

The image shows the interior of a tokamak fusion reactor chamber. The walls are made of polished metal, likely stainless steel or copper, and are covered with various diagnostic instruments, including cameras, sensors, and ports. The lighting is bright, creating a high-contrast environment. The overall appearance is that of a complex, high-tech scientific facility.

CDX-U BENCHMARK

A.Y. Pankin, D. D. Schnack

SAIC

S. E. Kruger

TechX

S. Jardin, J. Breslau

PPPL

CDX-U Basic Parameters

CDX-U Plasma Parameters

<i>Parameter</i>	<i>Description</i>	<i>Value</i>
R_0	Major radius	33.5 cm
a	Minor radius	22.5 cm
$A=R_0/a$	Aspect ratio	1.5
κ	Plasma elongation	1.5-1.7
B_T	Toroidal magnetic field	2300 gauss
$n_e(0)$	Central electron density	$\sim 4 \times 10^{13} \text{ cm}^{-3}$
$T_e(0)$	Central electron temperature	100 eV
I_P	Plasma current	70 kA
	Pulse length	25 ms
	Pulse flat-top	5-10 ms

NIMROD nonlinear runs

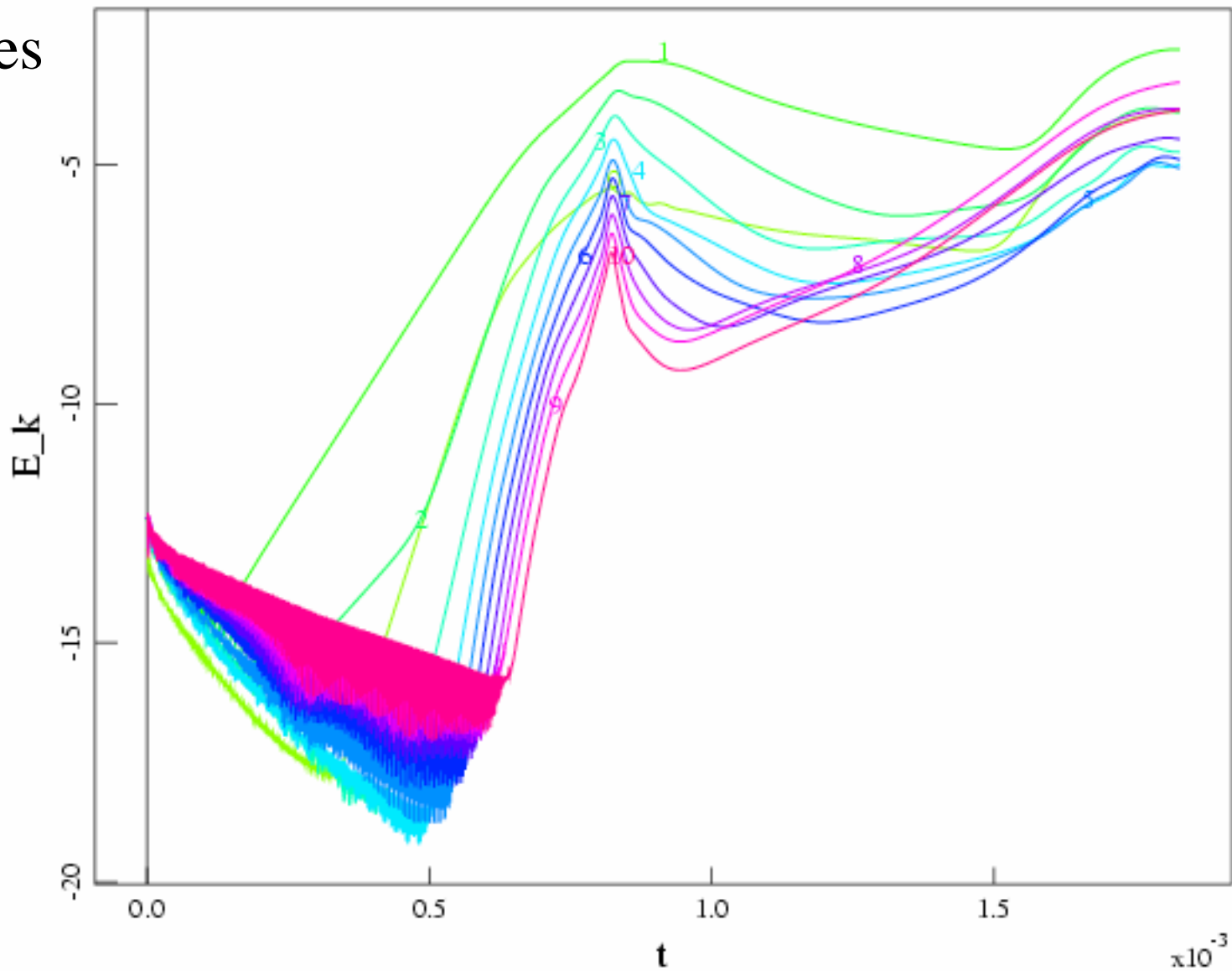
w11d and w11e

- Cases are based on run06time11 with $q_0=0.925$
 - w11d - 11 modes
 - w11e - 22 modes
- $S=1.940E+04$
- $Pr=10$
- Density is evolving, but the equilibrium density is used in the velocity advance
- Anisotropic thermal conduction with $k_{\parallel}/k_{\perp}=10^8$
- ds_use=orig

