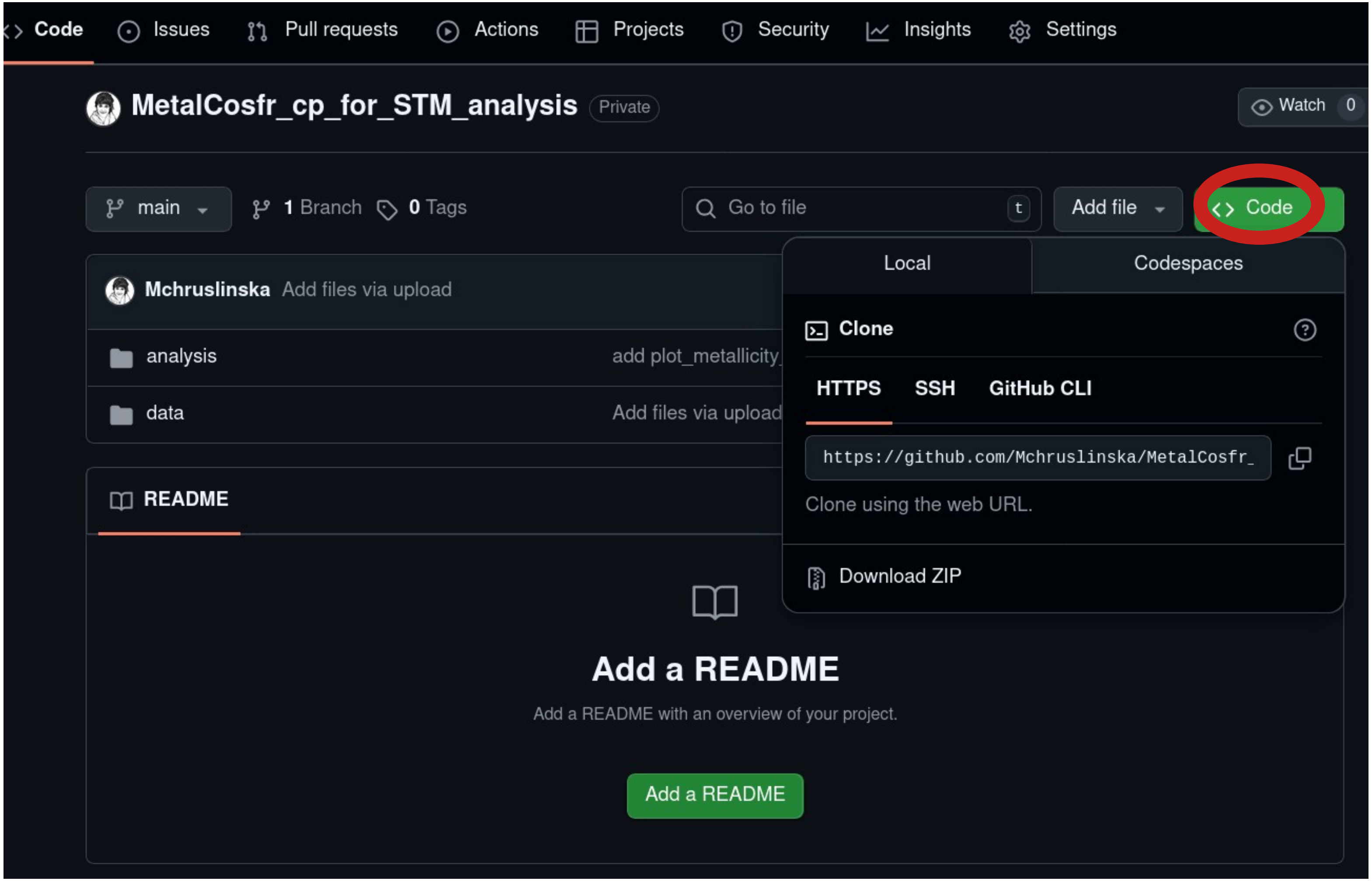
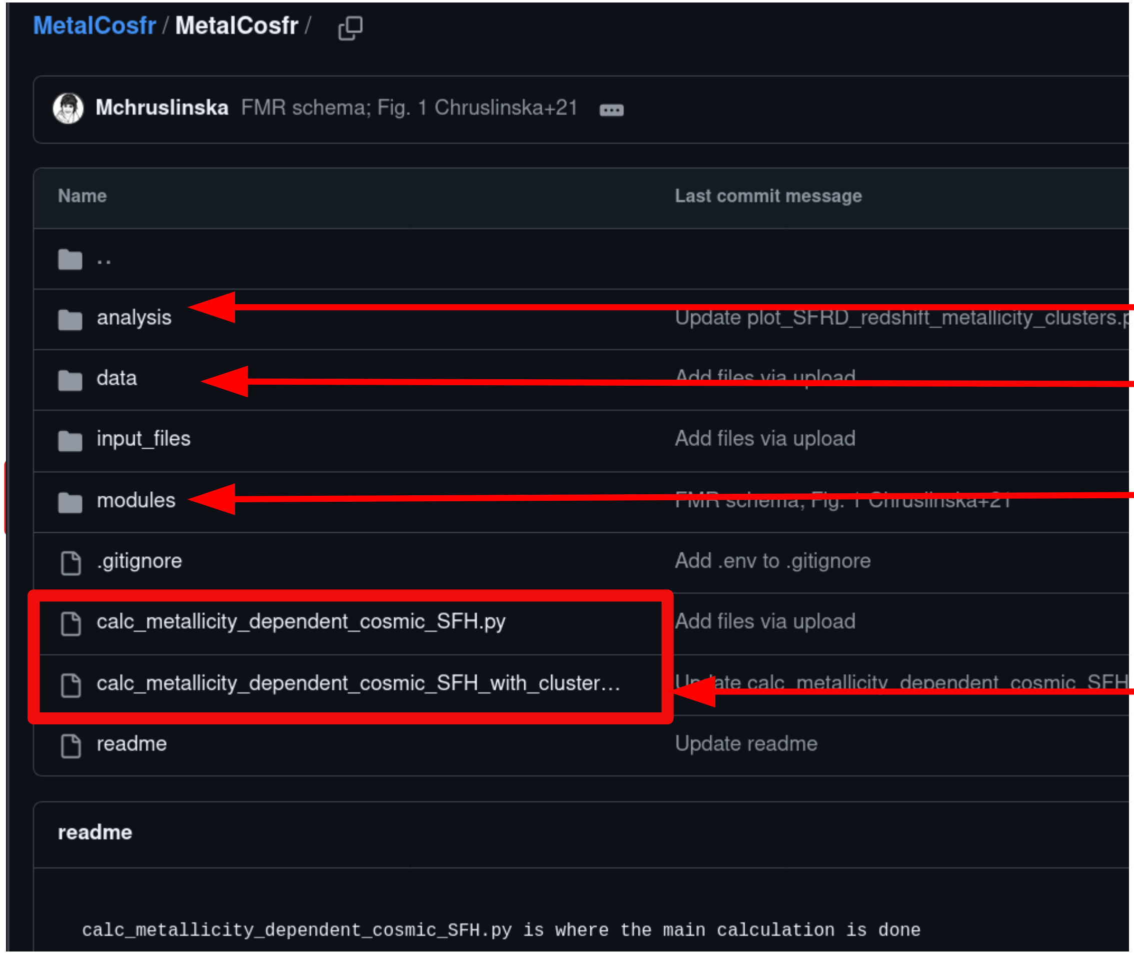

