Motional Stark Effect Imaging on ASDEX Upgrade:

April 2014 initial results.

(AUG OPS meeting 26/05/2013)

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Camera Faults

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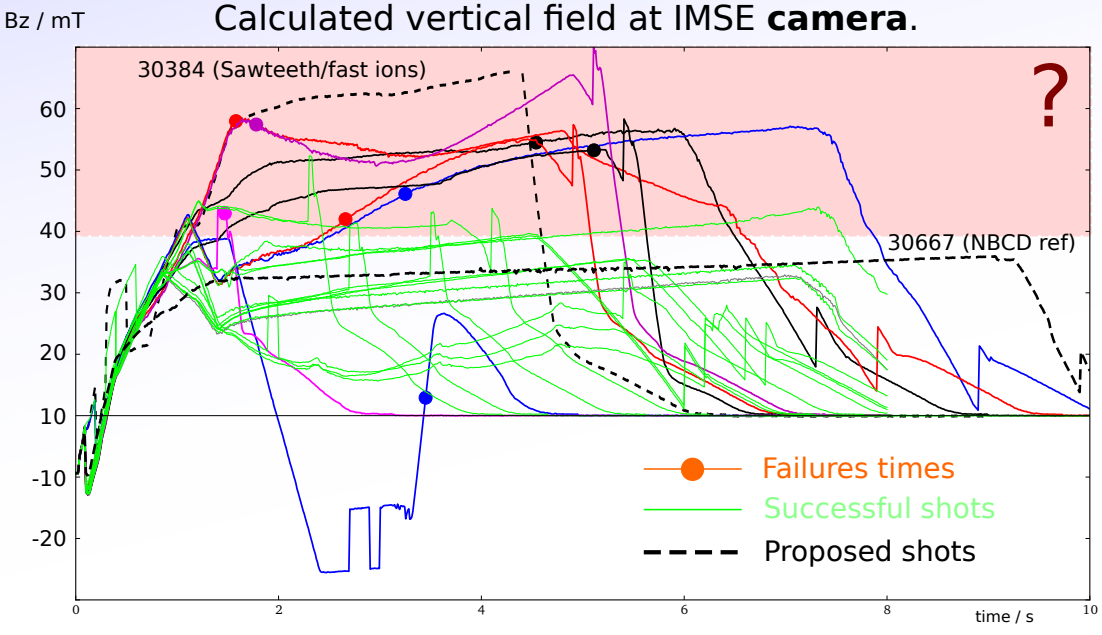
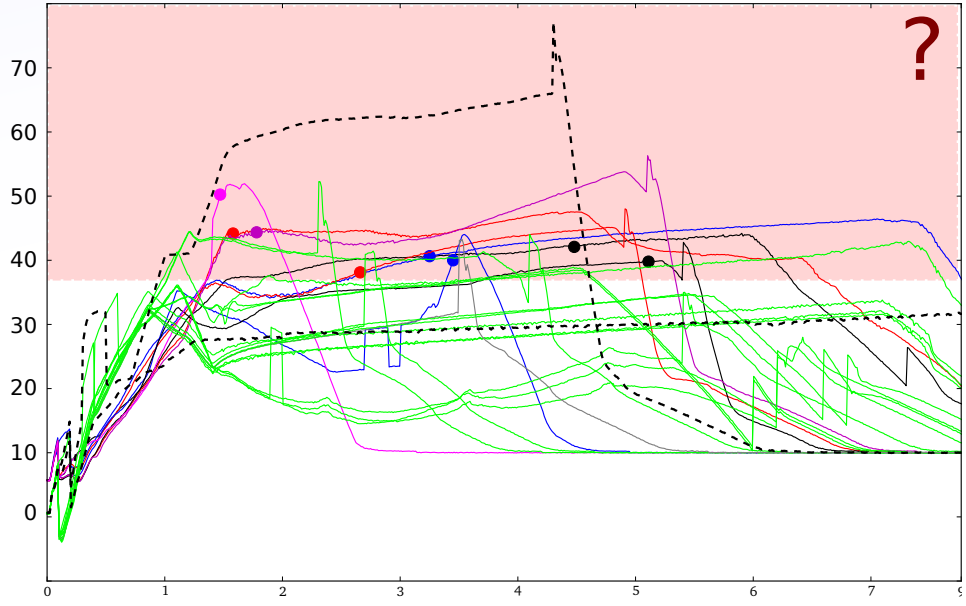
gmds/AUG/29317

Previous week, the camera stopped during many shots.
Eventually found some correlation with the magnetic field at power supply and/or camera.

Calculated vertical field at IMSE **camera**.



Calculated vertical field at **Power supply.**



Replaced power supply - didn't fix it, but may have helped.
5mm Iron around camera - this solved the problem.

