Summer Semester 2018:

Master course Astrophysics II:
Galaxies and Cosmology

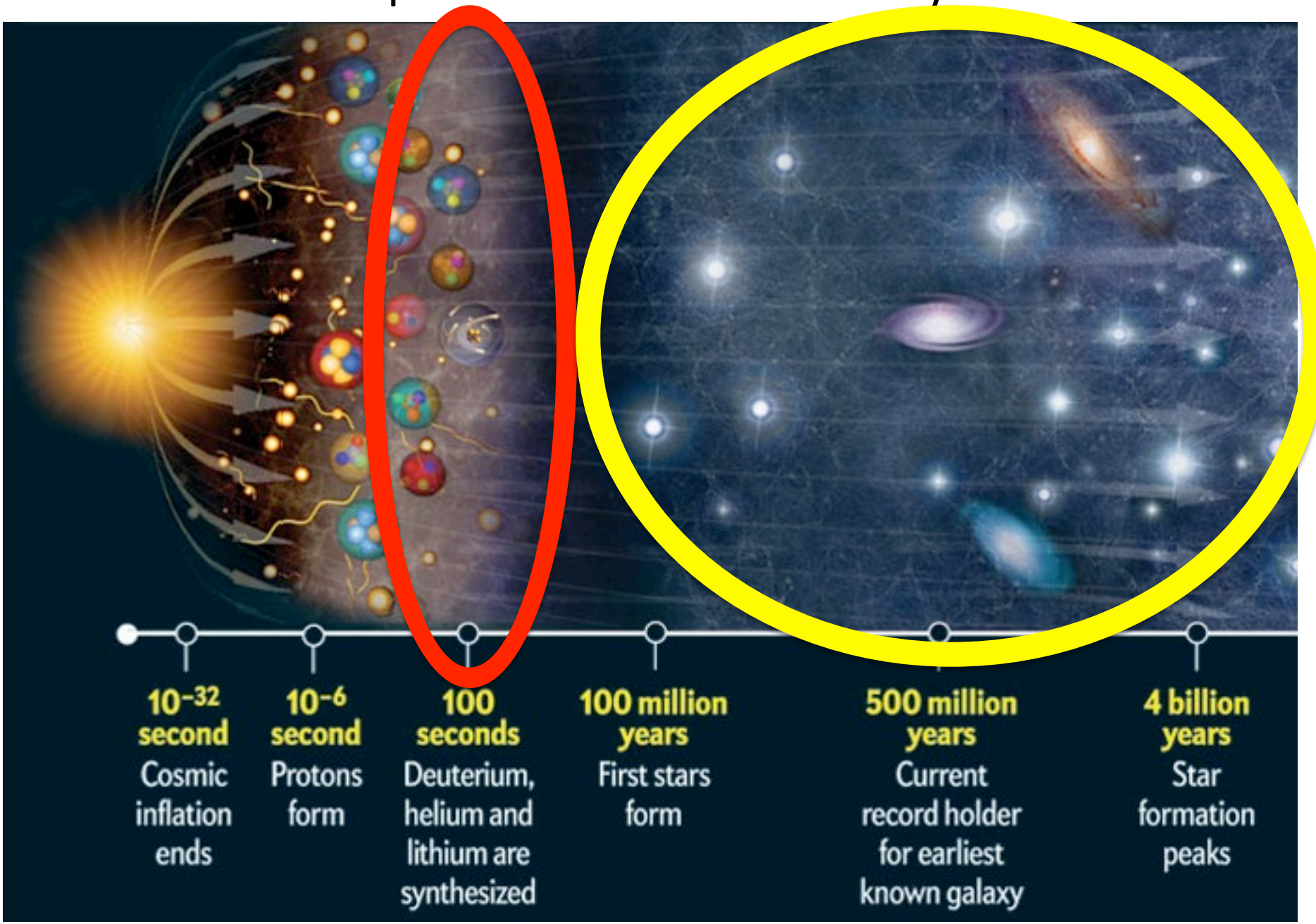
Lecture 9, 12 Jun 2018:

Chemical evolution of galaxies

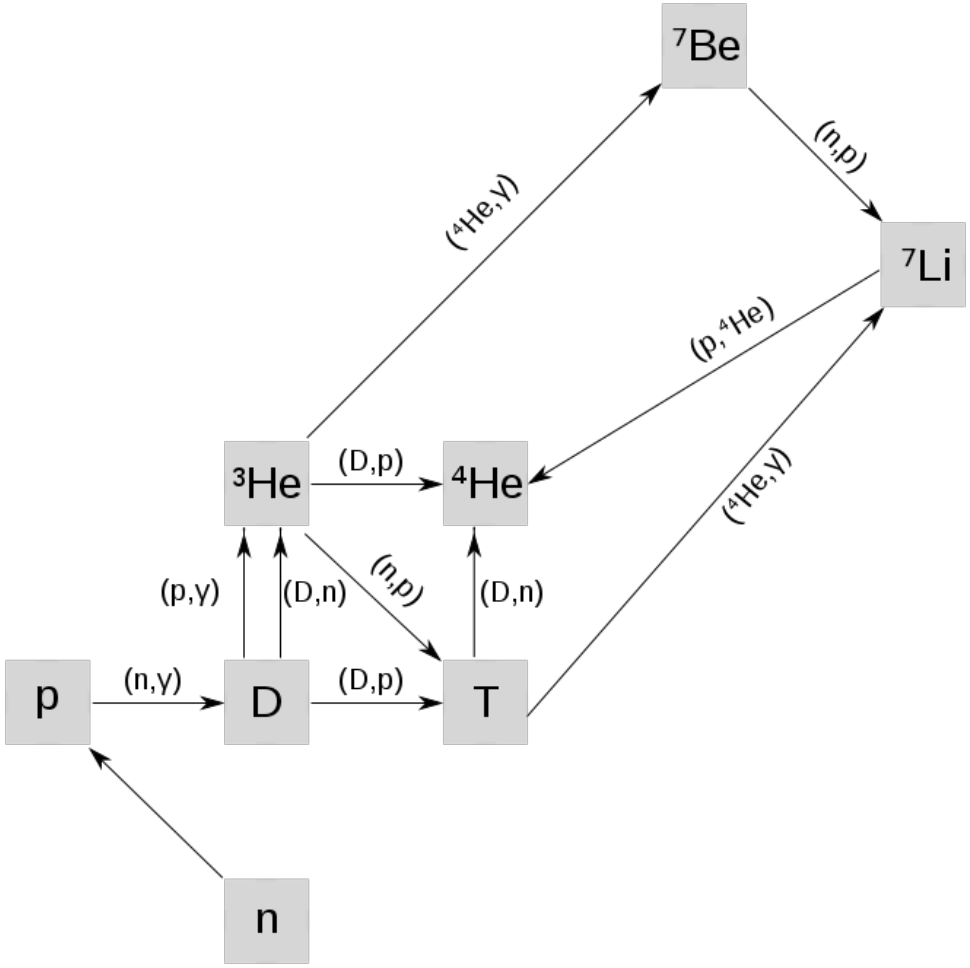
Responsible:
Prof. Christoph Pfrommer,
Prof. Lutz Wisotzki

