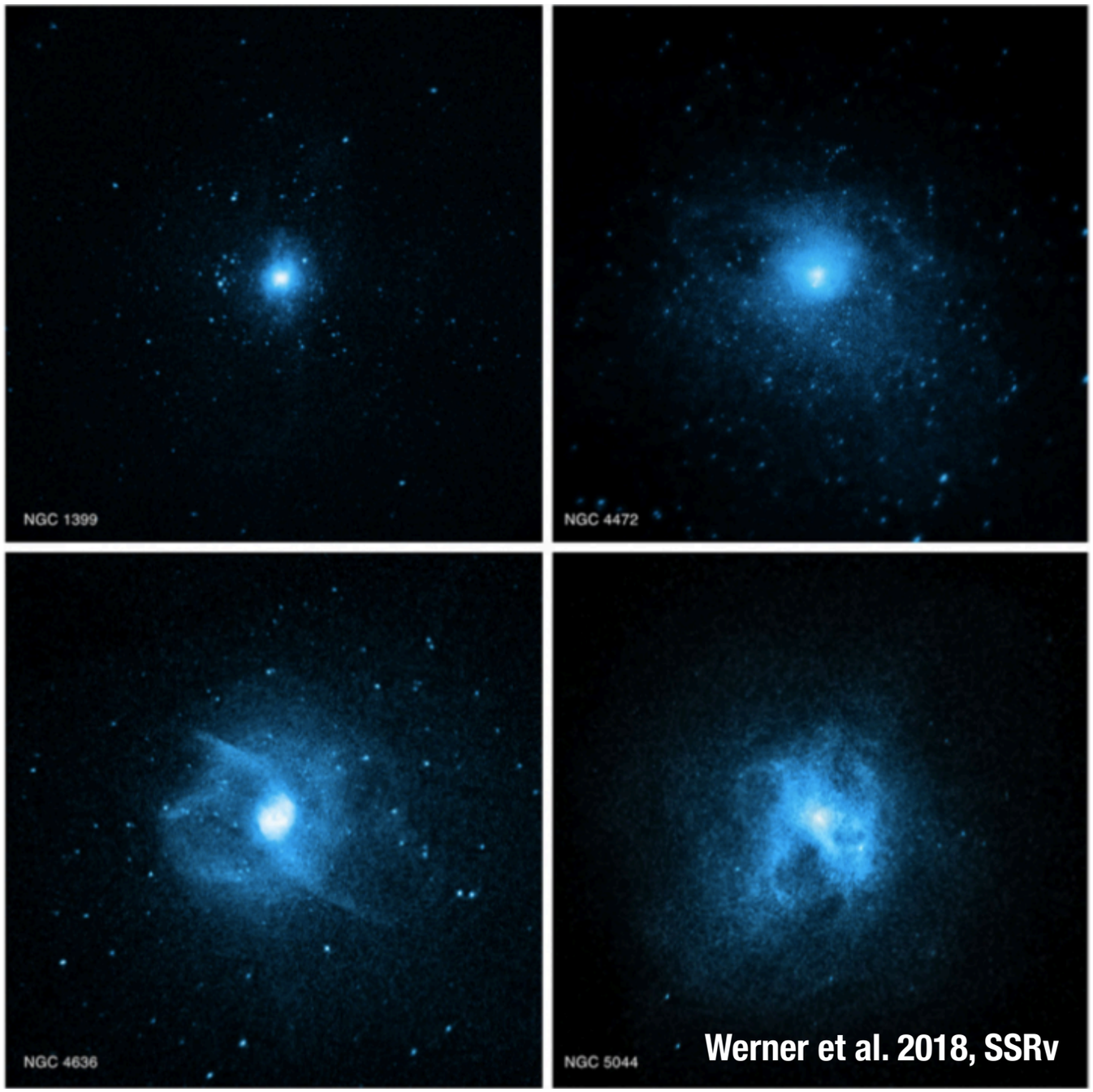
xmm-newton

Nitrogen abundance in the X-ray halos of clusters and groups of galaxies

Junjie Mao

J. de Plaa, J. S. Kaastra, C. Pinto, L. Gu, F. Mernier, H.-L. Yan, Y.-Y. Zhang, and H. Akamatsu



Science & Technology Facilities Council

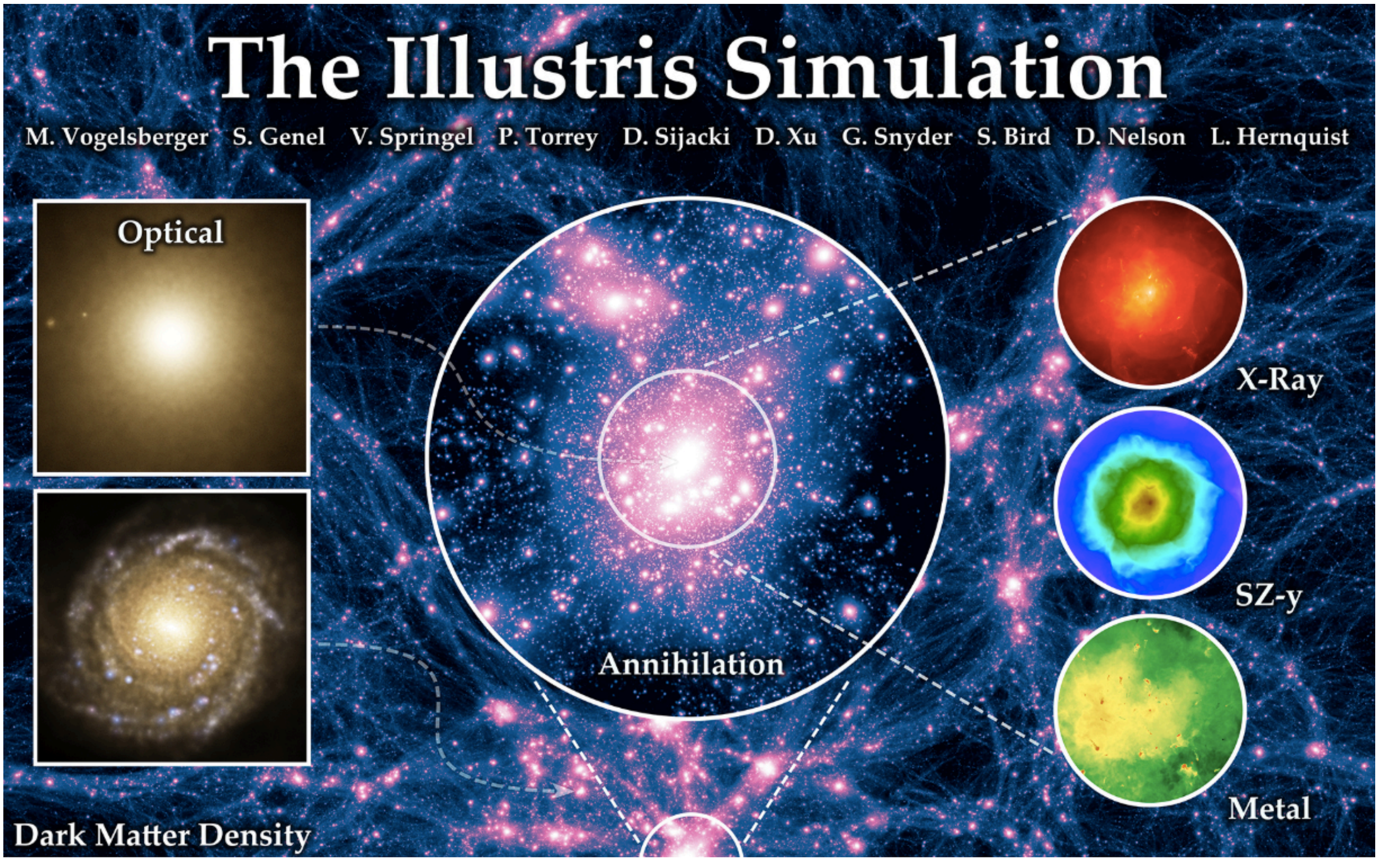
University of Strathclyde Glasgow

SRON Netherlands Institute for Space Research

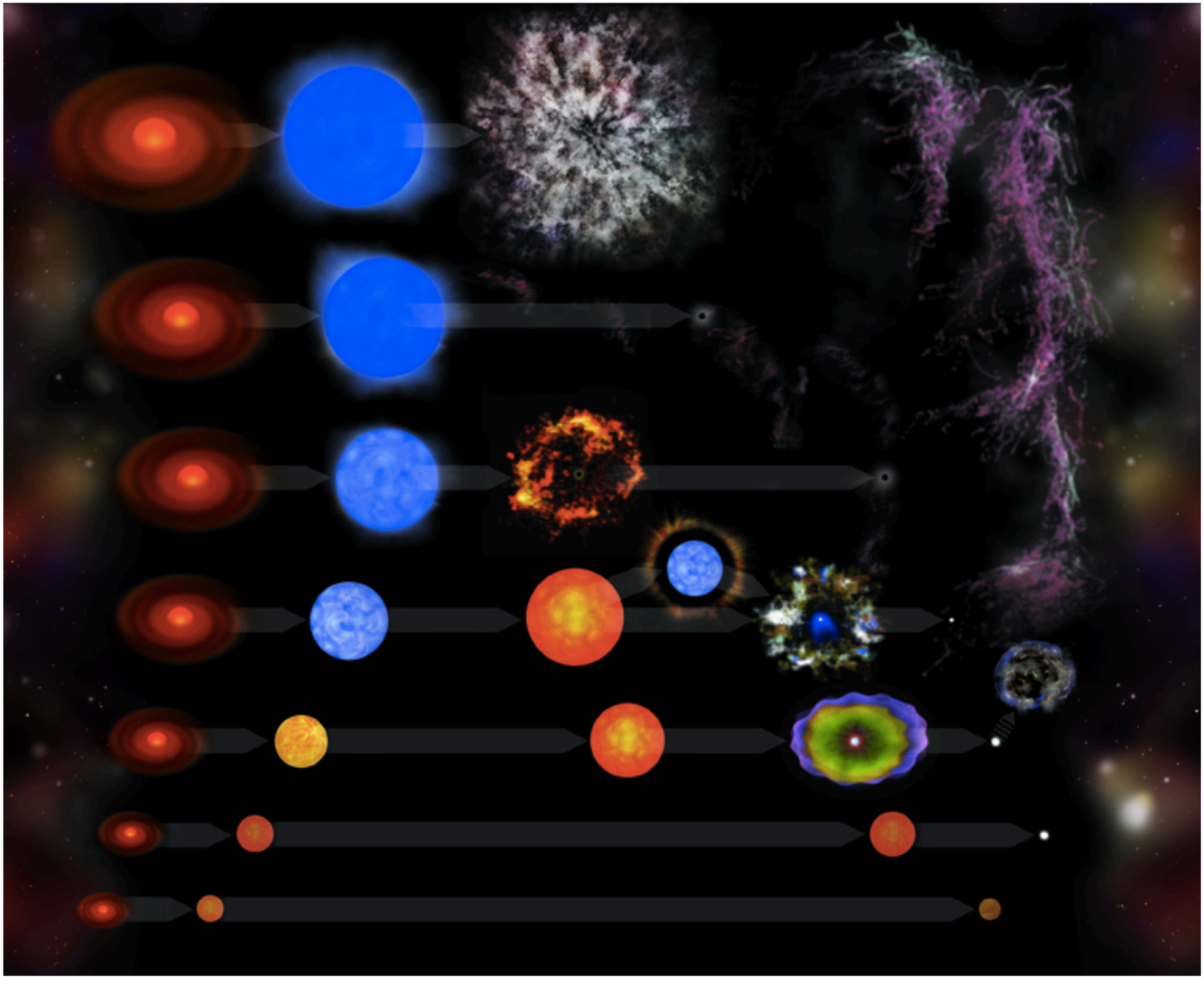
ASTROPHYSICS OF HOT PLASMA IN EXTENDED X-RAY SOURCES