All shots on Tuesday afternoon worked without a problem.

Camera will be used in W7X and was tested up to ~100s mT
- need to examine the exact test conditions and reconsider results!

IMSE vs MSE

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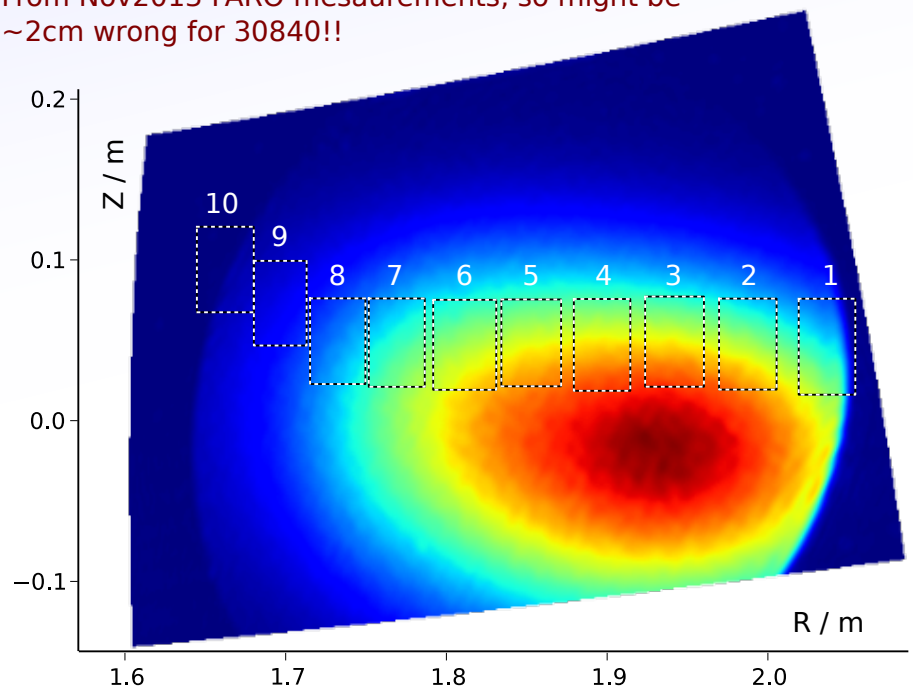
First, we can check the IMSE directly against the MSE polarisation angles, to make sure they see the same thing - since they are connected to the same optics.

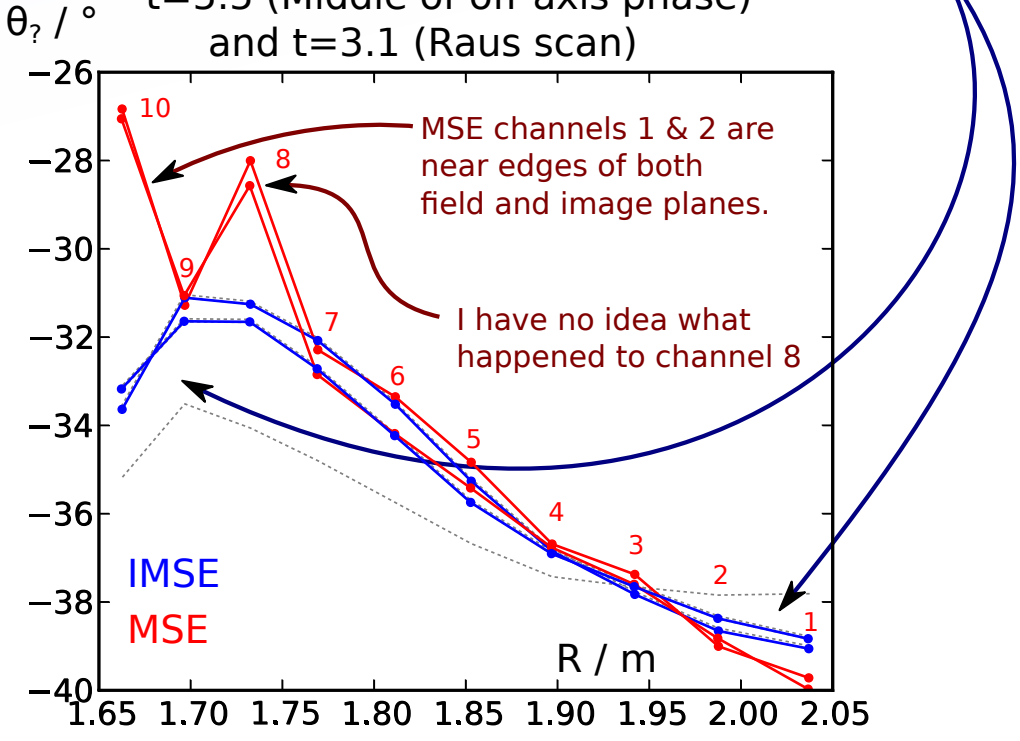
Using two 800kA NBCD pulses:
- IMSE:30823 , MSE:30840.
- Same shot program (~repeat).
- No significantly different mode activity.
- Same equilibrium results.
- Very similar polarimeter signals.