Kinetic energy history

Kinetic Energy vs. t

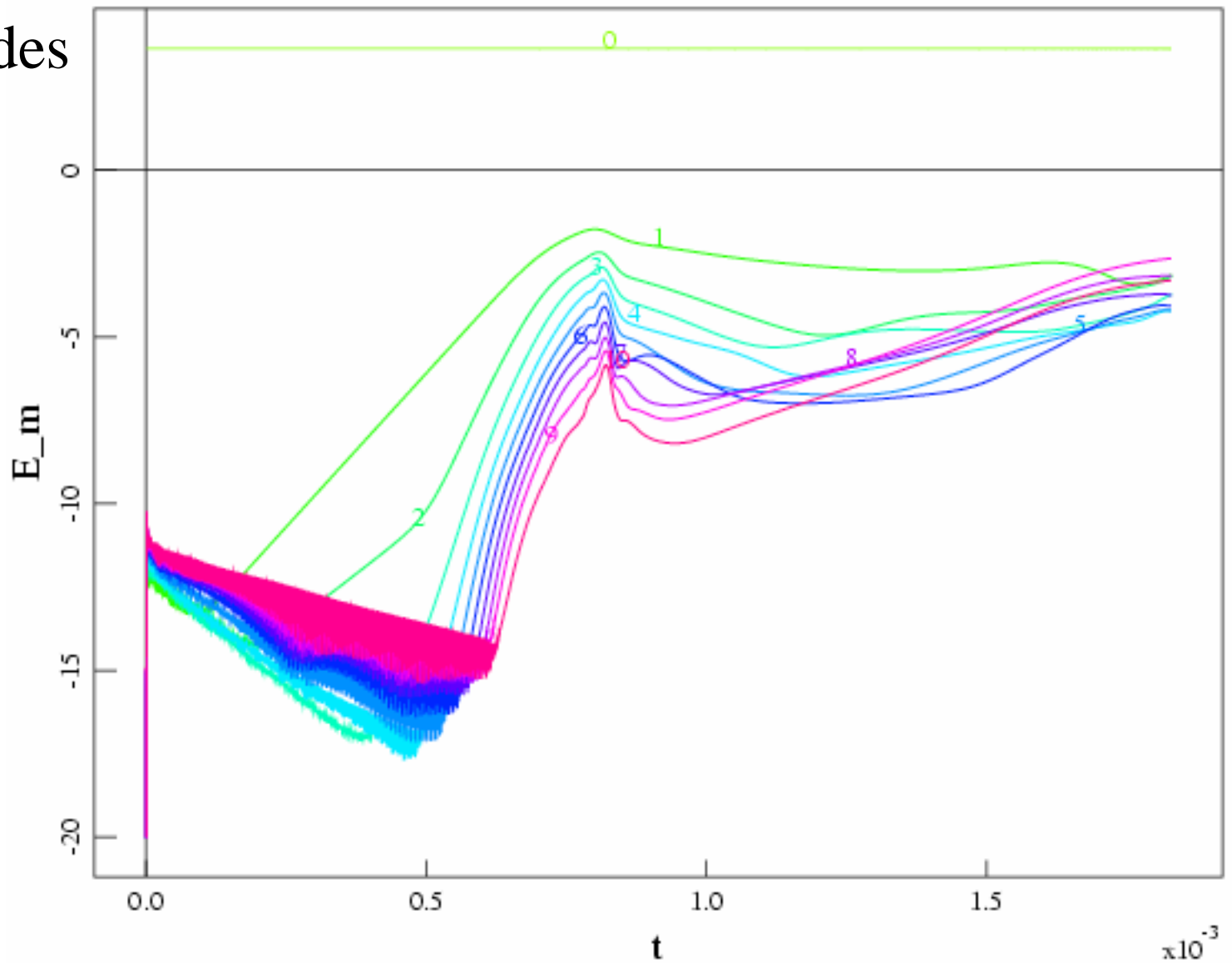
11 modes



Magnetic energy history

Magnetic Energy vs. t

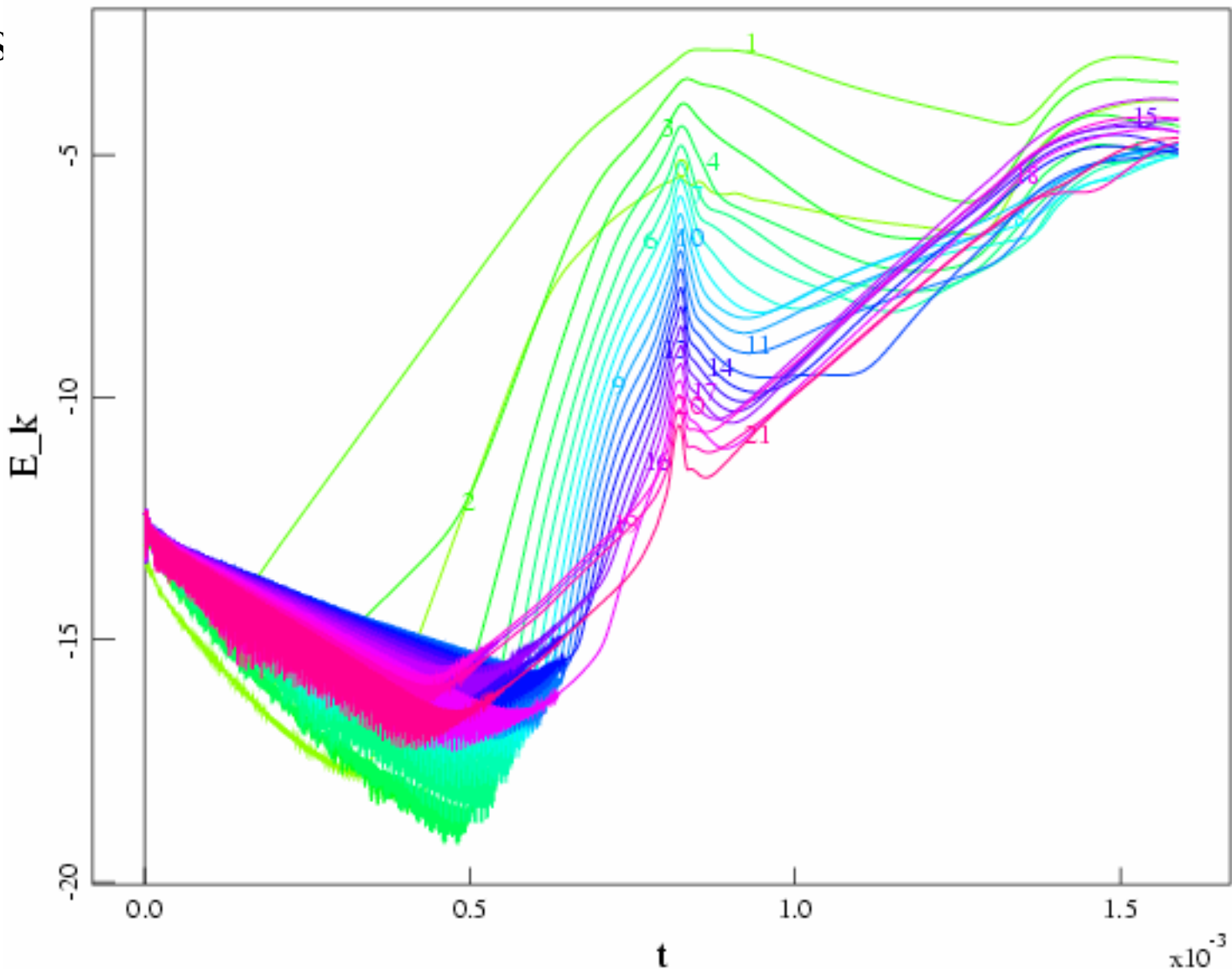
11 modes



Kinetic energy history

Kinetic Energy vs. t