June 14, 2019 @ESAC, Madrid

Cosmic lab


The Illustris Simulation
M. Vogelsberger S. Genel V. Springel P. Torrey D. Sijacki D. Xu G. Snyder S. Bird D. Nelson L. Hernquist
Optical
Dark Matter Density
Annihilation
X-Ray
SZ-y
Metal

Metal factories



28 Ni

26 Fe

25 Mn

24 Cr

20 Ca

18 Ar

16 S

14 Si

12 Mg

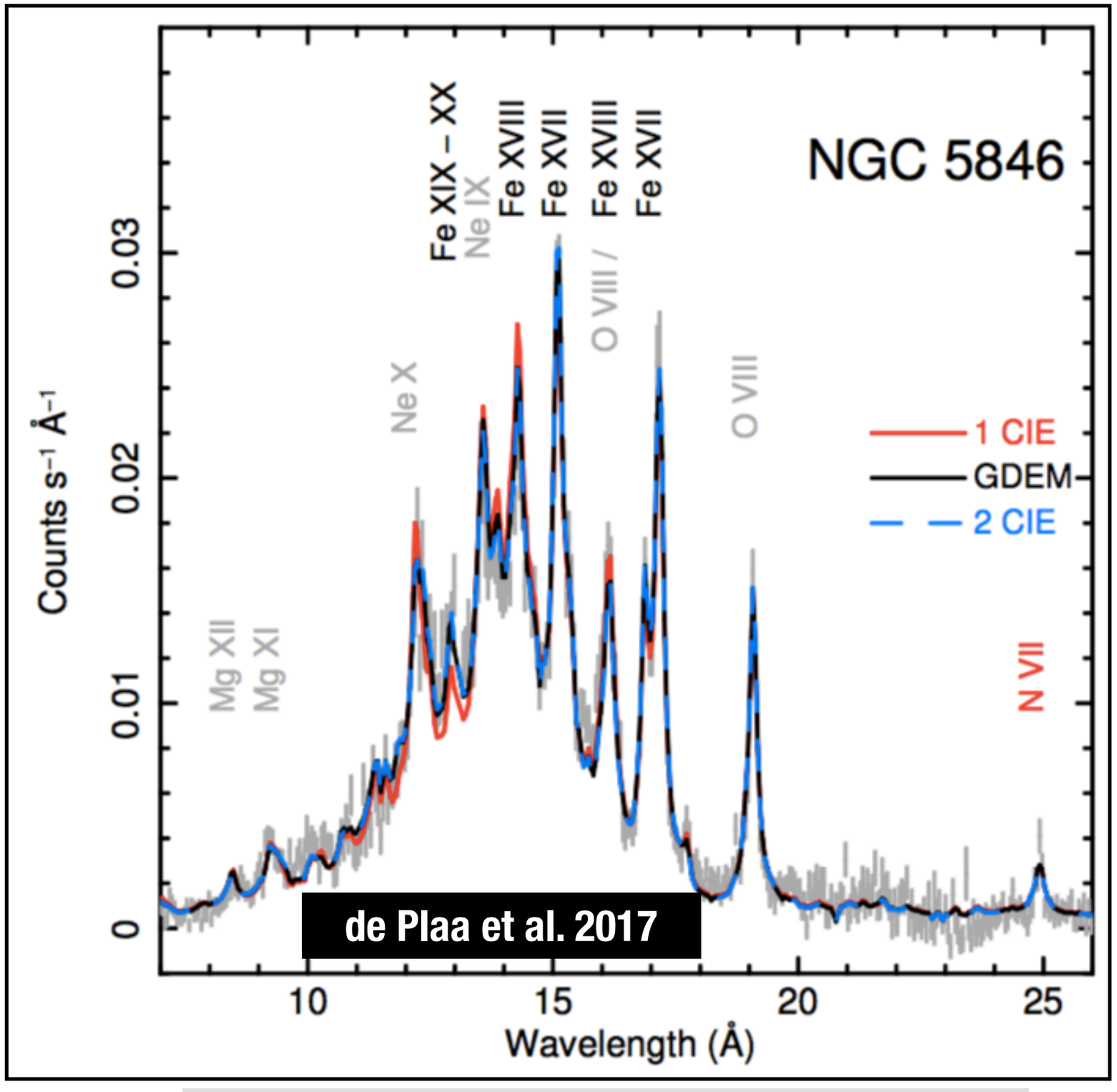
10 Ne

8 O

6 C

7 N

RGS & Nitrogen



See also e.g., Werner et al. 2006, Sanders & Fabian (2011)

