Tearing Modes stabilization by pellet injection

FTU Experimental Campaign 2019

27/03/2019 (Early & Late) ; 10/04/2019 (Early & Late)

G. Pucella, P. Buratti

RdO: S. Ceccuzzi, O. D'Arcangelo, W. Bin
PiC: E. Giovannozzi, V. Fusco

IFP

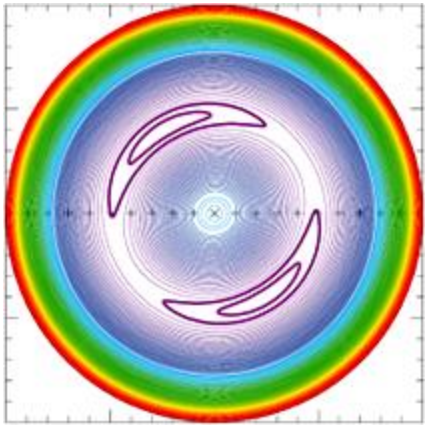
ENEA

CONSORZIO RFX
Ricerca Formazione Innovazione

TM stabilization by pellet injection

Background

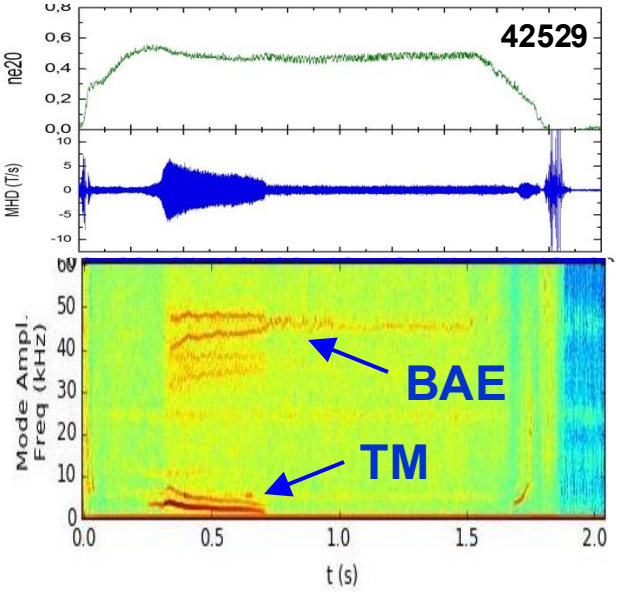
(2, 1) magnetic island



- A **Tearing Mode** (TM) is an instability that arises in magnetically confined plasma as a consequence of the plasma finite resistivity. It develops on rational magnetic surfaces and it is driven by the radial gradient of the toroidal current density.
- The study of the Tearing Mode stability is an important issue because the development of the **magnetic islands** characterizing the mode can deteriorate the confinement, leading to a decrease of the plasma energy content and sometimes to a plasma disruption.

