A Nearby Galaxy Perspective on Dust Evolution

Frédéric GALLIANO

& the DustPedia collaboration

AIM, CEA/Saclay, France

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Dust Content of Galaxies: the Potential of NIKA2

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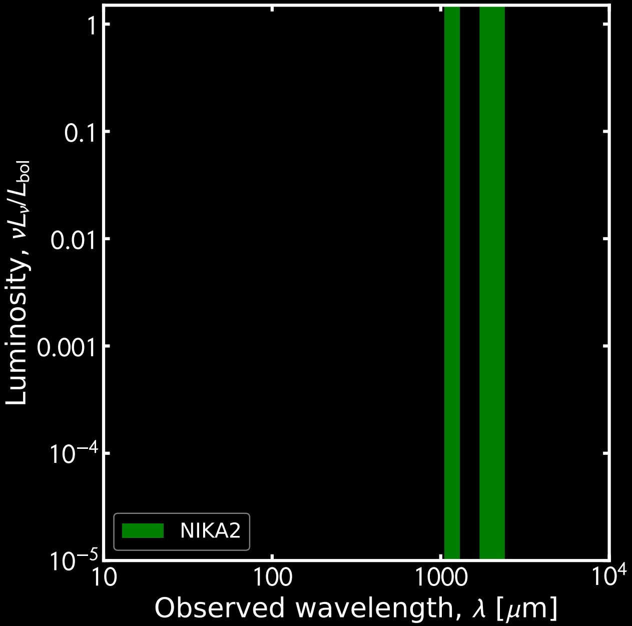

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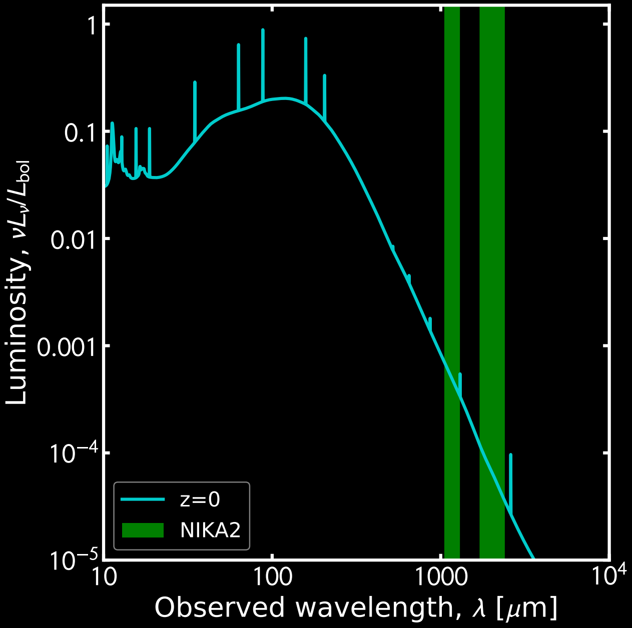

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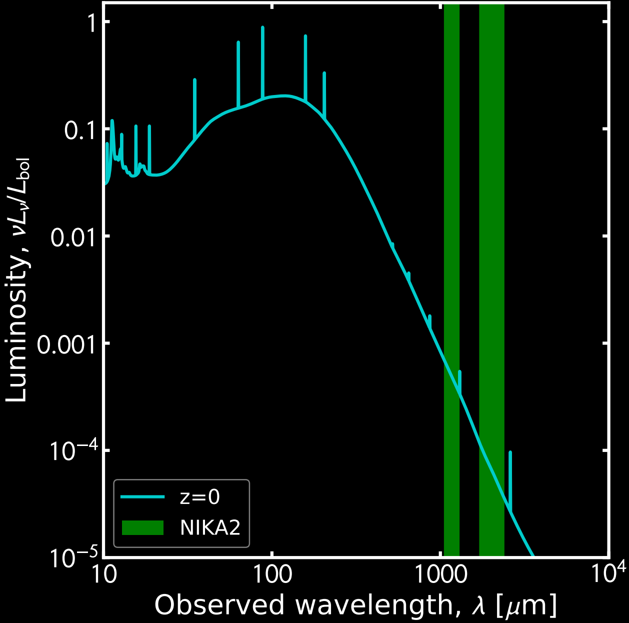

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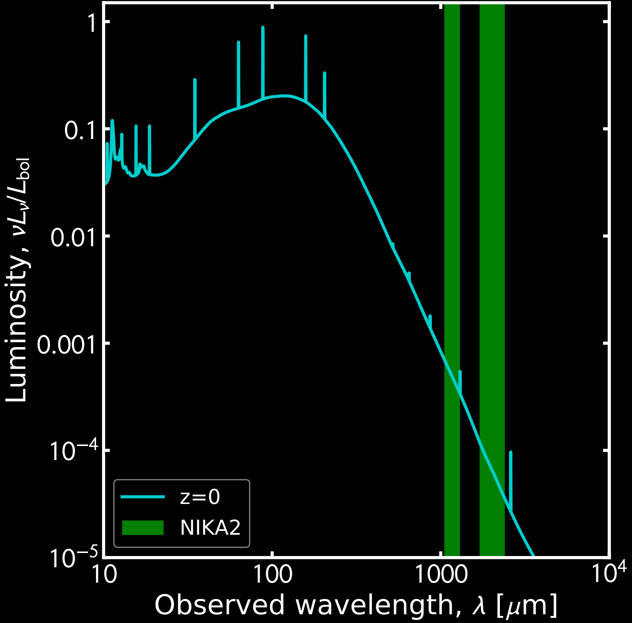

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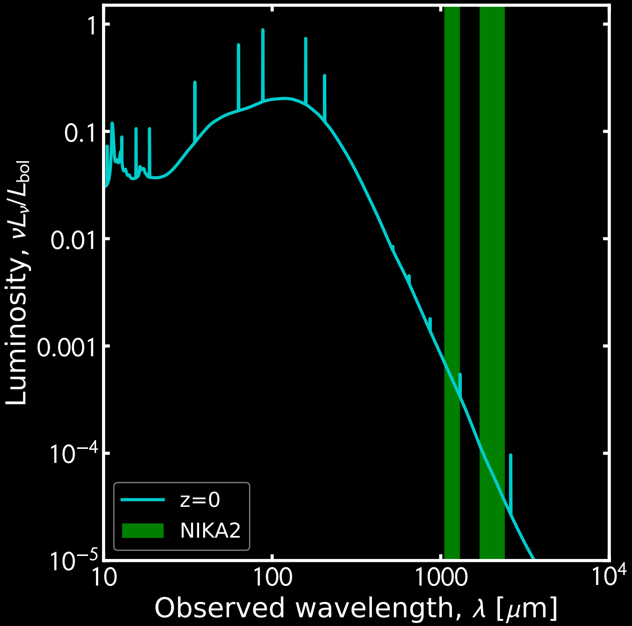

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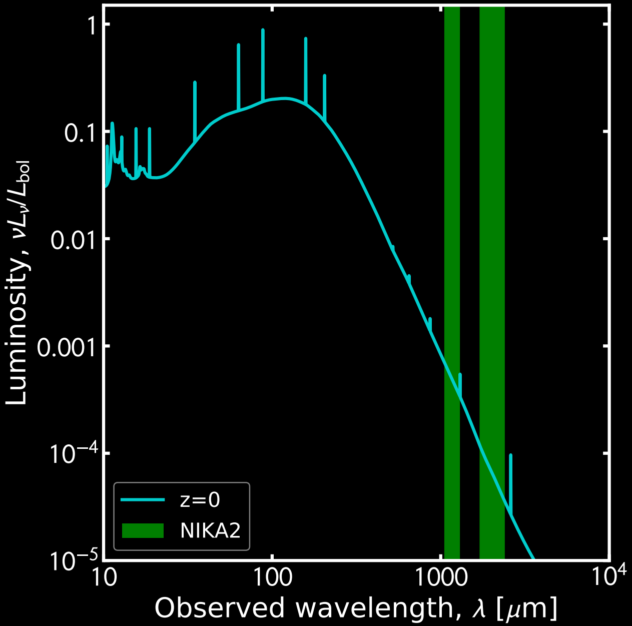

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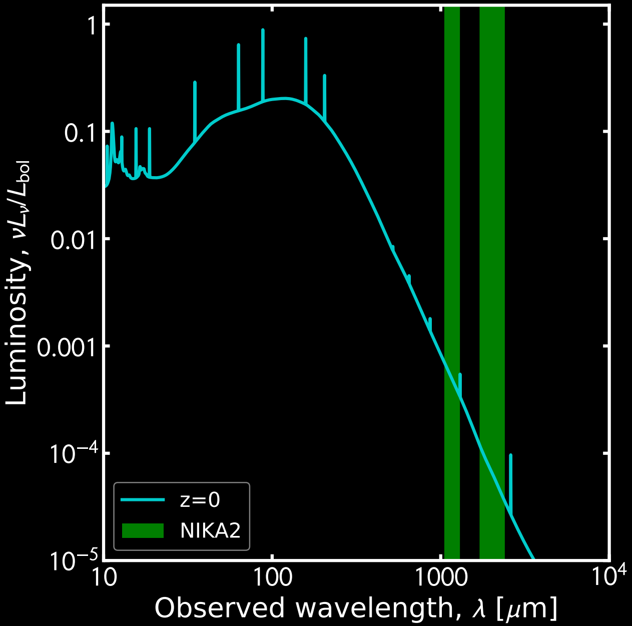

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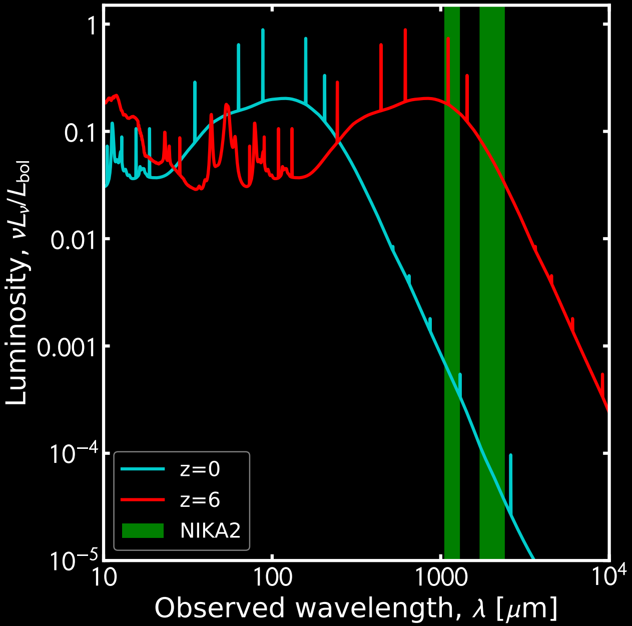