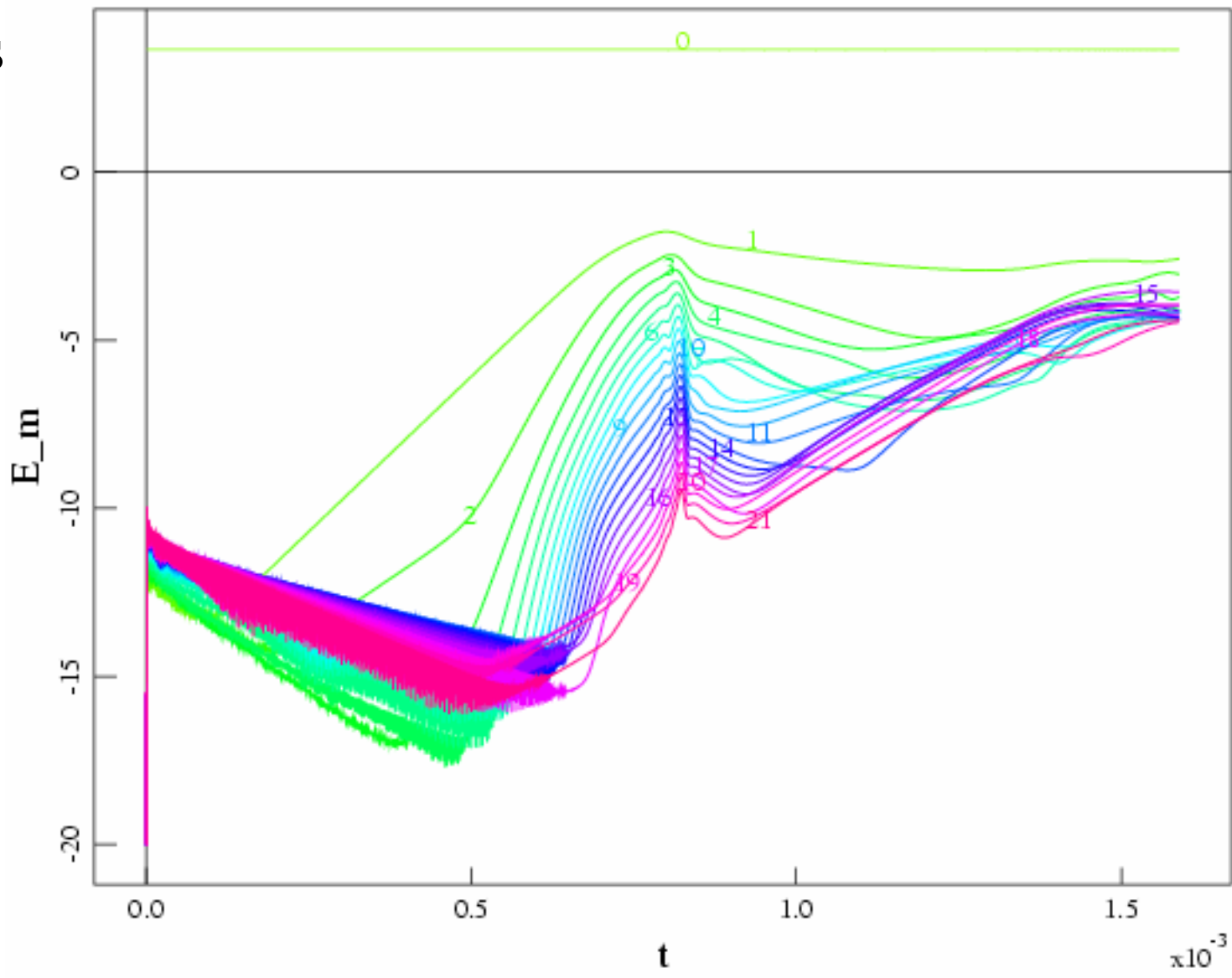
22 modes



Magnetic energy history

Magnetic Energy vs. t

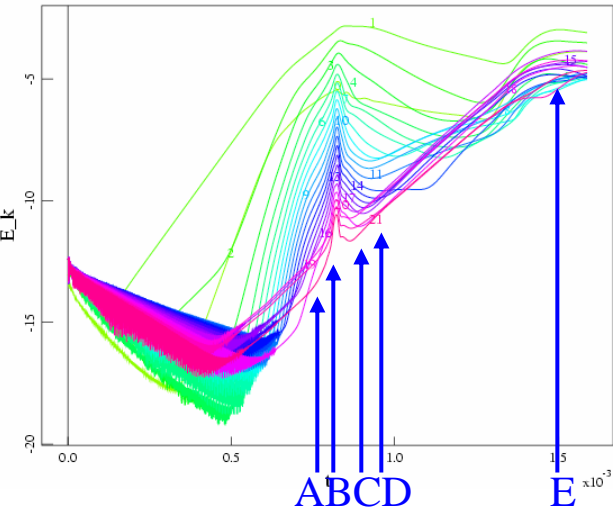
22 modes



Nonlinear run: n=1

22 modes

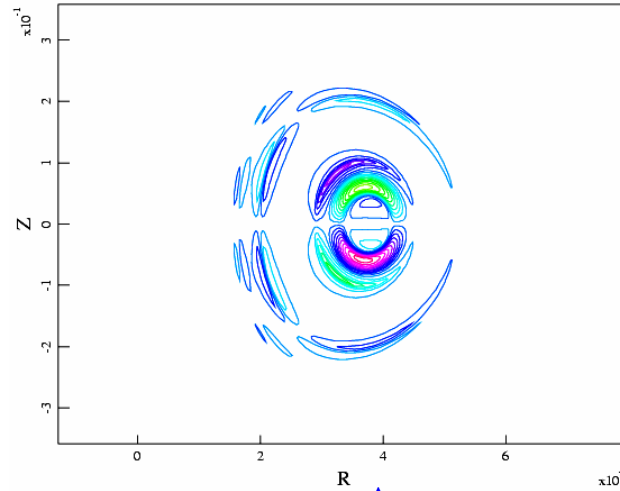
Kinetic Energy vs. t



A B C D

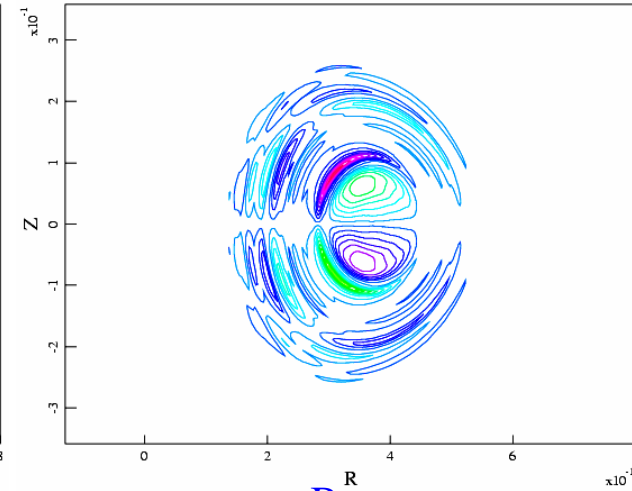
