ENR ATEP Progress meeting

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Tuesday 19 Oct 2021, 13:30 → 15:30 Europe/Berlin

https://zoom.us/j/6025051719?pwd=ZFhRdjdWVjUyMVZVZWVaRkladjFDQT09 (Zoom link) ()

Philipp Lauber philipp.lauber@ipp.mpg.de

13:30 → 15:30 **ENR ATEP Progress Meeting**

13:30	**ENR news (Philipp Lauber) 5+5 mins**	10m
13:40	**Rabbit discussion (M Weiland)**	25m
14:05	**Update WP 1 (F Zonca)**	15m
14:20	**Benchmark LIGKA/DAEPS discussion, WP4 update (10+10)**	20m
14:40	**discussion (30 mins)**	30m

4th E-TASC Scientific Board (Monitoring of ENR-MOD 2021 activities)

Friday 26 Nov 2021, 09:00 → 12:00 Europe/Berlin

Description **Monitoring of 2021 Enabling Research activities.**

During the meeting **Principal Investigators** must:

- present 2021 activities and their status;
- give the forecast regarding achievement of Scientific Deliverables foreseen for 2021; and
- report any modifications/changes to the project required in 2022.

The **Scientific Board** must:

- provide remarks regarding 2021 progress, which must be taken into account by PIs when submitting the intermediate report on project achievements; and
- endorse corrections to 2022 work programme following the requests by PIs.

meeting mid of November to collect and assemble the status/modifications of the various WPs

WP1: theoretical framework

WP 2: Advancing the comprehensive GK framework

WP 2.1: Development of a comprehensive local GK framework for solution of parallel mode structures and dispersion relation

WP 2.2: Further development of the local and global versions of the LIGKA code

WP 2.3: Extension to 3d geometry

WP3: Implementation, application and verification of reduced EP transport models

WP3.1: One-dimensional reduced models

WP3.2: Statistical analysis of test particle transport

WP 3.3 Extend HAGIS/LIGKA framework to calculate EP fluxes

WP 3.4 Fast ion transport model for RABBIT

WP 3.5 Hybrid kinetic MHD codes for verification and validation

WP 3.6 Fully gyrokinetic simulations for verification and validation: ORB5

WP 4. Selection of time-dependent reference cases

organisational changes since project start:

2021

Guo Meng 2.5 -> 1.0 PM
Alessandro Biancalani 2.5 -> 1.0 PM
Thomas Hayward-Schneider 0.0 -> 3.0 PM

2022

Guo 5 -> 4 PM
Alessandro 5-> 2.5 PM
Thomas 0.0 -> 3.5 PM

2023,2024 will be decided later.

WP 2.1/2.2 : final goal: use DAEPS/LIGKA as interchangeable building blocks for various transport models

EUROfusion

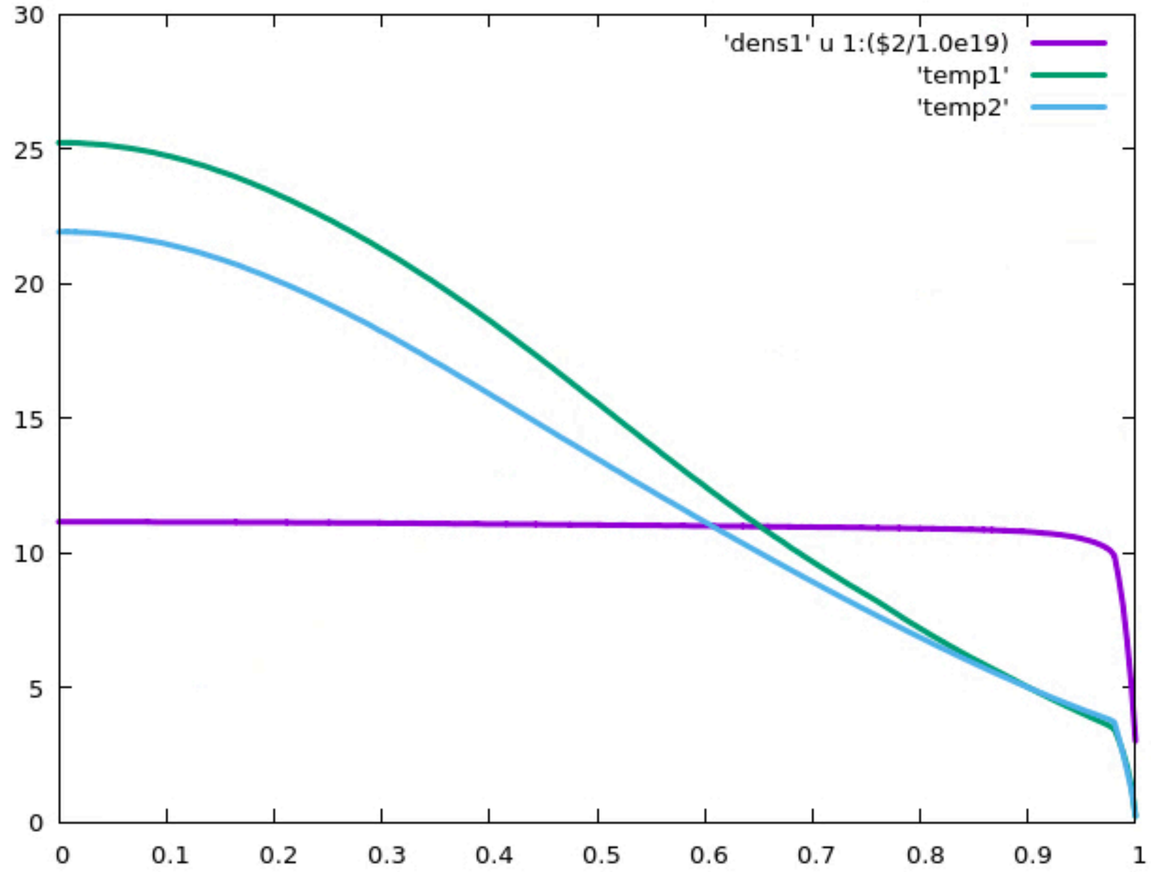
-what is a good benchmark for LIGKA and DAEPS?
  -analytical coefficients - dispersion relation - global modes
  -model EQ - start with circular shape ?
  -ITER/DTT/AUG?
  -which instabilities? low-f?
  -interesting case leading to a common paper

decision: AUG circular/ ITER 15MA circular - slab ITG/AITG transition i.e. beta scan at moderate mode numbers, & BAE [Philipp will prepare circular equilibria + profiles]

-is there common development possible/sensible for trapped particles?

considerable progress for DAEPS - speed up/interpolation; benchmark of various methods in 2022