Scenario

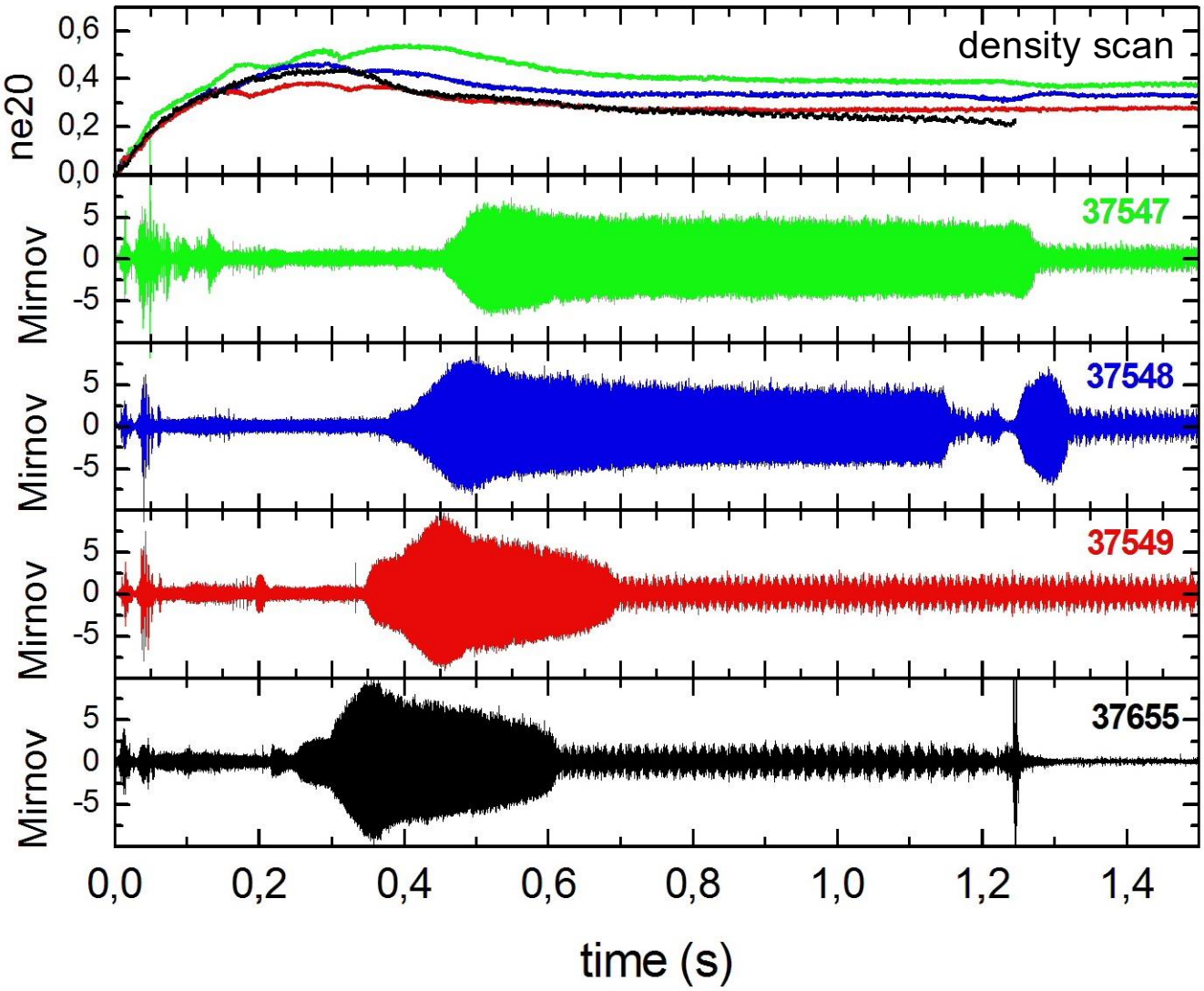
- In **saw-tooth free low density pulses**, magnetic islands formed by tearing instabilities around the q=2 surface can saturate at large amplitudes.
- Beta-induced Alfvén Eigenmodes (**BAE**) and Geodesic Acoustic Mode (**GAM**) are also observed in this scenario.



