



ATEP progress meeting 22.11.2023

ENR ATEP: https://wiki.euro-fusion.org/wiki/Project_No10

<https://indico.euro-fusion.org/event/2848/>



ATEP progress meeting



Wednesday 22 Nov 2023, 10:00 → 12:30 Europe/Berlin

Description <https://eu02web.zoom-x.de/j/6025051719?pwd=ZFhRdjdWVjUyMVZVZWVaRkladjFDQT09>

- | | | | | |
|-------|---------|---|-------|---|
| 10:00 | → 10:10 | ATEP news | 🕒 10m | ✎ |
| | | Speaker: Philipp Lauber (IPP) | | |
| 10:10 | → 10:30 | tbd | 🕒 20m | ✎ |
| | | Speaker: Nakia Carlevaro (ENEA, C. R. Frascati, Fusion and Nuclear Safety Department (TSM)) | | |
| 10:30 | → 11:00 | Recent STRUPHY developments | 🕒 30m | ✎ |
| | | Speaker: Byung-Kyu Na | | |
| 11:00 | → 11:30 | A model for Alfvén-eigenmode-induced transport of fast ions in stellarators | 🕒 30m | ✎ |
| | | Speaker: Christoph Slaby (IPP) | | |
| 11:30 | → 12:30 | short reports and discussion | 🕒 1h | ✎ |

- please use ATEP HPC resources on Marconi (till Feb. 2024)
- interest in ATEP from ITER side - discussion with Simon/ Guillaume next Friday
- starting work with TSVV11 and DEMO - start on technical level
- interest from JET - discussions started (+TSVV10)

- annual report: due date 31.12.2023
- **action item: check if all publications/conferences are on pinboard**

- Matteo and myself will draft report by Dec 8th
- comments/corrections via email by Dec 15th
- final version Dec ~20th
- usual style
- it was explicitly asked that executive summary has to be generally understandable (outside Eurofusion community)

„The Executive Summary should concisely state the most important conclusions and achievements. The text should be usable as a stand-alone document (max. 1/2 page), as it is going to be a part of the technical report submitted to the commission. Please, also avoid un-spelled abbreviations in this section (as this aspect was already criticized by the commission last year).“



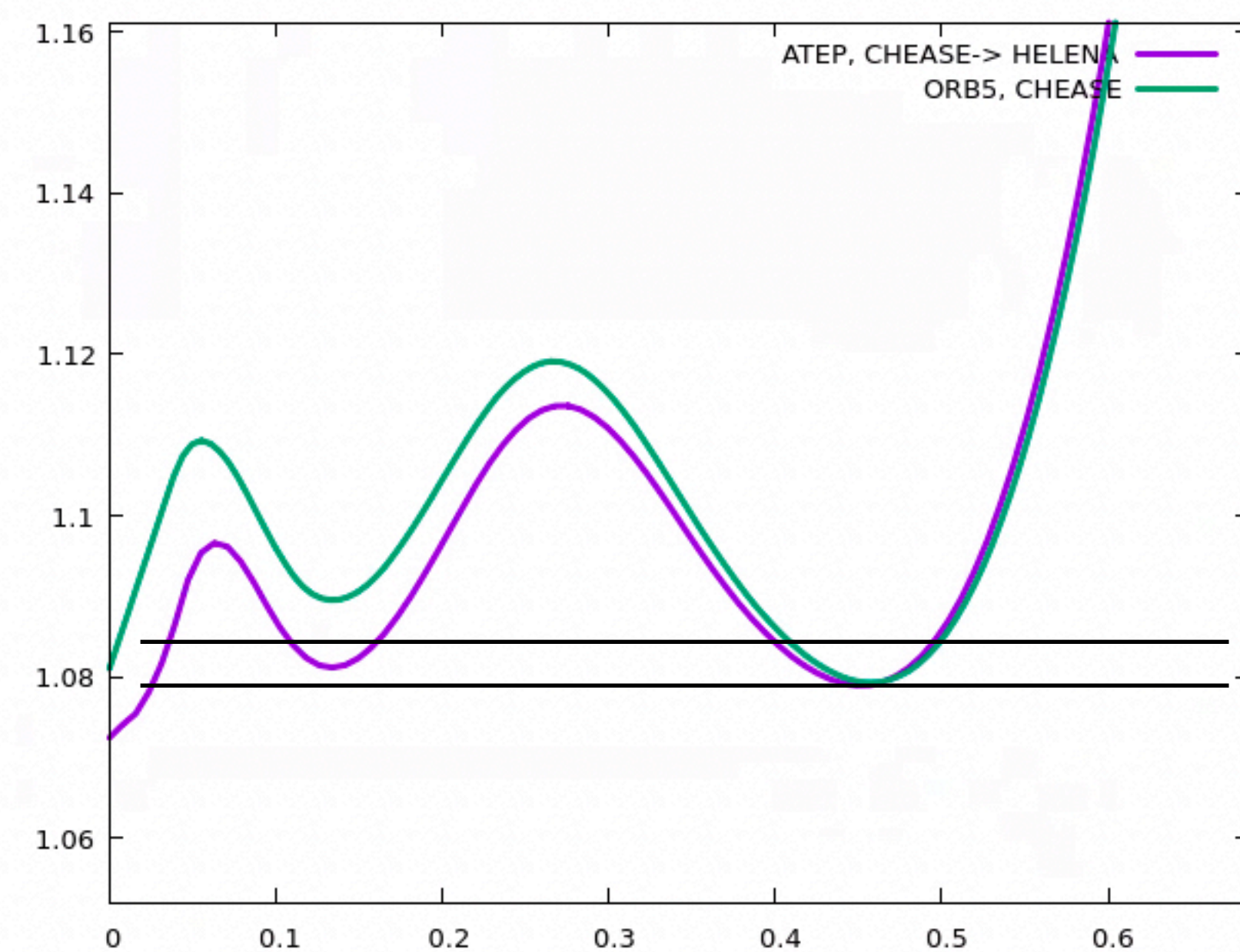
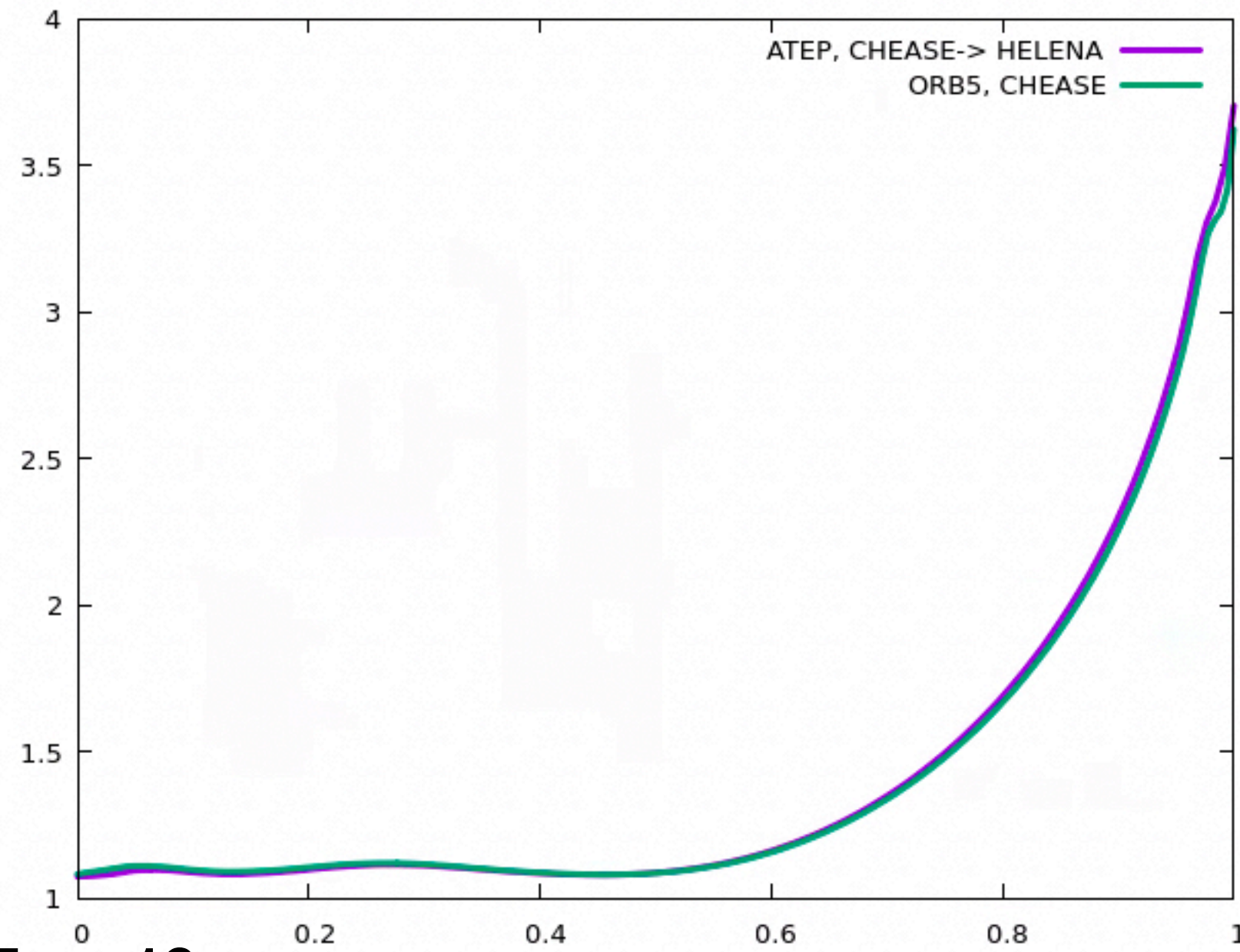
ORB5-LIGKA PSZS comparison is improving!
status and open issues



[T Hayward-Schneider,
FEC 2023]

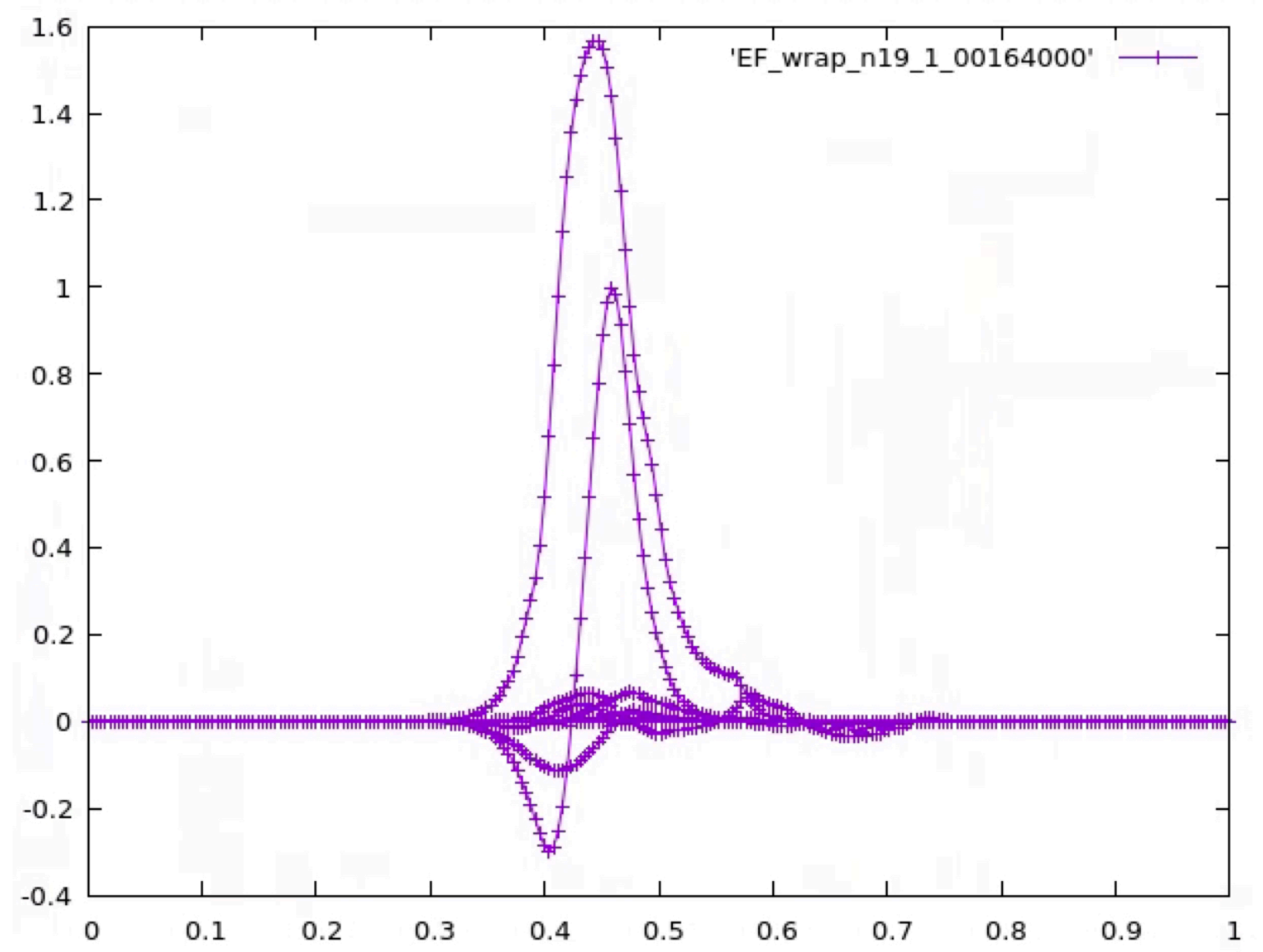
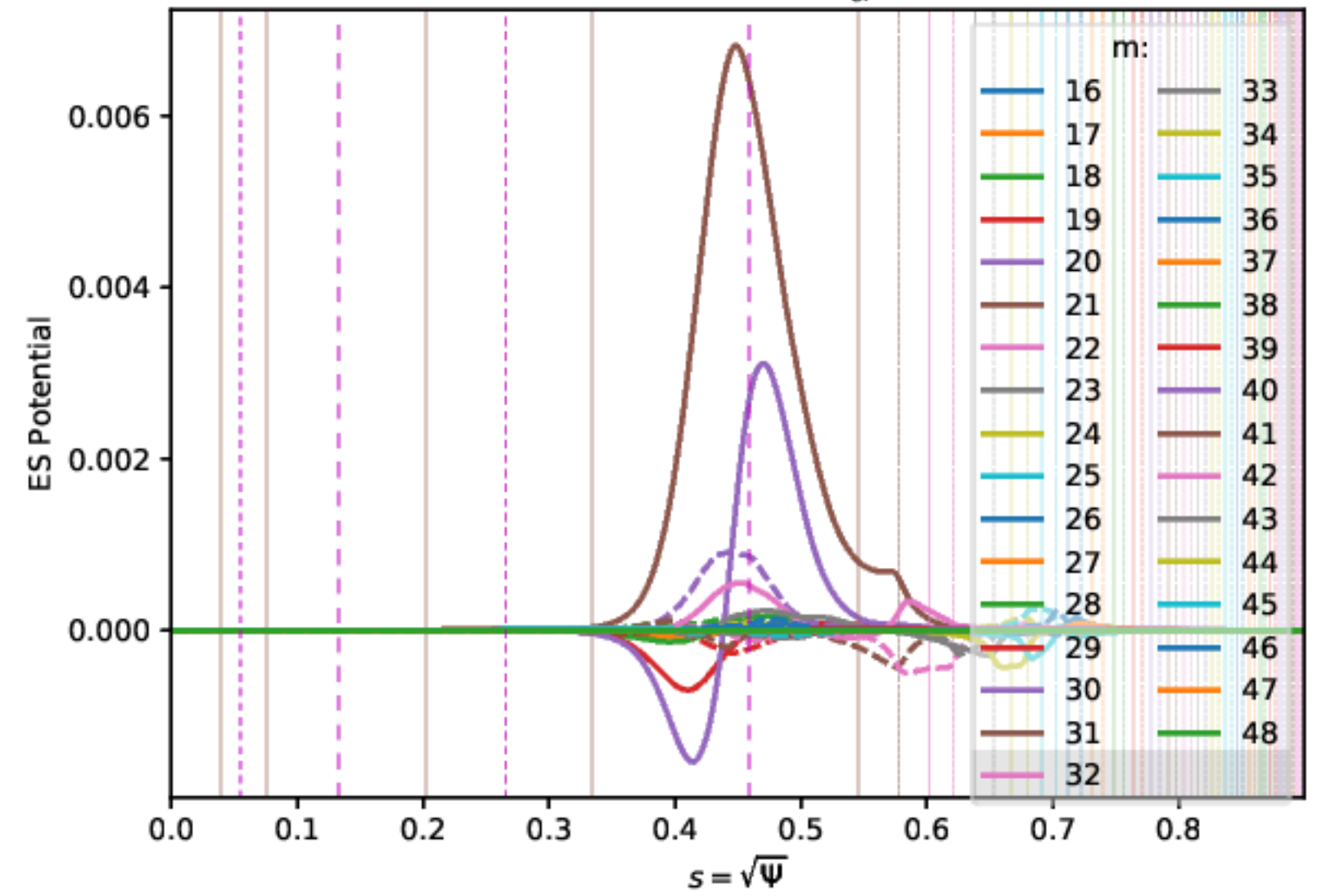
2 NBI beams: on-off