Instrinsic contrast calibration is not good at IMSE image edges, expect some offset!

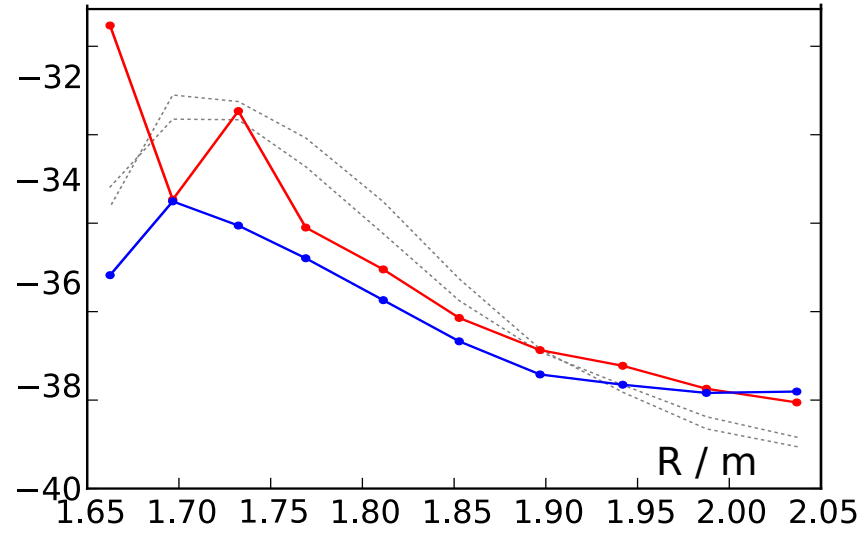
MSE equivalent regions on IMSE transformed image.
From Nov2013 FARO mesaurements, so might be ~2cm wrong for 30840!!



t=5.5 (Middle of off-axis phase) and t=3.1 (Raus scan)



t=9.6 (Middle of ramp-down)