Code
Issues
Pull requests
Actions
Projects
Security
Insights
Settings
MetalCosfr_cp_for_STM_analysis
Private
Watch 0
main
1 Branch
0 Tags
Go to file
t
Add file
Code
Mchruslinska Add files via upload
analysis
add plot_metallicity_
data
Add files via upload
Local
Codespaces
Clone
HTTPS
SSH
GitHub CLI
https://github.com/Mchruslinska/MetalCosfr_
Clone using the web URL.
Download ZIP
README
Add a README
Add a README with an overview of your project.
Add a README

extracted from
(not public yet)

https://github.com/Mchruslinska/MetalCosfr.git

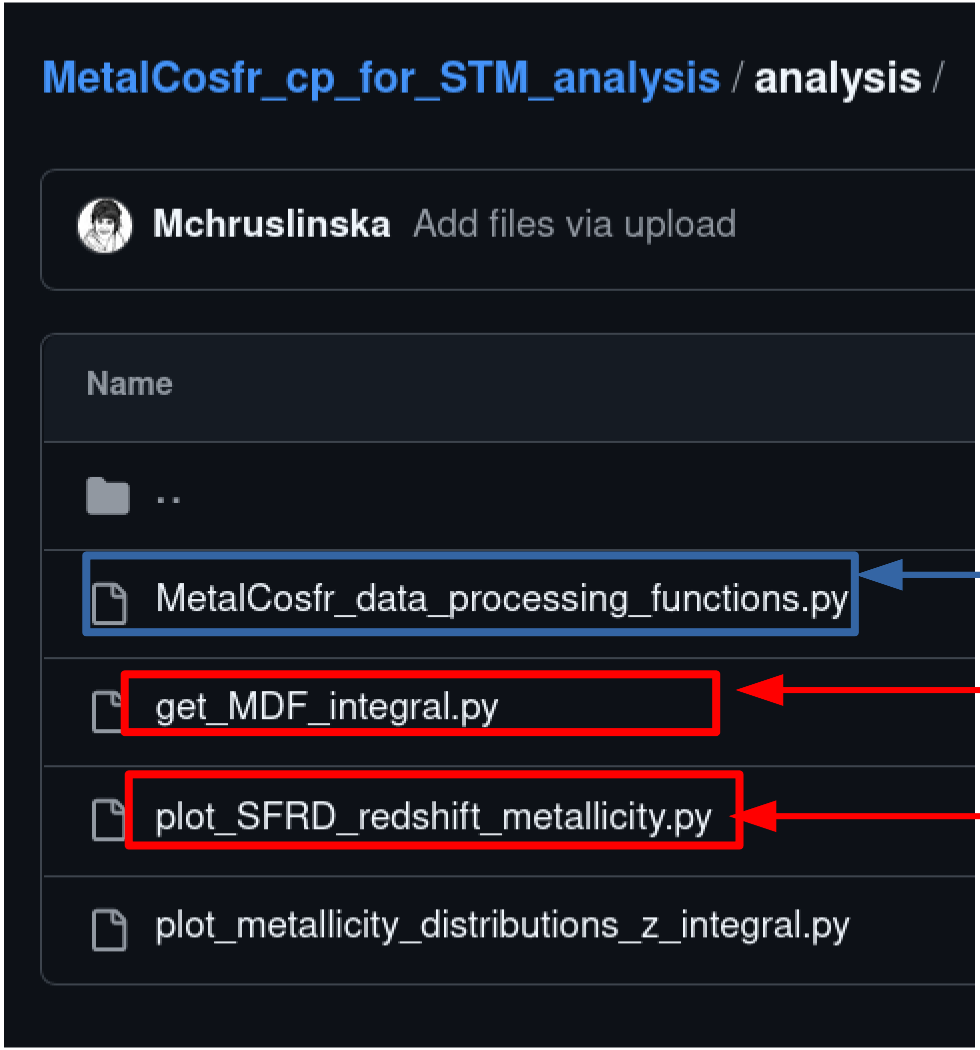


Example scripts to plot the output

Example output files

All the details.
Used in the main script

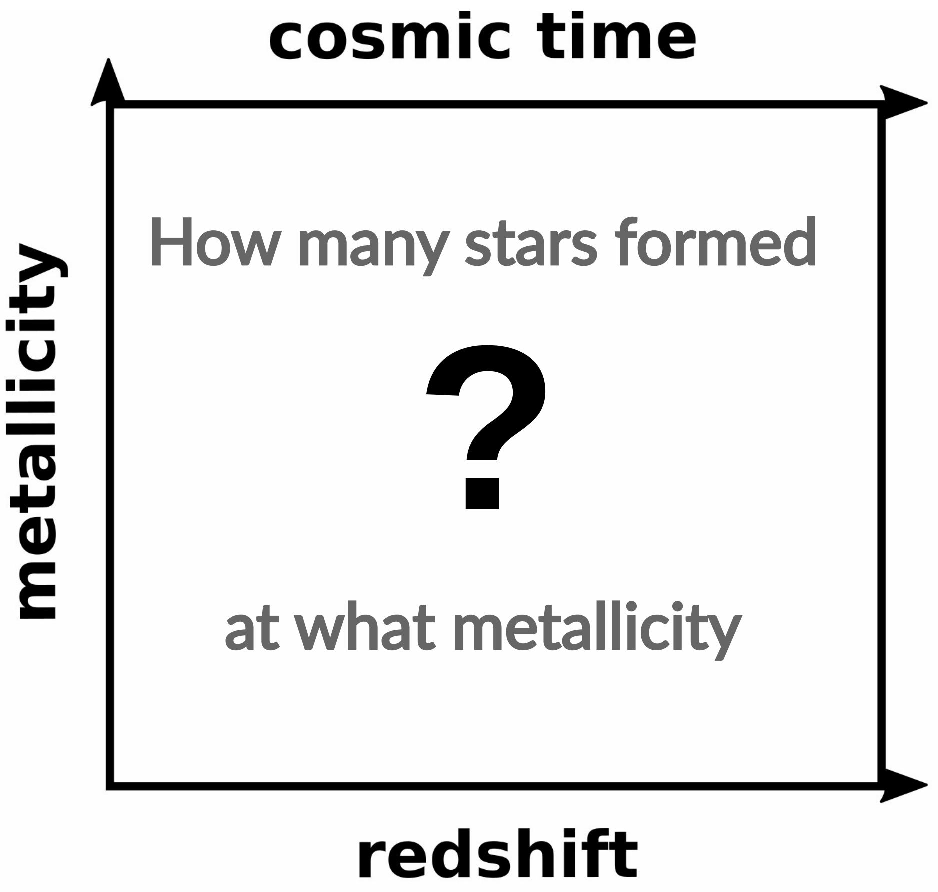
The main scripts producing output files
(full run without cluster evol. ~5h on a laptop)



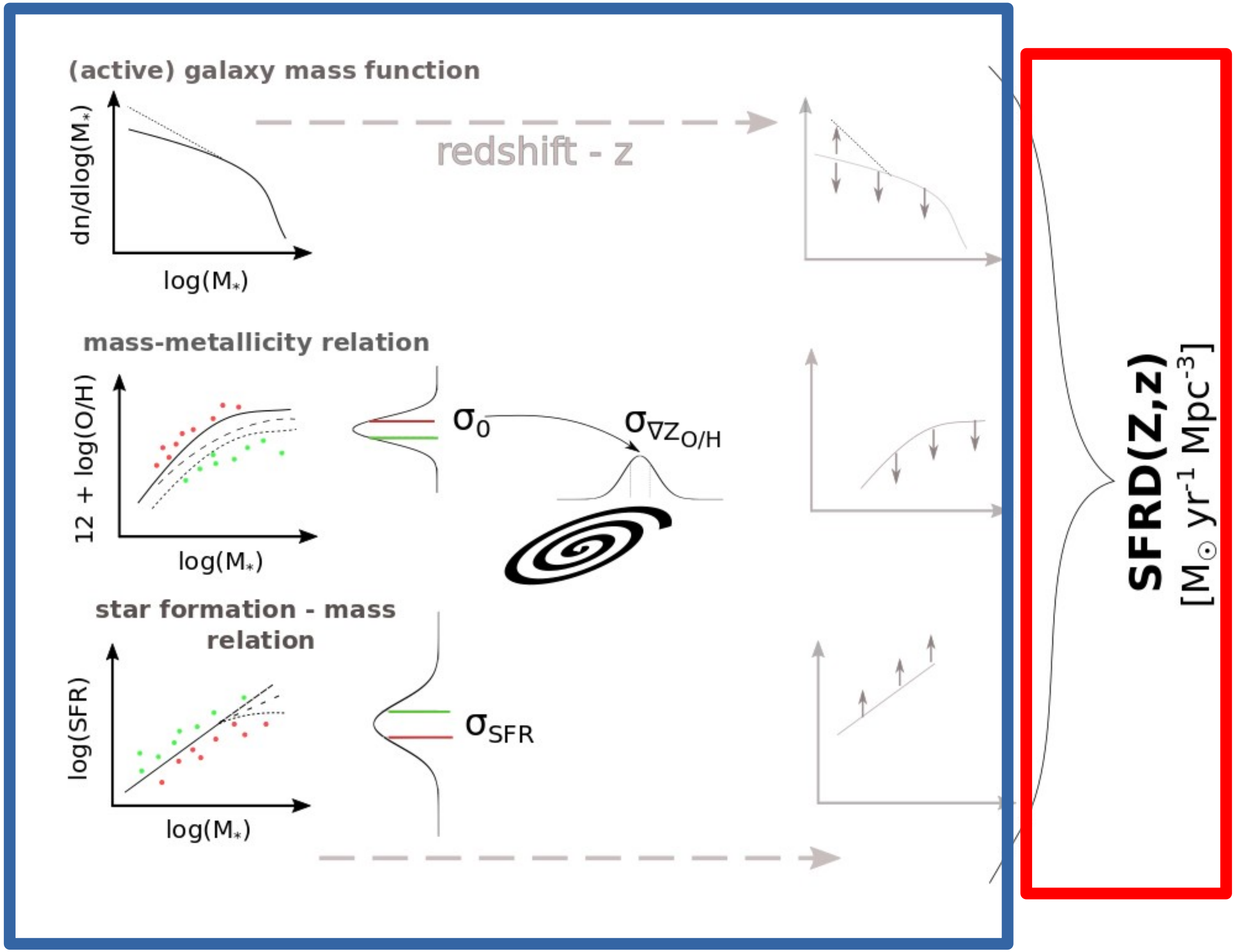
Various functions to read and handle the output files, used in all analysis scripts

