Galactic Chemical Evolution

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2026.08.14

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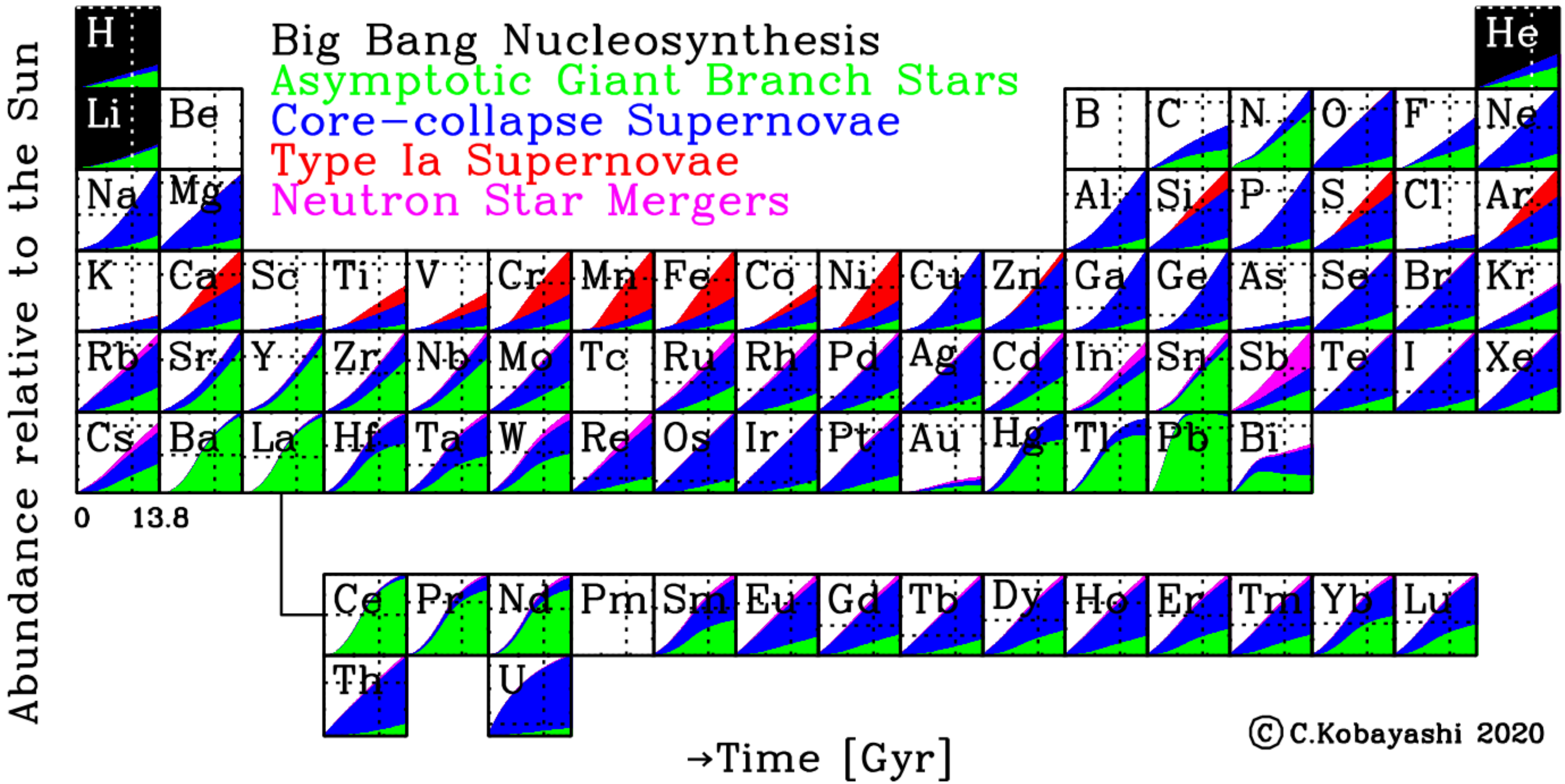
Galactic Chemical Evolution :

- GCE tries to explain how the chemical elements have formed and their abundances have evolved in time and distributed in space.