University of Potsdam

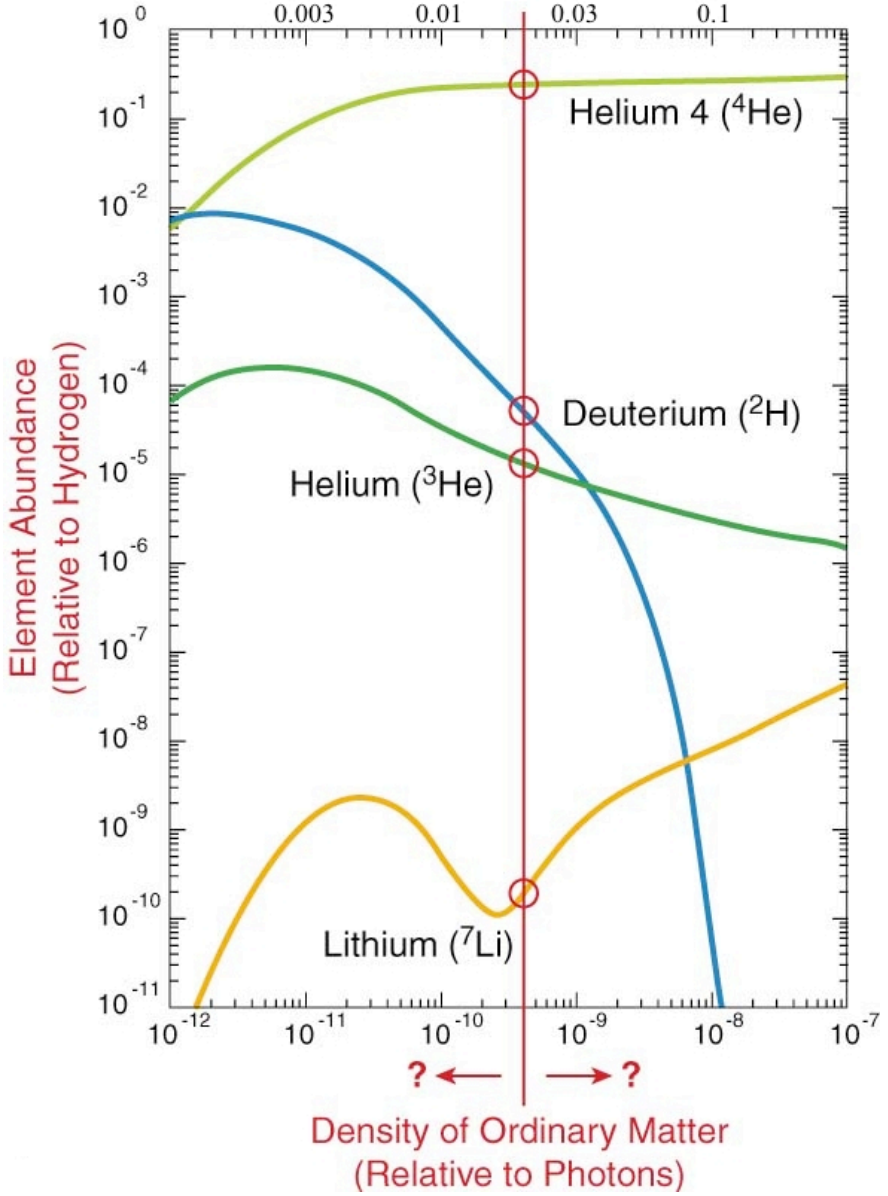
The two phases of cosmic nucleosynthesis



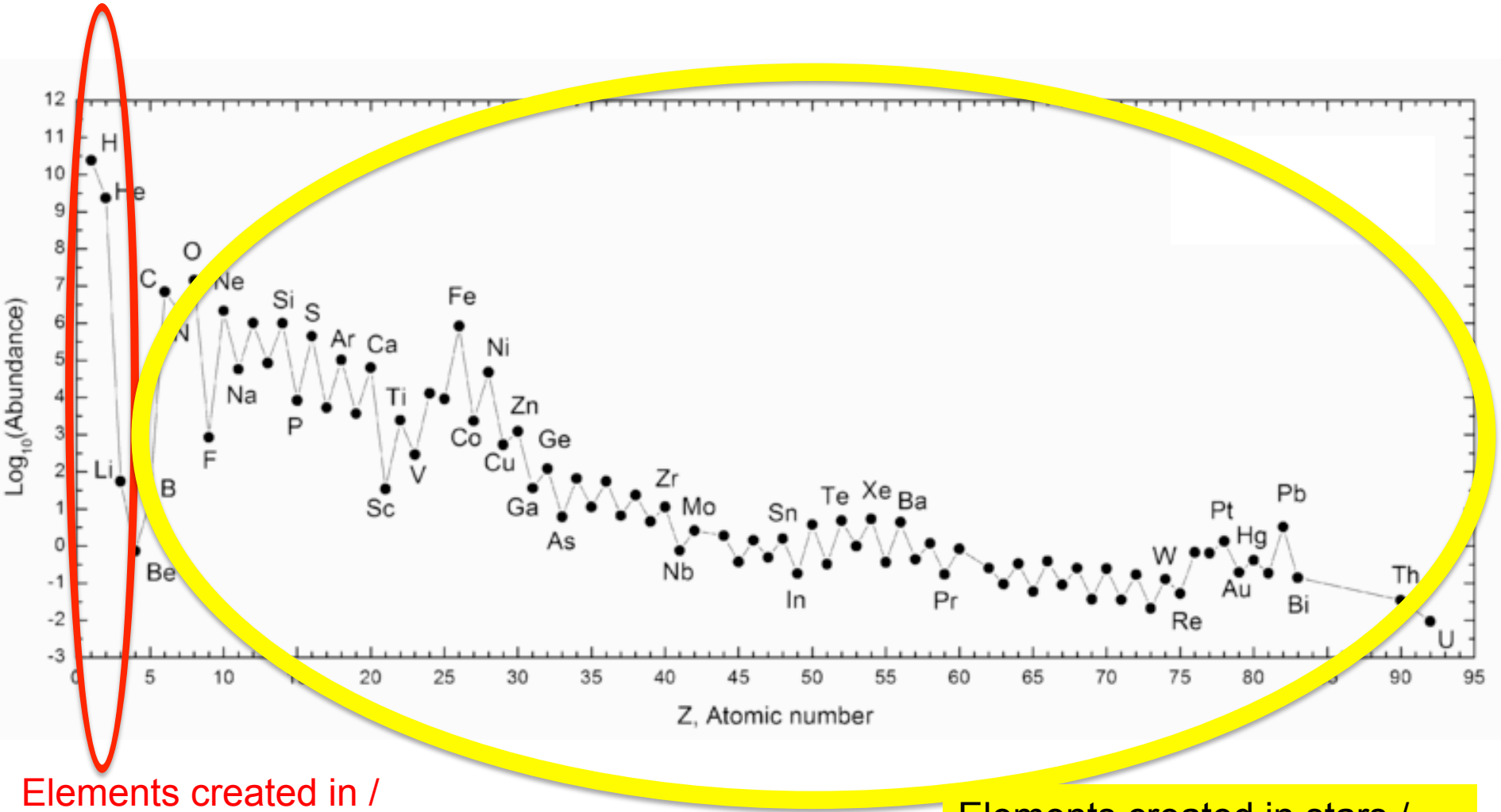
Elements created right after the Big Bang