-define ingredients needed from DAEPS and LIGKA for reduced transport models - do we have all levels of cost vs. fidelty? IMAS issues? how to calculate particle response averages?
Matteo et al to start python based project - implement Qualikiz-type,Kick-model type ansatz first;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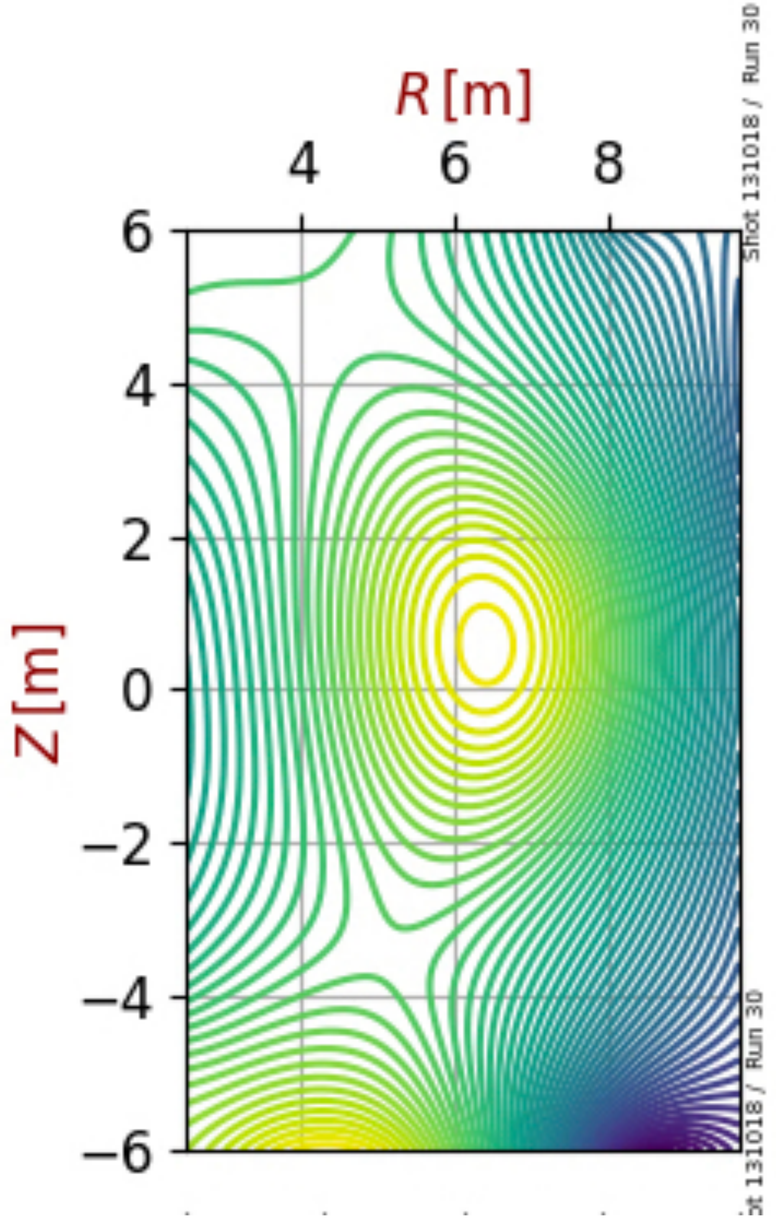
R [m]
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Z [m]
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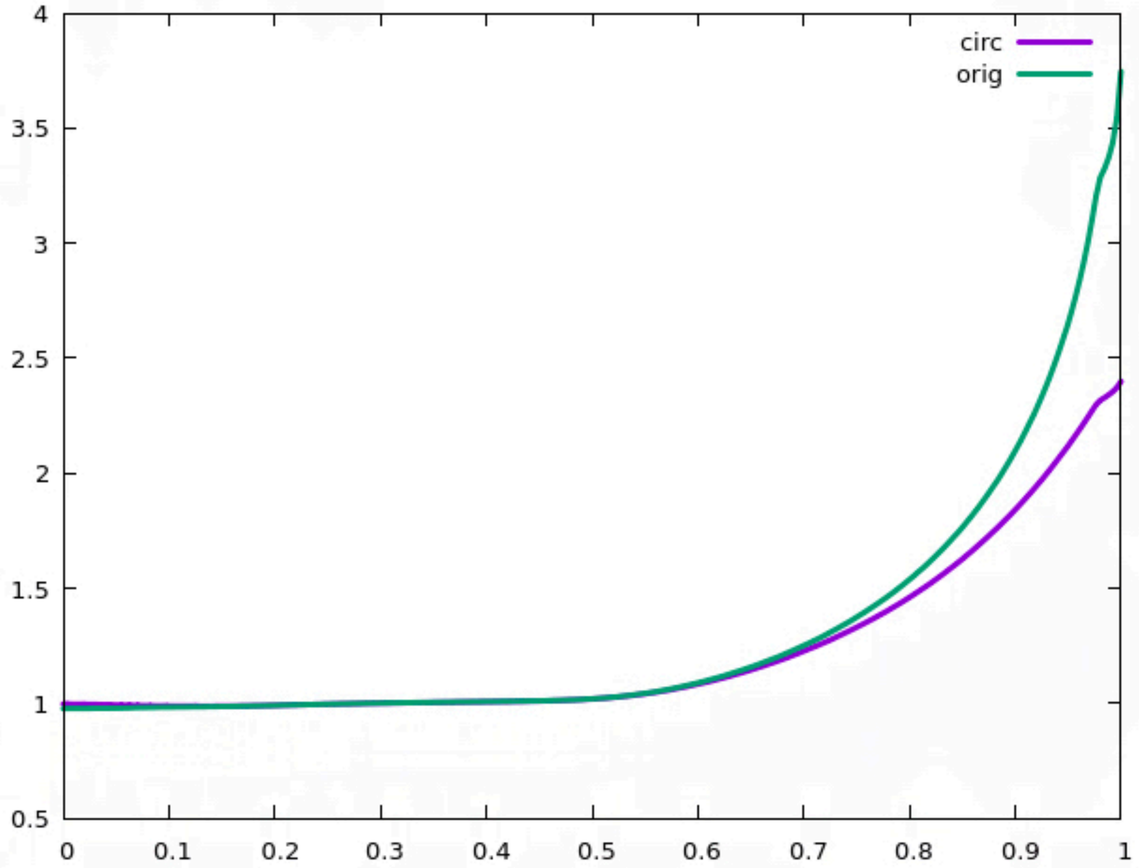
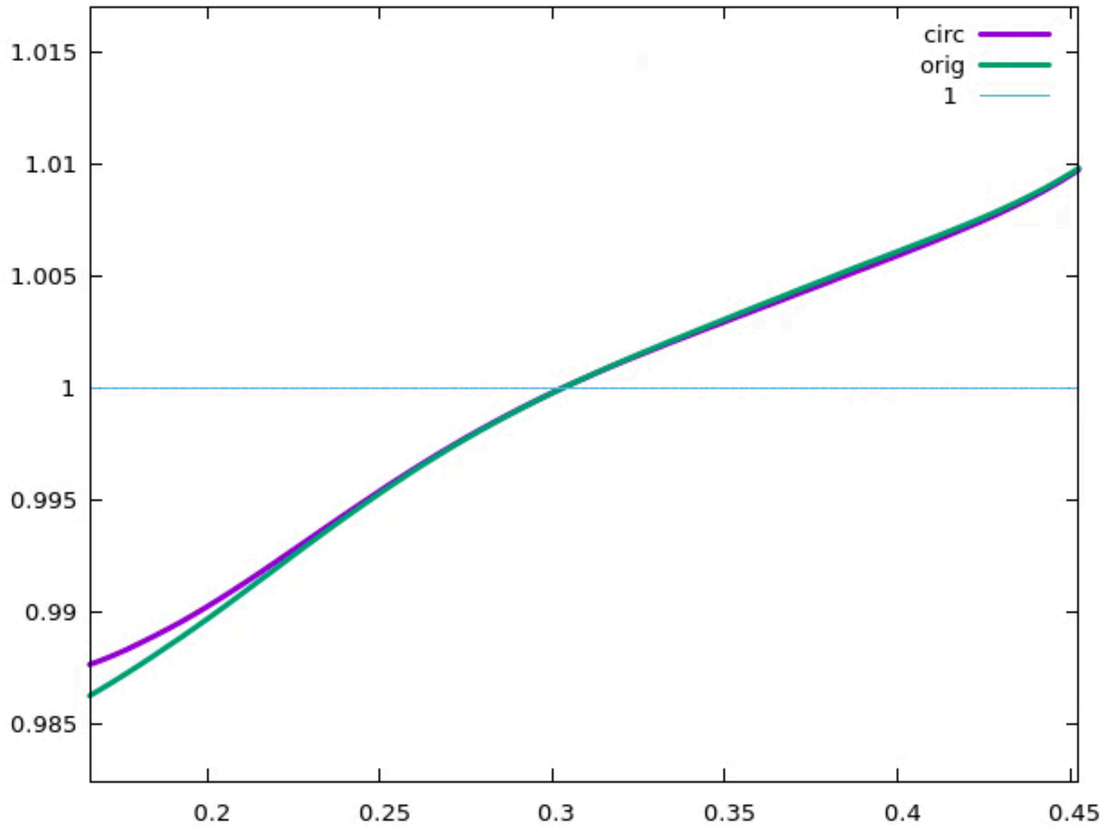
Shot 131018 / Run 30
Shot 131018 / Run 30

circular ‘clone’: a=2m

equilibrium_in%time_slice(itime)%global_quantities%ip divided by 1.76





helena GG:
<run_out>9</run_out>
<user_out>lauberp</user_out>
<machine_out>helena_test</machine_out>

match in q and shear close to rat. surface

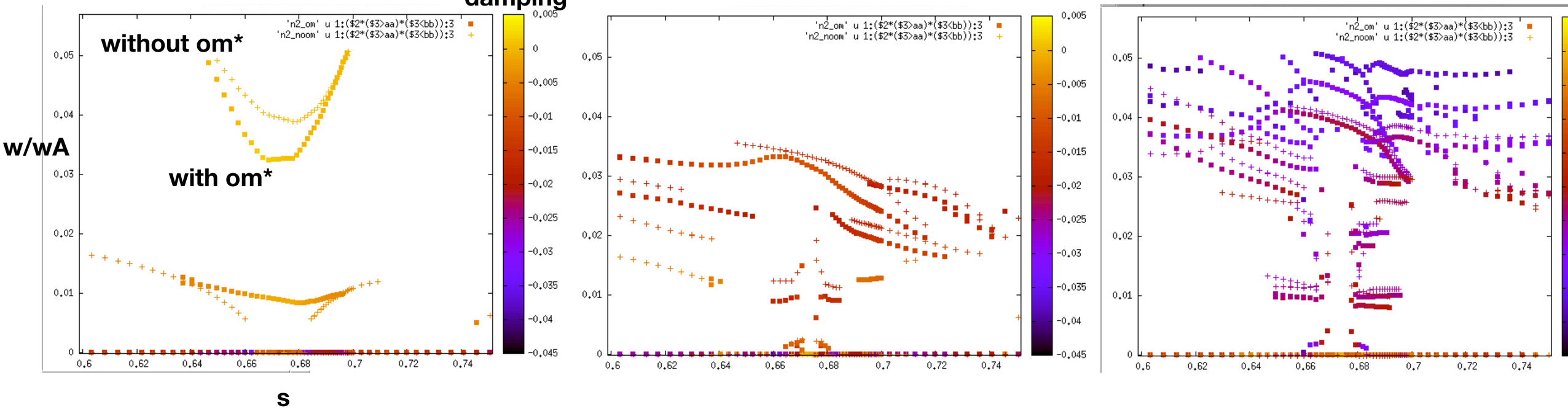
proposed scans: run n=10-20, with, w/o om_star, scan beta by scanning Ti