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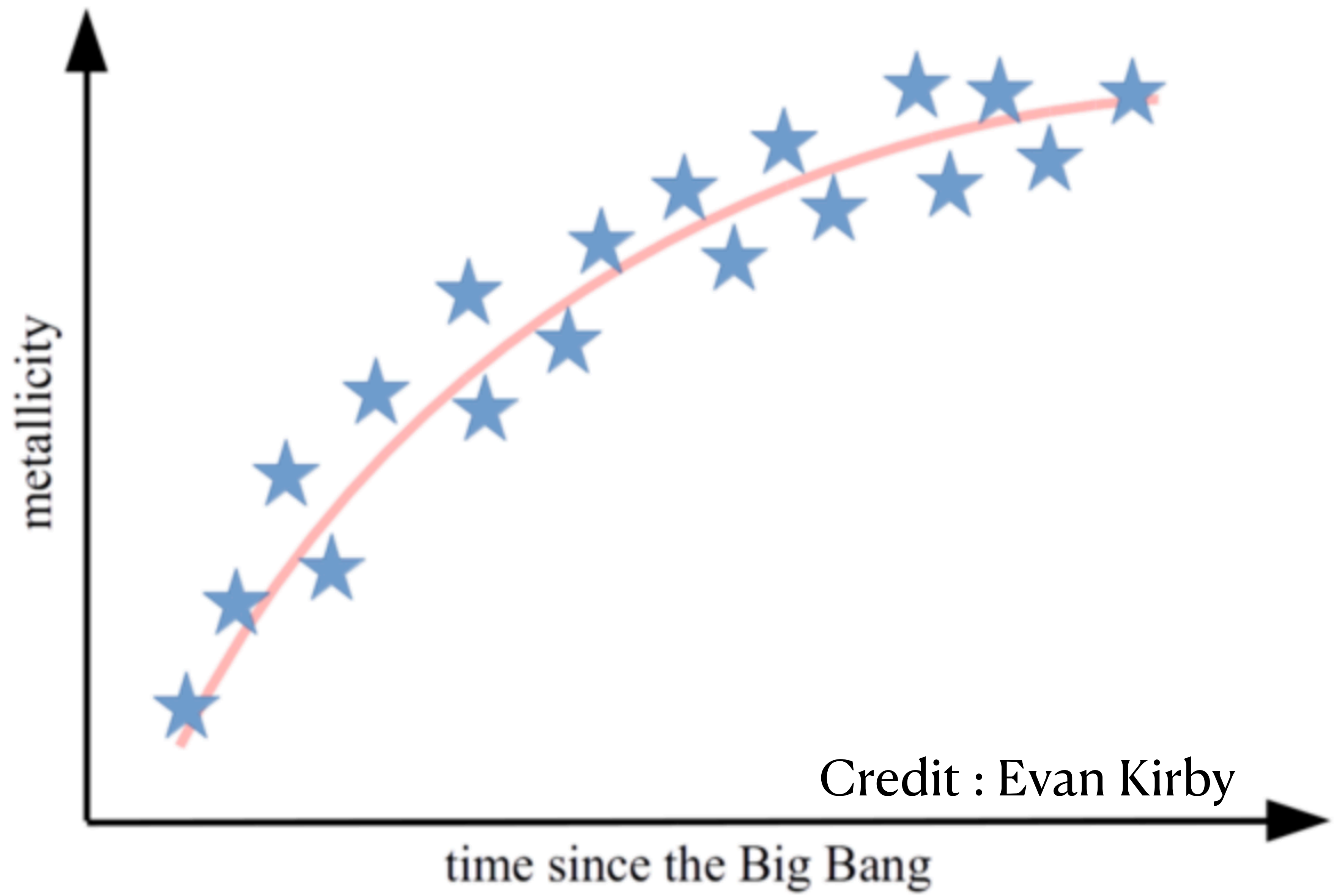