Ω_b



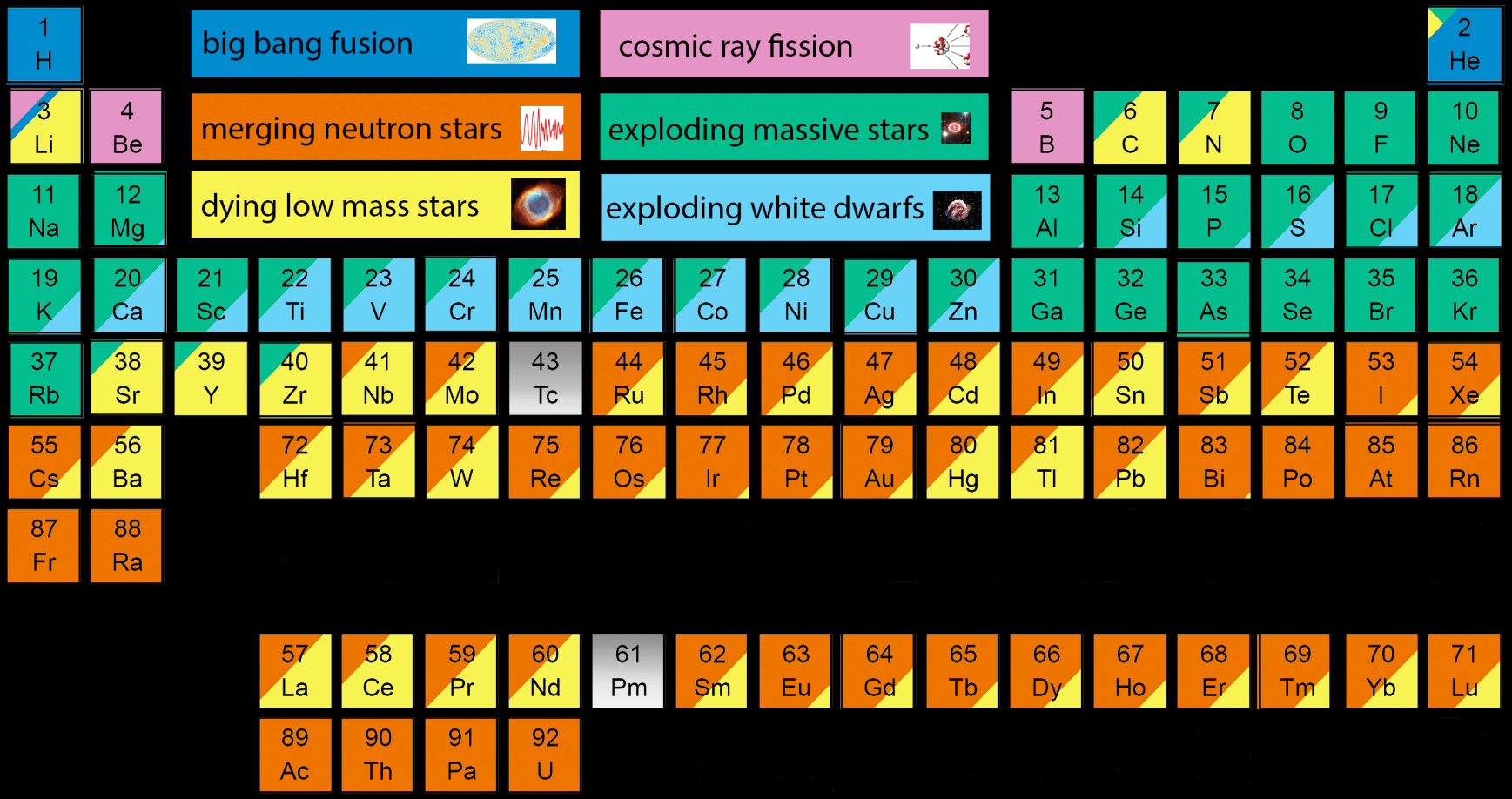
Element abundances in the sun / solar system