IMSE vs MSE

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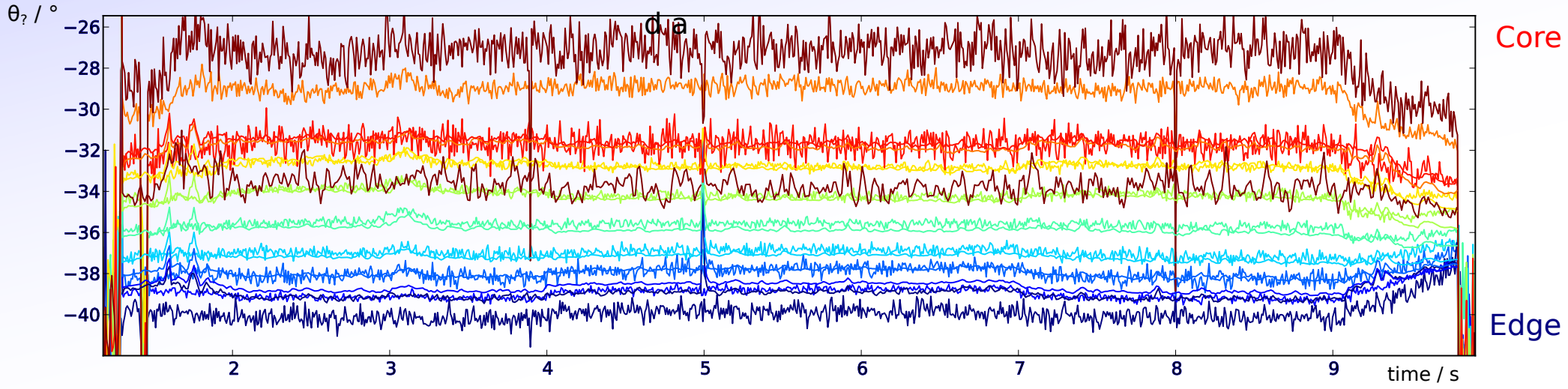
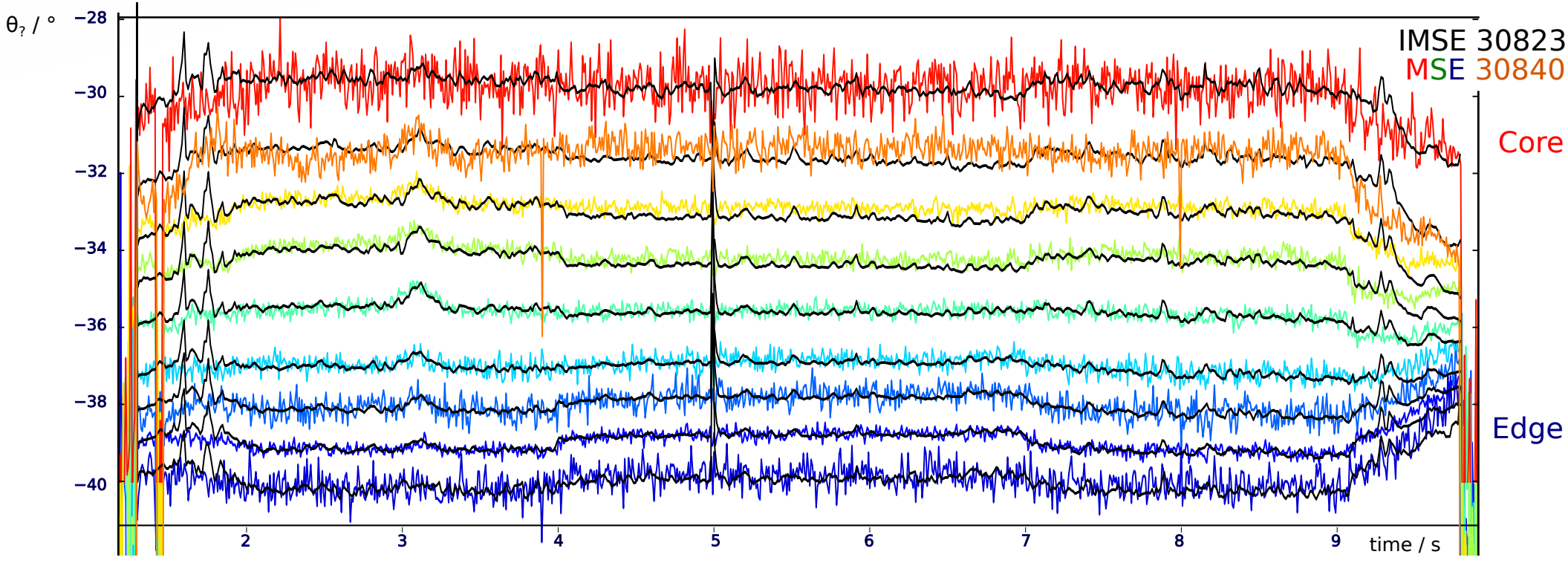
The raw time traces show a similar stroy - some offset and lots of noise on MSE at core/edge.



