# CDXU……

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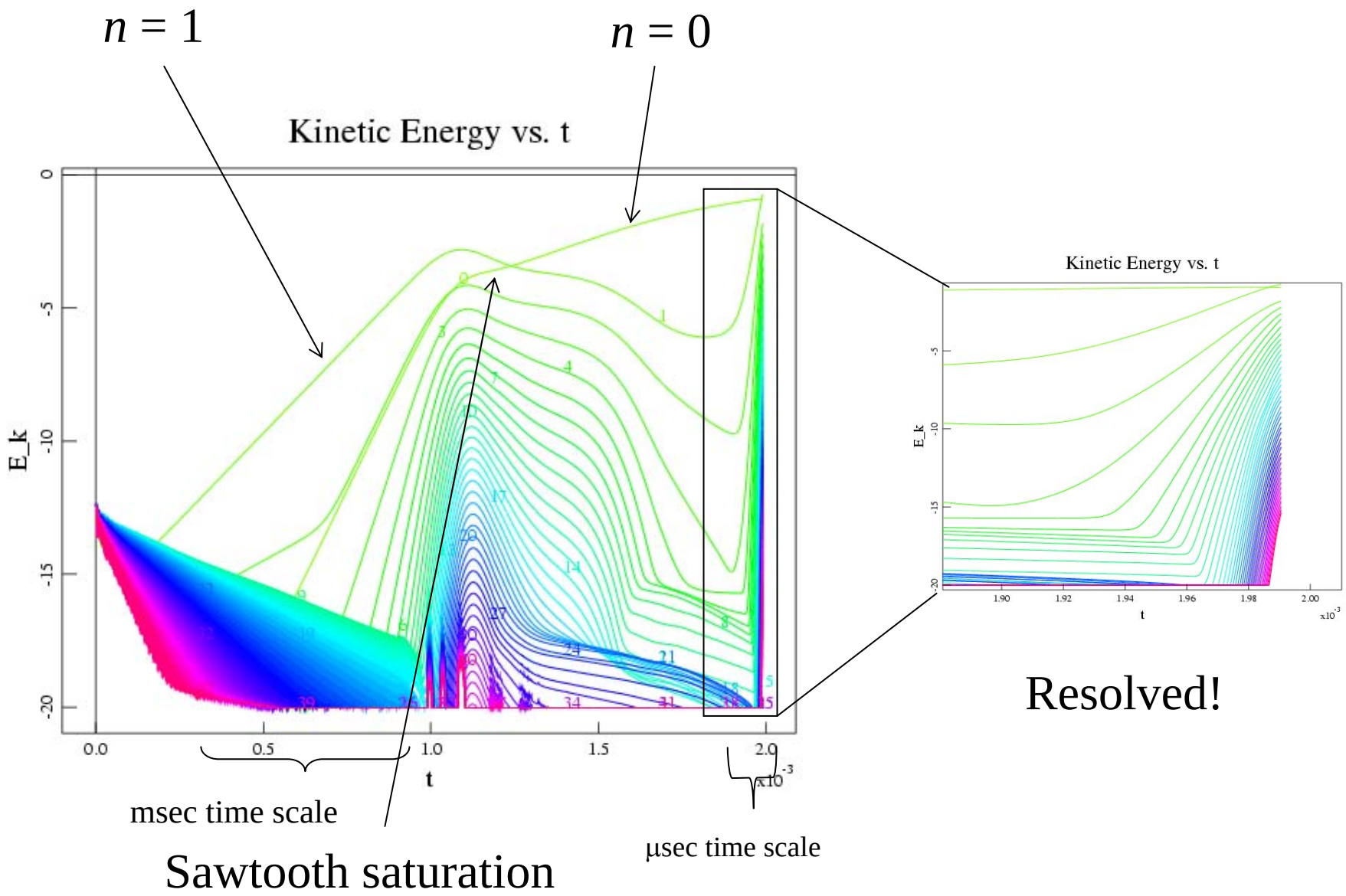
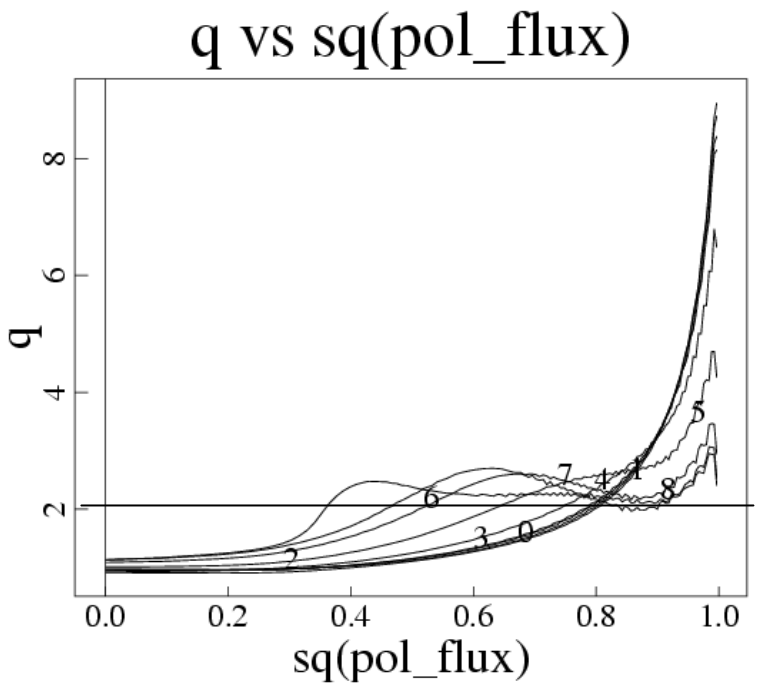
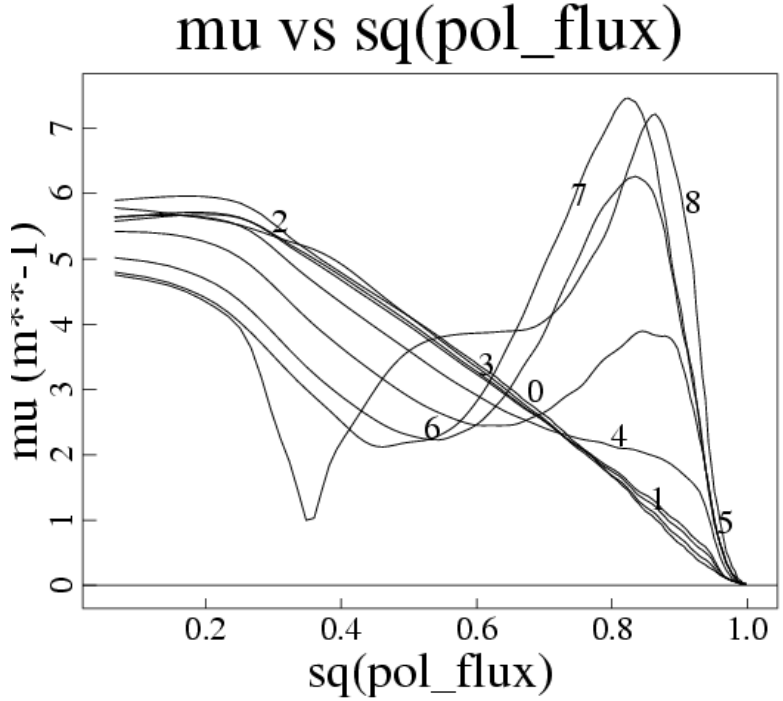
# Nonlinear CDXU Evolution

