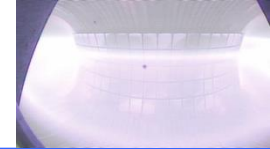


High resolution saddle coil array

G. Pucella, L. Boncagni, C. Cianfarani,
E. Giovannozzi, A. Grosso, M. Iafrati

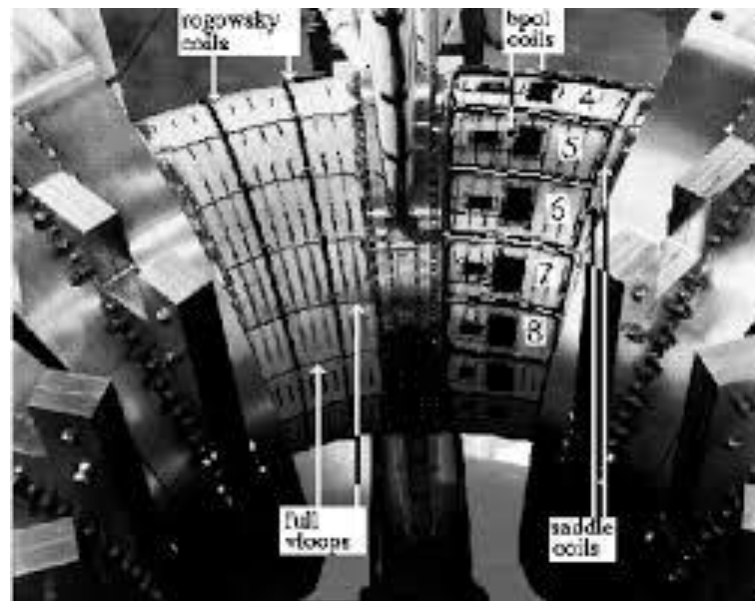
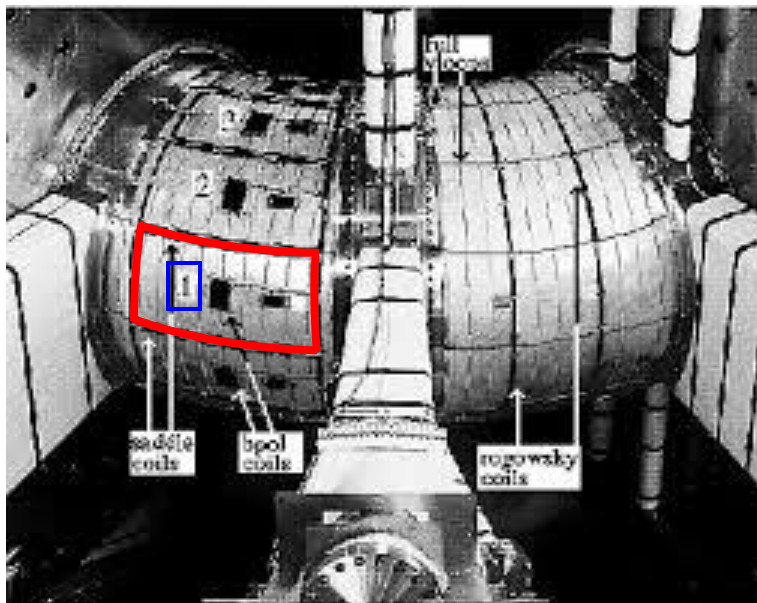


The magnetic diagnostics of FTU



Background

- The magnetic measurements of FTU are based on the standard technique of axisymmetric equilibrium magnetic measurements, in which **full voltage loops** and **saddle coils** measure the poloidal flux function and **poloidal pick-up coils** measure the normal derivative of the poloidal flux function over a contour enclosing the plasma cross section. These two data are the Cauchy conditions for the magnetostatic problem of finding the plasma boundary, starting from the measurement contour.
- All the magnetic probes are located outside the circular cross-section vacuum vessel, on a toroidal countour with major radius $R = 0.935$ m and minor radius $b = 0.356$ m. The standard magnetic measurements are composed of 16 full voltage loops and of four replicas of 16 poloidal pick-up coils and **16 saddle coils at four toroidal positions around the vacuum vessel.**