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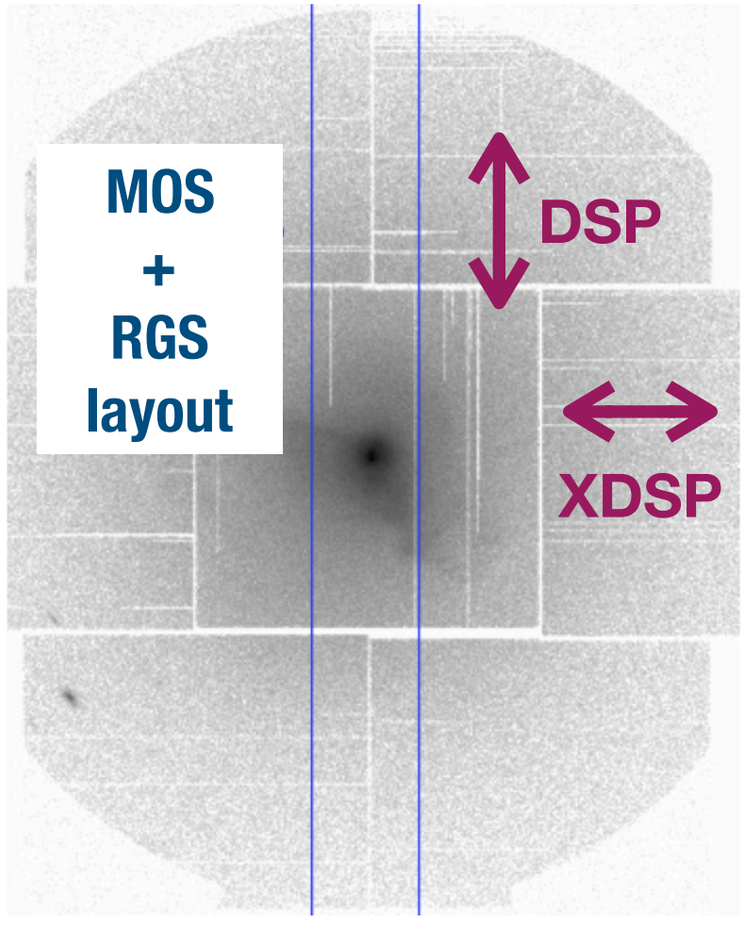
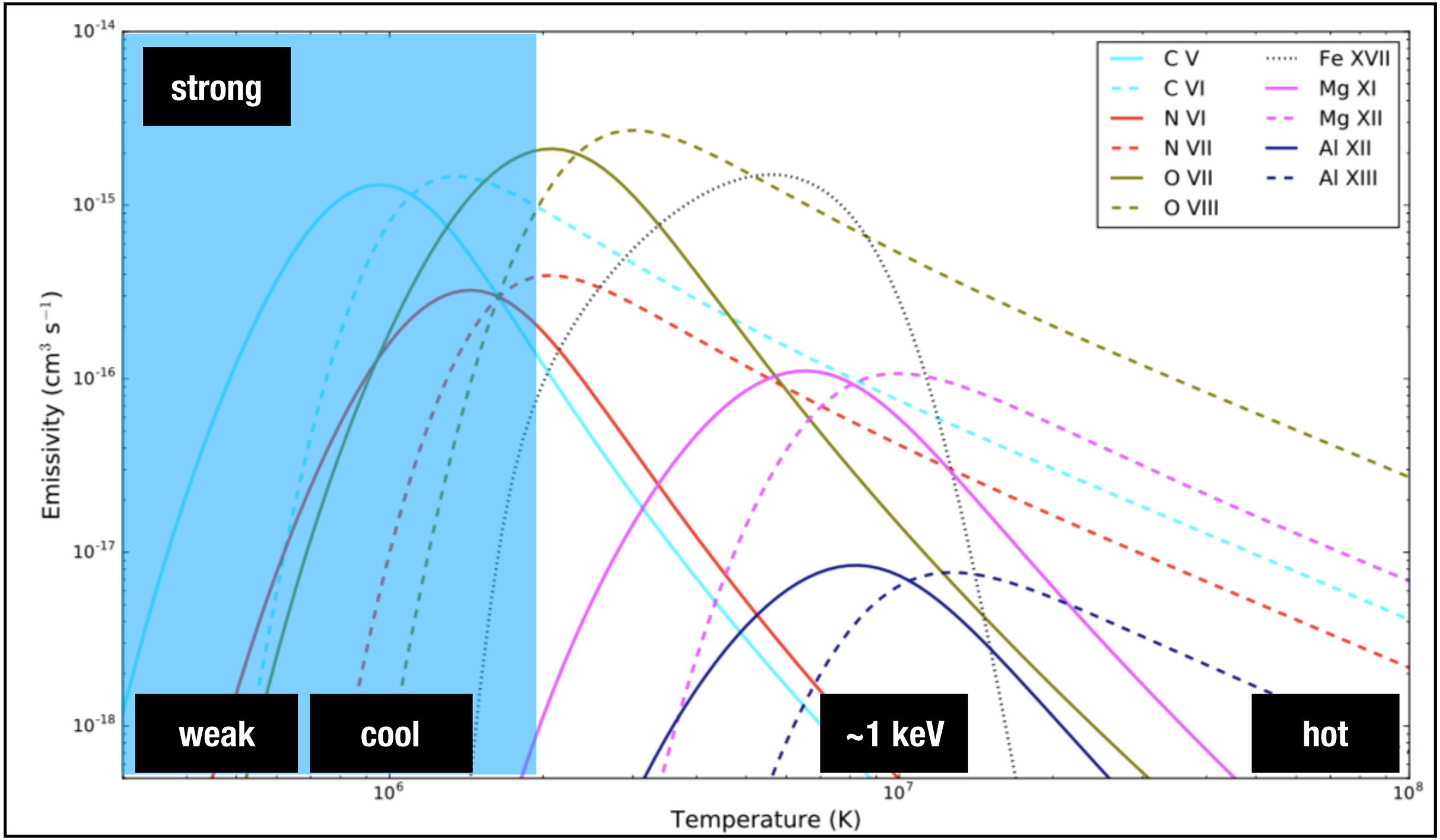
Reflection Grating Spectrometers



