Parallel Correlation of SOL Turbulence

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Goal:

Better understand the contribution of SOL turbulence and blobs to the SOL width, in part through theory and simulation

Method:

Measure the parallel (i.e. 3-D) structure of SOL turbulence and blobs using all available edge fluctuation diagnostics, and compare results with SOL widths, theory and simulation

Diagnostics to Cross-Correlate with GPI

1) GPI (at outer midplane) vs. fast camera on divertor plate (Scotti), using LiI filter (like Maqueda NF '10), or other lines (Dα, maybe C) Maybe use divertor gas puffing to do "GPI" at divertor plate, and maybe try to align B field to connect GPI and divertor camera.

2) GPI vs. divertor Langmuir probe I_{sat} or floating potential (Jaworski). Maybe sweep OSP over probes to minimize heating. Similar to Grulke in C-Mod (NF '14), where a ~75% correlation was seen.

3) GPI vs. lower divertor tangential imaging (Maqueda), maybe with local gas puff, maybe with B field alignment. Look for X-point effects on turbulence structure and motion (like MAST APS '14)

SOL Turbulence Measurements…cont…

4) GPI vs. wide-angle fast camera view of GPI gas puff from across machine, to look for parallel motion of 'blobs'

5) GPI vs. BES (Smith), similar to previous study (Sechrest), but maybe with improved B field alignment

6) GPI vs. reflectometer (Kubota), at least for $n \geq 1 \times 10^{13}$ cm^{-3}, but probably not possible to align along B field line

7) GPI vs. IRTV (Gray) using fastest possible IRTV speed; also compare SOL heat flux width to SOL turbulence properties

Plasma Conditions and Other Diagnostics

- Can do some of these correlations by piggy-backing on other XPs
- Dedicated shots needed for B-field alignment of GPI with divertor camera, probes, and IRTV, probably with OSP scan for probes
- Density scan -> OSP detachment interesting for SOL turbulence, also X-point location, snowflake, L_{II} scan, I_p scan, RMP fields, etc.

Additional useful diagnostics for SOL:

- Divertor spectroscopy, bolometry, and neutral density
- Thomson profiles at outer edge (pdf from repeated shots)
- Edge ion temperature, rotation, and USXR measurements
- Fast magnetics for separatrix magnetic fluctuations

Data Analysis and Interpretation Questions

- Is SOL turbulence highly correlated along B field line from outer midplane to divertor plate, or disconnected by shear, collisions…?

- How well does SOL turbulence correlate with SOL heat flux width ? Might be correlated through turbulence level, size, or radial speed.

- Can we use fluctuation levels to estimate turbulent vs. neoclassical transport? Does $\tilde{n}/n \sim 1$ imply that neoclassical transport is small ?

Theory/simulation tools:

- Analytic blob models for parallel correlation estimates
- 2-D SOLT simulations for turbulence vs. estimated SOL width
- XGC-a simulations for estimation of neoclassical transport
- XGC-1 simulations for SOL turbulence and transport