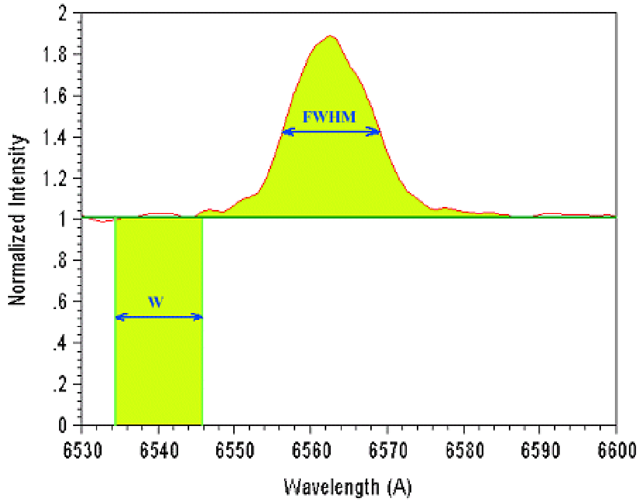
# Equivalent Width

Line profile $$\phi_\nu = \frac{I_c - I_\lambda}{I_c}$$




$$W_\lambda = \int_{-\infty}^{\infty} \frac{I_c - I_\lambda}{I_c}\, d\lambda = \int 1 - e^{\tau_\nu}\ d\lambda$$

measures the total absorption (strength) in a line, where $I_c$ is the continuum and $I_\lambda$ is the line profile.

$W_\lambda$ has the dimension of $\lambda$, e.g., Å, or mÅ.

In optical and UV ($h\nu >> kT$), stimulating emission can be neglected, i.e., $(1 - e^{h\nu/kT}) \rightarrow 1$, $\sigma_\nu \rightarrow \sigma_0$

$$\tau_\nu = \kappa_\nu \, ds = n\sigma_\nu \, ds = N \, \sigma_\nu$$

where $N$ is the column density $\quad \sigma_\nu = (\frac{\pi e^2}{mc}) \, f \, \phi_\nu, \; \sigma_\nu d\nu = \sigma_\lambda d\lambda$

$$\tau_\lambda = N(\frac{\pi e^2}{mc^2}) \, f \, \lambda_0^2 \, \phi_\lambda$$

(i) For weak lines ($\tau_\lambda \ll 1$ )

$$W_\lambda = \int \tau_\lambda \, d\lambda = N \frac{\pi e^2}{mc^2} \, f \, \lambda_0^2 \propto N \, f$$

or

$$\frac{W_\lambda}{\lambda} = N \frac{\pi e^2}{mc^2} f \lambda_0 = 8.85 \times 10^{-13} \, N f \lambda$$

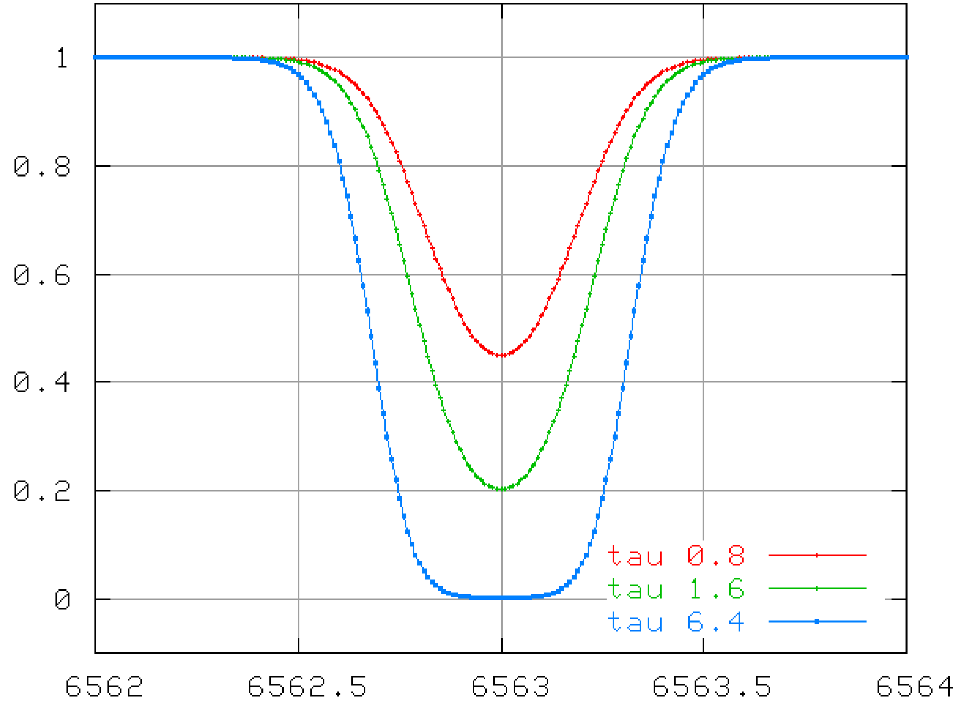
where $N$ is in [cm$^{-2}$], and $\lambda$ in [cm].

