

# **LIGKA/HAGIS WF**

## **porting to gateway, coupling to ETS, benchmarking to CASTOR**

### **update 9.7.2021**

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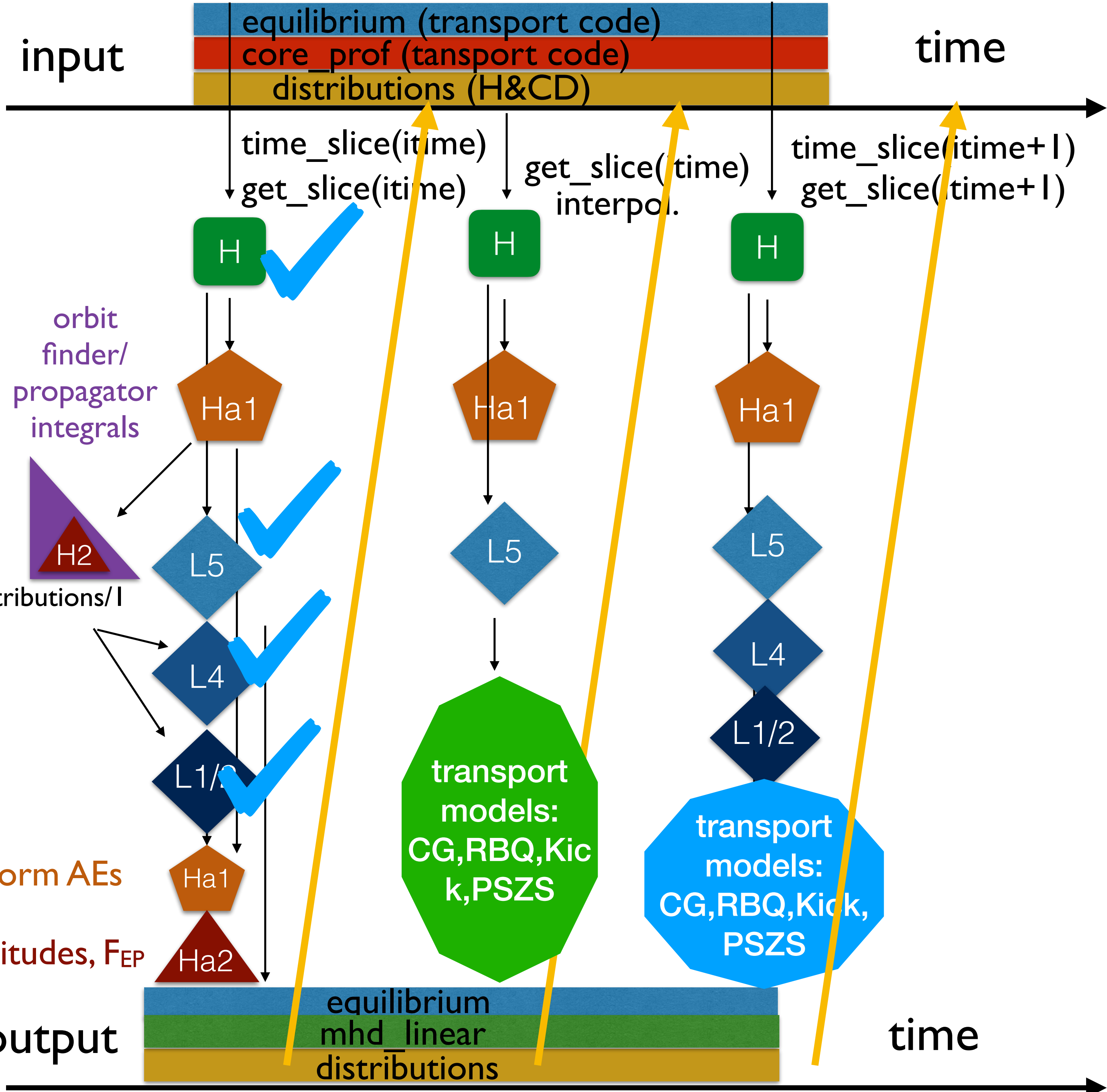
and ENR NLED, NAT, MET teams

special acknowledgements to:

F. Zonca, Z.Lu, M. Falessi, N. Carlevaro, A. Bierwage, S. D. Pinches, M. Schneider, O. Hoenen, M. Vallar  
and ITPA EP group

# EP WORKFLOW SCHEMATICS

- ✓ ported to gateway
- ✓ read ETS generated data
- ✓ read trview generated AUG data



