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Needs for Predictive (and Interpretive) Particle and Momentum Transport Modeling

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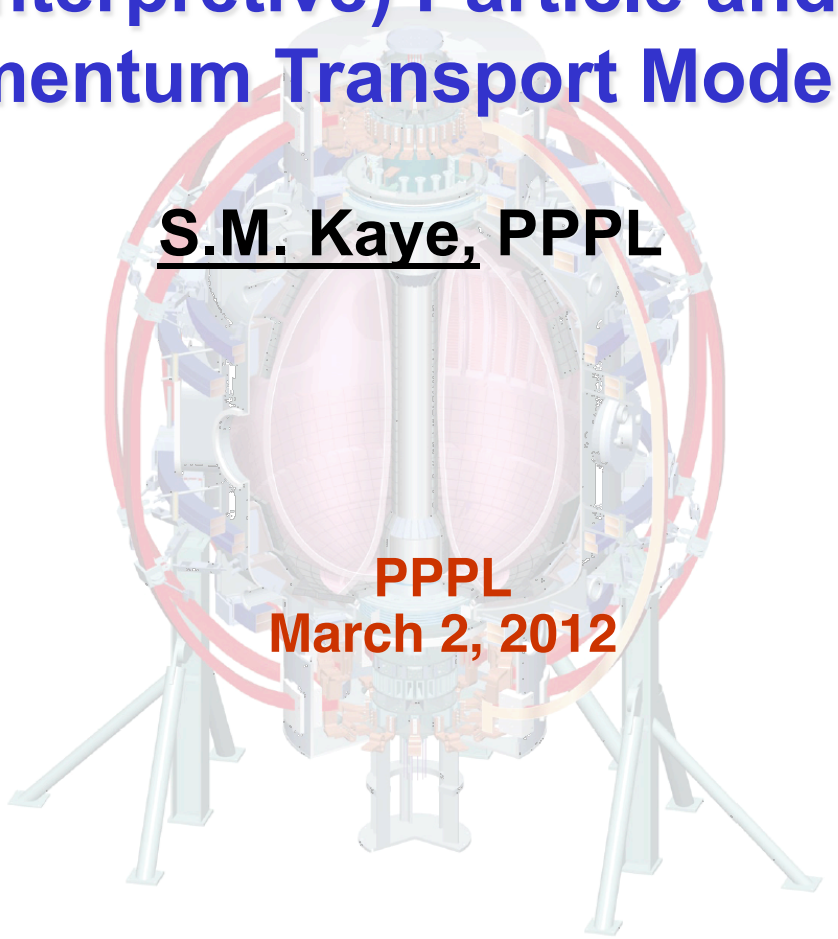

PPPL
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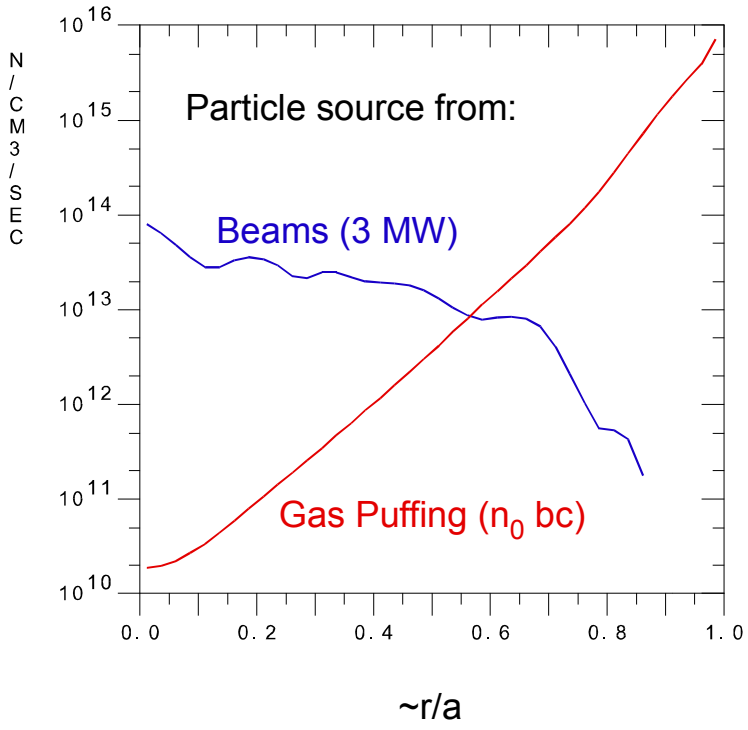
Particle Transport

Particle transport governed by: $\frac{\partial n}{\partial t} = S_{in} - \frac{1}{r}\frac{\partial}{\partial r}\left[rnv_r\right]; \qquad S_{in} = S_{beam} + S_{wall}$

