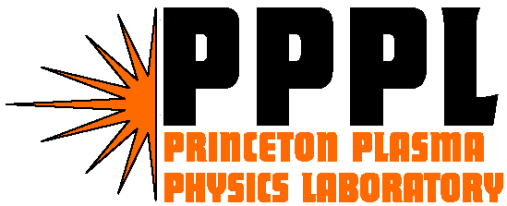




# MHD-Induced Beam Ion Loss from NSTX Plasmas

D. Darrow, E. Fredrickson, A. L. Roquemore,
K. Shinohara (JAEA)

48th American Physical Society, Division of Plasma Physics Meeting
October 30–November 3, 2006
Philadelphia, PA

# Abstract

The Scintillator Fast Lost Ion Probe (sFLIP) on NSTX measures the loss of neutral beam ions lost to the wall near the outer midplane, resolved in gyroradius and pitch angle. The diagnostic has recently been upgraded to record the characteristics of the loss at up to 40,500 frames/s, allowing resolution of losses arising from MHD activity. That loss is often at high pitch angle.

# Motivations

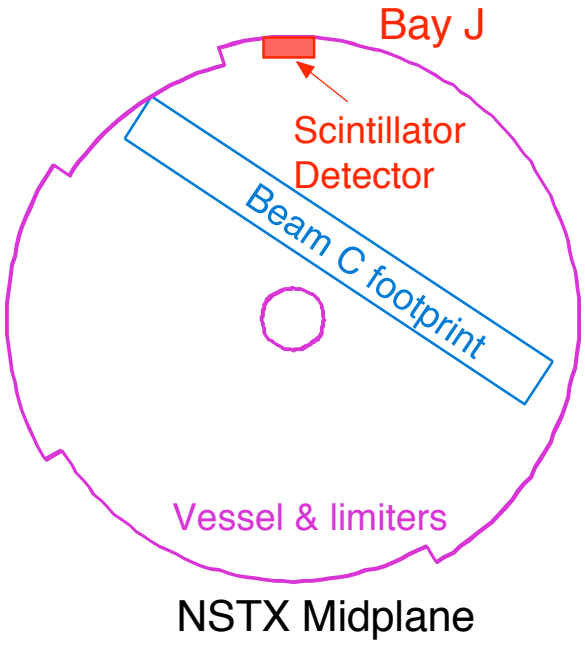

- Dimensionless parameters of beam ions similar to 3.5 MeV $\alpha$s in NSST (good model system)
- Lost beam ion characteristics can reveal internal physics, esp. effects of MHD instabilities
- MHD-induced loss often seen in NSTX plasmas

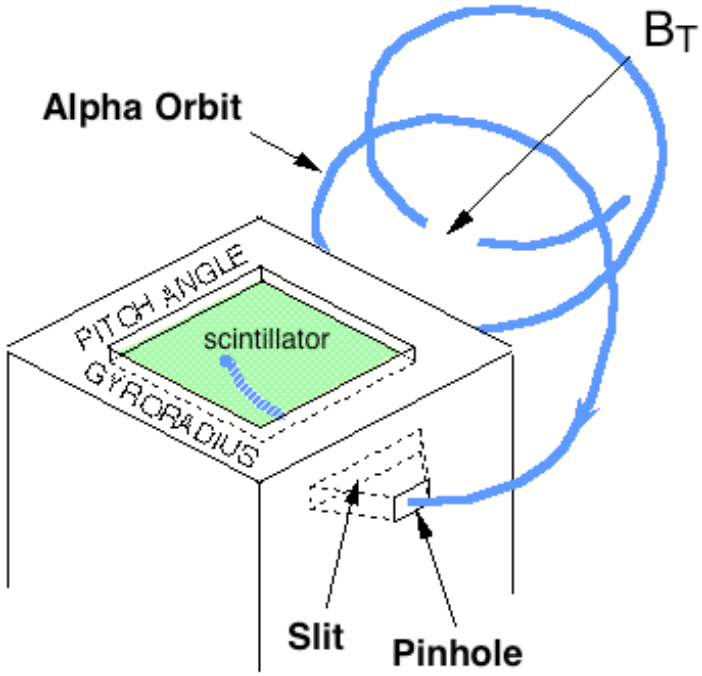
# Fast ion loss mechanisms


- Prompt orbit loss: fast ion born in loss cone
- Radial transport to wall (arises from changes in toroidal momentum, $P_\phi$):
  - MHD
  - TF ripple
- Pitch angle scattering into loss cone (arises from changes in the magnetic moment, $\mu$):
  - Classical collisions
  - ICRF heating