$q=q_{TAE}(n=18)=19.5/18=1.0833$
 $q=q_{TAE}(n=19)=20.5/19=1.0789=q_{min}$



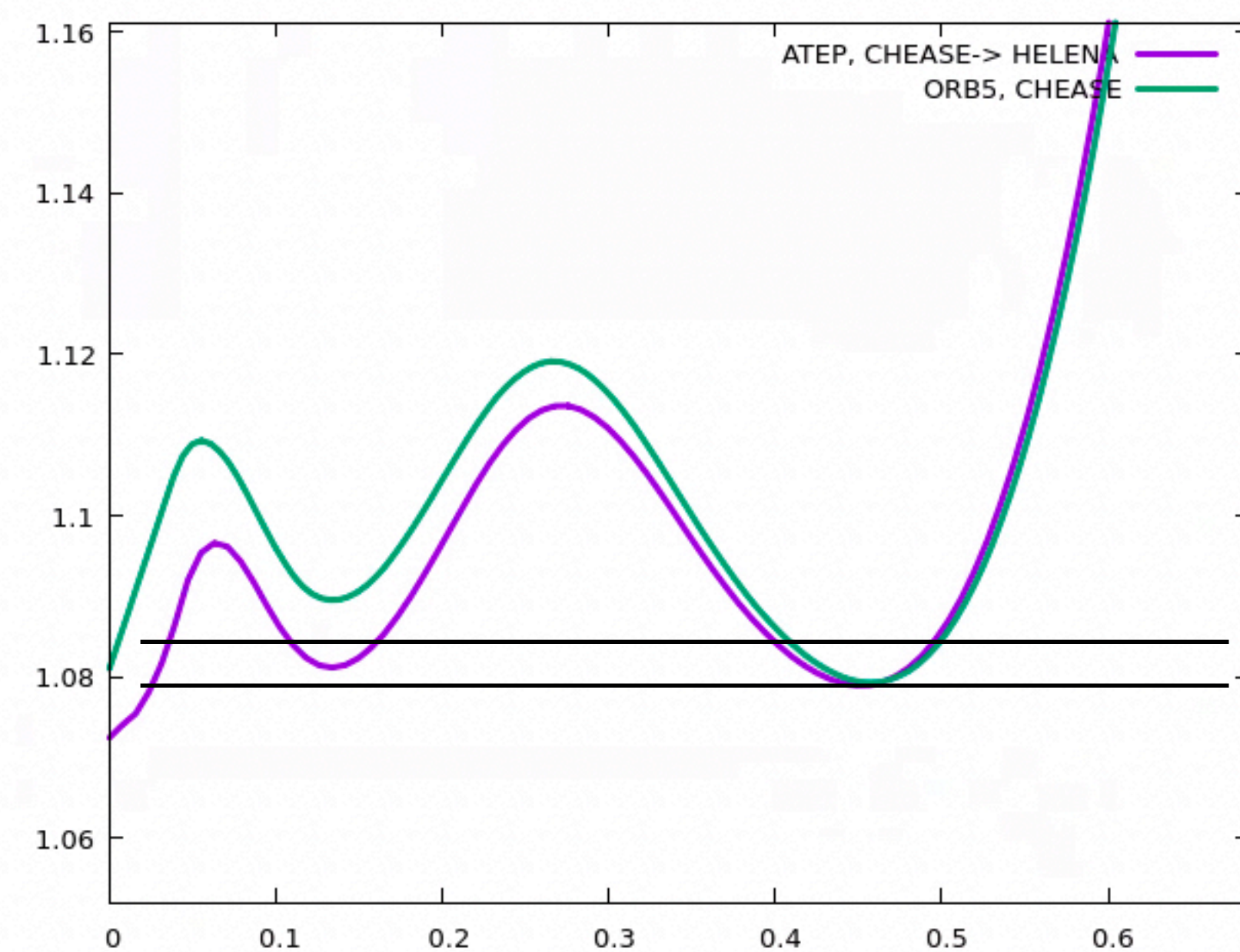
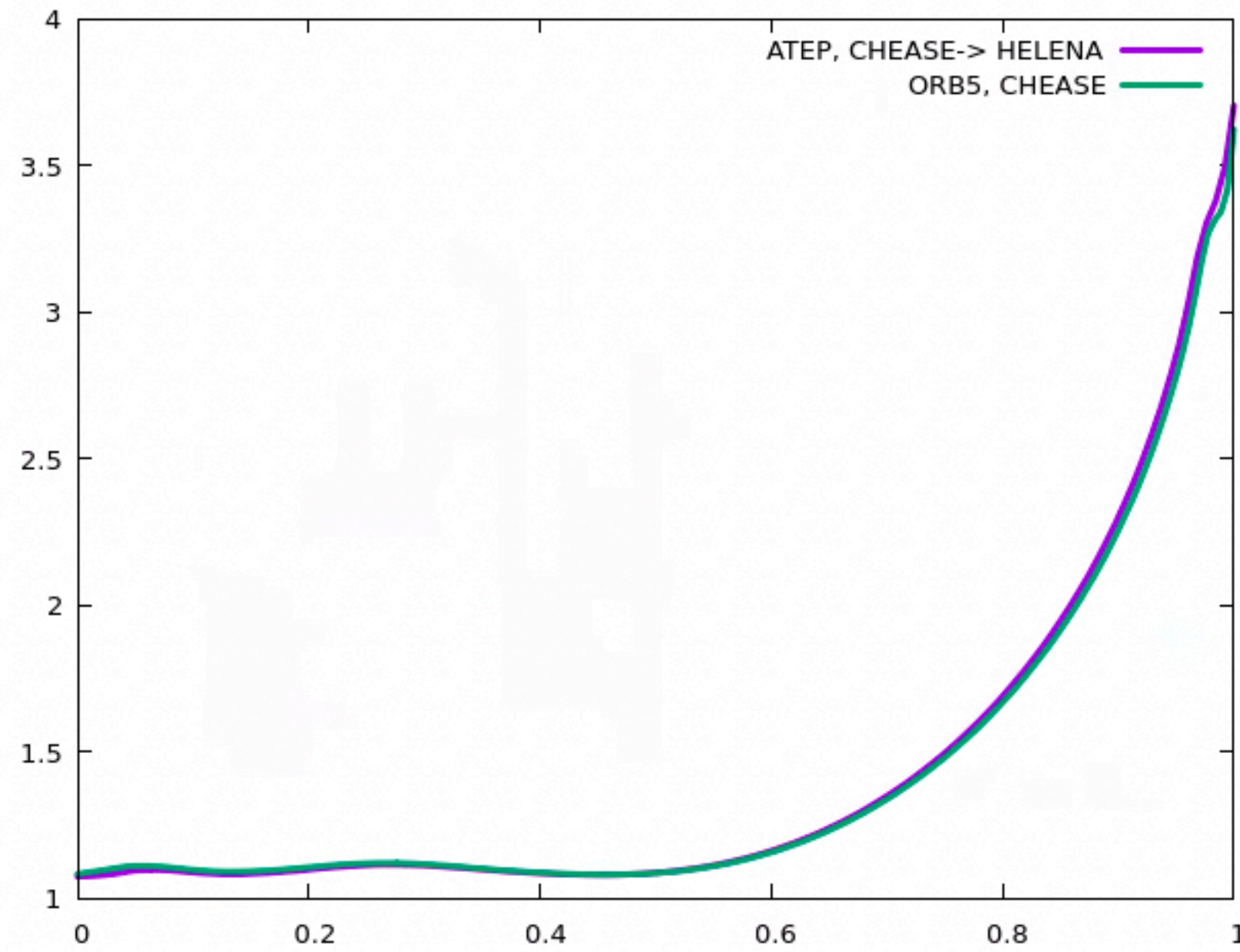
ORB5: n=19

$t = 235300.0 \omega_{ci}^{-1}$



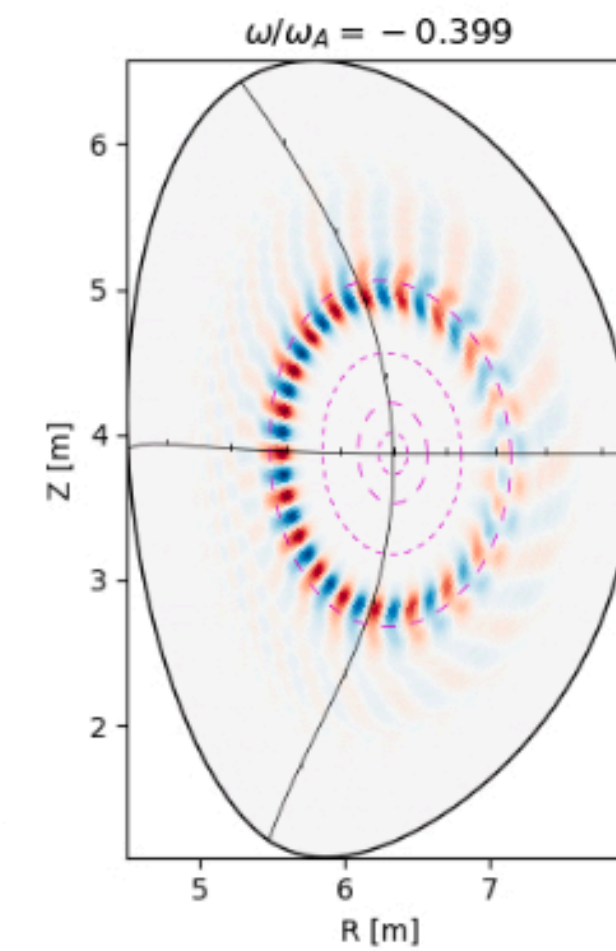
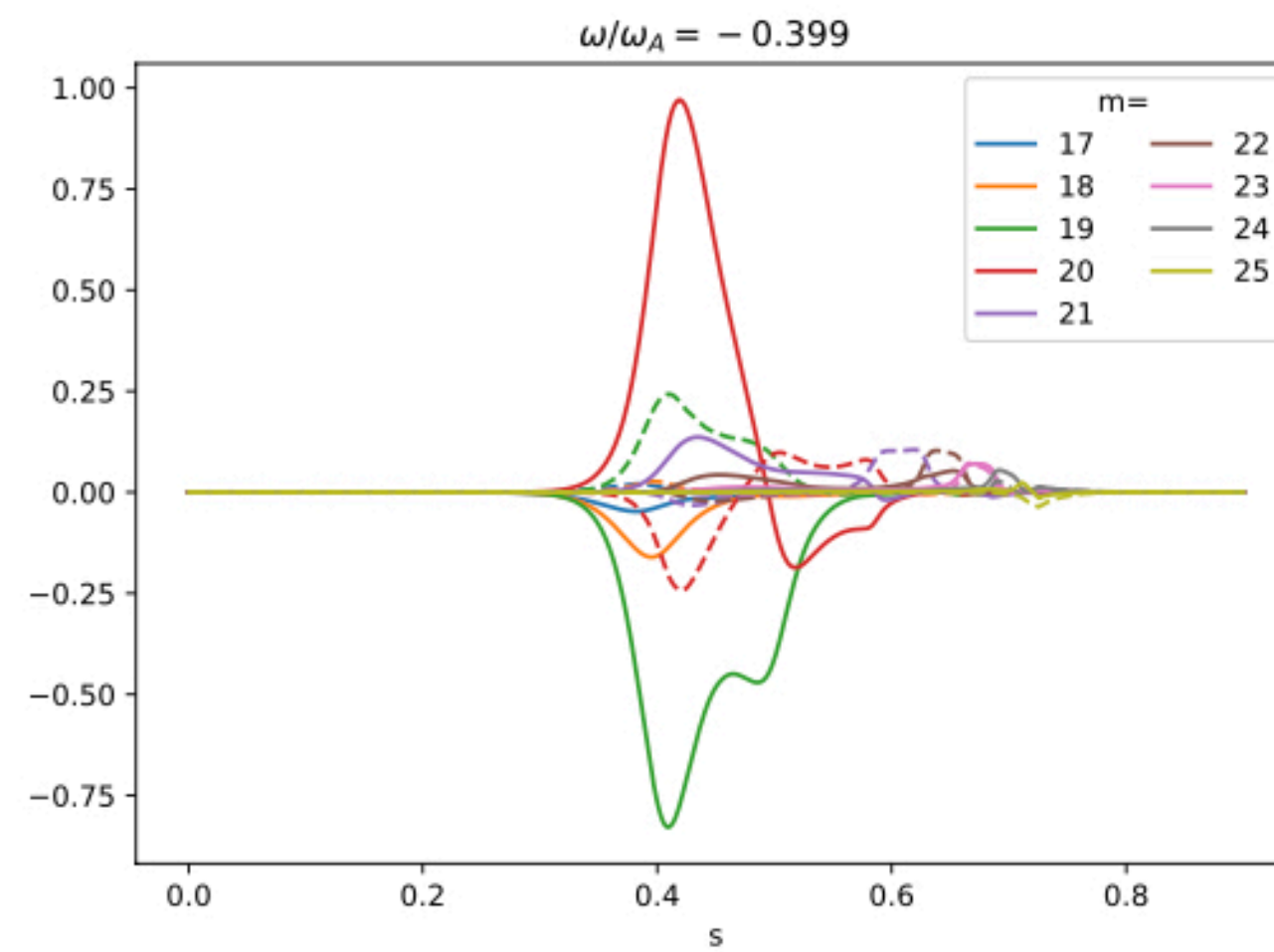
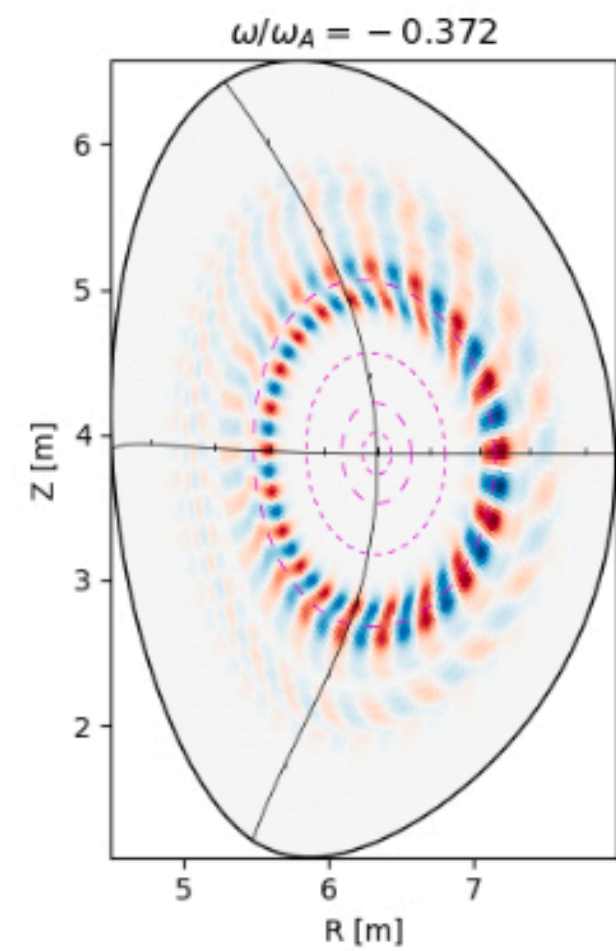
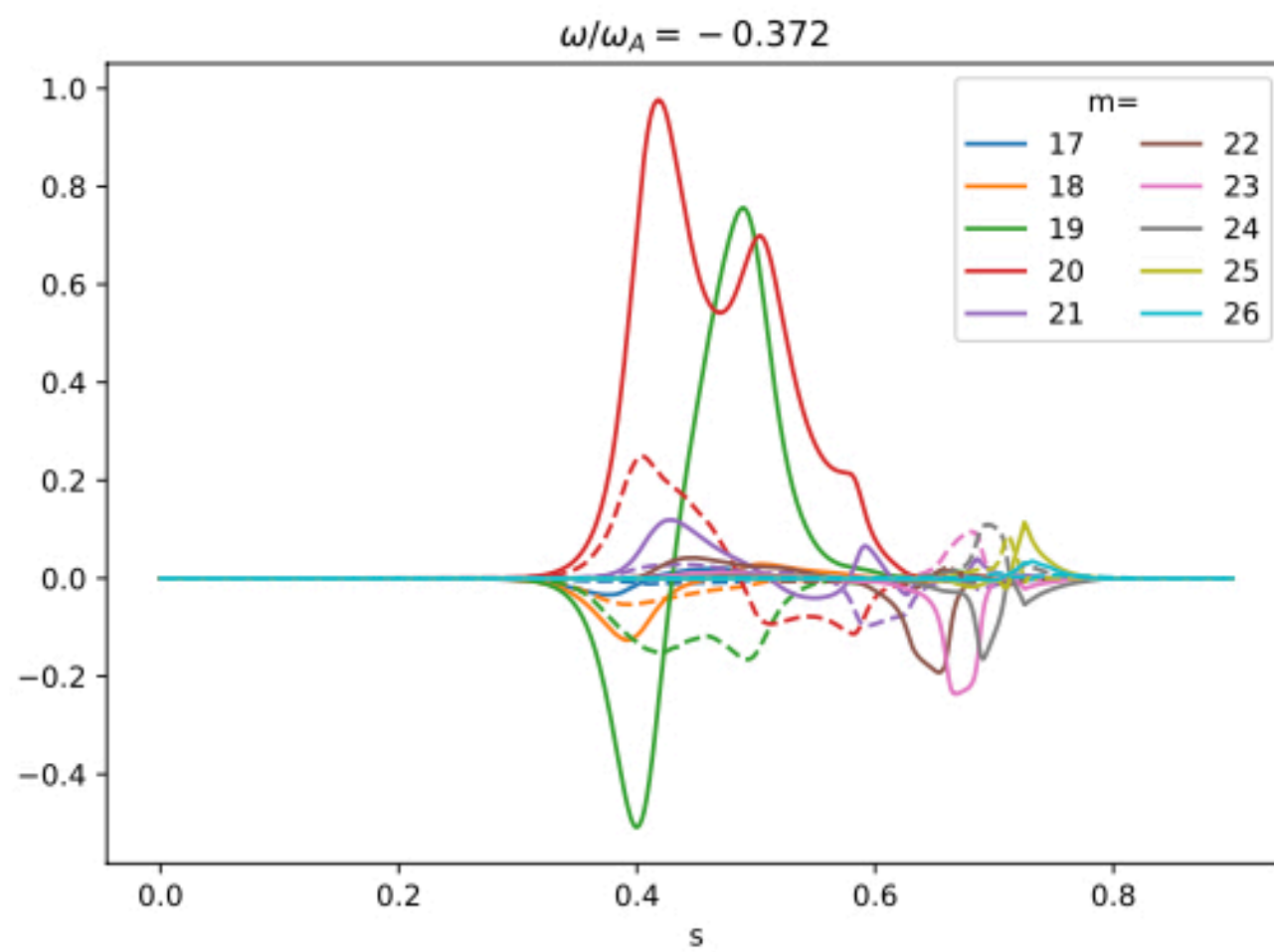
ultimate goal:
what happens to q-profile when EP
transport is included - smooth out minima?