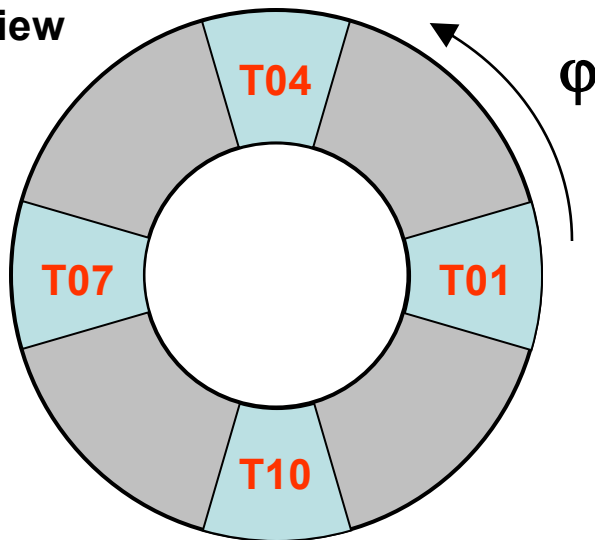


The new saddle coil array

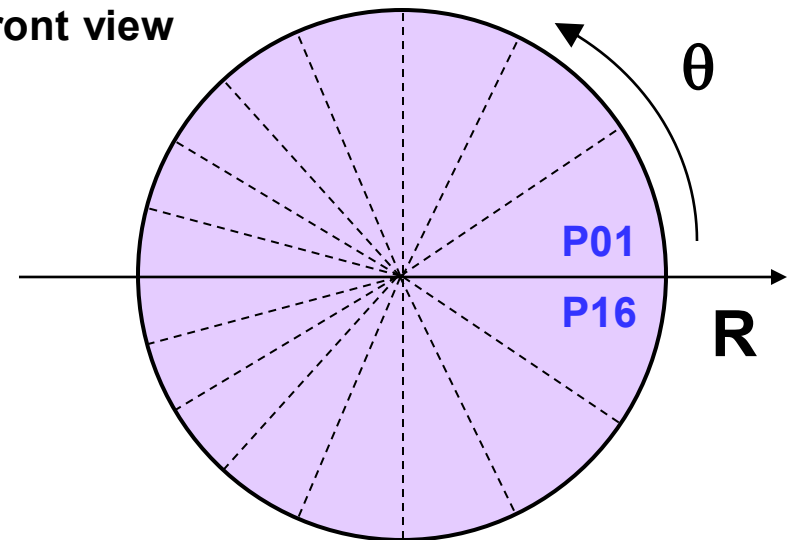
Geometry and original signal processing

- A set of 16 saddle coils covering all the poloidal contour along a Poicaré section is present at four positions along the toroidal contour. The saddle coils are displaced following magnetic coordinates.
- The change of magnetic flux through each saddle coil is **acquired at 2 kHz and integrated**. For toroidal sectors 1 and 7 the coils are acquired in pairs.