see here how to get metallicity distribution functions

plot the example outputs
Try to understand the differences between the runs

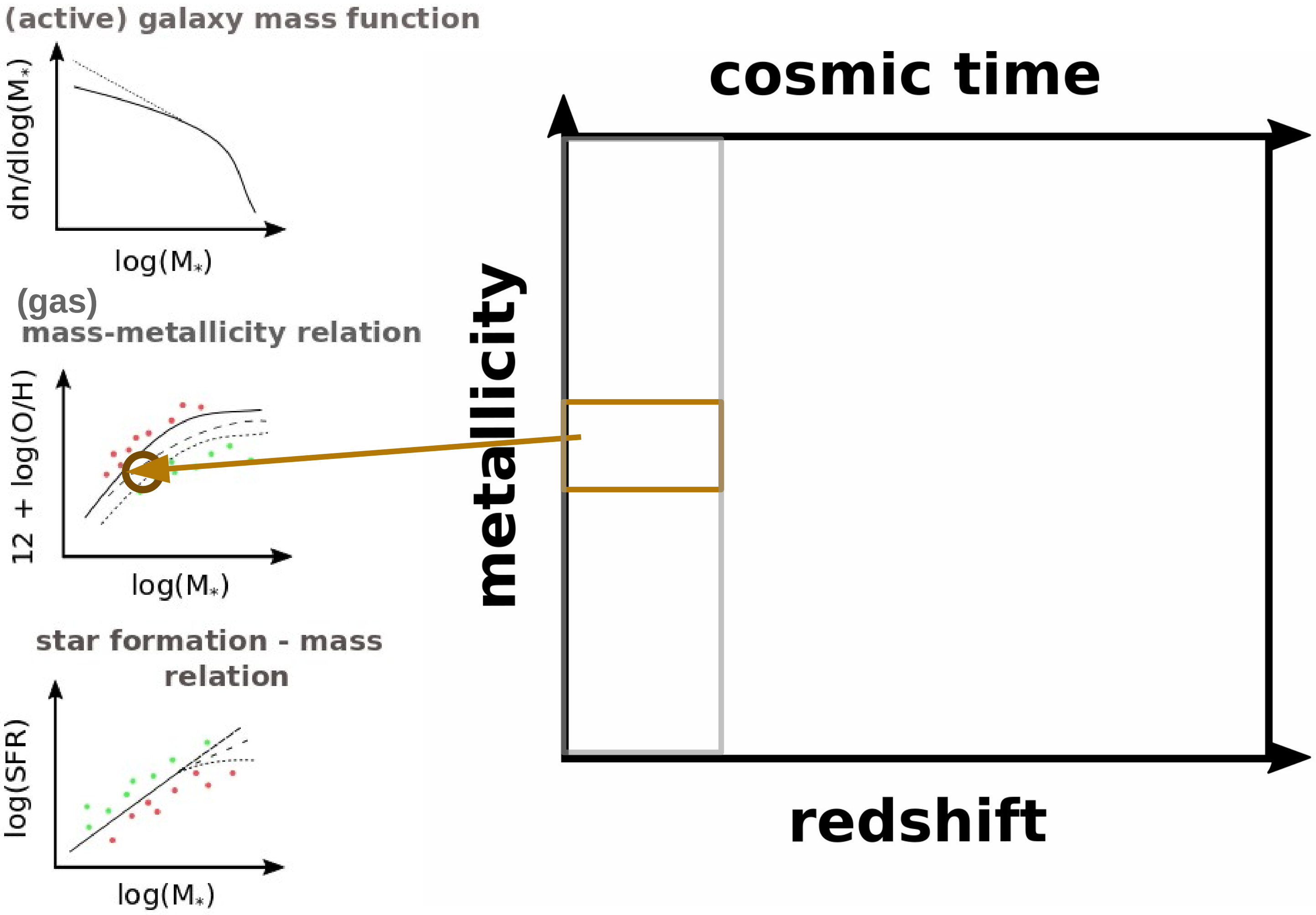

cosmic time
metallicity
How many stars formed
?
at what metallicity
redshift

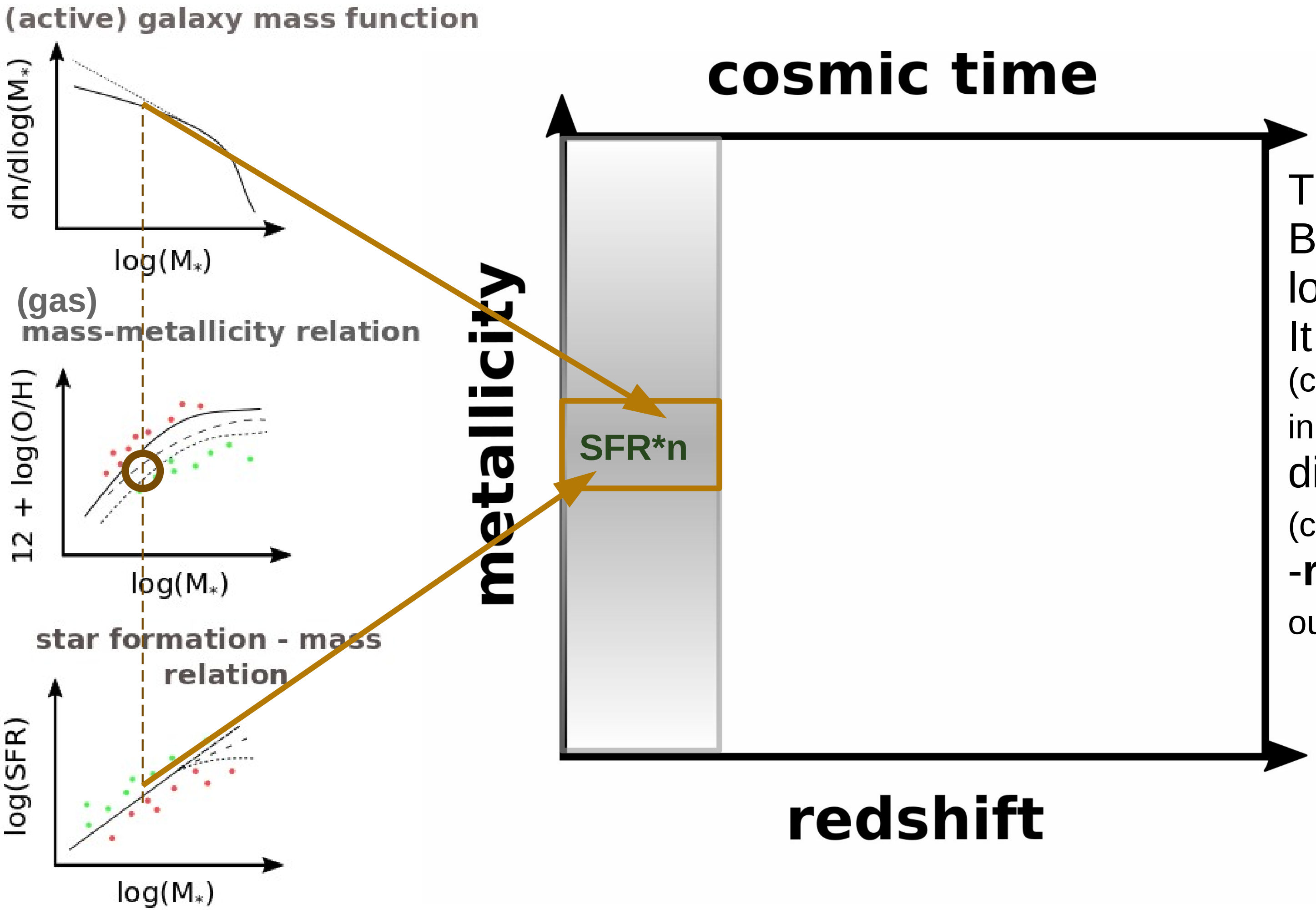
The main ingredients, “galaxy module”