HELENA

HAGISI - equilibrium

LIGKA mode 5/6

LIGKA mode 4

LIGKA mode 1/2

HAGISI - transform AEs

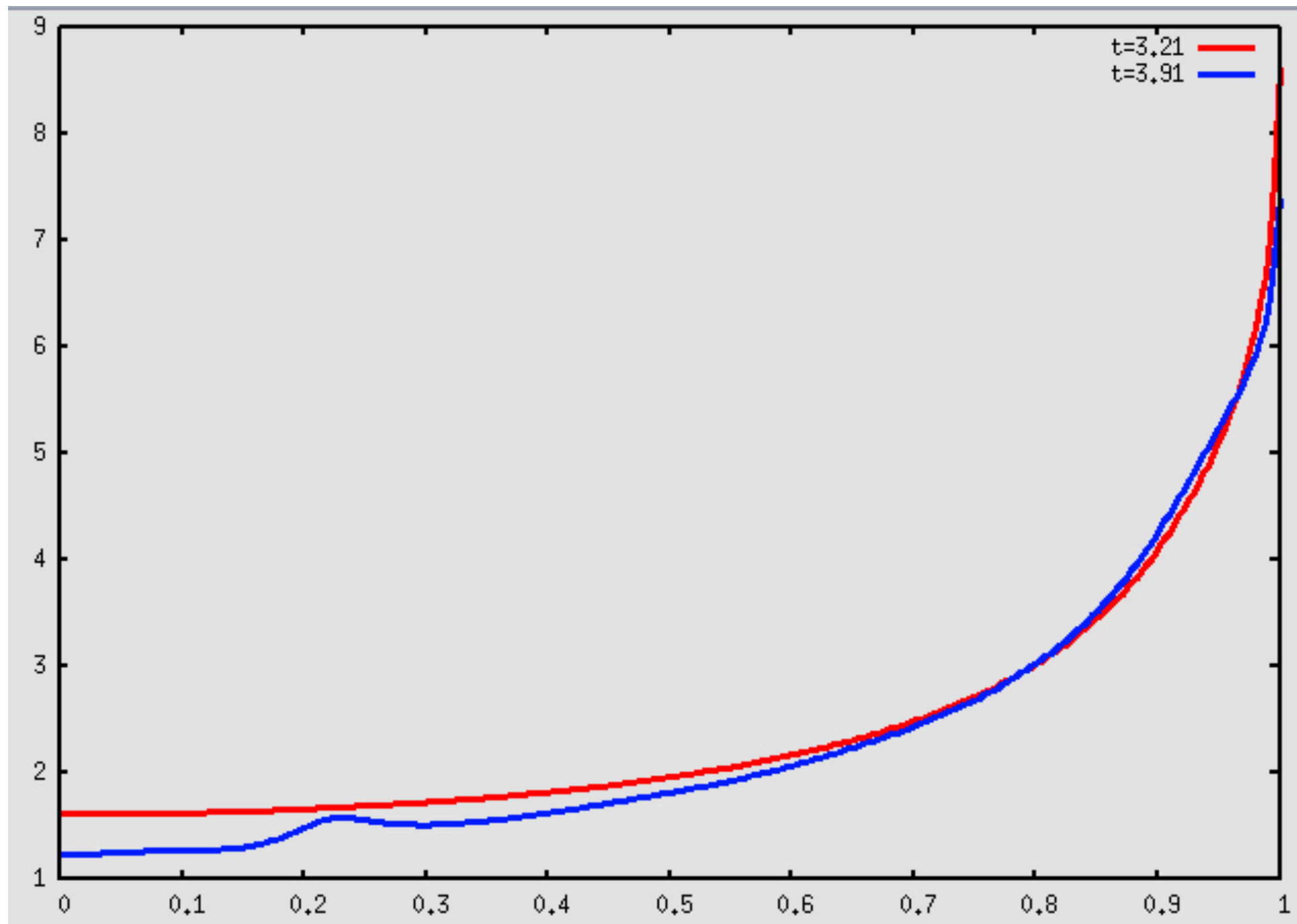
HAGIS2: add sat. amplitudes,  $F_{EP}$

output

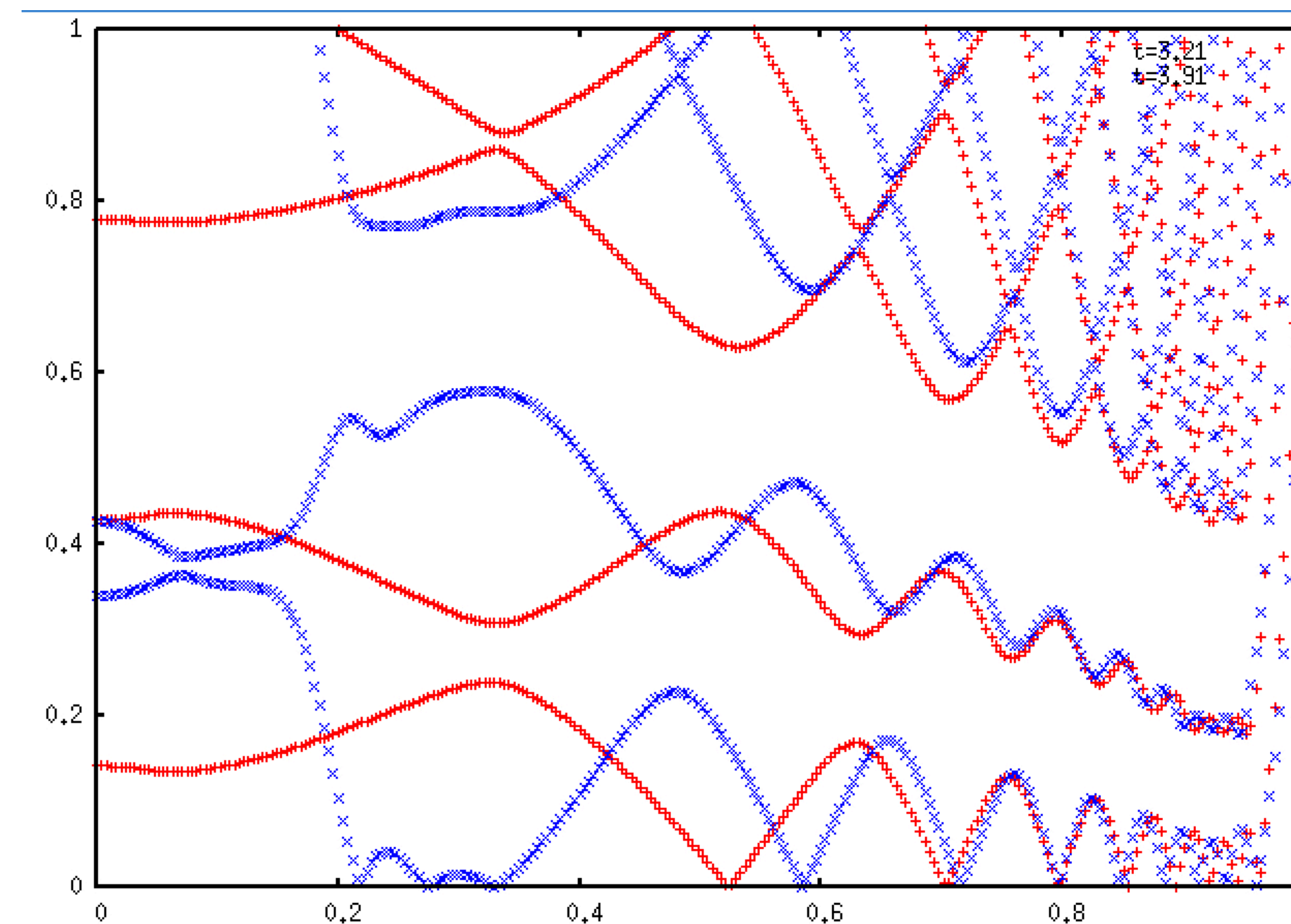
equilibrium  
mhd\_linear  
distributions

