model of interchange turbulent transport: on the correlation between scrape off layer width and core confinement in tokamaks

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- Spectral filament paradigm: self consistent prediction of turbulent spectra ($n_e, \Phi$) of flux driven 2D isothermal interchange turbulence
- Predicts macroscopic transport properties (flux, fluctuations) in scrape-off layer (→ SOL width $\lambda_q$) but also in the core (→ confinement time $\tau_E$)
- SOL transport: quantitative agreement with Tore Supra data (circular plasmas), recovers impact of divertor leg length on SOL width ($\lambda_q$) in TCV, recovers multi-machine parametric sensitivity of $\lambda_q$
- Core confinement: recovers multi-machine parametric sensitivity of $\tau_E$ and correlation between core confinement and heat flux width
- Offers a flexible paradigm for addressing the optimization of power exhaust versus core confinement (key: impact of geometry in model)

2D isothermal interchange model (TOKAM2D)

Flux driven (source $S$), control parameters: $g = \frac{\partial g}{\partial n}$, $\sigma_1 = \frac{\sigma_1}{n_0}$

$\frac{d n}{d t} + D^2 \frac{n}{n} = S - \sigma g e^{-\Phi}$

$\frac{d \phi}{d t} = \frac{\partial g}{\partial n} - \sigma_1 (1 - e^{-\Phi})$

$\frac{d \omega + v b^2}{\omega} = \frac{\partial g}{\partial n} - \sigma_1 (1 - e^{-\Phi})$

$\lambda_{df} = \frac{1}{(\Phi, \sigma_1)}$

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Spectral filament paradigm: self consistent prediction of turbulent spectra ($n_e, \Phi$) of flux driven 2D isothermal interchange turbulence

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