Top view



Front view



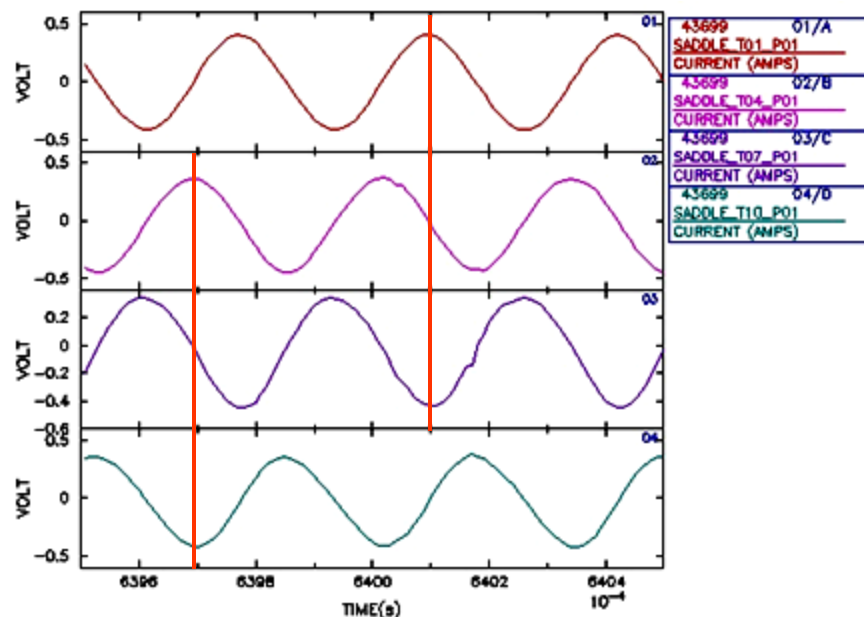
The new signal processing

- The 8 saddles (P01-P08) covering the $Z > 0$ region of the toroidal sector T10 and the 3 saddles P01 of the other toroidal sectors (T01, T04, T04) are acquired at 250 kHz, without the signal integration, allowing the observation of the MHD activity also at lower frequencies (thanks to their large area), where the Mirnov coils are limited by the external transformer acting as high-pass filter.

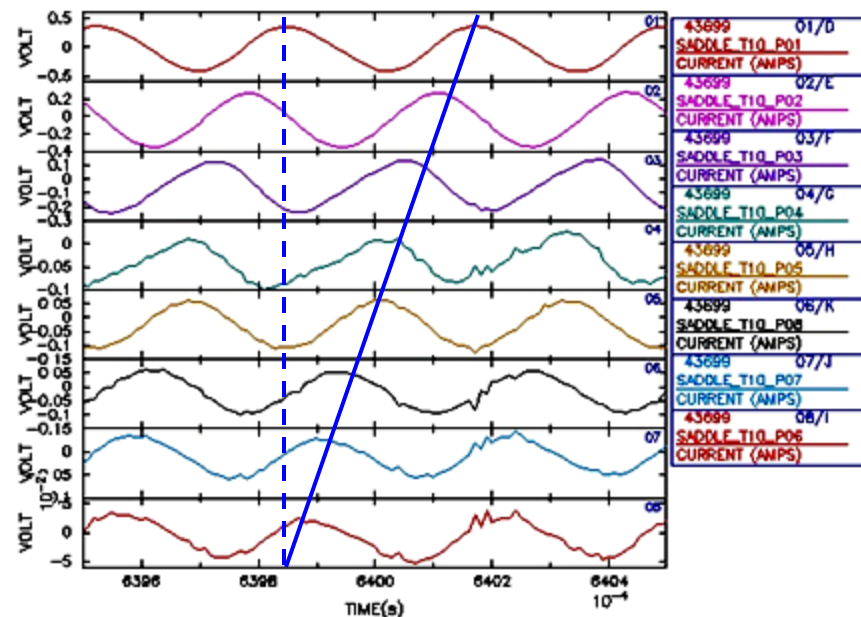


Mode number analysis

Toroidal array

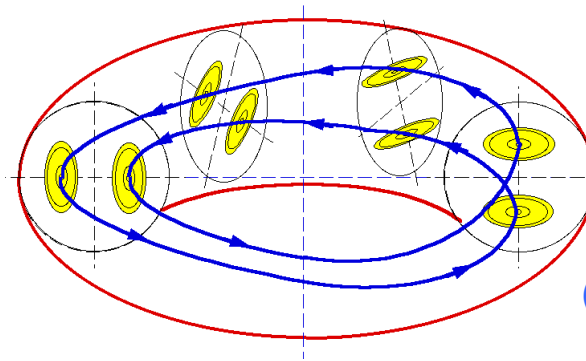


Poloidal array



43699

□ The new diagnostics allows the evaluation of the toroidal and poloidal mode number of Tearing Mode for all the frequencies above the inverse of the FTU wall time.

