Threshold Magnetic Island Overlap Conditions in the RFP

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Threshold $B_{r,n}$ for magnetic island overlap decreases rapidly for m=1, high n resonances.

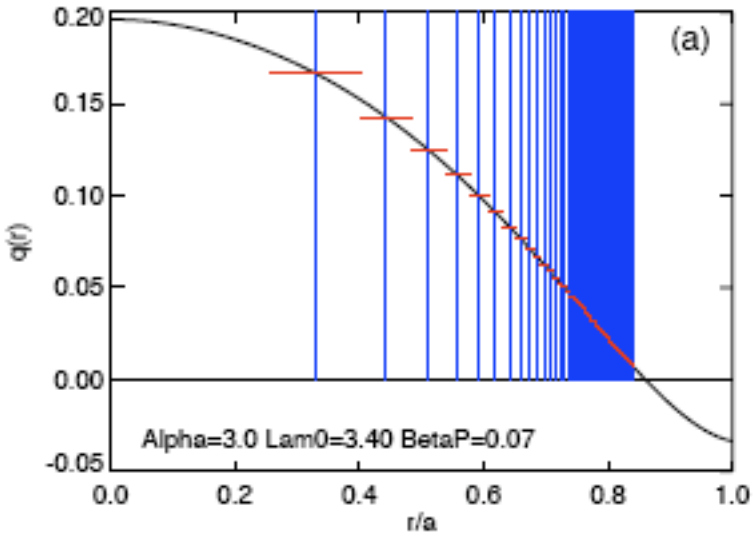
- Threshold island width for Chirikov parameter, s =1

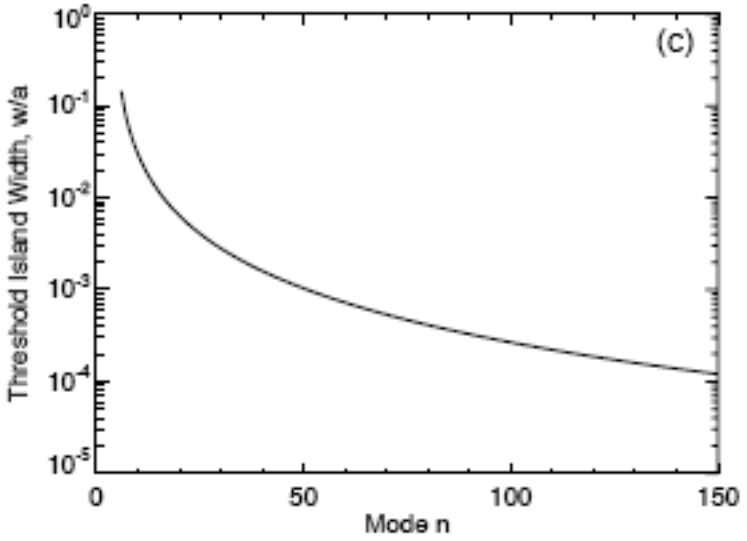
$$w_n = \frac{1}{n(n+1)|q_n'|} \qquad \text{(m=1 modes)}$$