Elements created in / after the Big Bang

Elements created in stars / stellar evolution processes

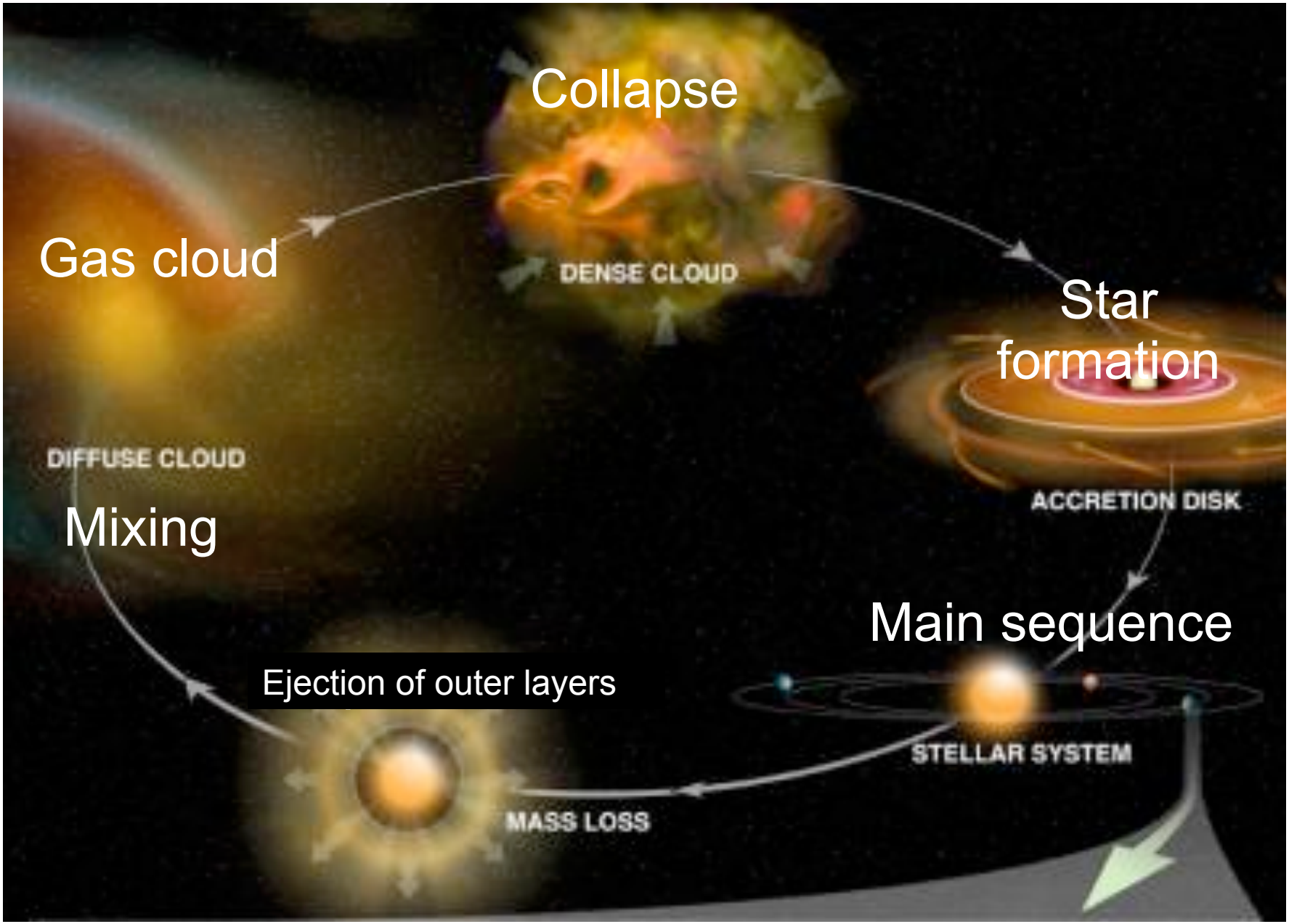
The Origin of the Solar System Elements



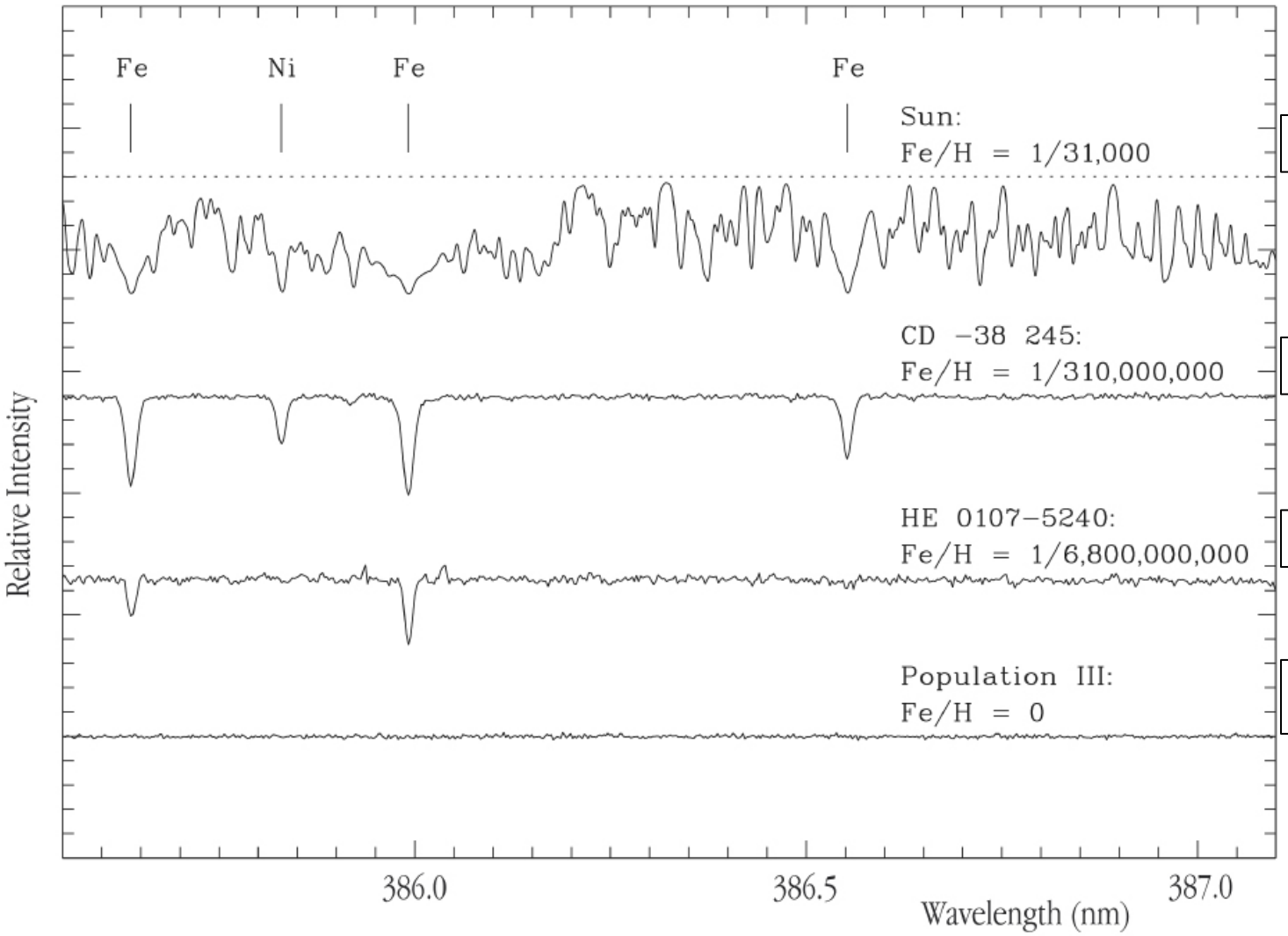
Graphic created by Jennifer Johnson

Astronomical Image Credits:
ESA/NASA/AASNova

Cosmic cycle of matter → enrichment with heavy elements



Example for abundance effects in stellar spectra: Discovery of the extremely low metallicity star HE 0107–5240