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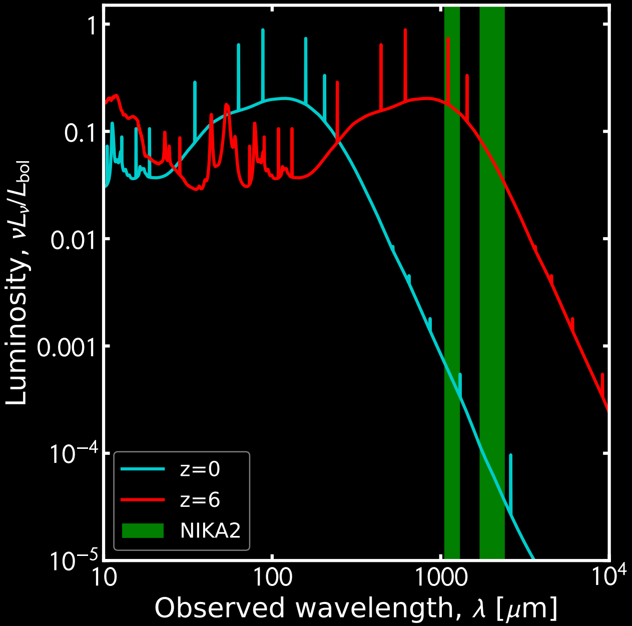

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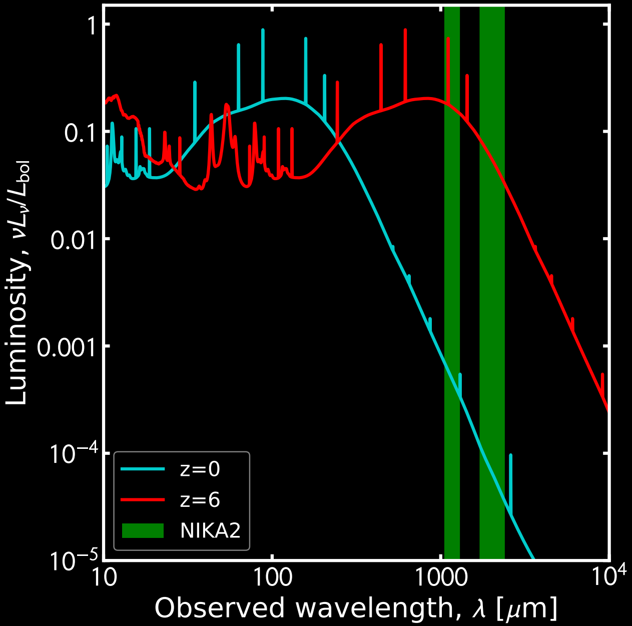

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$\Rightarrow$ understand its evolution in galaxies.

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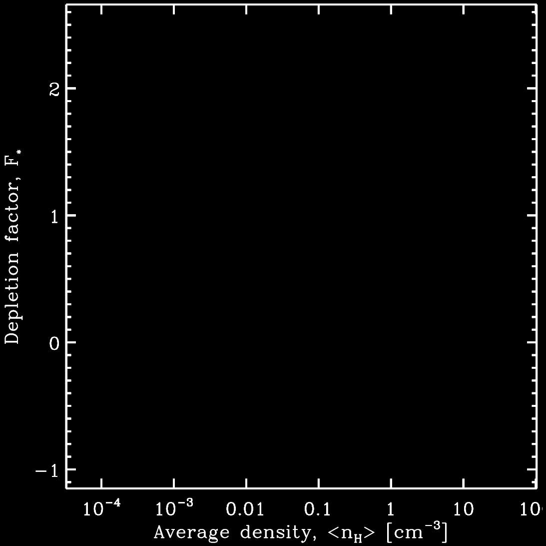

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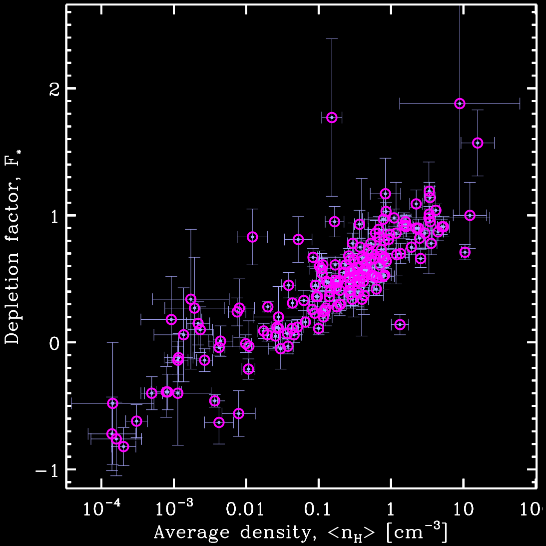

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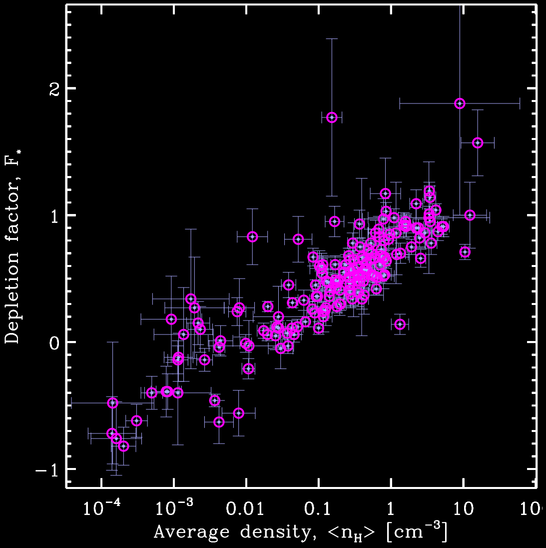

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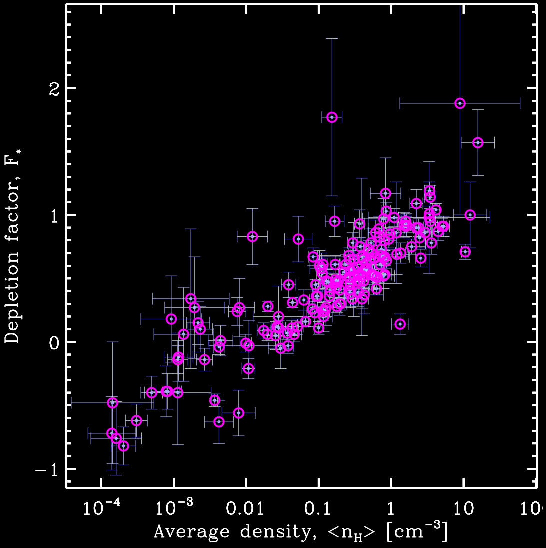

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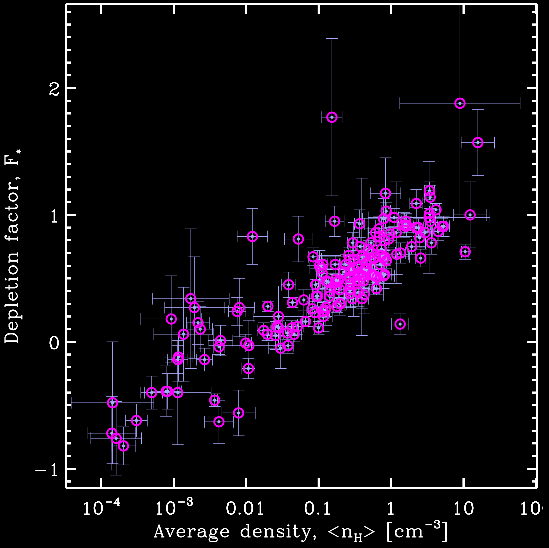

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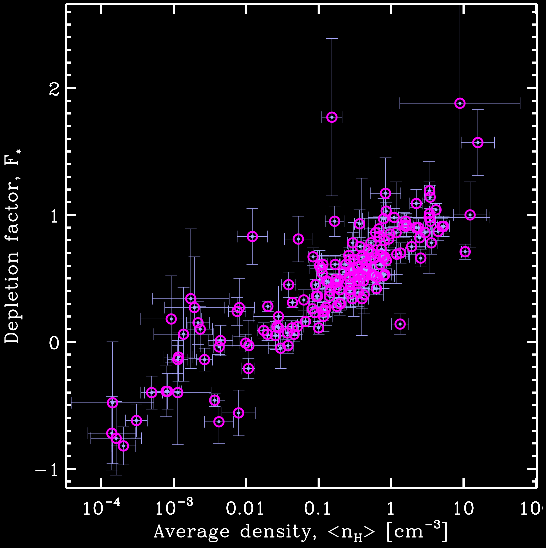

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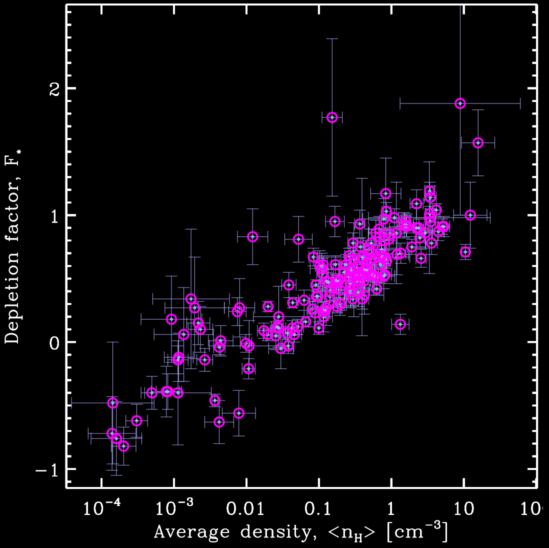
$\Rightarrow \simeq 10\,\%$ stardust (SN II & AGB).



