Flux and Spectrum Definitions Used by AMPS

AMPS Interface Documentation

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1 Differential intensity ("differential flux")

Throughout the AMPS interface, the particle spectrum is specified as a *differential directional intensity*

$$J(E) \equiv \frac{dN}{dA\, dt\, d\Omega\, dE}, \tag{1}$$

with units typically

$$J(E)\ [\mathrm{p\ cm^{-2}\, s^{-1}\, sr^{-1}\, (MeV/n)^{-1}}]. \tag{2}$$

If you are working in SI, replace $\mathrm{cm^{-2}}$ with $\mathrm{m^{-2}}$.

Energy per nucleon. For ions, AMPS commonly uses E in MeV/nucleon. This makes spectral shapes comparable across species.

2 Integral flux and pfu

NOAA/SWPC frequently reports integral proton fluxes above a threshold energy,

$$F(>E_0) = \int_{E_0}^{\infty} J(E)\, dE, \tag{3}$$

often in "pfu" where

$$1\ \mathrm{pfu} = 1\ \mathrm{proton\ cm^{-2}\, s^{-1}\, sr^{-1}} \quad \text{(integral)}. \tag{4}$$

When fitting spectra to integral channels, AMPS performs the above integral of the chosen model.

3 Rigidity spectra and variable changes

Some literature expresses spectra in rigidity R:

$$J_R(R) = \frac{dN}{dA\, dt\, d\Omega\, dR}. \tag{5}$$

Conversion uses $J_R(R) = J_E(E)\, \left|\frac{dE}{dR}\right|$. Because $R = pc/(Ze)$, $E(R)$ depends on species mass and charge.

4 Omnidirectional flux

The omnidirectional differential flux is

$$j(E) = \int J(E, \Omega)\, d\Omega. \tag{6}$$

If the distribution is isotropic, $j(E) = 4\pi J(E)$. AMPS supports anisotropic source models, so the 4π factor should only be used when justified.

5 How the interface expects spectra

- You select a spectrum *model* (power law, cutoff, Band, LIS force-field, or table).
- You enter parameters in the units displayed by the UI.
- The preview shows $J(E)$, and AMPS expects $J(E)$ in the input file.

6 References (selected)

- Grieder, P. K. F. (2001). *Cosmic Rays at Earth.* (Rigidity and intensity conventions.)
- NOAA/SWPC. "GOES Proton Flux" product documentation (pfu conventions).