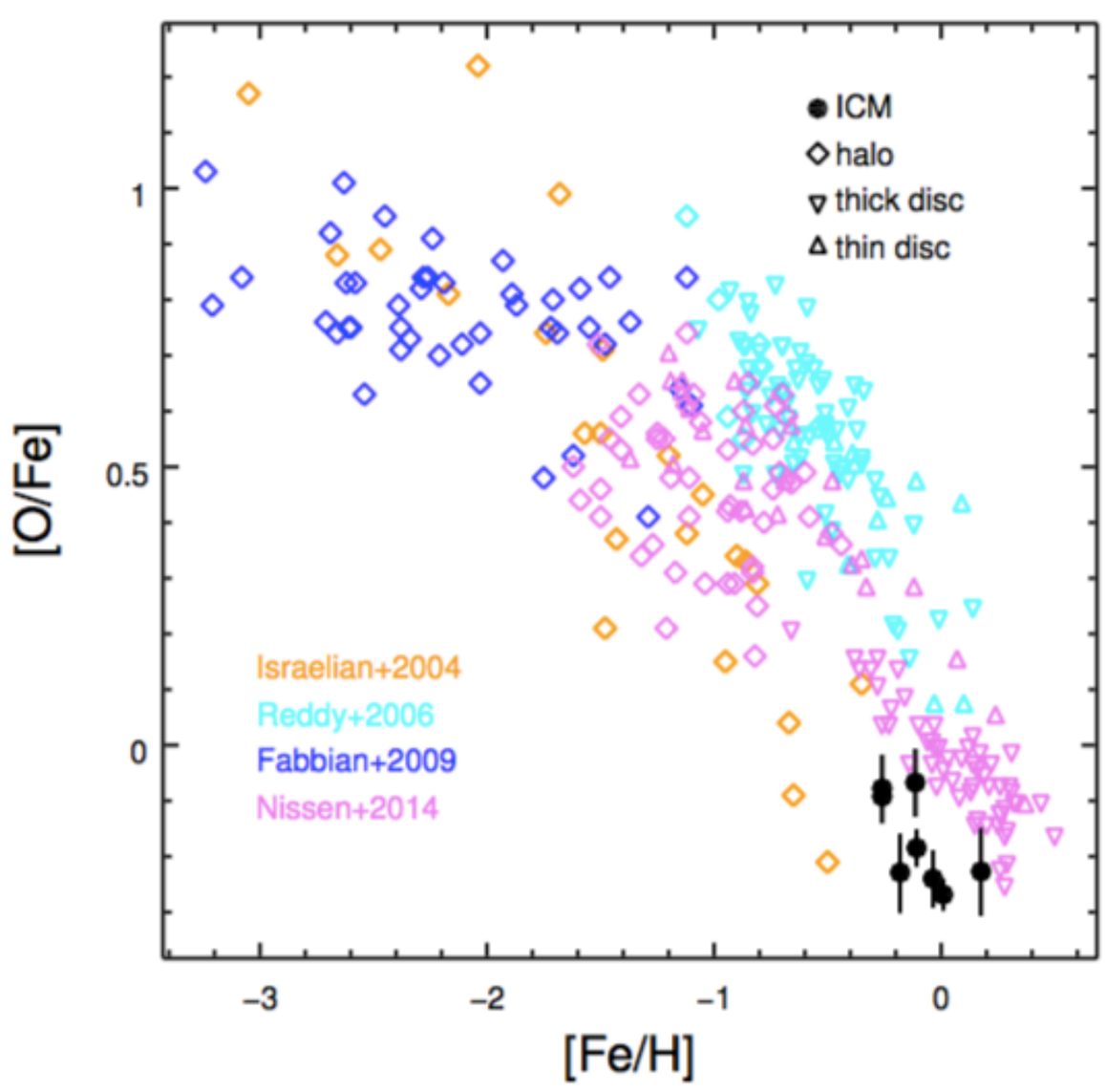
Emissivity — Temperature

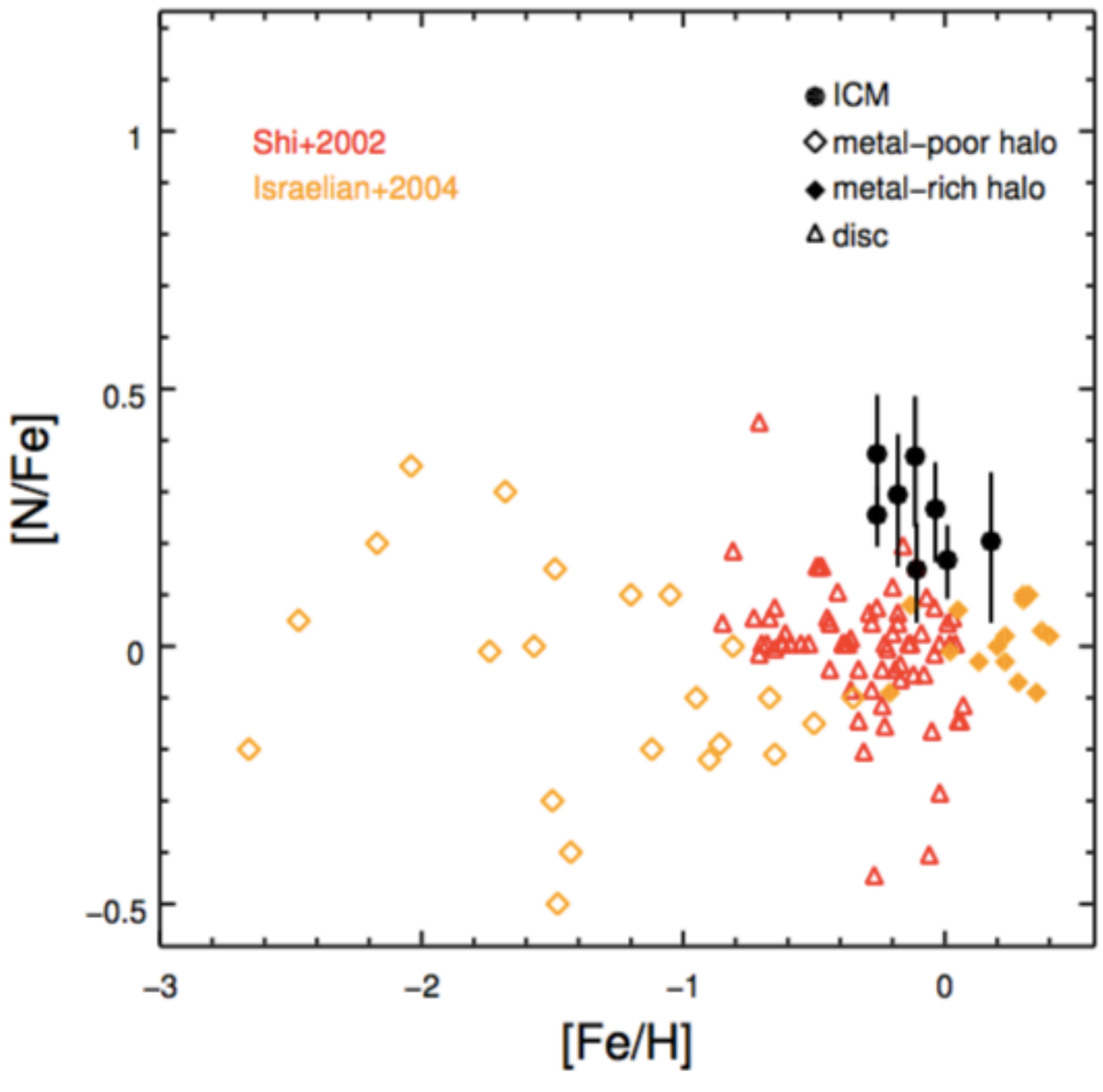


8 out of 44 in the CHEERS sample ($Z_N > 3\sigma$)
more exposure for a few low-T systems

See also Sanders & Fabian (2011)