- nmax=41 (n=0-41)
- mx=my=30
- nxbl=nybl=2, nlayers=41 (164 PEs)
- $S$=2.06 X $10^4$
- $q_0$ = 0.98
- Pr=10
- eta_model=“eta_full”
- K_perp=200, K_par=$10^8$
- Ohmic heating
- **** nd_diff = 1000 $m^2$/sec (~ same results with 50 $m^2$/sec)

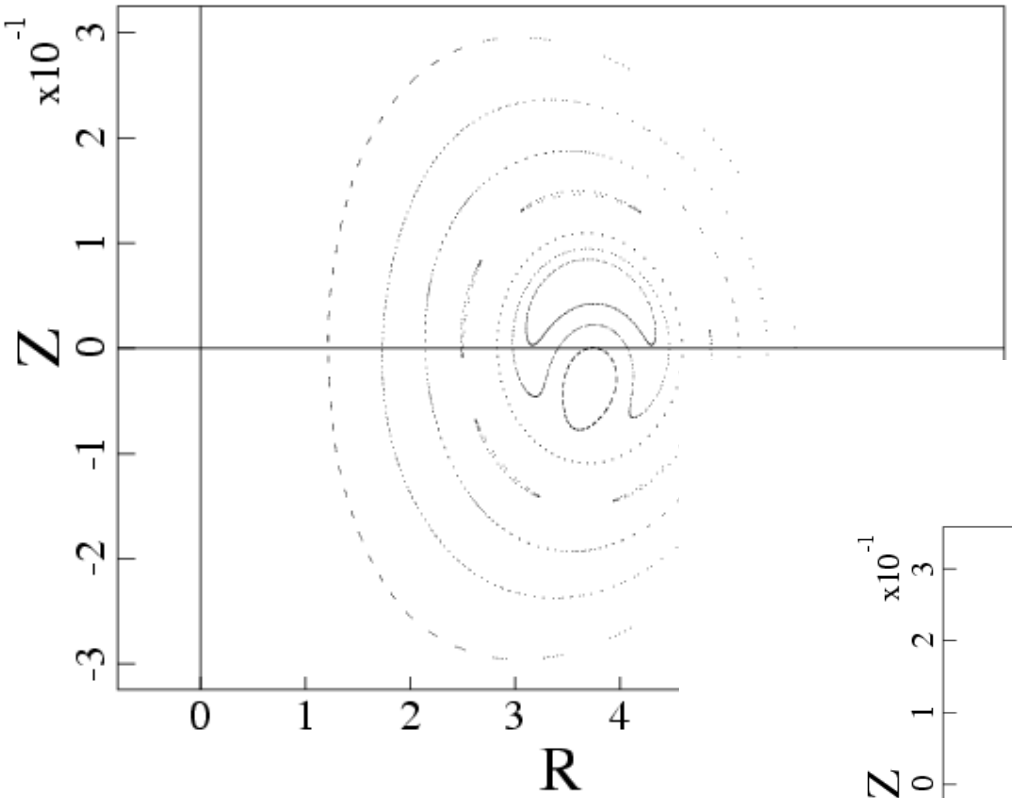

n = 1
n = 0
Kinetic Energy vs. t
E_k
t
x10^-3
msec time scale
μsec time scale
Sawtooth saturation
Kinetic Energy vs. t
Resolved!