[Fe/H] ≈ 0.0

[Fe/H] ≈ –4

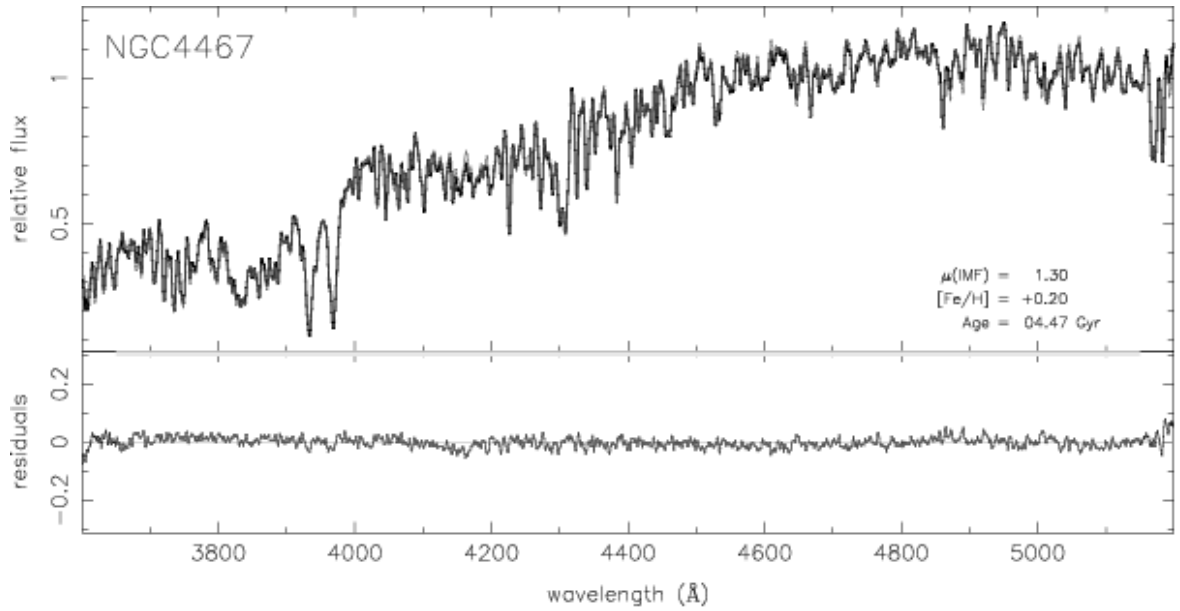
[Fe/H] ≈ –5.3

[Fe/H] ≈ $-\infty$

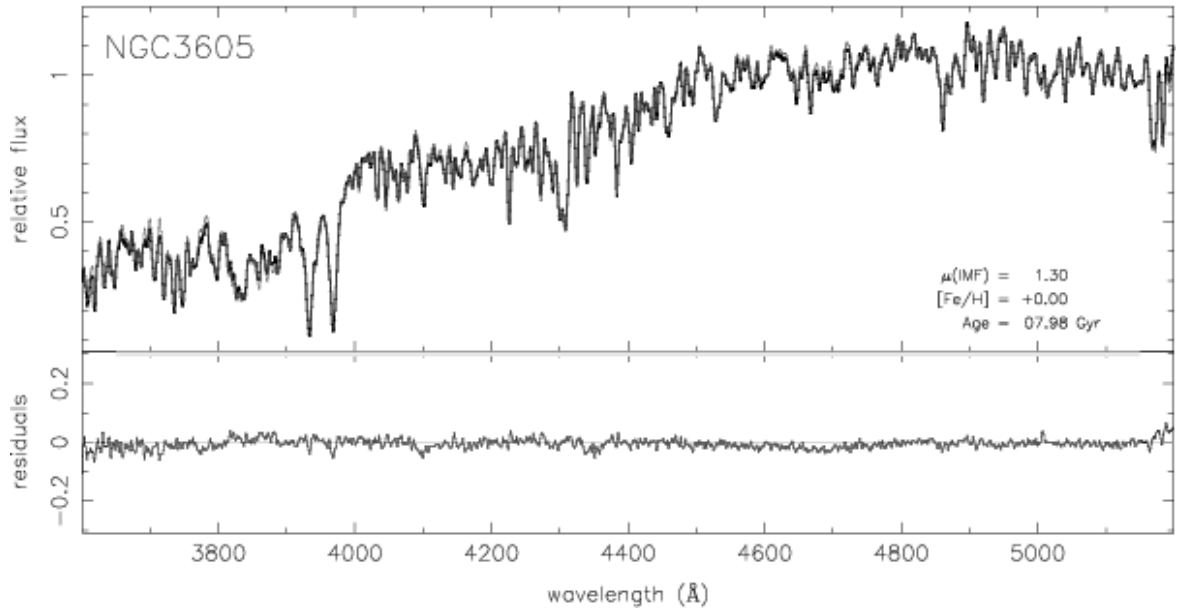
Spectra of Stars with Different Metal Content

ESO PR Photo 25b/02 (30 October 2002)

Example for determination of mean metallicities of early-type galaxies from SSP model fitting of their integrated starlight spectra