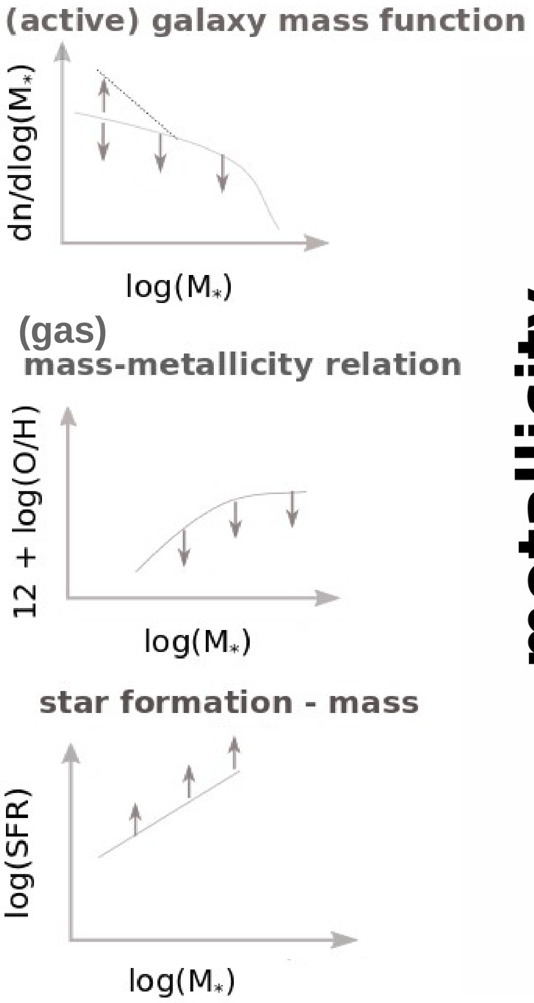
SFRD:
star formation
rate density at
z-redshift
Z- metallicity

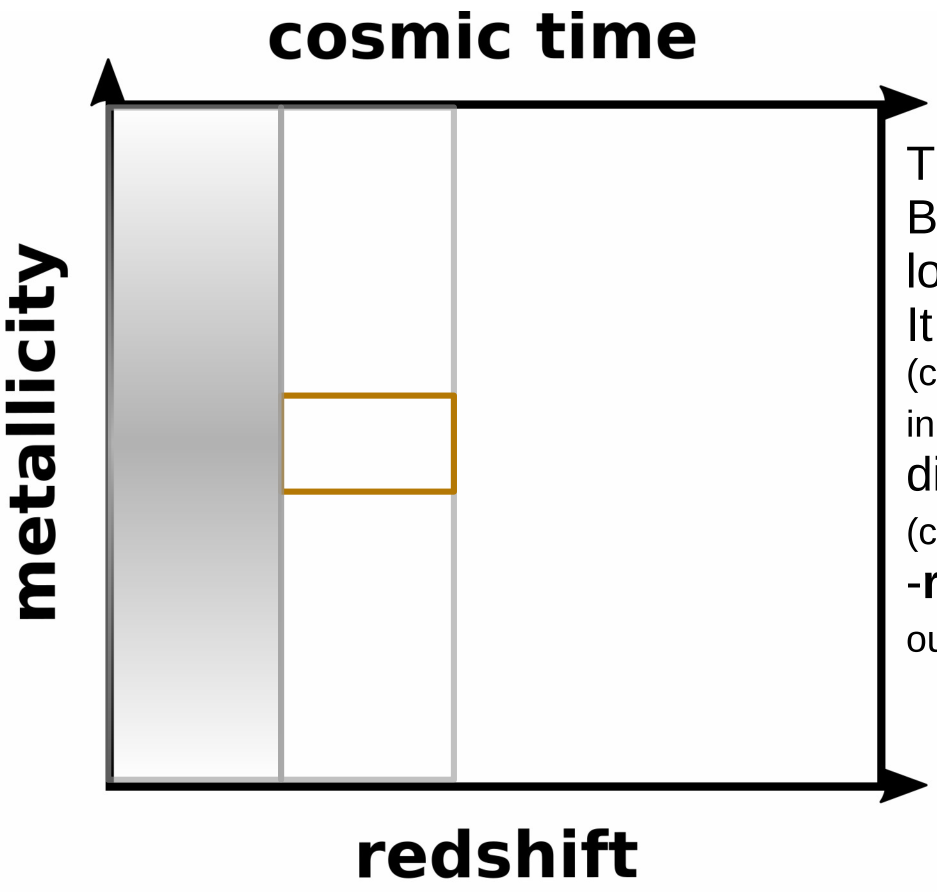
integration,
big loop over
cosmic time
“the main script”