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The Dust Life Cycle

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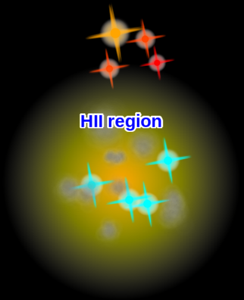

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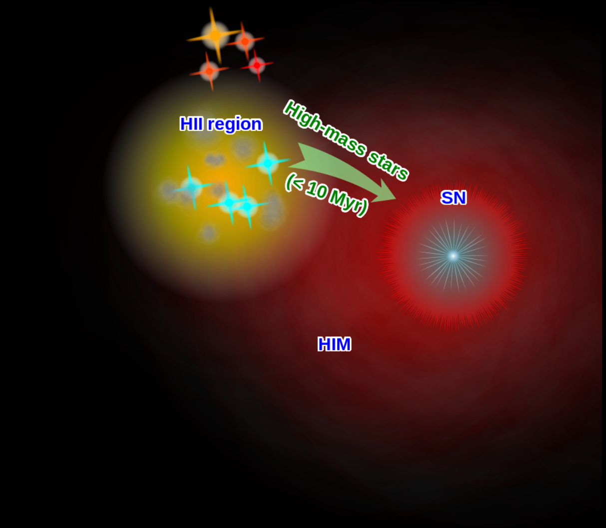

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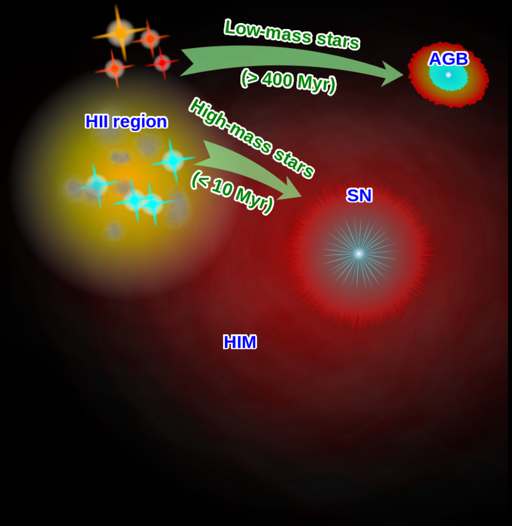

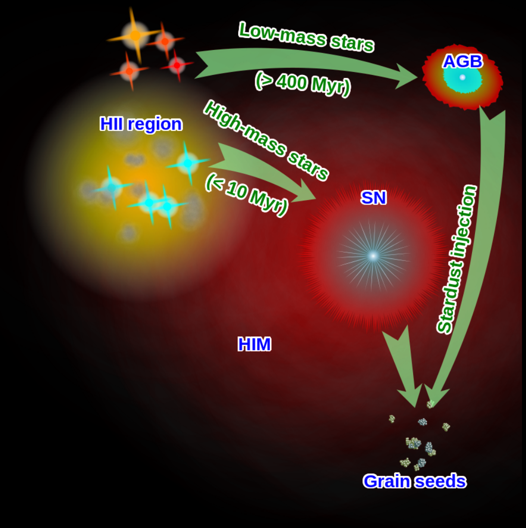

Low-mass stars
(> 400 Myr)
AGB
HII region
High-mass stars
(< 10 Myr)
SN
Stardust injection
HIM
Grain seeds

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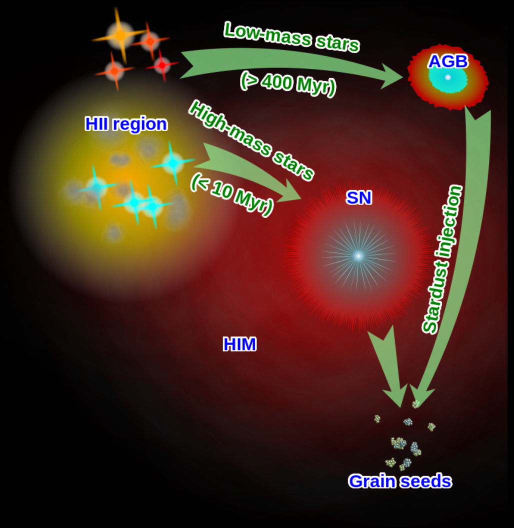

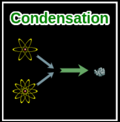

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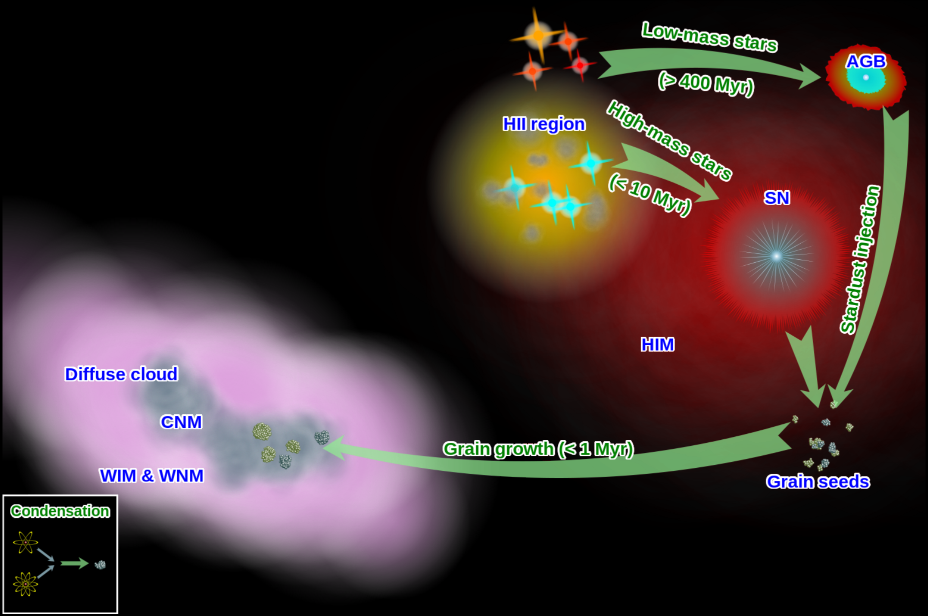

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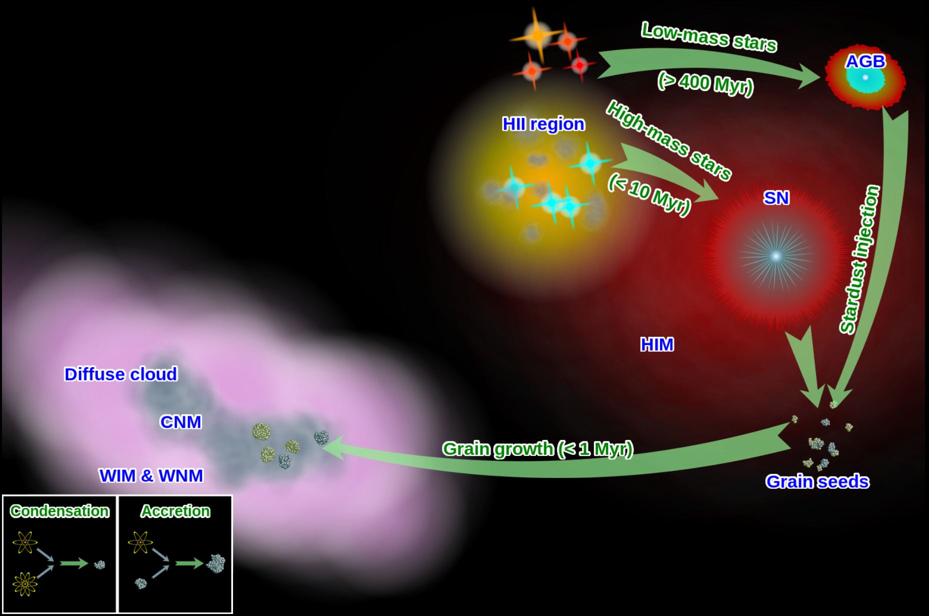

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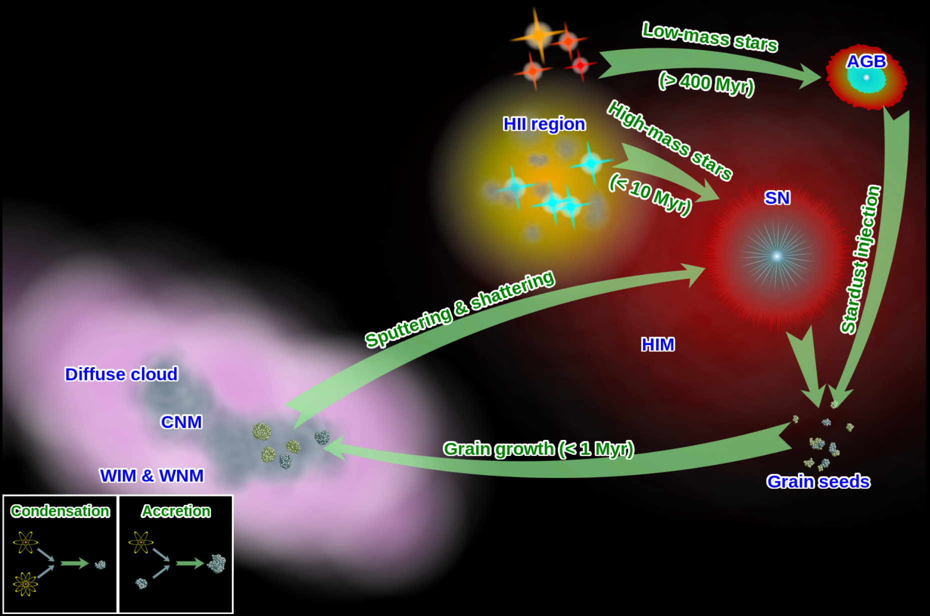

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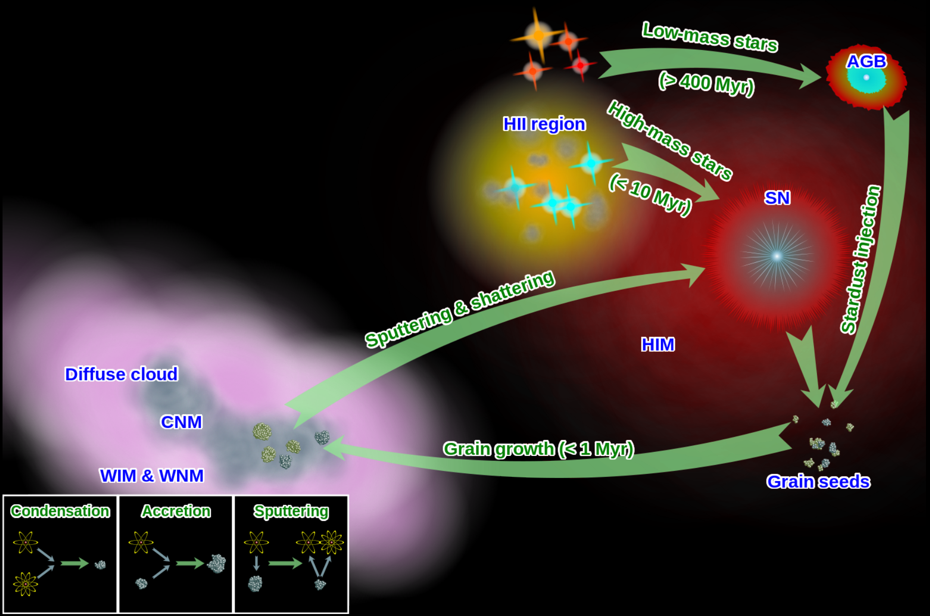