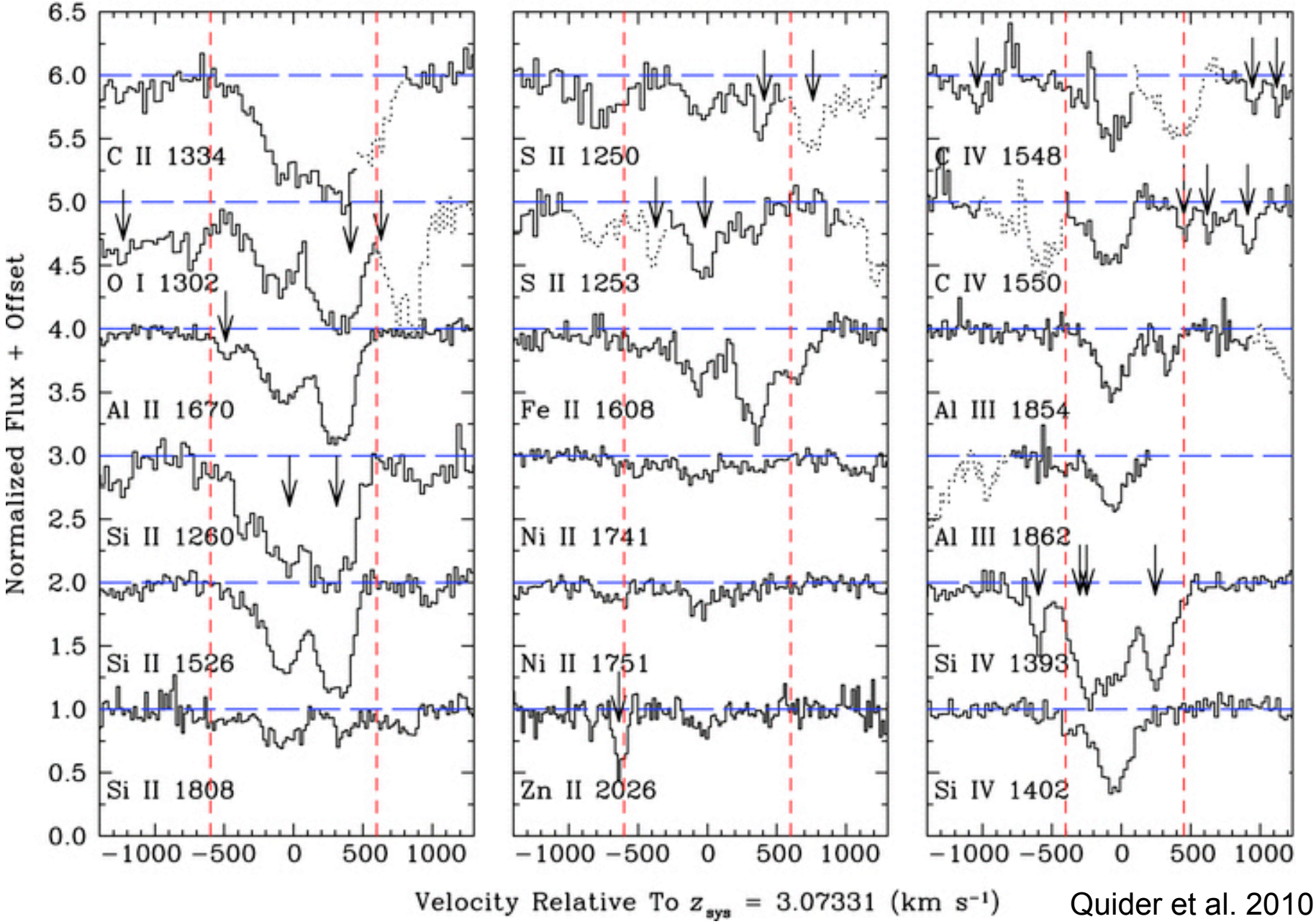
NGC 4467,
[Fe/H] ≈ +0.20



NGC 3605,
[Fe/H] ≈ 0.00

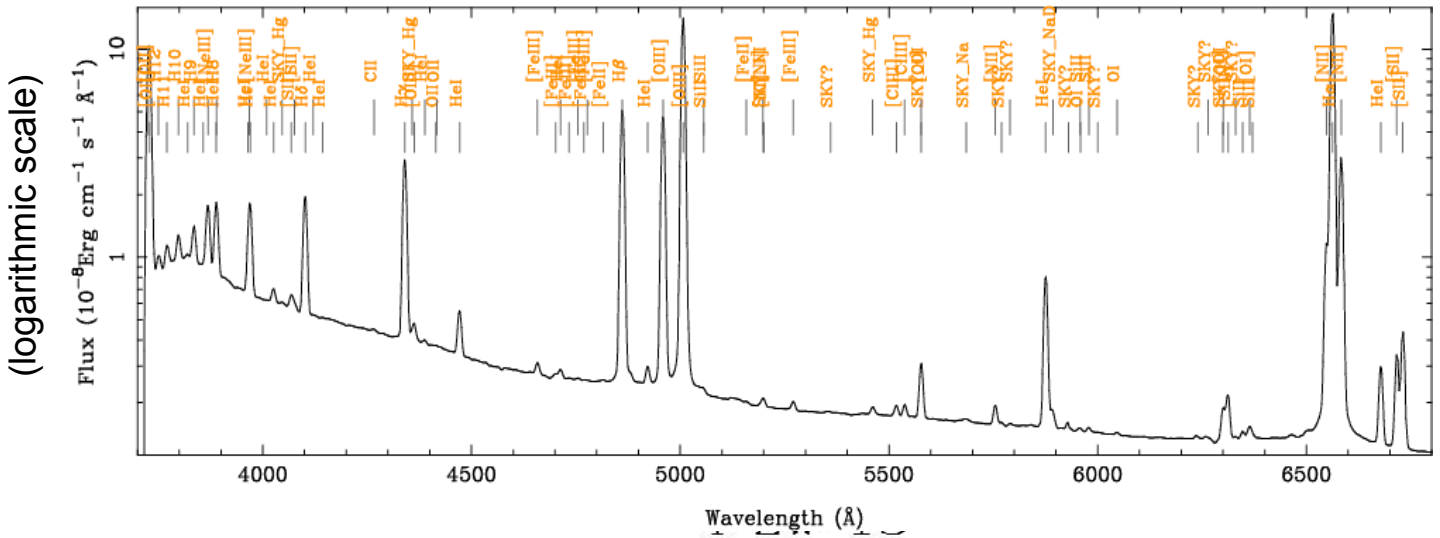
Sanchez-Blazquez et al 2006

Example for interstellar absorption lines from a high-redshift galaxy



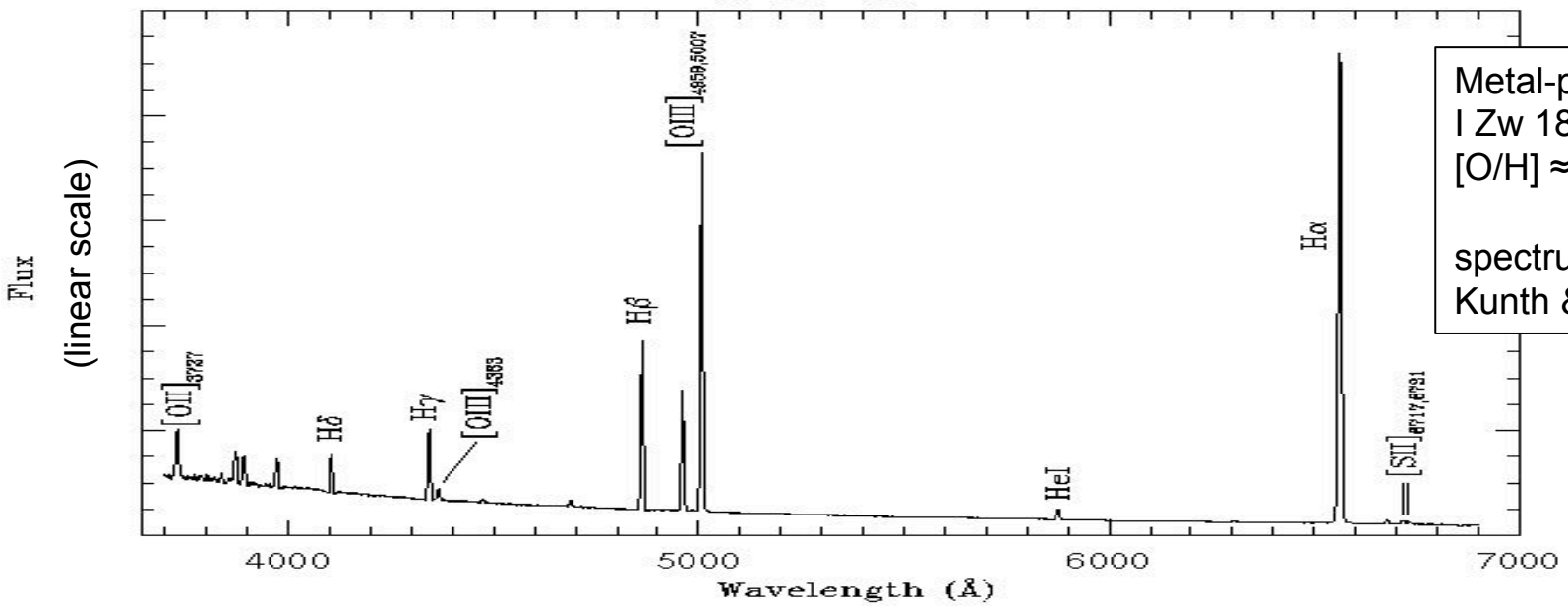
Quider et al. 2010

Example for measuring gas-phase oxygen abundances in emission line spectra from photoionised interstellar gas



Orion nebula,
[O/H] ≈ 0 (i.e. solar)