E

Re JPhi



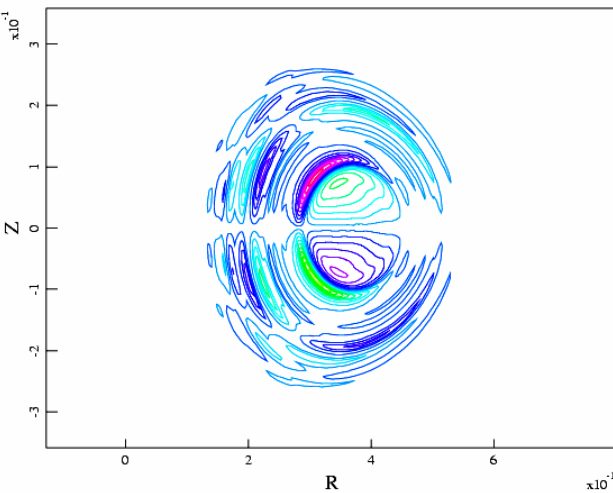
A

Re JPhi



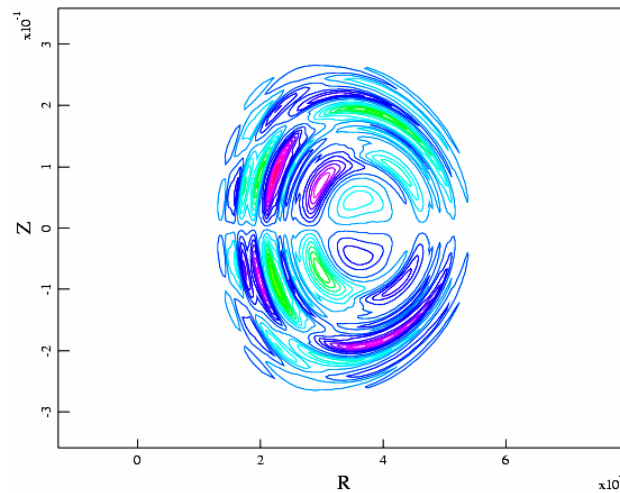
B

Re JPhi



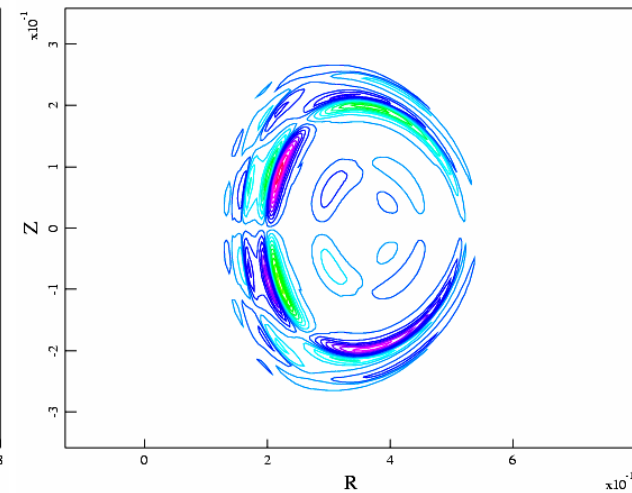
C

Re JPhi



D

Re JPhi

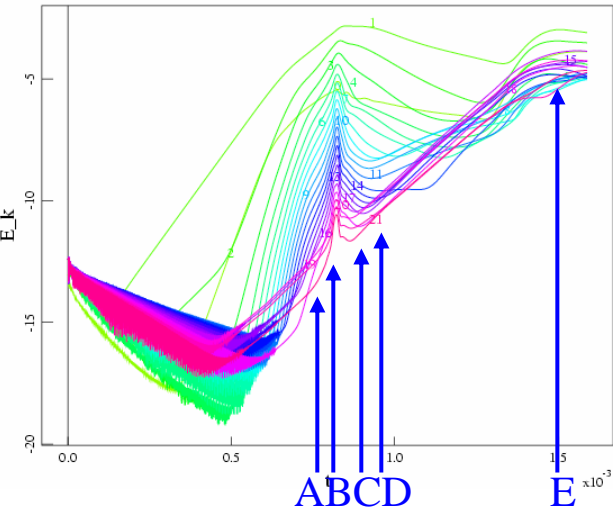


E

Nonlinear run: n=2