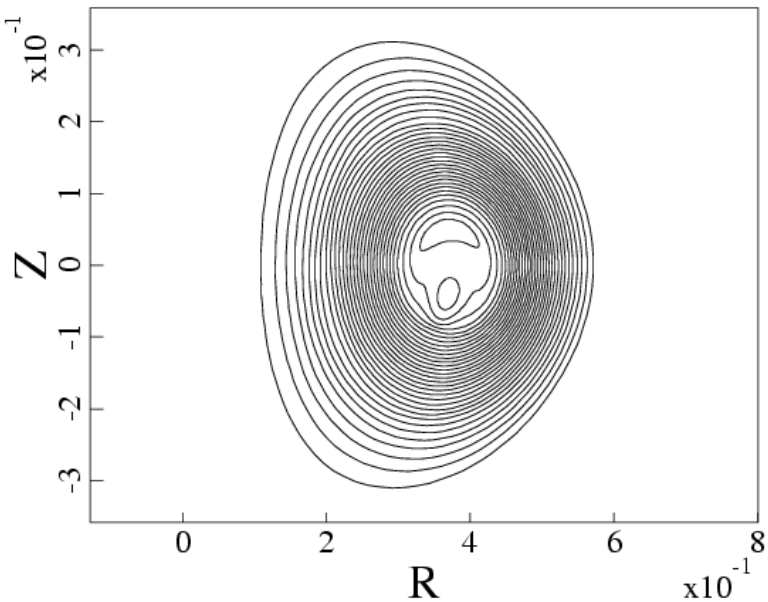




- $q_0$ raised above 1 during sawtooth
- Parallel current steepens near edge
- $q$ decreases at edge, flattens
- Clamps near $q = 2$