ORB5-LIGKA PSZS comparison improving, ITER #101006



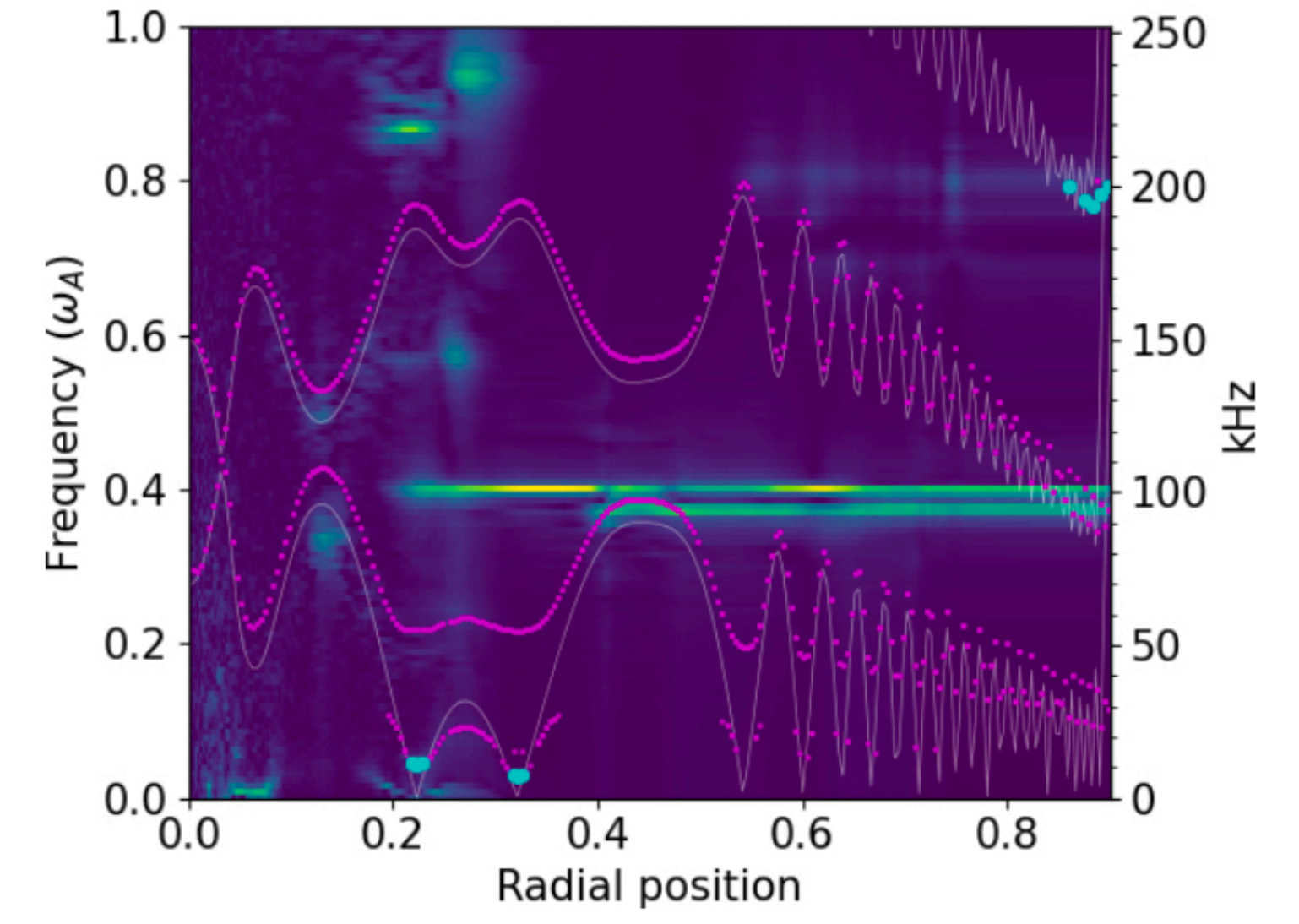
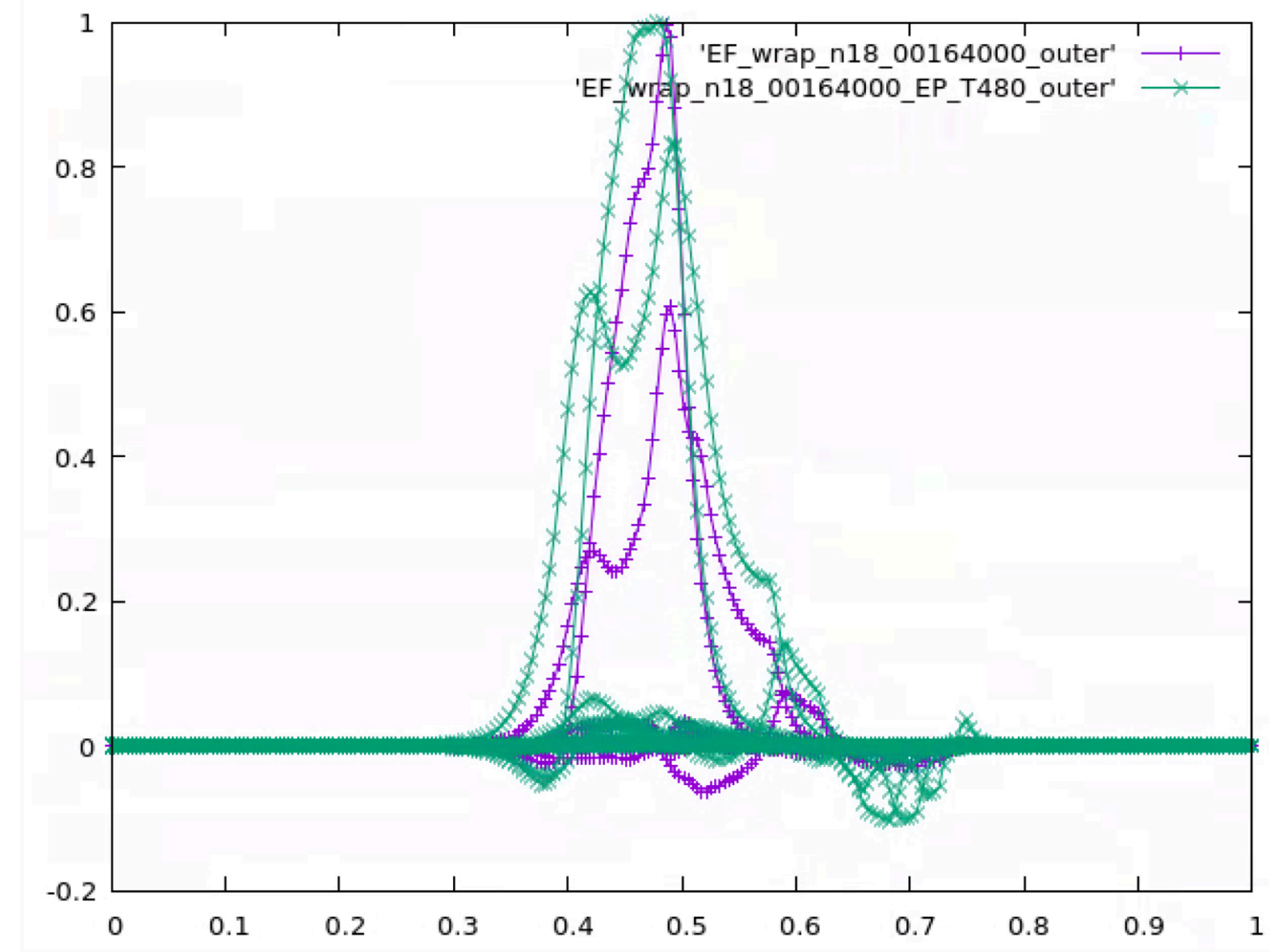
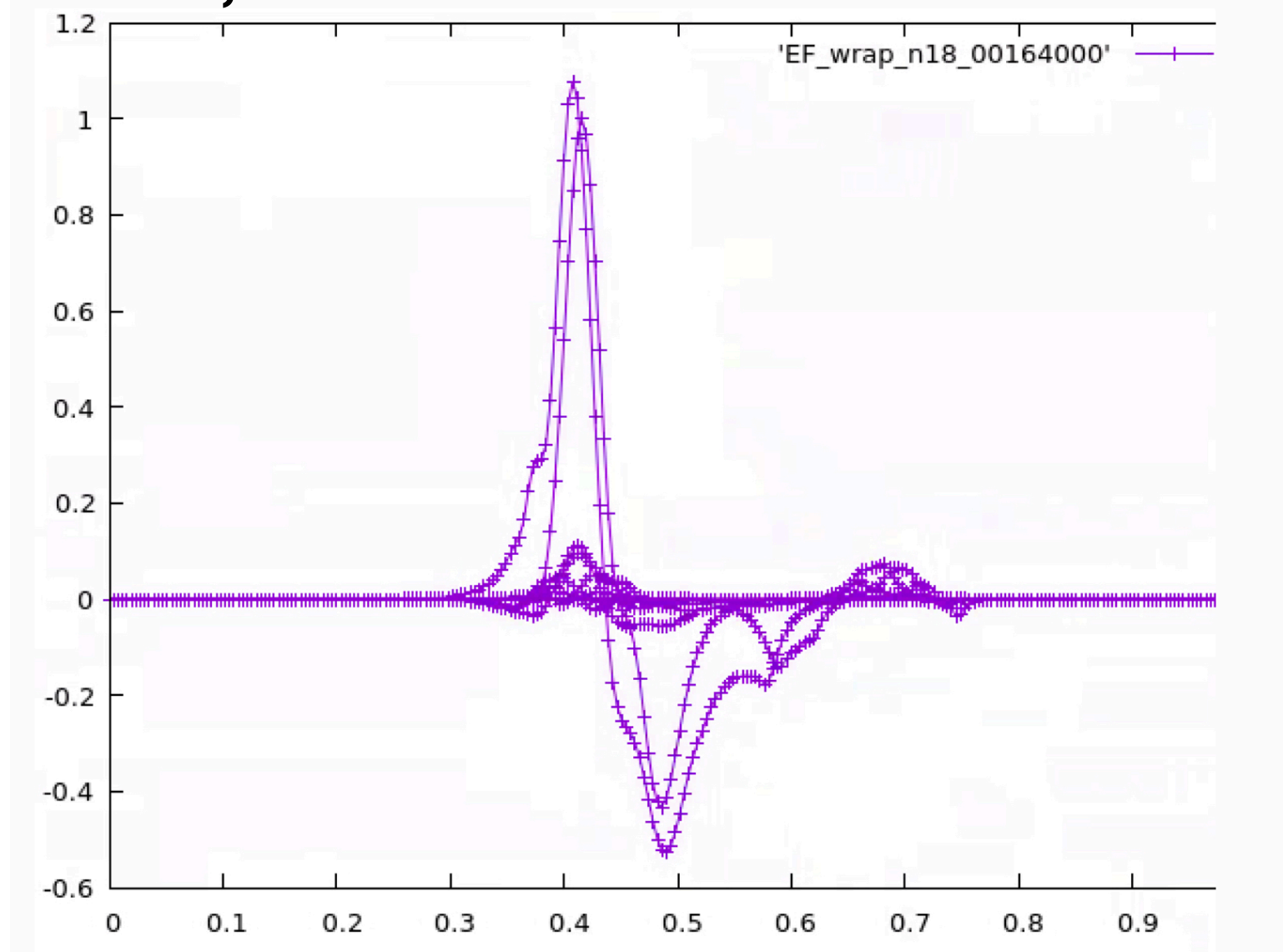
$q=q_{TAE}(n=18)=19.5/18=1.0833$
 $q=q_{TAE}(n=19)=20.5/19=1.0789$