for AUG NLED: https://pwl.home.ipp.mpg.de/NLED_AUG//data.html

EUROfusion

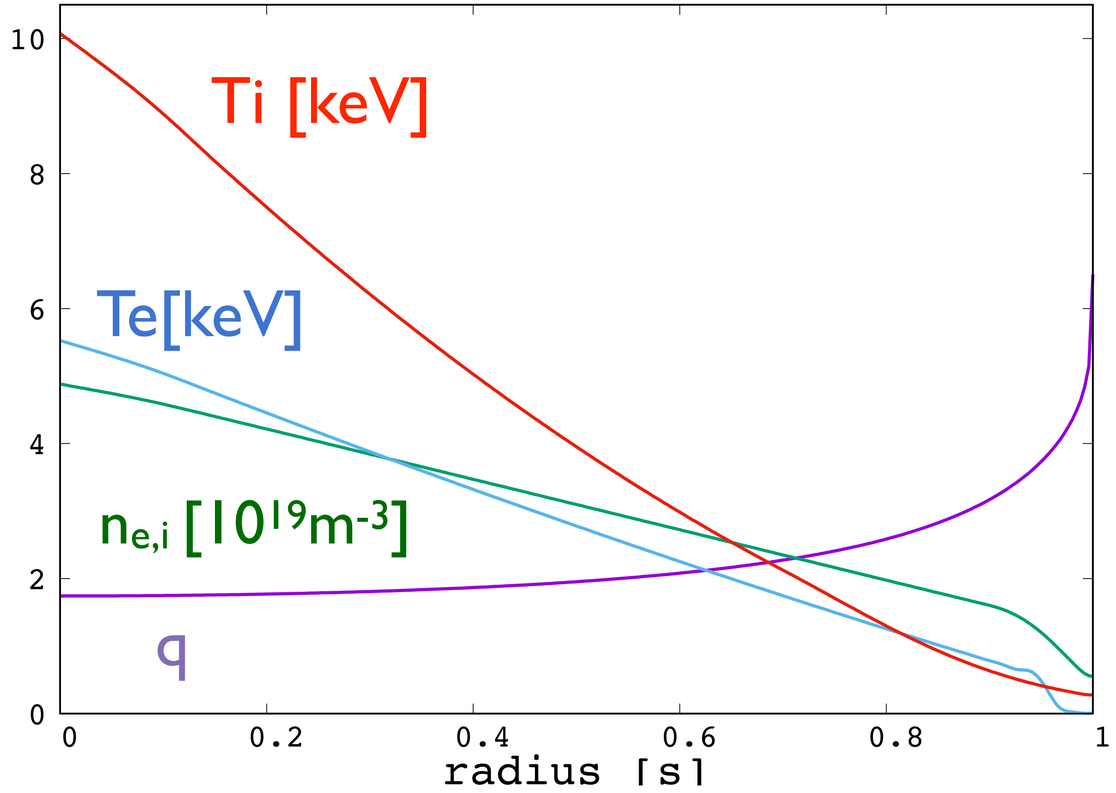
circular boundary given on web-page
q=2.5 surface at s=0.672: scan n=1-10, scan Ti; here: AUG case based on EQDSK file given by Gregorio

damping

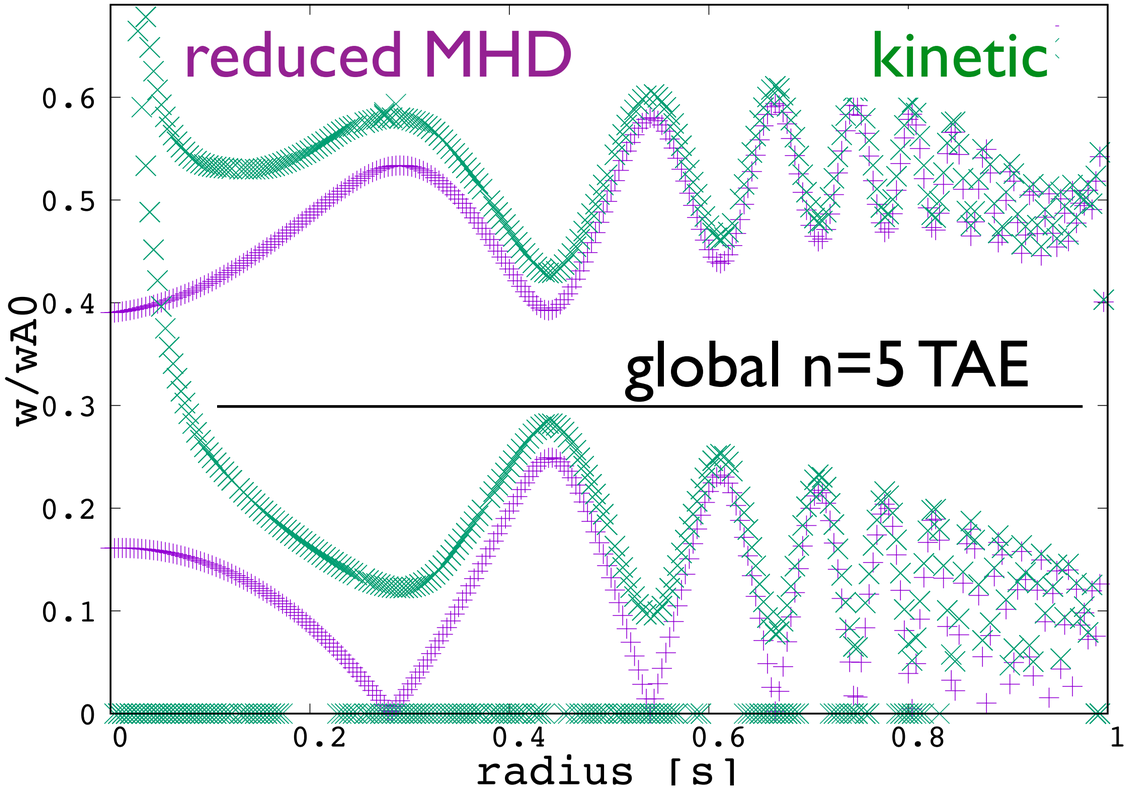


improve analytical model for LIGKA: JET case

similar to [M Fitzgerald et al in prep 2021]



