

Setting limits on a cutoff-like parameter

- Want lower bound on cutoff-like parameter E_c . Could be exponential cutoff, hard cutoff, max e^\pm energy, etc.
- Can forward folding provide this?

Procedure

- 1 Assume some γ -ray emission model $\Phi(E; E_c, \theta)$ where θ is a vector of other spectral parameters.
- 2 Compute likelihood function $L(E_c, \theta)$ and profile likelihood $L_p(E_c) \equiv \max_{\theta} [L(E_c, \theta)]$.
- 3 Find point estimate \hat{E}_c such that $L_p(\hat{E}_c) = \max_{E_c} [L_p(E_c)]$.
- 4 Find p -confidence lower limit $E_c^* < \hat{E}_c$ such that $2 \ln [L_p(\hat{E}_c) / L_p(E_c^*)] = \Delta \chi_1^2(p)$. E.g., $\Delta \chi_1^2(95\%) = 2.71$.

- PWN emission \sim log parabola (de Jager et al., 1996):

$$\Phi_{\text{PWN}}(E) = \Phi_0 (E/E_0)^{-\alpha - \beta \ln(E/E_0)}. \quad (1)$$

- In LIV model with γ dispersion relation

$$E^2 = p^2 + p^4/M_{\text{LV}}^2, \quad (2)$$

γ will decay with probability ≈ 1 before reaching Earth if $E > E_c \equiv \sqrt{2m_e M_{\text{LV}}}$:

$$\Phi(E) = \Phi_{\text{PWN}}(E) \Theta(E_c - E). \quad (3)$$