ORB5: n=18

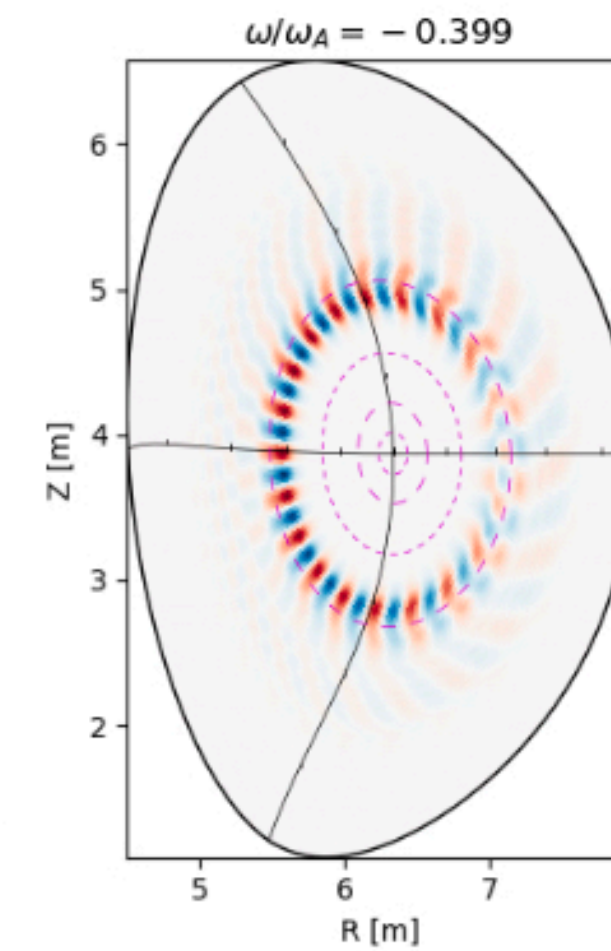
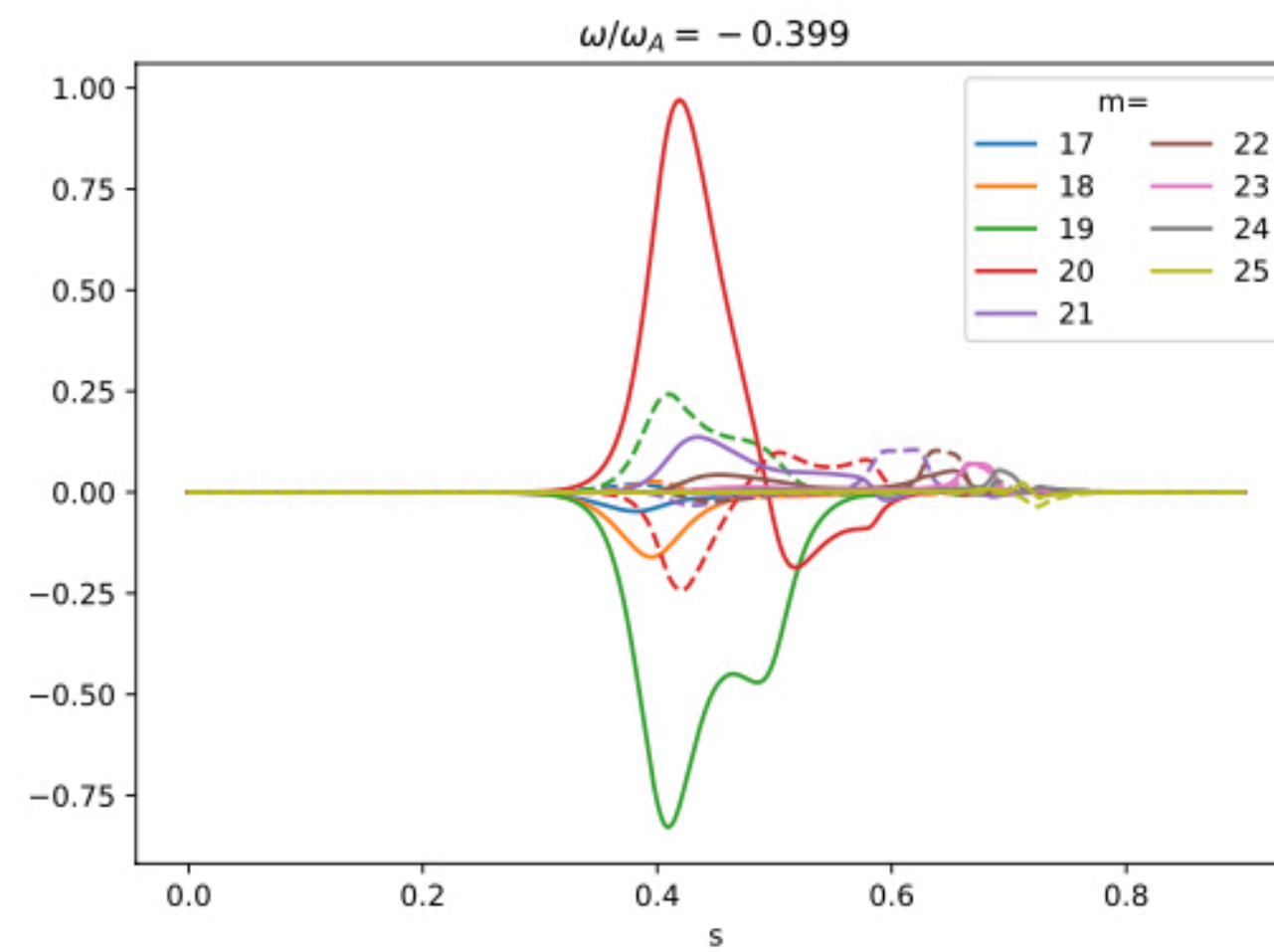
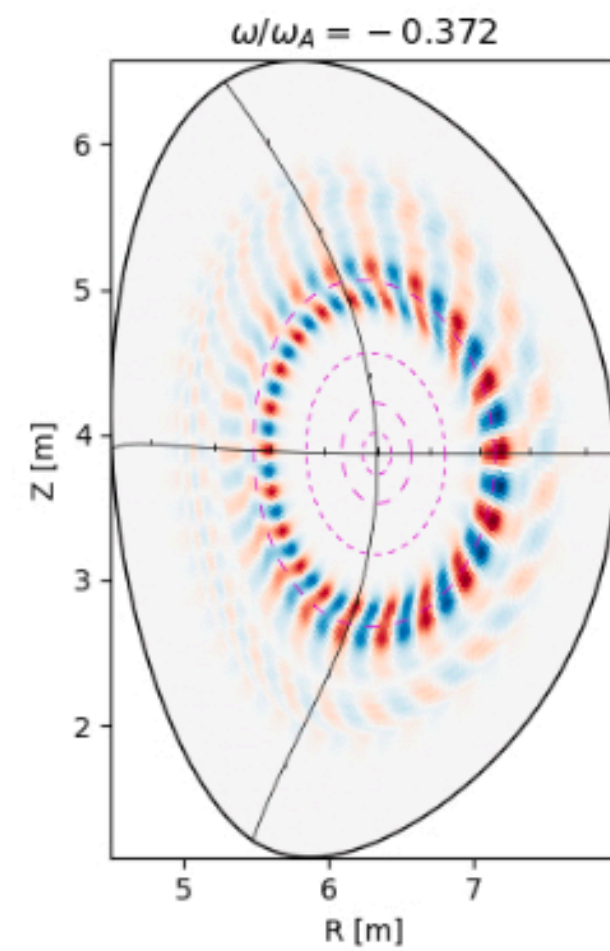
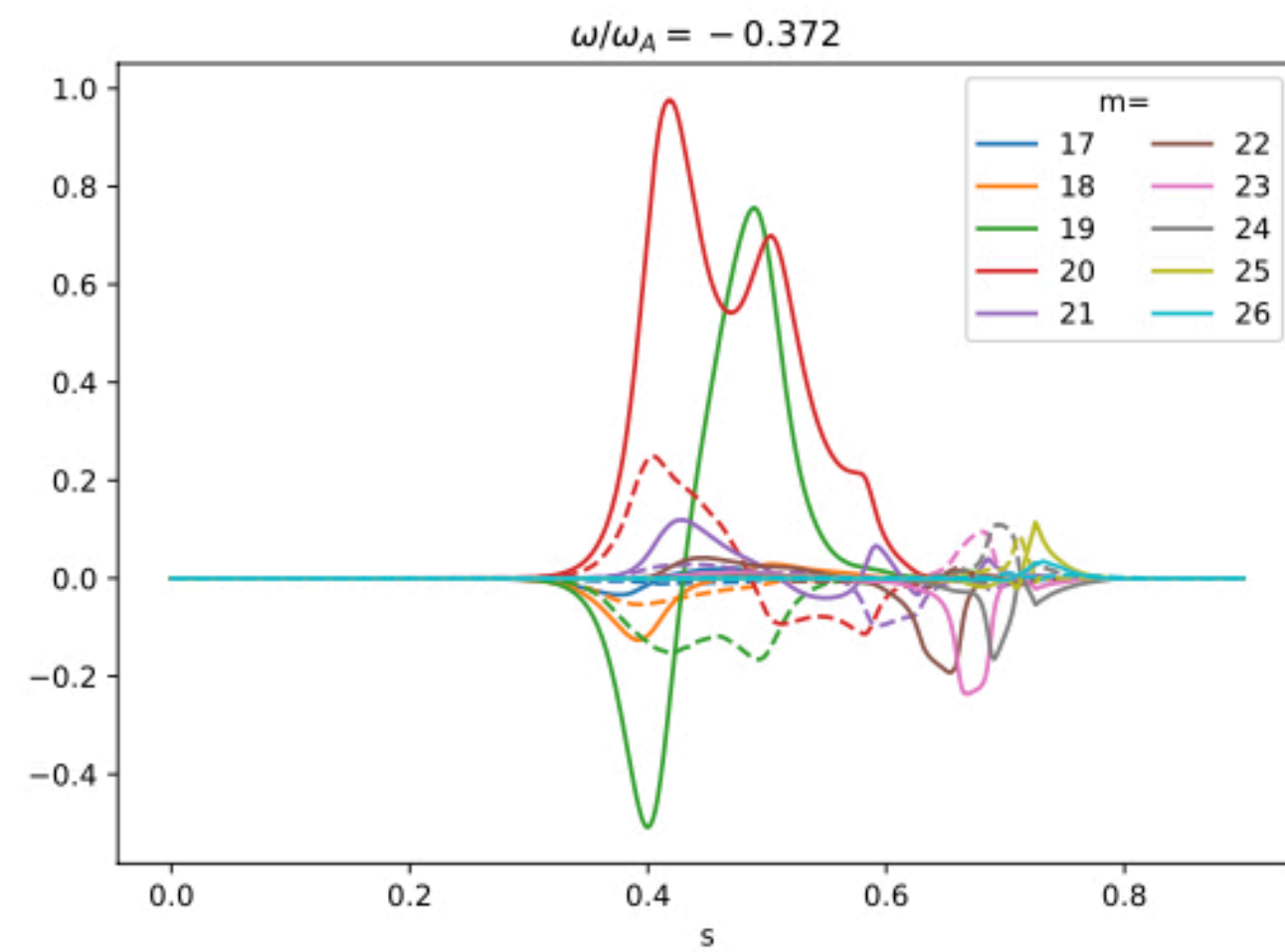


**[T Hayward-Schneider
FEC 2023]**

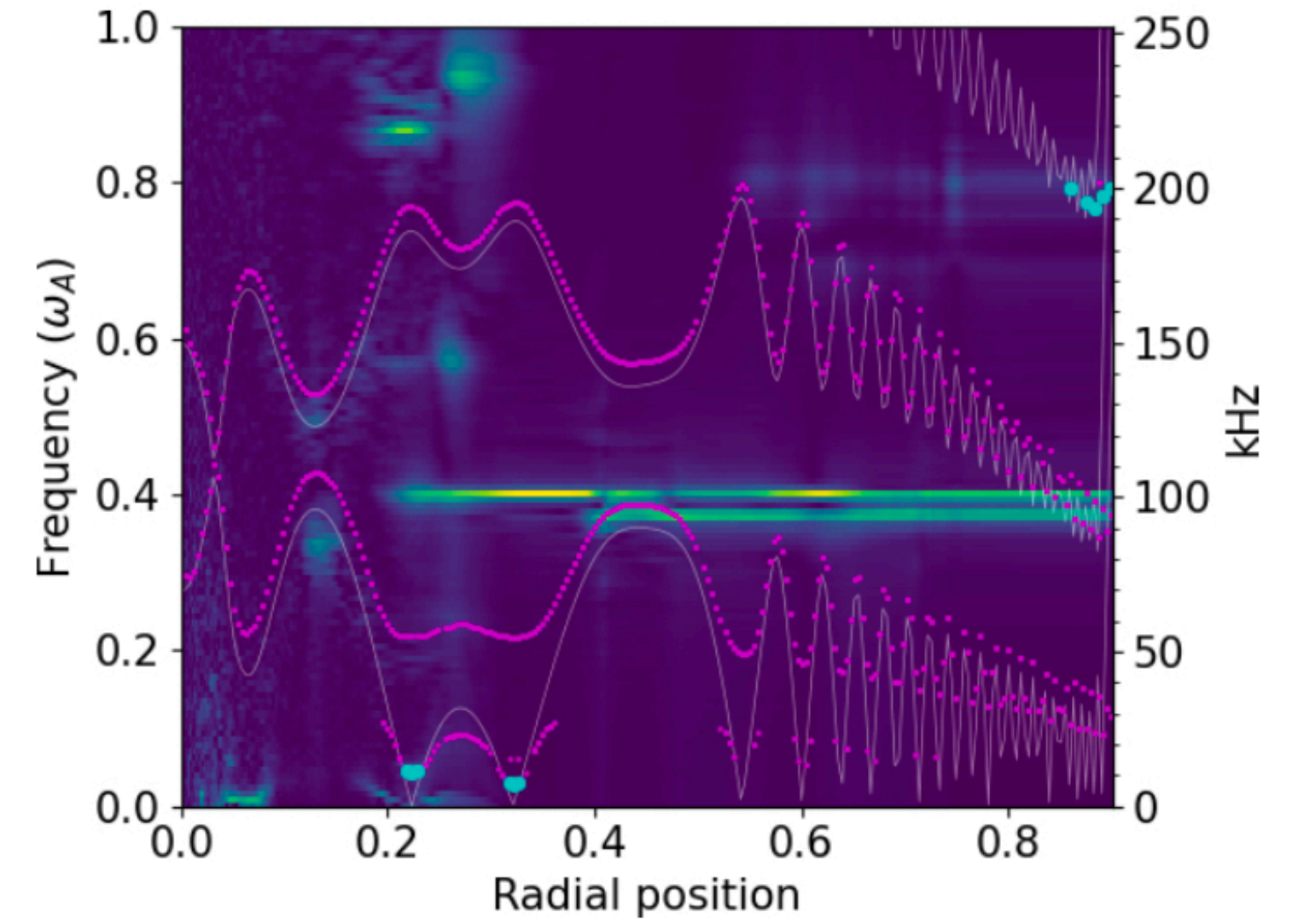
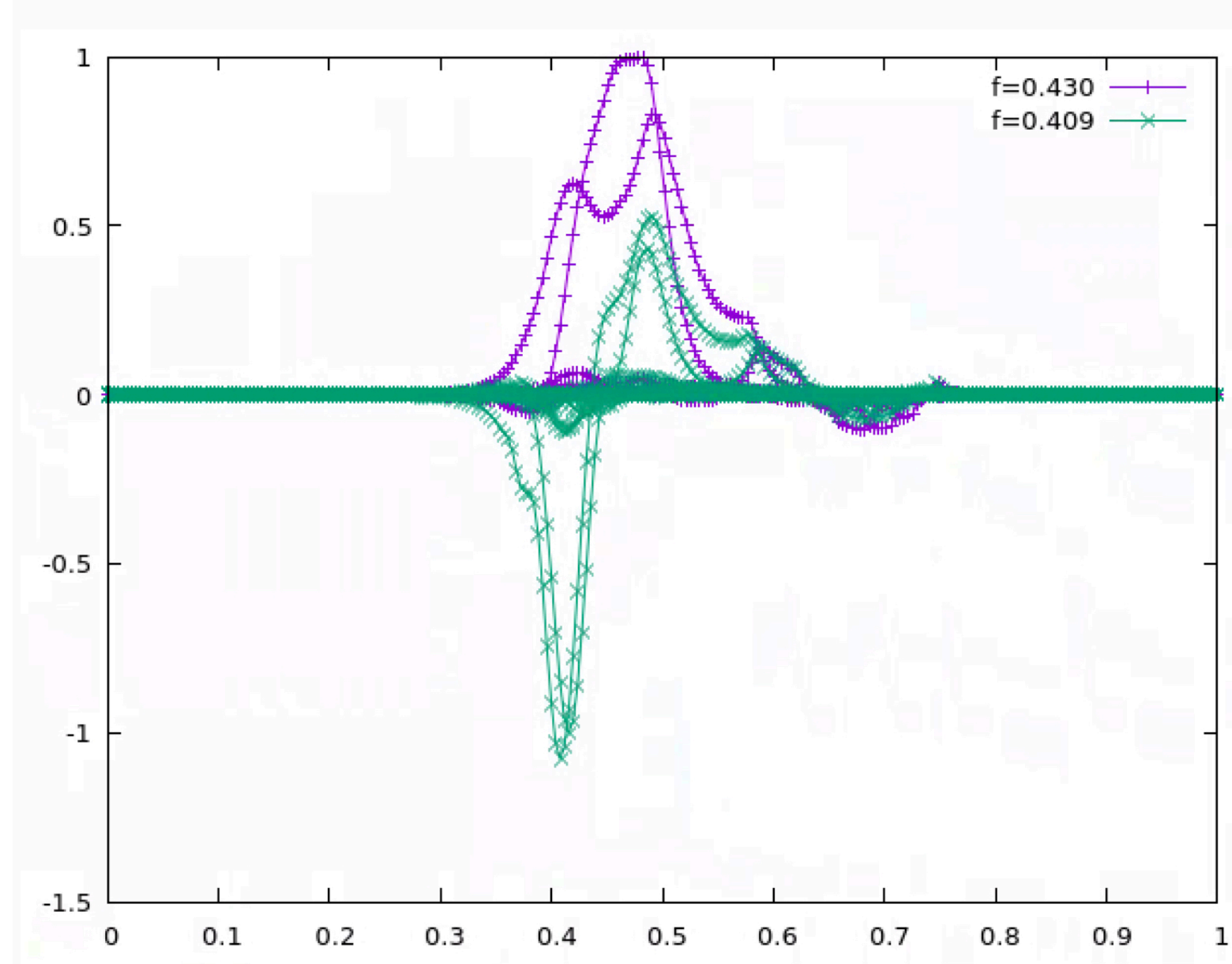
LIGKA: n=18, no EPs



