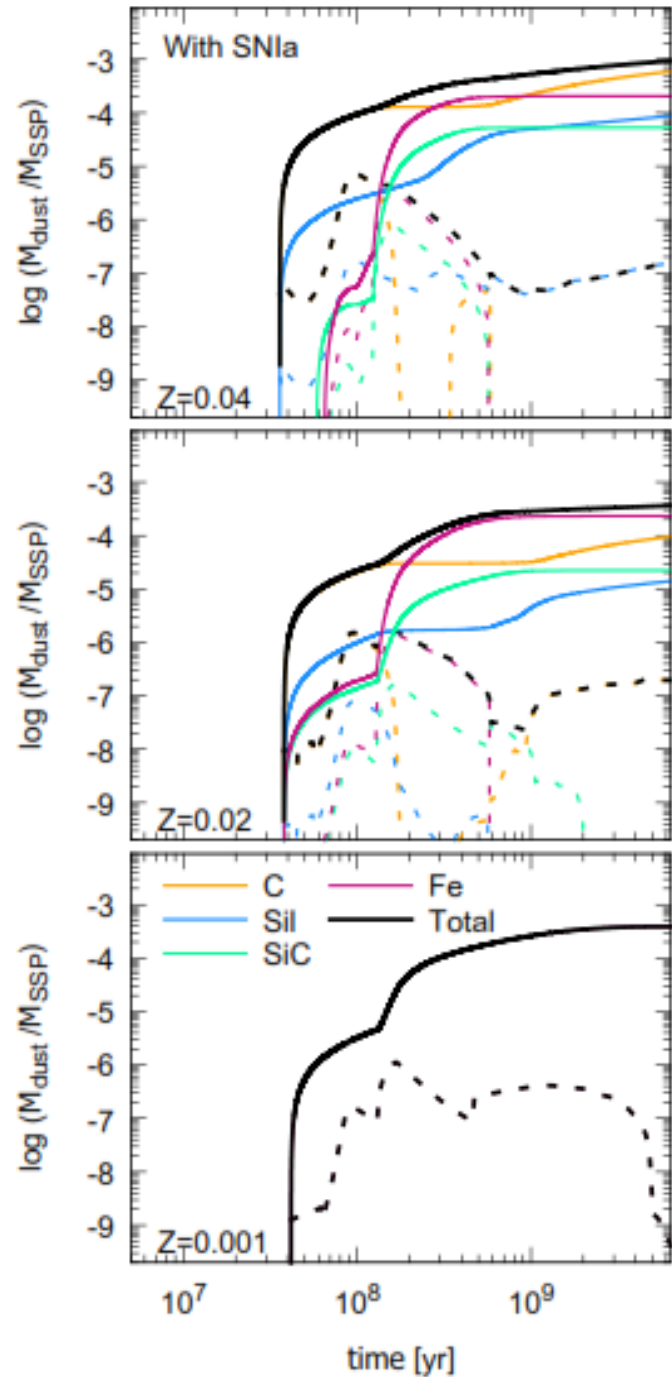
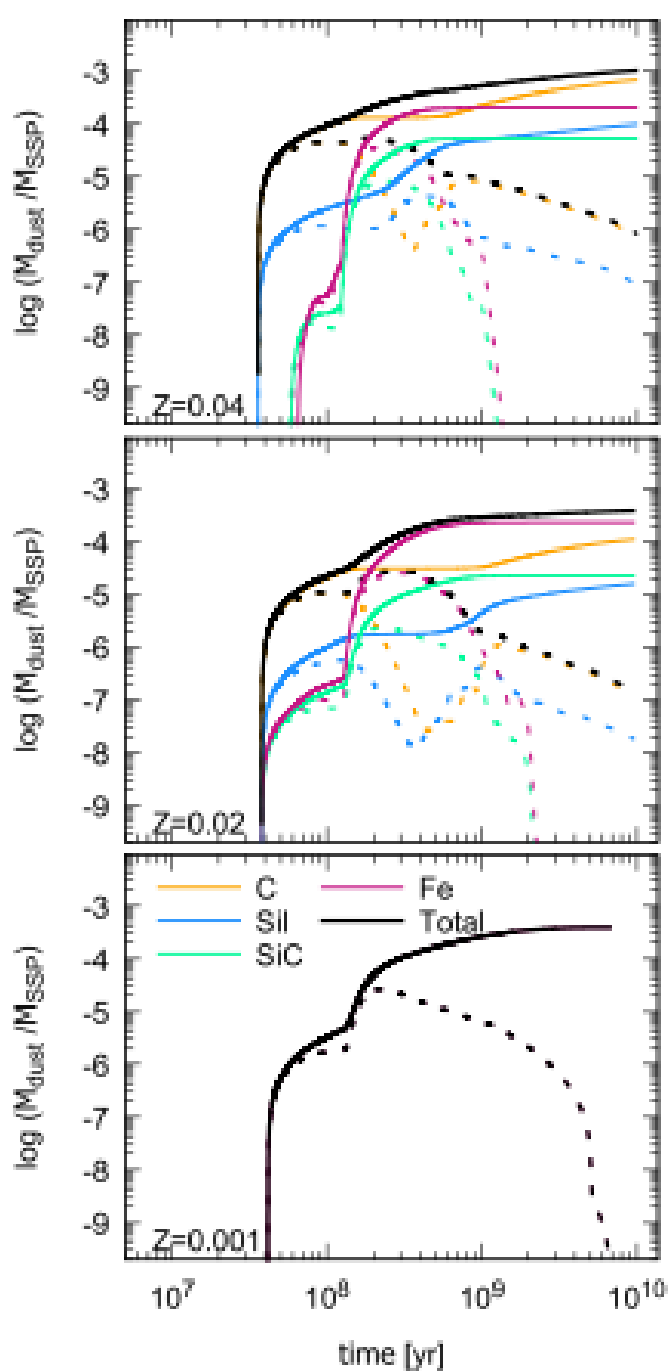
$$M_s = 500 E_{51}^{0.86} n_0^{-0.28} \left(\frac{v_s}{v_{PDS}} \right)^\alpha$$