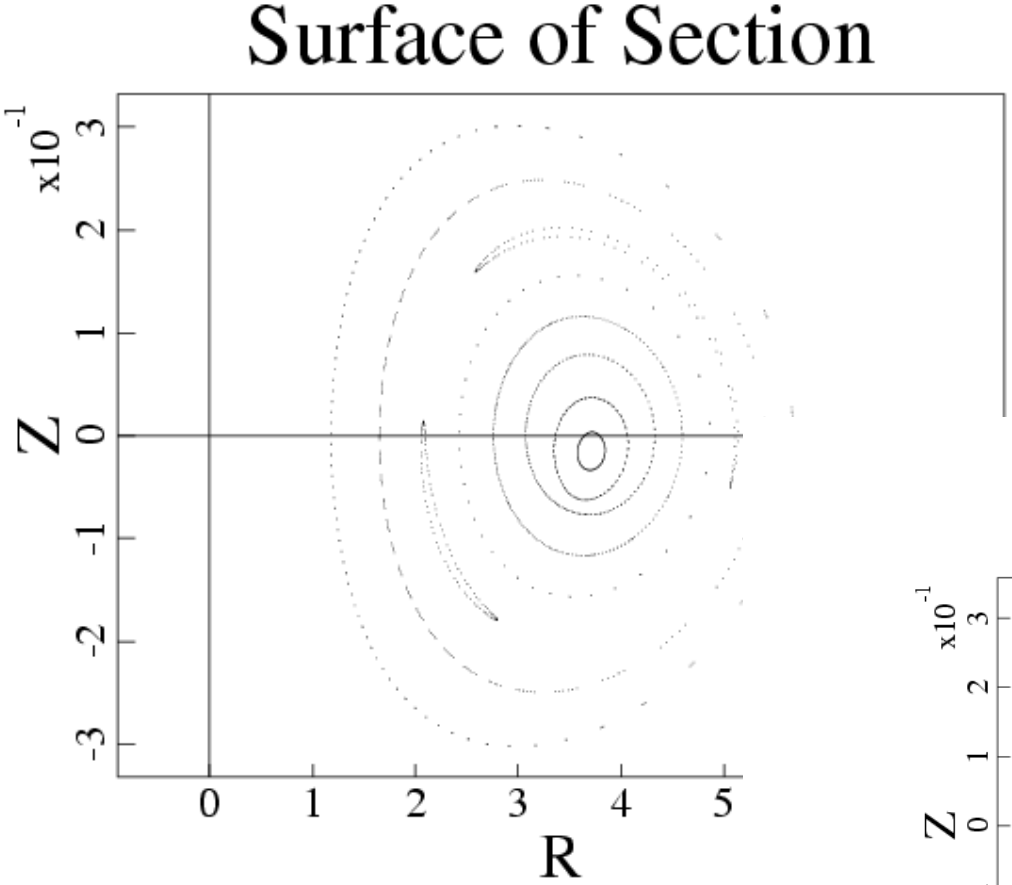
# Surface of Section



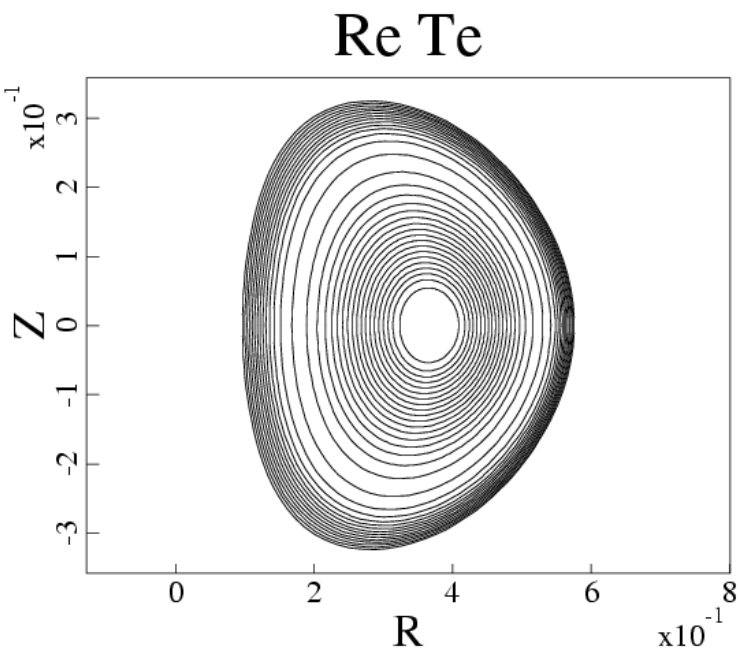

Re Te




- $t = 1.08 \times 10^{-3}$ sec
- Near sawtooth saturation

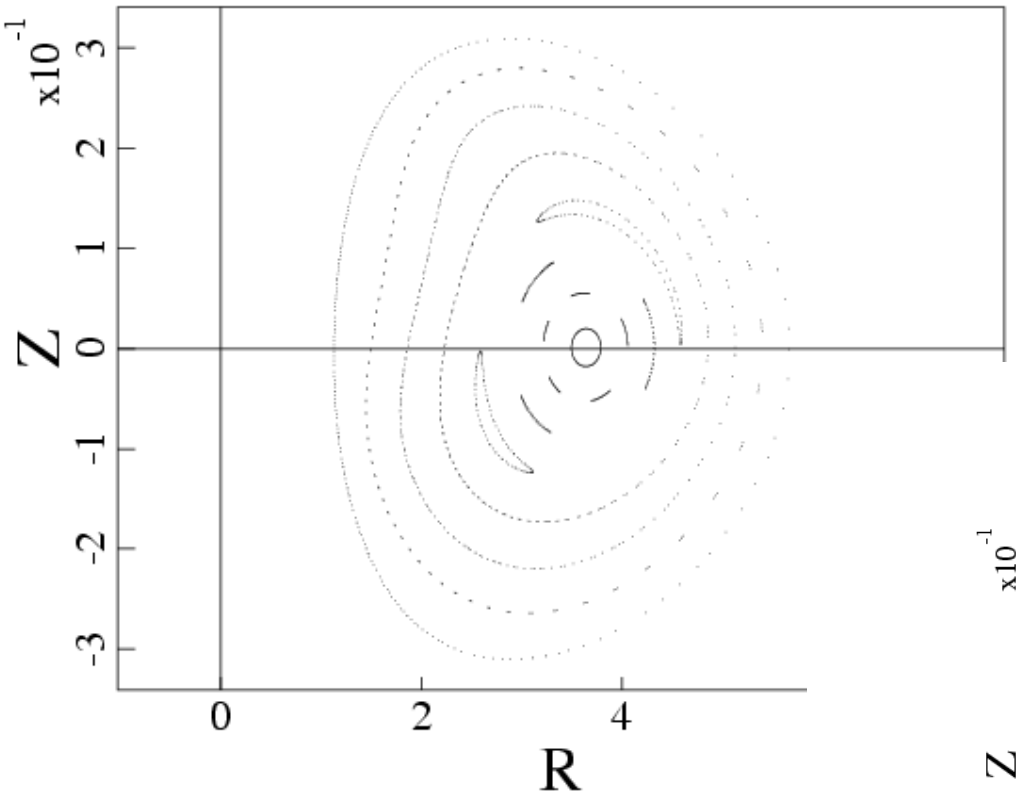



No stochasticity

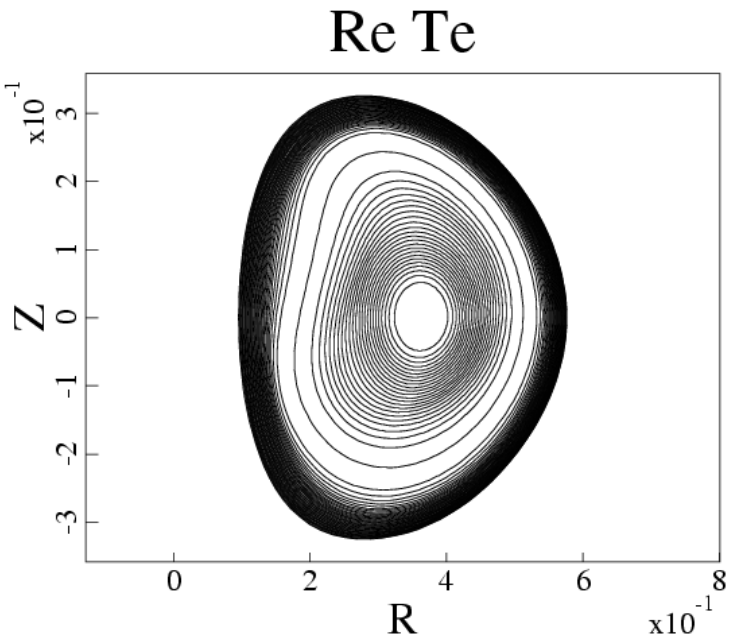



- $t = 1.77 \times 10^{-3}$ sec
- After sawtooth saturation
- Note steepening temperature profile at edge (flattening in core??)

