M18-03 C39 TAE Strategy
7 April 2020

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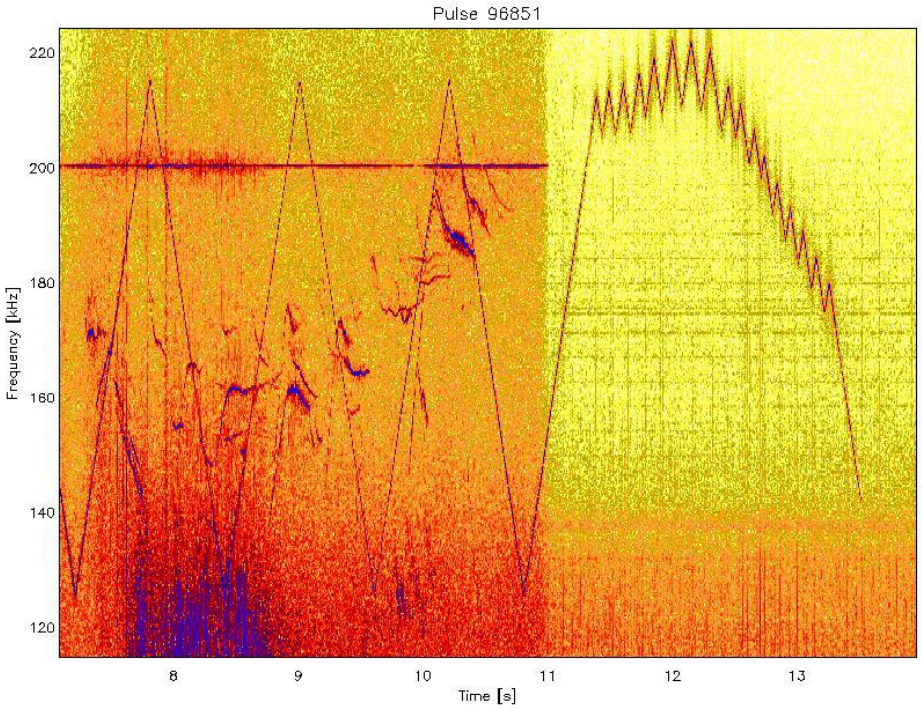
This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

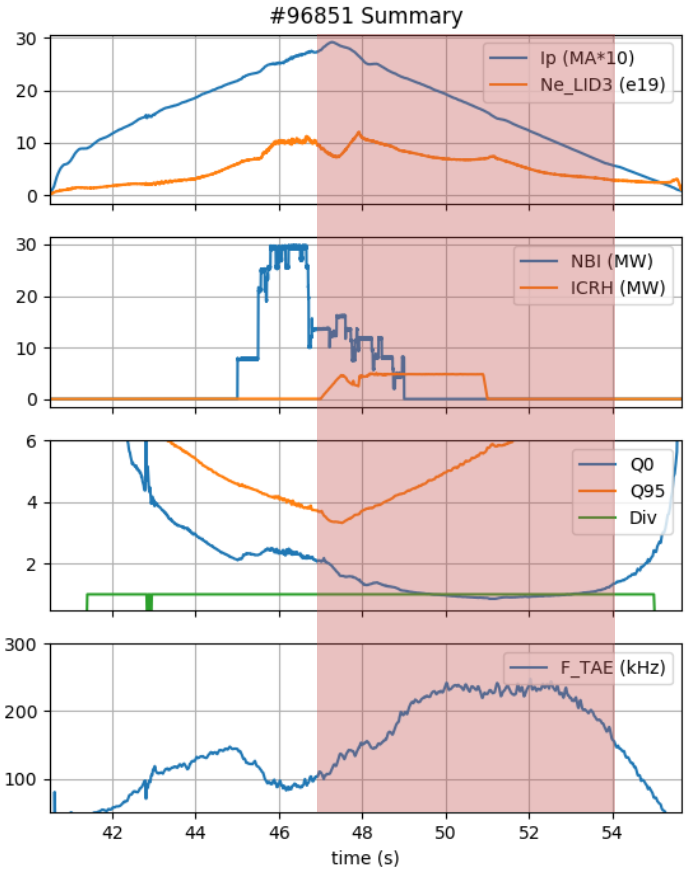
Outline

- Recent successful tracking of TAE in M18-03
- New M18-03 deliverables
- TAE antenna strategy for C39
  - Part 1
  - Part 2
  - H plasmas