Adjusting the offsets independently to see the temporal behaviour shows very good agreement:



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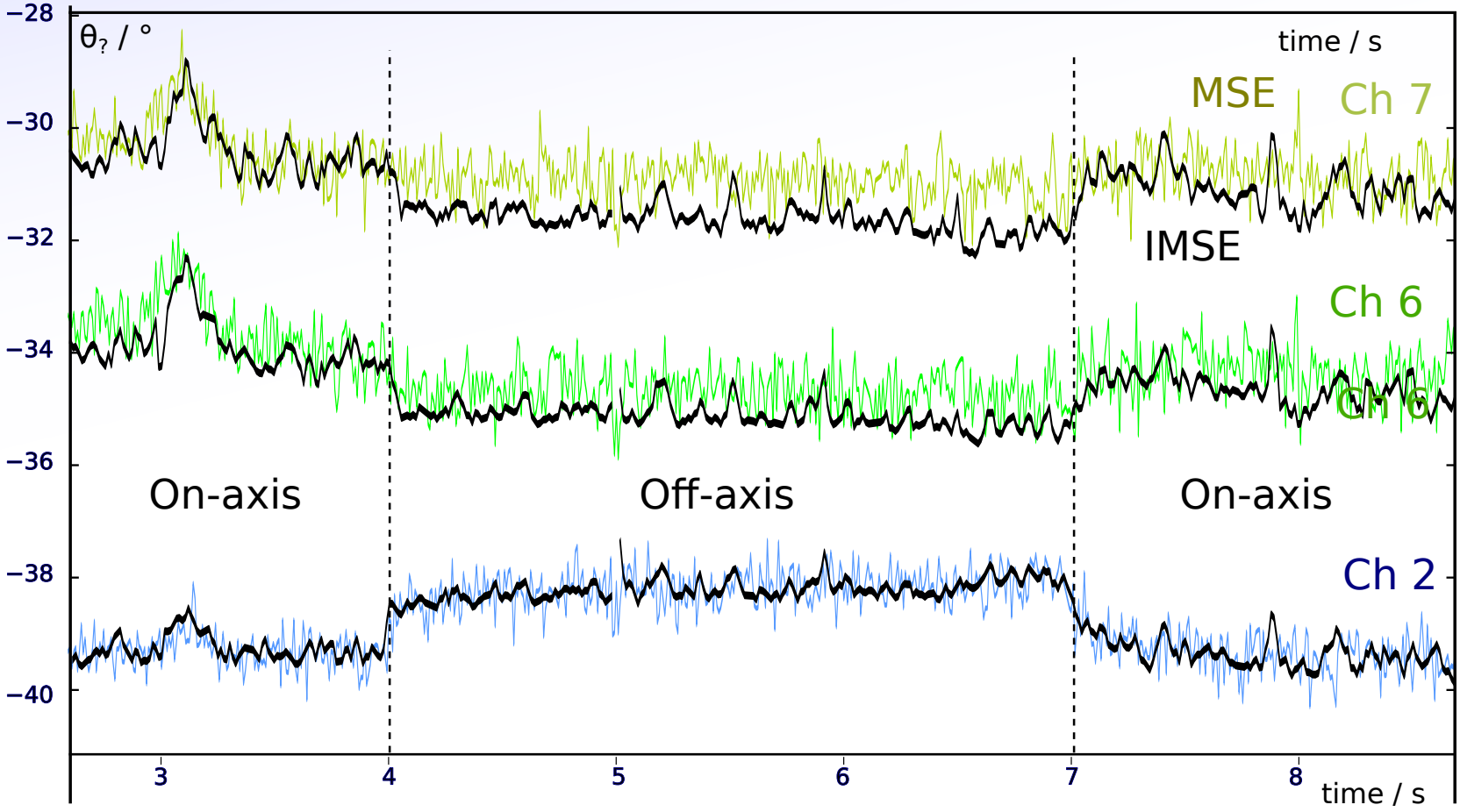
Neutral Beam Current Drive