Enrichment timescale



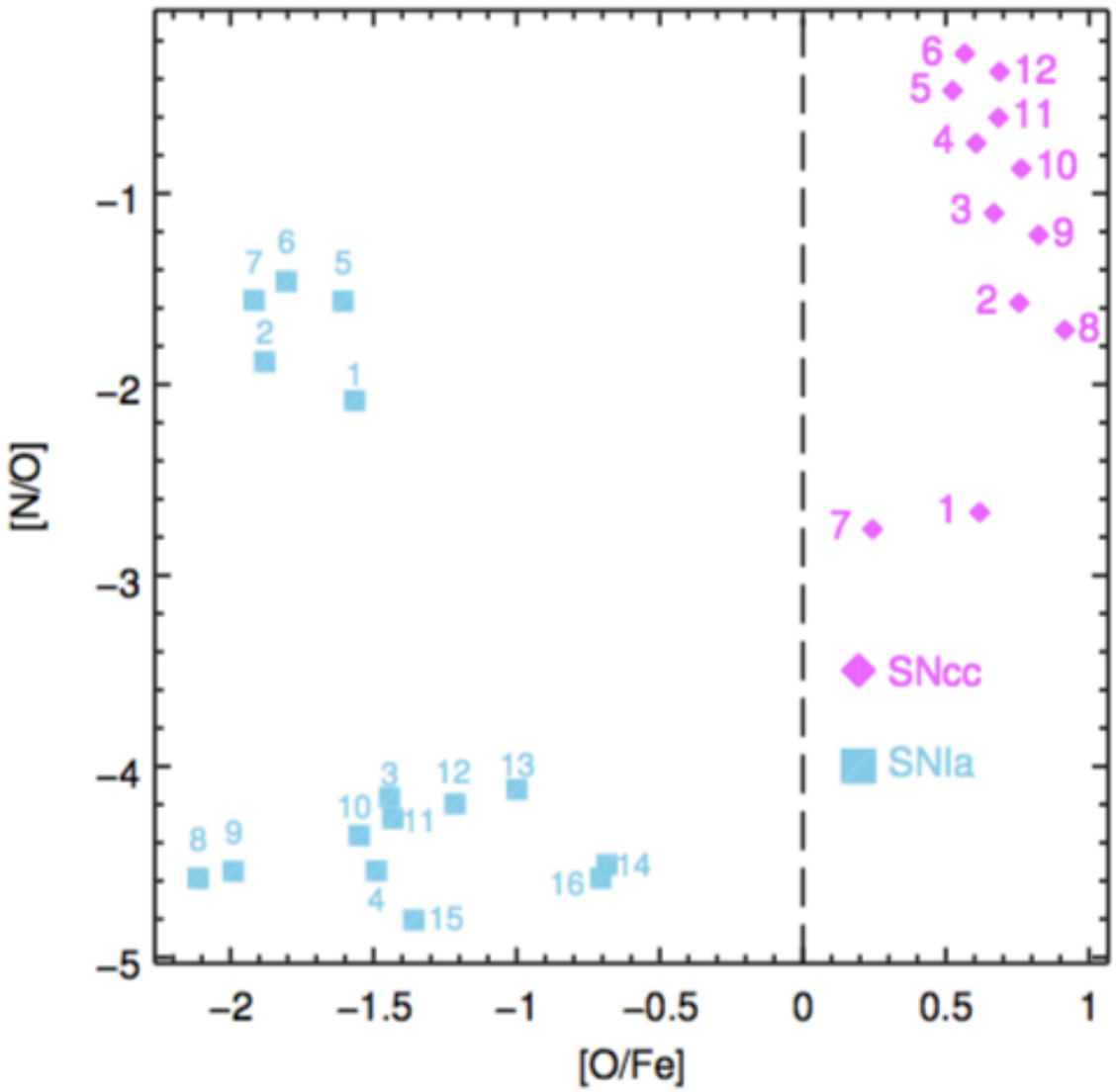


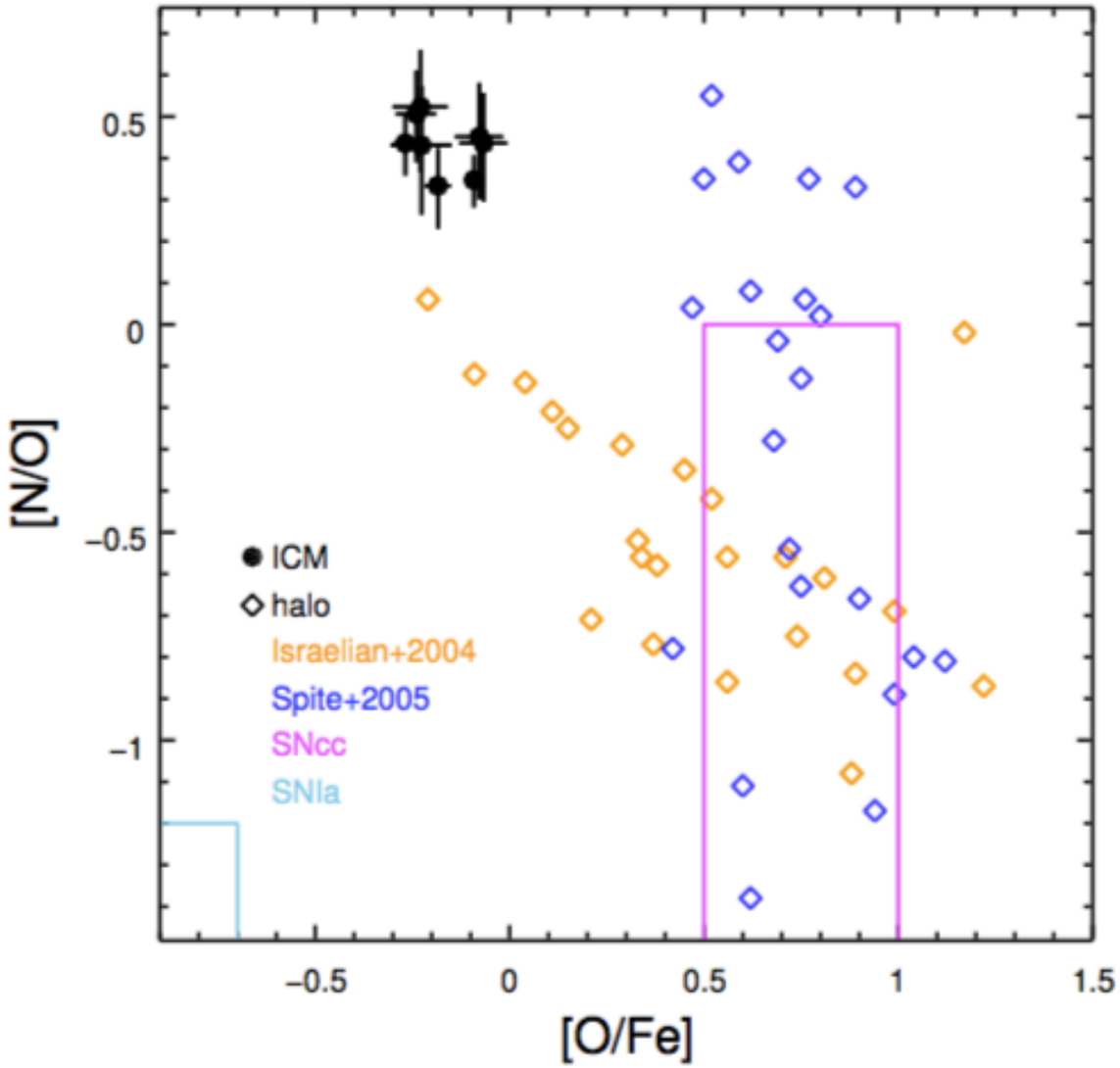
O: SNcc, massive progenitors
Fe: SNIa (delay)