# Surface of Section

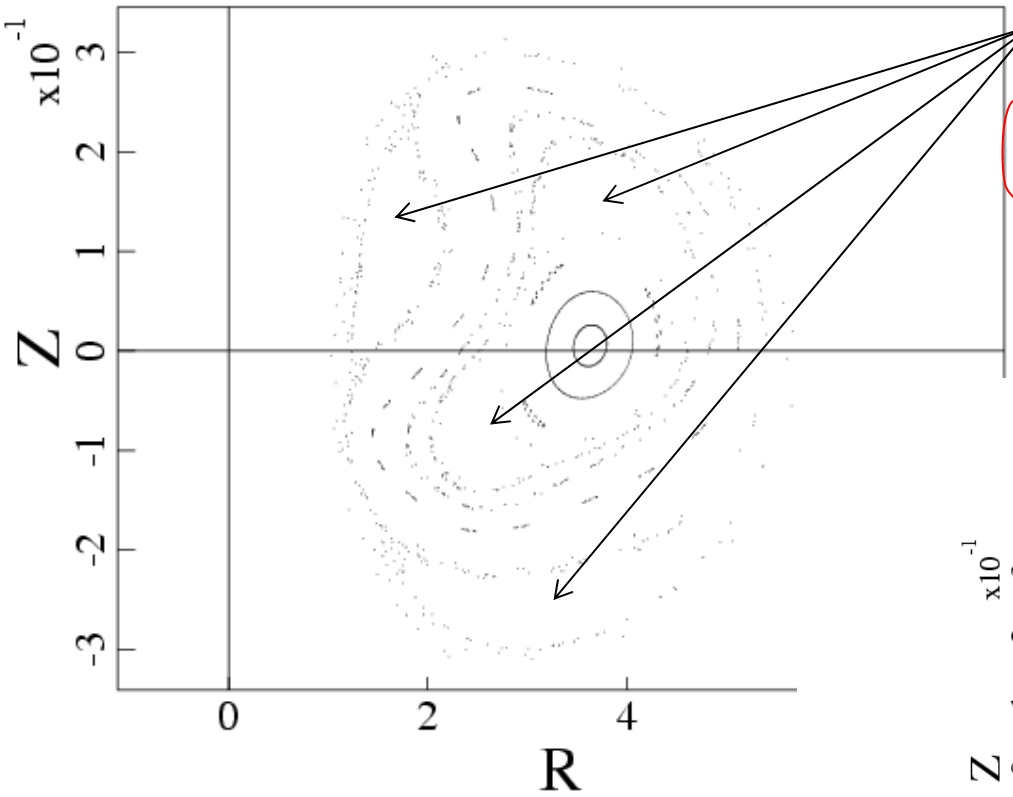



$n = 2$

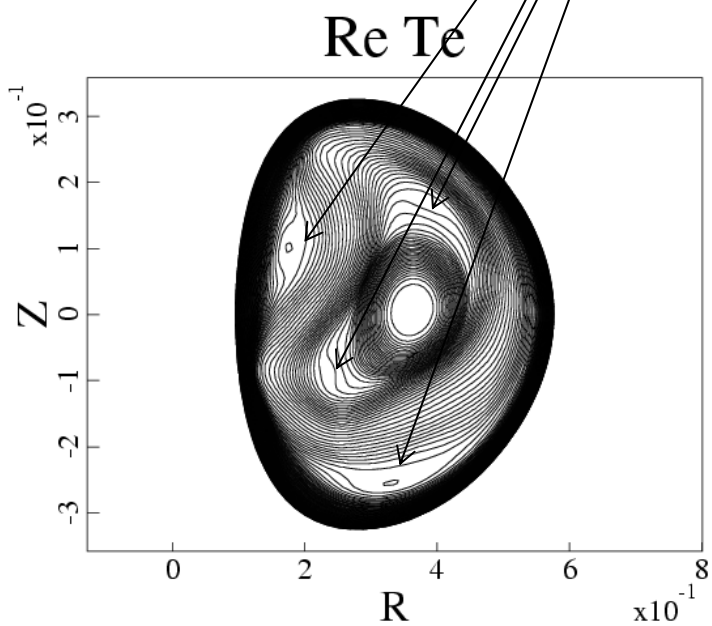



- $t = 1.972 \times 10^{-3}$ sec
- Beginning of late time growth

# Surface of Section



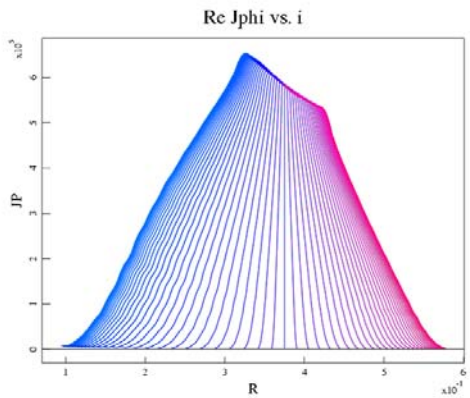

- $n = 2$ double tearing mode!
- K_perp too large to allow complete flattening in islands
- Clamps $q$ at 2