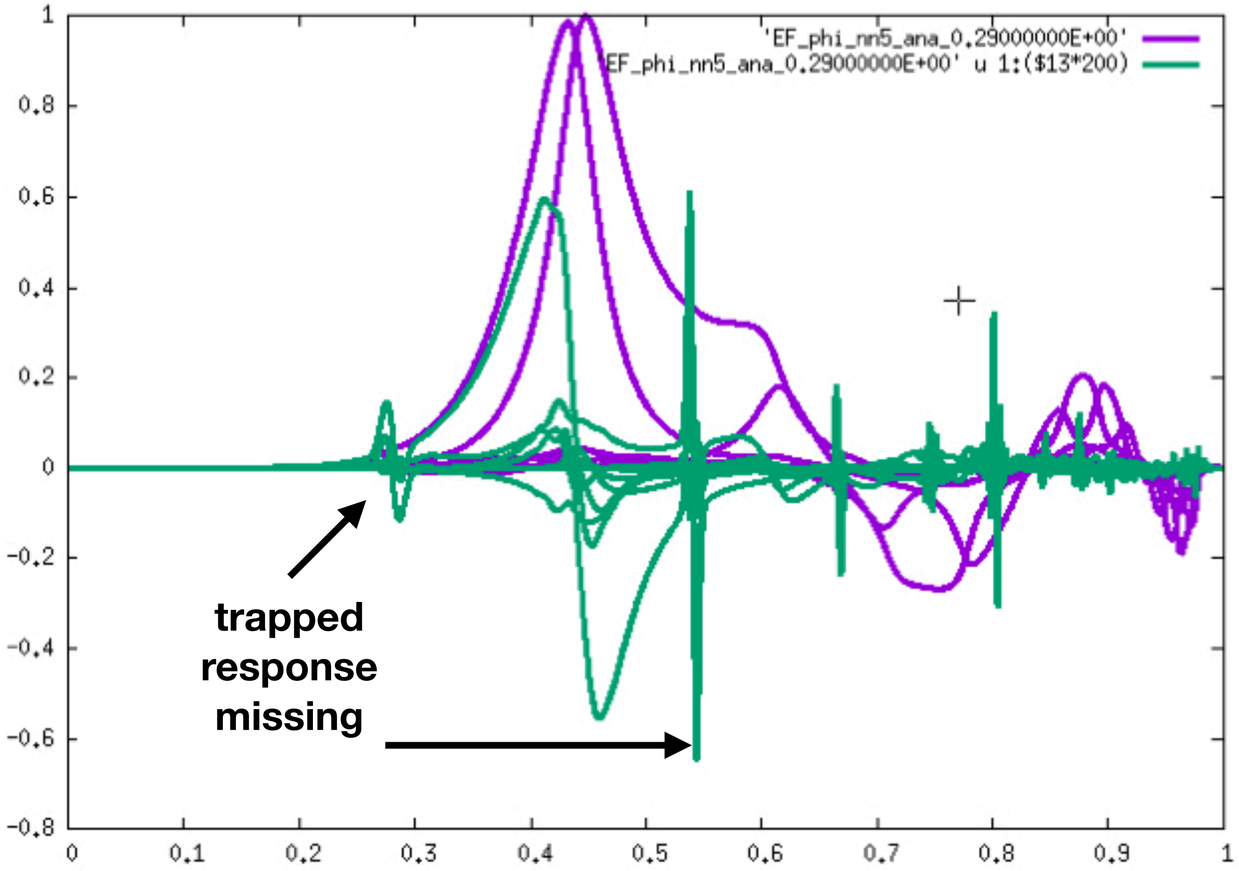
B0=3.4, R0=2.97m



JET-like case: elevated q case as candidate for DT scenario

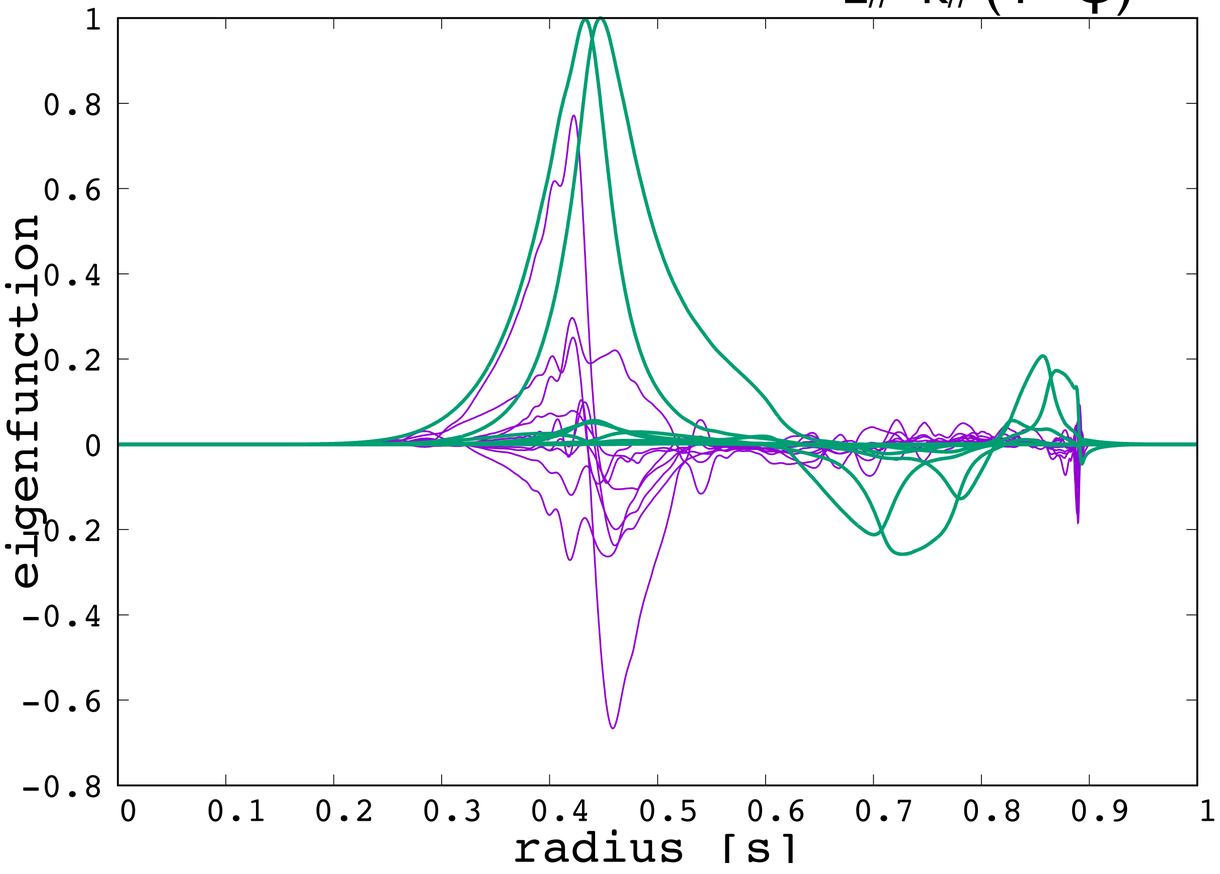
compare analytical- numerical

e.s. potential
$E_{//}$ x 200



e.s. potential
$E_{//}$ x 200

$E_{//}=k_{//}$ (Φ- ψ)



γ/ω =(all analytical) -0.451214520693625 [%] fully kinetic: γ/ω = -0.87% (ion LD+all el)

JET-like case: analysis of mode structures

adding step by step electron resonances:
no electron LD damping:

γ/ω = -0.16% (ion LD)

adding circulating k=0 resonance:

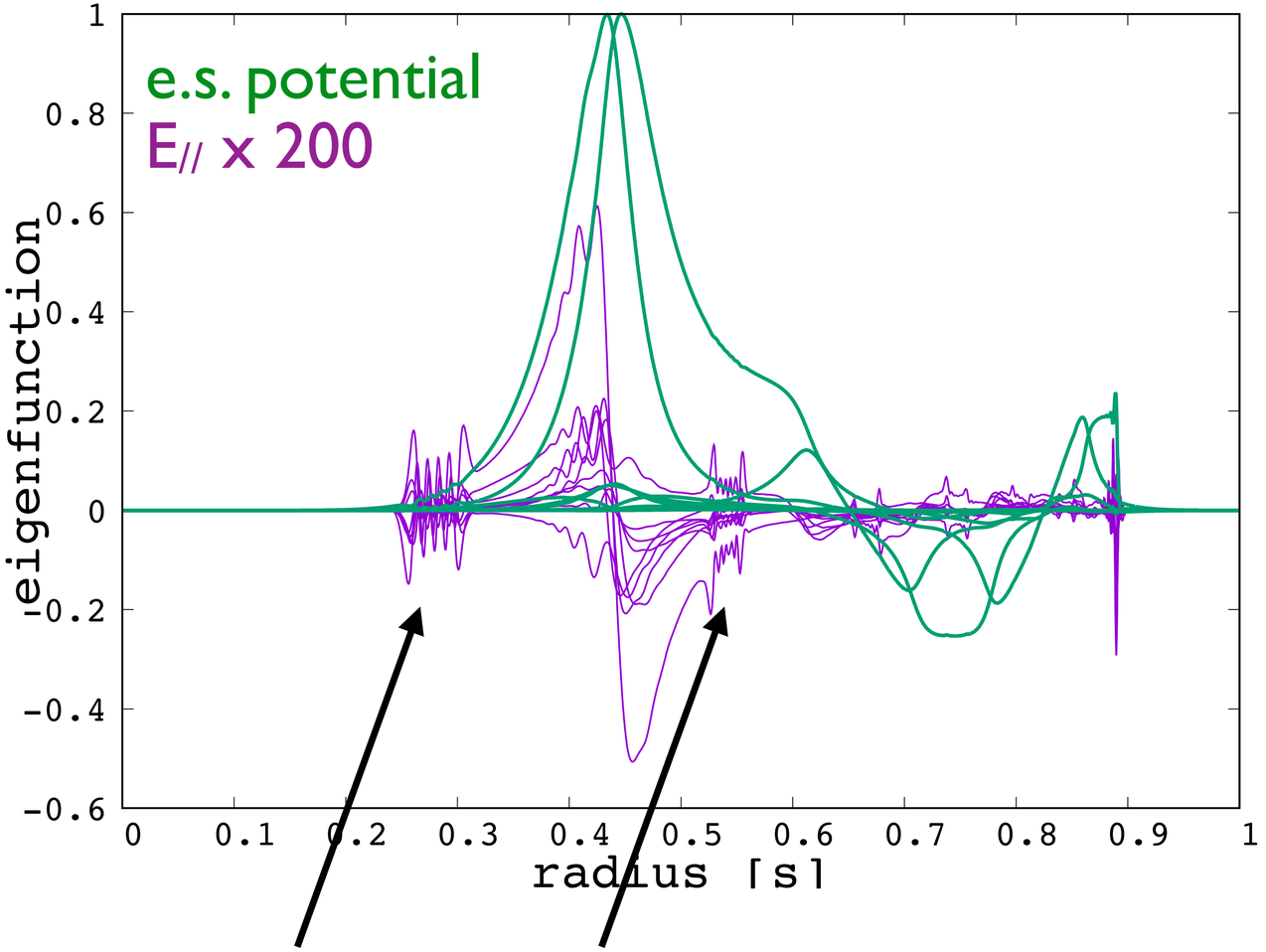
γ/ω = -0.67% (ion LD+circ el)

adding circulating k=±1 sidebands:

γ/ω = -0.77% (ion LD+circ el+sb)

adding trapped electrons:

γ/ω = -0.87% (ion LD+all el)



missing trapped electrons lead to weakly damped region close to k//=0

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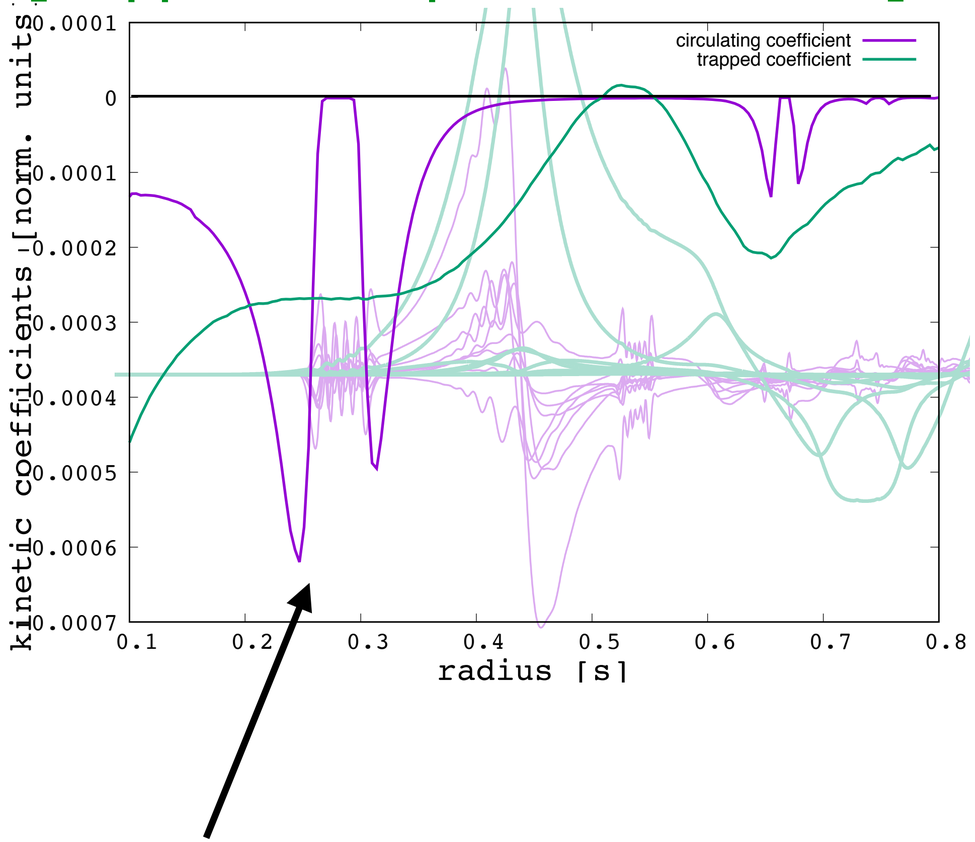
Im[circ. el response coefficient]
Im[trapped el response coefficient]



missing trapped electrons lead to weakly damped region close to k//=0 - non-local, non-perturbative effects are crucial