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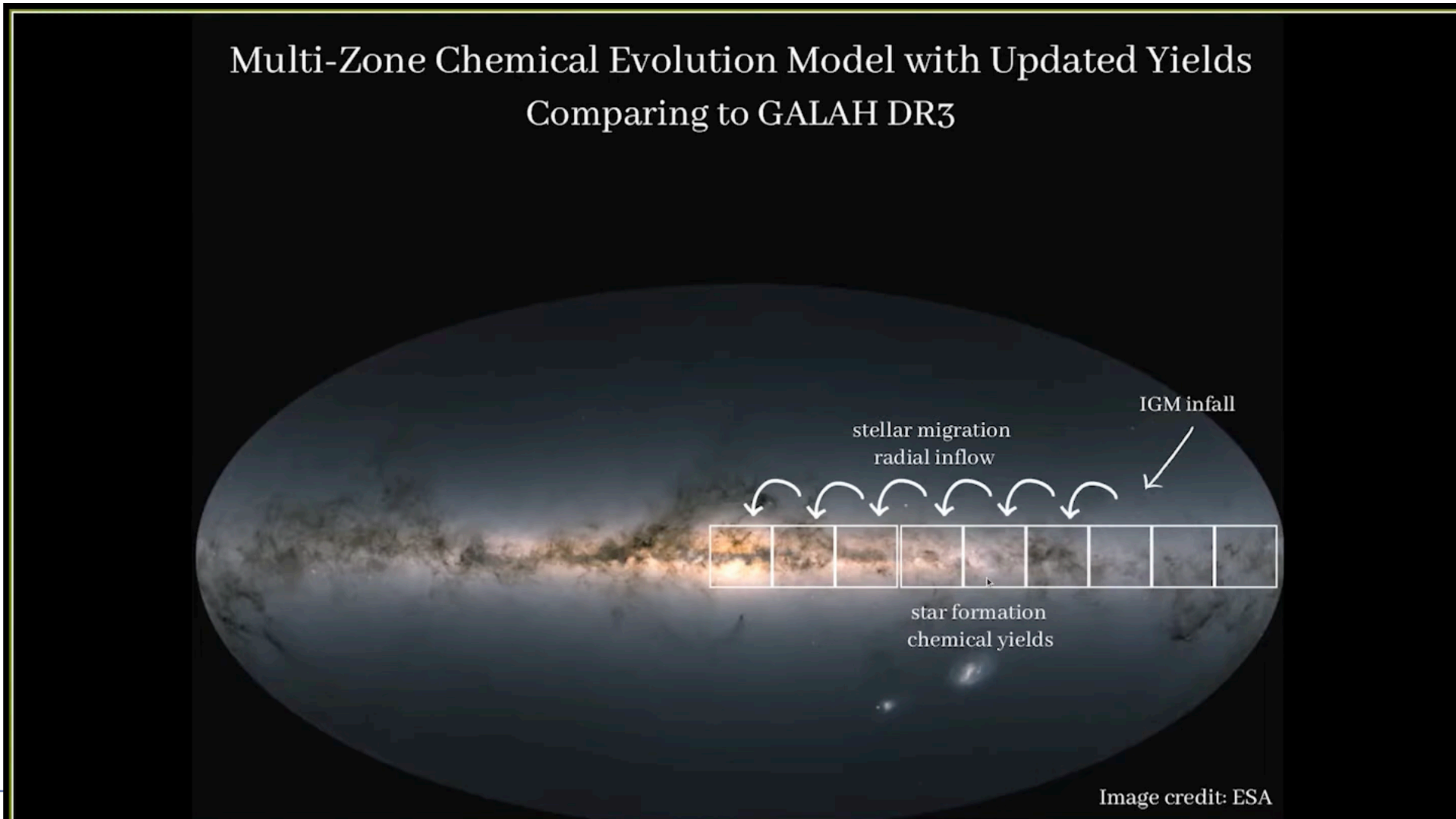
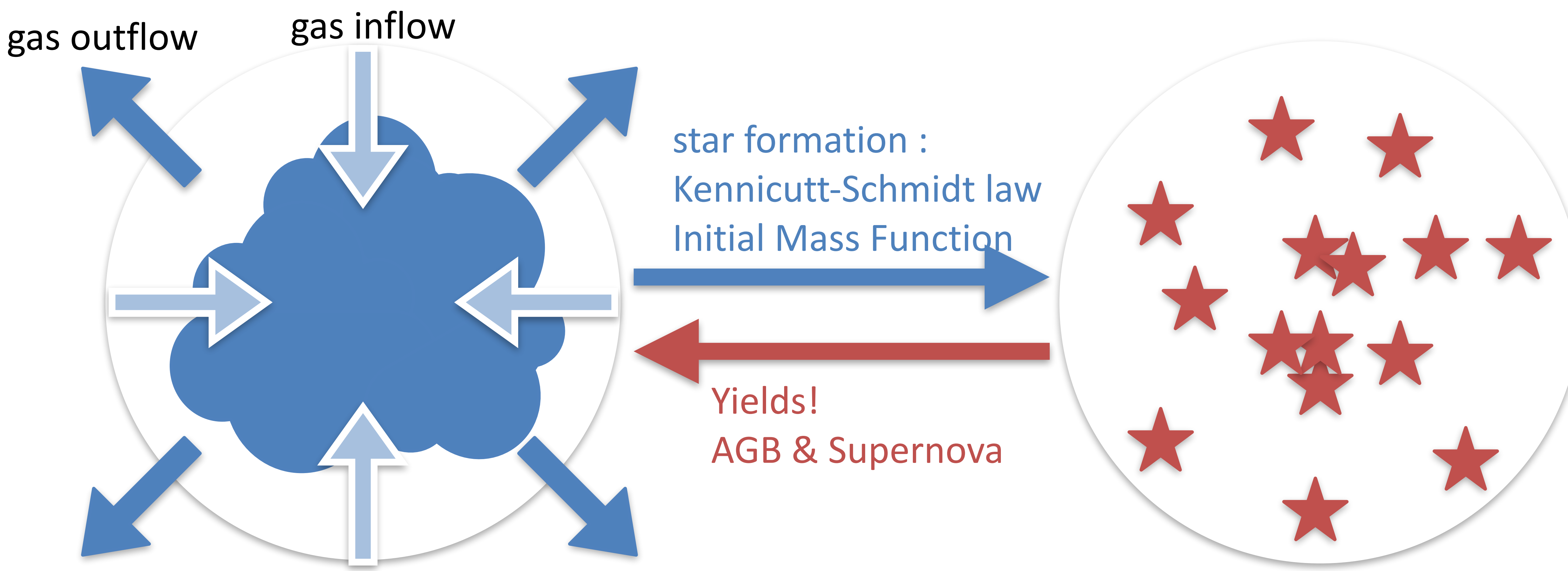


GCE models :

Basic ingredients:

