

## Number abundances in stellar atmospheres – three scales

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Number abundances:

$N$  ... number density,  $M$  ... any metal,  $H$  ... hydrogen

- $\log(N/N_H)$  ... the absolute scale relative to hydrogen
- $\log \epsilon_H \equiv \log(N/N_H) + 12$  ... the “H=12 scale” (often used in the literature)
- $\log(N/N_{\text{tot}})$  ... the absolute scale relative to the total number density of atoms (used by e.g. Kurucz and SME)

Relations:

$$\log(N/N_H) = \log(N/N_{\text{tot}}) - \log(N_H/N_{\text{tot}})$$

$$N_H/N_{\text{tot}} = 0.92 \Rightarrow \log(N_H/N_{\text{tot}}) = -0.04$$

$$\Rightarrow \log \epsilon_H = \log(N/N_{\text{tot}}) + 12 + 0.04$$

Abundance relative to solar:

$$[M/H] = \log \epsilon_H(M) - \log \epsilon_H(M)_{\odot} = \log(N_M/N_H) - \log(N_M/N_H)_{\odot} = \log(N_M/N_{\text{tot}}) - \log(N_M/N_{\text{tot}})_{\odot}$$

Example (solar abundances from Asplund, Grevesse, Sauval, Scott 2009, Annu. Rev. Astron. Astrophys. 47, 481, Table 1):

Element	$\log \epsilon_H$	$\log(N/N_{\text{tot}})$	$\log(N/N_H)$
H	12.00	-0.04	0.00
He	10.93	-1.11	-1.07
O	8.69	-3.35	-3.31
C	8.43	-3.61	-3.57
Ne	7.93	-4.11	-4.07
N	7.83	-4.21	-4.17
Mg	7.60	-4.44	-4.40
Si	7.51	-4.53	-4.49
Fe	7.50	-4.54	-4.50