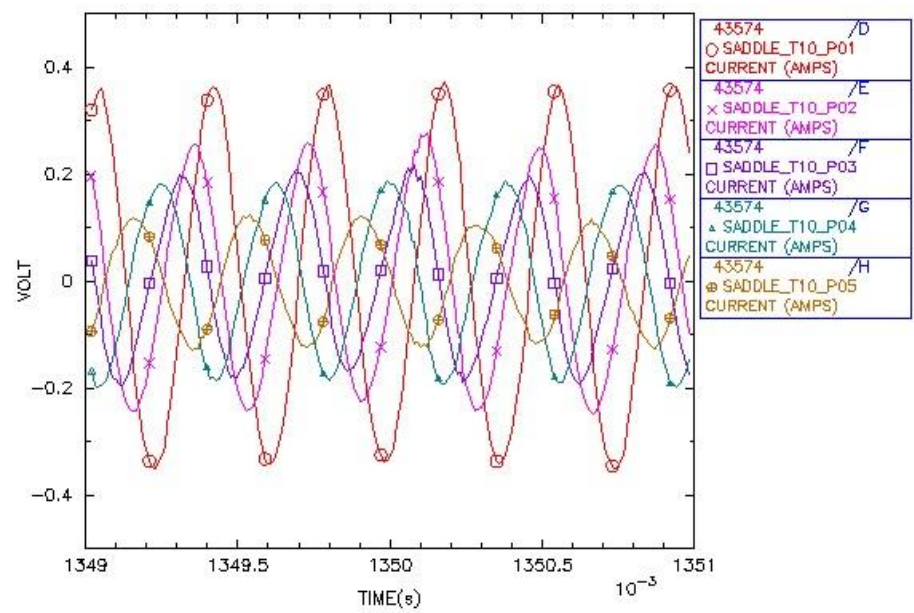
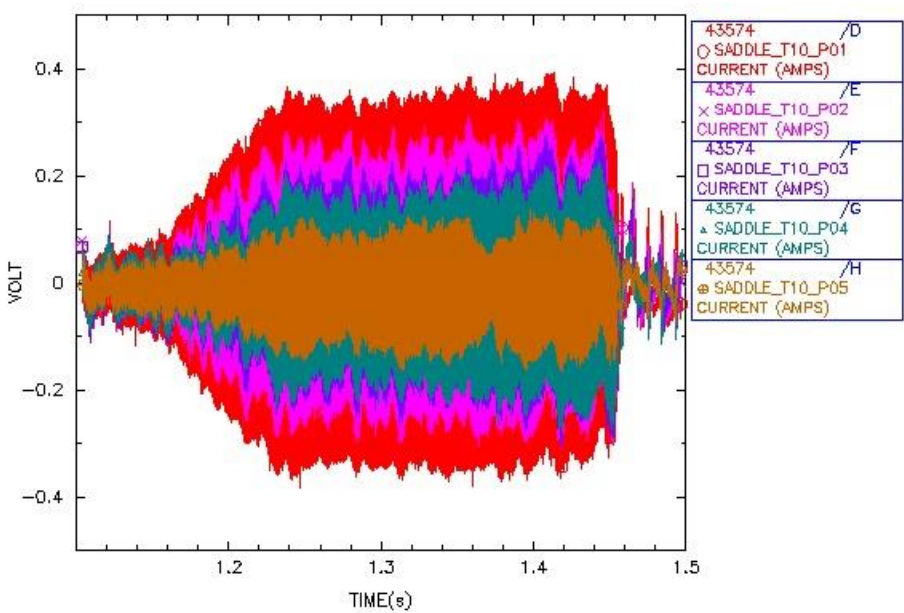