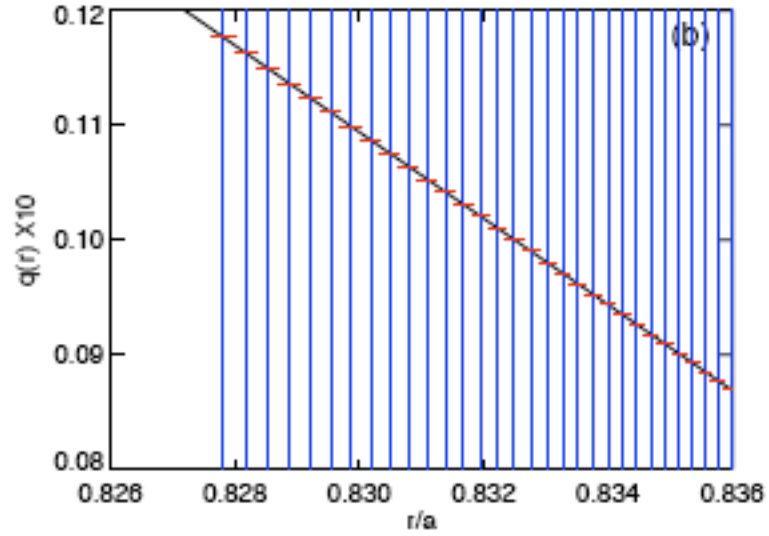
- Magnetic island width

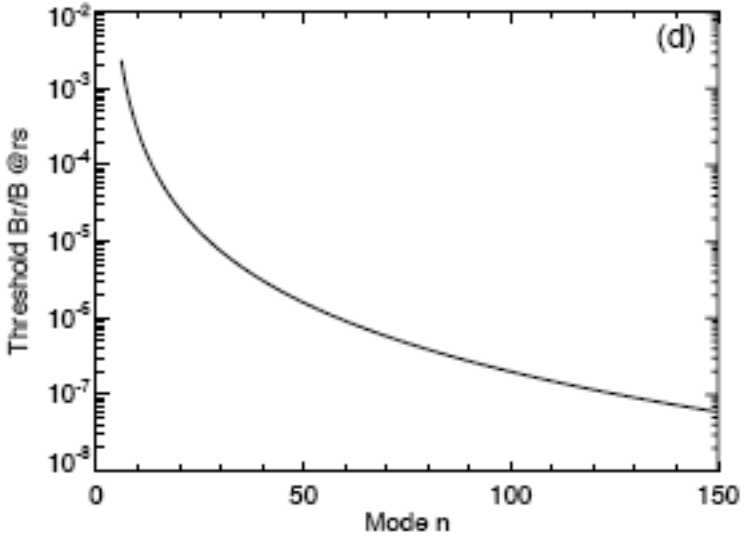
$$w_n(r_n) = 4\sqrt{\frac{B_{r,n}(r_n)}{B_\theta(r_n)}\frac{r_n}{n}\frac{1}{|q_n'|}} \quad \Rightarrow \quad \text{threshold amplitude} \quad \frac{B_{r,n}(r_n)}{B(r_n)} \sim n^{-3}$$

Threshold amplitudes for resonant modes extremely small approaching the reversal surface.