Initial conditions, SFR, IMF, yields, Gas flows



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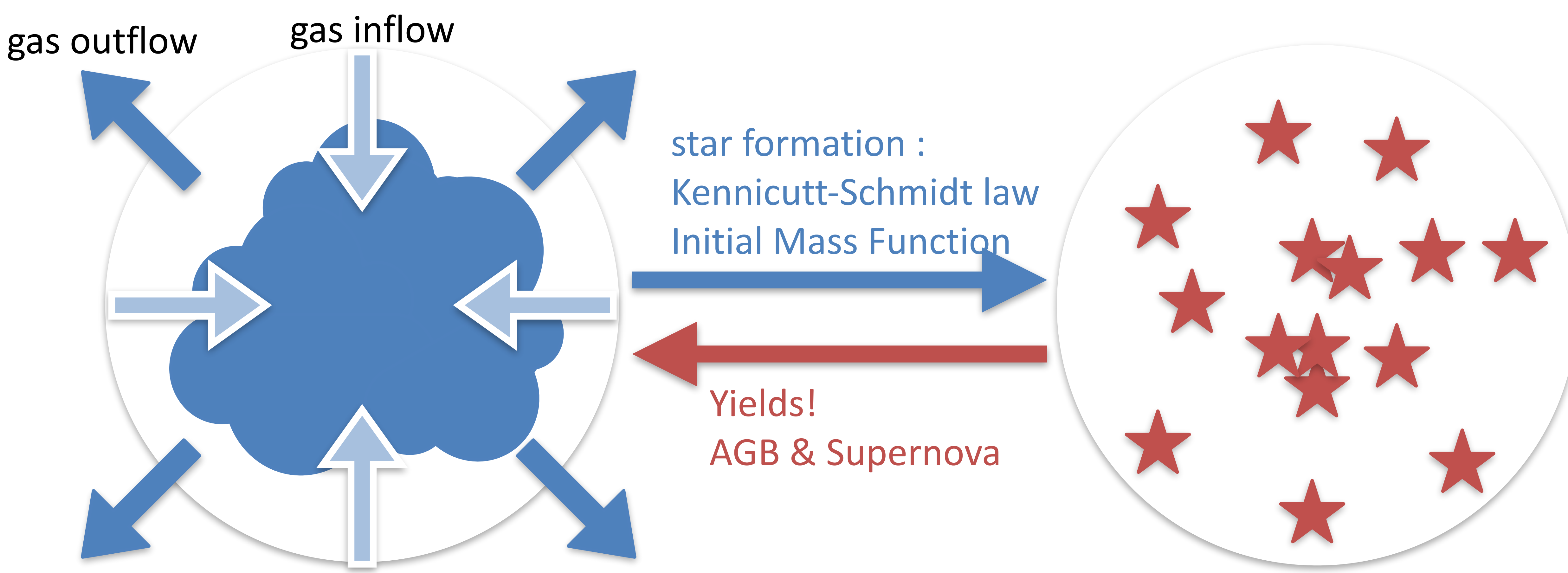


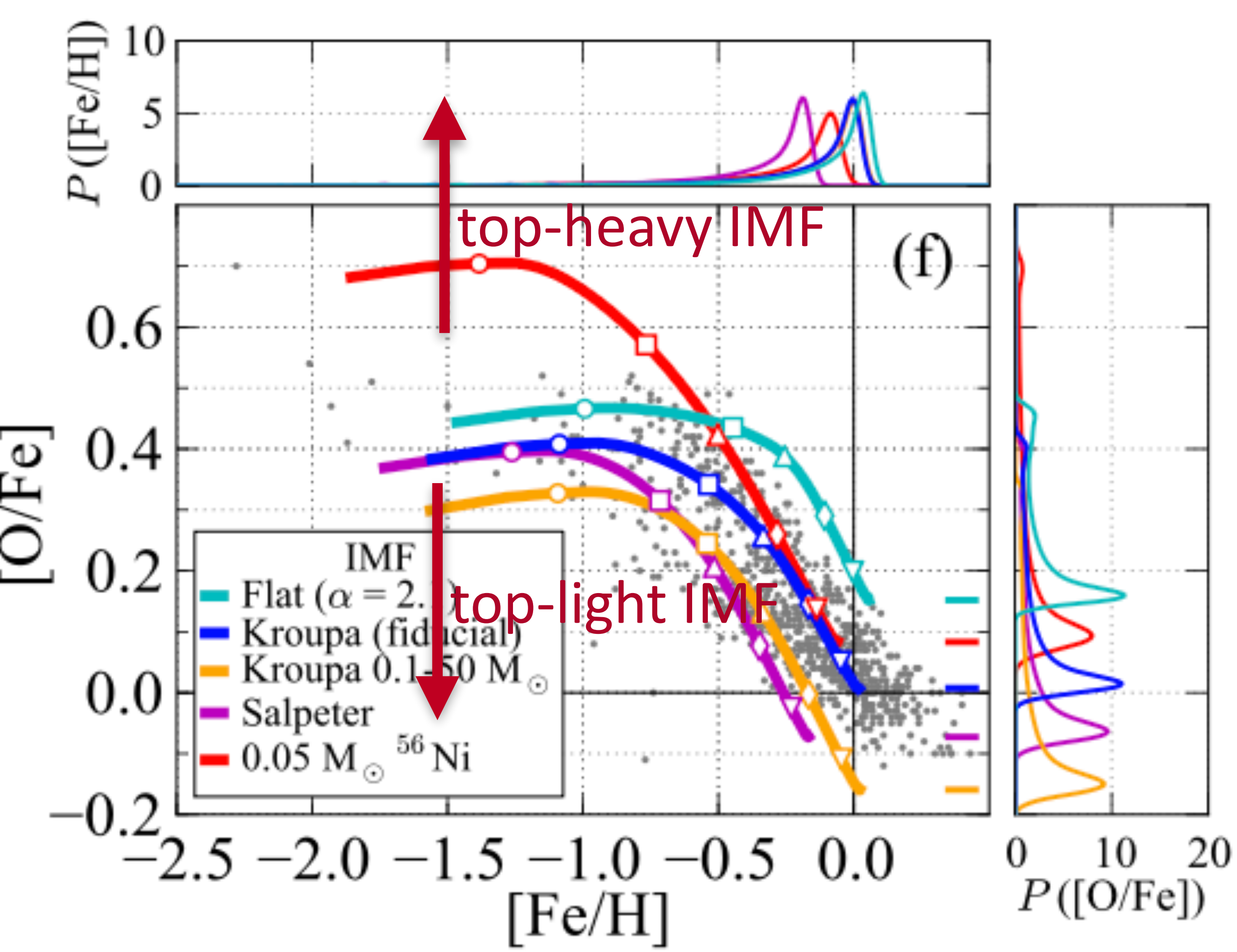
$$\dot{G}_i = \underbrace{-\,\psi(t)X_i(t)}_{\text{star formation}} + \overbrace{R_i(t)}^{\text{return}} + \underbrace{(\dot{G}_i)_{\rm inf}}_{\text{inflow}} - \overbrace{(\dot{G}_i)_{\rm out}}^{\text{outflow}}$$