time

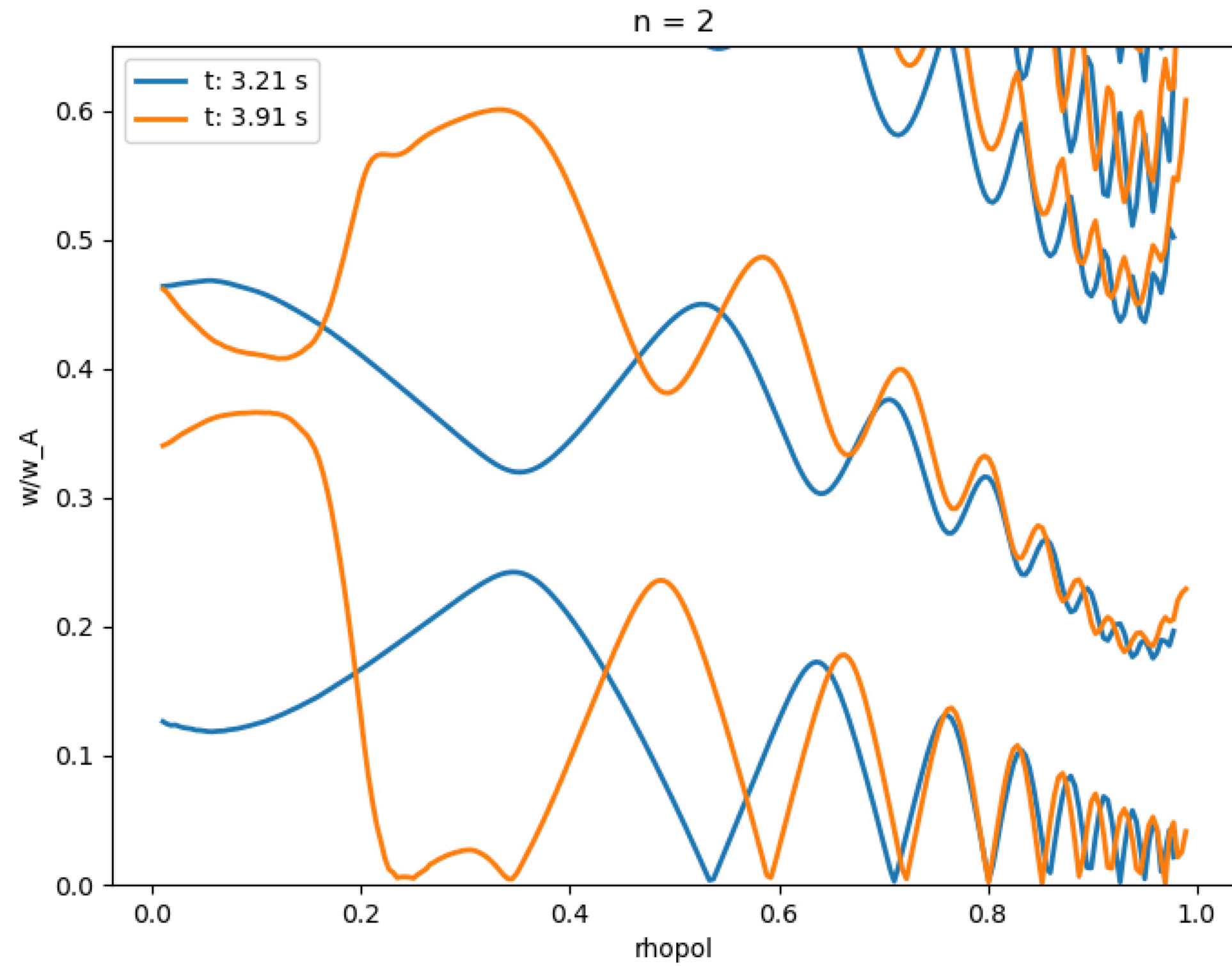
AUG observation: switching on core ECCD at 3.5s, n=2 TAE disappear