These are the off-axis NBCD shots, where we are looking to see if the IMSE can detect the current profile changing on the current diffusion timescale after the switch to off-axis NBI.

Firstly, the IMSE shows slightly more of a jump in the core as the switch is made:



This gave me some concern that the IMSE is susceptible to background contamination.
Here, the background drops by ~20% during the off-axis period (probably changing charge exchange Hα 'Halo' or FIDA emission).

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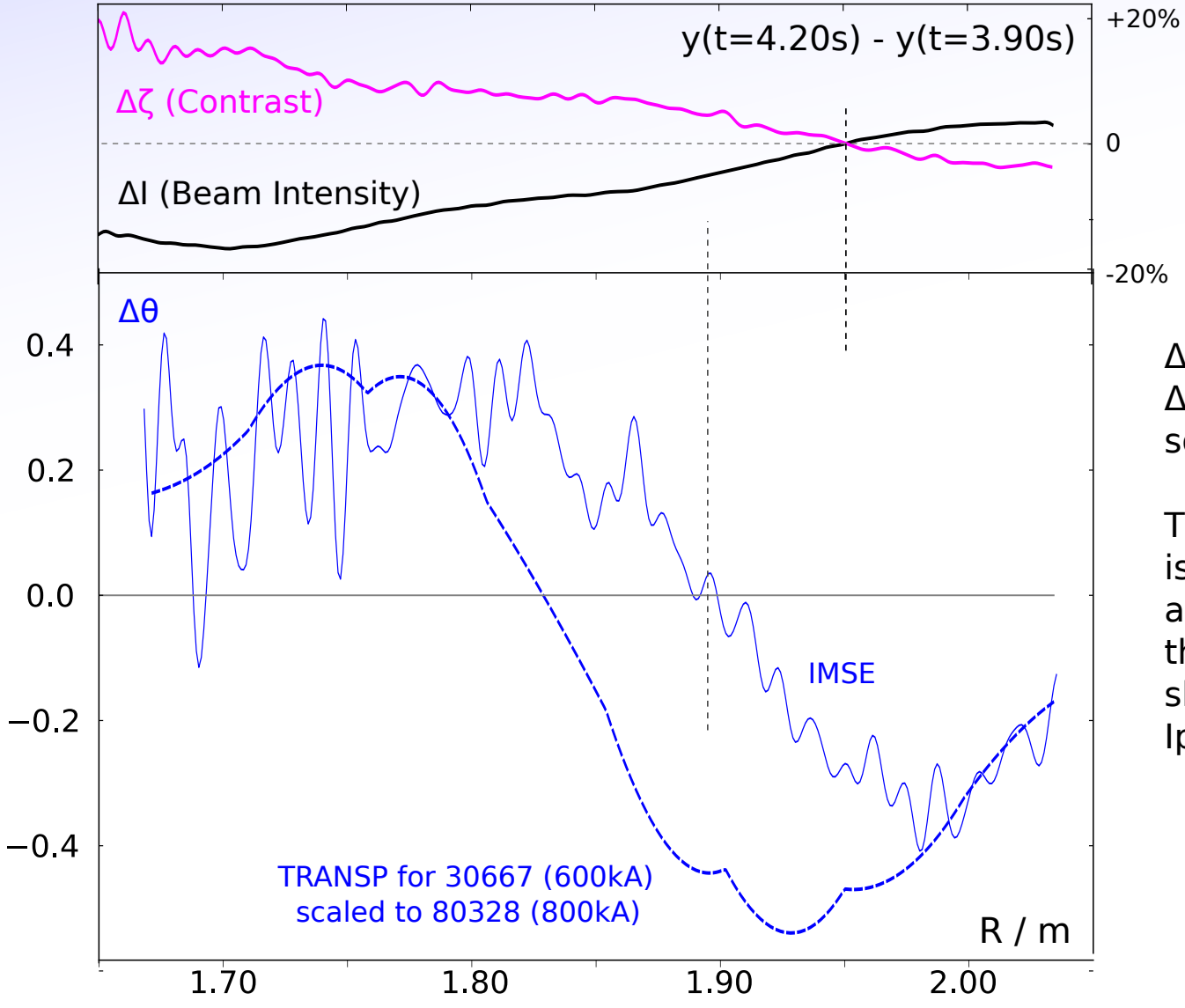
Neutral Beam Current Drive

