Magnetic fluctuations in fusion relevant plasmas in the RFX-mod device

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The RFX-mod device is a toroidal device for the magnetic confinement of fusion relevant plasmas, which is presently being upgraded and is planned to restart operation as RFX-mod2 with a modified and improved magnetic boundary. Thanks to the flexibility of its power supply and advanced feedback control systems it can be operated in a variety of configurations, mainly the tokamak and the reversed-field pinch. Here we present an analysis of the magnetic fluctuation properties measured by means of distributed high-frequency in-vessel sensors. The spectral characteristics of the fluctuations are observed to strongly depend on the magnetic equilibrium.

In particular, reversed-field pinch plasmas exhibit almost cyclic relaxation phenomena, also known as dynamo events, associated with magnetic reconnection processes, with the generation of toroidal magnetic flux and with the destabilization of Alfven eigenmodes. At high plasma current, these events result in the transition from self-generated helical equilibria, induced by the action of a dominant kink-resistive mode, towards a more turbulent state with many modes at comparable amplitude and overlaps of magnetic islands within the plasma, producing strong chaoticity of the magnetic field map and a degradation of the confinement properties.

It has been proven that active dynamical modification of the magnetic edge toroidal field, and the associated poloidal current drive (through the so-called Oscillating Poloidal Current Drive, OPCD technique) can induce the transition toward improved confinement regimes, with the generation of internal thermal barriers. The associated steep pressure gradients act as free energy source for various electrostatic and magnetic plasma instabilities, like the micro-tearing modes. The effect of the plasma equilibrium on the measured magnetic spectral properties will be here discussed.