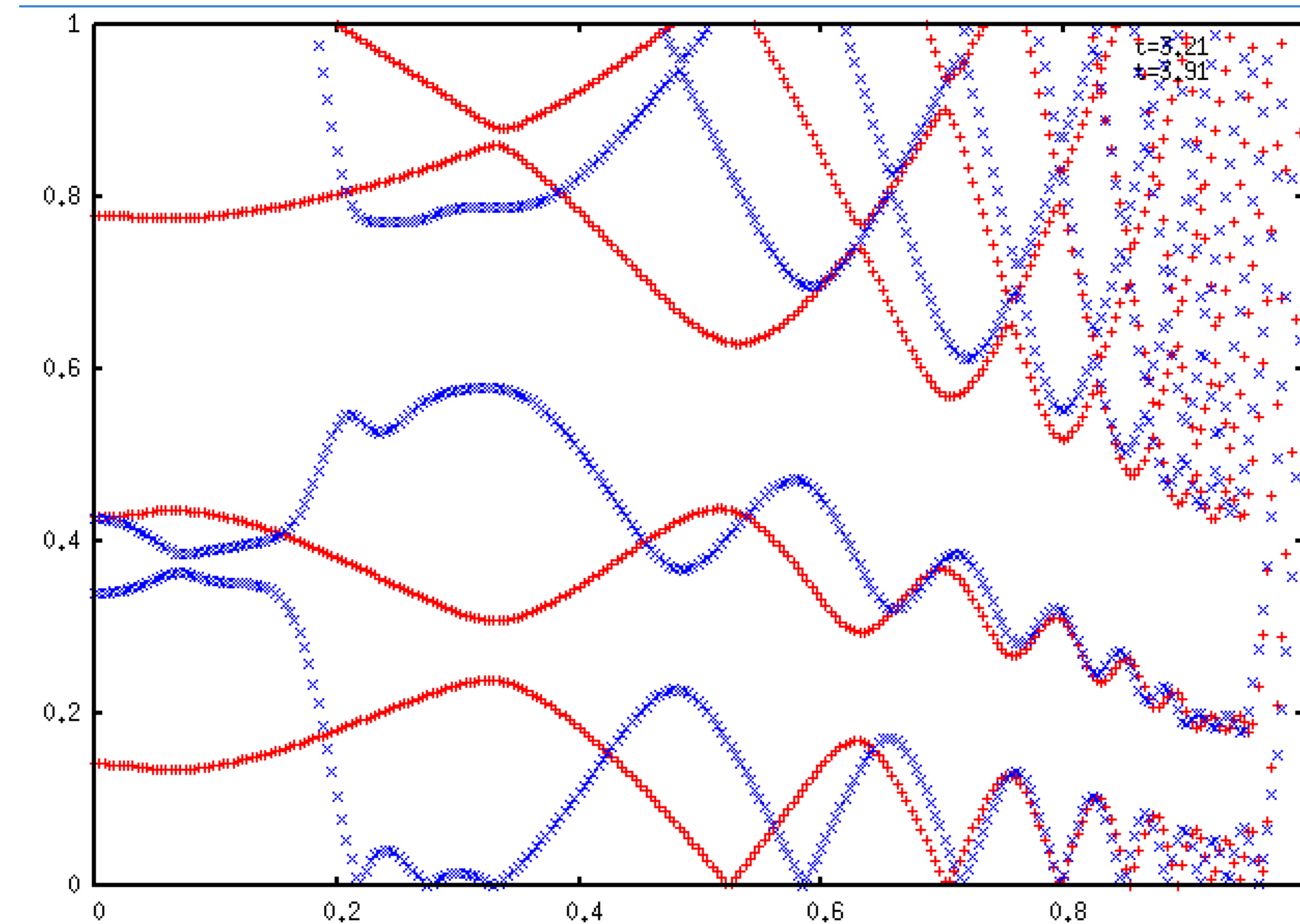
ITER helena IMAS version



LIGKA mode 6



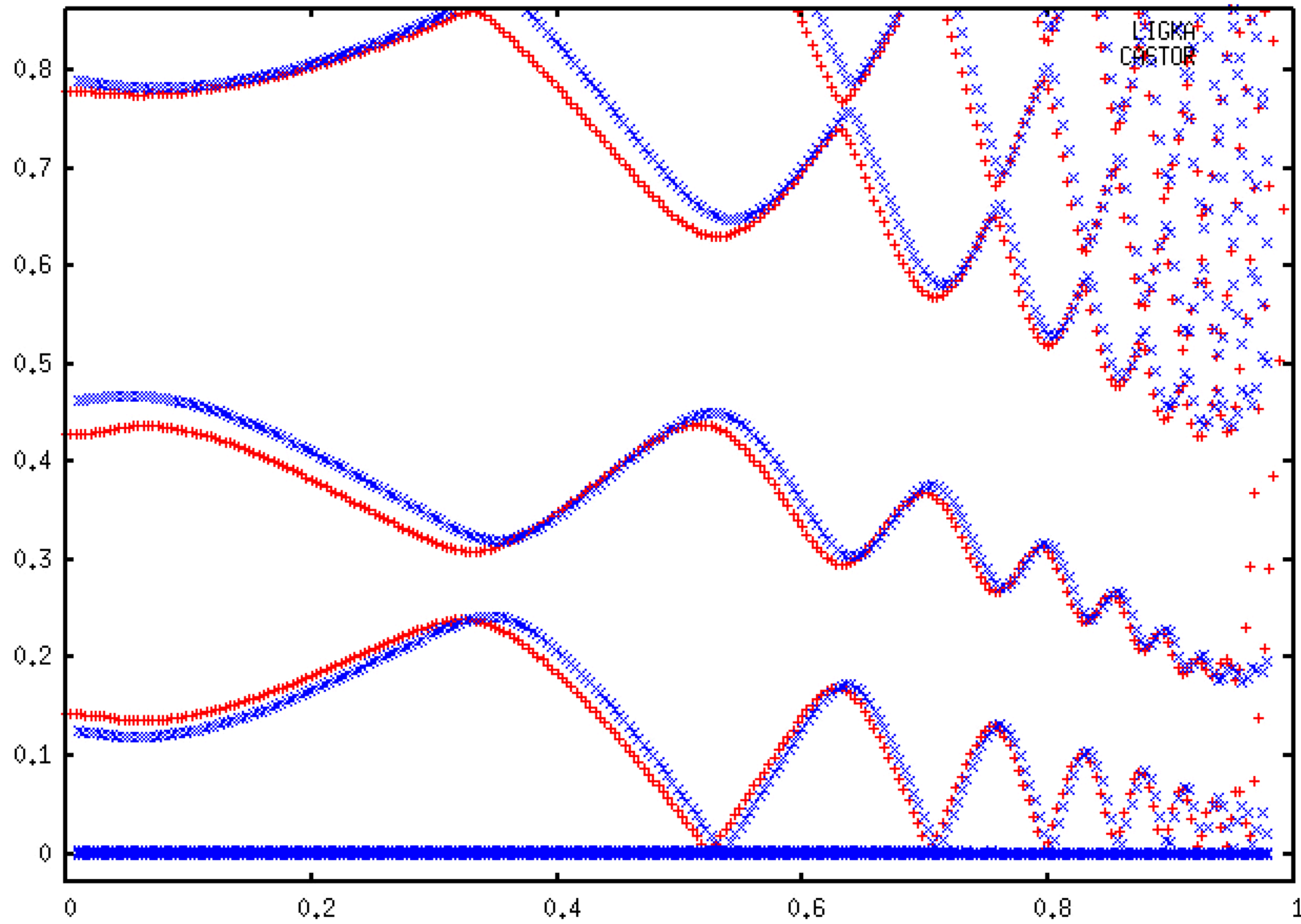
CASTOR



LIGKA mode 6

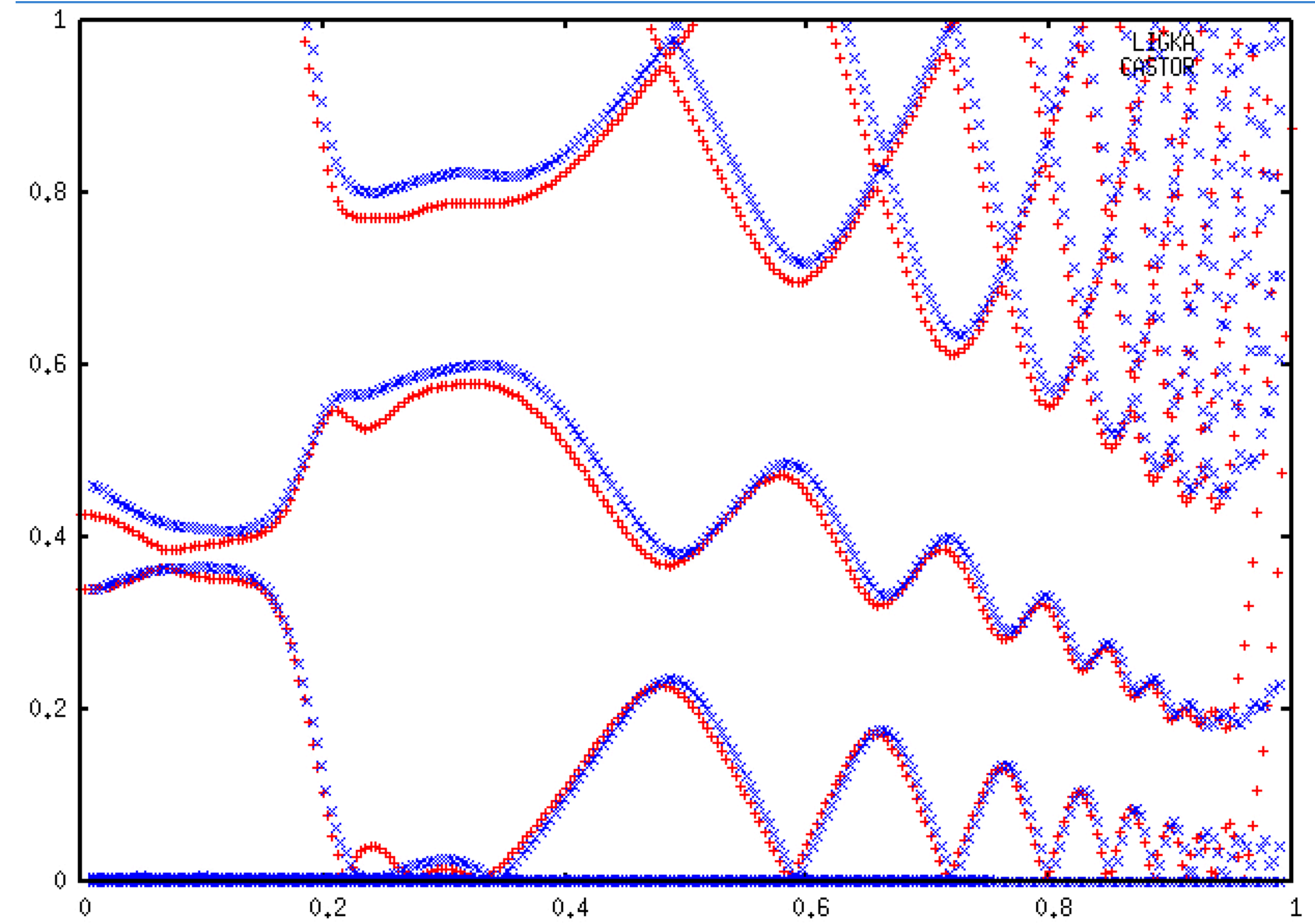
good agreement, except details of q in very core for the ECCD time slice....