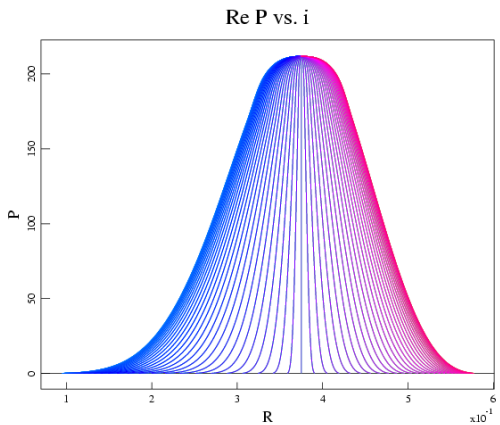


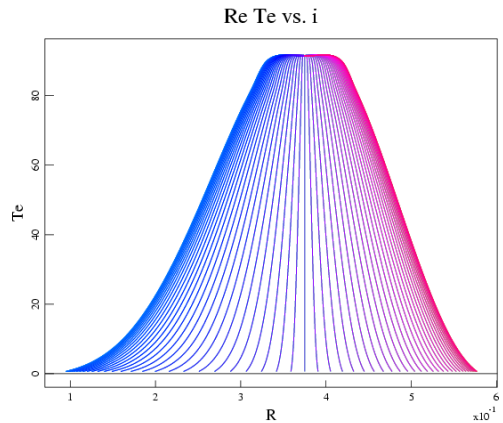

- $t = 1.988 \times 10^{-3}$ sec
- Top of late time growth

# Axisymmetric Profiles

t = 0

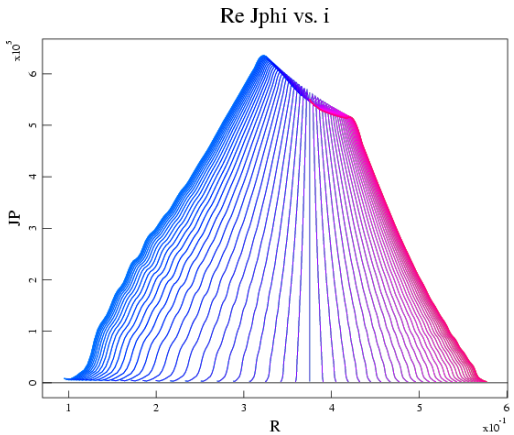


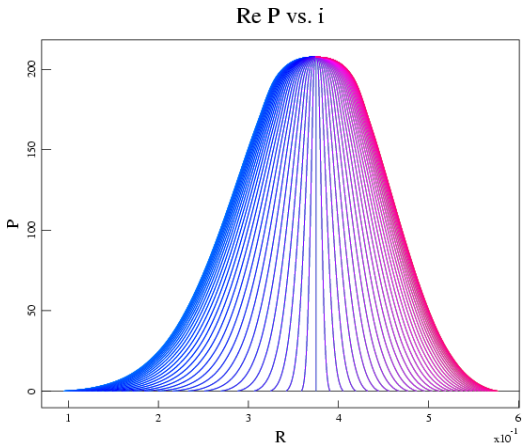



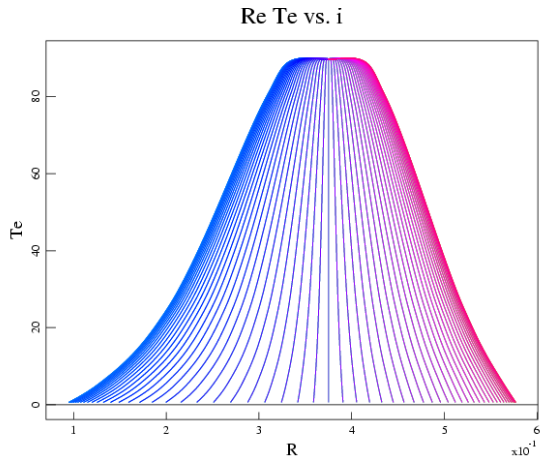



# Axisymmetric Profiles

t = 1.26 X $10^{-3}$ sec

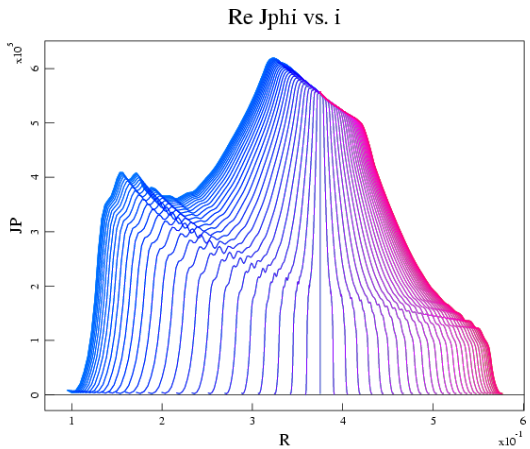


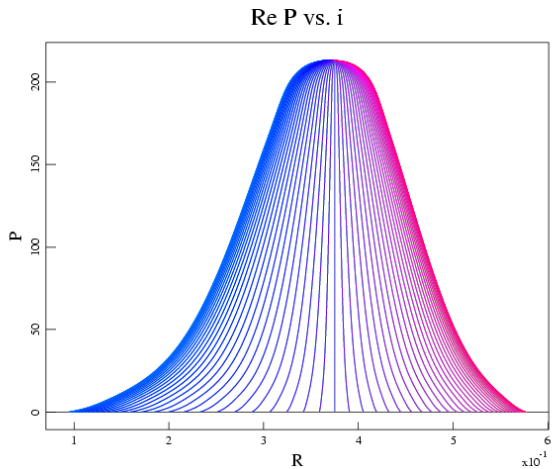



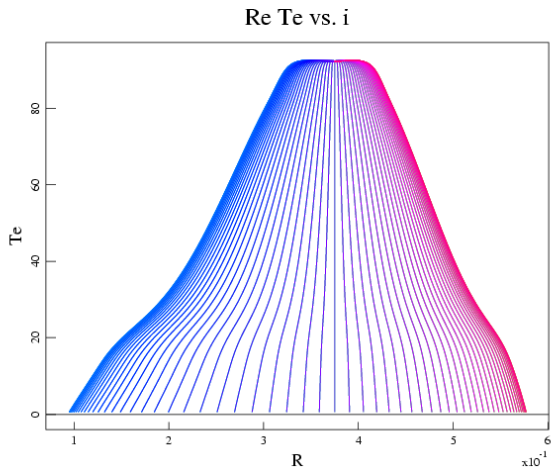



# Axisymmetric Profiles

t = 1.53 X $10^{-3}$ sec

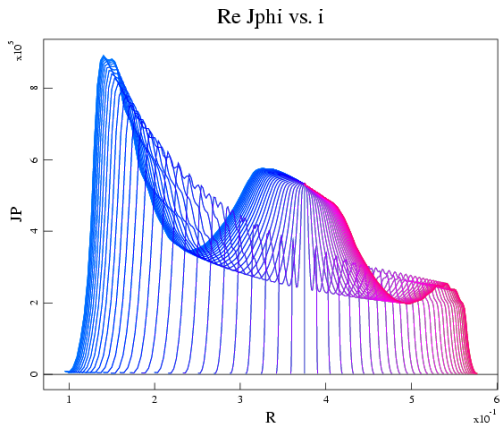


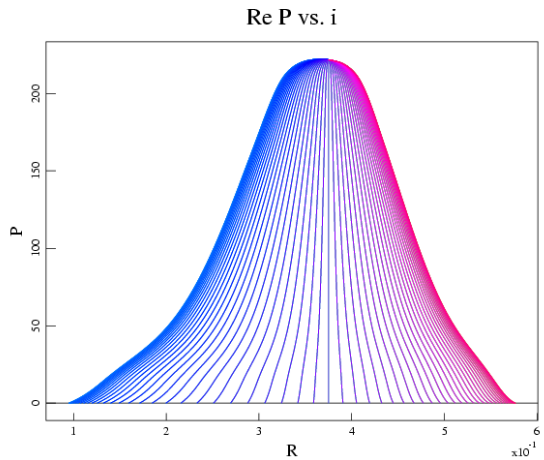



