PT_SOLVER vs TGYRO Comparison (TGLF)

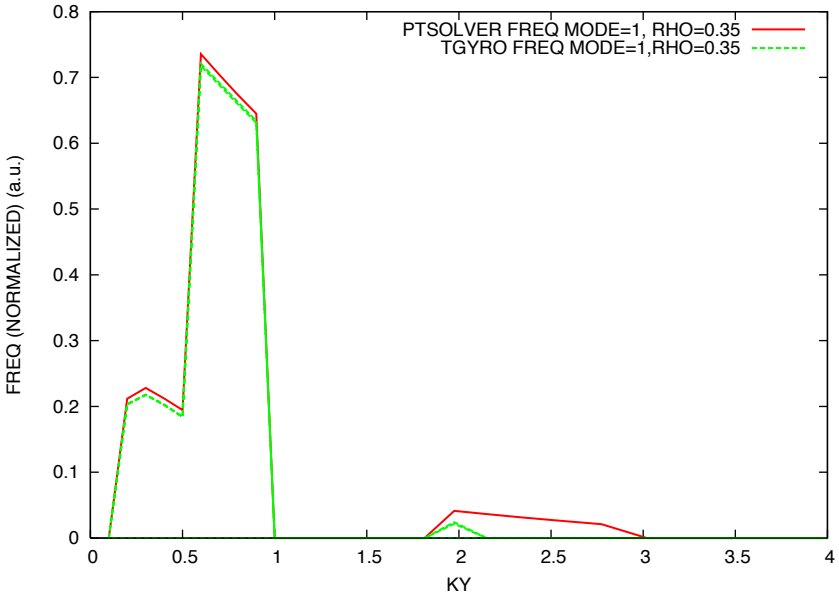
S. Kaye

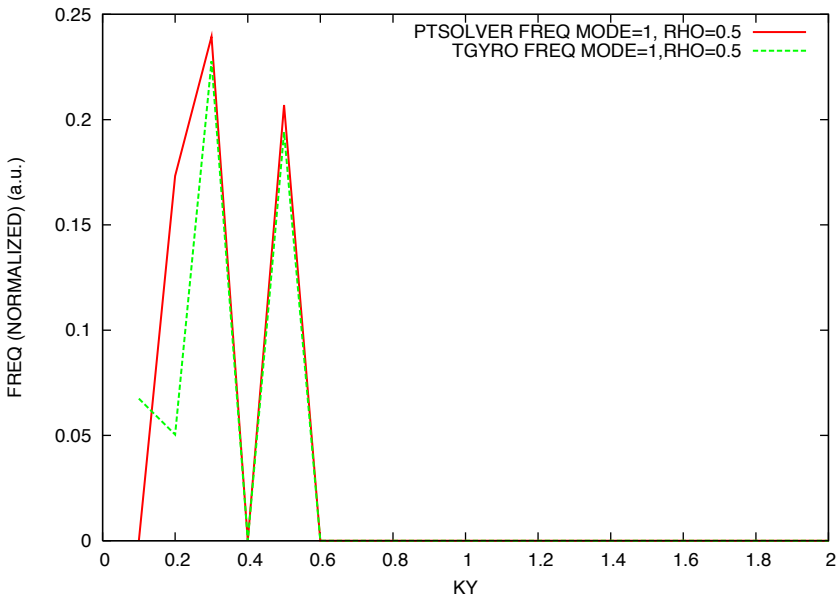
X. Yuan

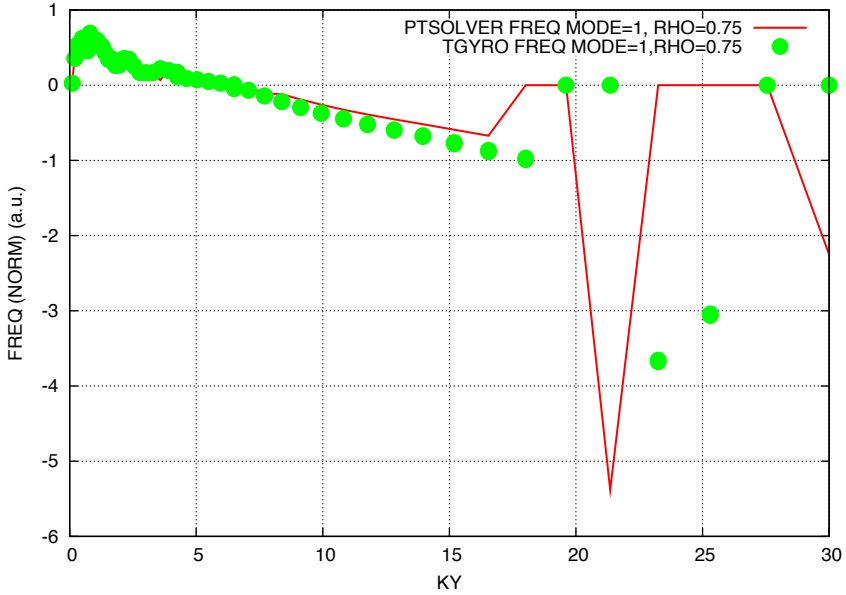
Motivation: Initial comparisons I did showed poor agreement between TGYRO and PT_SOLVER wrt underlying modes and their growth rates and real frequencies

- Difficulty getting TGYRO to converge for predicting temps.
- X. Yuan carefully reran TGYRO cases using his namelist settings
- Based on NSTX L-mode (where ITG/TEM modes could be impt)
- Point of comparison was not to try to match exptl temps (which neither did by a long shot!)

Carefully run cases showed good agreement between PT_SOLVER and TGYRO (both using TGLF as a basis)