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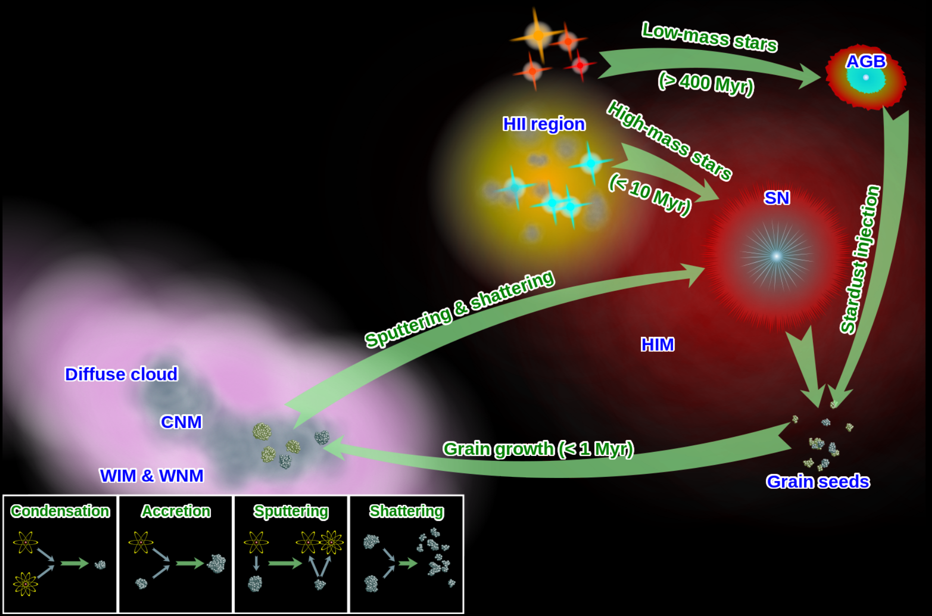

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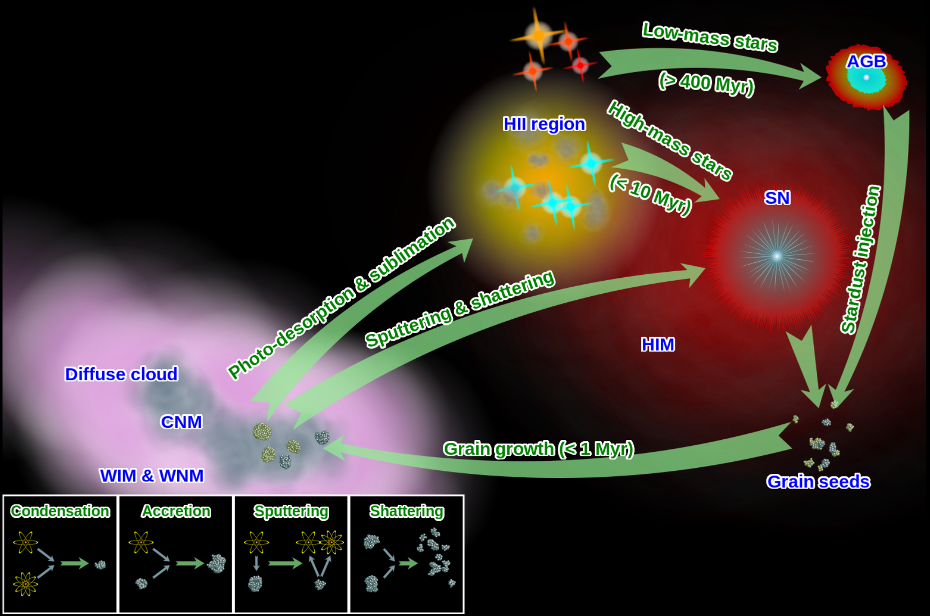

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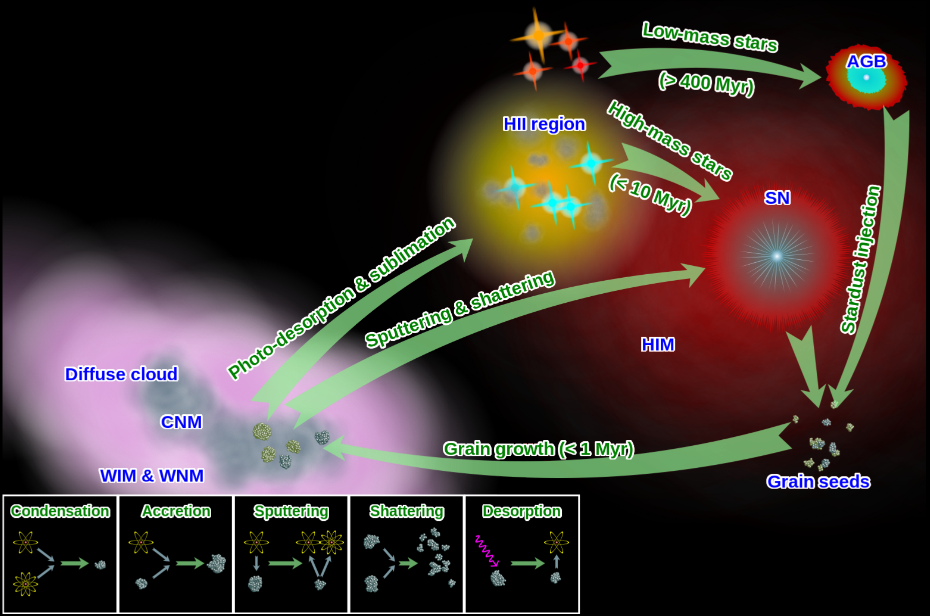

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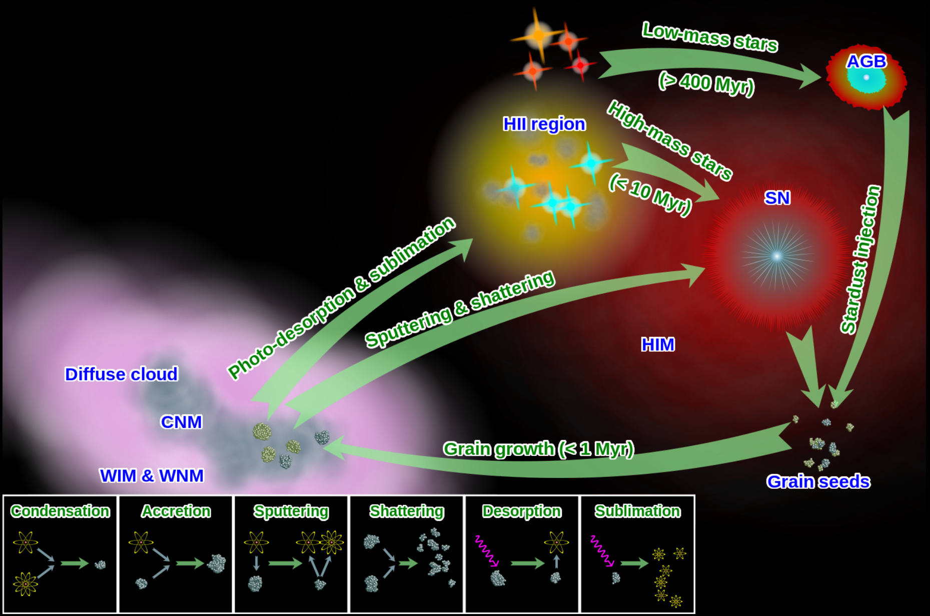

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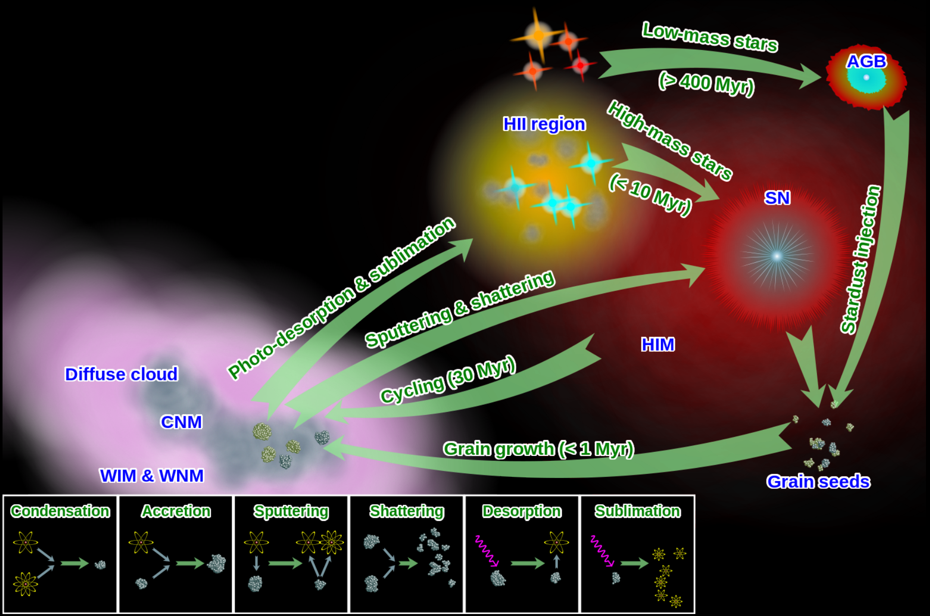