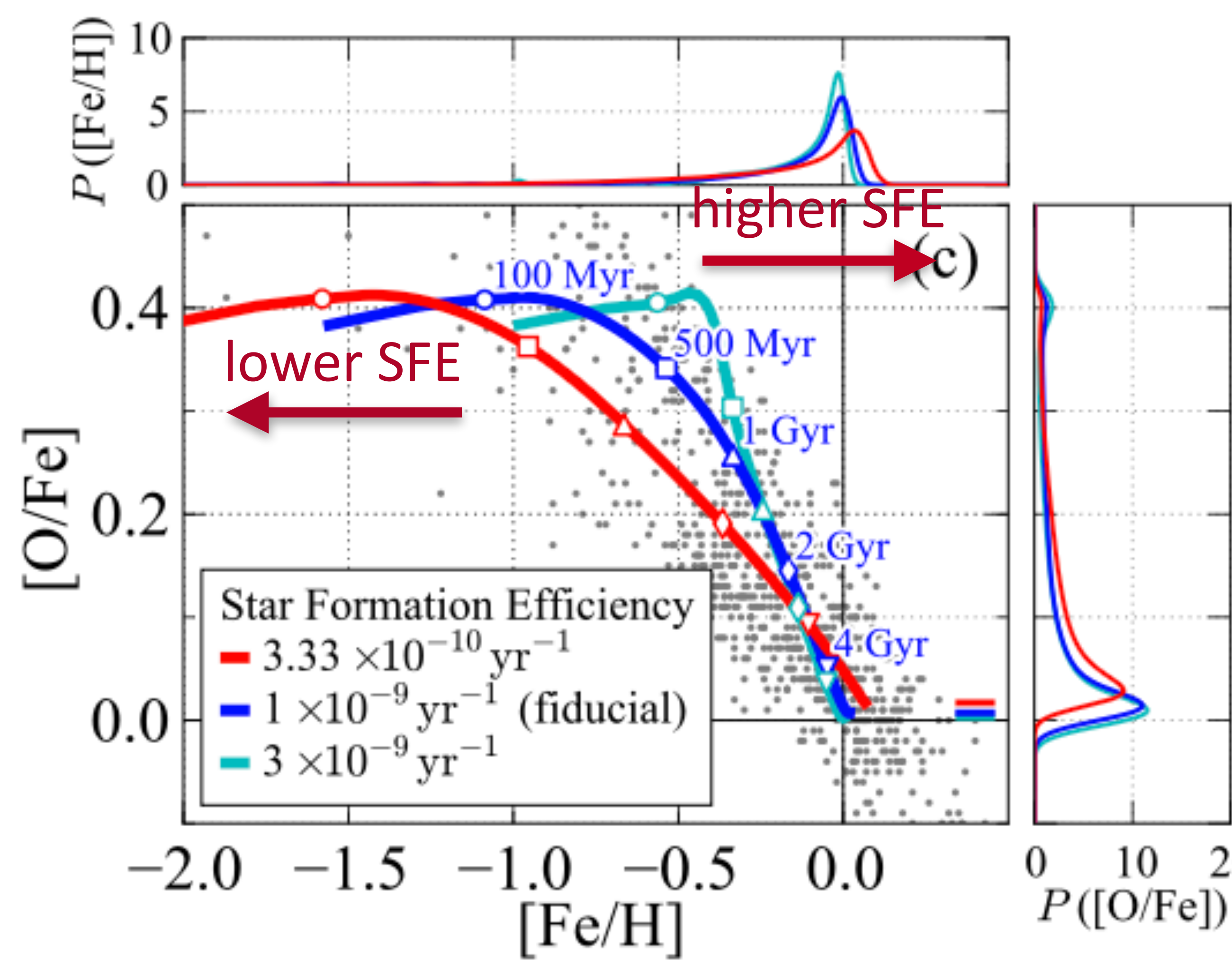
GCE models :

GCE model : flexCE (Andrews 2017) $\theta(\mathrm{SFE}, \alpha, \mathrm{M}_{\mathrm{inf}}, \tau_{\mathrm{inf}}, \eta_{\mathrm{wind},\ldots})$

One-zone chemical evolution model with inflow and outflow.