# Scintillator fast lost ion (sFLIP) probe is magnetic spectrometer

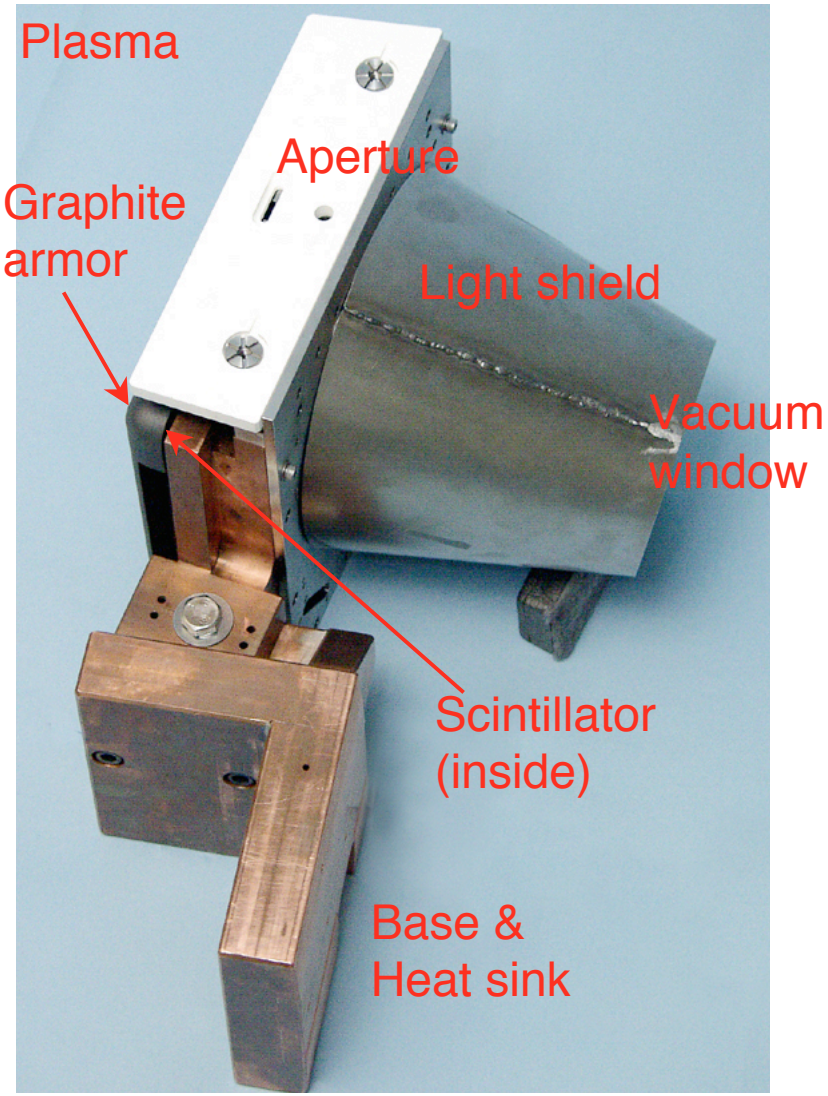
- Combination of B and aperture geometry disperse different pitch angles and energies on scintillator plate

