Visualization of the turbulent states transition in GYM plasmas using fast imaging

D.Iraj\textsuperscript{1}, D.Ricci\textsuperscript{1}, A.Cremona\textsuperscript{1}, S.Garavaglia\textsuperscript{1}, G.Granucci\textsuperscript{1}, D.Minelli\textsuperscript{1}

\textsuperscript{1}I.F.P. - CNR, Euratom-ENEA-CNR Association, Via R. Cozzi 53, 20125-Milano, Italy

Turbulence is an important research line in magnetic fusion and one that is common to tokamak experiments and basic plasma physics devices. In the GYM linear magnetized plasma device, low frequency electrostatic fluctuations can be measured by means of Langmuir probes as well as a nonperturbative imaging system consisting a Photron Ultima APX-RS fast framing camera and a Hamamatsu C10880-03 fast gated image intensifier. The imaging system provides data of the light emission from microwave-produced plasmas in GYM with a temporal resolution of 4\(\mu\)s. From the line-integrated camera images, the time resolved emissivity profiles of the plasma are reconstructed. This allows comparing statistical, spectral, and spatial properties of visible light radiation with electrostatic fluctuations.

Effects of different plasma conditions, obtained with different levels of microwave power (500W to 1750W), axial magnetic field (70mT to 80mT) and hydrogen pressure (2\(\times\)10\(^{-4}\) mbar to 5\(\times\)10\(^{-4}\) mbar) upon the characteristics of plasma turbulence and associated fluctuations have been studied. Analysis such as the time-space Fourier analysis, two-point correlation analysis and conditional average sampling (CAS) technique have been applied. Results show that in GyM plasmas a state transition occurs between relatively large and slow turbulent structures to small and fast structures by increasing the magnetic field, the microwave power or the neutral gas pressure. The transition is mainly sensitive to the value of the magnetic field and to the injected microwave power while the neutral gas pressure has less pronounced impact. The state transition appears as dissipation of large amplitude-low frequency fluctuations into small amplitude-high frequency turbulent structures which lower gradient of the electron density.