The change of the intensity I, contrast ζ and angle θ all have opposite sign at the core and edge.
We can check to see if the position of the inversion of the change is in the same.



ΔI and Δζ inversions at 1.95m
Δθ inversion at 1.90m
so, Δθ is *probably* real.

The prediction from TRANSP is the same magnitude but in a different position, although this TRANSP run was for a 600kA shot and has been scaled to the 800kA Ip here.

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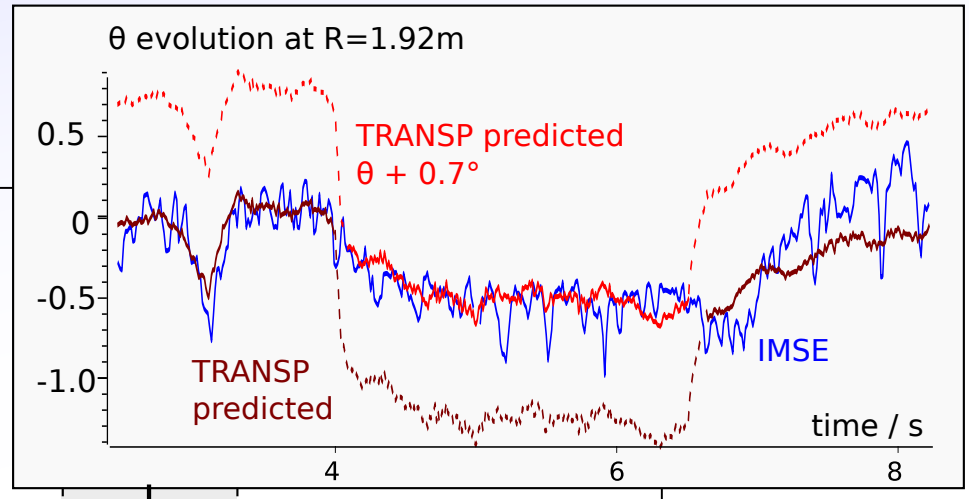
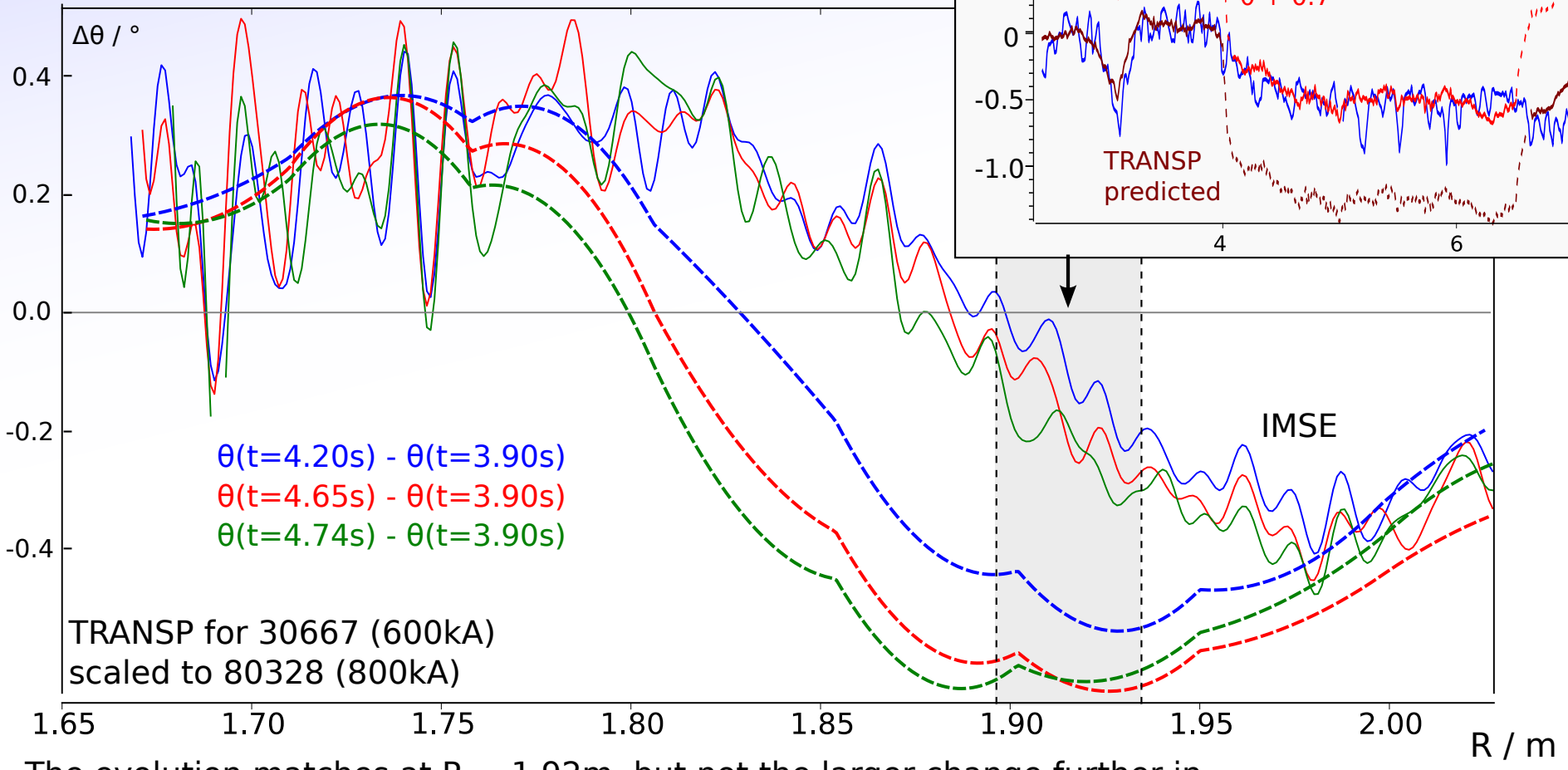
Neutral Beam Current Drive

