

Studies of magnetic islands in the TJ-II heliac and the related transport

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Phenomenology in TJ-II to be explained:

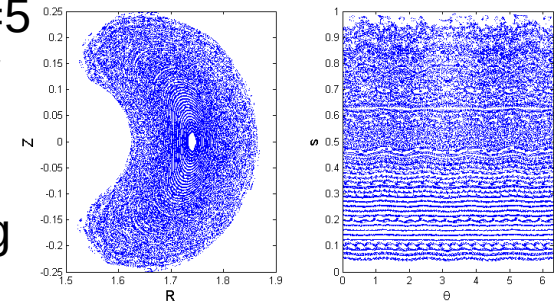
- Transport barrier formation in low-order rational surfaces
- MHD activity from the same surfaces.
- Fast particles detected at the edge

Proposed explanation:

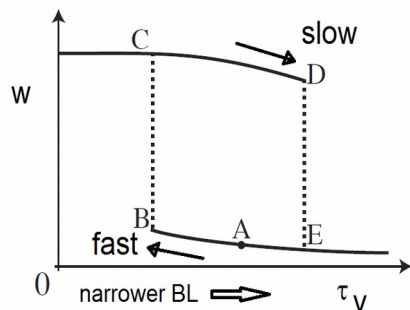
Magnetic islands in rational surfaces are affected by plasma dynamics

And islands affect transport → create transport barriers by forming large electric shear around separatrix.

We show that $m=5$ islands are easily formed in TJ-II from equilibrium calculations using SIESTA



Model based on island width evolution experiencing two bifurcations as a result of viscous torque and electromagnetic torque balance (Fitzpatrick, NF 33 (1993) 1049)



Model sequence:

- Small vacuum island grows by reconnection when viscous torque τ_v decreases
- Large island has flat ϕ profile → large E gradient creates barrier
- Barrier rises temperature, reduces collisions, increases τ_v until second bifurcation narrows island

Astra transport simulations reproduce observations