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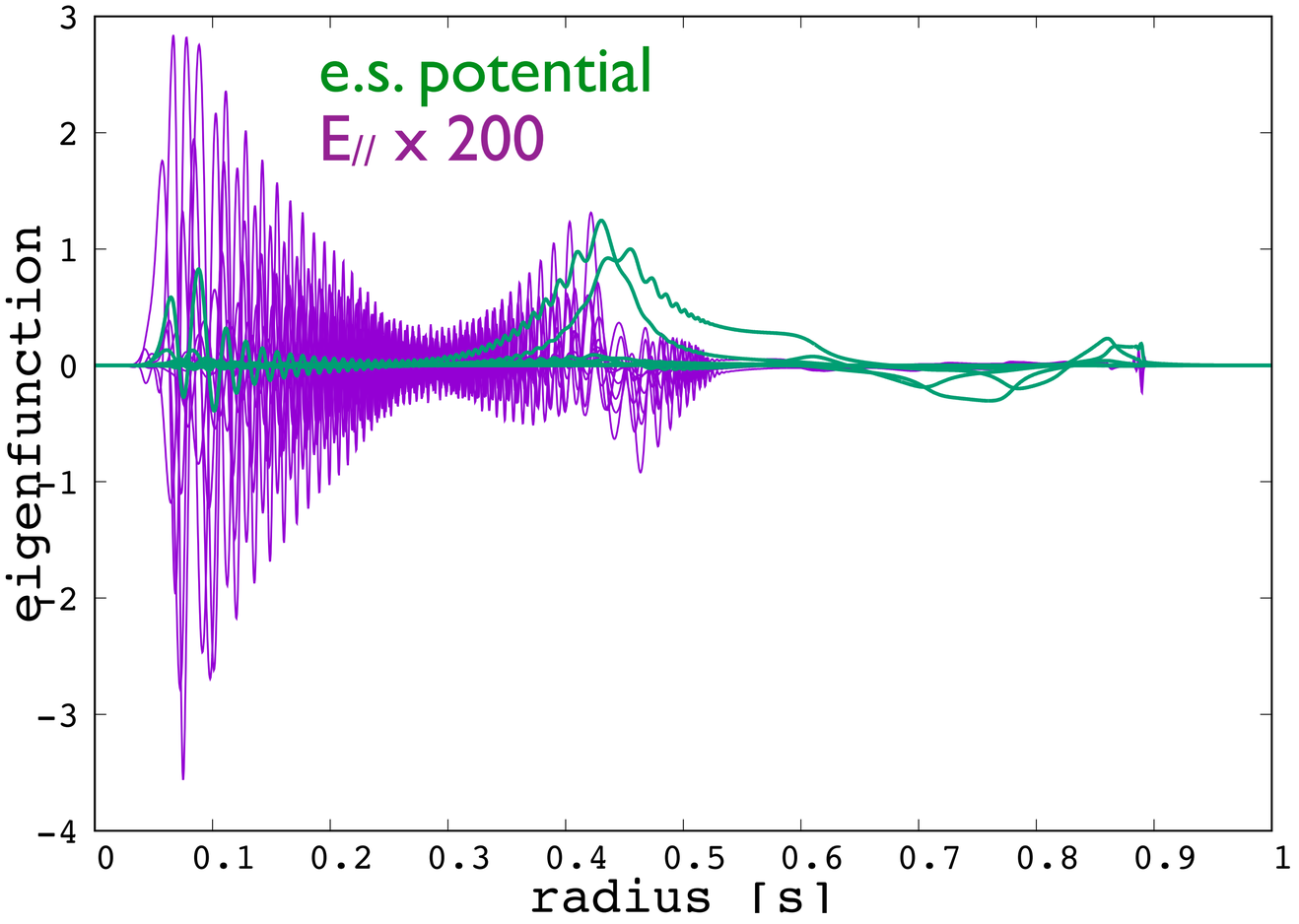


almost undamped KAW - in agreement with theory

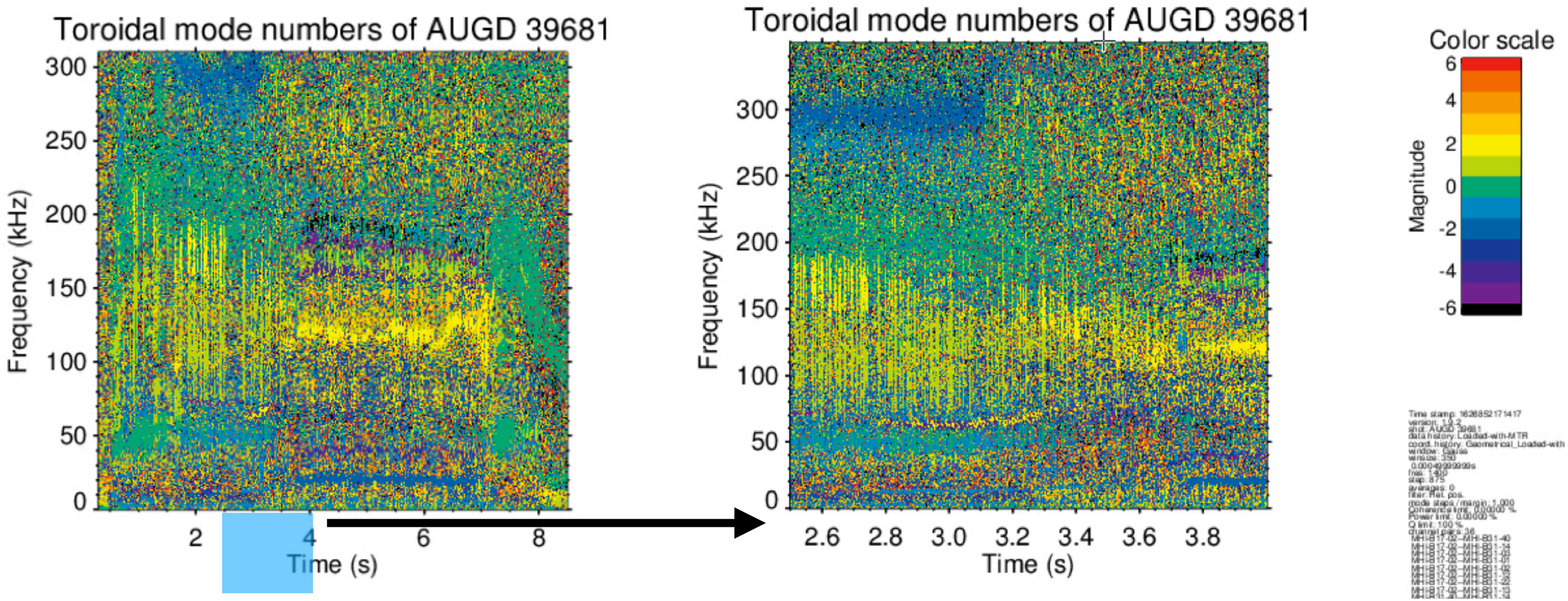
WP2.2-M2: estimate analytical mode structures:

- work on analytical mode structure ‘guess’ started -PhD V.A. Popa

test and verify for many scenarios/time points (WF-LIGKA)

presently porting, producing data-base of global modes, memory issues, etc..

record-low n with 5MW 93keV off-axis beams -plasma dominated by EPs and related modes
Hydrogen campaign, July 2021

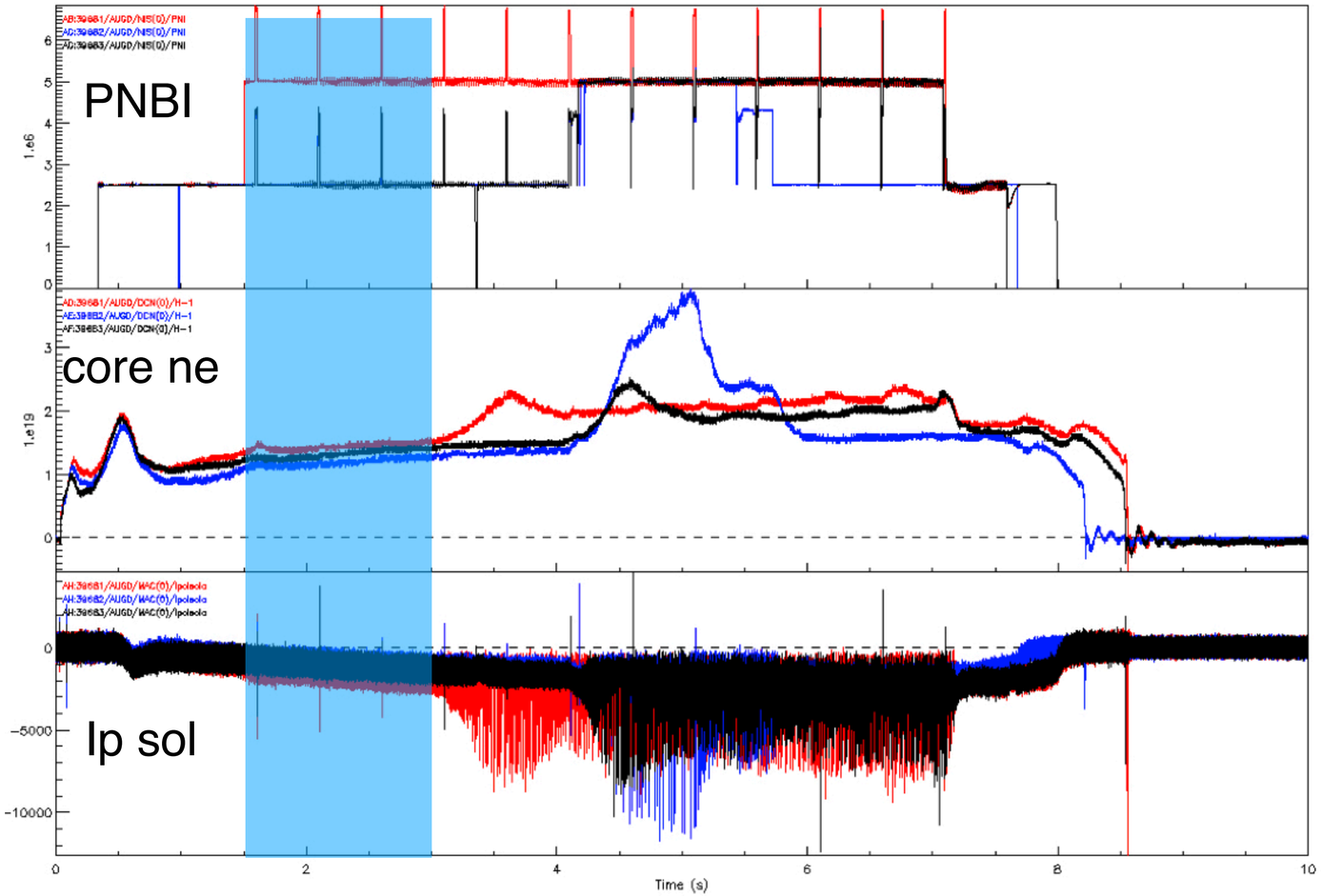


- activity has similar patterns as NLED base case (EGAM/BAE/TAE intermittent crashes, #31213) - but now in flat top phase with transport analysis possible…
- new: n=2 edge AE at 300kHz - not NBI driven - disappears during L-H transition

3 discharges: 39681,82,83 - technically fine, thx to Marc, Markus, Philip!