Recent success in session 10

- TAE antenna current: 6A, phasing: n=0
- Antenna detected TAE and locked on to frequency during L-mode ramp-down phase of 96851
- **Good candidate pulse to repeat in C39 with no NBI and better timing?**





Still to achieve: Detect TAEs with antenna in high power part of expt./afterglow

3 new deliverables added to M18-03 aimed at improving TAE antenna coupling to plasma during H-mode phase of M18-03.

- D15: Identify operational space for which good TAE antenna-plasma coupling is obtained and use to optimise coupling in conditions relevant to M18-03
- D16: Probe kinetic toroidal Alfven eigenmodes (KTAEs) and verify effects of finite Larmor radius
- D17: Assess the evolution of TAE stability/damping with increasing power and energetic particle population

Pulses relevant to these deliverables intended to be executed as low power shots in C38B. After early cessation of campaign, now to be executed during C39.

- D plasmas are preferred. H plasmas may require us to change plasma parameters in order to keep the TAE frequency within the antenna's range.
- **Will there still be a D phase of C39?**

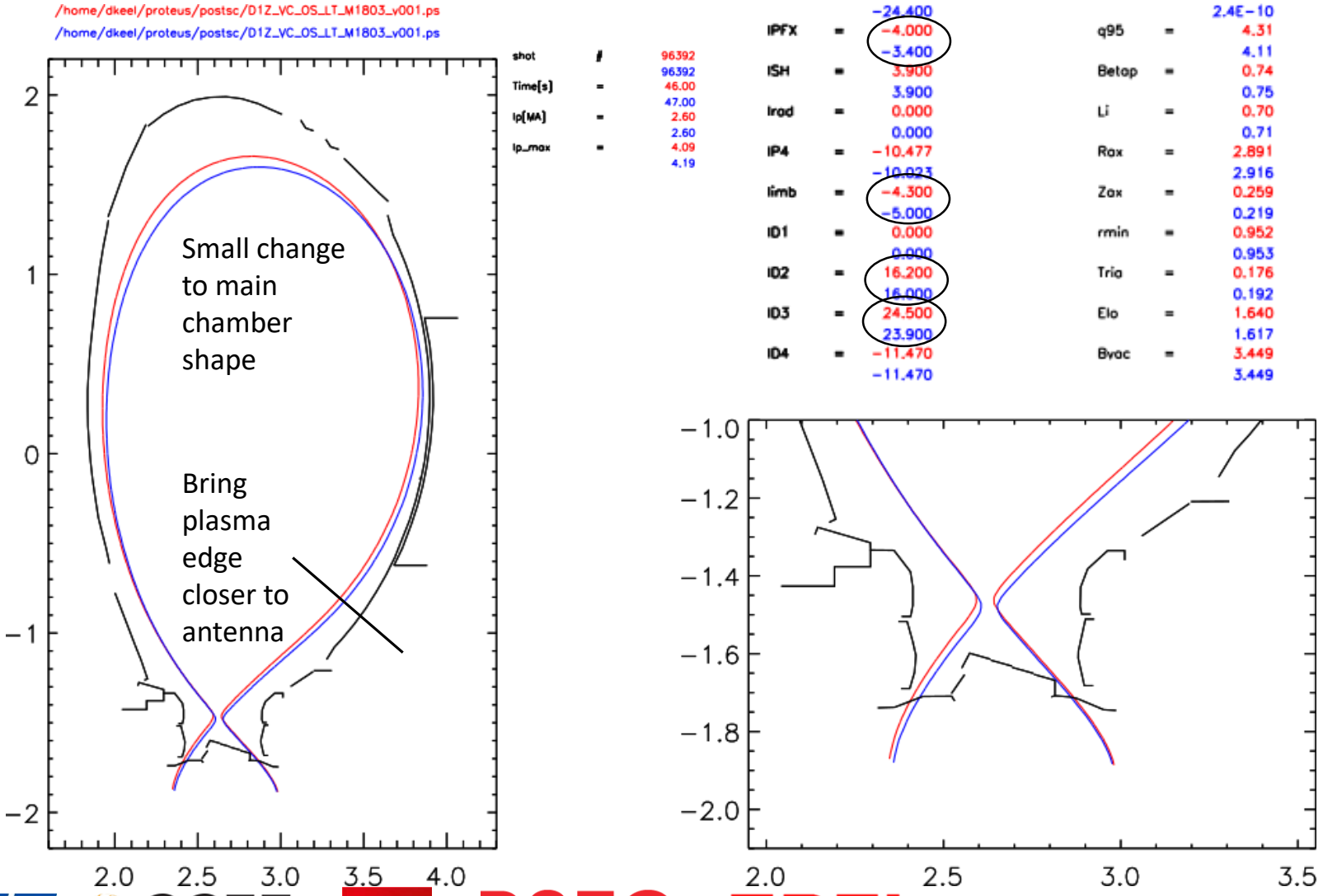
TAE antenna experiment: strategy

Part I: Optimize plasma-antenna coupling for M18-03-relevant plasma

- Start with M18-03 reference pulse JPN 95987 (afterglow + RF)
  - Disrupted at t = 46.5 s due to impurity accumulation/radiation event after an ELM
  - Disruption should be avoided with no NBI, but we can also reduce RF if needed