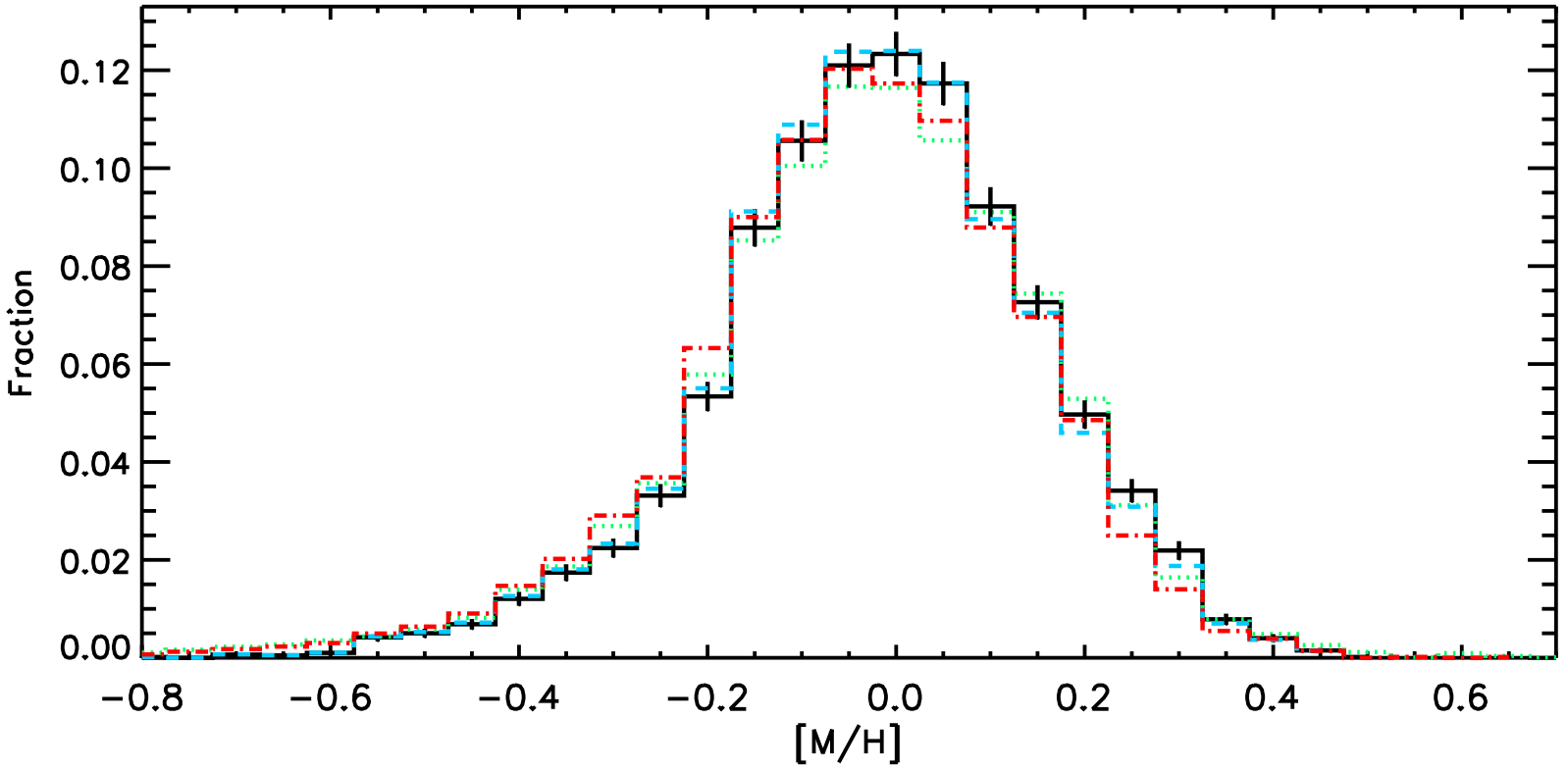
spectrum from
Sanchez et al. 2007



Metal-poor galaxy
I Zw 18,
[O/H] ≈ –1.8

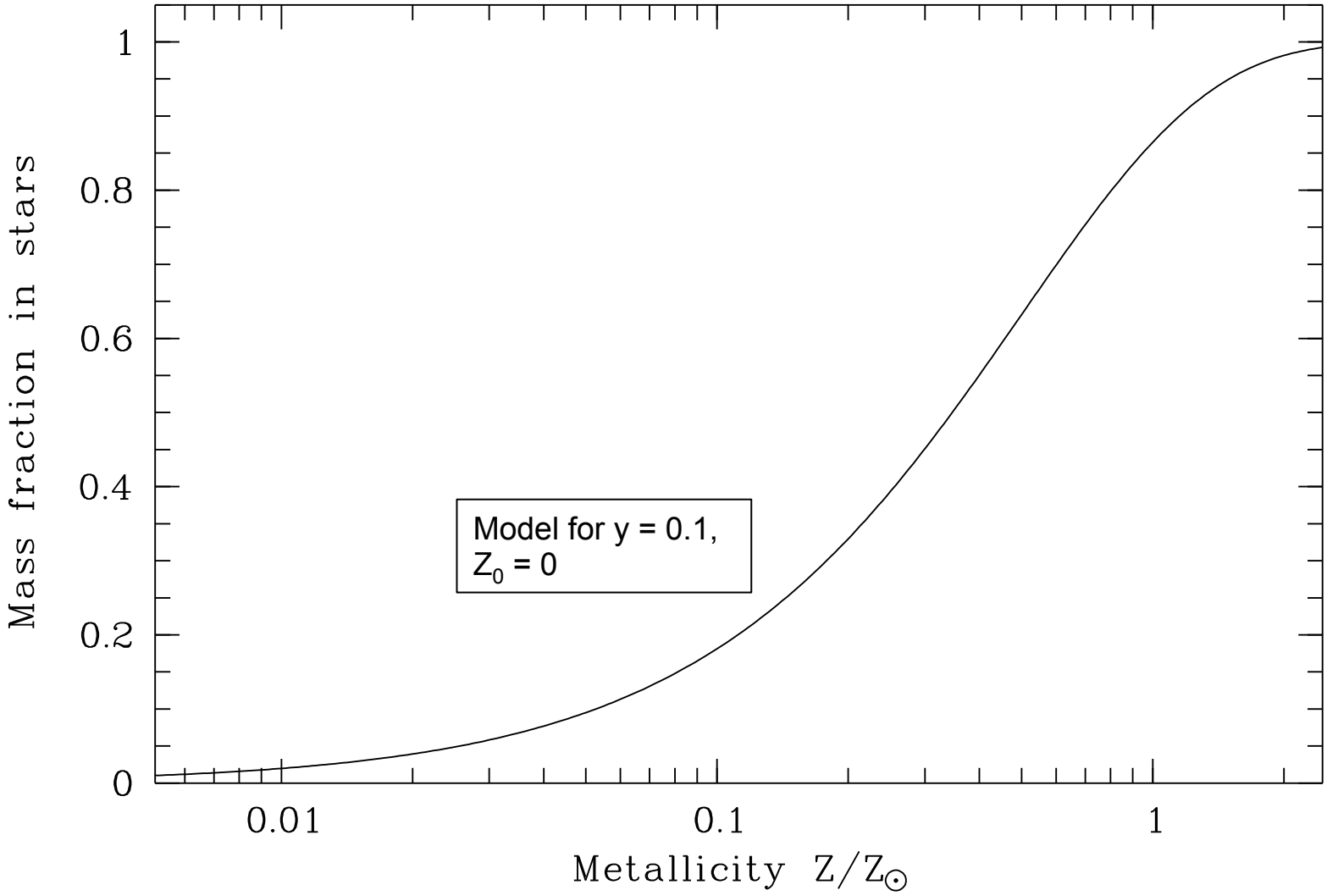
spectrum from
Kunth & Östlin 2000

Observed metallicity distribution for stars in the **solar neighbourhood**

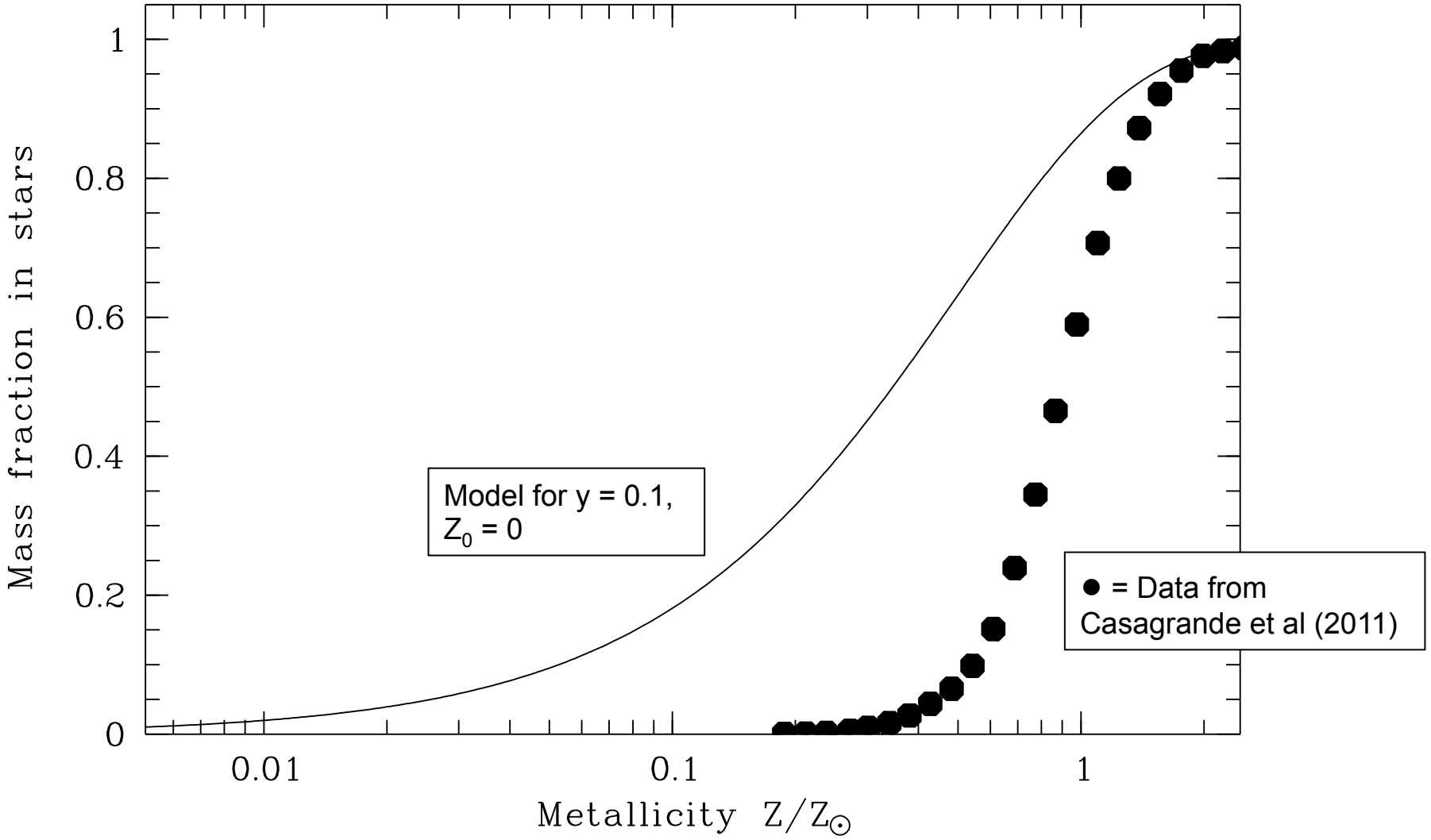


based on Geneva-Copenhagen Survey,
Casagrande et al 2011

Comparison of the "Simple Model" of galactic chemical evolution with observations of stars in the solar neighbourhood



