M08: Pulse list May-June 2014 experimental campaign

Runaway Electron Control in FTU

WP14-MST2-9 – 1-9PY (1.5py ENEA-TorVergata, 0.4 py CNR)

IAEA 2014 contribution (FED RE beam modelling)

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GOALS

D01

Find a recipe to obtain a reliable RE current plateau (density reduction during flat top (RE generation) + Ne injection)

D02

RT upgrade of Diagnostics (FC, SI, Vloop)

D03

Reduce RE dangerous effects during disruptions by

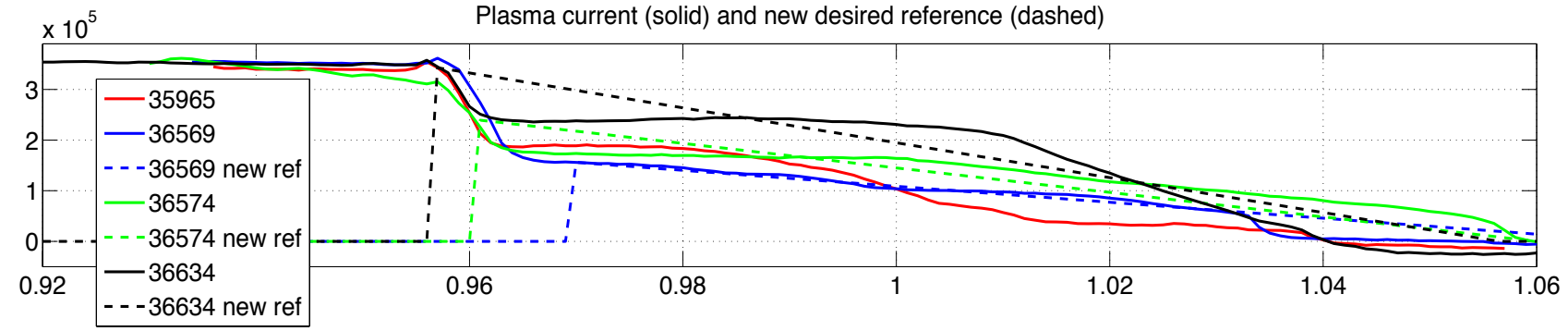
a) RE controlled current ramp down (longer, possibly with preprogrammed gas injection to improve RE current mitigation – Soft Gas Injection)

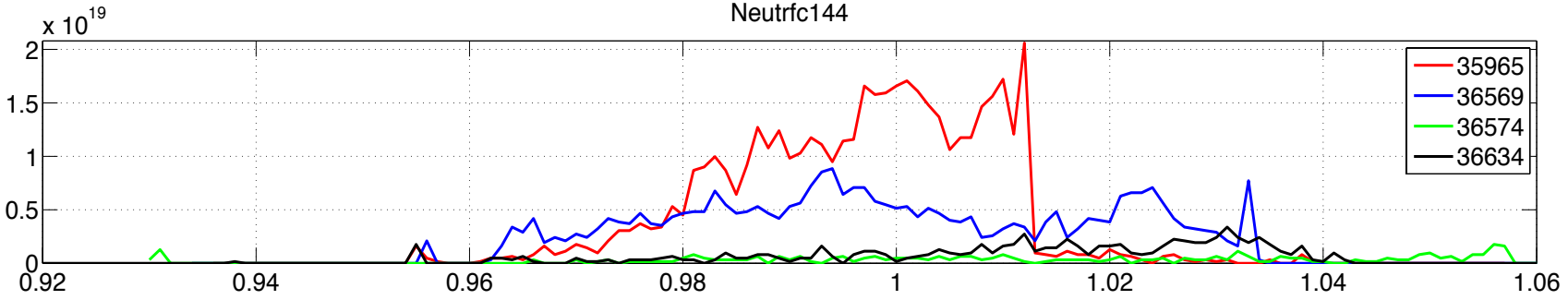
b) RE horizontal position control to avoid/minimize RE interaction with PFC (adaptive R_{ext} reference and not preprogrammed)