t=3.21

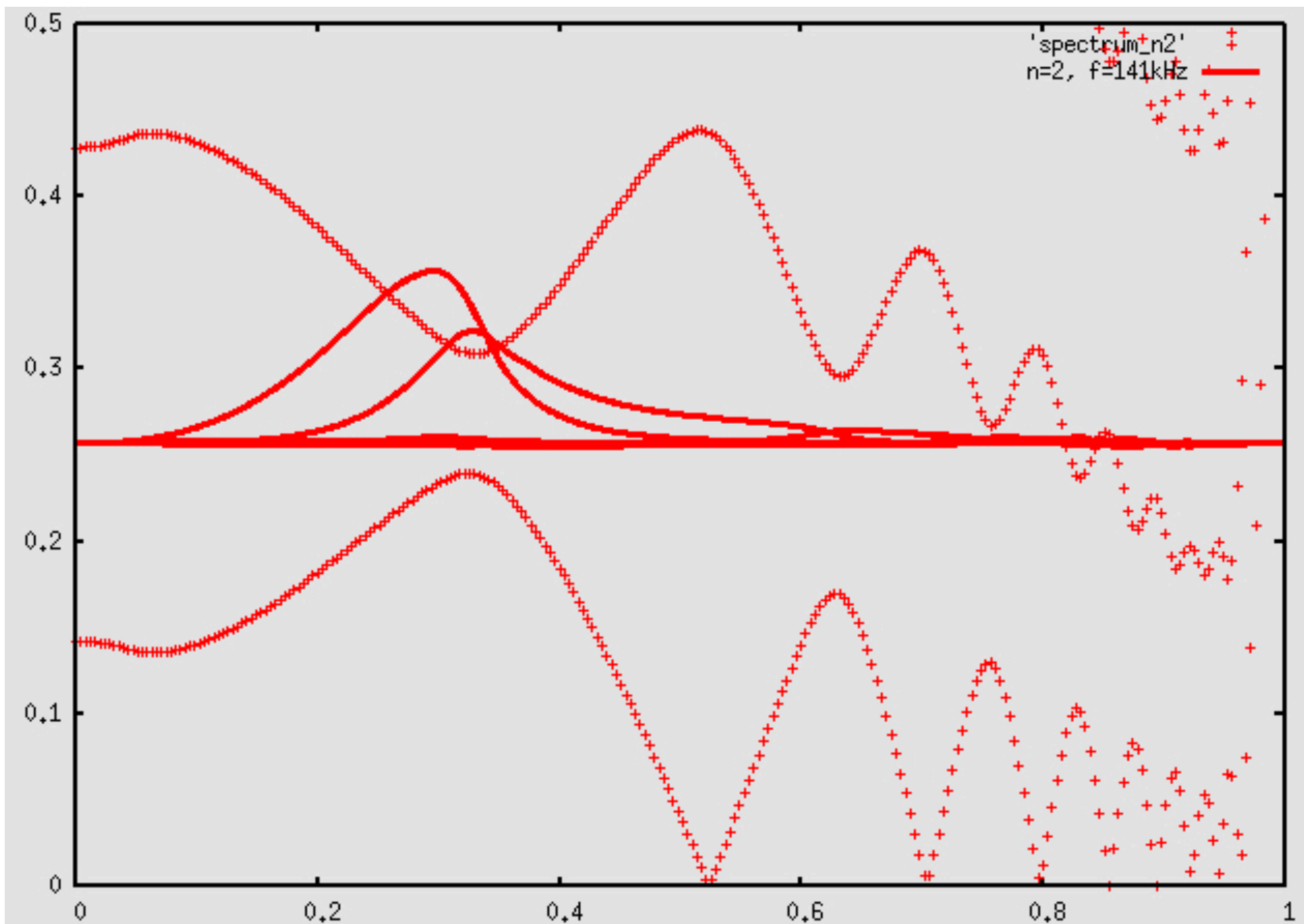


LIGKA CASTOR

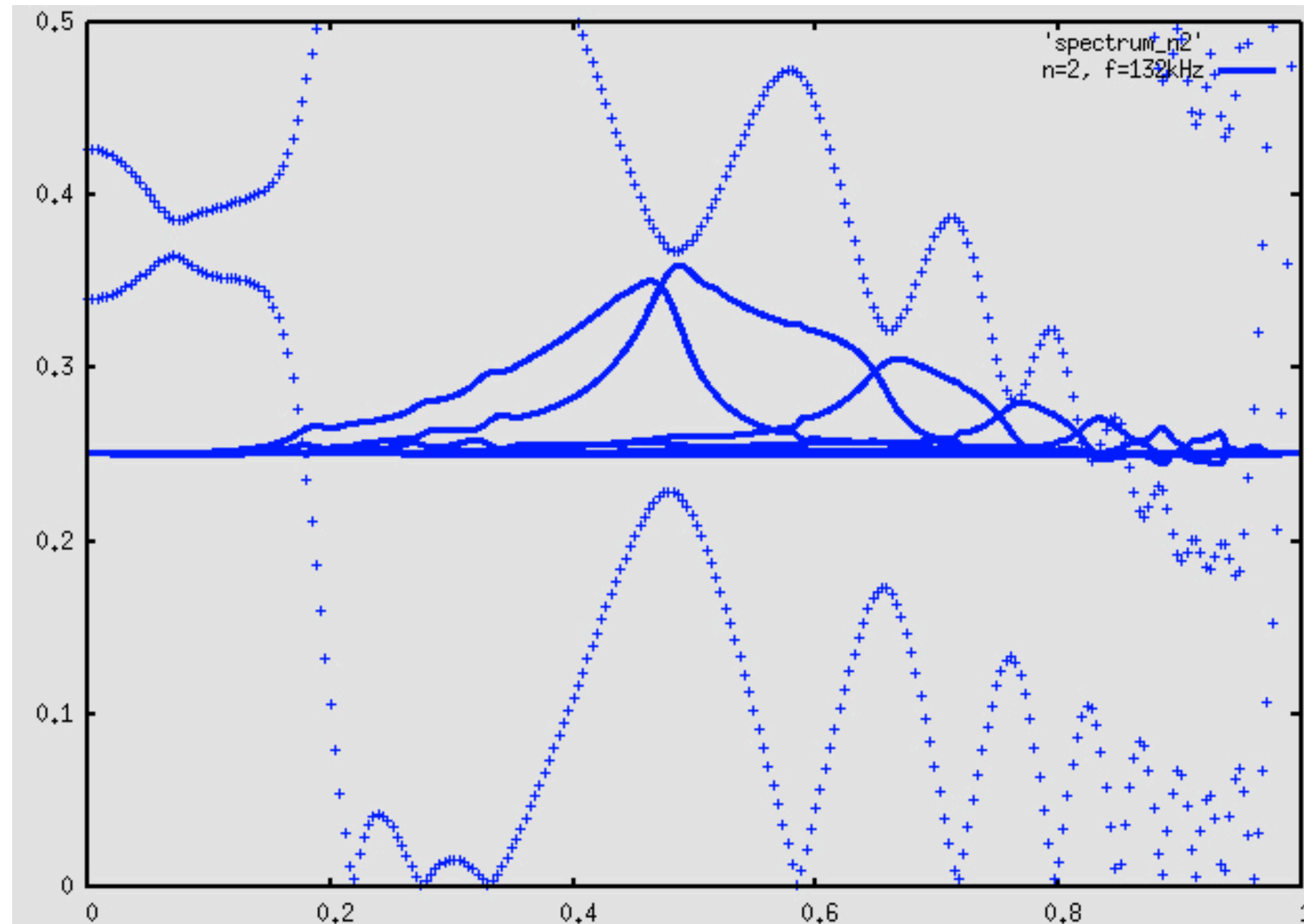
t=3.91



LIGKA CASTOR

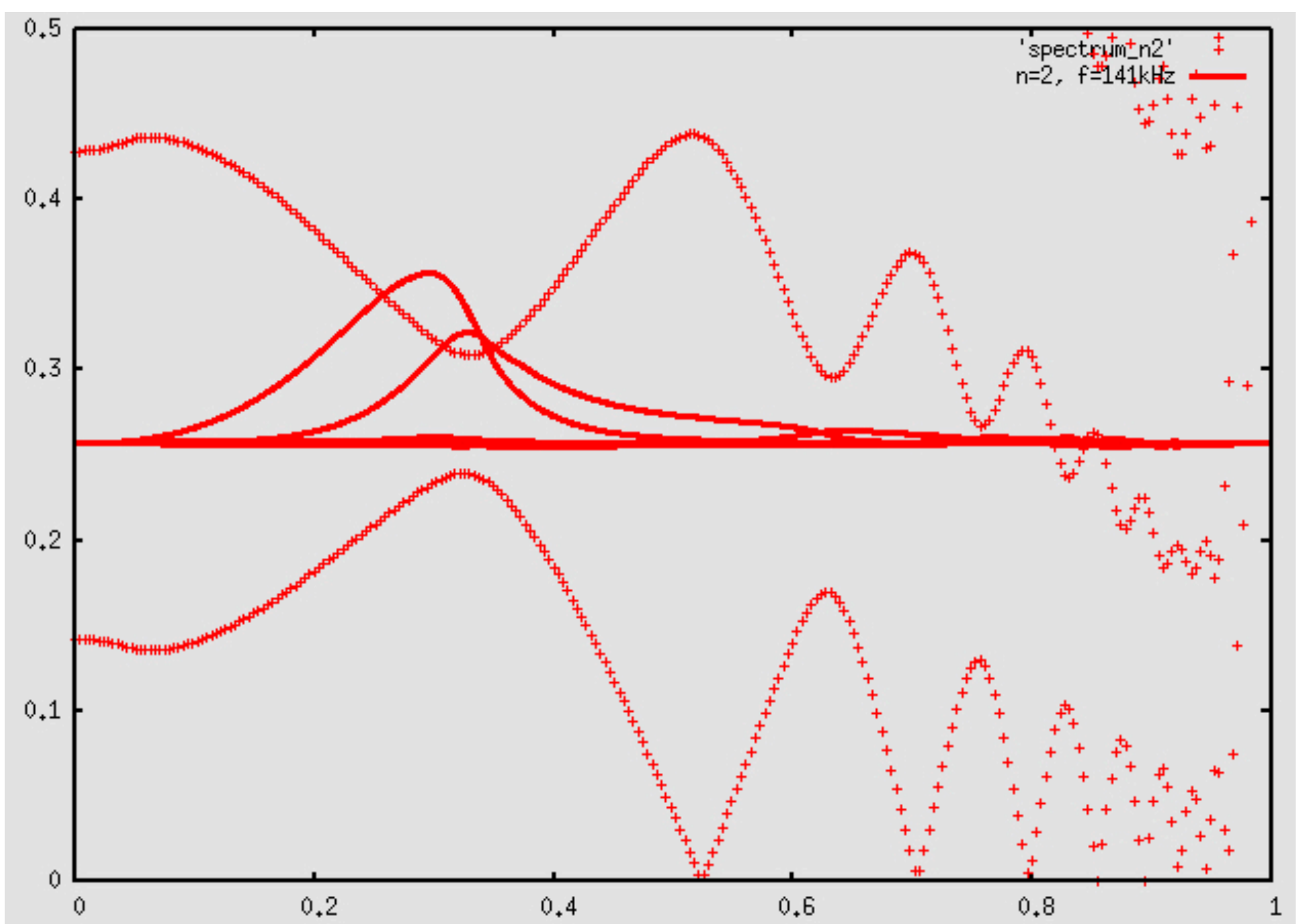


t=3.21:  
 radial pos [s] : 0.333933393339334  
 q of rat. surface : 1.74992581171410  
 n\_tor : 2  
 m\_pol : 3.000000000000000  
 f[kHz] : 141.098790181049  
 w/wA : 0.256870000000000  
 damping/growth rate [%] : -0.375164195262852 [%]  
 damping/growth rate : -3326.01759282279 [1/s]