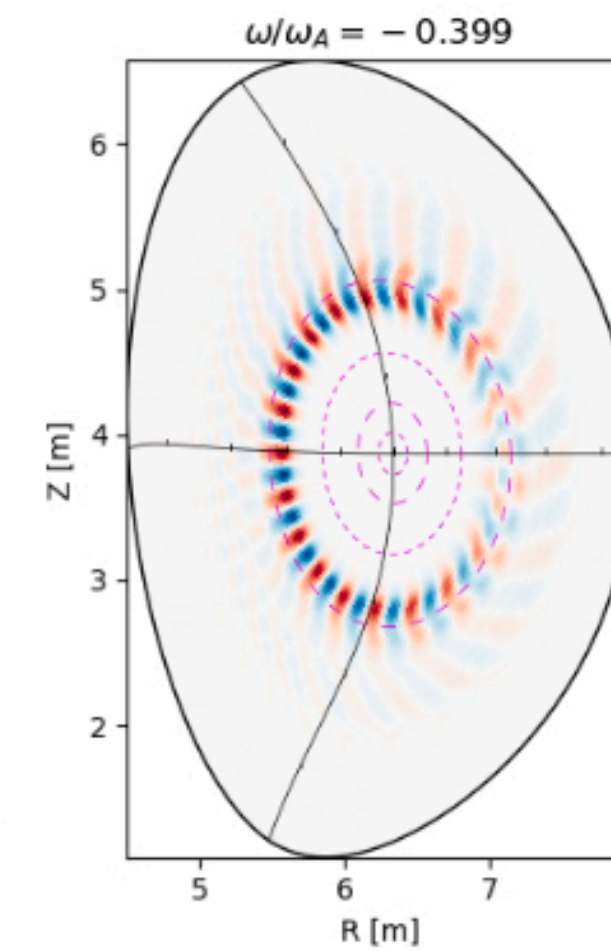
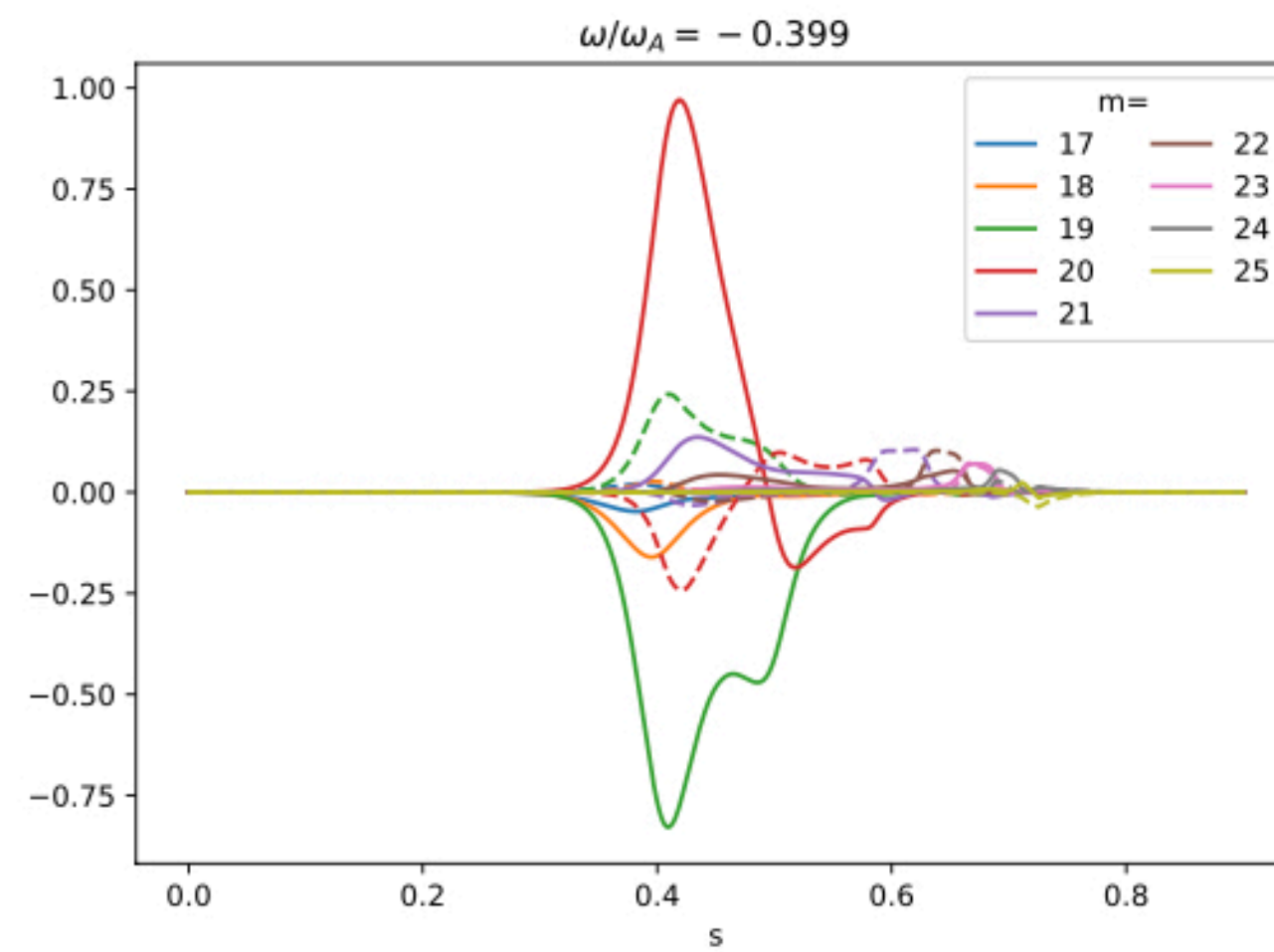
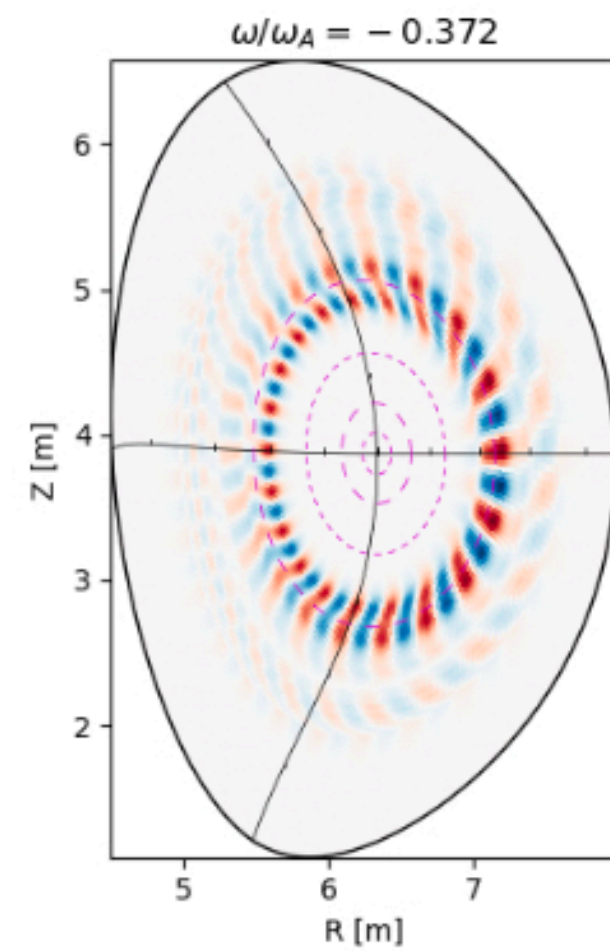
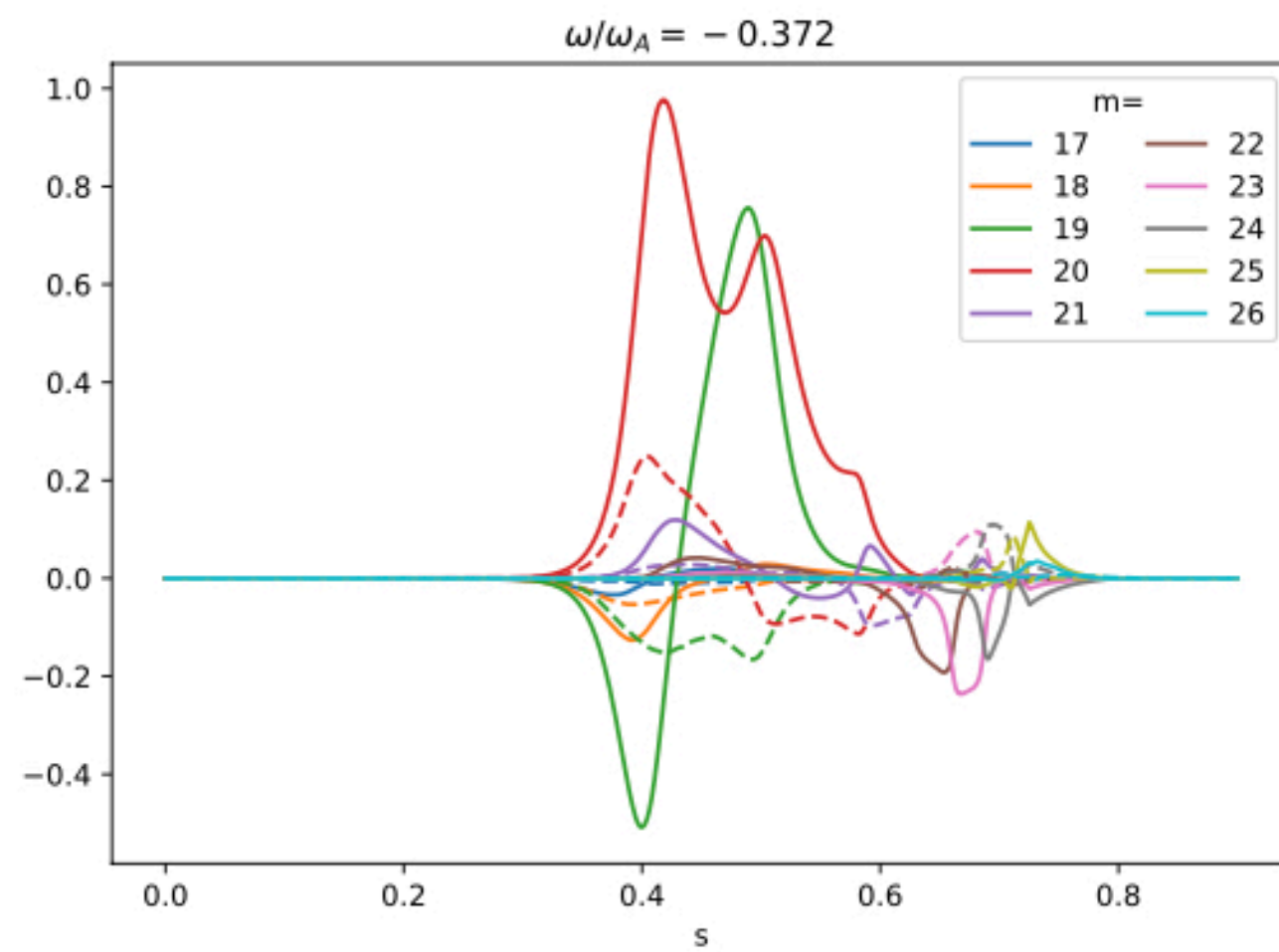
ORB5: n=18



