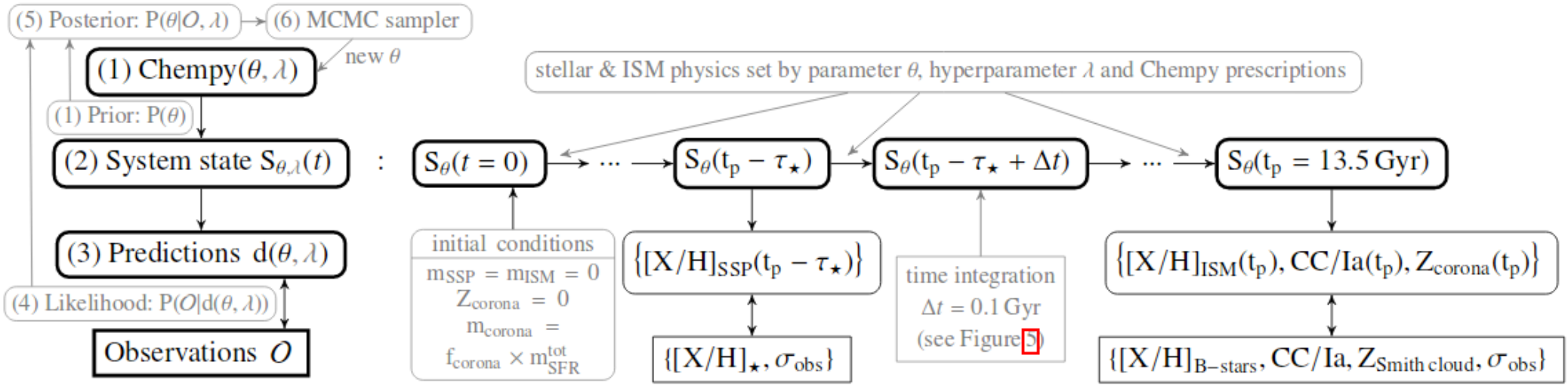
Chempy: A flexible chemical evolution model for abundance fitting

What is Chempy?

- Chempy is a code for modeling galatic chemical evolution. Chempy stands out by being able to calculate the posterior probability distribution in a given parameter space. By incorporating free parameters of chemical evolution, the magnitudes of each feedback channel and the constraints of observational data, provides a powerful tool for insight in stellar nucleosynthesis.