22 modes

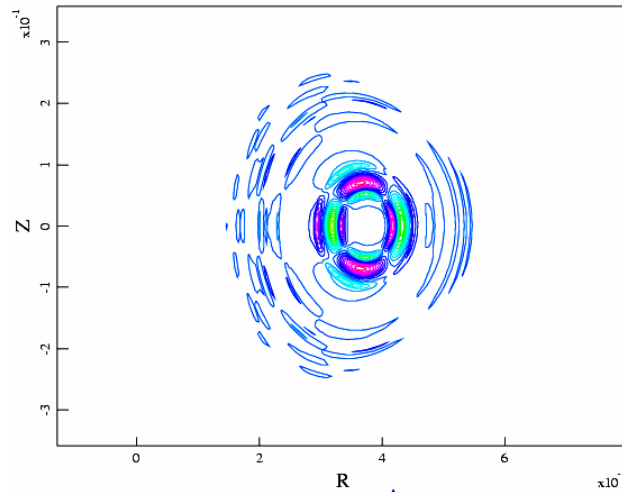
Kinetic Energy vs. t



A B C D

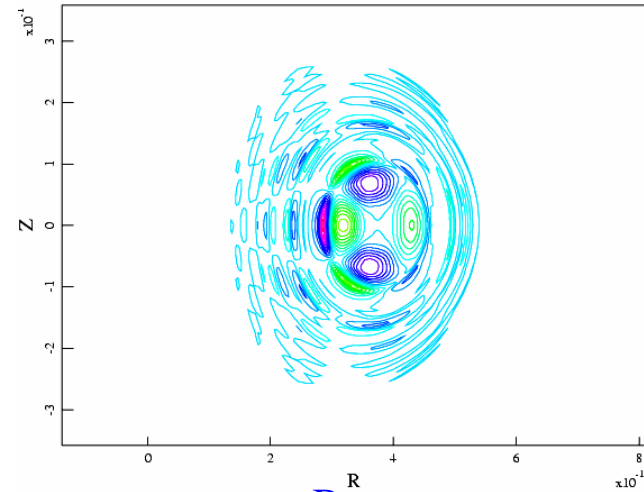
E

Re JPhi



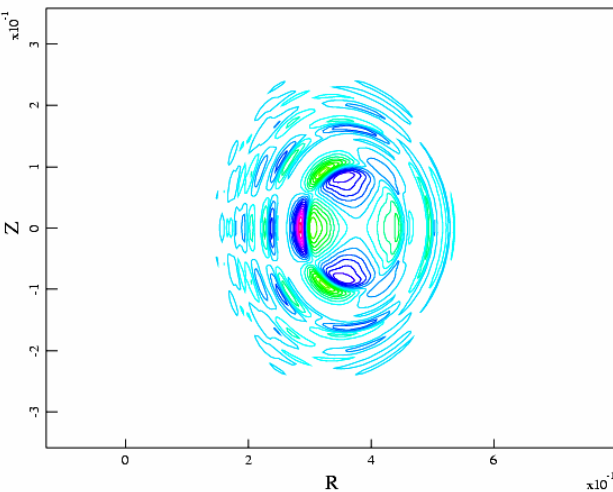
A

Re JPhi



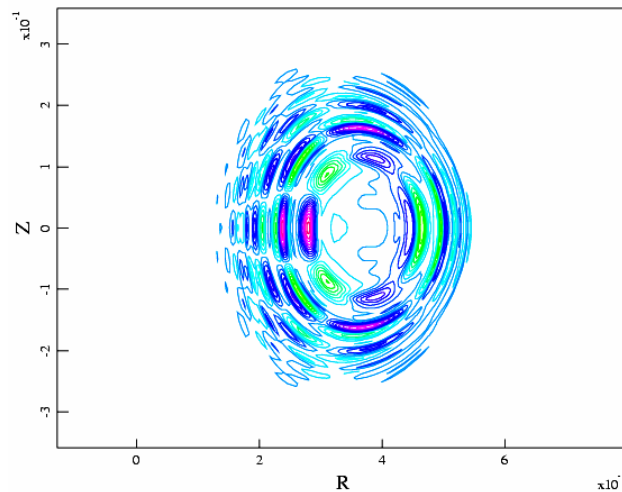
B

Re JPhi