- beam box 1: H - measurements, control core Ti
- beam box 2: D - drive instabilities

in all discharges: 55-60% H/(H+D)



- first discharge as planned - good data
- lower densities in 2nd discharge caused beam modifications
- ‘fixed’ in 3rd discharge by slightly increased H puffing

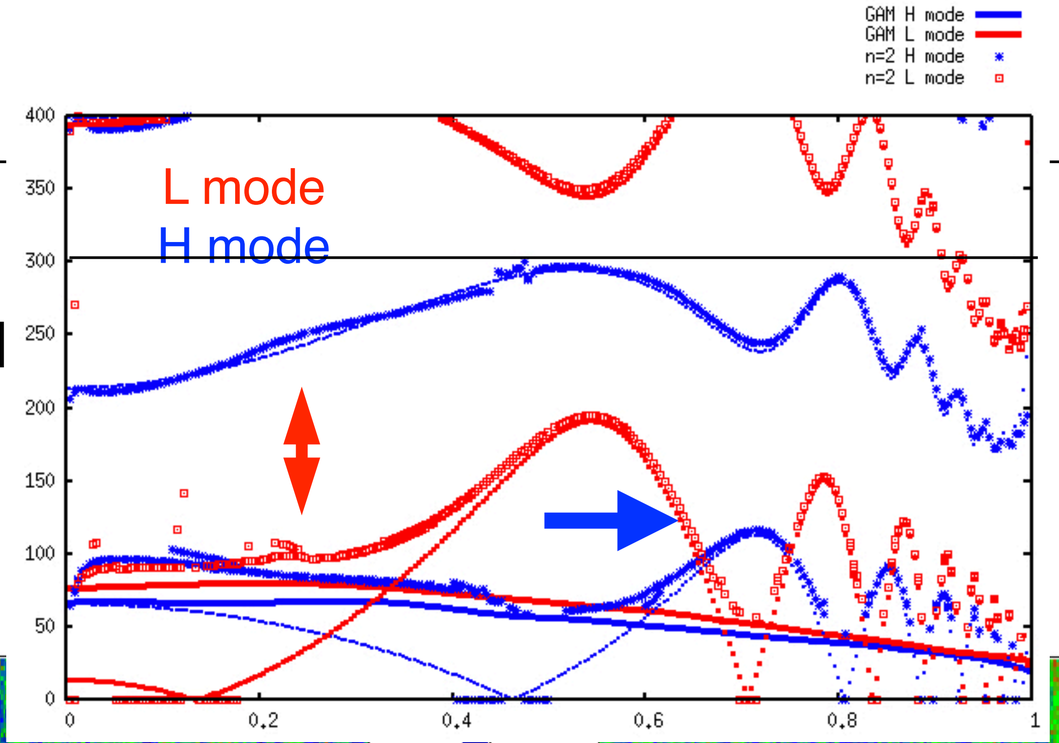
despite low H/(H+D) we have L mode phase with 5MW NBI - most interesting phase (& diagnostics availability)

MHI, SXR,RFL,ECEI,FILD,CXS,… thanks Branca, Rachel, Jose, Roman,Vladimir, …

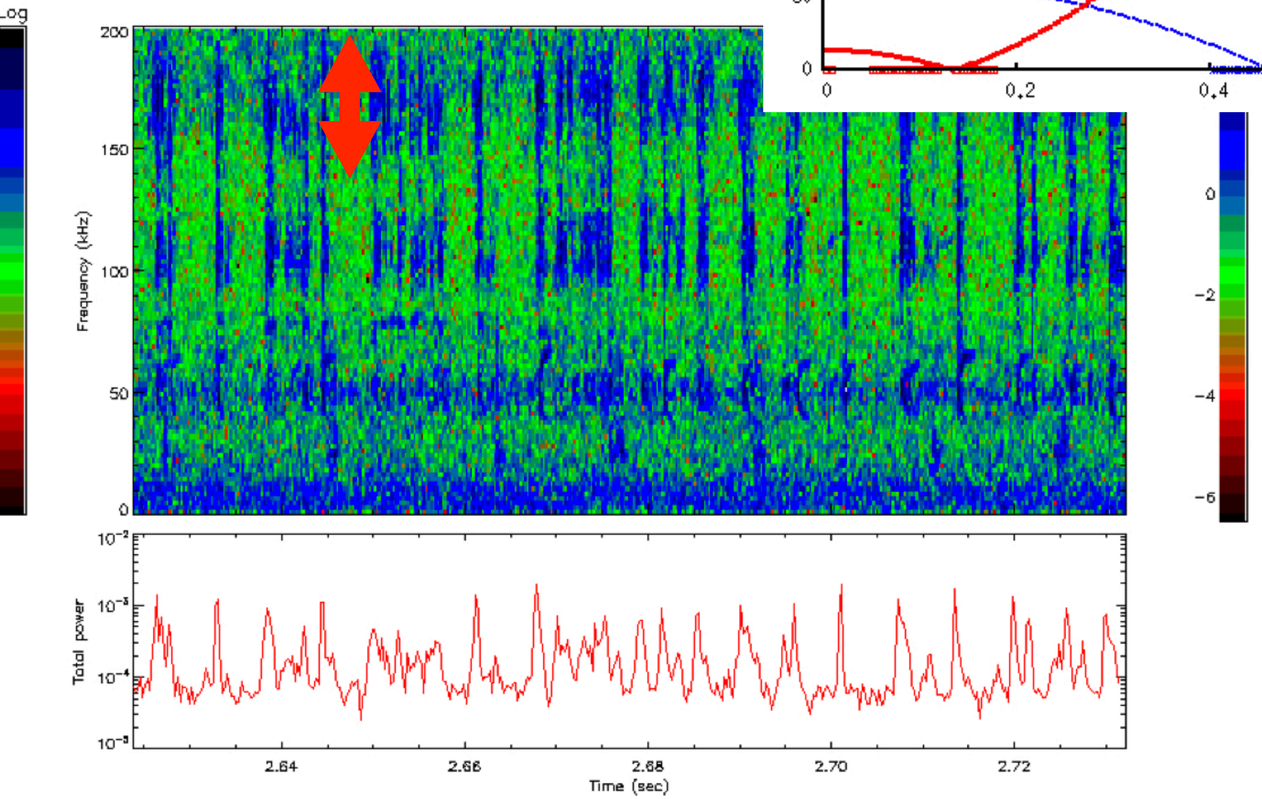
n=2 analysis

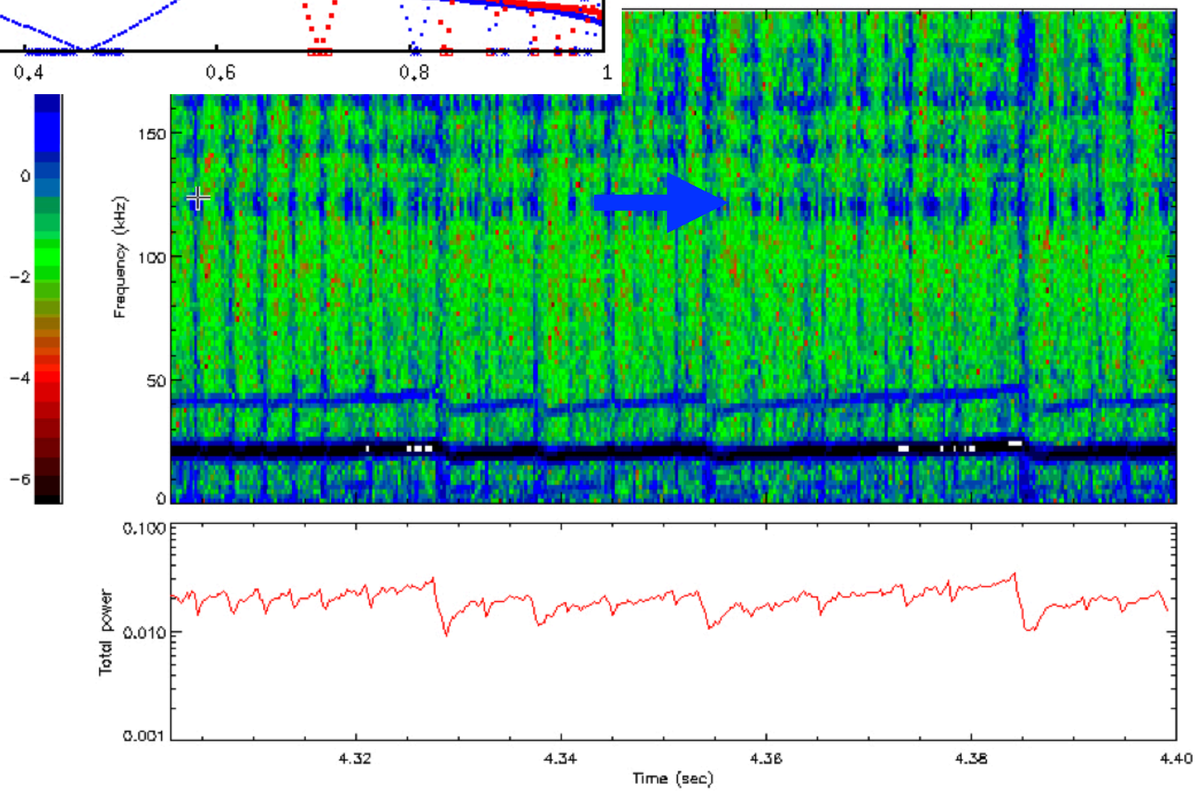
using new IMAS EP LIGKA/HAGIS workflow on gateway thx G. Tardini!