- S_{beam} generally "well-known"
  - Determined from collisional processes, sometimes with AFID
  - Match neutrons by adjusting n_0
- S_{wall} is computed in a simplistic fashion
  - Assumed n_0, 1D neutral transport model
- Can infer particle D in core region, where beam source dominates
- D outside r/a~0.5 highly uncertain

- Need better determination of
  - S_{wall}
  - Up-to-date particle transport calculations (physics model for pred.)
- Critical to both interpretive and predictive modeling

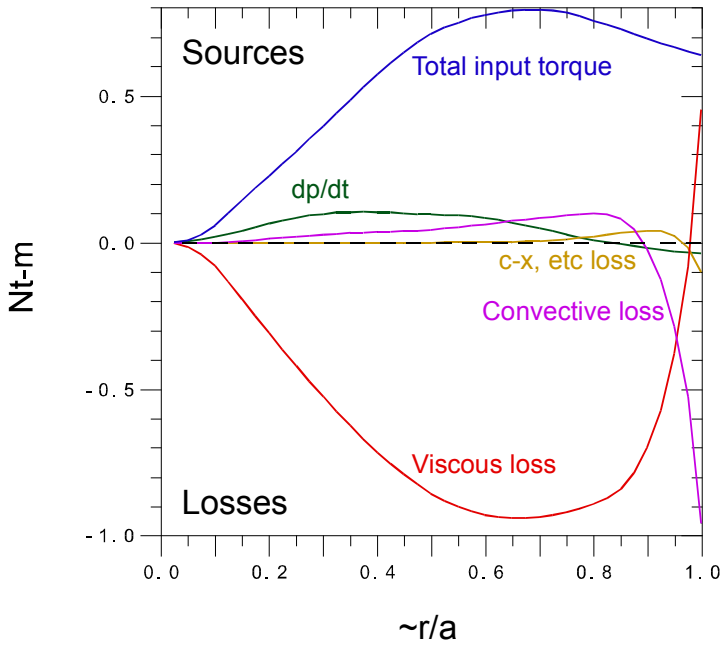


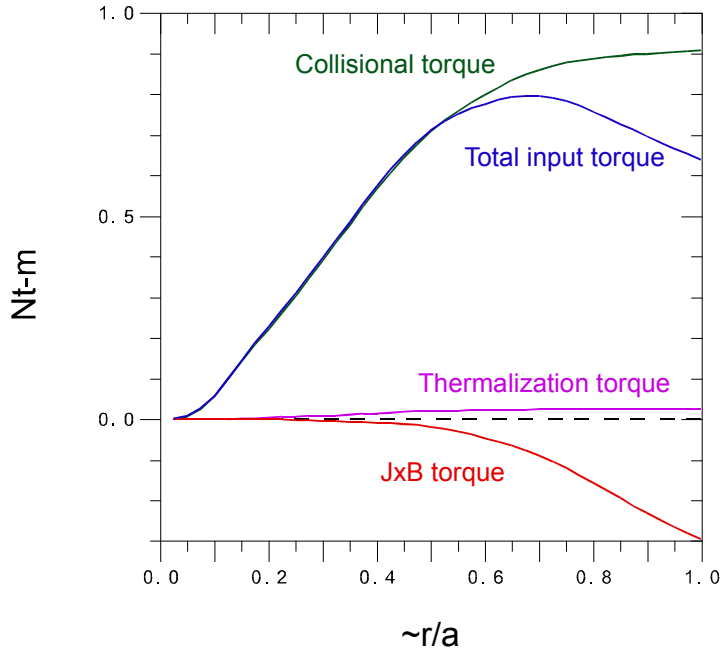
Momentum Transport

Momentum transport governed by:

$$mnR\frac{\partial v_\phi}{\partial t} = \sum T_{input} - \nabla \cdot \Pi_\phi - \frac{mnR(v_\phi - v_\phi^*)}{\tau_{damp}}$$

$$= T_{driven} + T_{self-generated}$$





Momentum Transport

- For full interpretive/predictive modeling, need to include all torques.
- Missing is residual stress
  - Conversion of turbulent energy to directed flow
  - Needs toroidal symmetry breaking of turbulence wave propagation

$$\propto \nabla p$$

  - Develop reduced models from gyrokinetic calculations
  - Verify and validate analytical models (Weiland, MMM,…?)
  - Use empirical expressions (Solomon, sub. to NF (2012):

$$T_{\mathrm{int}rinsic}^{edge} \sim f(\nabla p_{ped}, T_i^{\rho=1}, v_\phi^{\rho=0.9}, \frac{R_x}{R_{mid}})$$