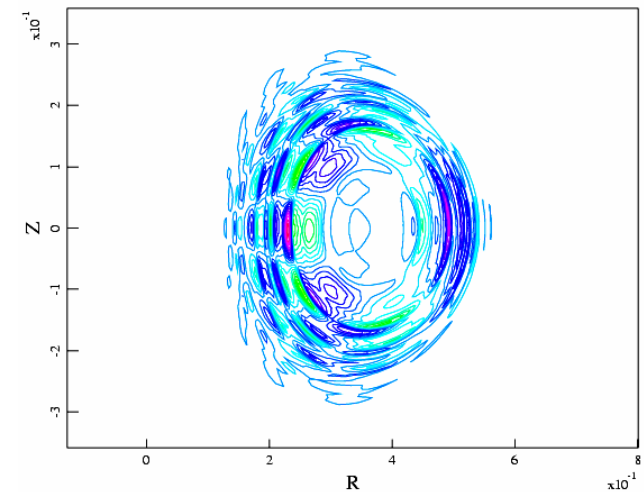
C

Re JPhi



D

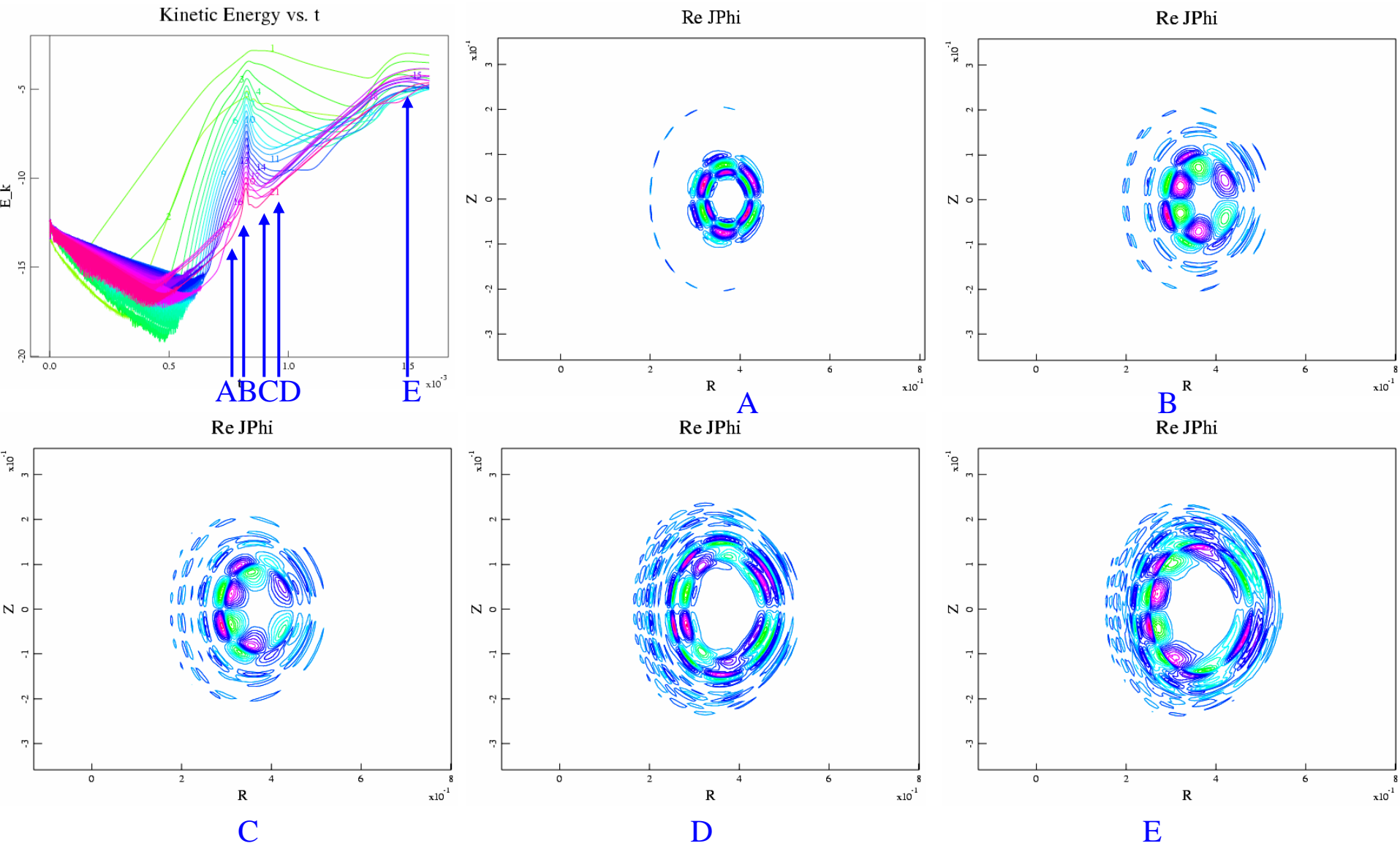
Re JPhi



E

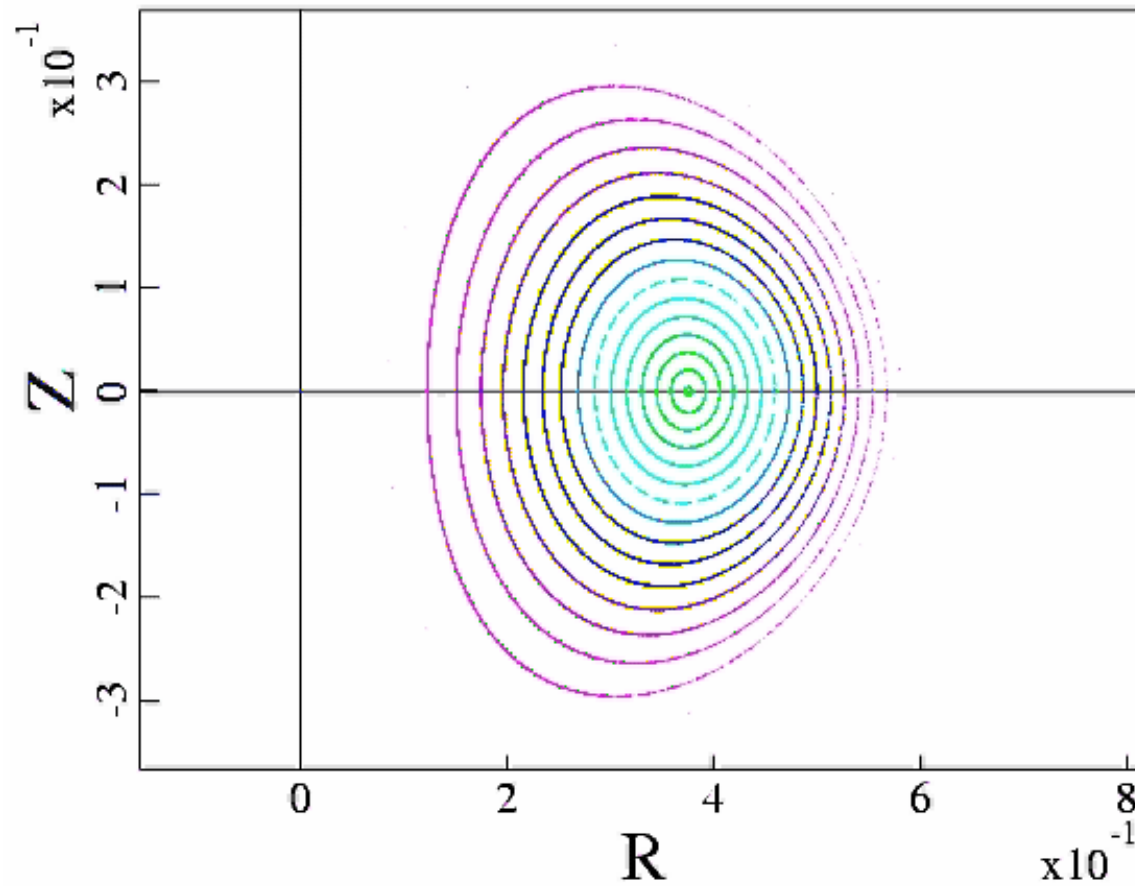
Nonlinear case: $n=3$

22 modes

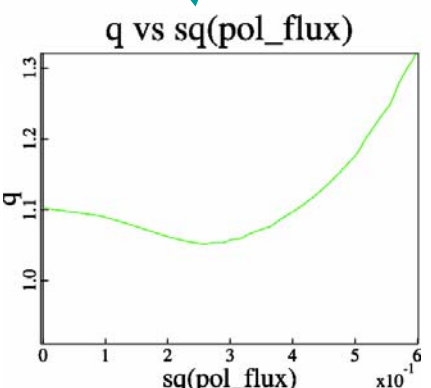
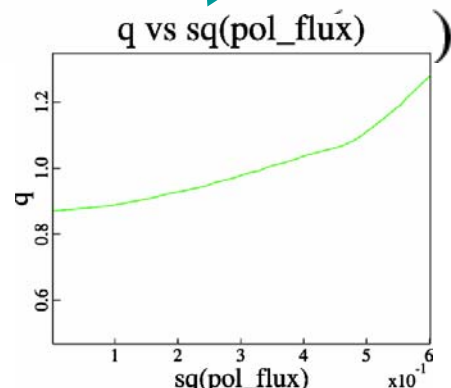