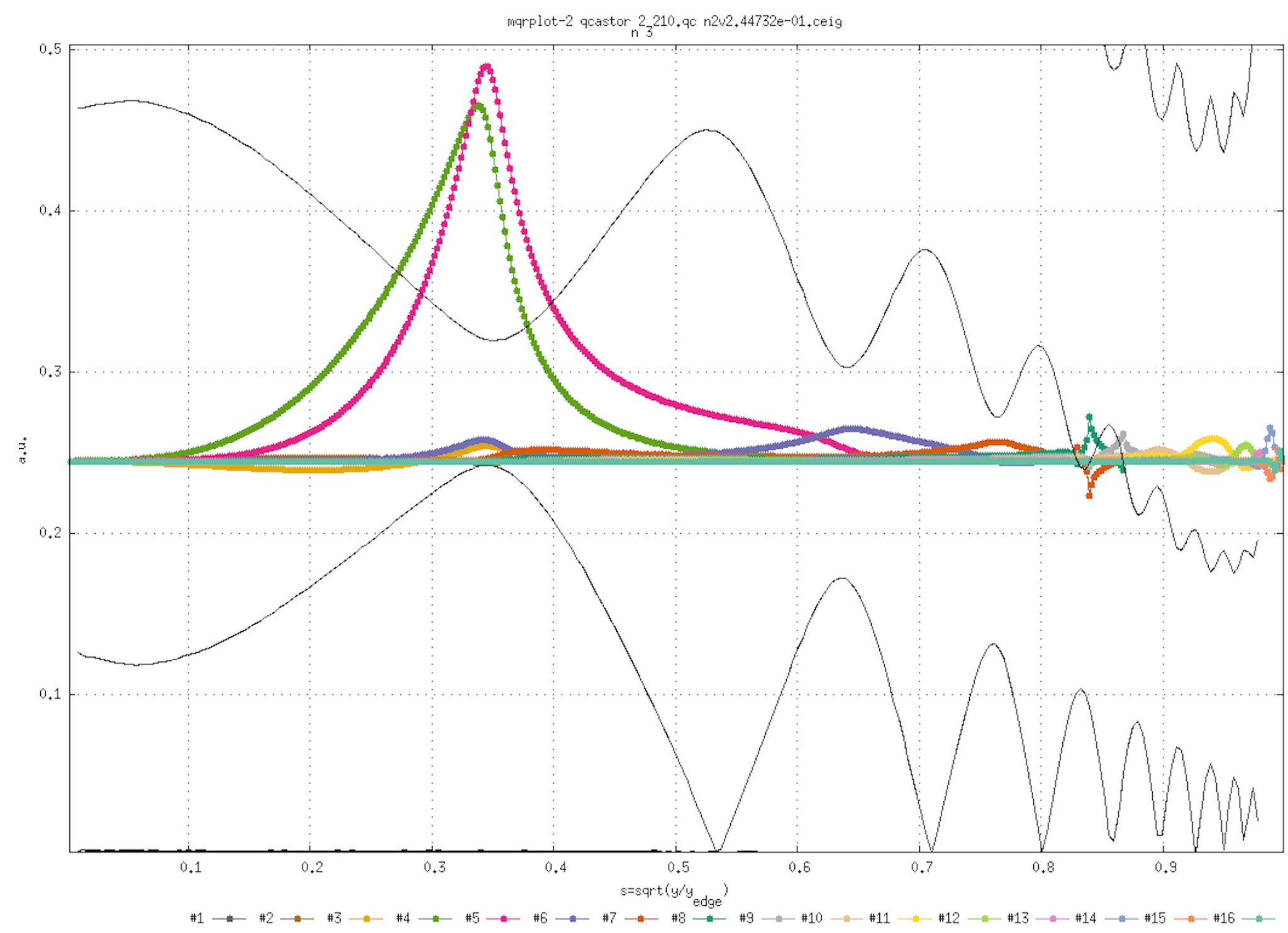


t=3.91:  
 radial pos [s] : 0.482748274827483  
 q of rat. surface : 1.74982040215799  
 n\_tor : 2  
 m\_pol : 3.000000000000000  
 f[kHz] : 132.303577852924  
 w/wA : 0.250660000000000  
 damping/growth rate [%] : -0.292669494696365 [%]  
 damping/growth rate : 2432.92608602040 [1/s]