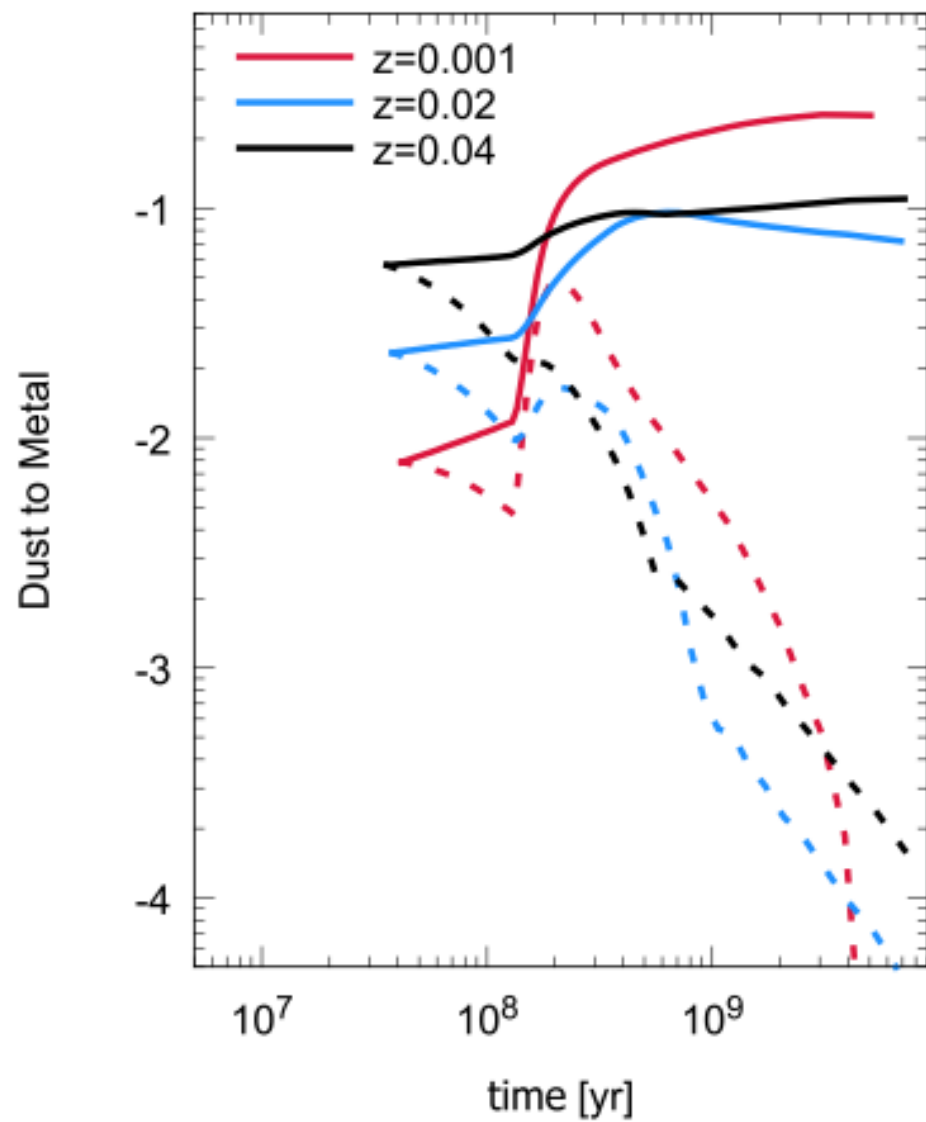