(active) galaxy mass function
dn/dlog(M*)
log(M*)
(gas)
mass-metallicity relation
12 + log(O/H)
log(M*)
star formation - mass
relation
log(SFR)
log(M*)
cosmic time
metallicity
redshift



The main script :
Big loop from high redshift to low redshift.
It calculates the **values** (comoving stellar mass density formed in timestep and metallicity bin) for different cells in **metallicity** (columns in output file)
-redshift/cosmic time (rows in output file) array

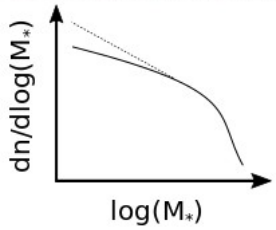




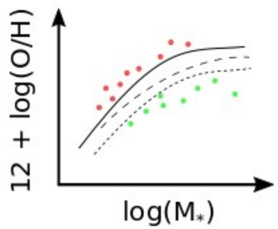
The main script :
Big loop from high redshift to low redshift.
It calculates the **values** (comoving stellar mass density formed in timestep and metallicity bin) for different cells in **metallicity** (columns in output file) **-redshift/cosmic time** (rows in output file) array

open questions → varying the relations & assumptions → **uncertainty of the final result**

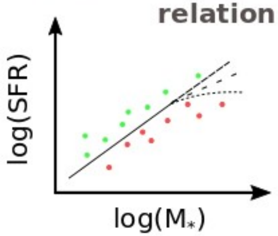
(active) galaxy mass function



mass-metallicity relation



star formation - mass relation



Chruslinska & Nelemans (2019) (the core framework)
Chruslinska, Jerabkova et al. (2020) → IMF (systematic variations)
Chruslinska et al. (2021), Boco et al. (2021)
→ closer look on extrapolations
- low mass/faint/distant galaxies
- metallicity evolution at z>3
- SFR-metallicity correlation (FMR)

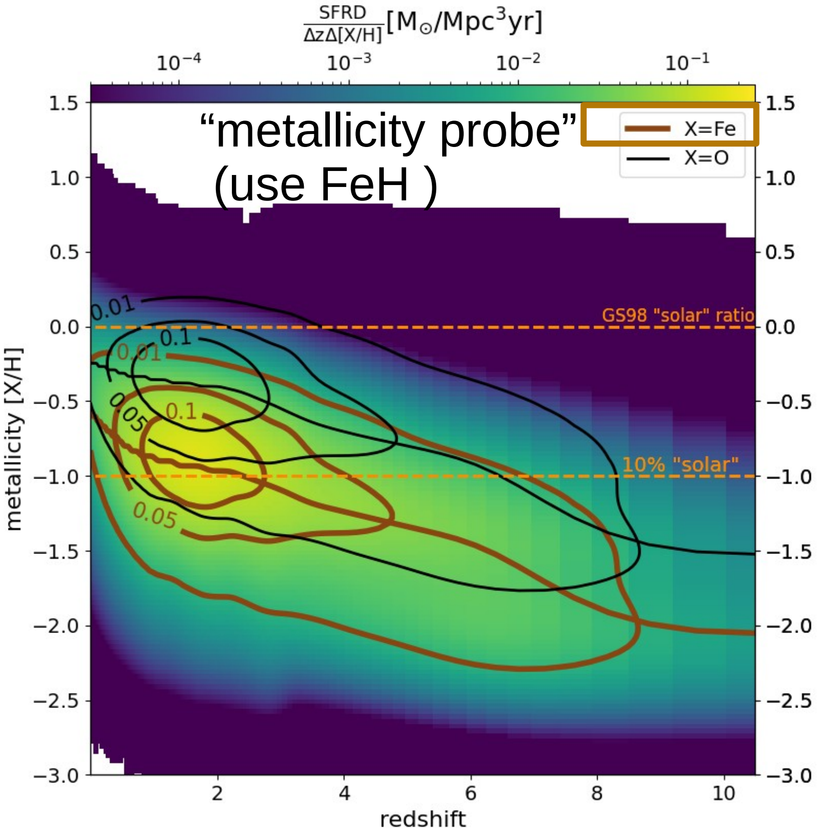
→ outliers ("starbursts")

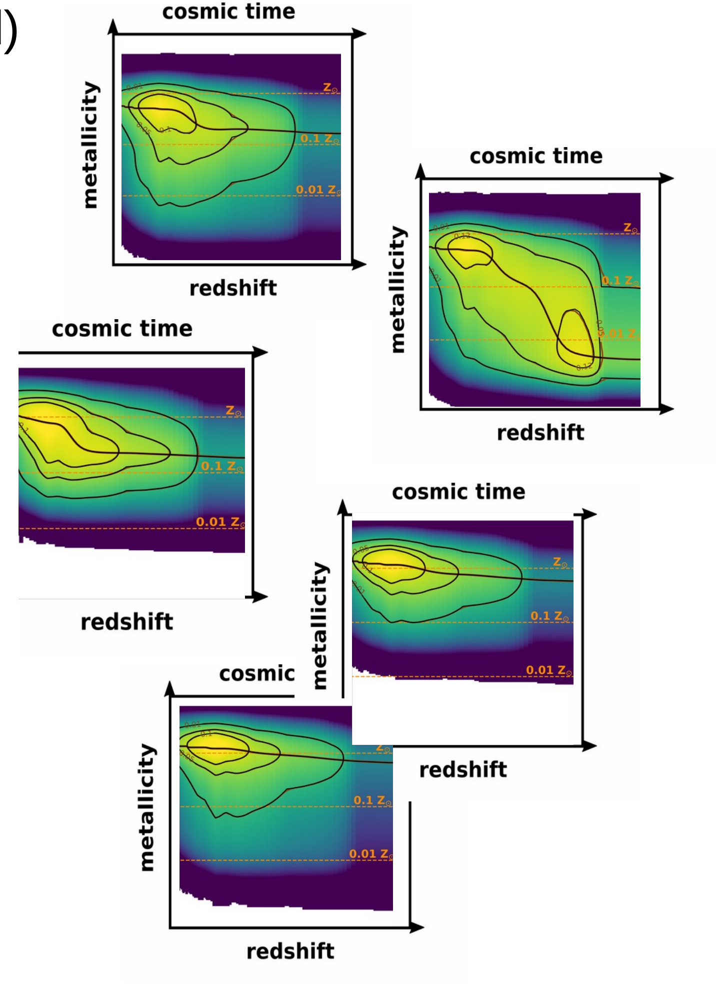
Chruslinska et al in prep.:
→ updates (esp. metallicity evolution at z>3!)
→ use [O/Fe] – sSFR relation to calculate the metallicity-dependent cosmic SFH for both "metallicity"=oxygen and "metallicity"=iron