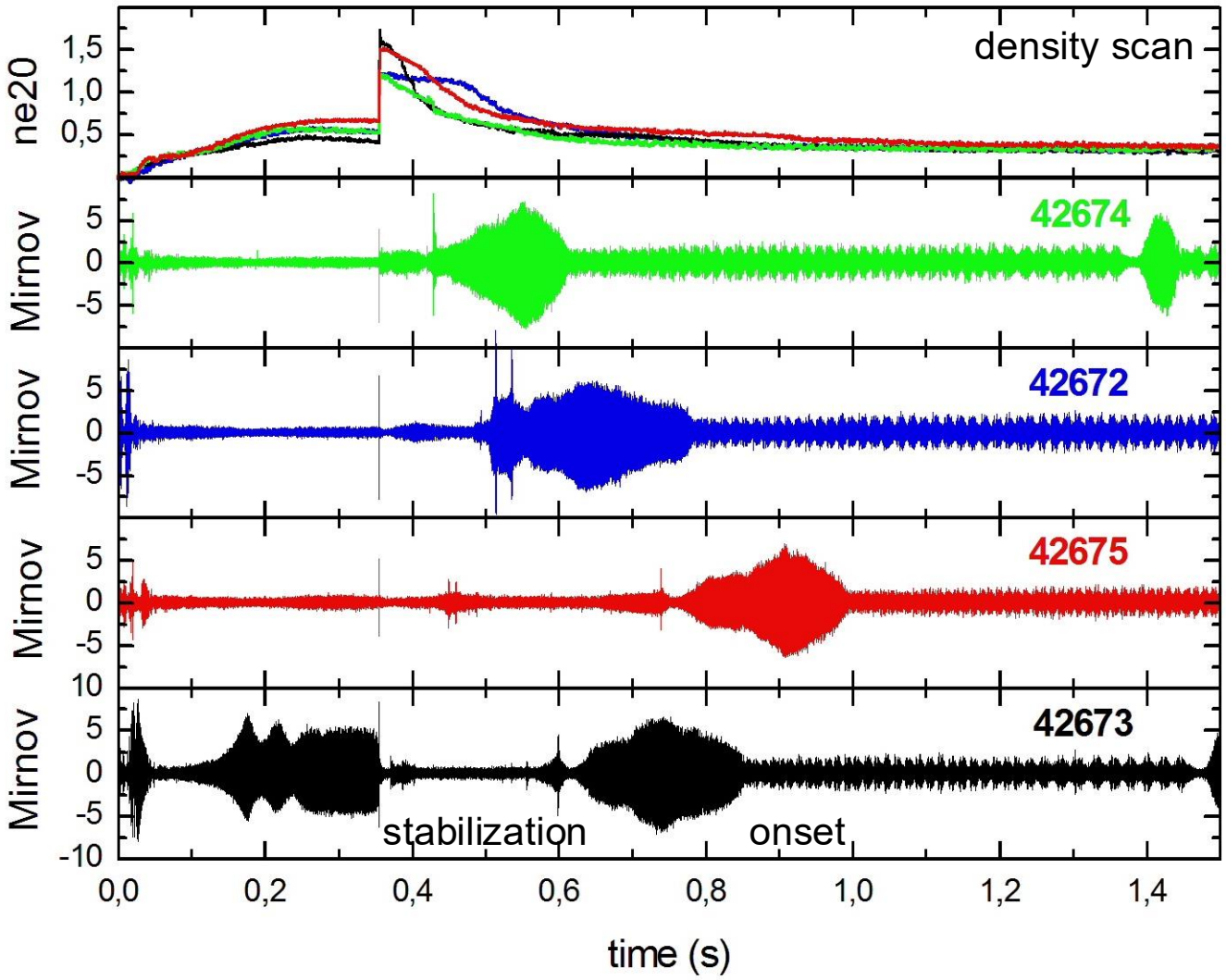
Goals

To study the effect of a D **pellet** injection on the temporal evolution of a magnetic island.