We can also look at the Δθ after a few more 100ms, to see if the TRANSP predicted current profile evolution is present:





The evolution matches at R ~ 1.92m, but not the larger change further in.
If we ignore the shift at that position, the evolution magnitude looks correct
--> Need a proper TRANSP run for this pulse.
--> Need to independently separate plasma movement and current evolution **in the measurements.**
Please note: Only time evolution of θ is diagnosable at this level!
0.1° is the best systematic error/calibration level you can really hope to acheive for any type of MSE.

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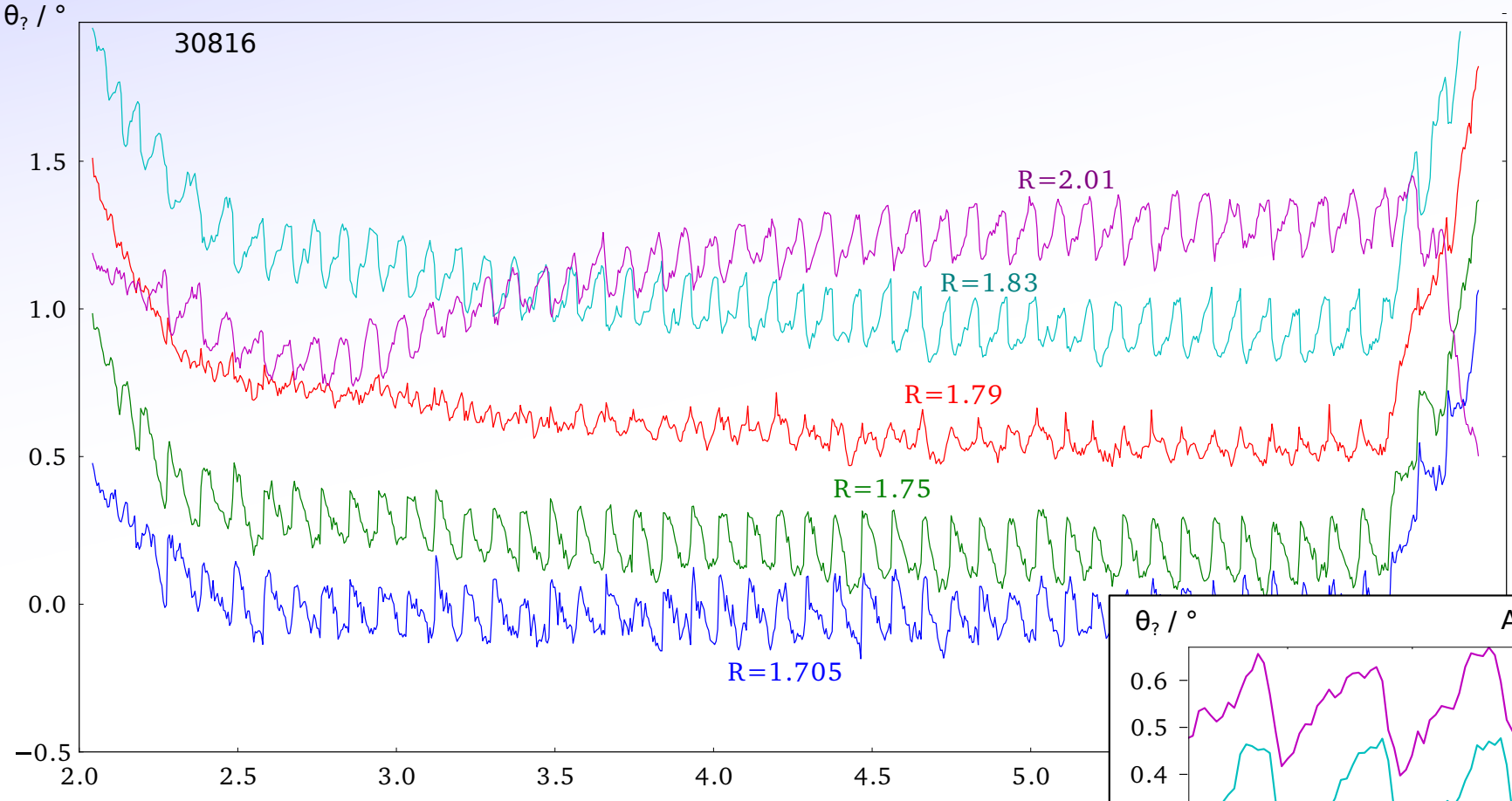
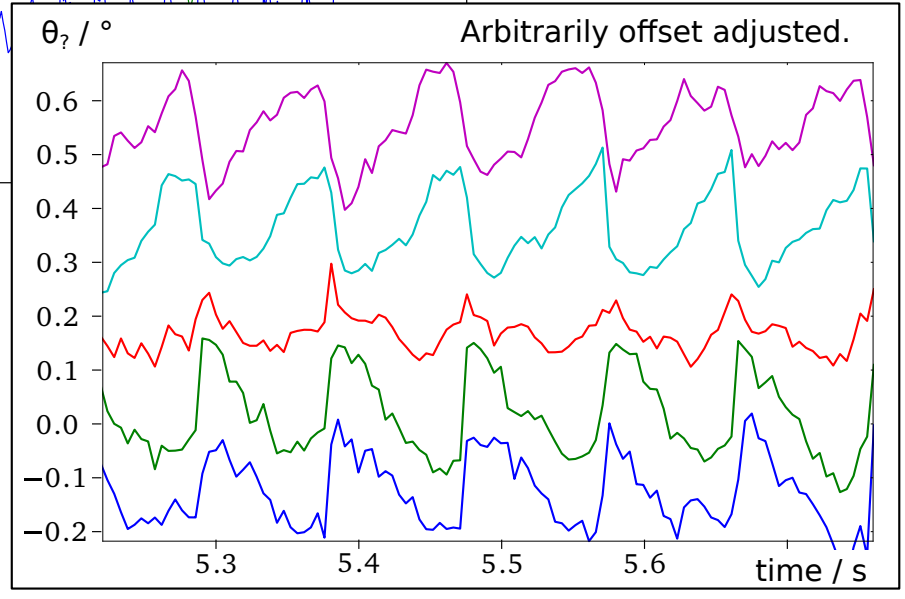
Sawteeth

Tuesday also had some very nice discharges with large/slow sawteeth.
Some were missed, but the camera shielding came just in time for the last few.





Data looks very good and shows the sawtooth pattern very clearly throughout the shot.
- Evolution direction inverts at R~1.79m.
- Pattern is unexpectedly large near the edge - R ~2.01m ??

Still need to check for contamination by other variables, plasma position and Shafranov shift.