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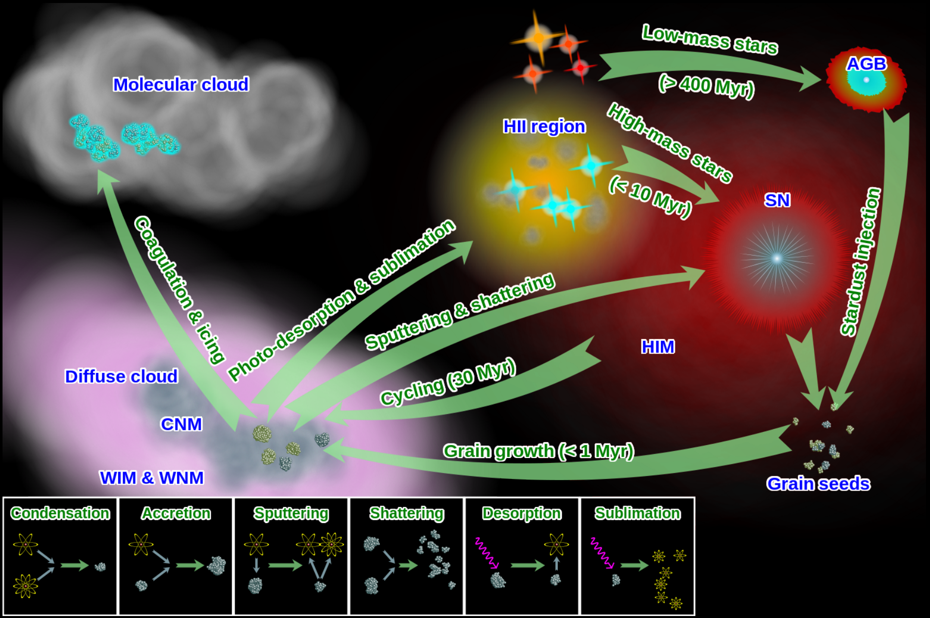

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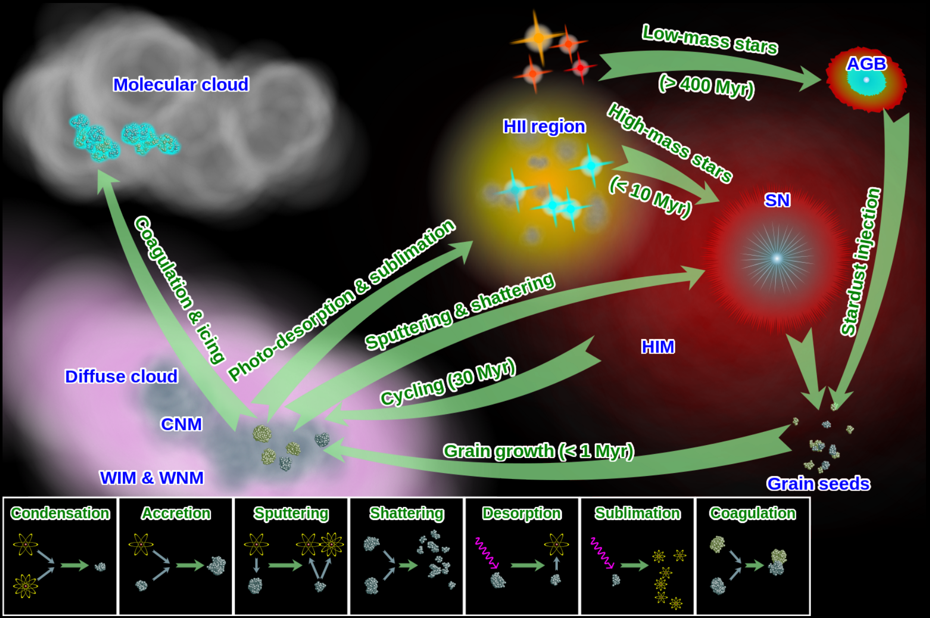

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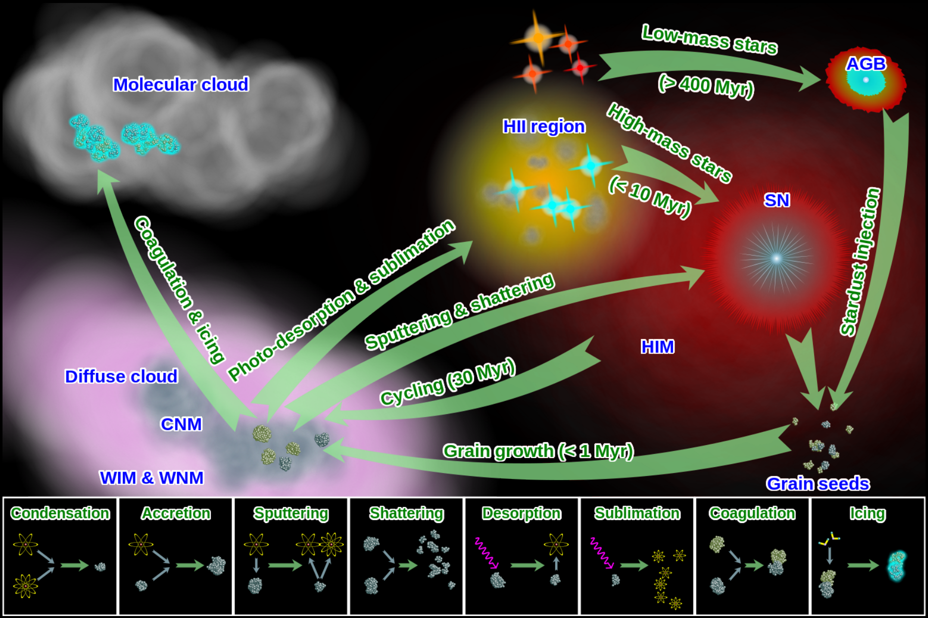

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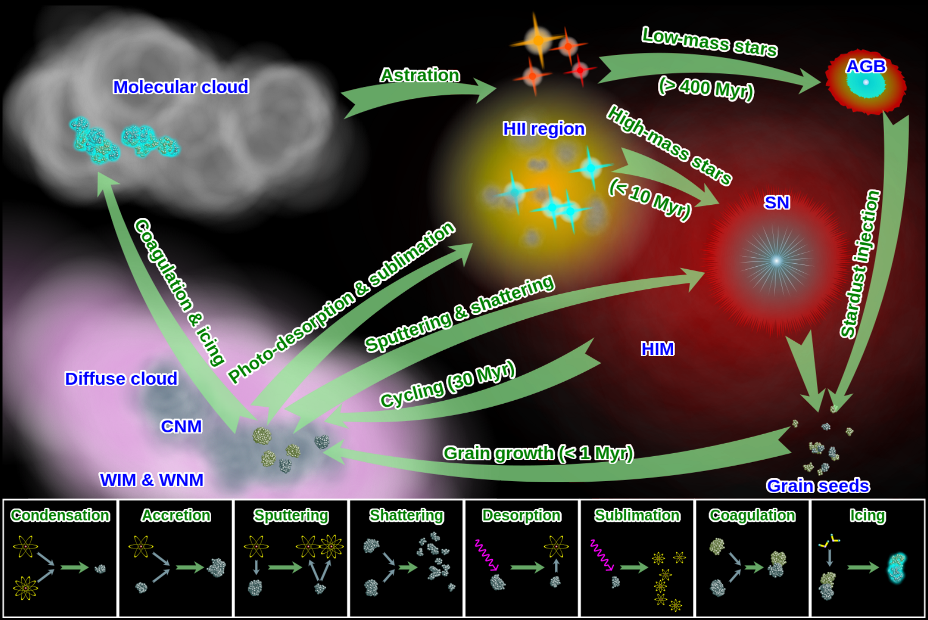

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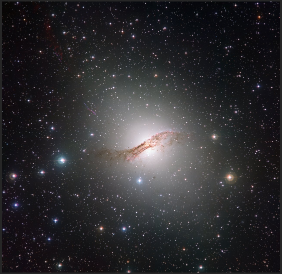

Elliptical/Lenticular
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- 875 DustPedia galaxies observed by *Herschel* (photometry from Clark *et al.*, 2018).
- \- 89 galaxies with all IR fluxes flagged.
- \- 22 AGNs classified by Bianchi *et al.* (2018).

⇒ 764 DustPedia galaxies.

Galaxies from the Dwarf Galaxy Sample (DGS; Madden *et al.*, 2013):

- \+ 33 galaxies not in DustPedia (photometry from Rémy-Ruyer *et al.*, 2013).

⇒ 798 galaxies in total.

Ancillary Data Used as *Prior Dependencies*:

- Metallicity by De Vis *et al.* (2018; PG16S calibration).
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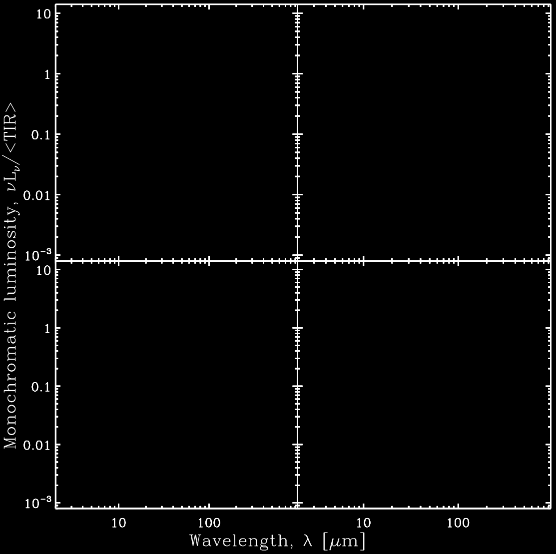

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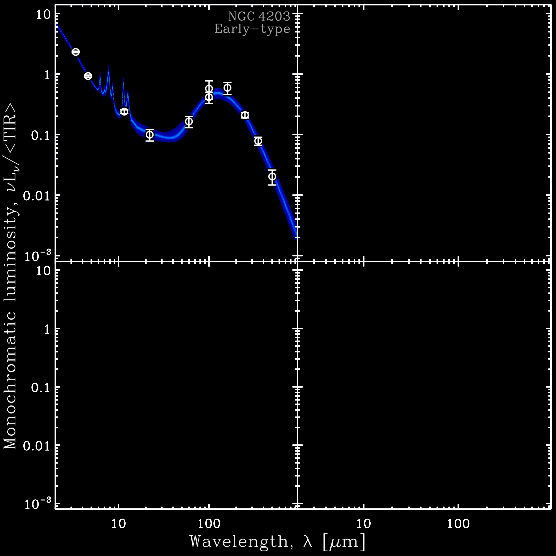

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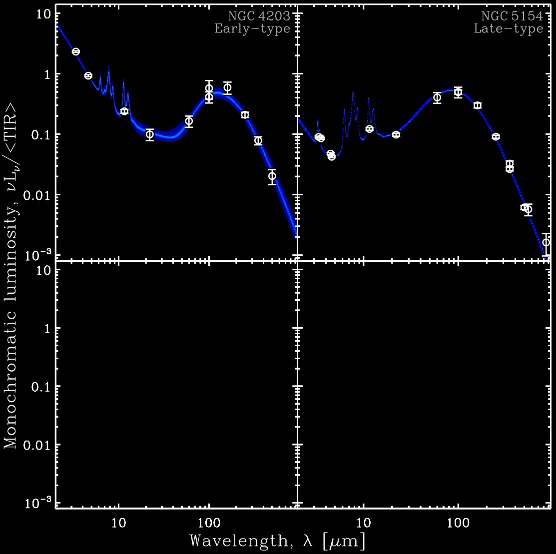