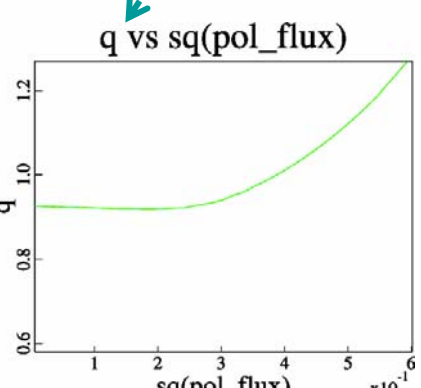
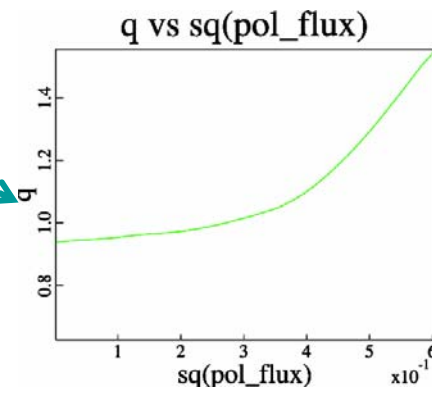
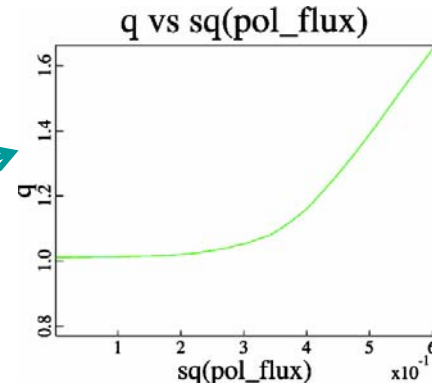
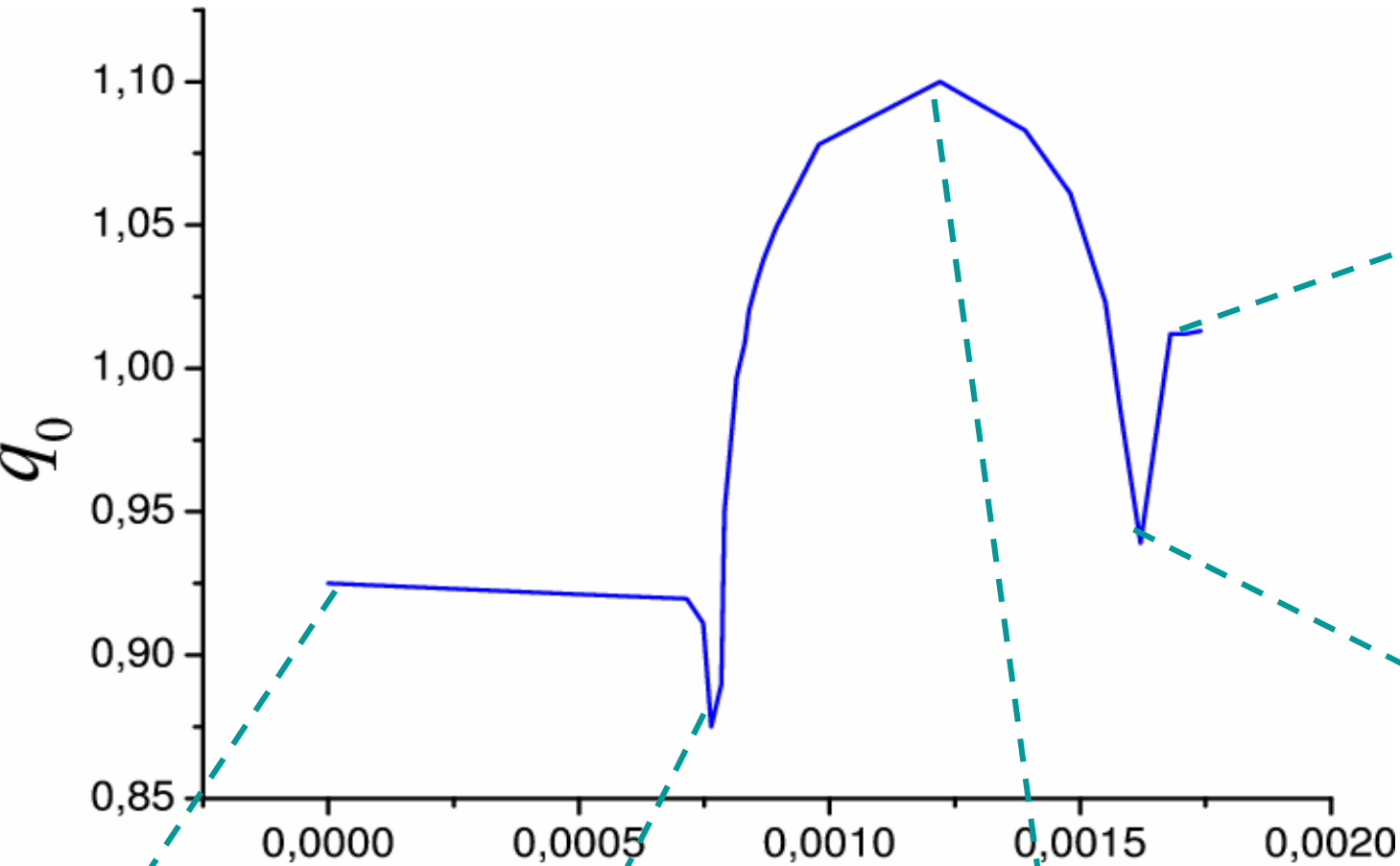


Nonlinear case: Poincare plots

Surface of Section



Nonlinear case: evolution of q



Summary

- Two nonlinear runs with 11 and 22 modes that are based on equilibria run06time 11 with initial q on the magnetic axis below 1 are studied
- Both runs produces qualitatively similar behavior
- Multiple reconnections of $n=1$ are observed
- All modes saturate at the end of the run