Work in Progress: Parameters of the Equilibrium Distribution Function for the NLED Reference Scenario

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NLED Reference scenario

Reference AUG pulse ♯ 31213

- Energetic Particles from NBI
  - Passing Orbits
  - n, P show off axis profiles
- Rich Phenomenology (similarly seen in DIII-D and JT-60U)
  - e-GAMs
  - TAEs
  - RSAEs
- DATA for comparison and code validation
  - spectrograms
  - modal analysis
  - post processing analysis by transport codes

Equilibrium Distribution Function

- Constants of Motion at leading order if $B = \nabla\psi \times \nabla\phi + F\nabla\phi$
  - toroidal canonical momentum: $\mathcal{P}_\phi = \psi + (F/\omega_c)v_\parallel$
  - energy: $w = v^2/2 = v_\parallel^2/2 + \mu|B|$
  - $\lambda = \mu/w = (1 - v_\parallel^2/v^2)/|B|$, being $\mu = v_\perp^2/(2|B|)$
- Parameters
  - $\mathcal{N}$ is the overall regularization factor
  - T_w, α_w are the parameters of the $Gamma$ distribution in energy (at fixed λ)
  - $\mathcal{P}_{\phi 0}, \Delta_{P_\phi}$ are the parameters of the $Normal$ distribution in $\mathcal{P}_\phi$
  - $\lambda_0, \Delta_\lambda$ are the parameters of the $Normal$ distribution in λ (at fixed energy)
  - w_b, w_c are the parameters of the $SlowingDown$ distribution in energy

$$f_{\mathrm{Ref1}}(\mathcal{P}_\phi, w, \lambda) = \mathcal{N}\frac{(1+\lambda/\lambda_0)(w/T_w)^{\alpha_w}}{\sqrt{2\pi}}\frac{\mathrm{H}(w_b - w)}{w^{3/2} + w_c^{3/2}} \times$$
$$\times \exp\left[-\frac{(\mathcal{P}_\phi - \mathcal{P}_{\phi 0})^2}{\Delta_{P_\phi}^2}\right] \exp\left[-\frac{w}{T_w}\left(\frac{\lambda - \lambda_0}{\Delta_\lambda}\right)^2\right]$$

First set of Parameters for the NLED REF Scenario

First estimate of the EDF parameters

- $\mathcal{N} = 1.2 \times 10^{17}$ m^{-3},
- $T_w = 31.13$ keV,
- $\alpha_w = 1.0$,
- $\mathcal{P}_{\phi 0} = 0.035$ Wb,
- $\Delta_{P_\phi} = 0.02$ Wb
- $\lambda_0 = 0.08$ T^{-1}
- $\Delta_\lambda = 0.12$ T^{-1}
- $w_b = 93$ keV,
- $w_c = 15$ keV