Mao et al. 2019

N: AGBs, low- and intermediate- mass progenitors

Stellar yields

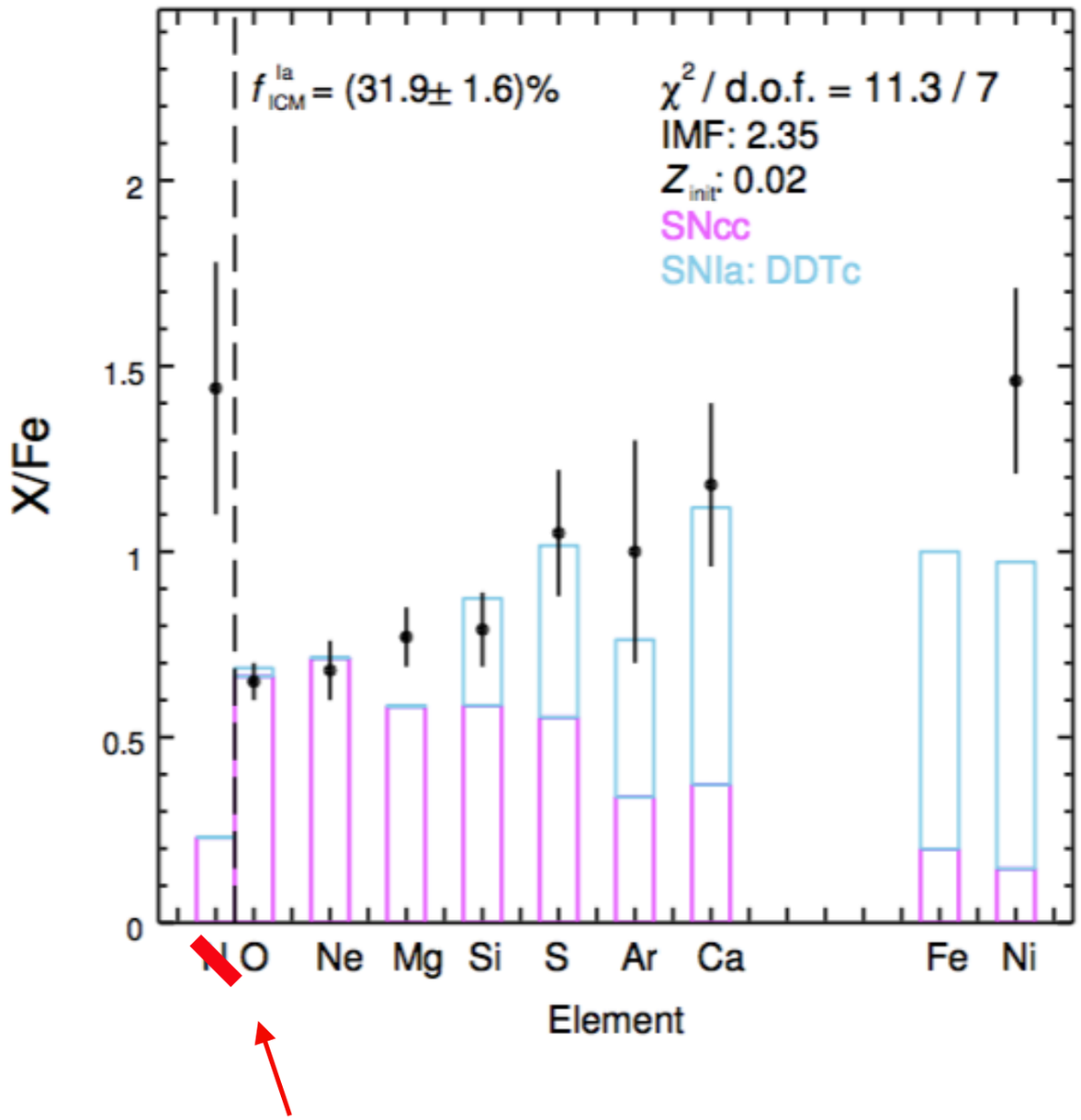




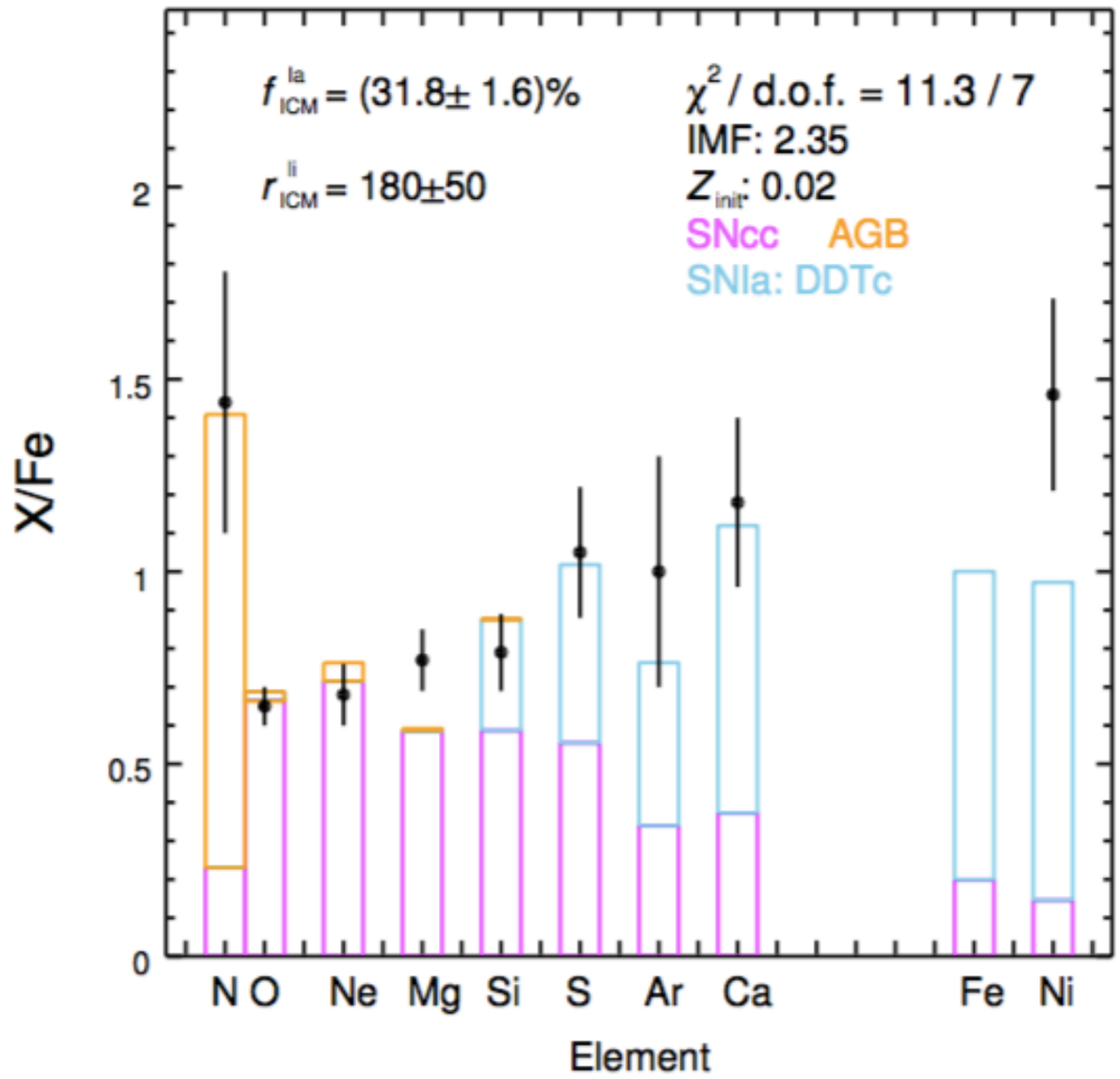
- A mix of SNcc and SNIa enrichment is required for [O/Fe]
- SNe enrichment is not enough to explain [N/O]