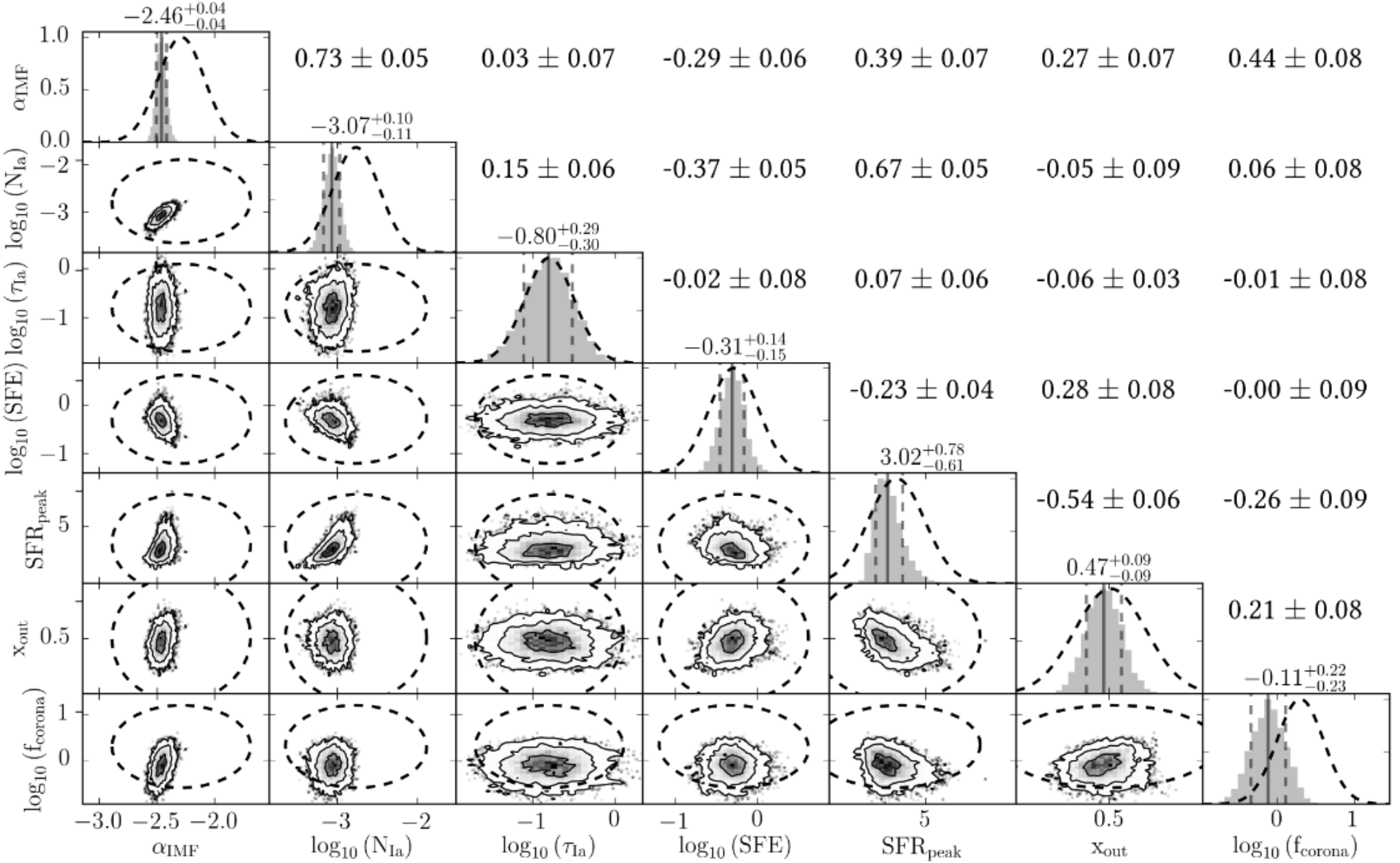


θ	description	$\bar{\theta}_{\text{prior}} \pm \sigma_{\text{prior}}$	limits	approximated prior based on
	stellar (SSP) evolution parameters			
α_{IMF}	high-mass slope of the Chabrier (2001) IMF (eq. 1)	-2.29 ± 0.2	$[-4, -1]$	Côté et al. (2016b, tab. 7)
$\log_{10}(N_{\text{Ia}})$	number of SN Ia exploding per $M_\odot$ over 15 Gyr	-2.75 ± 0.3	$[-\infty, 0]$	Maoz & Mannucci (2012, tab. 1)
$\log_{10}(\tau_{\text{Ia}})$	SN Ia delay time in Gyr for Maoz et al. (2010) distribution	-0.8 ± 0.3	$[-\infty, 1]$	estimate from Maoz et al. (2012)
	ISM evolution parameters			
$\log_{10}(\text{SFE})$	star formation efficiency governing the infall and ISM gas mass	-0.3 ± 0.3	$[-\infty, \infty]$	Bigiel et al. (2008) [a]
SFR_{peak}	peak of SFR in Gyr (scale of γ-distribution with k=2, eq. 2)	3.5 ± 1.5	$[0, \infty]$	inspired by van Dokkum et al. (2013, fig 4b)
x_{out}	fraction of stellar feedback outflowing to the corona	0.5 ± 0.2	$[0, 1]$	estimate because uncommon parametrization
$\log_{10}(f_{\text{corona}})$	corona mass factor times total SFR gives initial corona mass	0.3 ± 0.3	$[-\infty, \infty]$	Stern et al. (2016), Werk et al. (2014)

[a] Theoretical work by Côté et al. (2016a) derives values in a range of 2 - 0.03 per Gyr. The work of Chiappini et al. (2001) and Andrews et al. (2016) use 1 per Gyr, both assuming linear Schmidt law $n_{\text{Schmidt}} = 1$ (same as this work).

Sun+ model

- Protosolar abundances
- CC-1a ratio in Sbc galaxies
- Corona metalicity


$-2.46^{+0.04}_{-0.04}$
0.73 ± 0.05
0.03 ± 0.07
-0.29 ± 0.06
0.39 ± 0.07
0.27 ± 0.07
0.44 ± 0.08
$-3.07^{+0.10}_{-0.11}$
0.15 ± 0.06
-0.37 ± 0.05
0.67 ± 0.05
-0.05 ± 0.09
0.06 ± 0.08
$-0.80^{+0.29}_{-0.30}$
-0.02 ± 0.08
0.07 ± 0.06
-0.06 ± 0.03
-0.01 ± 0.08
$-0.31^{+0.14}_{-0.15}$
-0.23 ± 0.04
0.28 ± 0.08
-0.00 ± 0.09
$3.02^{+0.78}_{-0.61}$
-0.54 ± 0.06
-0.26 ± 0.09
$0.47^{+0.09}_{-0.09}$
0.21 ± 0.08
$-0.11^{+0.22}_{-0.23}$
α_{IMF}
$\log_{10}(N_{Ia})$
$\log_{10}(\tau_{Ia})$
$\log_{10}(SFE)$
SFR_{peak}
x_{out}
$\log_{10}(f_{corona})$

Multi-zone

- Galactic chemical evolution modeling too simplified by using single zone.
- By using multiple stars with different properties as constraints a more complex modeling is achieved.

Results

- There is a discrepancy between the prediction of some elemental abundances and the observed abundances. Might imply unknown nucleosynthesis processes.