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JÜLICH FORSCHUNGSZENTRUM

Long range and radial correlation measurements with correlation reflectometry at TEXTOR

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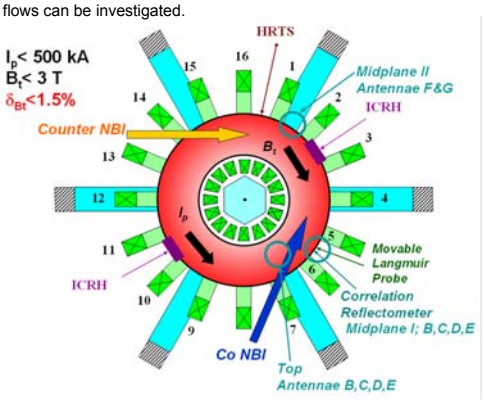
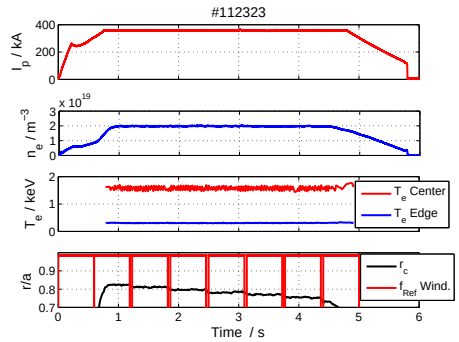
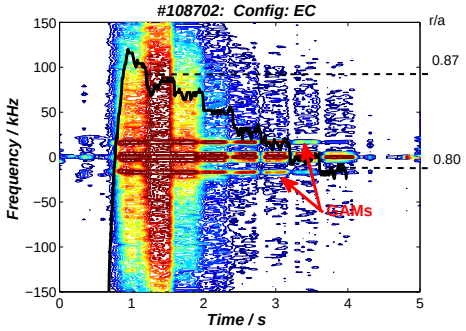
Within the last year the existing O-mode correlation reflectometry system at TEXTOR has been upgraded by an additional mid plane antennae array for the measurement of long range correlations. Together with the new antennae array measurements with the following toroidal, poloidal separations: (i) $\Delta\phi$ = 112, $\Delta\theta \approx 90$, (ii) $\Delta\phi$ = 90, $\Delta\theta$ = 0 and (iii) $\Delta\phi$ = 22.5, $\Delta\theta \approx 90$ become possible. In addition radial correlation measurements are performed with an additional reflectometer, operating in a similar frequency range as the first one. Due to the measurement of density and velocity oscillations on different toroidal cross sections the interaction of the ambient turbulence with mesoscale structures as GAMs and zonal flows can be investigated.



The reflectometer system at TEXTOR allows to measure the density fluctuations of GAMs with the top antennae array as well as the velocity oscillations. Simultaneous measurements of density- and velocity oscillations allows determination of the phase between them. According to the m=1/n=0 structure the $\delta n/n_c$ oscillations are only observed at the top antennae. Measurements are performed for ohmic plasmas GAMs appear mostly at the plasma edge and show a global scaling with c_s.



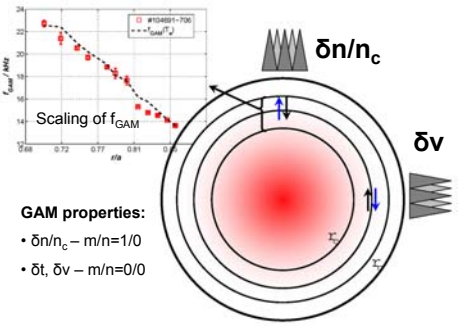
GAMs and ambient turbulence (AT) are investigated in ohmic plasmas with a long flat top to allow radial scans of the reflectometer with sufficient long time intervals for each radial position as well as radial correlation measurements.

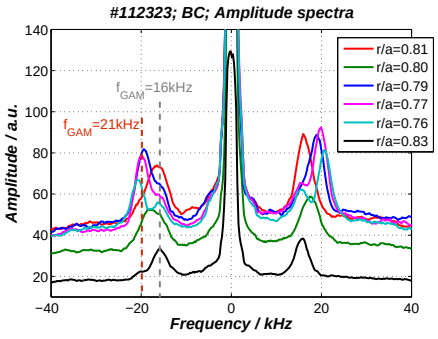


Color coded coherence for radial correlation of combination EC for the top array. It shows the **different behaviour of AT and GAMs**. GAMs show a much longer radial correlation (l_r≈0.04m) than AT (l_r=0.012m, see right side of the poster)