Mao et al. 2019

NGC 5044



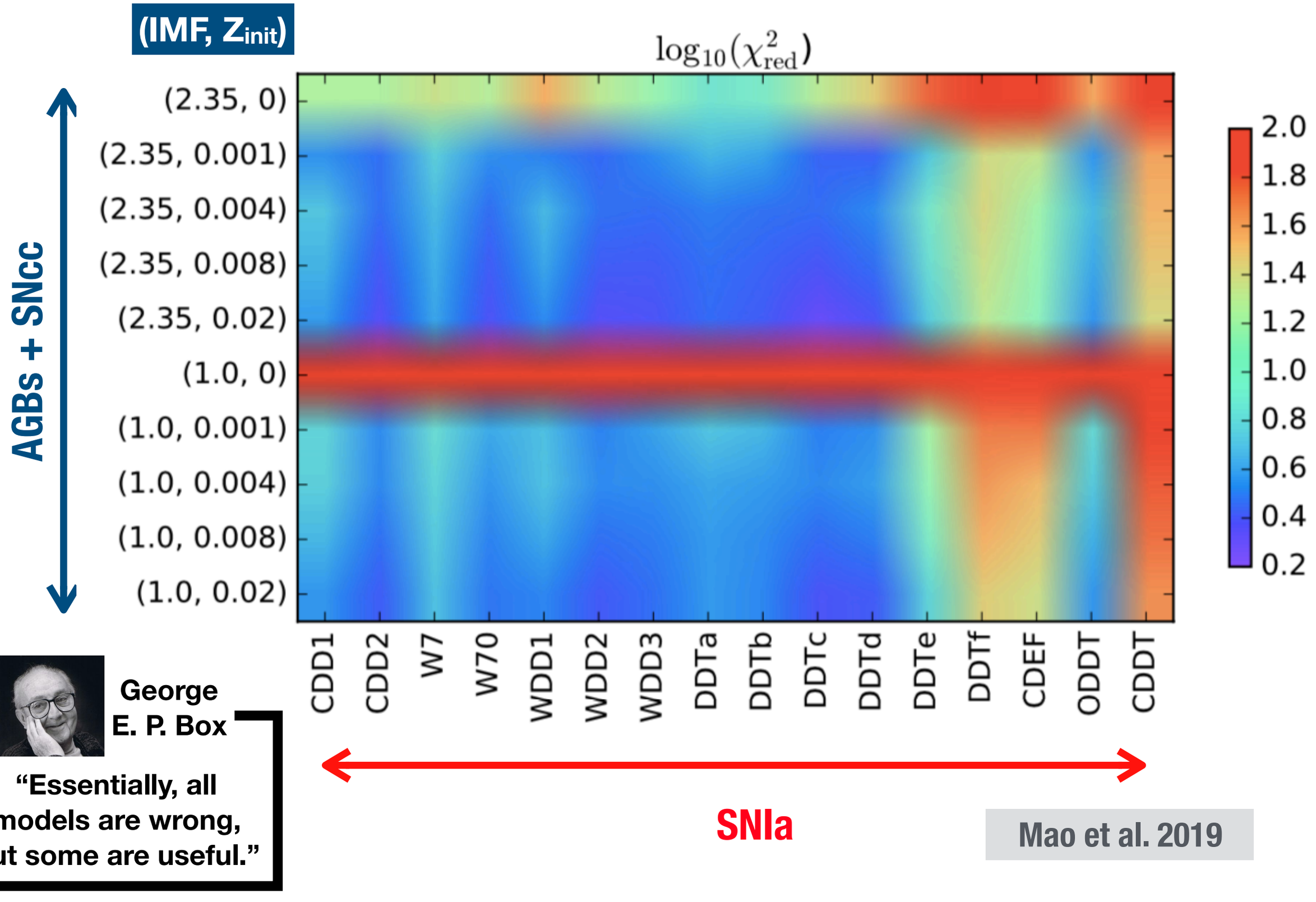
Excluded from the fit



Nitrogen enrichment can be explained by AGBs

Mao et al. 2019

Model degeneracy

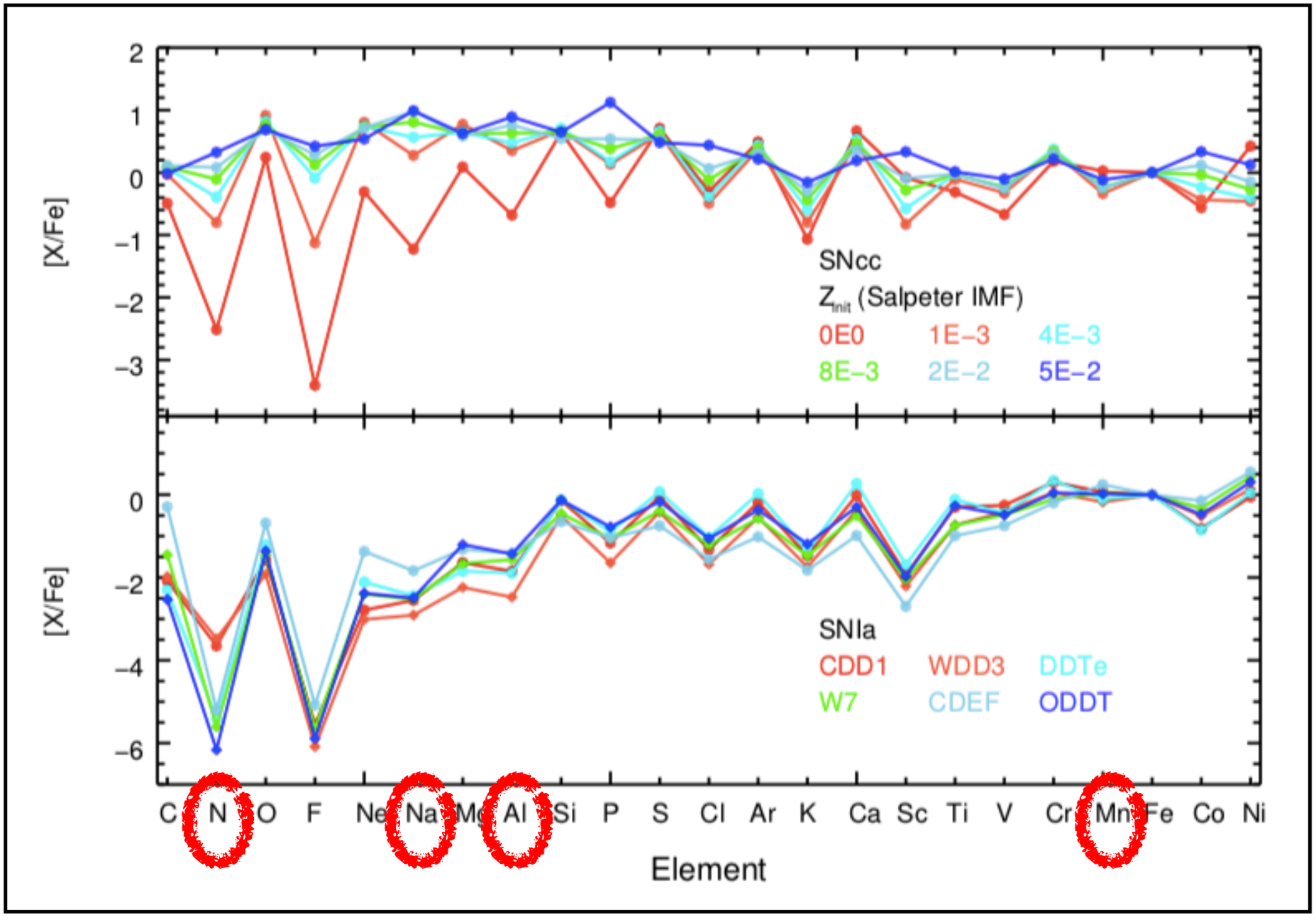


George E. P. Box

"Essentially, all models are wrong, but some are useful."