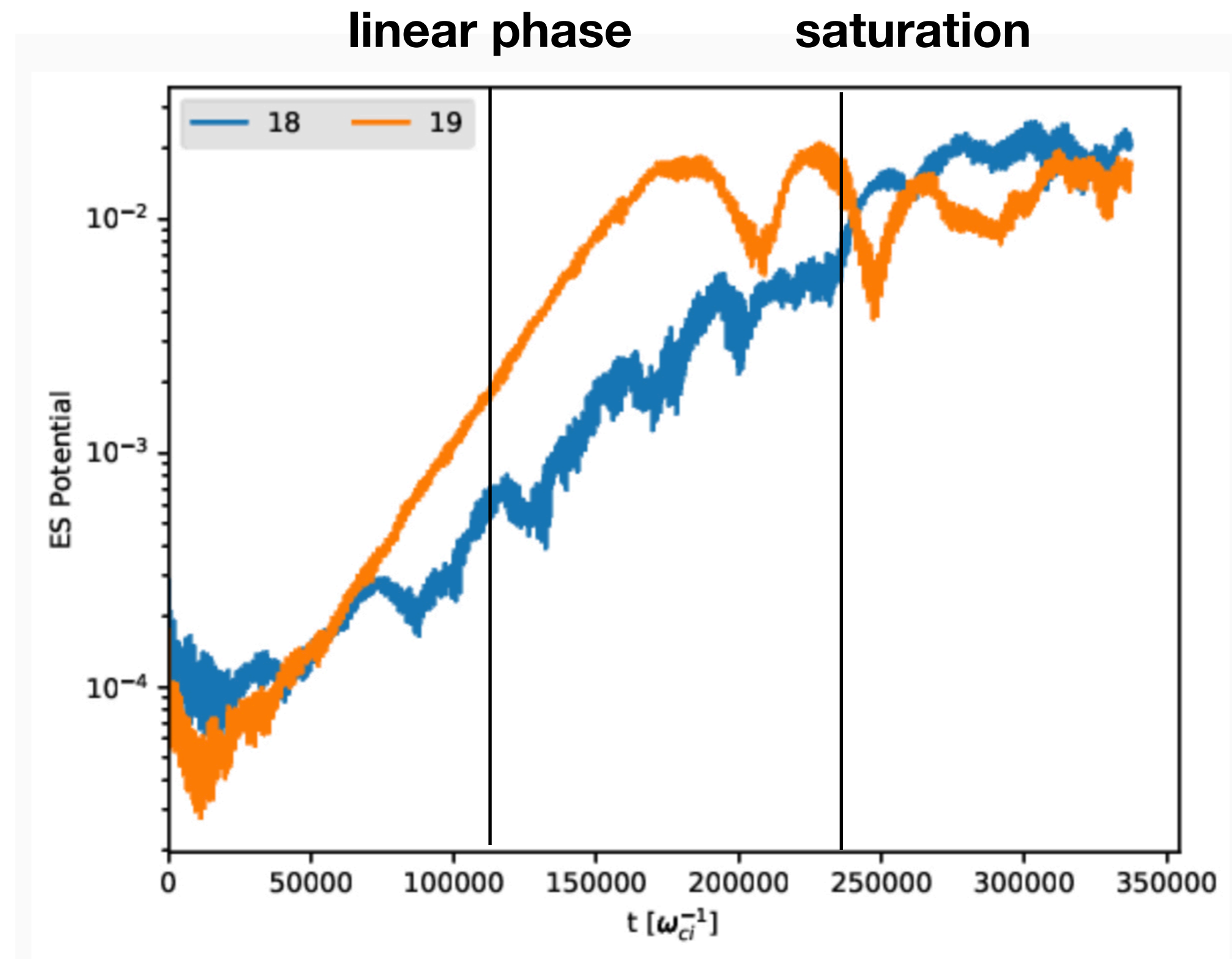
LIGKA: n=18+ EPs



ORB5: n=18



C



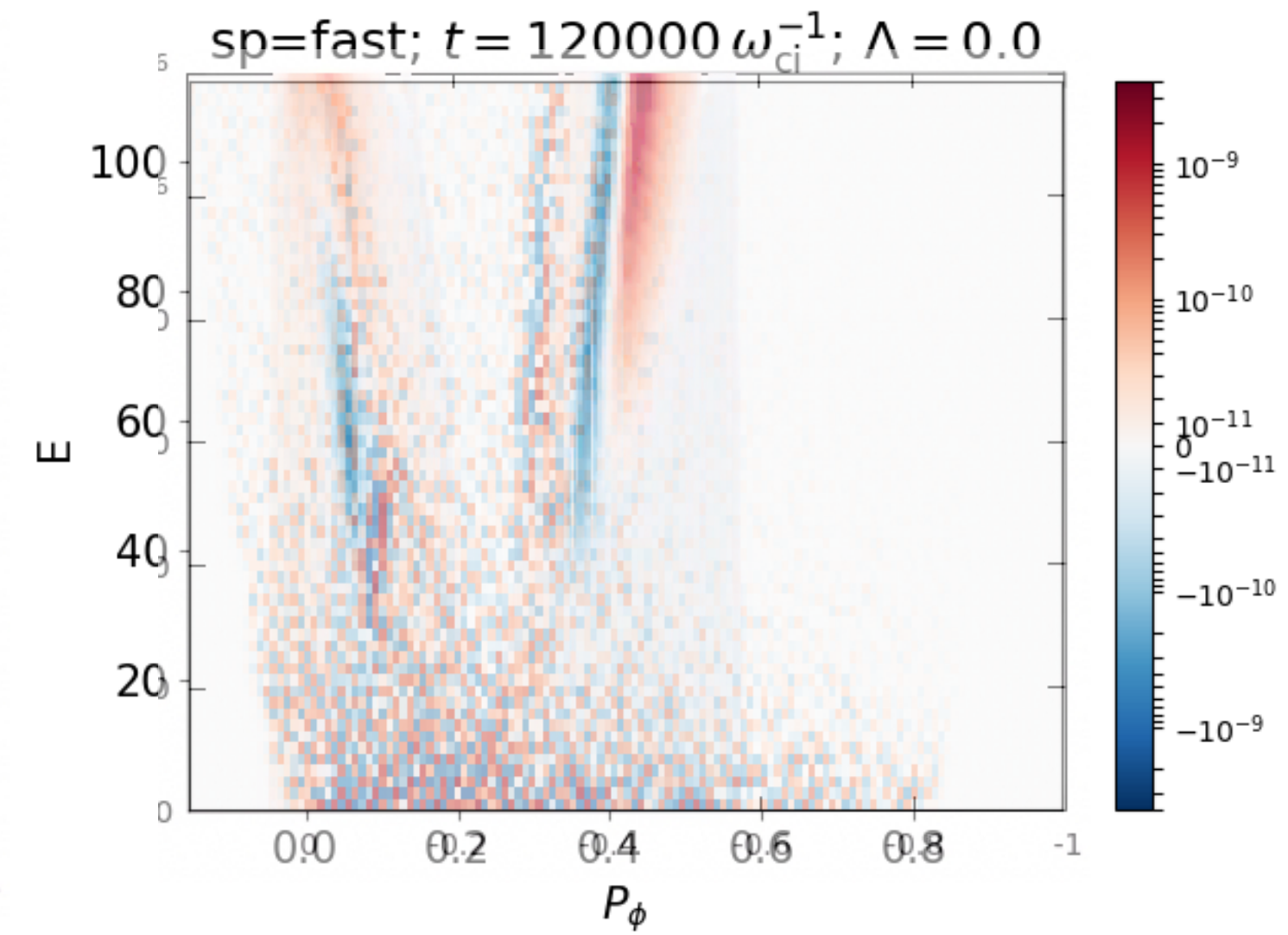
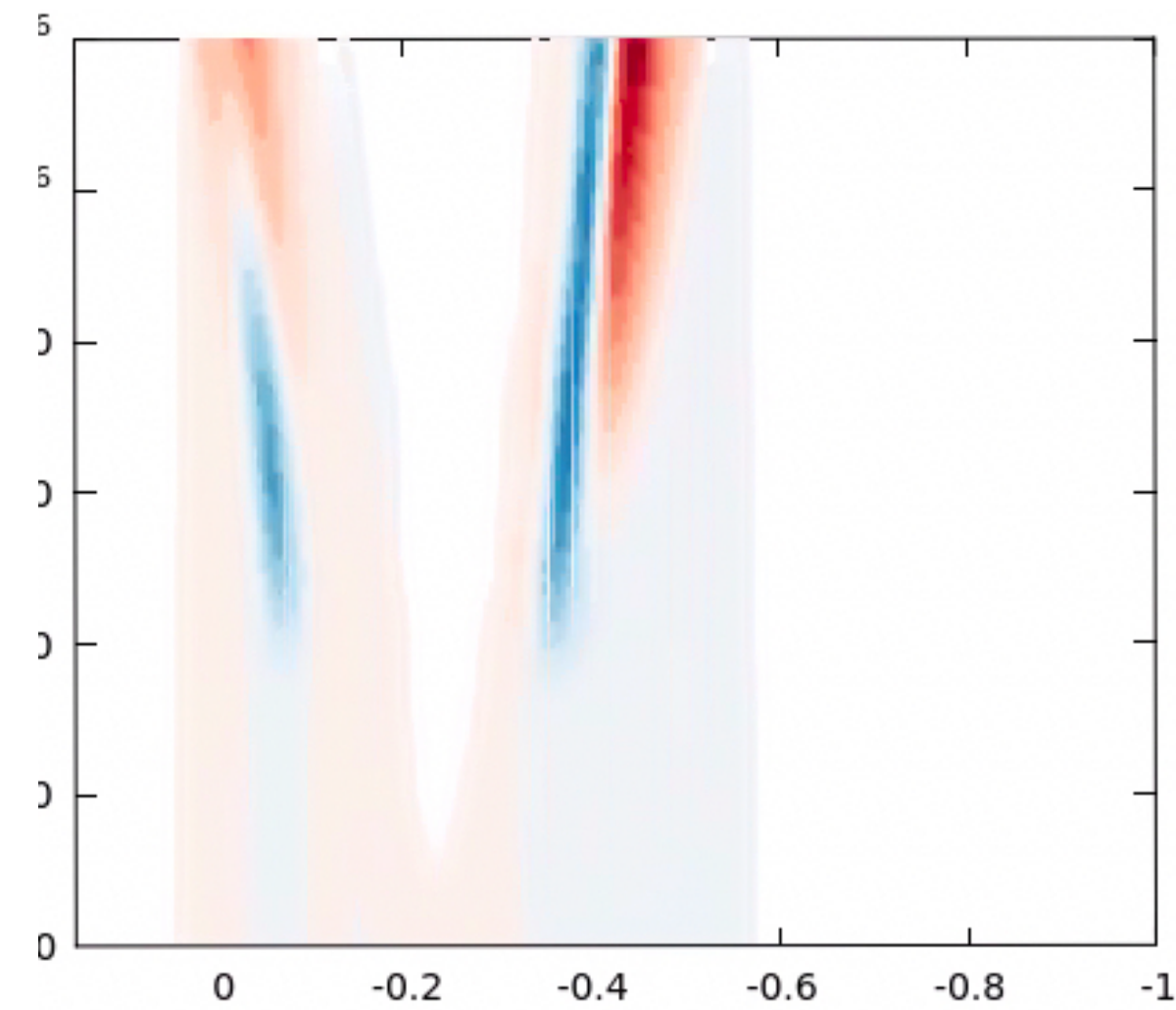
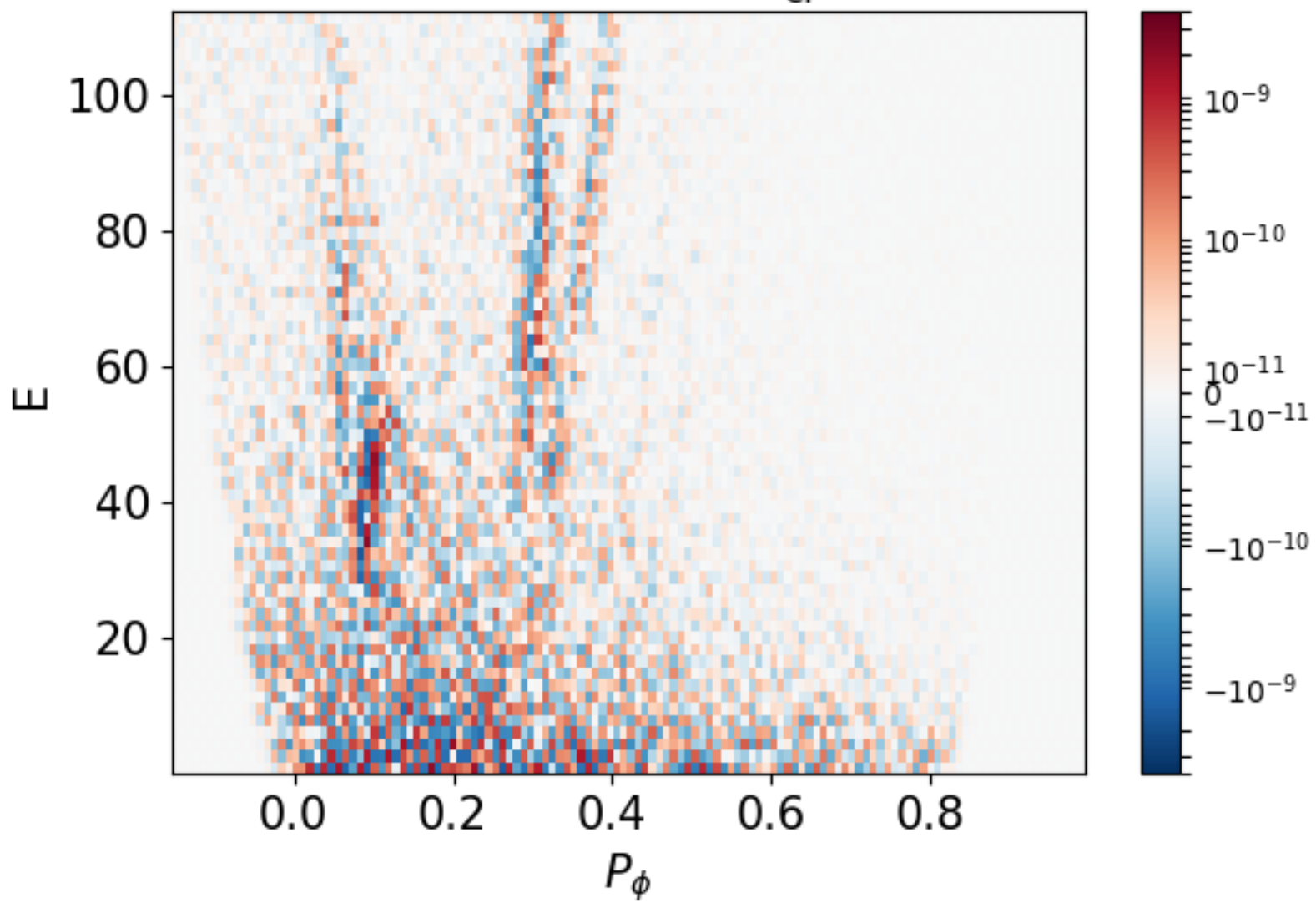
ORB5:

slowing down, $n=18+19$ case, linear phase

LIGKA

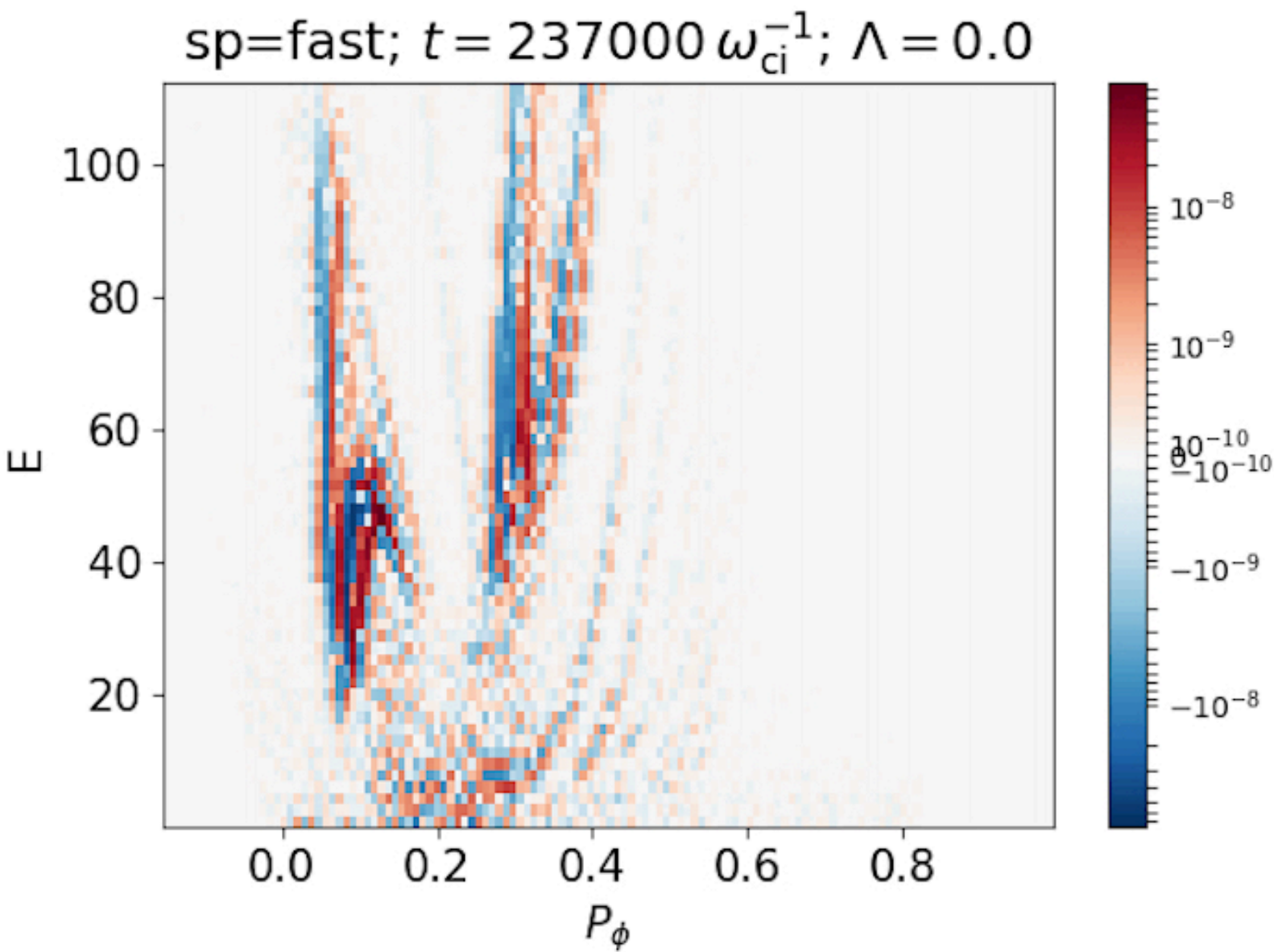
$n=19$, $\langle dP/dt \rangle$ i.e. uniform F