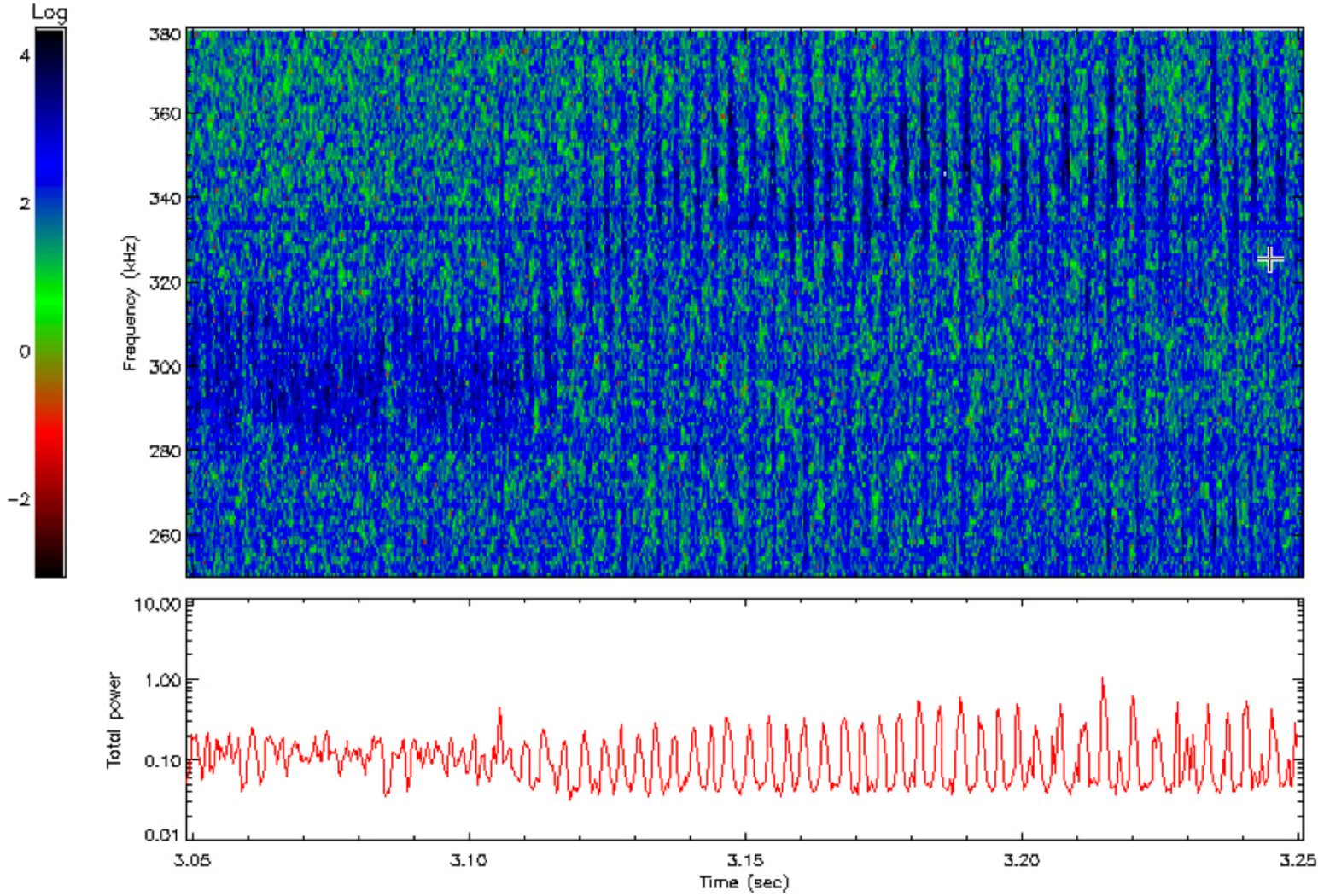
fA[kHz]



modelling of EP transport during transition






Log
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Frequency (kHz)
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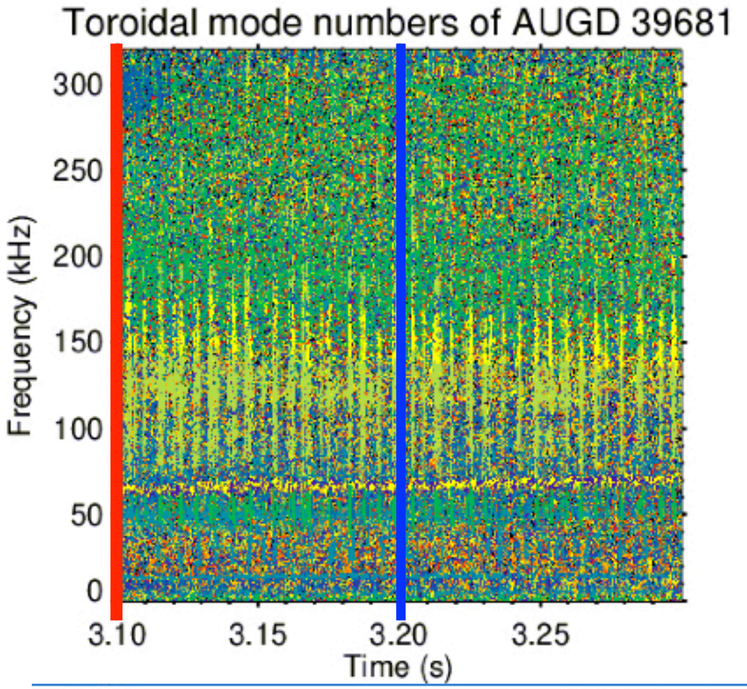
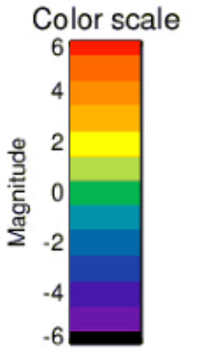
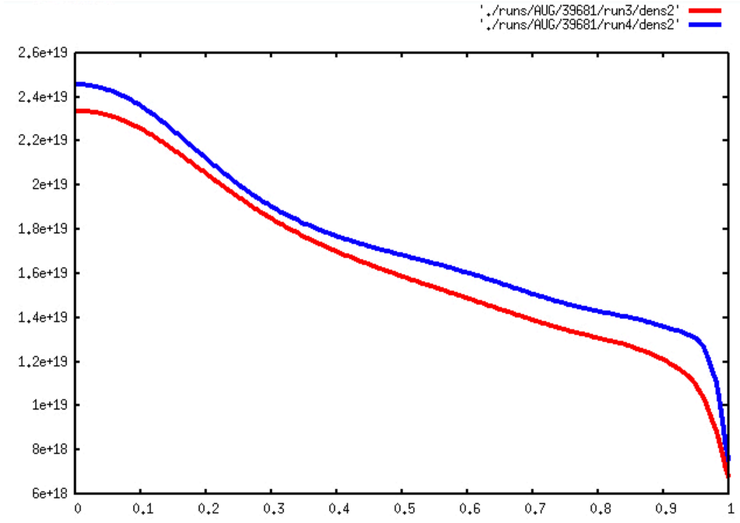
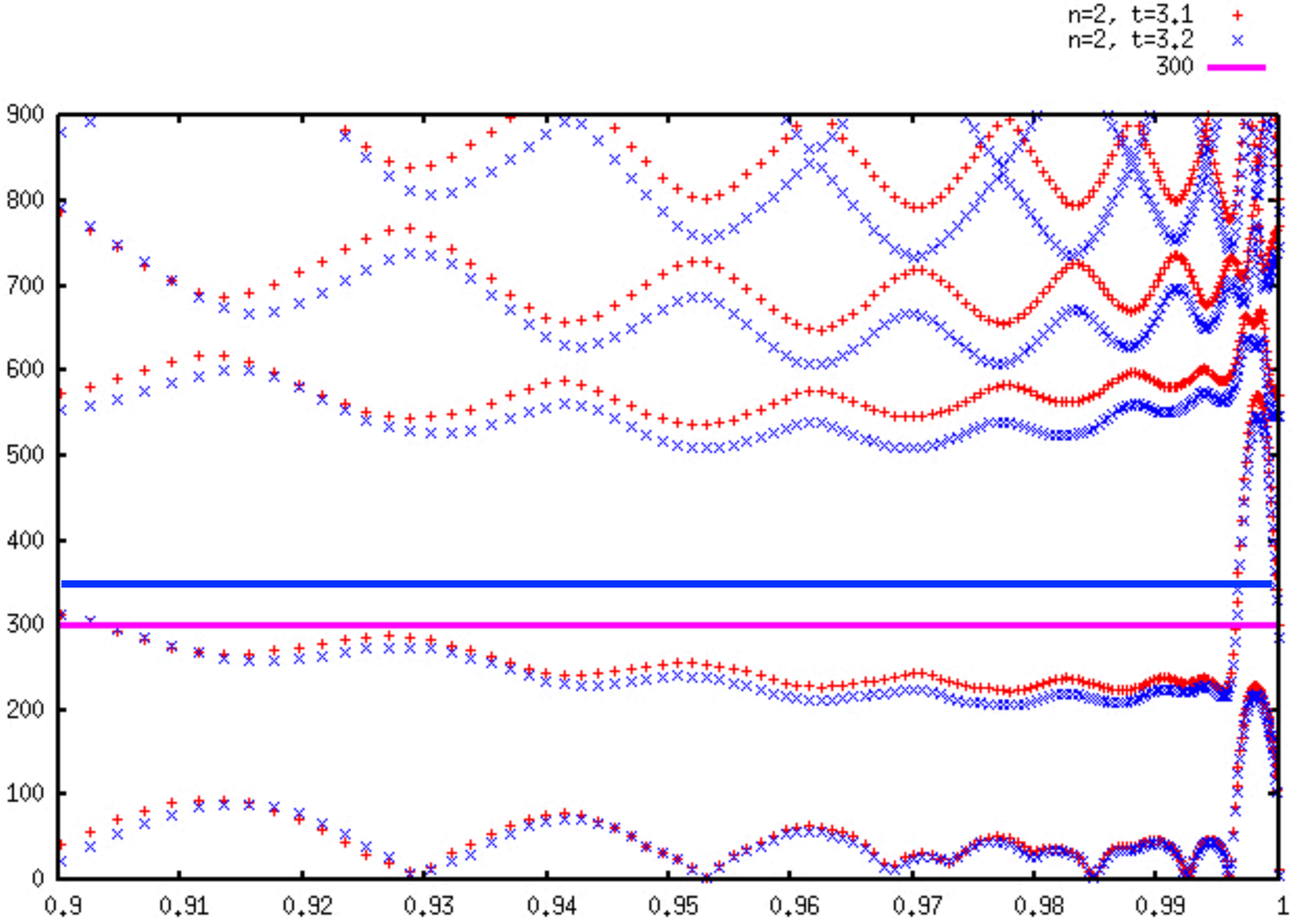
1.00
0.10
0.01
Total power
3.05
3.10
3.15
3.20
3.25
Time (sec)
AUG Shot: 39681 : 5XB : L052 npts: 404250
Time: 3.048 to 3.251 frq: 250.0 to 380.0 nfft: 2048 npad: 0 nstp: 512 nrms: 1000 ncor: 200