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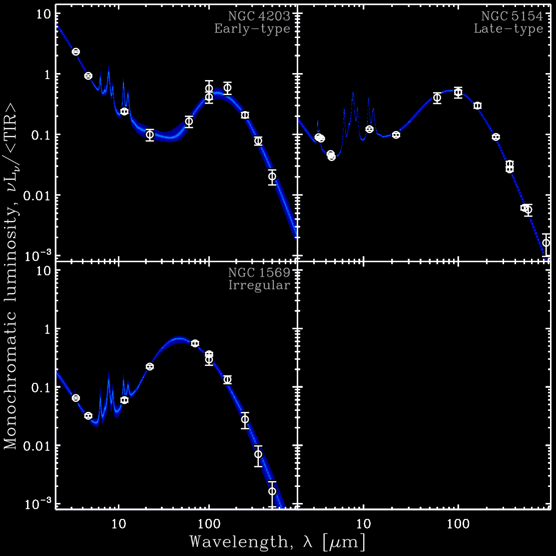

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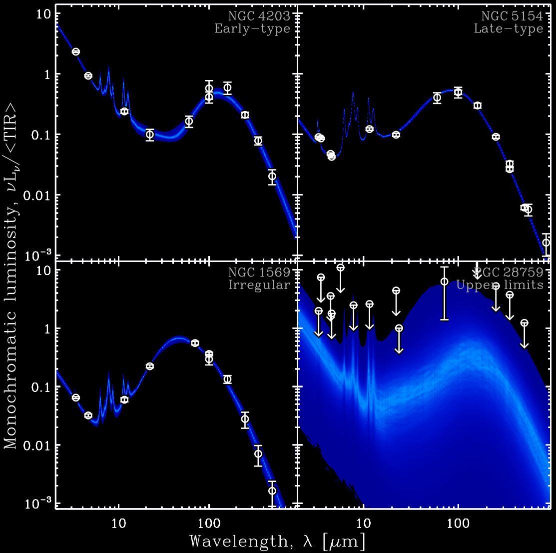

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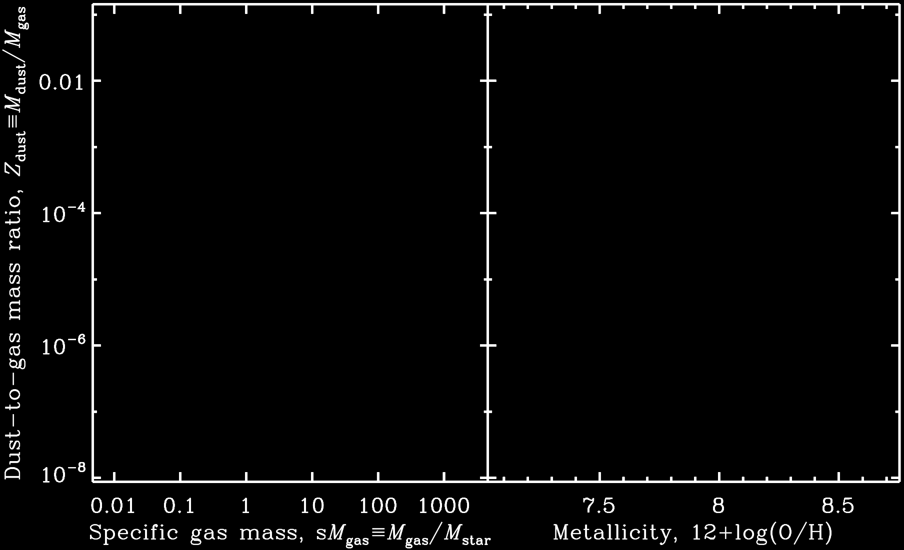
The Derived Scaling Relations



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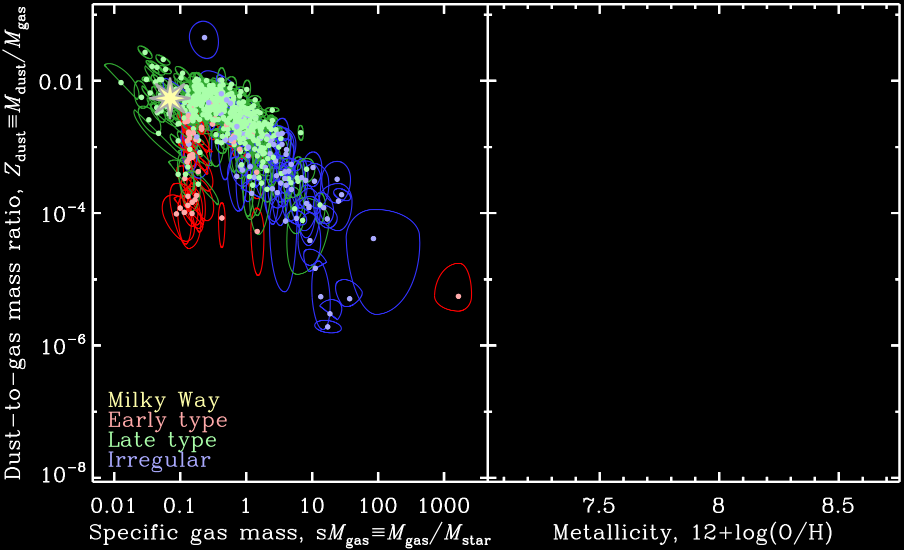

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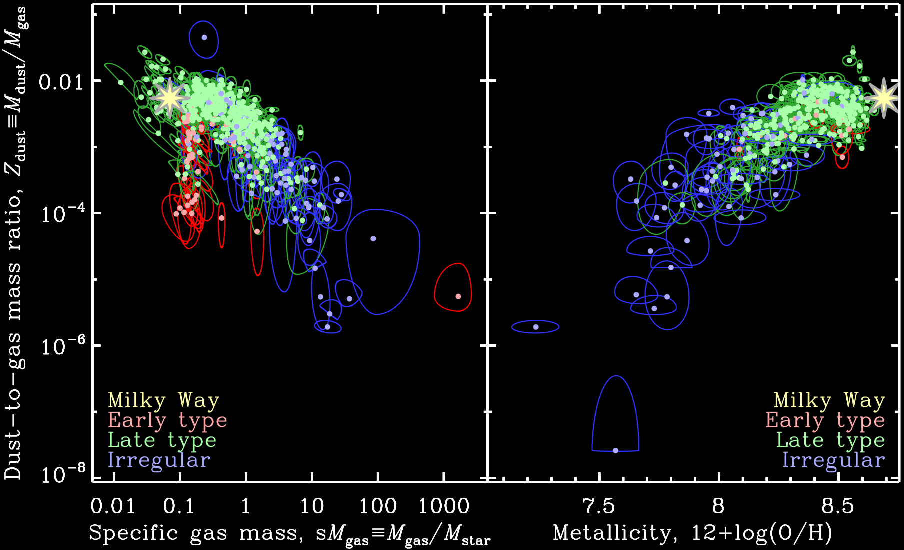

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Modelling Dust Evolution in Galaxies

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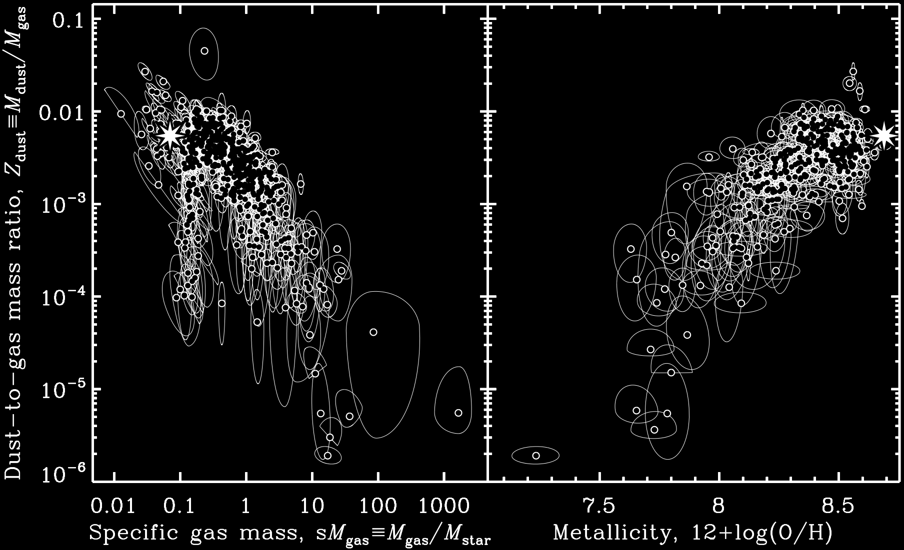
The Fitted Dust Evolution Tracks



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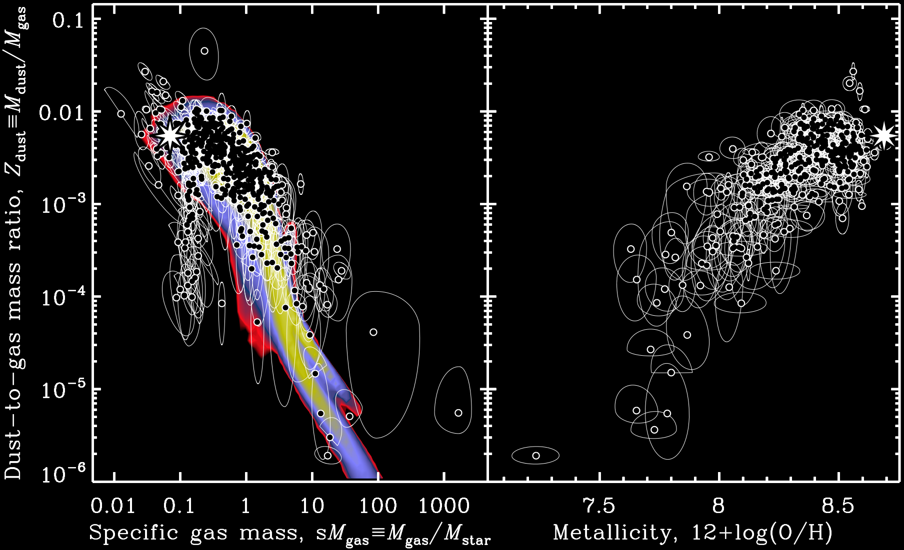