- Ip/Bt = 2.6 MA / 3.4 T, ne ~ 4e19 m-3
- No NBI. NBI damps AEs (ion Landau damping) and causes noise in magnetics data (NBI unavailable in C39)
- RF heating, 4.5 MW, f = 51 MHz (H minority), t ~ 45-? s
- Start with vertical position of the current centroid Zp = 0.23 m. Move plasma downward (toward antenna) to improve coupling

TAE antenna experiment: strategy

PROTEUS:



TAE antenna experiment: strategy

Part II: Explore coupling and kinetic effects in 'steady-state' M18-03 plasma

- Ip/Bt = 2 MA / 3.35 T, ne = 4e19 m-3 (similar to other pulses with good coupling, e.g. 94999 or 96600)
  - Truncate current ramp of 95987 for flattop t ~ 44.5-50.5 s
  - Reduce toroidal field slightly to lower the TAE frequency within the antenna's range while maintaining M18-03 relevance (He3 pulses?)
  - If we are not able to measure AEs (from poor coupling), try decreasing the plasma current to 1.8 MA and toroidal field to 3 T
- No NBI (NBI unavailable in C39)
- RF heating informed by Part I, 4-6 MW, f = 51 MHz, t ~ 44.5-50.5 s. Step up power every dt = 2 s to observe kinetic effects.
- Vertical position Zp determined by best coupling of Part I

In C39 H phase

If new antenna filter is ready to go (~320 kHz),

- Ip/Bt = 2.6 MA / 3.4 T
- ne ~ 4e19 m-3
- f = 35 MHz (He3 minority)

If using 250 kHz filter,

- Decrease to Ip/Bt = 1.8 MA / 2.4 T
- ne = 4e19 m-3
- f = 25 MHz (He3 minority)

Pulse lists at:

https://users.euro-fusion.org/tfwiki/index.php/M18-03:Scenario_for_EP_and_EPM_in_DT#Strategy_for_TAE_antenna_coupling_optimization_and_exploitation