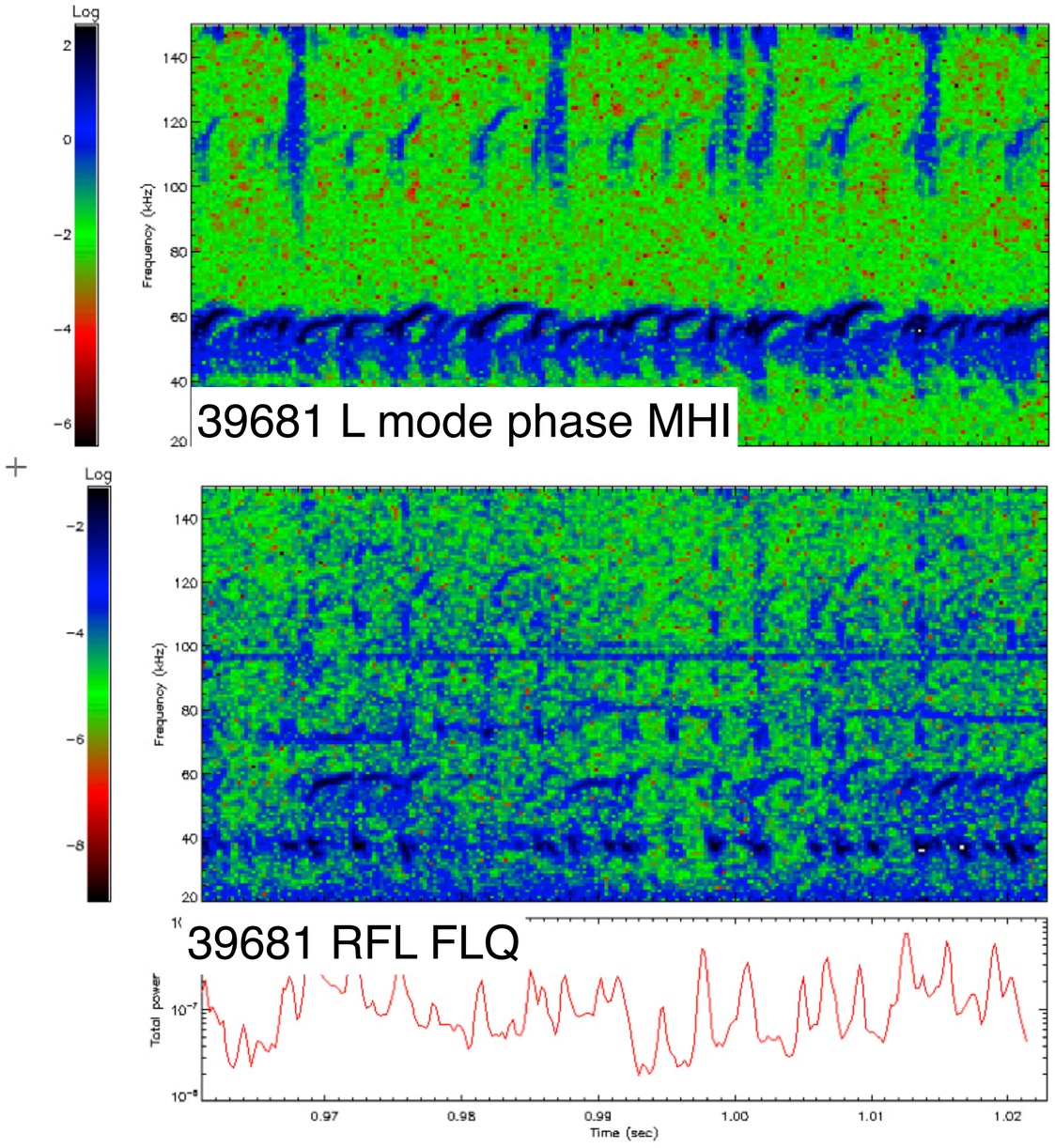
damping for n=2 is not changing in 100ms time window - drive must vanish!











comparison of magnetic and reflectometry reveals radial structure of EGAM band [similar to Horvath 2016]

bonus:

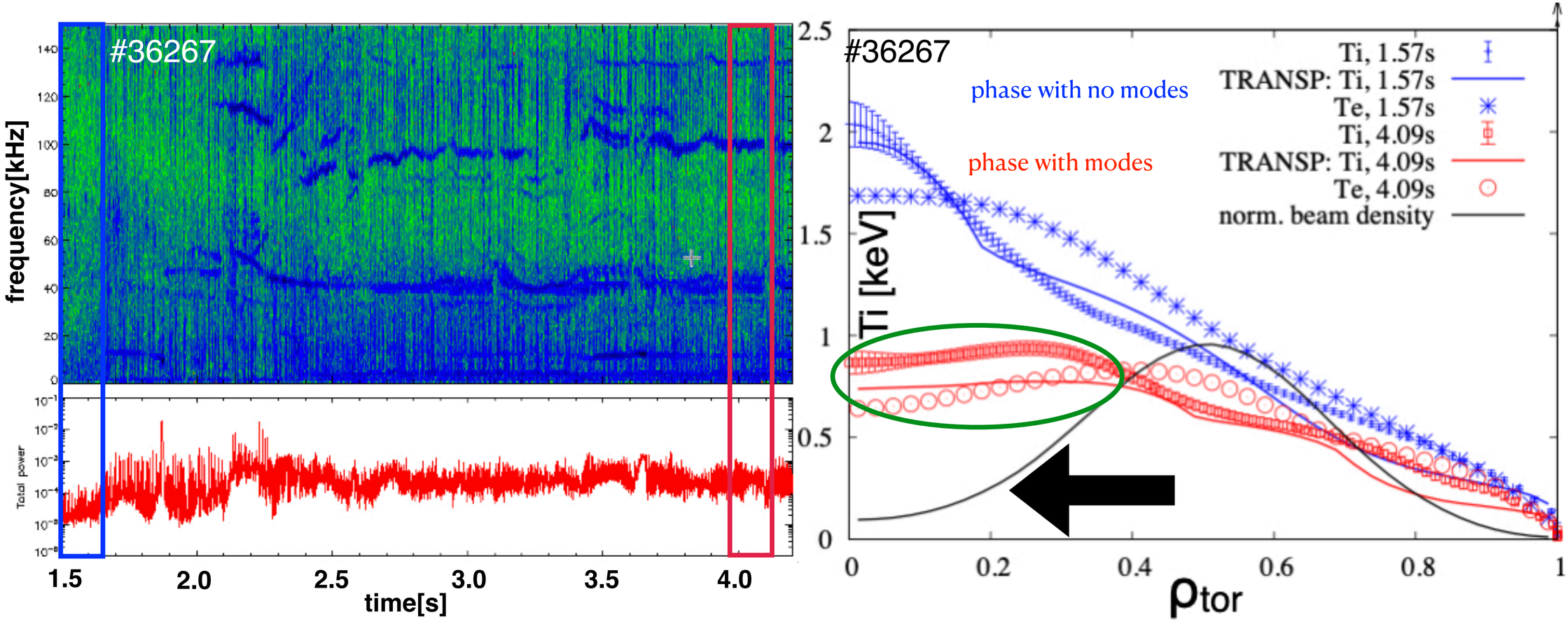
- FILD measurement, despite non-optimised shape [J. Rueda]
- high-f mode visible throughout discharge 39681 (17MHz), in particular during low-n/ L-mode phase [R. Ochoukov]

WP 4: experiments suitable for time-dependent transport studies; influence of EP transport on background profiles

motivation: impact of EP-driven modes on self-organisation

FIDA measurements show clear EP redistribution

potential evidence for anomalous core background ion heating due to Alfvénic modes?



control mode activity with on/off-axis heating mix