sp=fast; $t = 120000 \omega_{ci}^{-1}$; $\Lambda = 0.0$

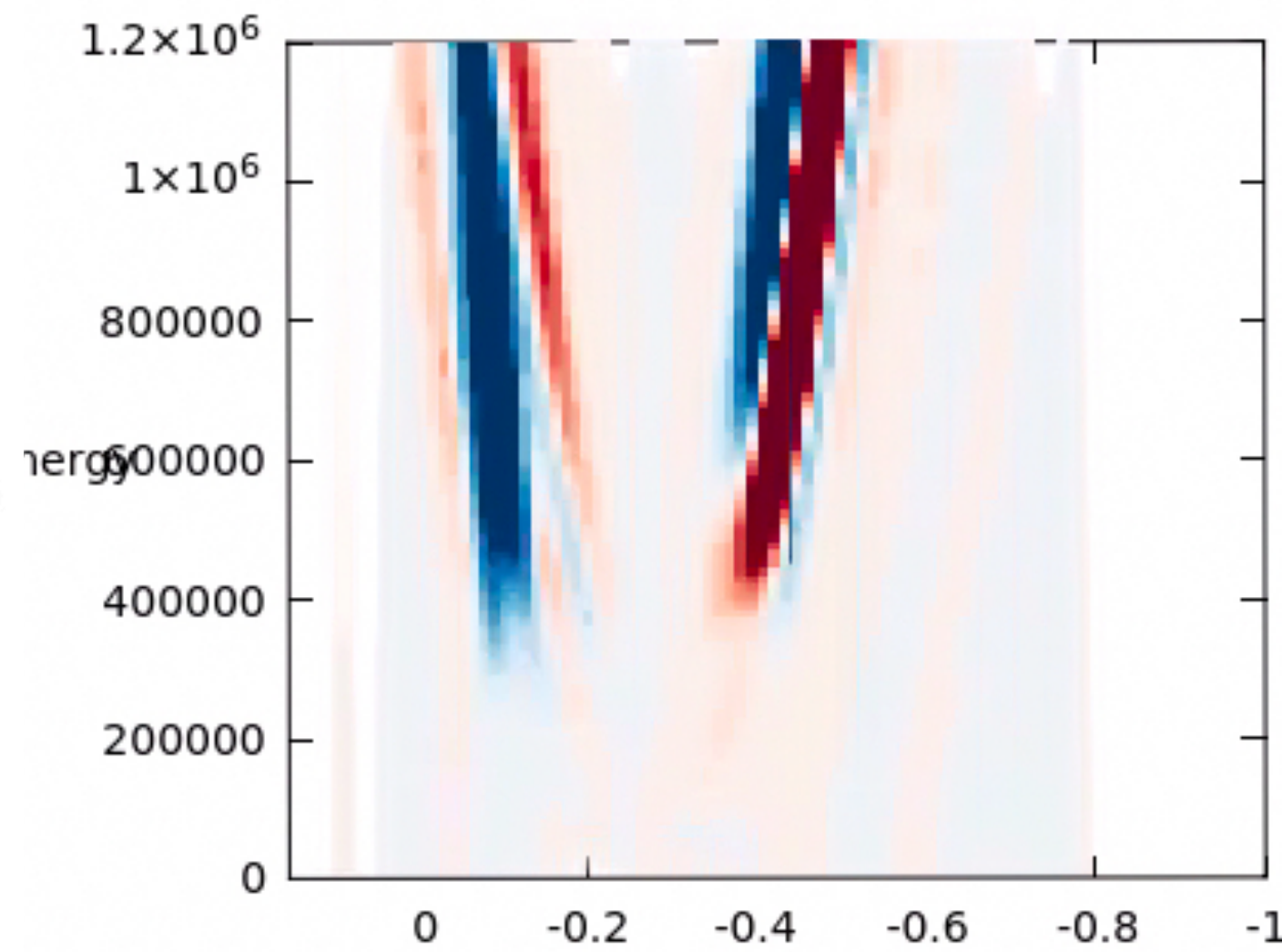


$n=19$ is dominating in linear phase

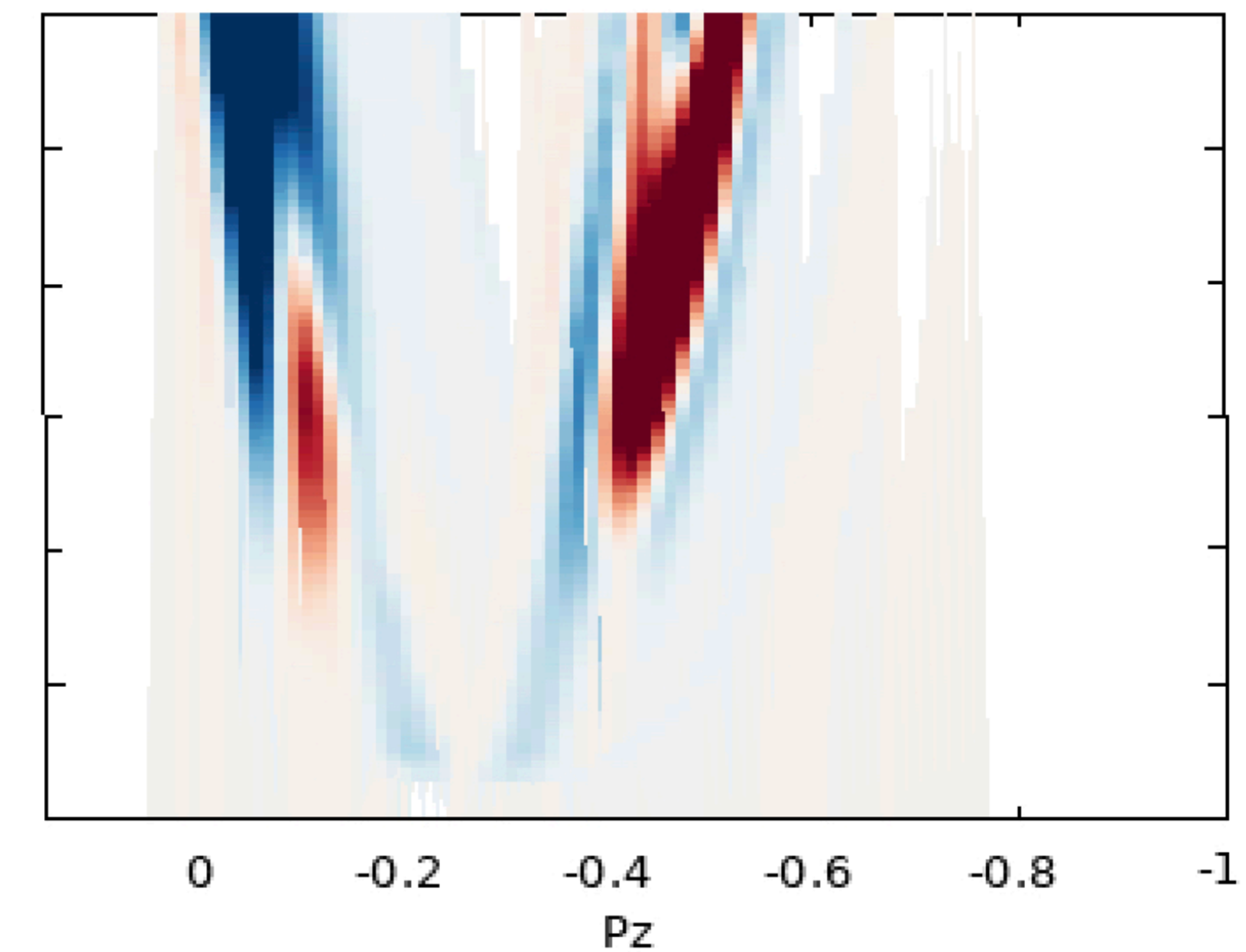
ORB5:
slowing down, n=18+19 case
at saturation



LIGKA
n=19 & n=18, same amplitude
<dP/dt> i.e. uniform F (312)
with non-perturbative EPs



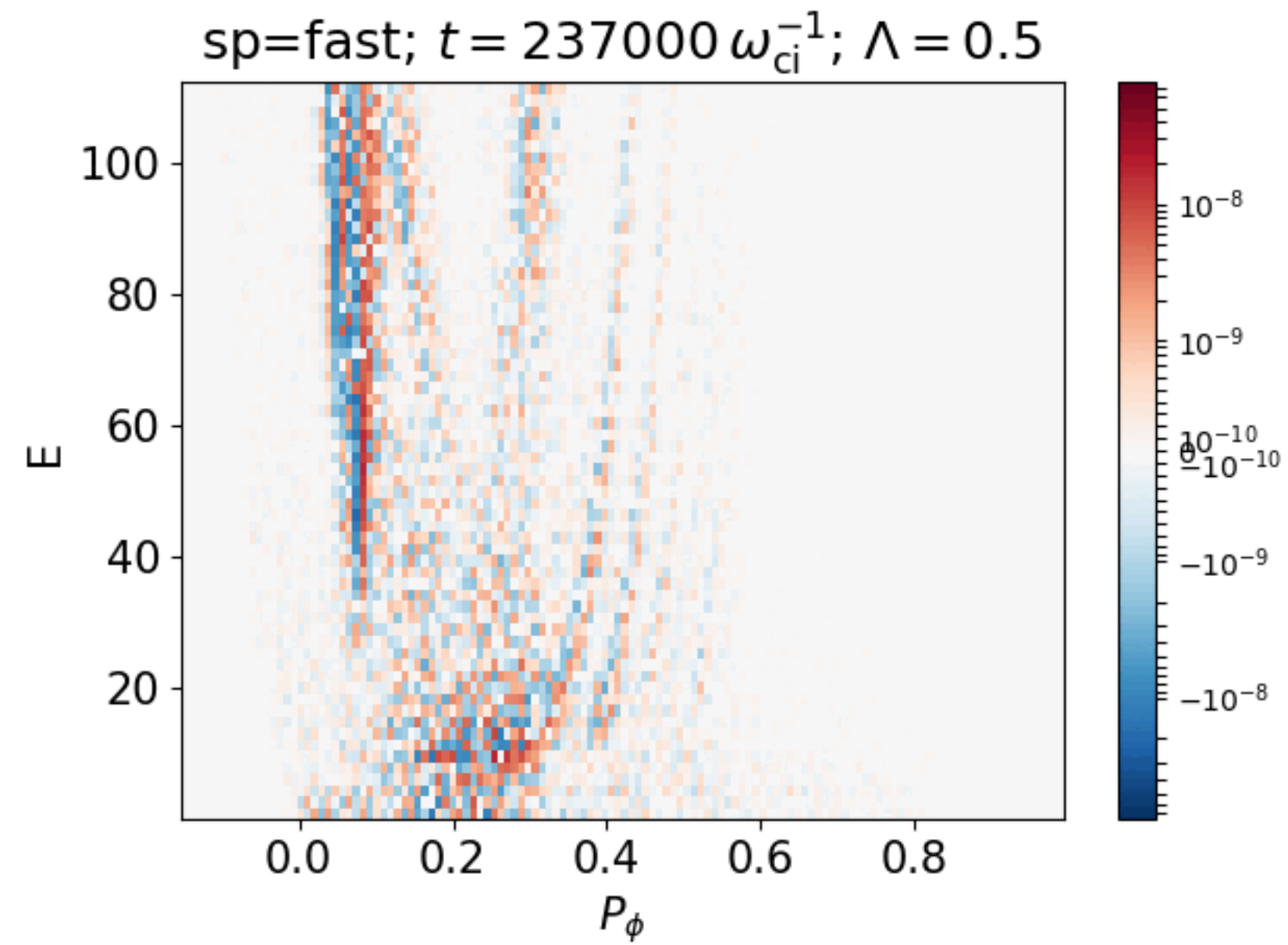
LIGKA
n=19 & n=18, same amplitude
<dP/dt> i.e. uniform F (309)
no EPs for EF



**very interesting, challenging, non-perturbative case:
PSZS as ultimate measure for linear and non-linear EP transport!**

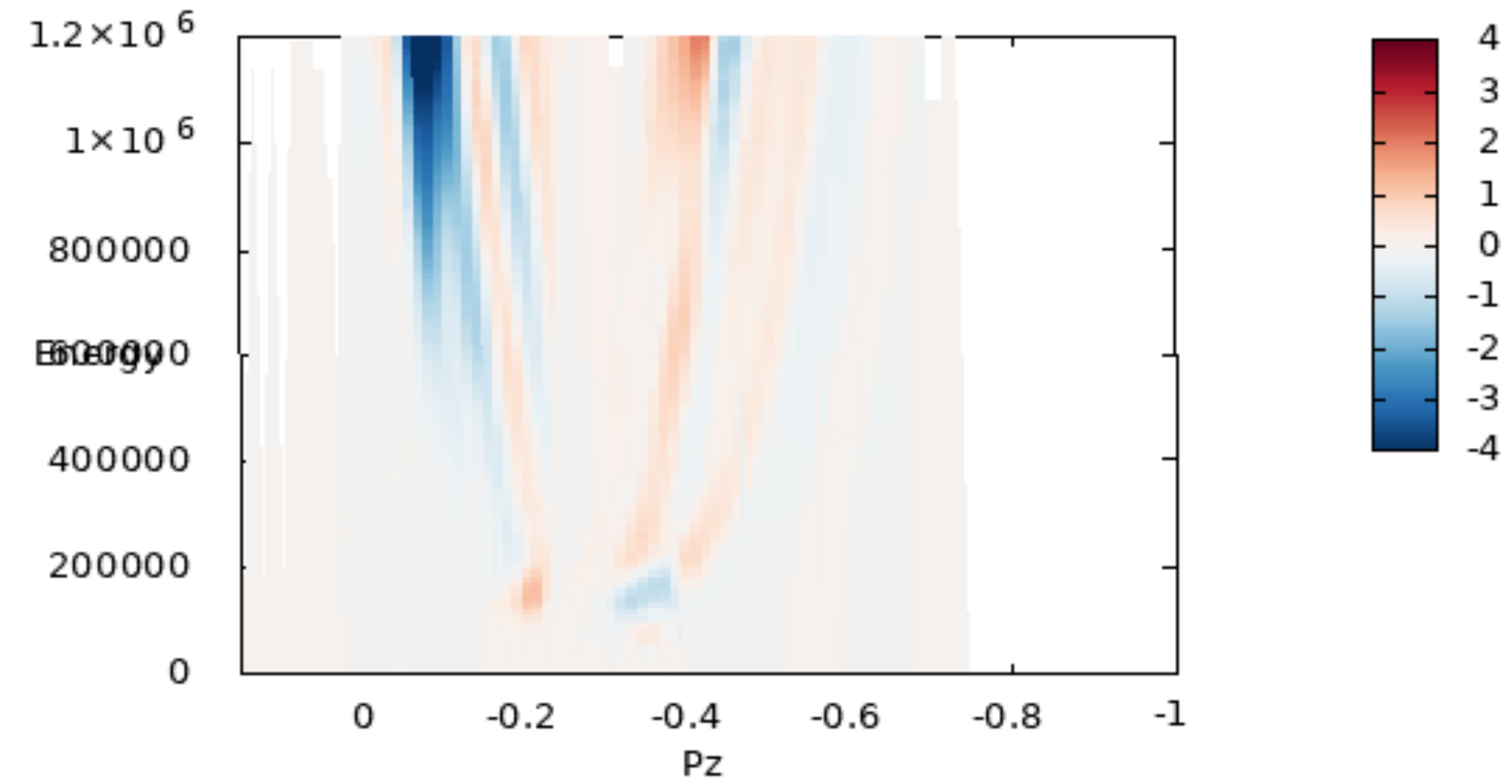
can be compared for all perpendicular energies, i.e. Λ

ORB5

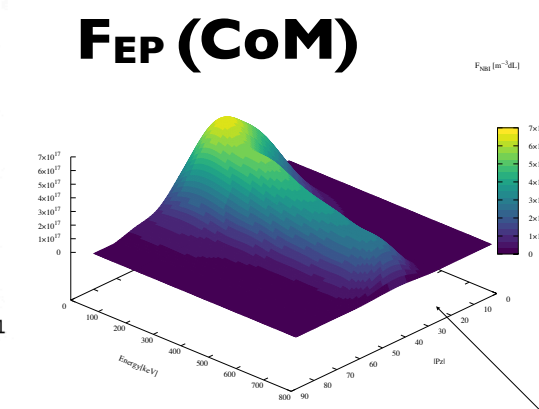
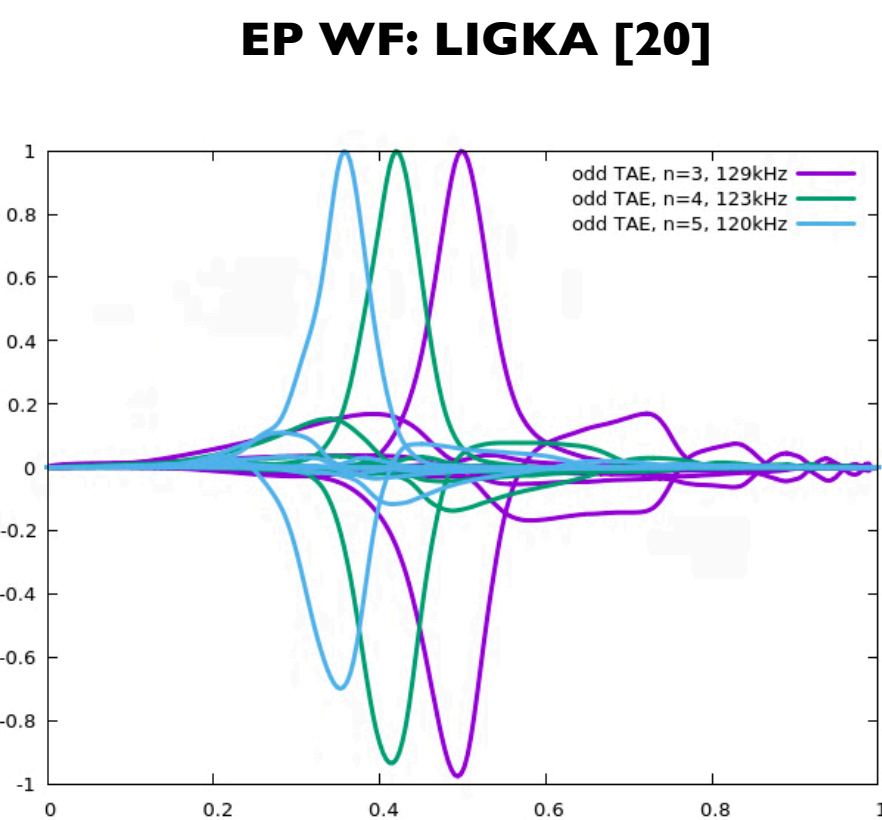
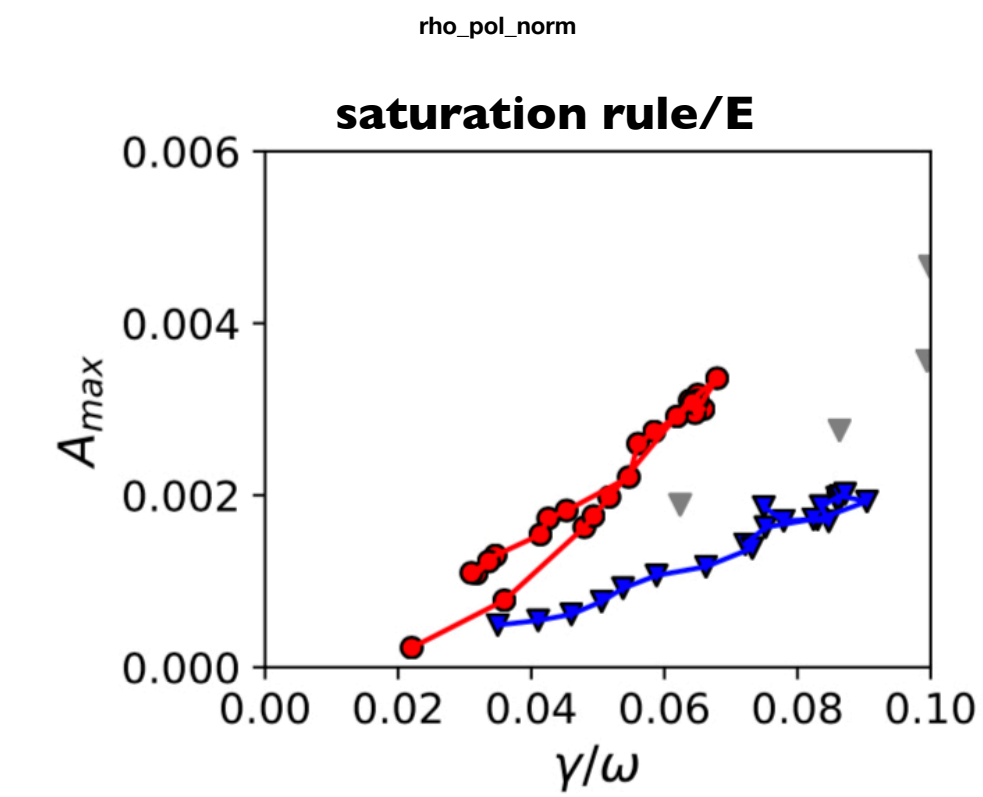
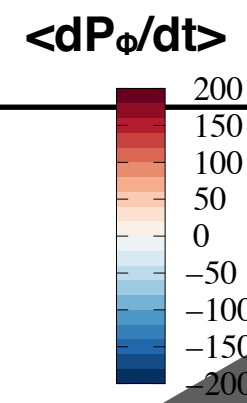
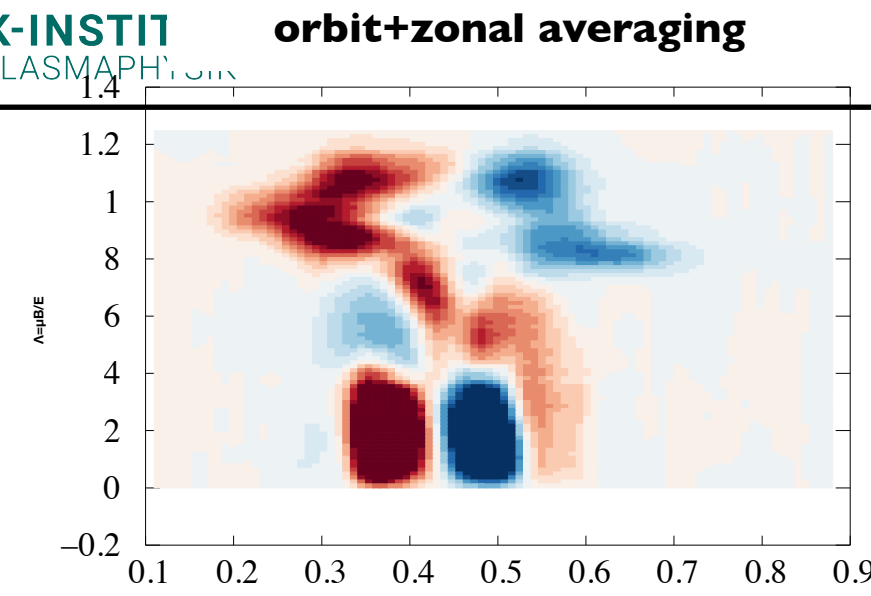