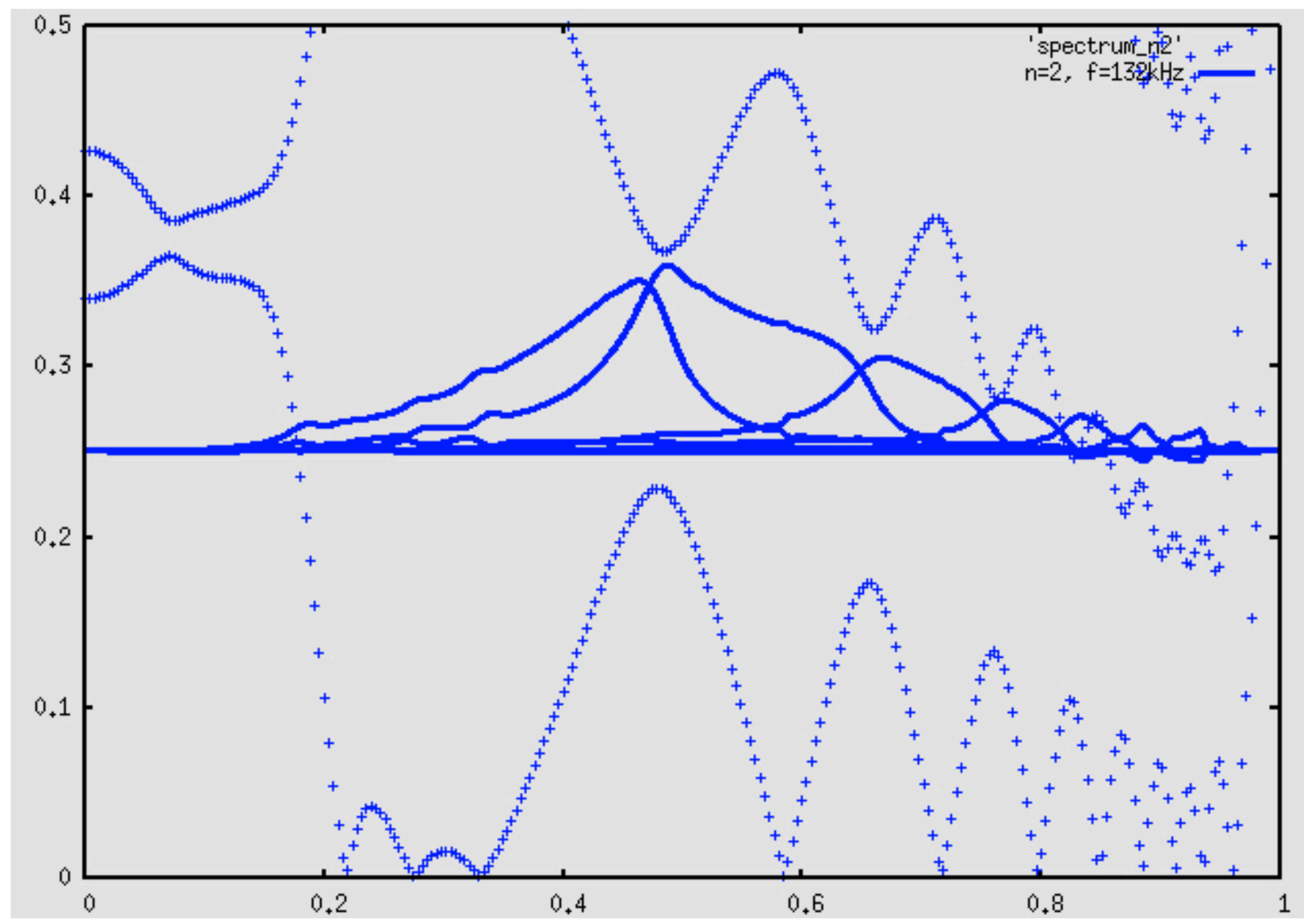
**smaller damping!**  
 (lower  $T_i, T_e$ , far from continuum)



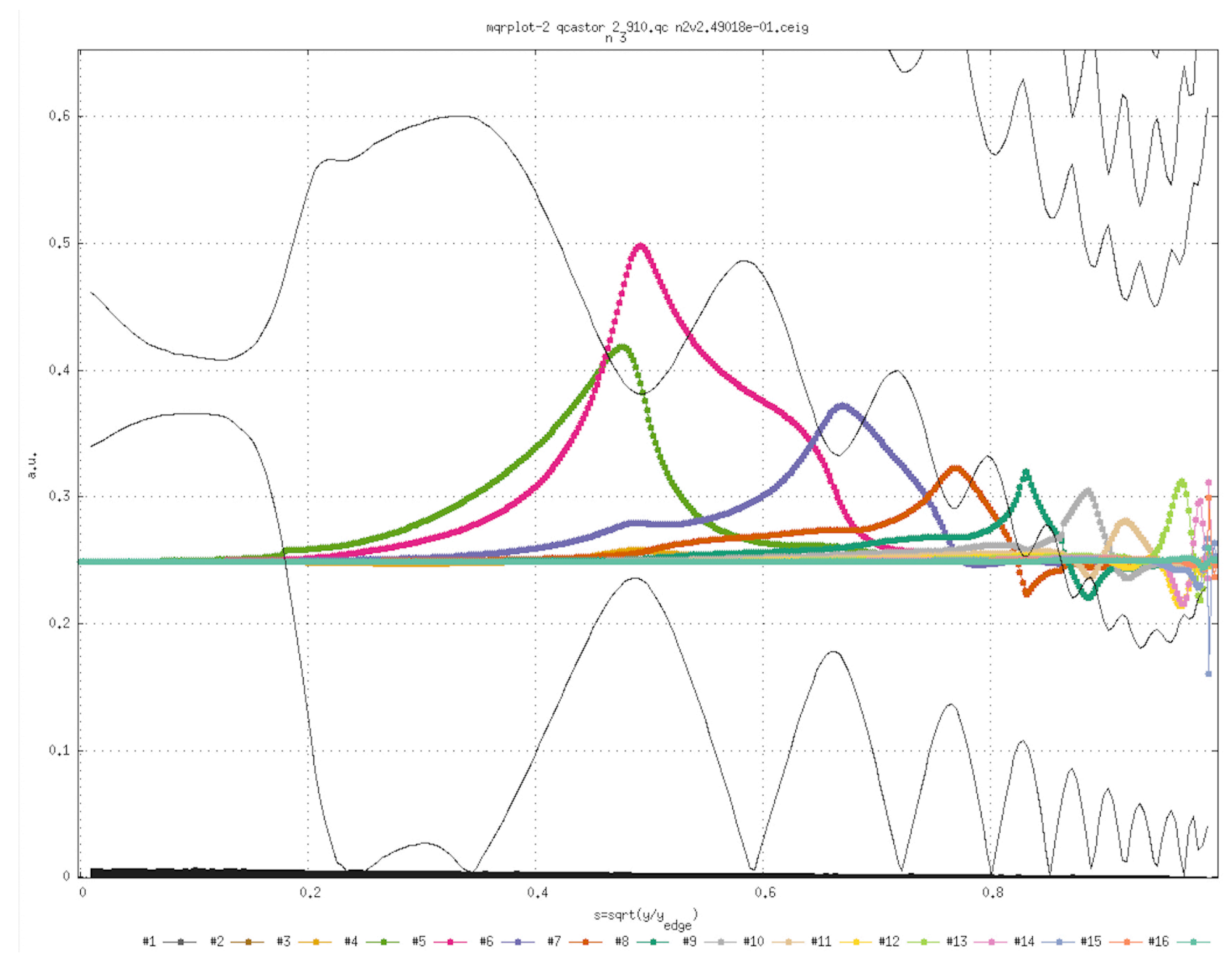
LIGKA



CASTOR



LIGKA



CASTOR



- start with critical gradient model, all ingredients ready (physics is not sufficient, but many technicalities can be solved; use as reference)
  - next: use HAGIS with estimated fixed mode amplitudes to calculate phase space resolved  $P_\Phi$  transport (kick-model like, not decided if probability matrices will be used like in [Podesta, 2016-2021])
  - advanced EP transport models (to be implemented and tested in ENR ATEP [M Falessi et al])
  - compare to non-linear multi-mode HAGIS and ORB5
- validation: AUG cases with modified background  $T_i$  (and possibly current?) found in scenarios with strong EP-driven mode activity, ETS-AUG ECCD case, JT-60SA, TCV, others? JET? (with A. Bierwage AE stability, fall 2020)