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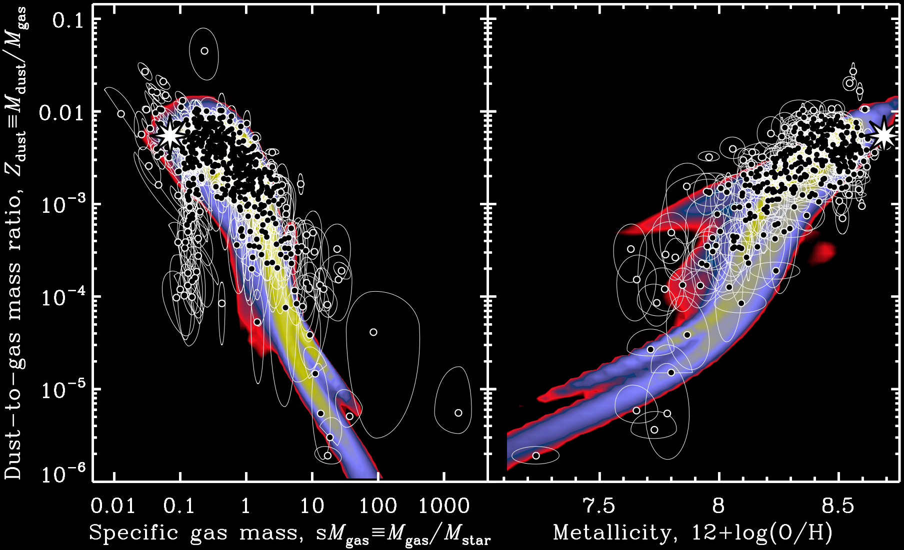

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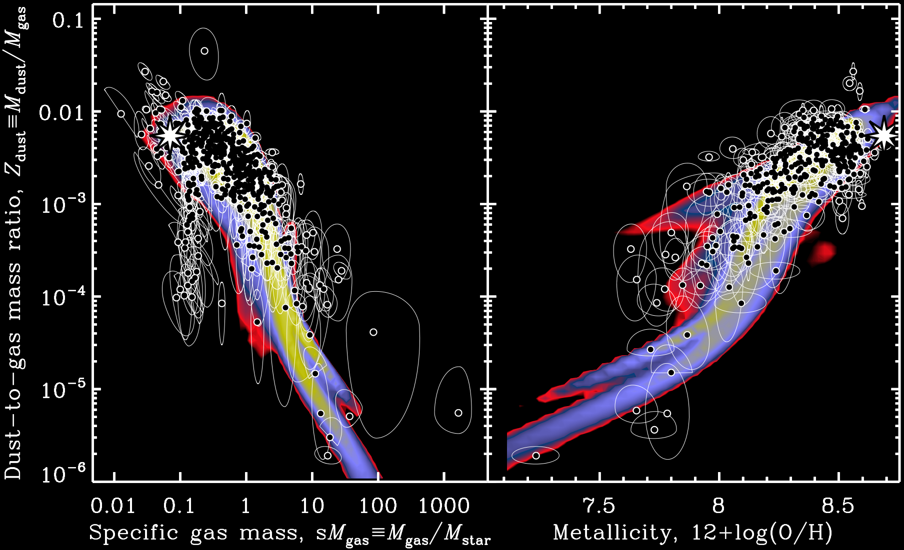

⇒ Low-Z regime crucial to constrain $\langle Y_{SN} \rangle$.

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Inference of Dust Evolution Parameters

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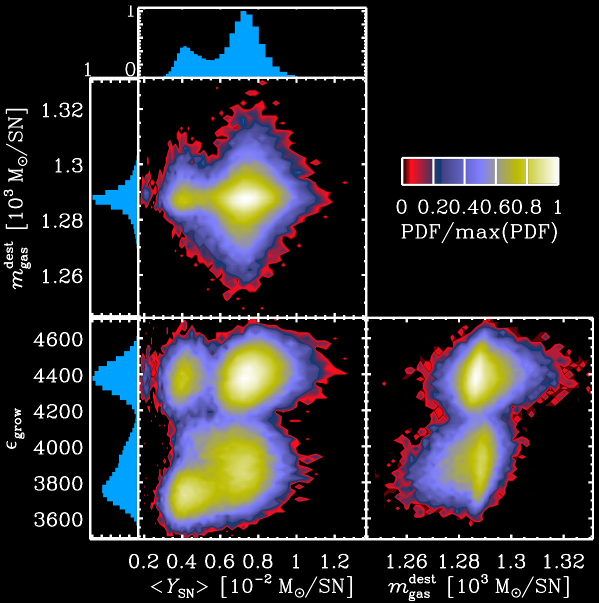

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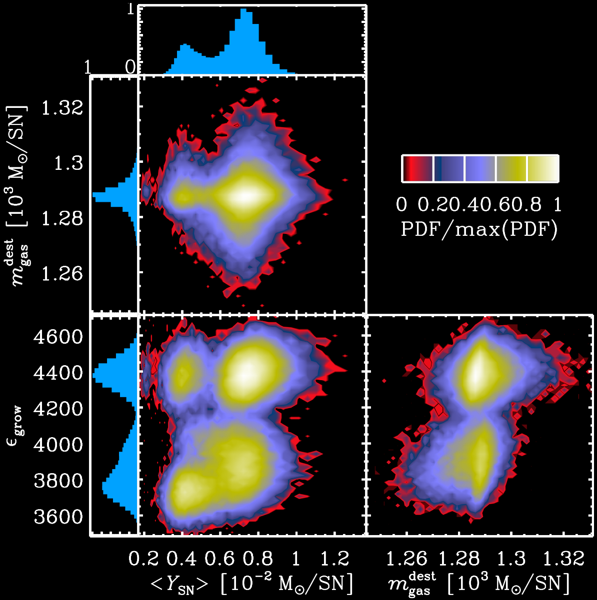

Accounting for systematics:

- $\langle Y_{SN} \rangle \lesssim 0.03\ M_\odot$/SN;
- $\epsilon_{grow} \gtrsim 3000$;
- $m_{gas}^{dest} \gtrsim 1200\ M_\odot$/SN.

(for a Salpeter IMF).

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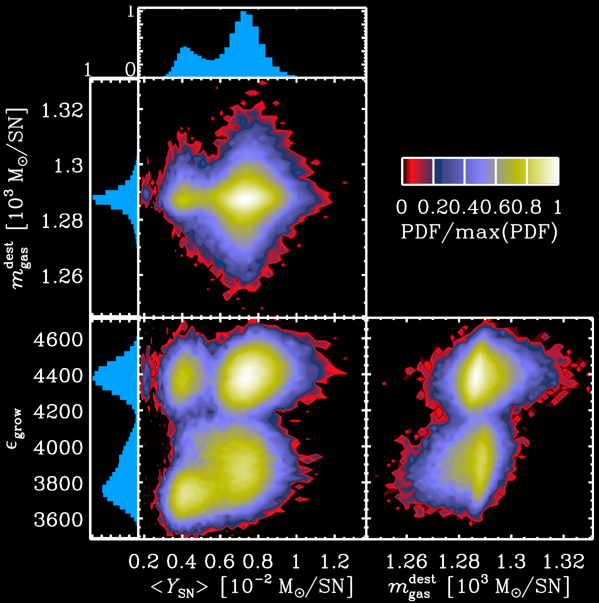

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Sensitivity to IMF:

Consistent results with Chabrier IMF, *provided that the SFR and $M_\star$ are estimated consistently.*

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Conclusion: Dust Evolution Timescales

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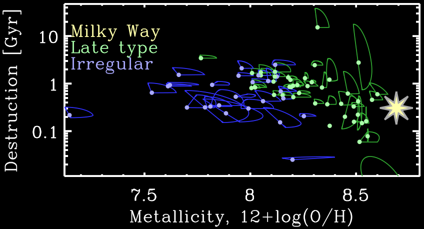

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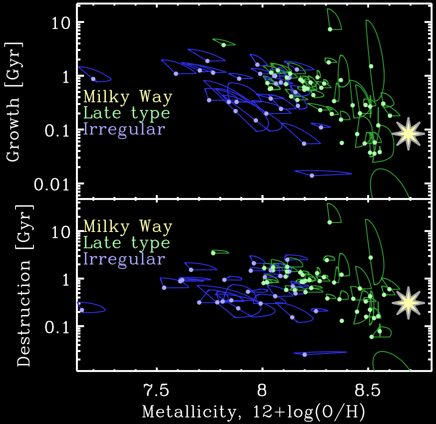

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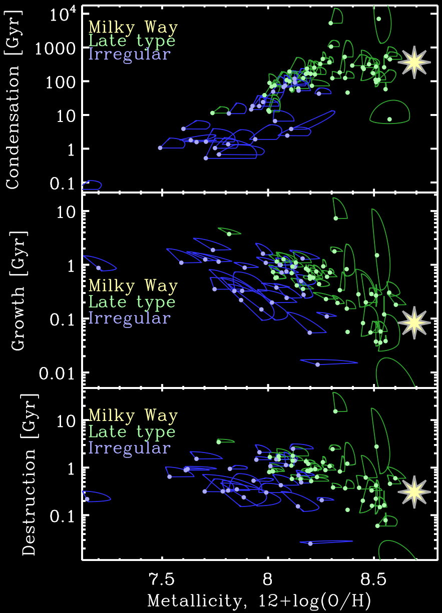

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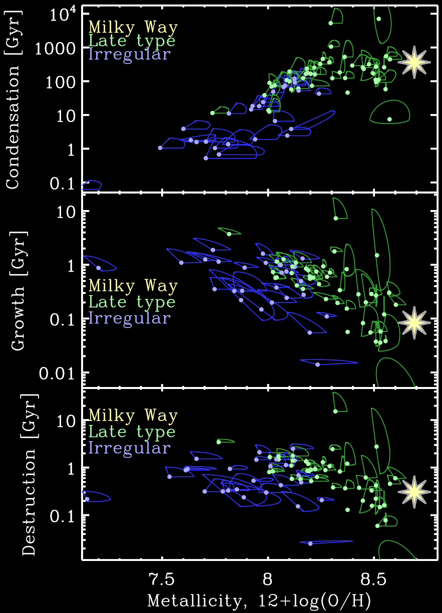

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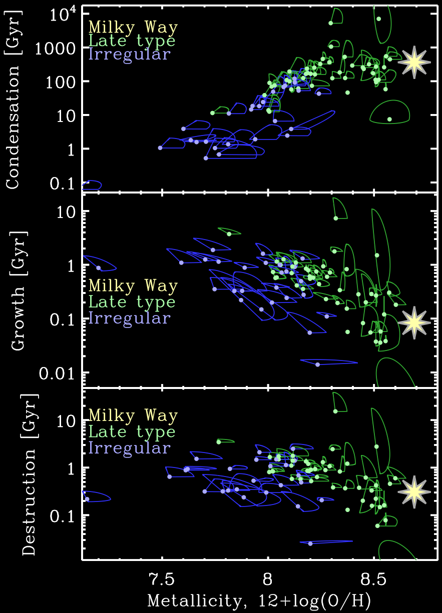

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Solar metallicity: consistent with what we know of the Milky Way $\Rightarrow$ rapid growth & destruction.