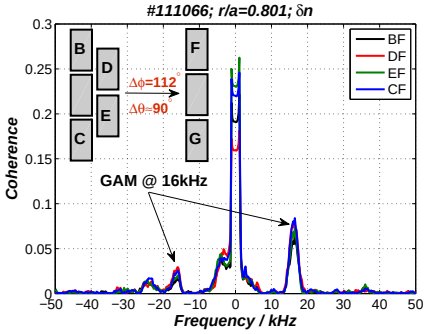
GAMs properties

Visit also O2.05 & O4.07

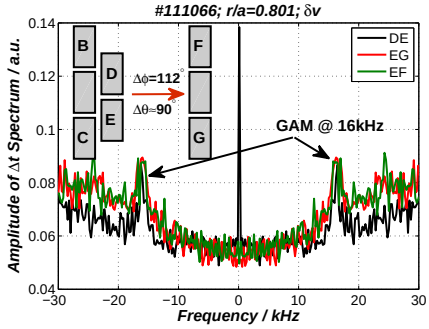




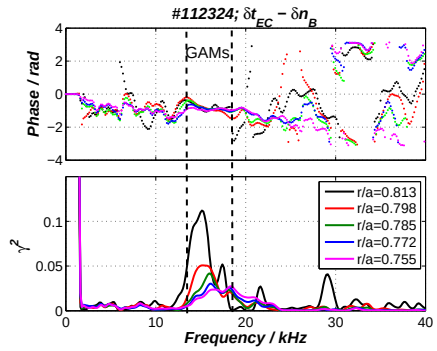
Amplitude spectra show GAMs for 16<f_{GAM}<21kHz. At r/a=0.81 two GAM frequencies are observed. Higher GAM frequency f_{GAM}=21kHz dominates 2.4cm further inside of the probed reflection layer. Evidence for concurrency of GAM frequencies.



Long range correlation (LRC) of **density fluctuations** show the concurrency of GAMs at different toriodal positions. The phase delay is estimated to $\Delta\zeta$=0rad. This confirms the n=0 mode number.



LRC of **oscillations in Δt**. The spectra where achieved after applying a filter (50<f<150kHz) to see effect on AT only. The peak f_{GAM}=16kHz for several combinations demonstrates the interaction of the GAM with the ambient turbulence.

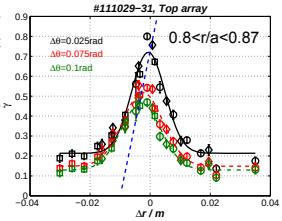


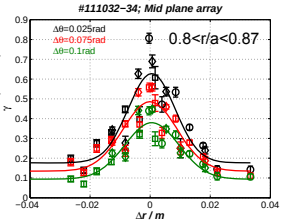
Measurement of phase between $\delta n/n_c$ and δv for different radial positions. To avoid contributions of low frequency turbulence and MHD modes, data are filtered in the range 50<f<150kHz. To reduce unwanted correlations disjunct antennae for $\delta n/n_c$ and δt (correspond to δv) are used. The measurement yields **ζ=-45°±10°**.

Ambient turbulence properties

Measurement of $\gamma(\Delta r,\theta)$ for AT and 0<f<150kHz. 3 different poloidal separations measured simultaneously.

Top – midplane asymmetry observed. Broader Gaussian distribution for midplane array. FW@1/e level depends on radial and poloidal correlation length. Radial correlation length (l_r) yields 11mm at top and 17mm at mid plane.

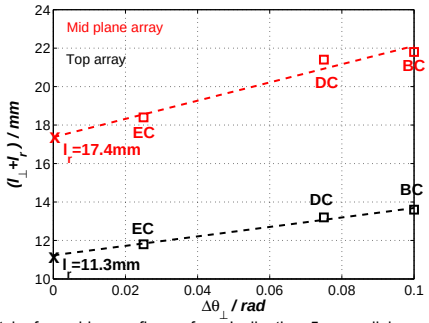




De correlation time (τ_{dc}) different for top and mid plane. Calculation of turbulent transport (random walk) according $D=l_r^2/\tau_{dc}$ yields 8m²/s for top and 20m²/s for mid plane array.

Top antennae shows shift in the Gaussian fits (indicated by blue line). Inclination of eddy or radial propagation?

Estimation of l_r



Sketch of an eddy on a flux surface; Inclination: 5° or radial propagation v_r≈400m/s. Cannot be concluded from measurements