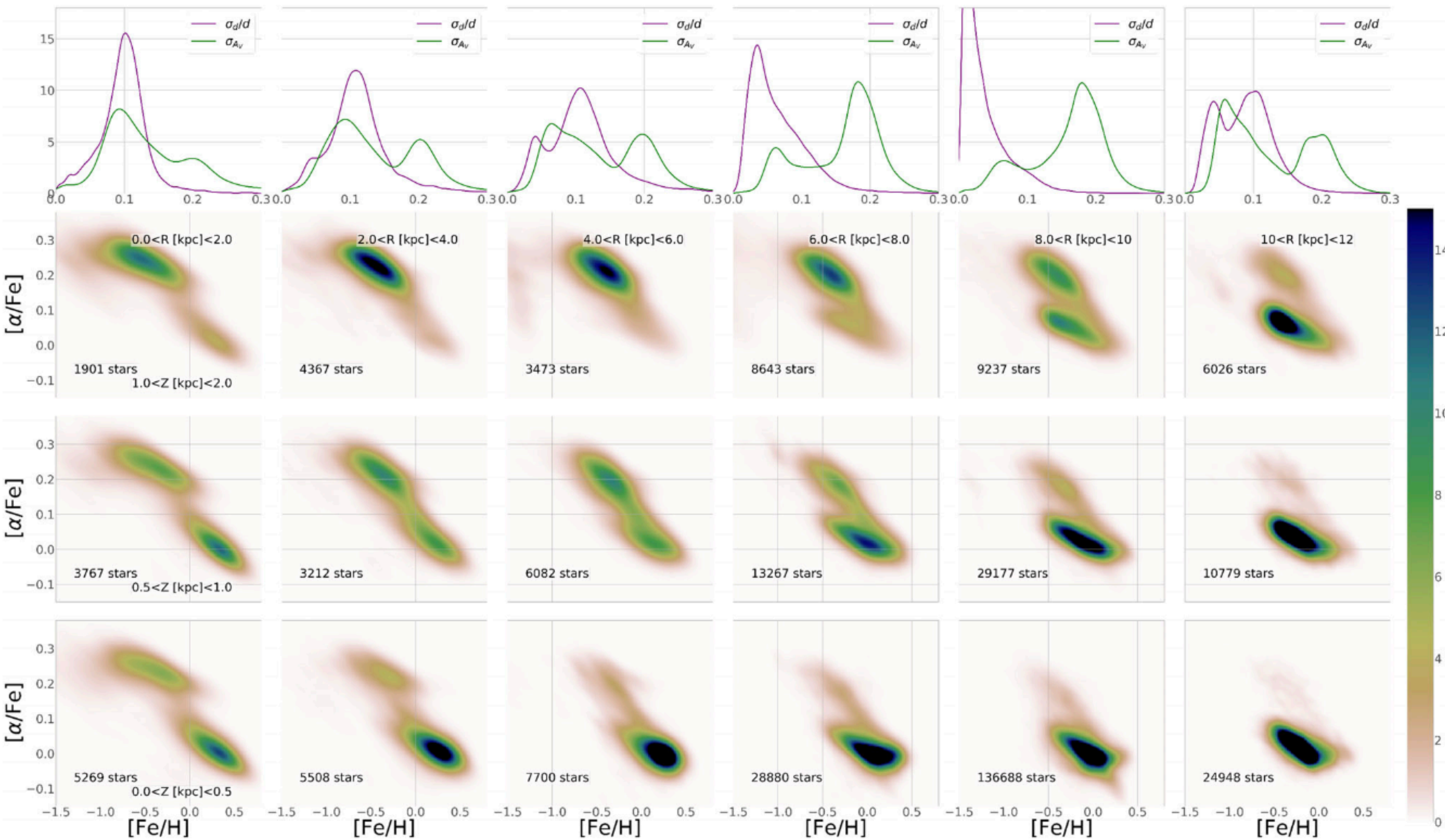
$$\dot{M}_{\mathrm{inf}} = \frac{M_{\mathrm{inf}}}{\tau_{\mathrm{inf}}} e^{-t/\tau_{\mathrm{inf}}};\ \ \dot{M}_{\mathrm{outflow}} = \eta_{\mathrm{wind}}\mathrm{SFR};\ \ \mathrm{SFE} = \frac{\mathrm{SFR}}{M_{\mathrm{gas}}}$$





	reference		Enrichment channels	Yields		DTD	Solar A
flexCE	Andrew 2017	one-zone	CCSN SN Ia AGB	Chieffi & Limongi 2004; Limongi & Chieffi 2006 Iwamoto 1999 Karakas 2010	open-box	Schonrich & Binney 2009	Lodders 2003
OMEGA	Cote 2017	one-zone			closed-box		
GalIMF	Yan 2017						
Chempy	Rybizki 2017	one/Multi-zone	CCSN SN Ia AGB	Nomoto 2013/CL 2004 Seitenzahl 2013/Theilemann 2003 Karakas 2010/ Ventura 2013	open-box	Maoz 2010	Asplund 2009
VICE	Johnson & Weinberg 2020	one-zone	CCSN SN Ia AGB	CL 2004 Schonrich & Binney 2009 Cristallo 2011/ Karakas 2010	open-box	Maoz 2012	
GalCEM	Gjergo 2023	one-zone	CCSN SN Ia AGB (LIM) BBN(primordial infall)	LC 2018 Iwamoto 1999 Cristallo 2015 Galli & Palla 2013	open-box	Greggio	Asplund2009