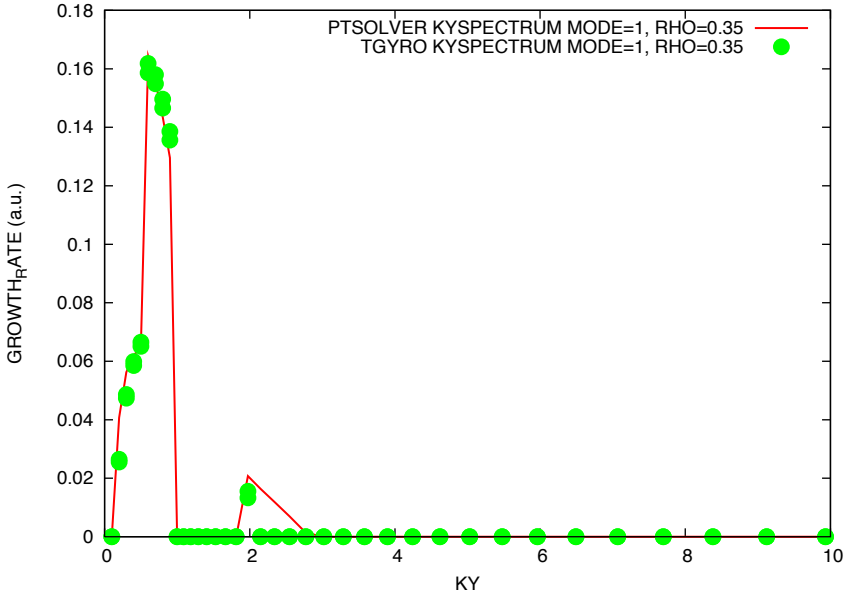


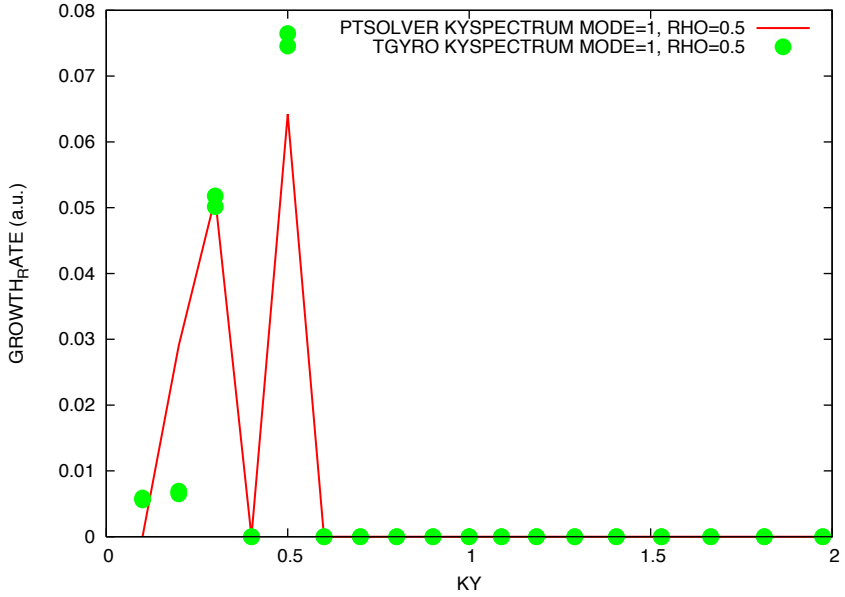


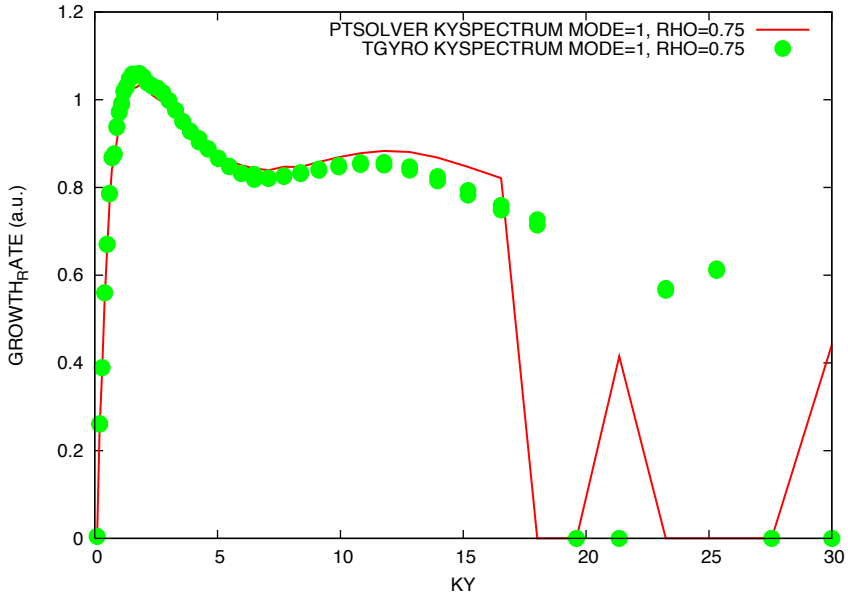


Real Frequency

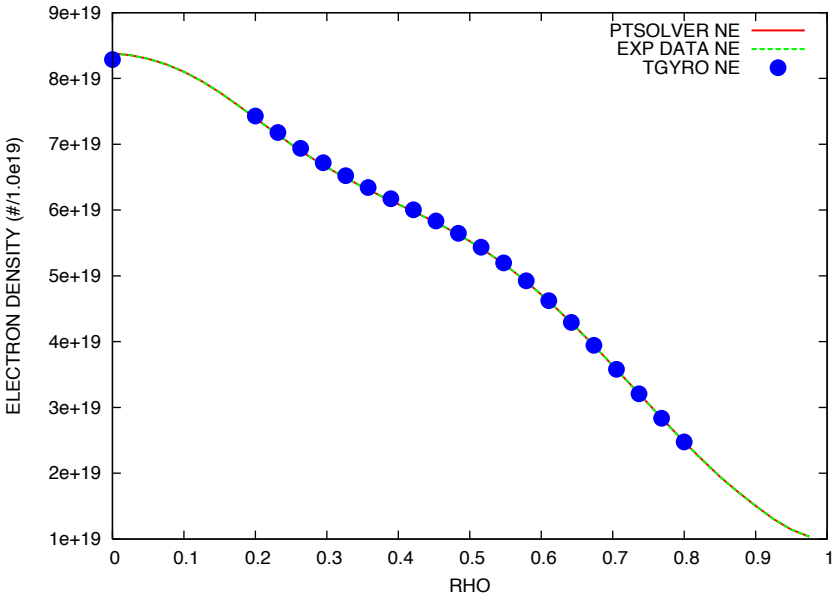
Growth Rate

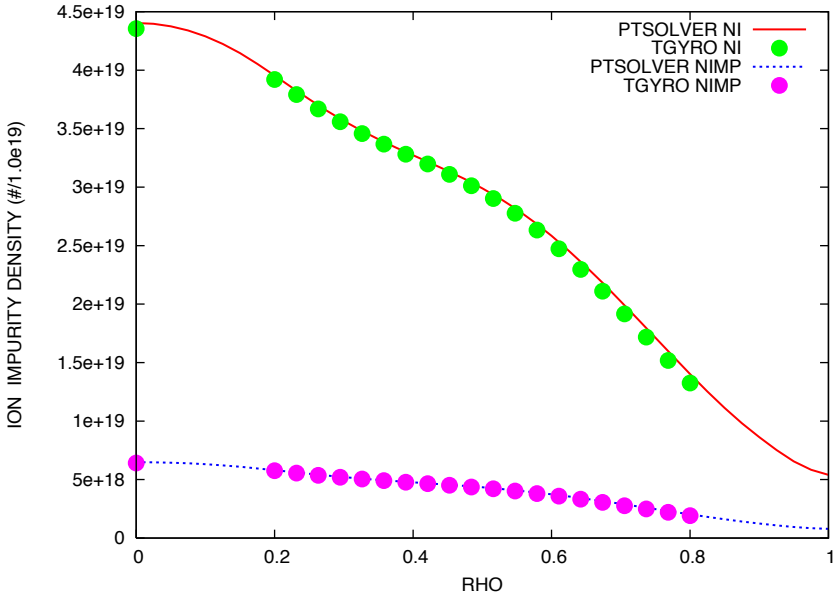

PTSOLVER KYSPECTRUM MODE=1, RHO=0.35
TGYRO KYSPECTRUM MODE=1, RHO=0.35
GROWTH_RATE (a.u.)
KY
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10


PTSOLVER KYSPECTRUM MODE=1, RHO=0.5
TGYRO KYSPECTRUM MODE=1, RHO=0.5
GROWTH_RATE (a.u.)
KY
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.5
1
1.5
2