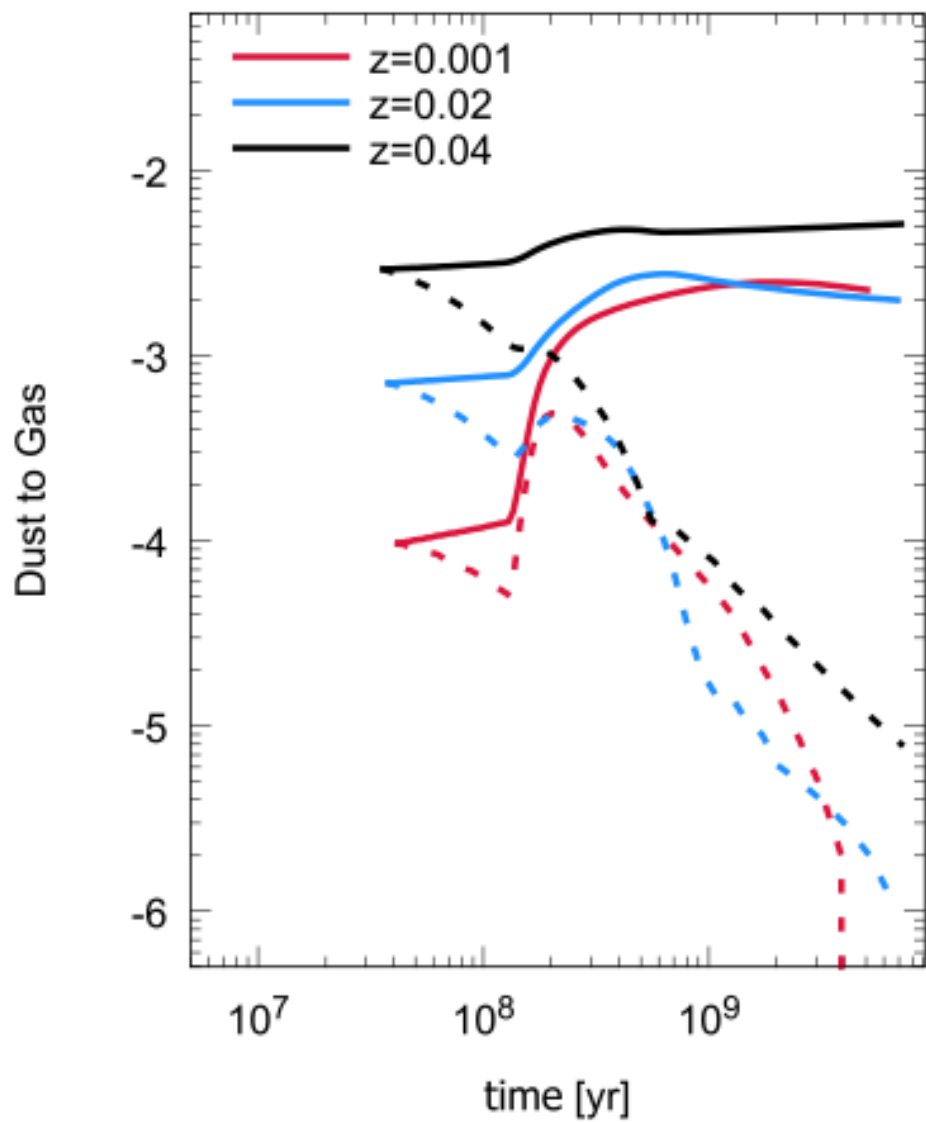