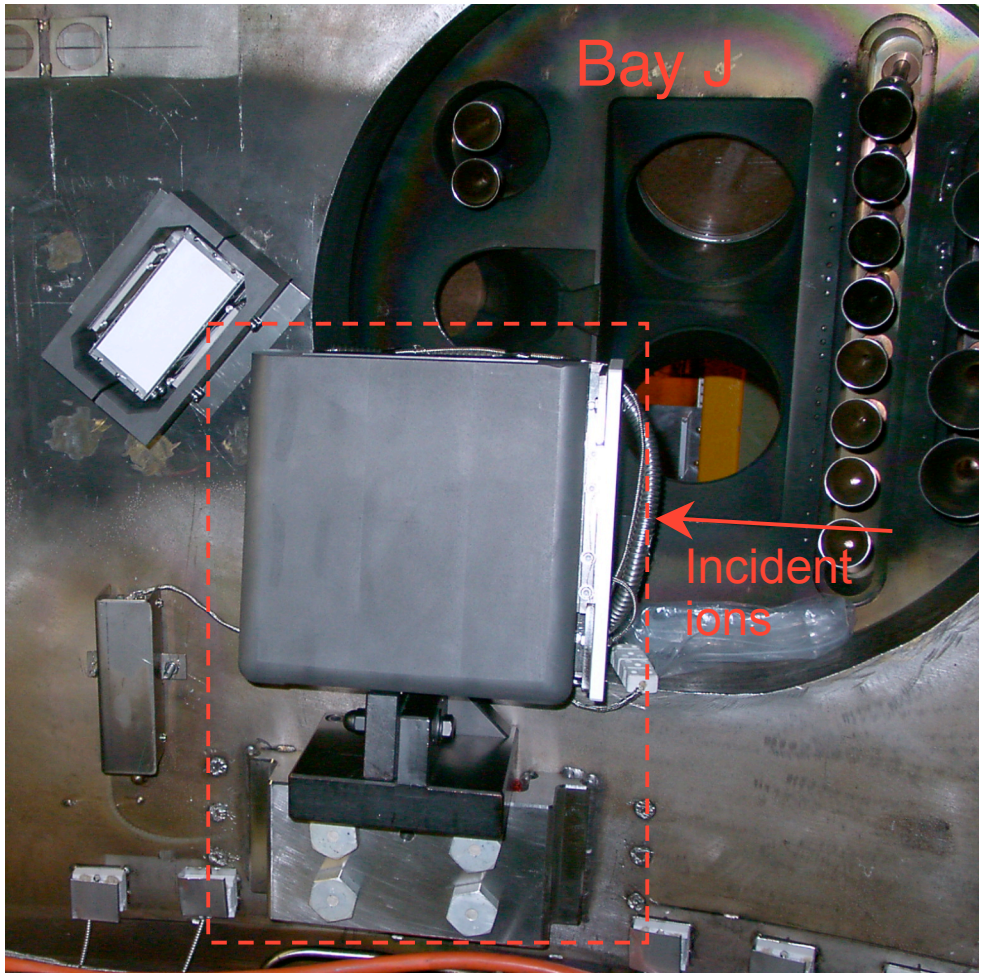



Scintillator detector: principle of operation

# Scintillator probe assembly



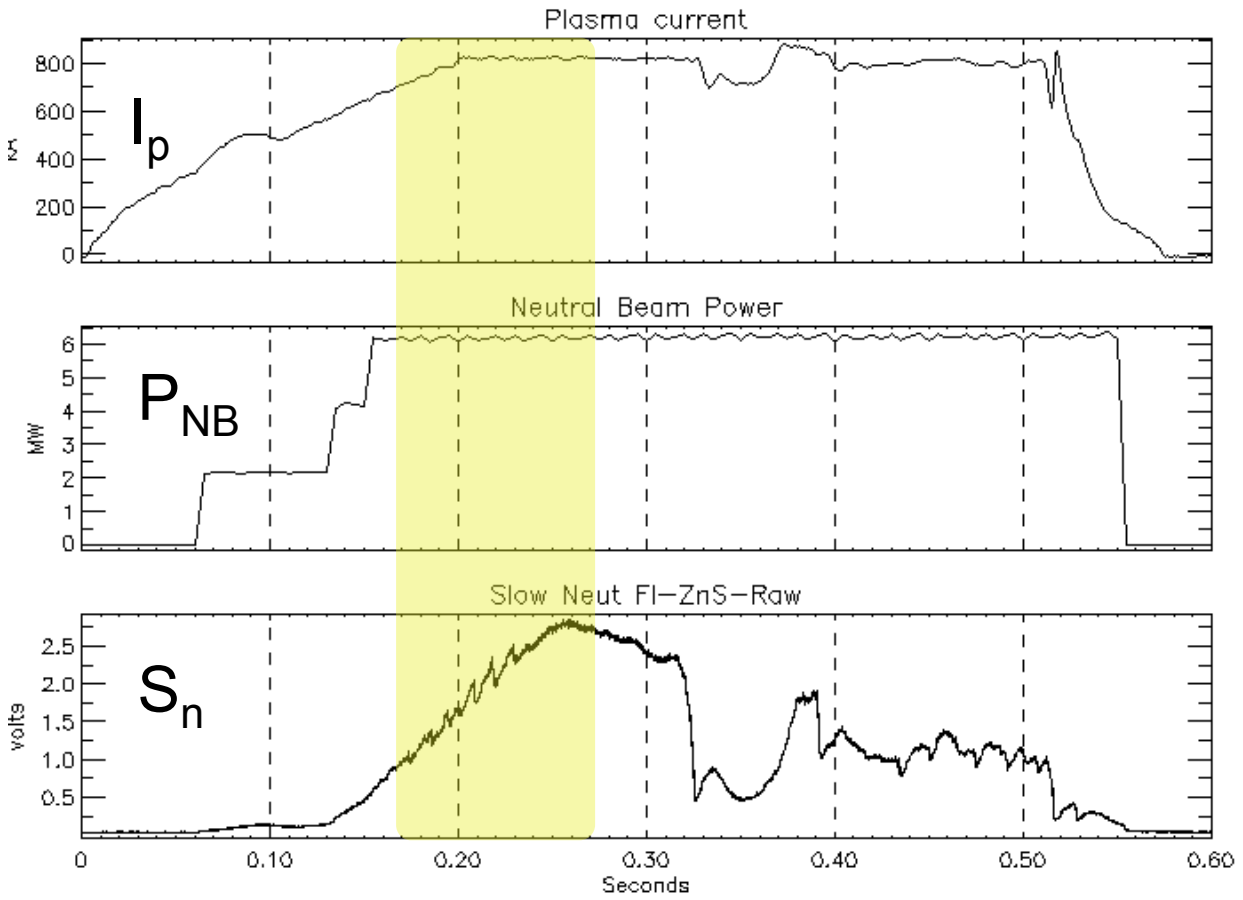

ρ: 5–60 cm, χ: 10°–70° (typ.)