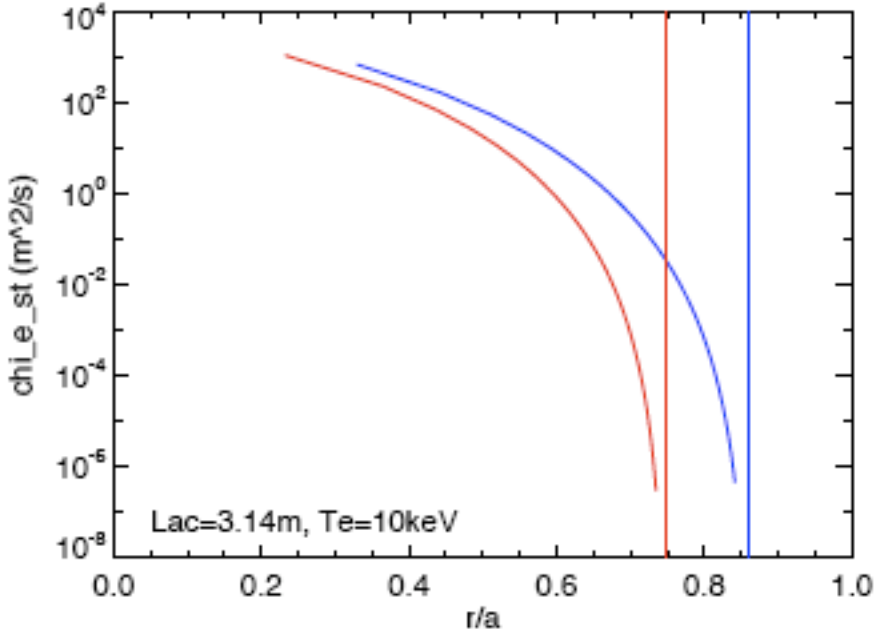






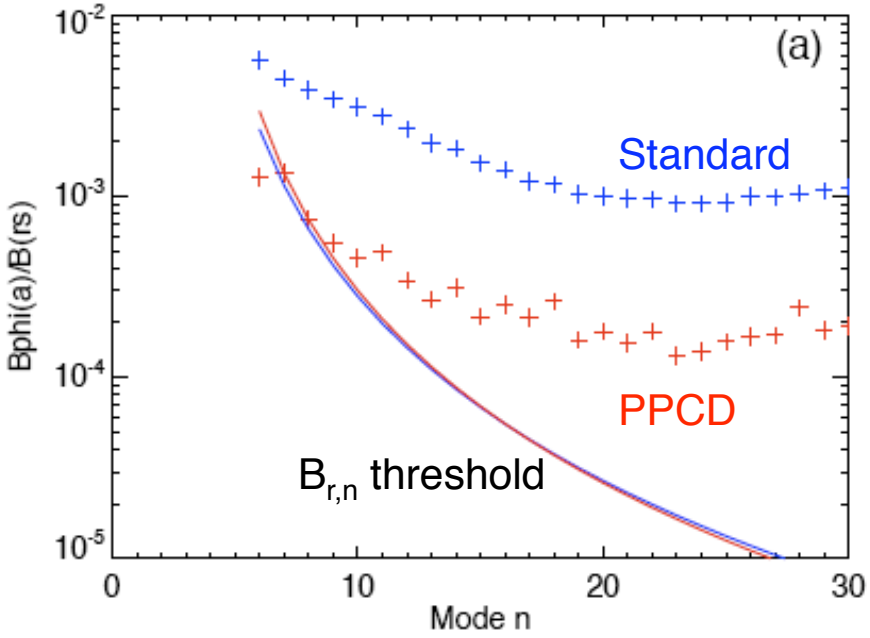


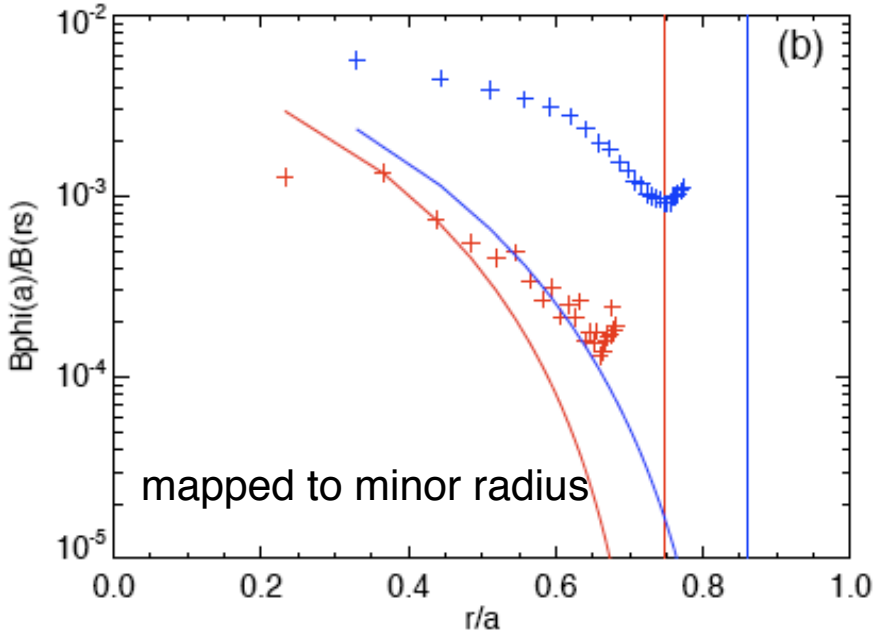
Projected stochastic heat diffusivity at threshold island overlap amplitudes is < 1 m^2/s for over half the plasma volume.