The chemical evolution of the MW



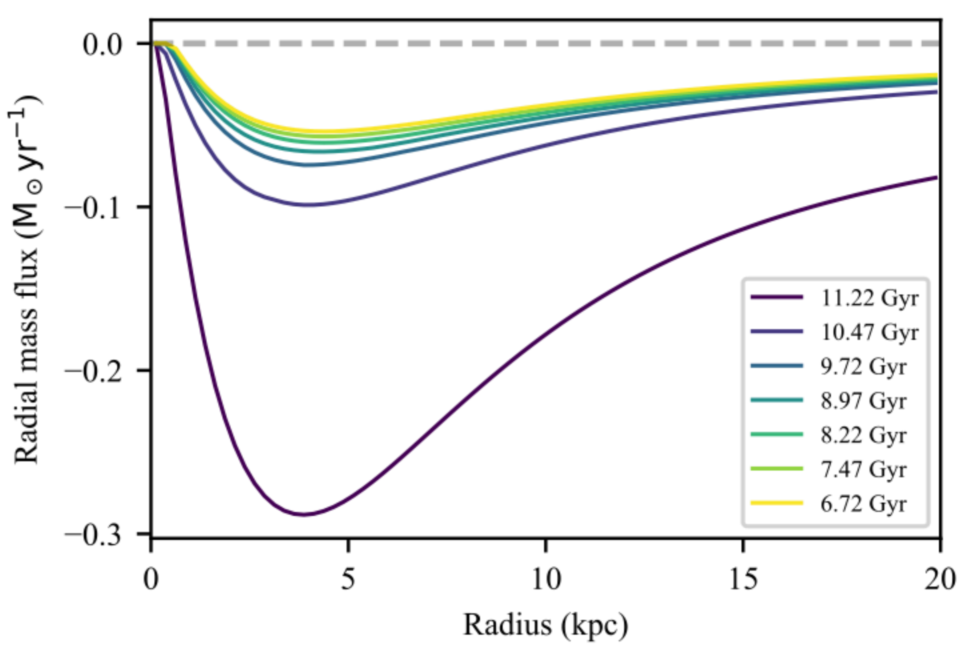
Matteucci et al.2021 ARA&A

The chemical evolution of the MW

Basic ingredients:
Initial conditions, SFR, IMF
yields, Gas inflow and outflow

+

multi-zone, radial flows,
radial mixing, AGN/BHs effects

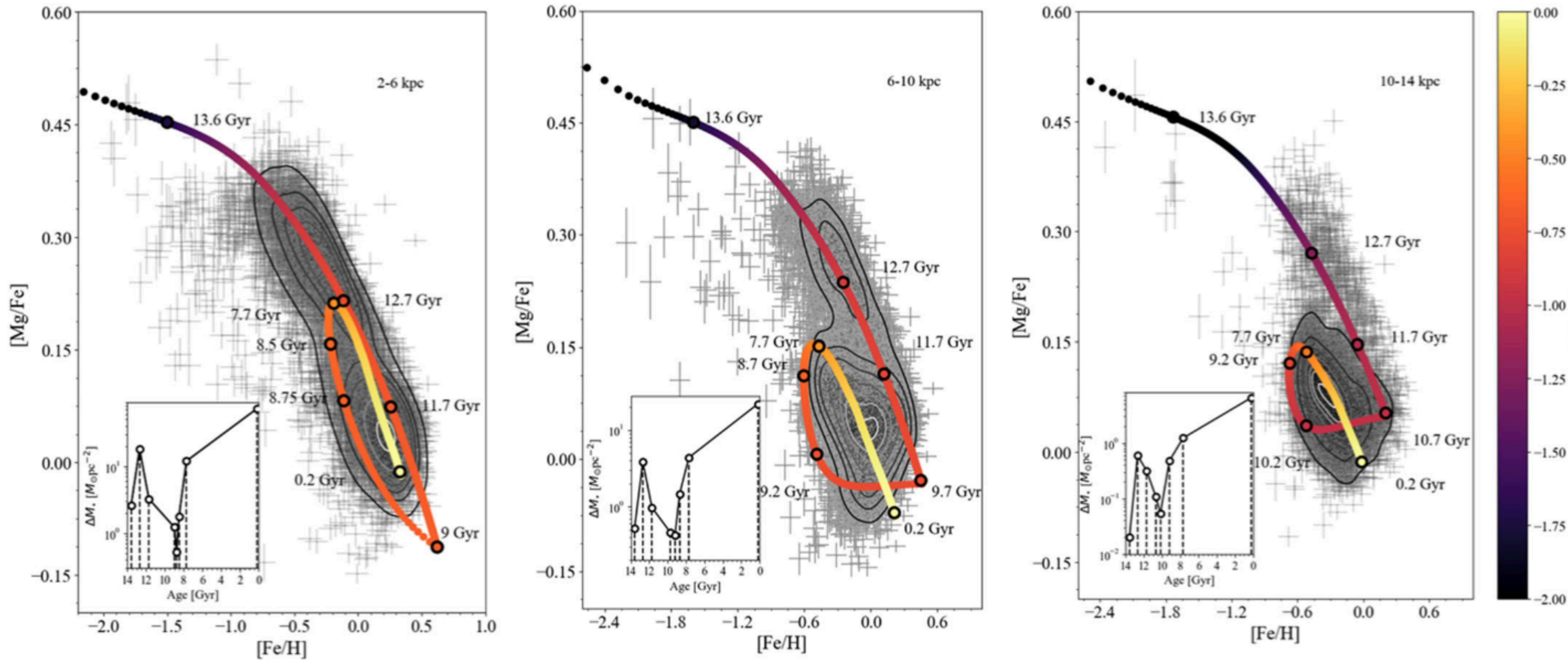


Historical model approaches :

- The serial approach : a continuously gas accretion (one-infall, two-infall, three-infall)