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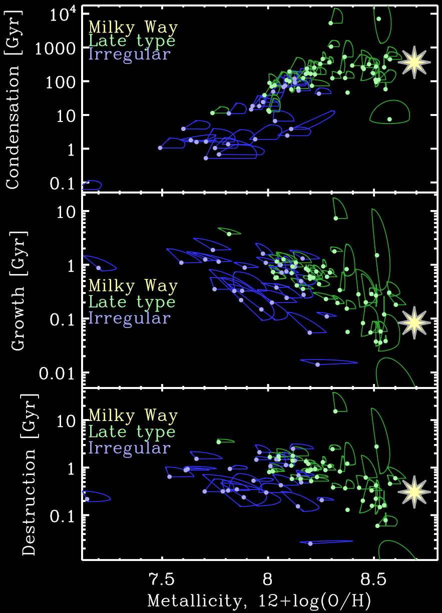

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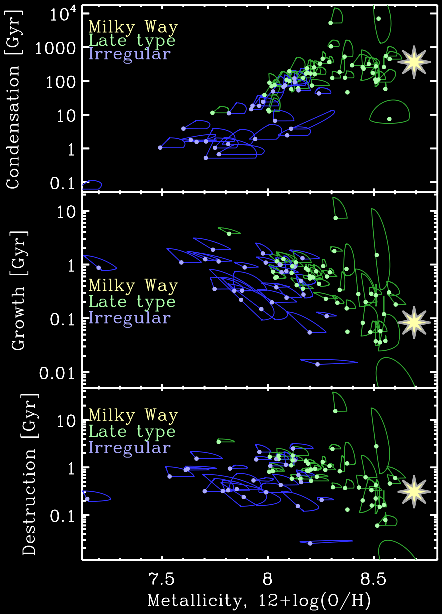

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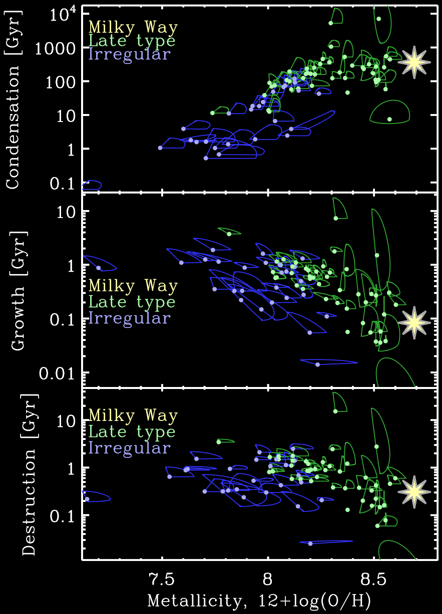

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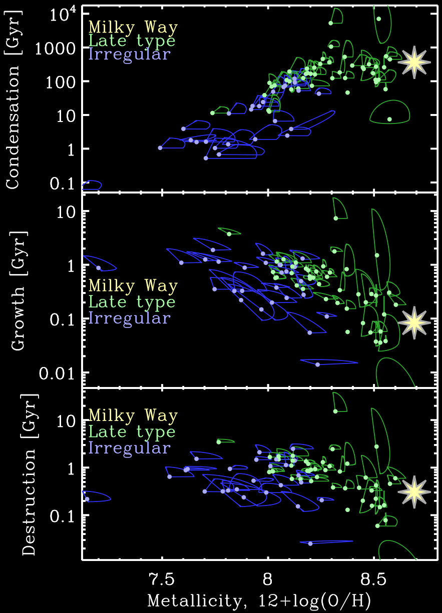

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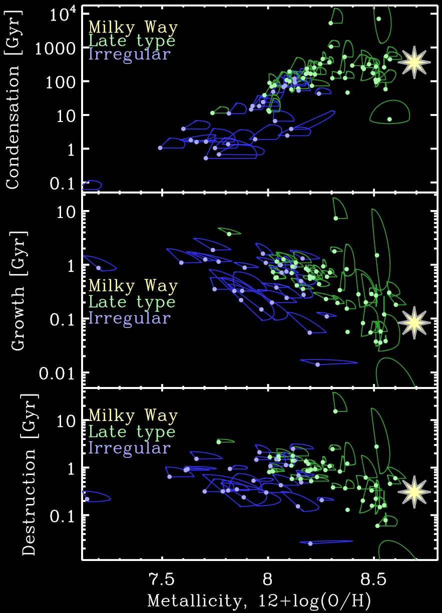

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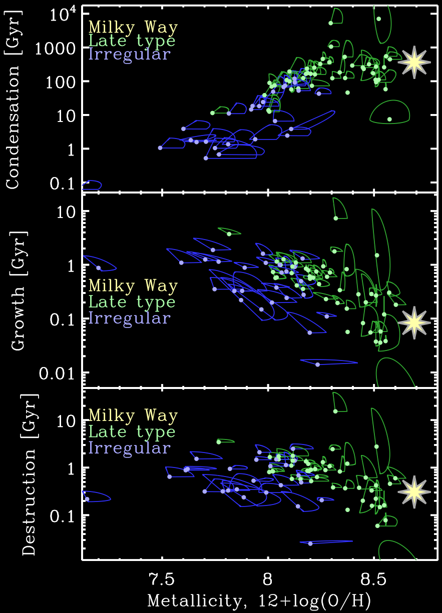

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(Galliano *et al.*, 2021)

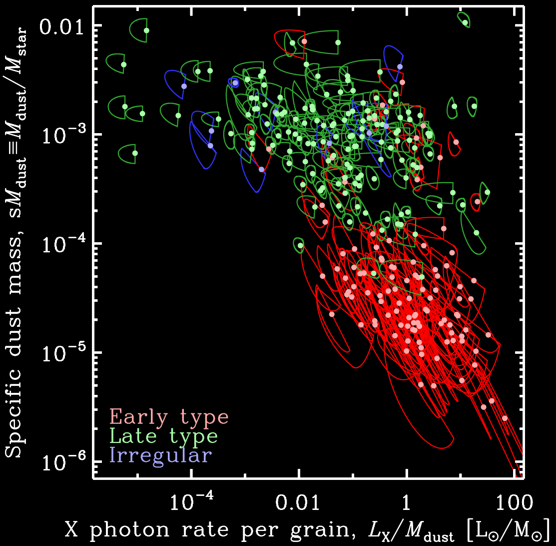
Evidence of Thermal Sputtering in Ellipticals

Peculiar trend of ellipticals:

- Dust deficient @ a given gas fraction;
- Their ISM is permeated by X-ray emitting coronal gas;
- Thermal sputtering could dominate (*e.g.* De Vis *et al.*, 2017).

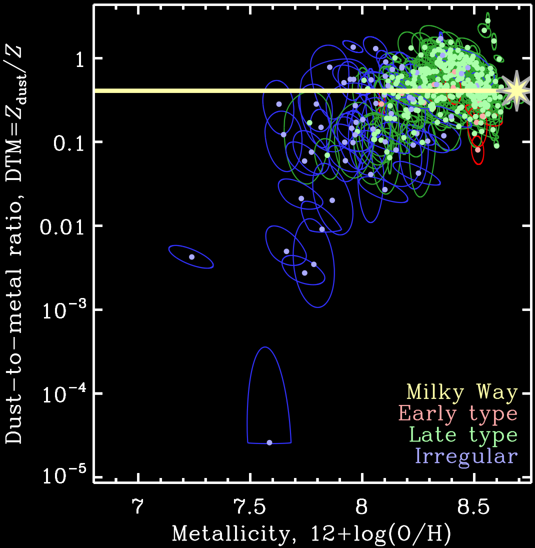
In our sample:

⇒ correlation w/ X-ray luminosity supports this hypothesis
⇒ exclude ellipticals from dust evolution modelling.



(Galliano *et al.*, 2021)

The Dust-to-Metal Mass Ratio Variations



(Galliano *et al.*, 2021)

Dust-to-metal ratio:

Fraction of elements locked in dust.

In our sample:

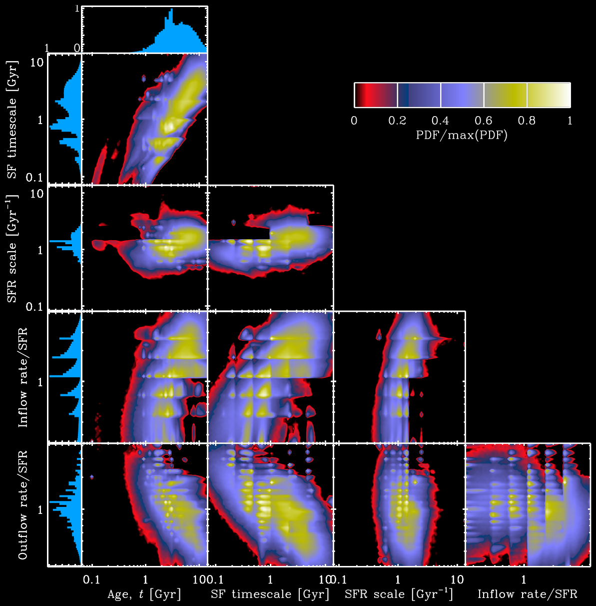
Clear variation with Z, by 2 orders of magnitude.

Possible biases:

- H I halo $\Rightarrow$ factor $\lesssim 1.5$;
- Grain opacity $\Rightarrow$ factor $\lesssim 2$;
- Size distribution $\Rightarrow$ factor $\lesssim 3$;
- Very cold dust $\Rightarrow$ unlikely.

$\Rightarrow$ factor $\lesssim 4.25 \ll 10^2$.

Inference of SFH-Related Parameters



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