$$\chi_{st} \sim \sqrt{\frac{T}{m}} \left(\frac{\tilde{B}_r}{B} \right)^2$$

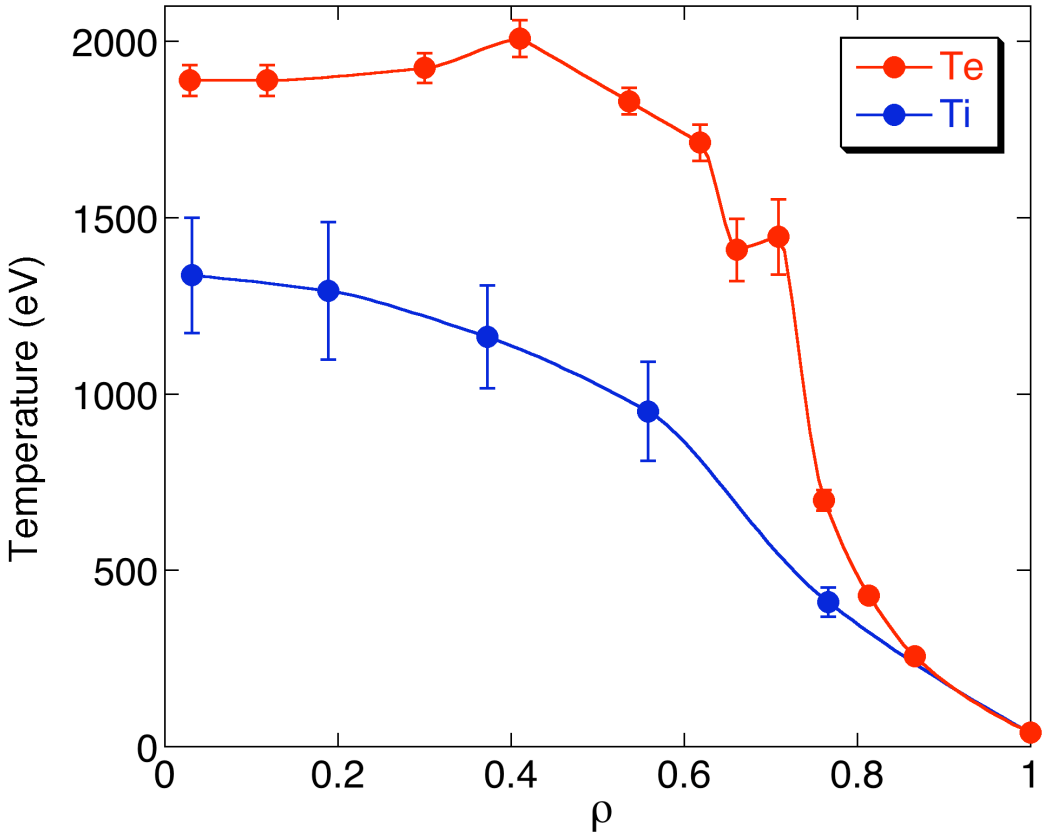
The region near the reversal surface remains stochastic in PPCD plasmas.