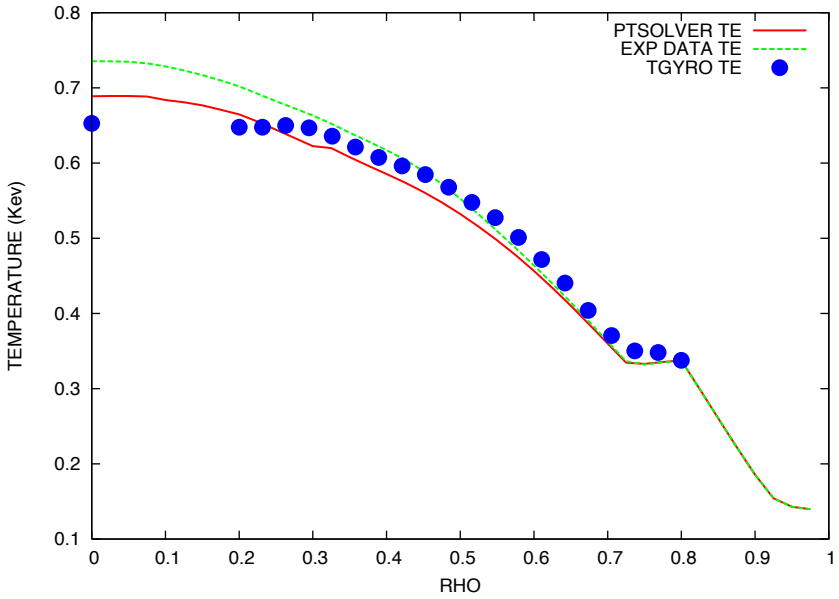

PTSOLVER KYSPECTRUM MODE=1, RHO=0.75
TGYRO KYSPECTRUM MODE=1, RHO=0.75
GROWTH_RATE (a.u.)
KY
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30

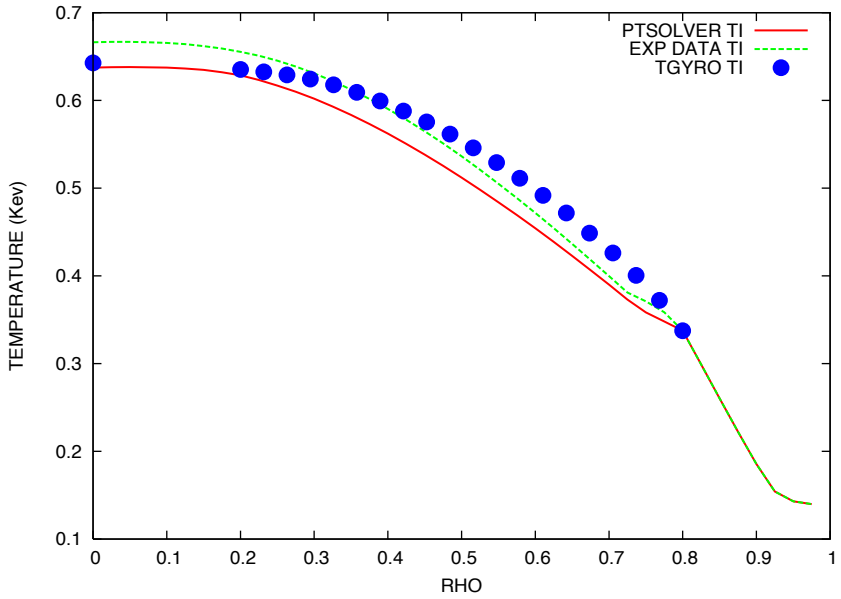
For this verification, keep it simple - only temps predicted -





Good agreement in temperature predictions Experimental values (in core) around 50% higher than predictions





Good agreement between PT_SOLVER and TGYRO predictions using TGLF (Limited verification successful!)

- Slight difference of standalone PT_SOLVER and PT_SOLVER inside TRANSP
  - Different equilibrium treatments (Miller vs numerical)
  - Time dependent (TRANSP) vs time independent (stand-alone PT_SOLVER
  - TGLF predictions in poor agreement with NSTX L-mode data (but that is not the point of this exercise)

Level of agreement can depend strongly on input settings

- Quasi-neutrality setting
  - PT_SOLVER assumes quasi-neutrality
  - Agreement with TGYRO not an issue if small number of thermal/impurity species (i.e., NSTX case)
  - An issue for ITER with large number of species: Find agreement only if quasi-neutrality is relaxed in TGYRO
    - PT_SOLVER more accurate predictor?
- Will also be investigating other parameters
- Recommendation (strong): justify use of reduced model (through comparison with gyrokinetics) prior to using for temperature prediction