Comparison of the "Simple Model" of galactic chemical evolution with observations of stars in the solar neighbourhood

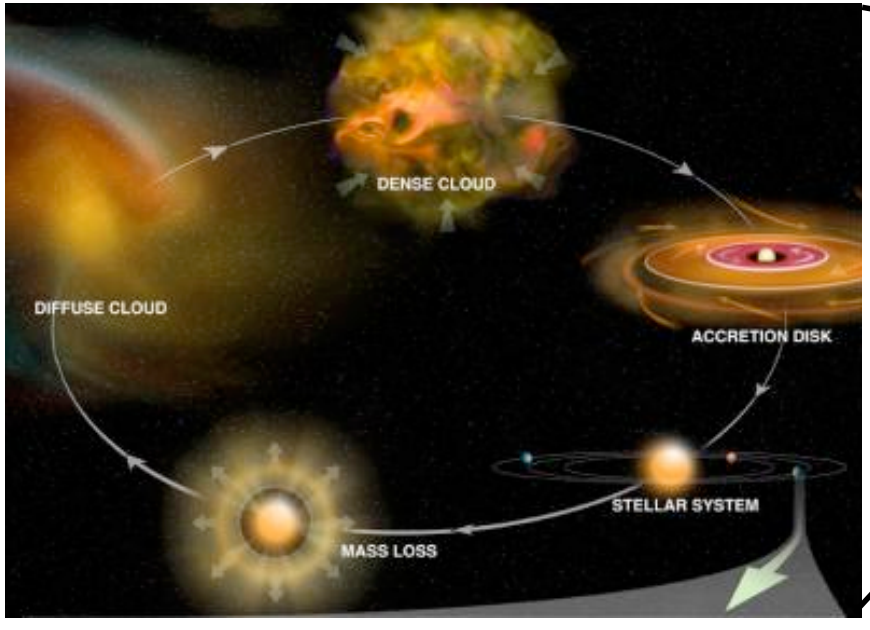


Galactic ecosystems
instead of closed-box cosmic matter cycle

Merging

Gas accretion

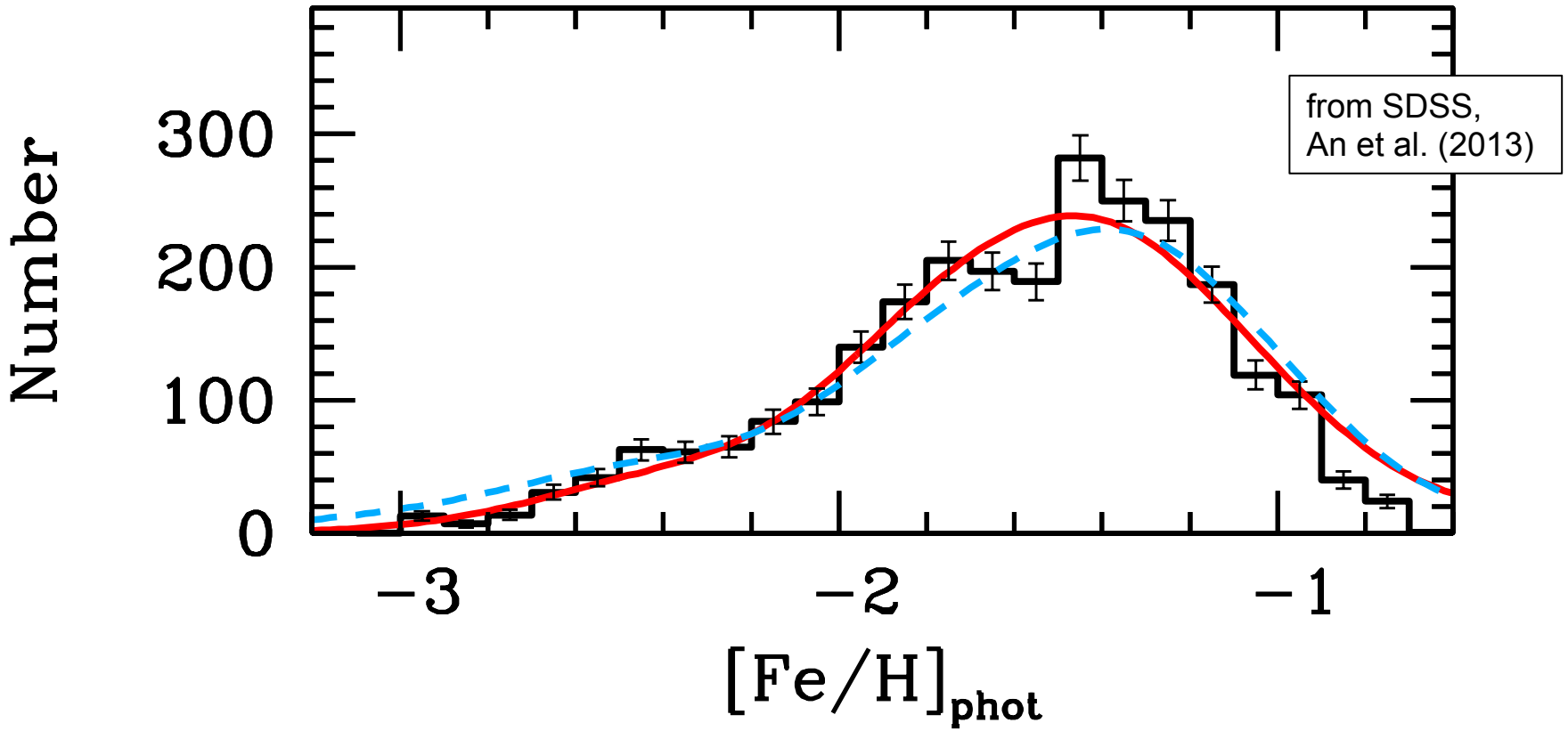
Matter cycle



Mattercycle

Winds

Observed metallicity distribution for stars in the **Galactic halo**



→ Exercises!