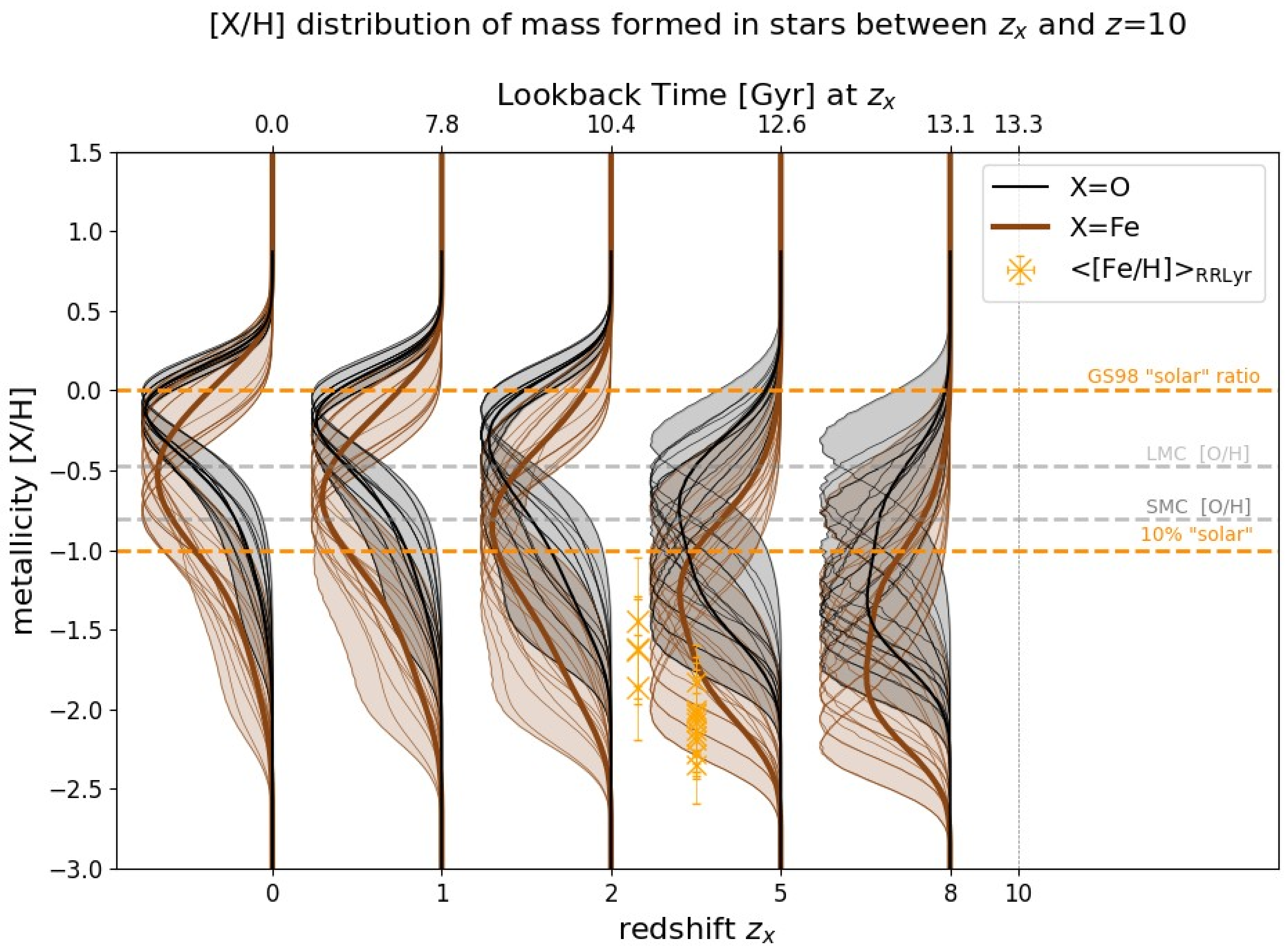
(those changes are already included in the code on Github)

Outputs plotted for example variations (old)