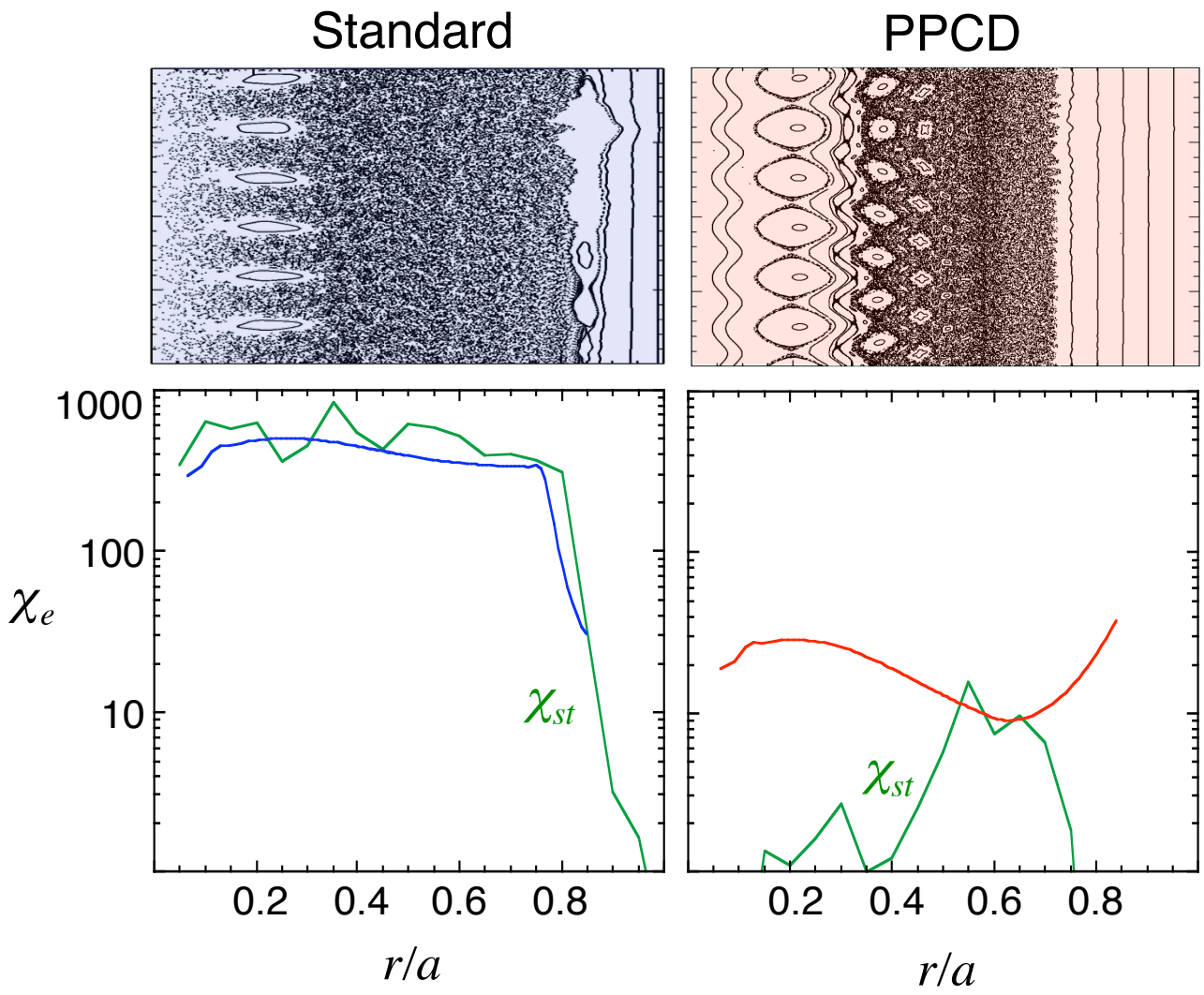
"+" = measured $B_{T,n}$ mode amplitudes

Temperature gradients are largest where the field remains stochastic.



B. Chapman et al

Measured heat diffusivity consistent with stochastic transport expectations.



Good agreement with stochastic transport scaling

$$\chi_{st} \sim \sqrt{\frac{T}{m}} \left(\frac{\tilde{B}_r}{B} \right)^2$$

Discussion

- Island overlap in the outer region of the plasma is hard to avoid, simply due to very small threshold amplitudes.

- For MST parameters, the threshold magnetic island widths are smaller than the ion gyroradius for $n \geq 20$

- Suggests broken-surface requirement for helicity transport does not automatically lead to large stochastic transport. (At least for an RFP equilibrium with $q \rightarrow 0$)

- Maximum temperature gradients in PPCD are in a stochastic field region.