Mao et al. 2019

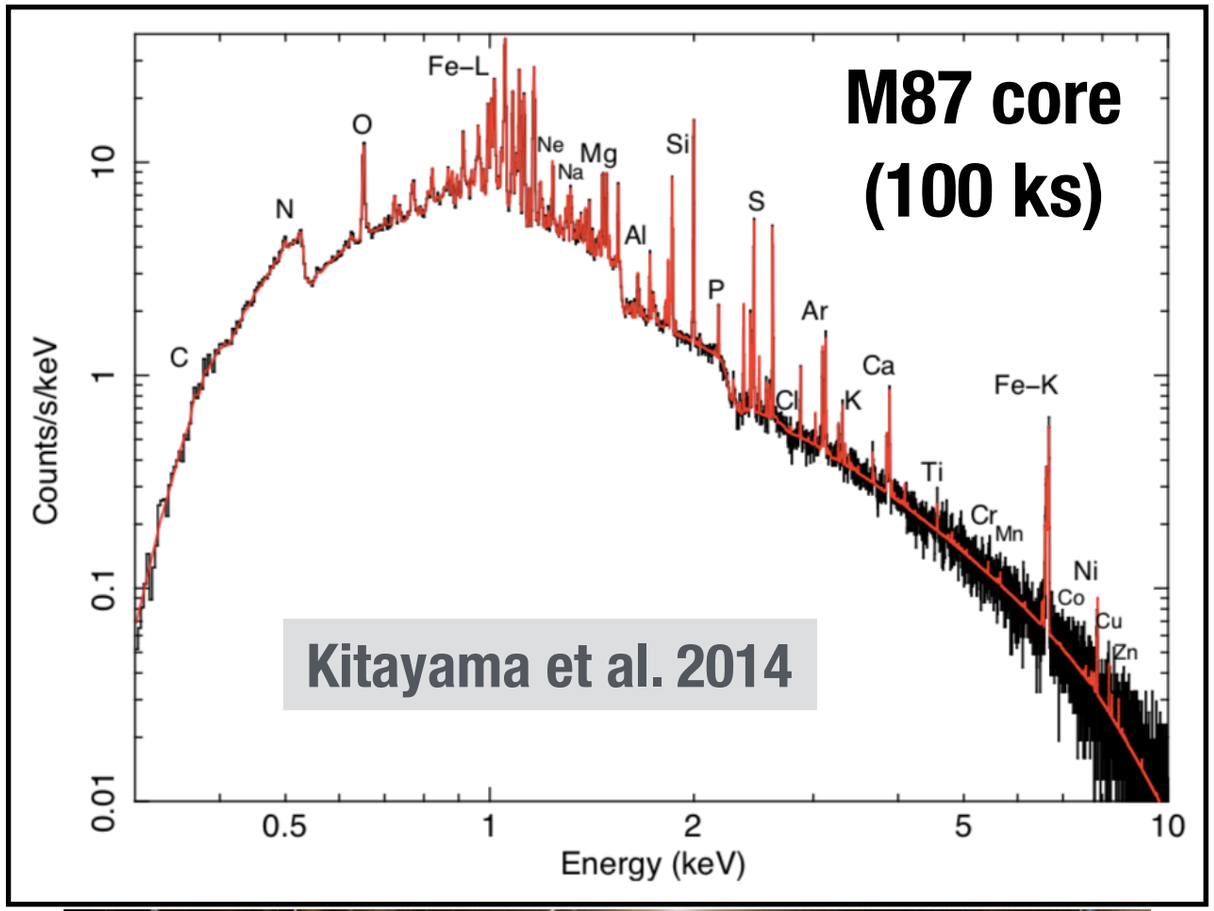
Odd-Z elements (N, Na, Al)

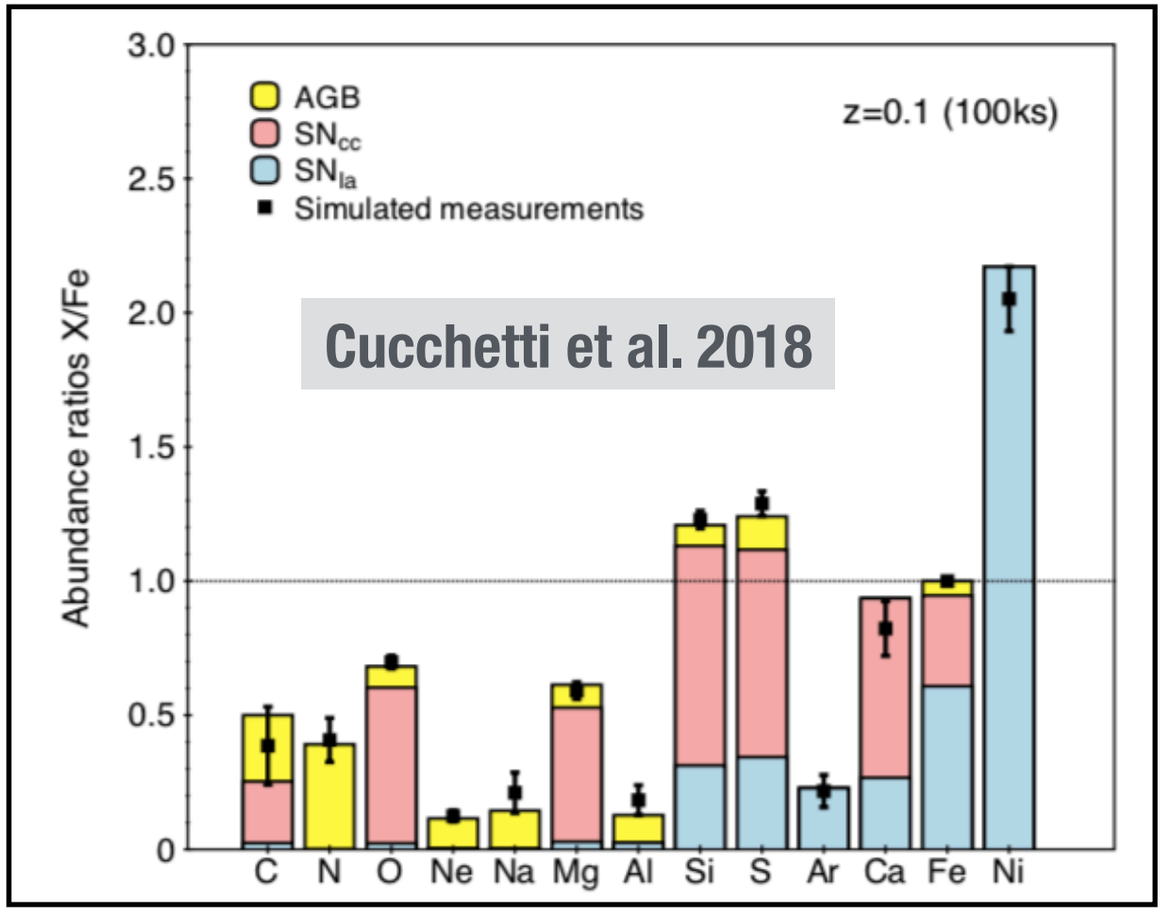


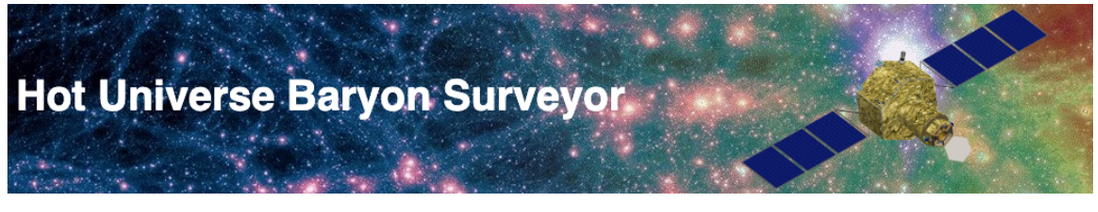
- Initial metallicity of progenitors
- Need more observations
- Higher spectral resolution & large effective area (XRISM, Athena/XIFU, HUBS)

Nomoto et al. 2006 & 2013, Sanders & Fabian (2011), Paerels et al. 2014

Future perspectives







- Abundances from Carbon to Zinc in the core region
- Average abundance ratios with respect to Fe within R_{500} at z ~0.1

Thanks for your attention!