(ii) For strong lines ($\tau_\lambda \gg 1$)

$$W_\lambda \propto \sqrt{N\,f}$$

(iii) Intermediate case

$$W_\lambda \propto \sqrt{\ln N\,f}$$



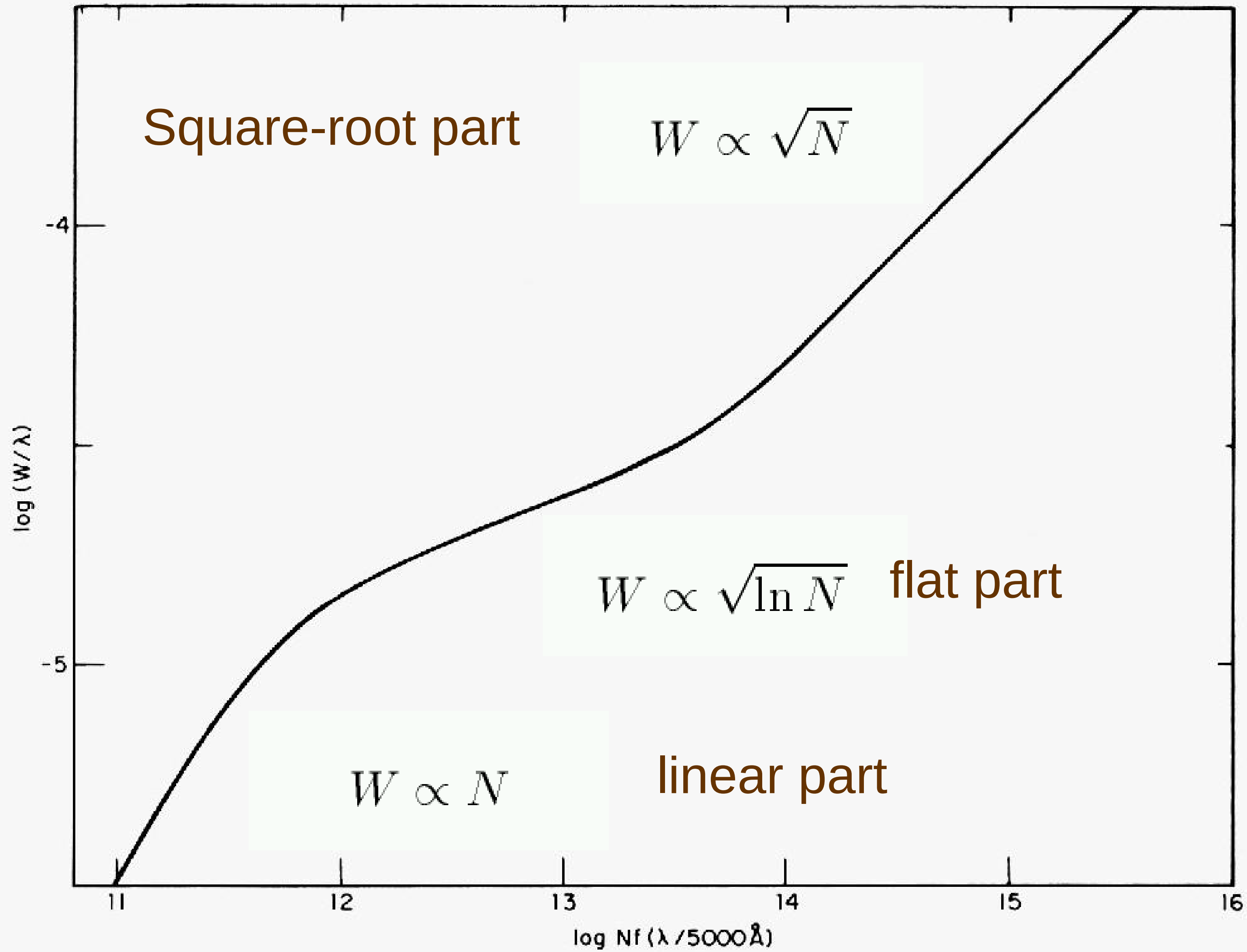



**Figure 9.22** A general curve of growth for the Sun. (Figure from Aller, *Atoms, Stars, and Nebulae*, Revised Edition, Harvard University Press, Cambridge, MA, 1971.)