Delayed time distribution

$$R_{\text{SNIa}}(t) = k_{\alpha} \int_{\tau_i}^{\min(t, \tau_x)} A_B(t - \tau) \psi(t - \tau) \text{DTD}(\tau) d\tau$$





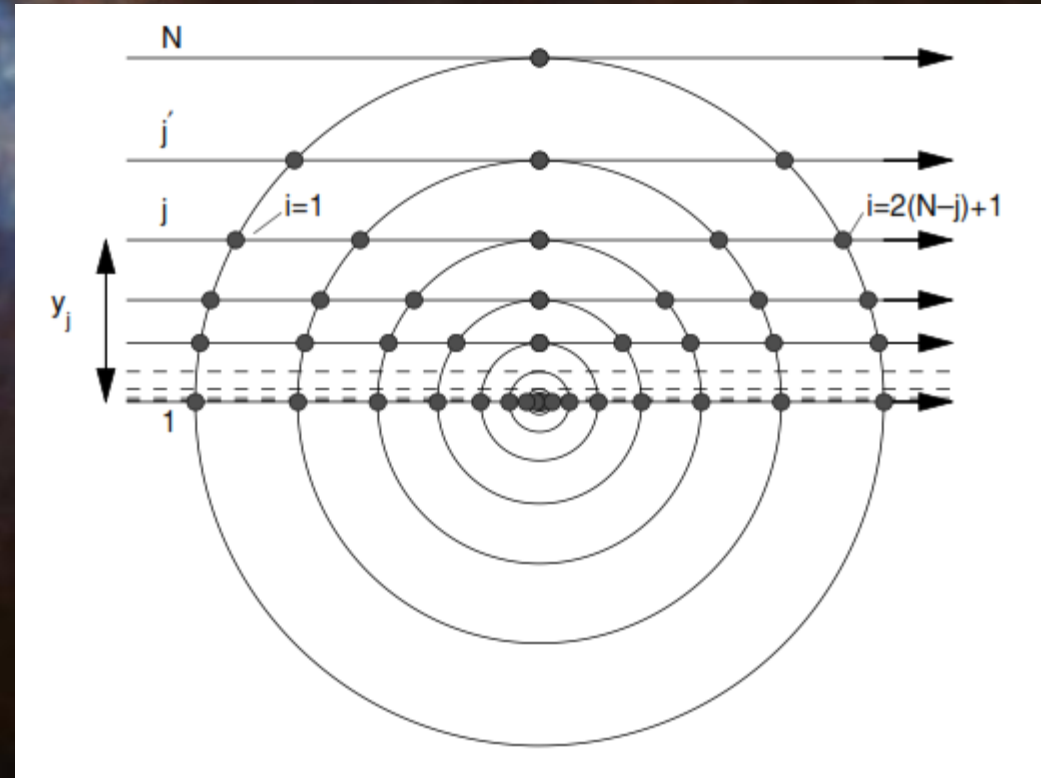


Moguća poboljšanja

1. Spacijalna distribucija materije
preferirani model:

$$\rho_i(r) = \rho_{0,i} \left[1 + \left(\frac{r}{r_{c,i}} \right)^2 \right]^{-\gamma_i}$$

2. Generisanje spektra na osnovu SSP-a
 - Ray-tracing prenos zračenja
 - Upotreba DUSTY koda



Hvala na pažnji!

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