- The parallel approach : different gas accretion rate
- The stochastic approach : halo
- The stellar accretion approach : halo

The chemical evolution of the MW

Two-infall model from Spitoni et al.2021



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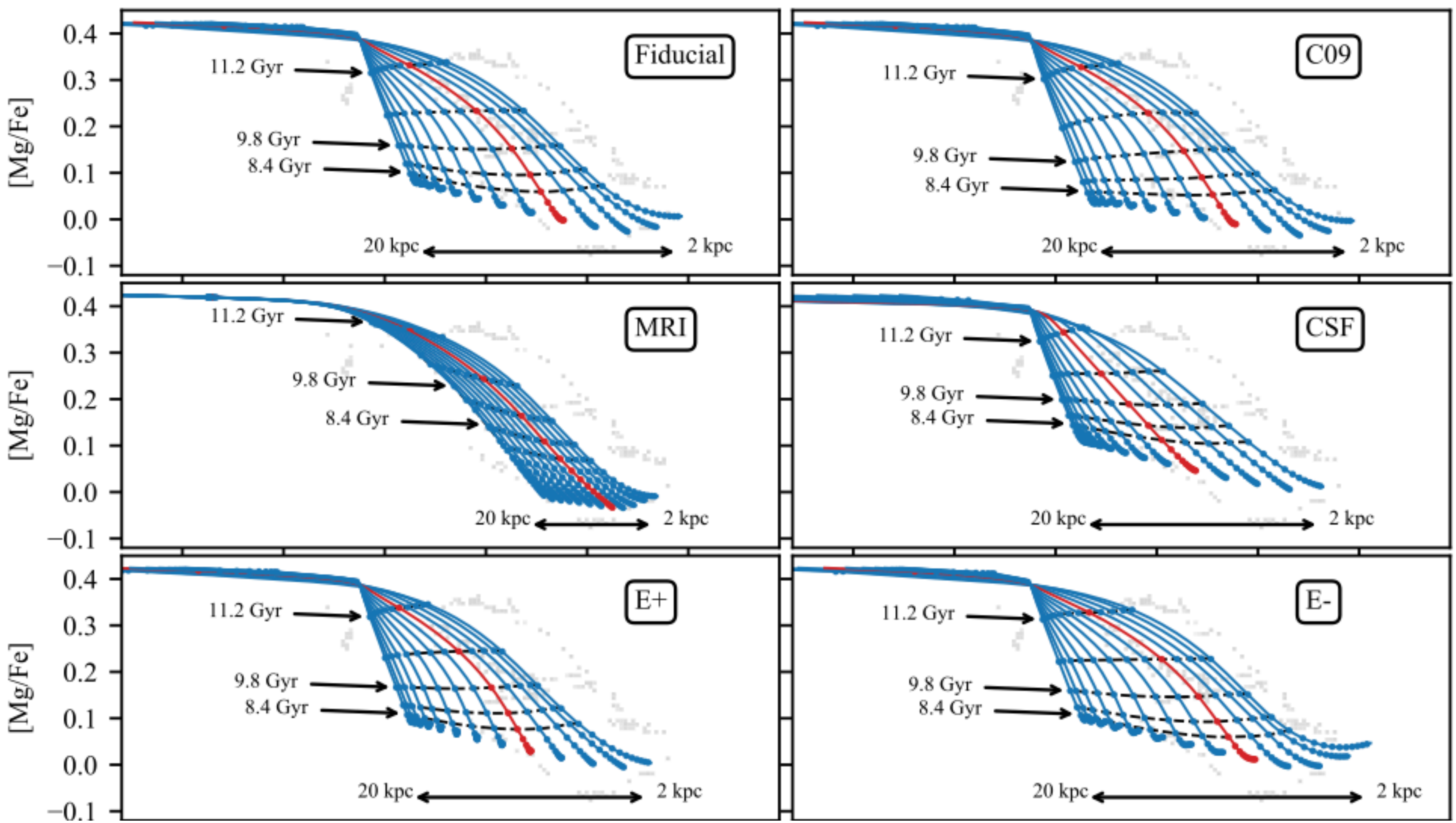
The chemical evolution of the MW

Multi-Zone model from Chen et al. 2023



The chemical evolution of the MW

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