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BROADENING THE HEAT FLUX VIA FORCED OR INSTABILITY-DRIVEN TOROIDAL POTENTIAL VARIATION

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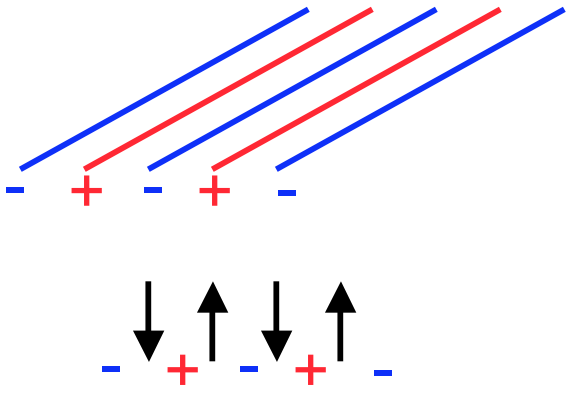
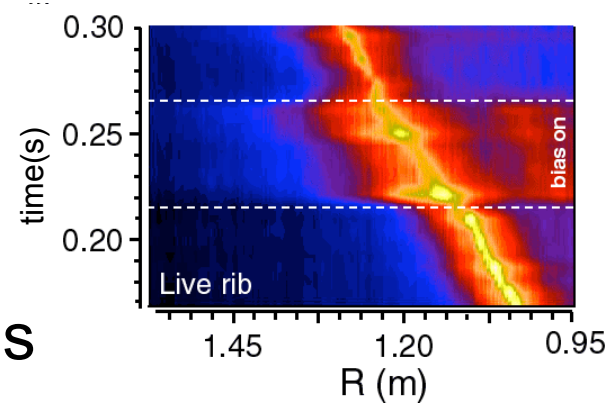
$E_\perp$ within flux surface leads to SOL broadening

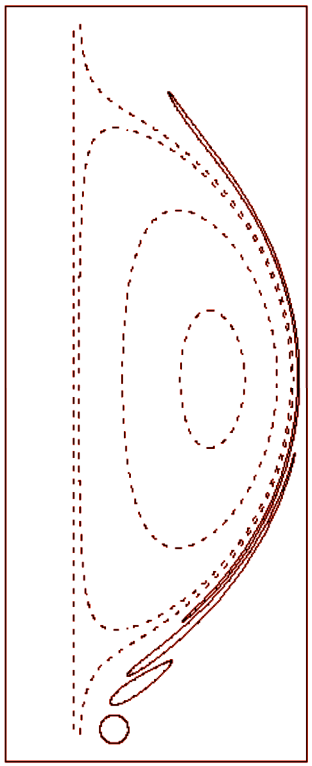
- Φ variation from field line to field line within flux surface → $E_{\perp,pol}$ → v_r
- Various ways to exploit
  - Instabilities: limited coherence leads to radial diffusion
  - Forced variation (DC)
    - e.g. by toroidal (+ radial) spatial modulation of boundary conditions
    - Create convective cells
    - If strong enough, creates shear-driven instabilities
    - Tried on MAST and it works (see below)
  - Forced variation (AC): no obvious advantage