(2, 1) magnetic island

The area effect



43574



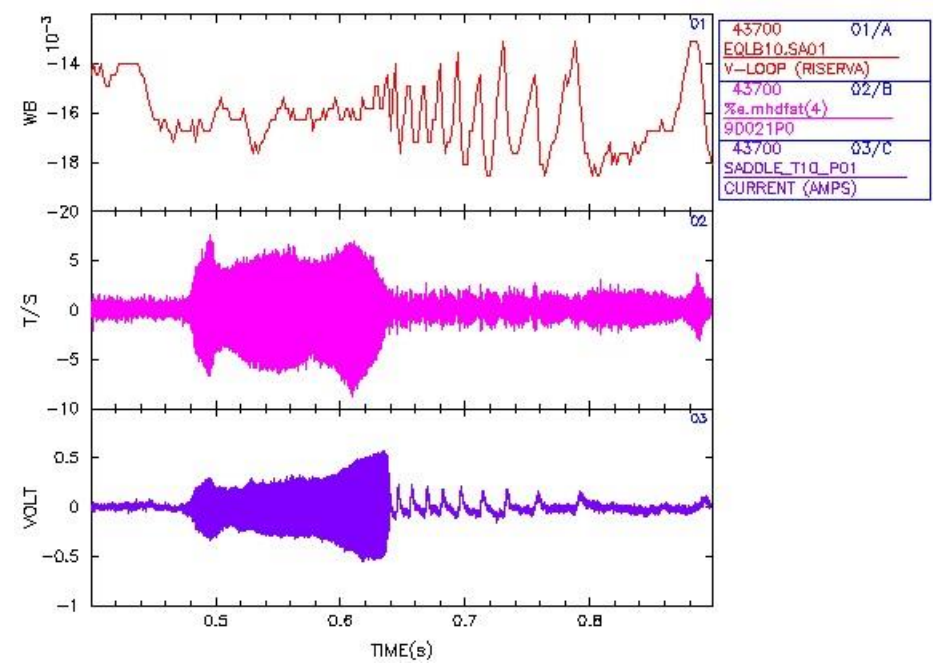
□ For a given magnetic island, the signal amplitude is approximately proportional to the coil area.

n	1	2	3	4	5
An / A1	1	0.714	0.565	0.532	0.340
Sn / S1	1	0.840	0.637	0.459	0.339

Quasi-locked and locked modes

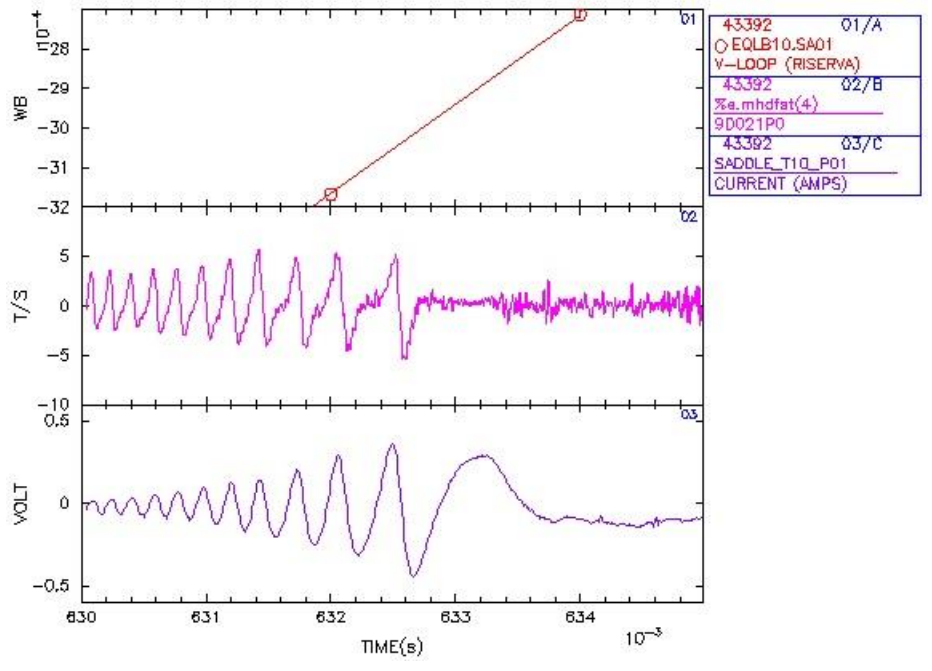


43700



Quasi-locked mode

43392



Locked mode