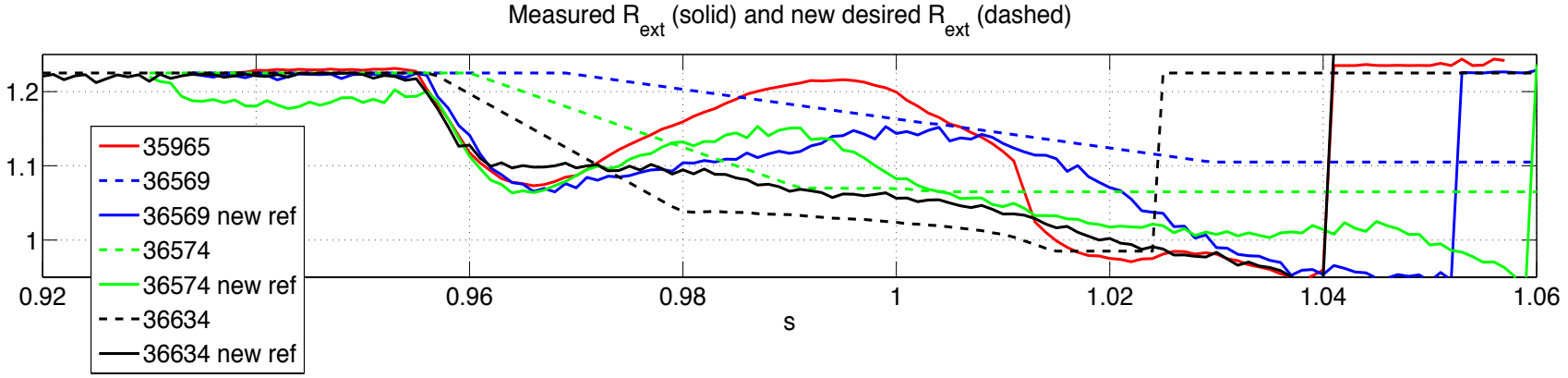
D05

RE dynamical model (plateau phase, current and horizontal position) for effective controller design and simulation (RE controllability) [models and control law]

Experimental Results – 2012/13







GOALS: method

D01

- S60M36RC01: low-prefill, V and F optimized for large F excursion, Ne injection (3 Atm, 40ms, 98V) @ 1.0s, density reference 1.5E-19 m^{-3} up to 1.0 s [see 36569]
- One recovery shot each 3 shots with S60M36RC01

D03

Controller parameters (scan)

- Ip desired ramp down
- Fixed (initial) desired R_{ext}
- Tuning of Extremum Seeking-like parameters
- Vloop thresholds
- Final kick tuning
- PID-F gains tuning for RE control
- Possibility of deuterium gas injection at RE current plateau/ramp down (RE delayed mitigation effects)

D05

Modelling tests (scan)

- Changing the position reference (partially done by D03) at RE current plateau
- Changing plasma elongation before disruption (Allocator)
- Test a new feedback controller instead of PID-F during RE

M08: Pulse List

Pulse Plan: Friday 13th of June

[D01-D02] Perform a series of low density with low prefill and neon injection induced disruptions to obtain RE plateaus and validate the new signals (even before if possible by other pulses). In the meanwhile the new controller that make use of new signals is tested (RE plateaus are necessary). The old RE position controller policy is turned on for safety reasons.

1) Zero at 6 T
2) Standard shot at 6T, 500 KA
3) S60M36RC01: low-prefill, V and F optimized for large F excursion, Ne injection (3 Atm, 40ms, 98V) @ 1.0s, density reference 1.5E-19 up to 1.0s [see 36569]
4) Repeat (adjust density profile)
5) Repeat (adjust prefill)
6) Repeat (adjust time and pressure of Ne puff)
7) Standard shot at 6T, 500 KA (re-establish good low density conditions and to clean the camera from Ne)
8) Repeat 3) (adjust density profile)
9) Repeat (adjust prefill)
10) Repeat (adjust time and pressure of Ne puff)
11) Standard shot at 6T, 500 KA

3/4	Program
1	Zero
4	Recovery
12	Repeat

SATISFACTORY TARGET SCENARIO (RE plateau), NEW CONTROL CODE & SIGNALS

12) Scenario Pulse [(Ip ramp down 100ms, REdes 1.16), (FC gain, Vloop gain, controller speed tuning]
13) Repeat (adjust FC gain, Vloop gain, controller speed)
14) Repeat (adjust FC gain, Vloop gain, controller speed)
15) Repeat (adjust FC gain, Vloop gain, controller speed)
16) Standard shot at 6T, 500 KA
17) Scenario Pulse [(Ip ramp down 200ms, REdes 1.1), (FC gain, Vloop gain, controller speed tuning]
18) Repeat (adjust FC gain, Vloop gain, controller speed)
19) Repeat (adjust FC gain, Vloop gain, controller speed)
20) Repeat (adjust FC gain, Vloop gain, controller speed)

NO SCENARIO

12) 6 T / 360 kA (M07 RE generation) with V and F optimized for large F excursion, Ne injection (3 Atm, 40ms, 98V) @ 1.1s
13) Repeat (adjust density)
14) Repeat (adjust prefill)
15) Repeat (adjust time and pressure of Ne puff)
16) Standard shot at 6T, 500 KA
17) 6 T / 360 kA (M07 RE generation) with V and F optimized for large F excursion, Ne injection (3 Atm, 40ms, 98V) @ 1.2s
18) Repeat (adjust density)
19) Repeat (adjust prefill)
20) Repeat (adjust time and pressure of Ne puff)