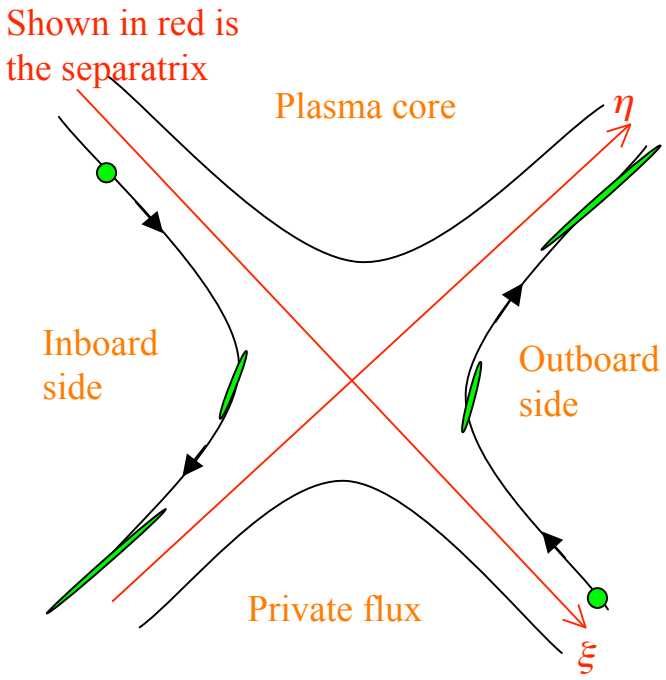




X-point magnetic shear can confine potential perturbations to a divertor leg

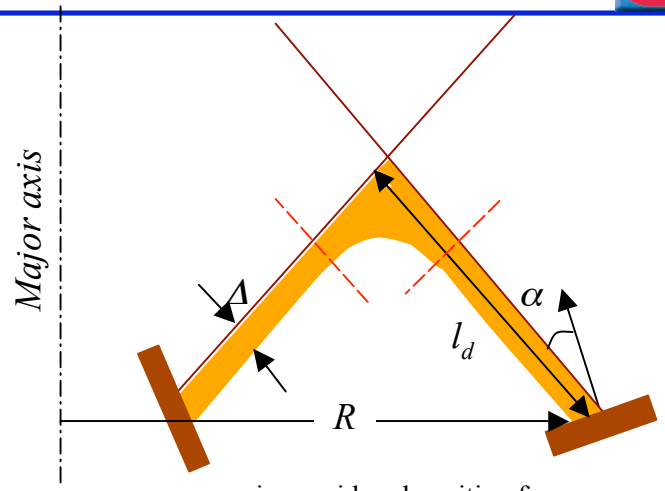
- A flux tube that is circular in the divertor leg becomes highly squeezed, to $\Delta r < \rho_I$, as it passes X point into main SOL
- (Similarly circular flux tube at SOL midplane squeezed in divertor leg)
- Isolates divertor leg from main SOL
- Opens possibility of manipulating divertor leg to stir up plasma and so broaden heat load, without impacting main SOL or core plasma.



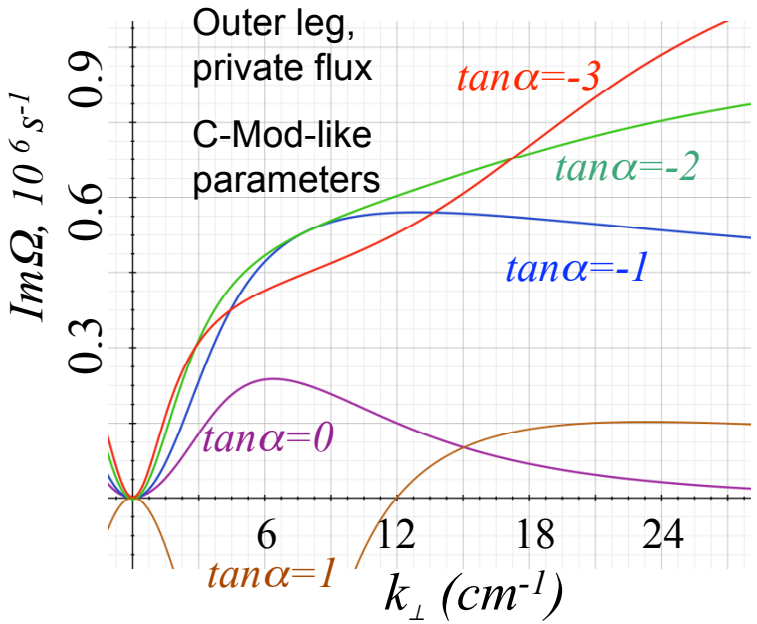


Divertor-leg instabilities may be exploitable to broaden divertor-leg plasma

- Divertor-leg instabilities can be driven by curvature and sheath boundary conditions
- These instabilities have the potential to grow into blobs
- Growth rate (and blob speed) strongly impacted by radial tilt of divertor plates
- Reference: Cohen et al, IAEA 2006 (to be submitted to Nuc. Fusion)

