

Parallel Correlation of SOL Turbulence

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DRAFT 2/13/15

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 Lil filter (like Maqueda NF '10), or other lines ($D\alpha$, 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 $\sim 75\%$ 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 $n \geq 1 \times 10^{13} \text{ cm}^{-3}$, 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, $L_{||}$ 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-0 simulations for estimation of neoclassical transport
- XGC-1 simulations for SOL turbulence and transport