ATEP

```
"/atep_pszs_pz_en_.occ."_j_.ty u 1:($2*scale*(abs($3)>floor)):3  
dPz/dt (Pz,Lambda), Lambda=504 [*100]
```



ATEP code: physics and structure



transport code

calculate PSZS

use NL code/model for intensity closure

or kick model

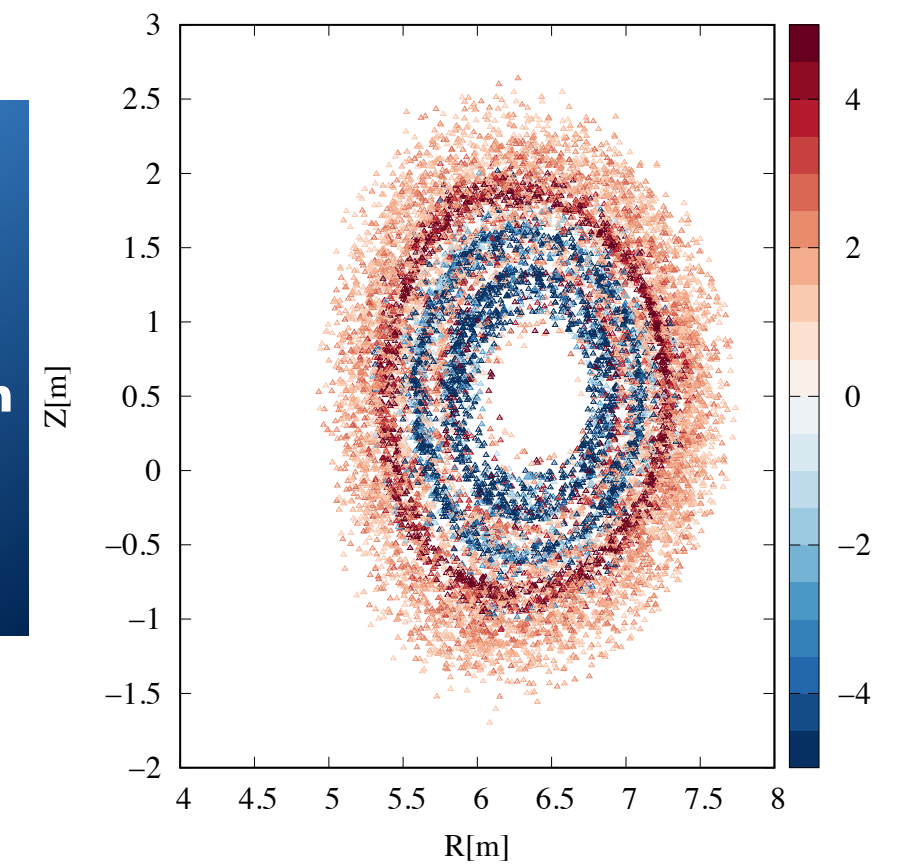
calculate linear mode spectrum

PSZS transport theory [M. Falessi et al, 2017-23]

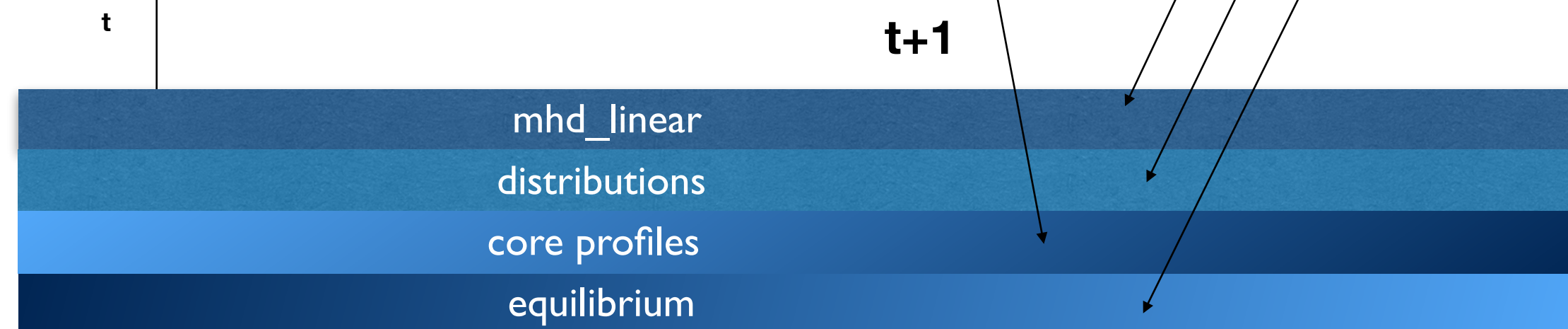
$$\frac{\partial \overline{F_{z0}}}{\partial t} + \frac{1}{\tau_b} \left[\frac{\partial}{\partial P_\phi} \overline{(\tau_b \delta \dot{P}_\phi \delta F)}_z + \frac{\partial}{\partial \mathcal{E}} \overline{(\tau_b \delta \dot{\mathcal{E}} \delta F)}_z \right]_S = \overline{\left(\sum_b C_b^g [F, F_b] + \mathcal{S} \right)}_{zS}$$

calculate $D(r,E)$

advance F_{EP} and return updated distribution IDS, or its moments

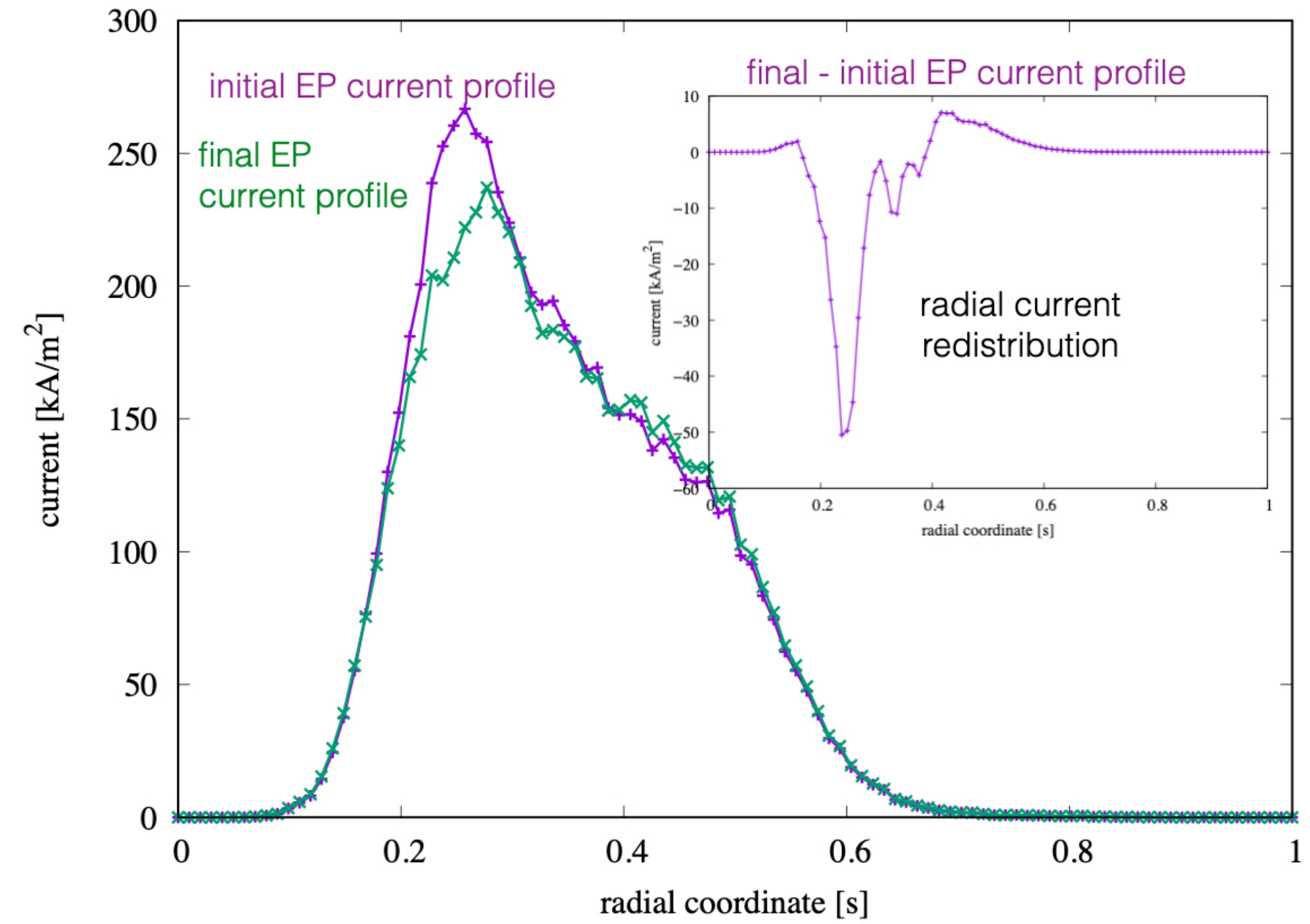
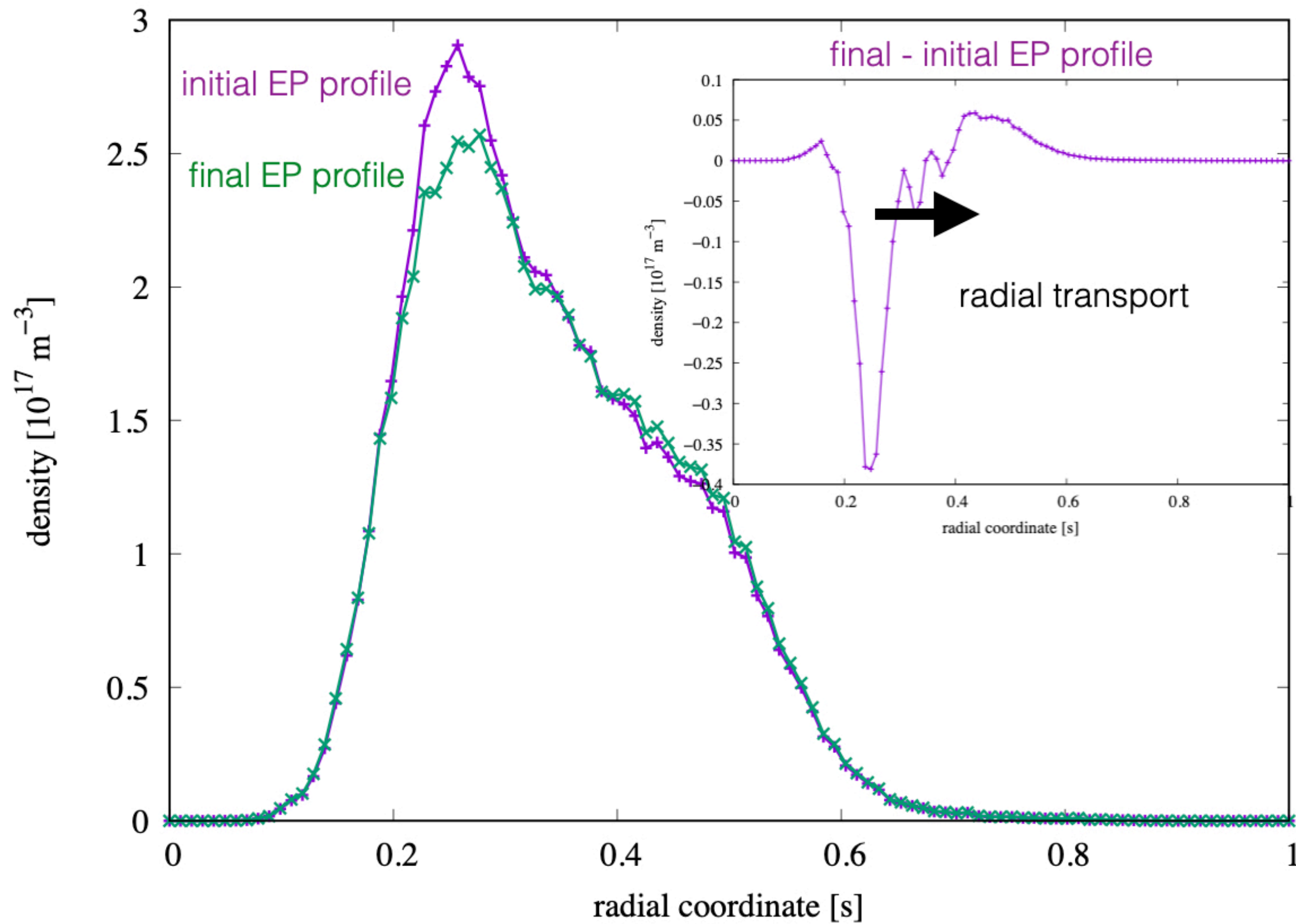


ATEP code [Ph. Lauber, G. Meng, 2022]



time

back-mapping and calculating moments given EP transport in physical units: example NBI at ITER



can be passed to transport/equilibrium code

[Lauber, FEC 2023]