

Shaing and Chang theories describe edge E_r generated via ion orbit loss to divertor

- Shaing bifurcation model

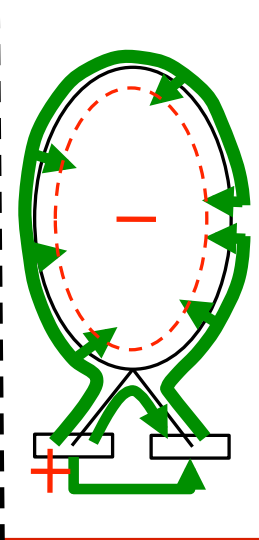
- Collisionless ions lost on banana orbits to wall or SOL collision
- Return current via reduction in collisional ion flux out of plasma
- L-root (**H-root**):
 - Solution at high (**low**) edge collisionality
 - Small (**large**) poloidal rotation (E_r) and rotation shear (E_r shear)
 - Finite (**small**) current
- Both roots are valid at critical v_{*i} , plasma state can bifurcate
- Predicts appropriate (fast) timescale

KC Shaing, and EC Crume,
PRL **63**, 2369 (1989)

- Chang X-transport model

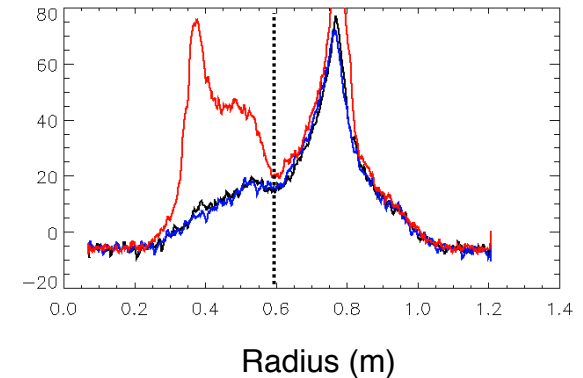
- X-point enhances orbit loss
- Ions primarily lost to inner divertor
- Current loop closes through parallel currents through SOL and conducting divertor

C.S. Chang, S. Ku, H. Weitzner,
PoP **9**, No. 9, 3884 (2002)



Low triangularity data on NSTX consistent with this picture

- L-mode with $P_{\text{heat}} < P_{\text{loss}}$
 - D_{α} light primarily from outer divertor
 - Near-zero current through CHI gap
 - Negligible ion flux to inboard divertor probes
- L-mode with $P_{\text{heat}} \sim P_{\text{loss}}$
 - Large increase in D_{α} light from inboard divertor
 - Several hundred amps of current from inboard to outboard divertor
 - Increase in ion flux to inboard divertor
- At LH transition
 - Edge collisionality very similar, independent of P_{nbi} , gas, lithium
 - D_{α} drops on both inboard and outboard
 - Current through CHI gap reverses in sign, decays to zero $\sim 20\text{ms}$
 - Change in ion flux not well resolved (100 Hz sweep)



Proposal for 2011 run campaign

- Successful P_{LH} vs X-point radius scan in 2010
 - Modifies ion-loss rate. Larger P_{heat} needed for high- δ shape.
- Propose P_{LH} studies with low triangularity
 - High P_{LH} desired: little or no lithium, high TF, high density
 - NBI preferred (2 MW on NBI A)
 - Pitch angle for BES, GPI
 - Strike point and X-point control if possible
 - Want strike-points aligned with probes
 - Inboard probes run in J_{sat} mode to increase resolution (2.5 kHz)
- Will propose 1 day XP
 - Power scan with desired shape
 - Repeat with 1 or 2 different X-point heights (PEP-28)
 - Repeat with 1 or 2 different levels of divertor fueling
 - If time, I_p and/or TF scan with fixed shape

Propose continuation of P_{LH} vs ion species XP1036

- P_{LH} in helium vs deuterium explored in 2010 with symmetric RF phasing
 - Hindered by available RF power $\rightarrow P_{LH}$ in helium not identified
 - Can be synergistic with RF conditioning
 - Would try to use strike-point / X-point control of low- δ shape if possible