plot_SFRD_redshift_metallicity.py







→ plot_metallicity_distributions_z_integral.py

[X/H] distribution of mass formed in stars between z=0 and z_x

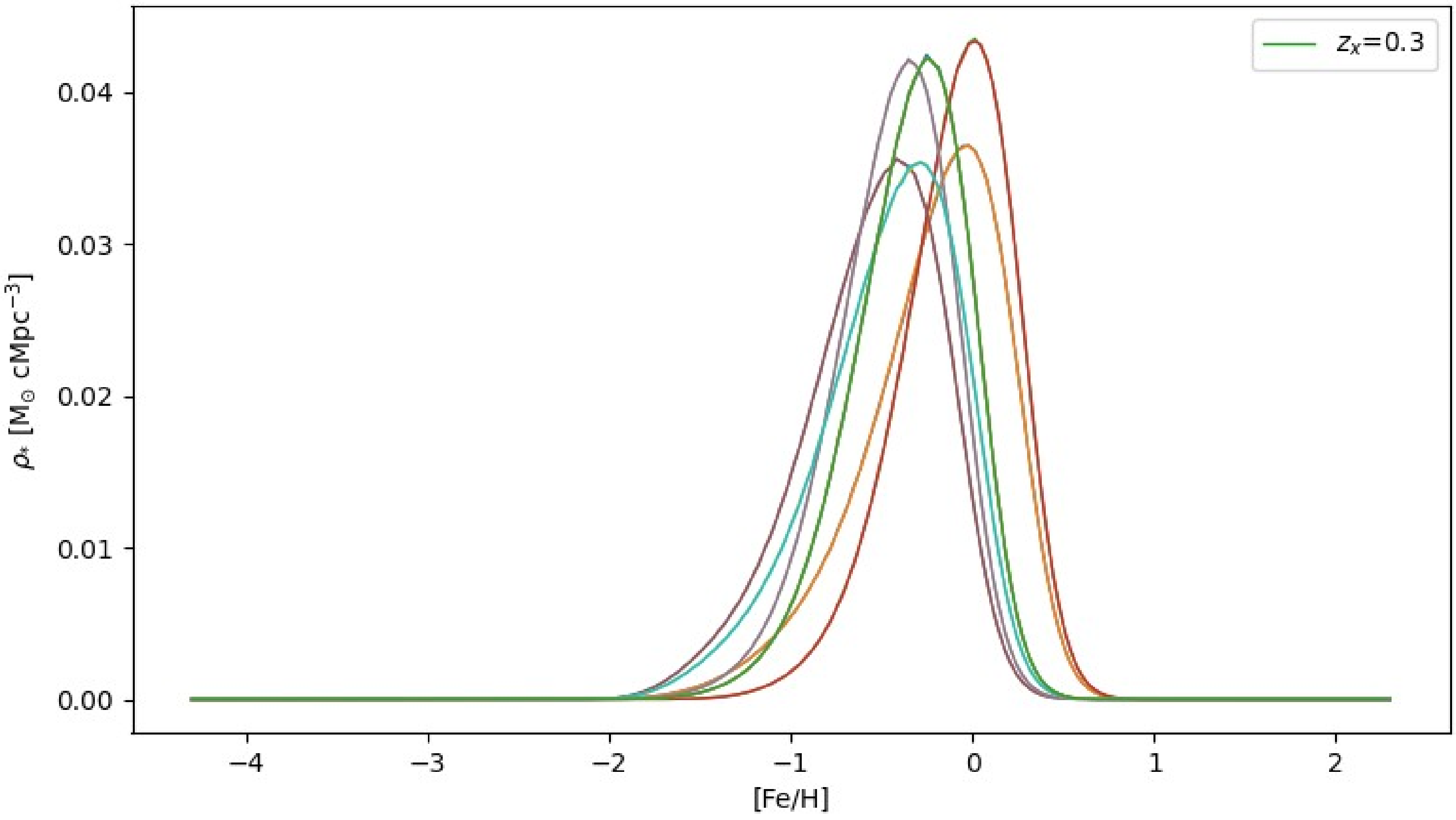


Table D.1. Overview of the assumptions (model variations) considered in this study.

Variation	Notes
	[O/Fe] – sSFR relation (following Ch24, see sec. 2.1)
"fast" Fe enrichment	$f_{\rm Ia} \propto t^{-1}$, $\tau_{\rm Ia;min}$=40 Myr, $m_{Fe}^{CCSN} = 0.03 M_{\odot}$
"mixed" Fe enrichment	$f_{\rm Ia}$ following Greggio (2010), $m_{Fe}^{CCSN} = 0.07 M_{\odot}$
"slow" Fe enrichment	$f_{\rm Ia} \propto t^{-1}$, $\tau_{\rm Ia;min}$=400 Myr, $m_{Fe}^{CCSN} = 0.1 M_{\odot}$
	SFMR/ galaxy main sequence
$a_{\rm SFR}$=1	following eq. 15 and table 2 in P23
$a_{\rm SFR}$=0.8	P23 with shallower slope: parameter a4 in Tab. 2 in P23 set to 0.8
$a_{\rm SFR}$=1 + evol.	P23 with faster evolution at $z > 1.8$: at $z \geqslant 1.8$ parameter a1 in Tab. 2 in P23 set to -0.3
	GSMF (following ChN19 with updates, see appendix B)
$\alpha_{\rm GSMF}(z)$	low mass end slope steepening with z: $\alpha_{\rm GSMF} = -1.4 - 0.08 \cdot z$
$\alpha_{\rm GSMF}$ fixed	$\alpha_{\rm GSMF}$=-1.45
	MZR($z = 0$) normalisation
$Z_{\rm O/H;MZR0} = 9.$	fiducial value used here, following Curti et al. (2020) but shifted by +0.2 dex to match recombination line based estimates
$Z_{\rm O/H;MZR0}$=8.8 - 9.1	range considered in Ch21, where relevant, we indicate how this would lead to a systematic shift in our results
	MZR(z=0)
-	eq. 7 in Ch21 with $a_{\rm MZR}$=0.28, $\beta_{\rm MZR}$=0.23, $M_{0;\rm MZR0} = 10.02$ to match Curti et al. (2020), $Z_{\rm O/H;MZR0}$ as above
	FMR($z > 3$)
fixed	redshift-invariant FMR modelled following Ch21
evol.	evolving normalisation at z >3, parameter $Z_{\rm O/H;0}$ in eq. 1 in Ch21 set to $Z_{\rm O/H;0}(z > 3)$ = -0.0357 (z - 3) + $Z_{\rm O/H;MZR0}$
	contribution of starbursts
negligible	following Ch21, fixed SB fraction f_{SB}=0.03, SB sequence 0.59 dex above the SFMR
high / high f_{SB}	see appendix C, based on Rinaldi et al. (2025) and considered only with $a_{\rm SFR}$=1 SFMR variation

You will notice that "data" contains folders with very long names
(e.g. 'SFR-P23-Z-C20_ADF-Zev-True-GSMFev-True-OFe-pl400CCFep1-FMR0-27-SB-Boco-dFMR3_10-25').

Those names store the full "model_ref" string, which defines assumptions used in the run (e.g. about the galaxy mass function slope: GSMFev-True : low mass end slope evolving with redshift – alpha_GSMF(z) in the table on the previous slide, SFR-P23 : SFR – mass relation from Popesso+23 etc.).

It is the same model_ref as used in all the plotting scripts.

model_ref can be created starting from those assumptions using the function: get_model_name()