Study of turbulence and transport in mirror geometries in the LAPD

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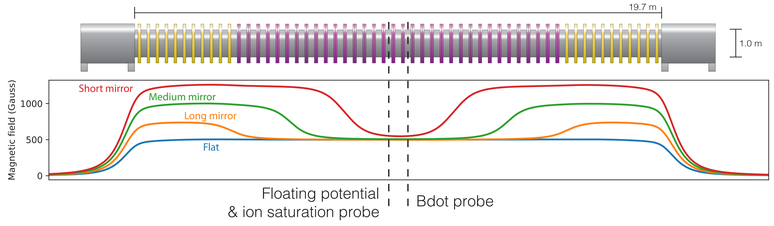
Motivation and results

- Does adding magnetic curvature drive change turbulence? **There are hints that it does**
- **Increasing mirror ratio results in decreased density and magnetic fluctuation amplitudes, but floating potential remains approximately flat**
- Radial particle flux decreases with increased mirror ratio

LAPD and discharge specifications

- Plasma length: 19.7 meters
- Inner diameter: 1.0 meter
- Discharge period: 12 ms
- Density: ~10^{12} particles / cm^3
- Ion cyclotron frequency: 383.6 kHz



Diagnostics

- Ion saturation current
- Floating potential x2
- Magnetic field fluctuations (bdot)

Data acquisition info

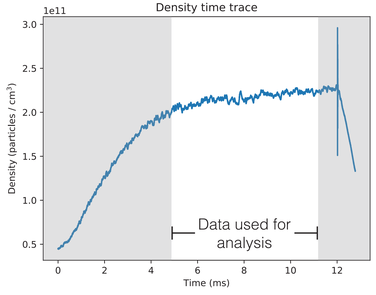
- 5 cm to 45 cm radial scan, 0.5 cm resolution
- 26 shots per position
- 6.25 MHz effective sampling rate (16-sample average)

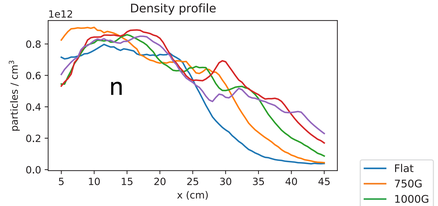
Magnetic field configurations

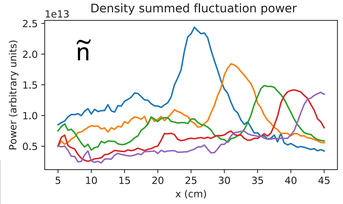
- Mirror geometry
- 500G at center of machine
- Flat magnetic field for reference
- Long mirror ratios: 1.5, 2, 2.5
- Medium mirror ratios: 1.5, 2, 2.5
- **Short mirror ratios: 1.5, 2, 2.5, 3**
- **Primarily short mirror ratios were analyzed**

Analysis methods

- Analysis is over the approximately quiescent period (4.8 ms to 11.2 ms)
- Fluctuations calculated by de-trending profiles
- Summed fluctuation power, particle flux, and cross-phases calculated from fluctuation DFTs
- Fluctuations between 1 kHz and 200 kHz were analyzed





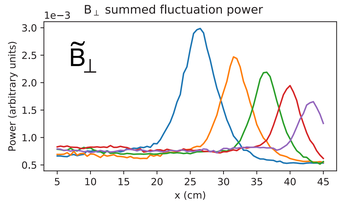


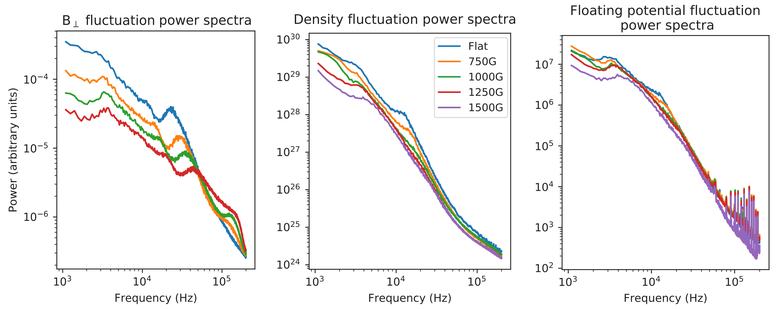
With increasing mirror ratio:

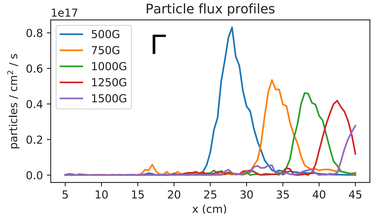
- density and floating potential profiles shift radially outward because of the magnetic field flare
- floating potential decreases
- **density and $B_\perp$ fluctuation amplitudes decrease**
- **floating potential fluctuation amplitudes remain constant**

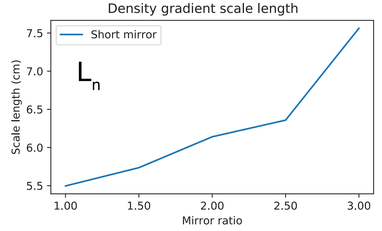
Power spectra shapes remain approximately the same

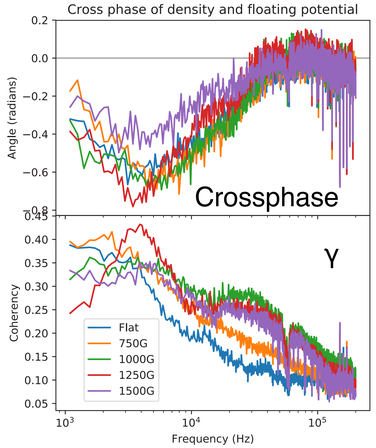
- Mysterious bump in the 20-40 kHz range











- **Particle flux decreases with increased mirror ratio, but the profiles relax**
- Changes in crossphase of density and floating potential fluctuations give evidence of new instabilities

Summary of results

- There are hints of changes in turbulence with the addition of magnetic curvature
- **Increasing mirror ratio does not appreciably change the floating potential fluctuation power, but density and $B_\perp$ fluctuations decrease**
- Radial particle flux decreases with increased mirror ratio
- Particle flux and density gradient length scale results are counterintuitive

Future work

- Analysis of the impact of mirror length on turbulence and transport
- Analysis of the 20-40 kHz bump in $B_\perp$
- Closer analysis of transport and diffusivity
- Confirmation of current trends in high-mirror-ratio regimes
- Measuring and analyzing plasma structure
- Analysis of multiple mirror cells
- Measurements on edges of mirror cells
- Comparison with existing literature