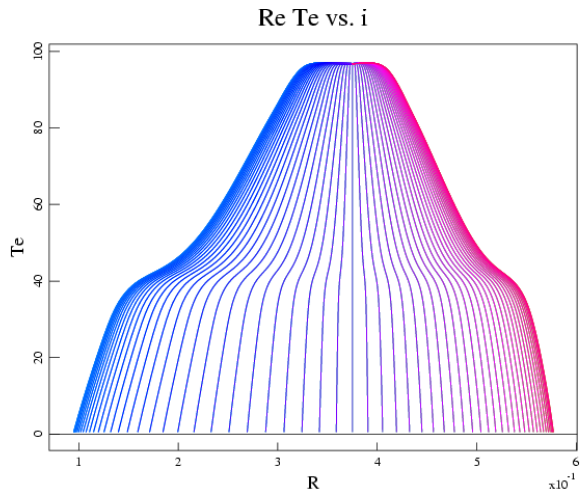



# Axisymmetric Profiles

t = 1.74 X $10^{-3}$ sec

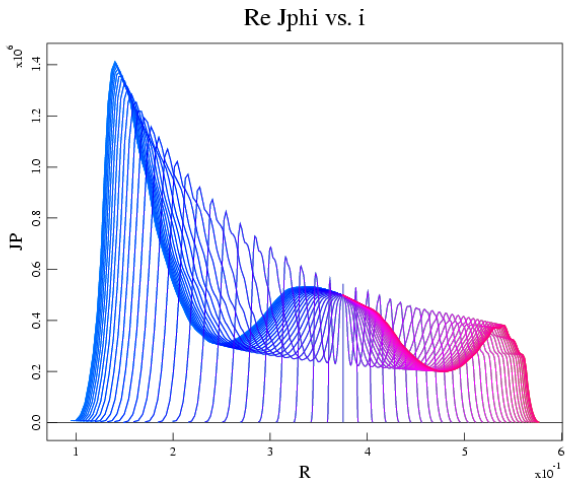


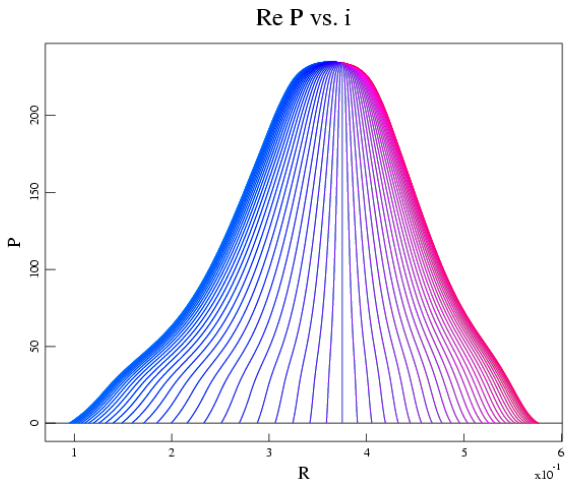



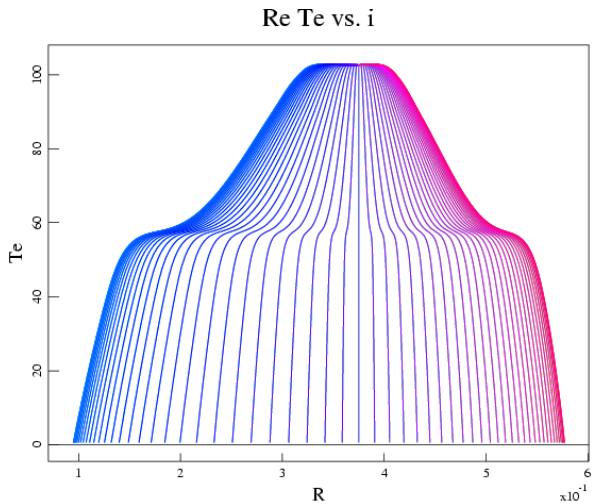



# Axisymmetric Profiles

$t = 1.88 \text{ X } 10^{-3}$ sec

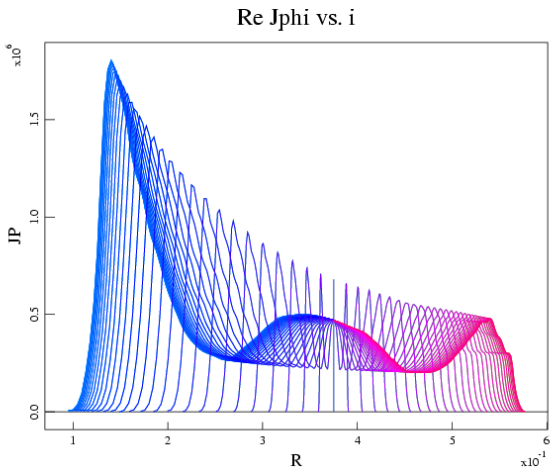


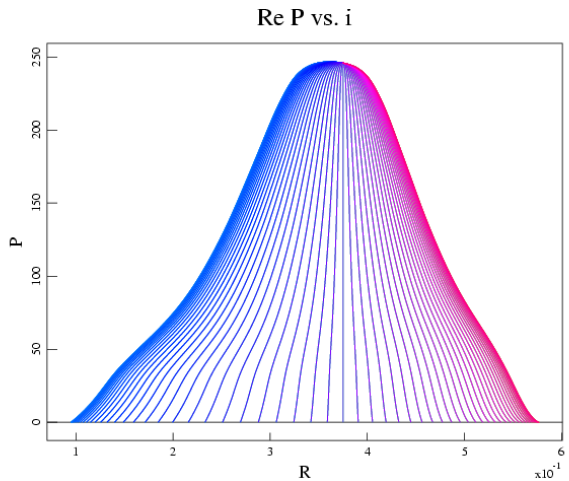



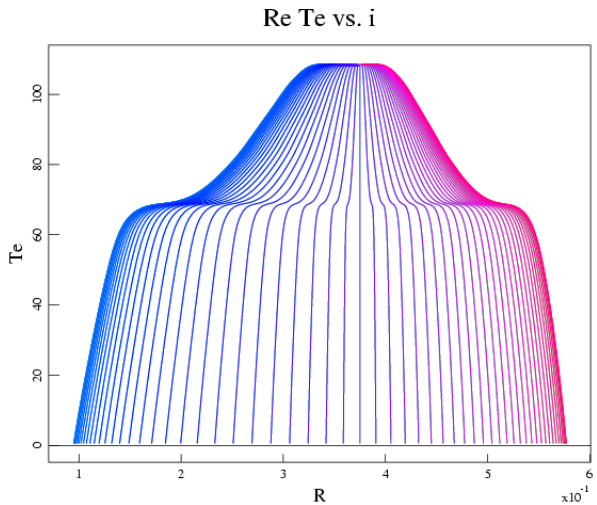



# Axisymmetric Profiles

t = 1.97 X $10^{-3}$ sec

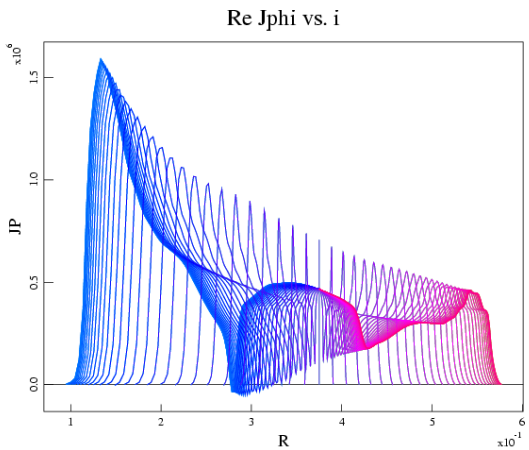


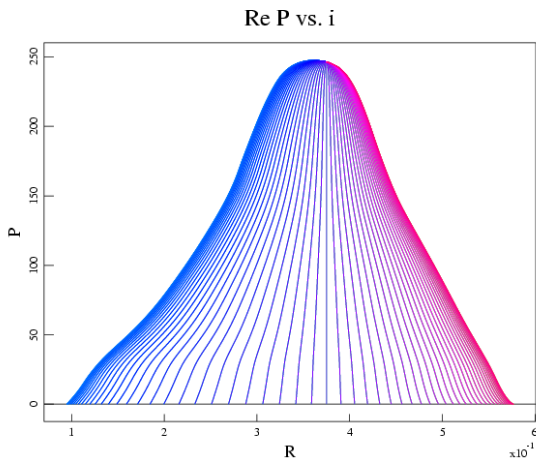



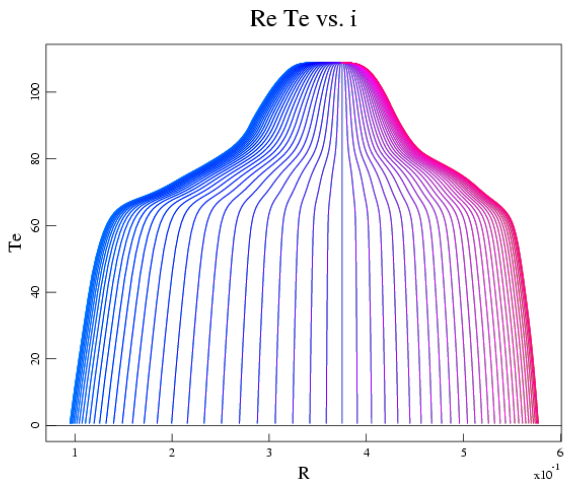



# Axisymmetric Profiles

$t = 1.99 \text{ X } 10^{-3}$ sec



# CDXU……

- Density diffusivity suppresses previous high-*n* interchanges
  - 1000 $m^2$/sec and 50 $m^2$/sec give ~ same result
- 42 toroidal modes
  - Spectrum remains well resolved throughout calculation
- Sawtooth saturates with no stochasticity
- Double tearing mode at end
- Observations after sawtooth saturation:
  - Discharge contracts inward (in *R*)
  - Parallel current peaks at inboard edge
  - Temperature gradient steepens at edge
  - *q* is flattened, becomes double valued
  - *n* = 2 double tearing mode grows
  - ?????????