ST-free low-density Tearing Modes

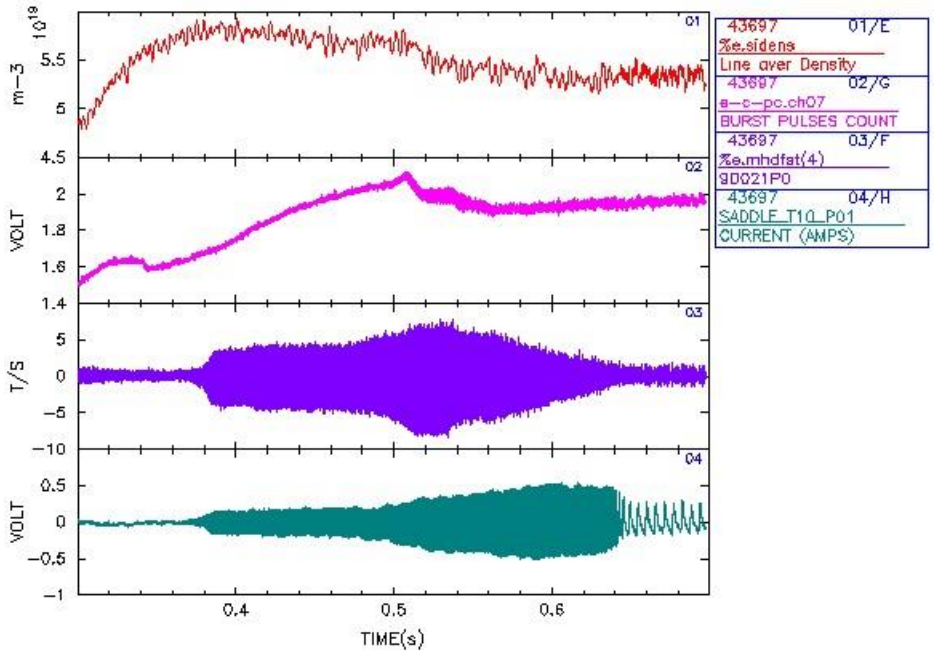


Pellet-induced Tearing Modes

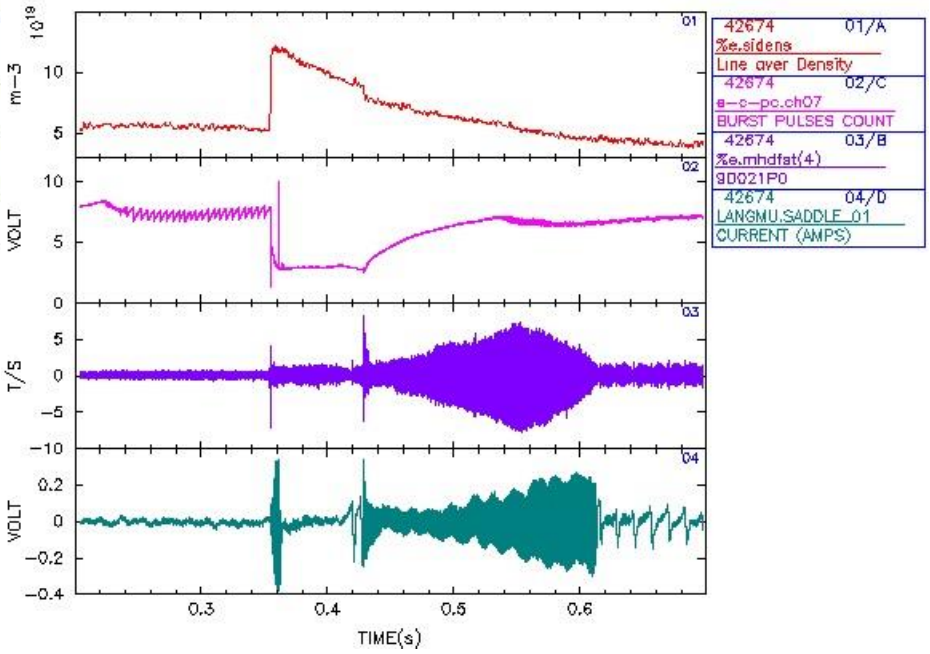


ST-free/low-density vs. Pellet-induced TM

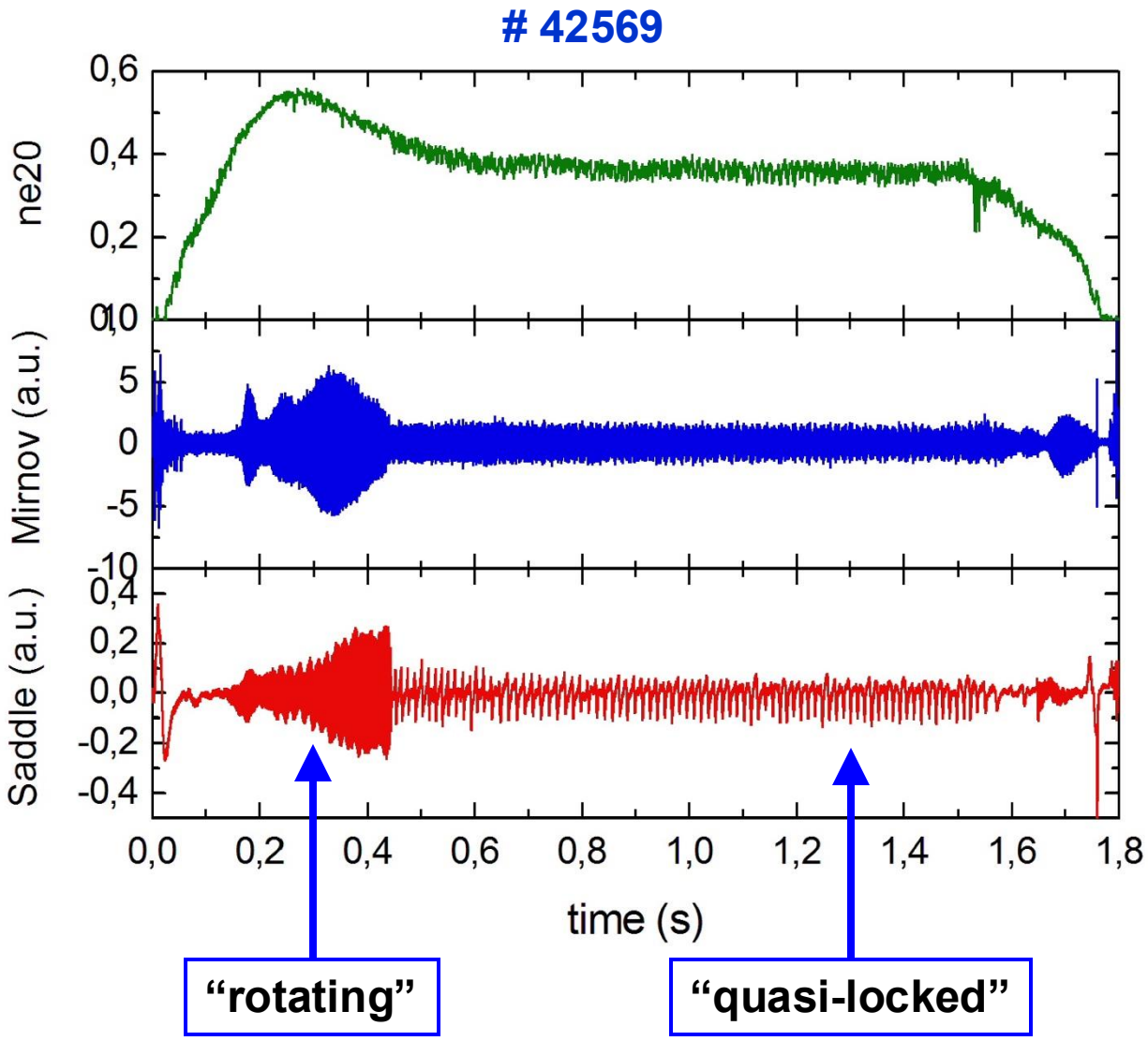
43697



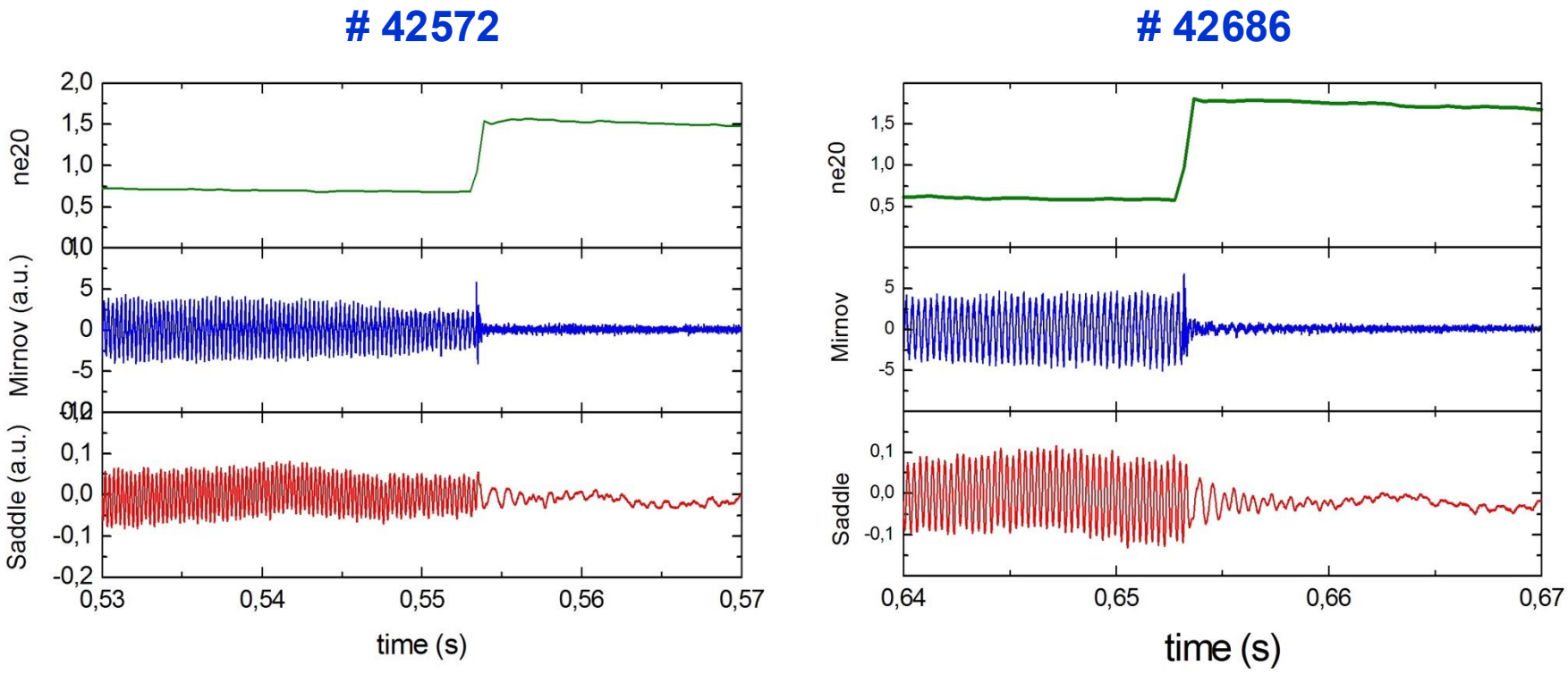
42674



Rotating and quasi-locked phases



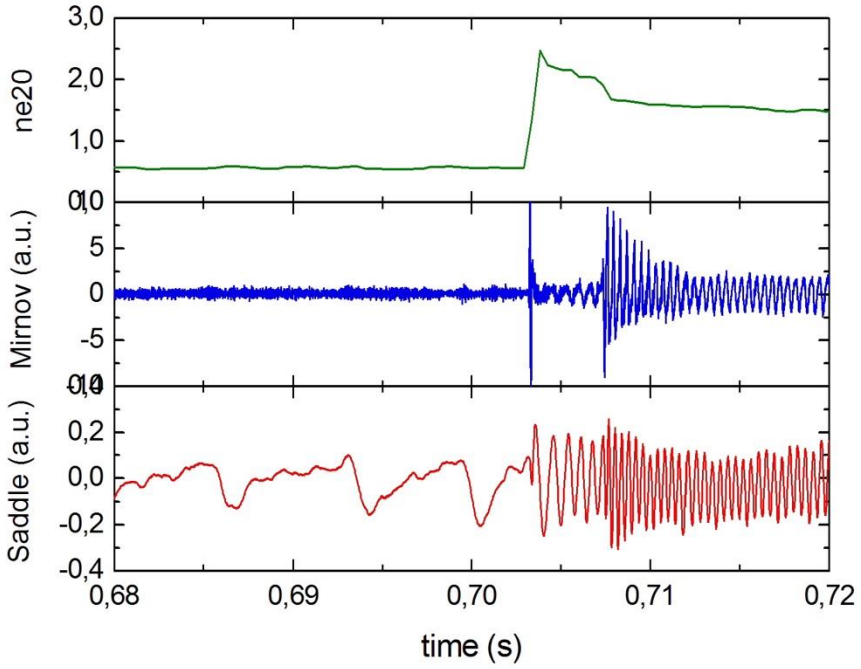
Pellet injection on a “rotating” mode



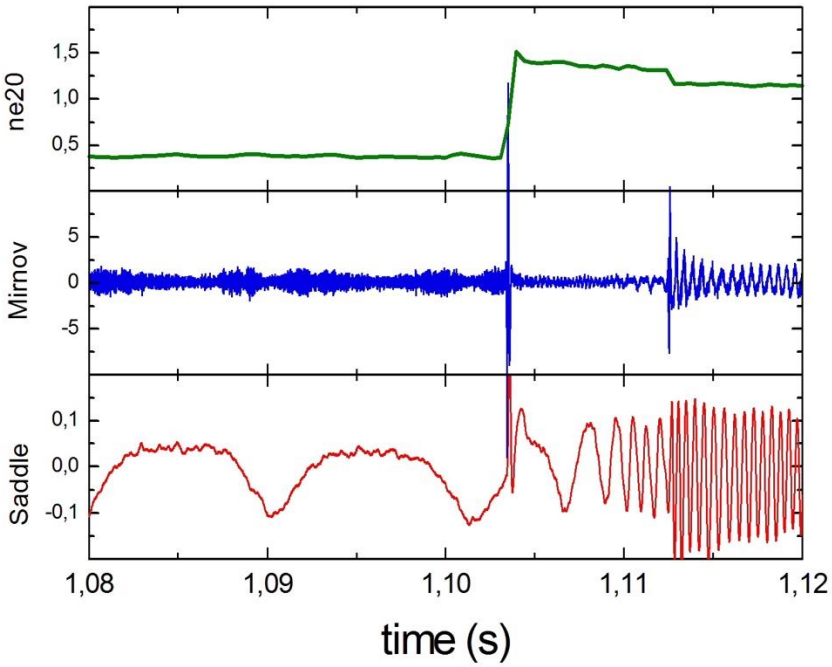
- A fast TM stabilization has been observed after a pellet injection in presence of a “rotating” magnetic island, possibly providing a new MHD stabilization strategy, through fast reconnection processes.

Pellet injection on a “quasi-locked” mode

42566



42690



- A pellet injected in presence of a “quasi-locked” magnetic island has induced a stable rotation, preventing a dangerous total locking.

Work in progress

- Estimation of the effective charge profile from bremsstrahlung signals with analytical constraint and simultaneous fit of all the lines of sight.
- Pulse simulation with the JETTO transport code, in which the current profile evolution is calculated according to the poloidal field diffusion equation considering the electron temperature profile from Electron Cyclotron Emission, assuming Spitzer resistivity and introducing the shaped Zeff profiles.
- Estimation of the temporal evolution of the linear stability parameter Δ' in the cylindrical/zero pressure limit.
- Analyses by means of the MARS code, which is a global, resistive, spectral code for full linear stability analyses.

- The main goal of this work is to study the mode stability before and after the pellet injection, to understand if the stabilization mechanism could be explained in terms of a global (albeit rapid) evolution of the current profile or if it is necessary to consider “local effects” due to the pellet ablation.