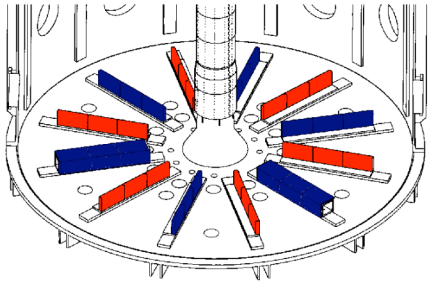


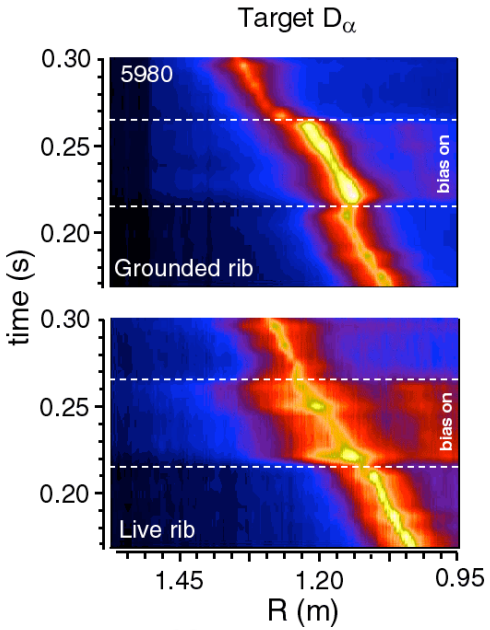
α is considered positive for the tilt shown in the figure

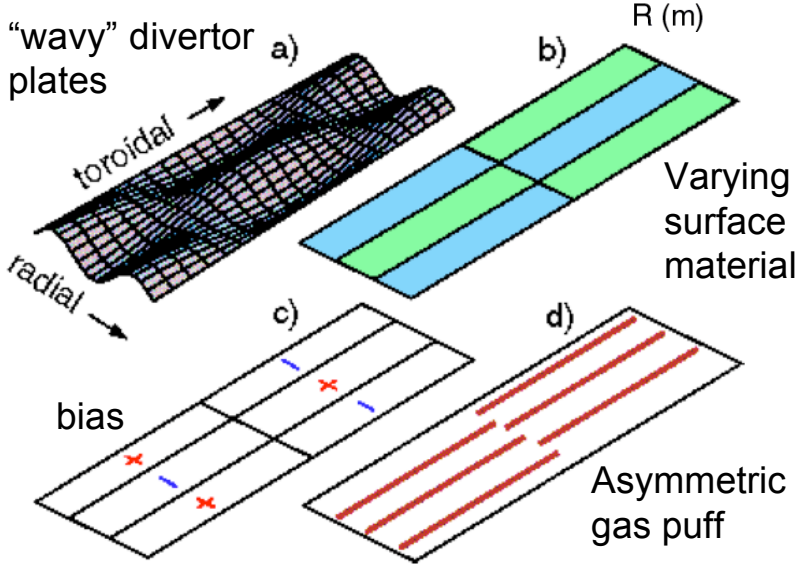


Another option is to deliberately introduce asymmetries

- There are a variety of ways to do this.
- Toroidally asymmetric biasing has been demonstrated to be effective on MAST
  - Broadens divertor leg plasma
  - No effect (except change in toroidal-av. Φ_{float}) in main SOL
  - Results agree with theory
- Other more reactor-friendly approaches should also be effective







References available for more information

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