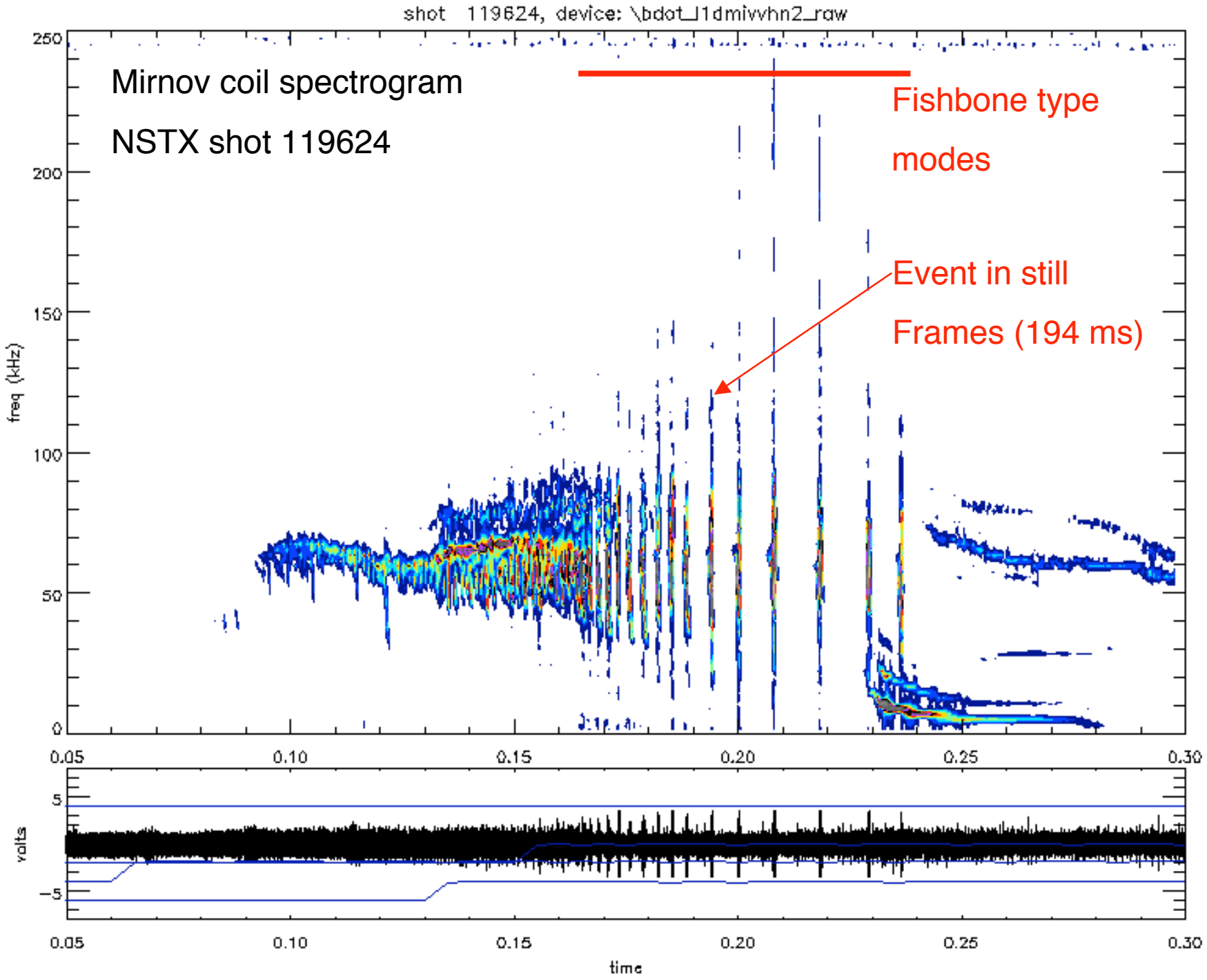
# Scintillator images recorded by fast videocamera


- Photron Fastcam on loan from JAEA for 2005 & 2006 campaigns
- Gives ≤40,500 frames/s
- Good for resolution of MHD & other rapidly-varying loss

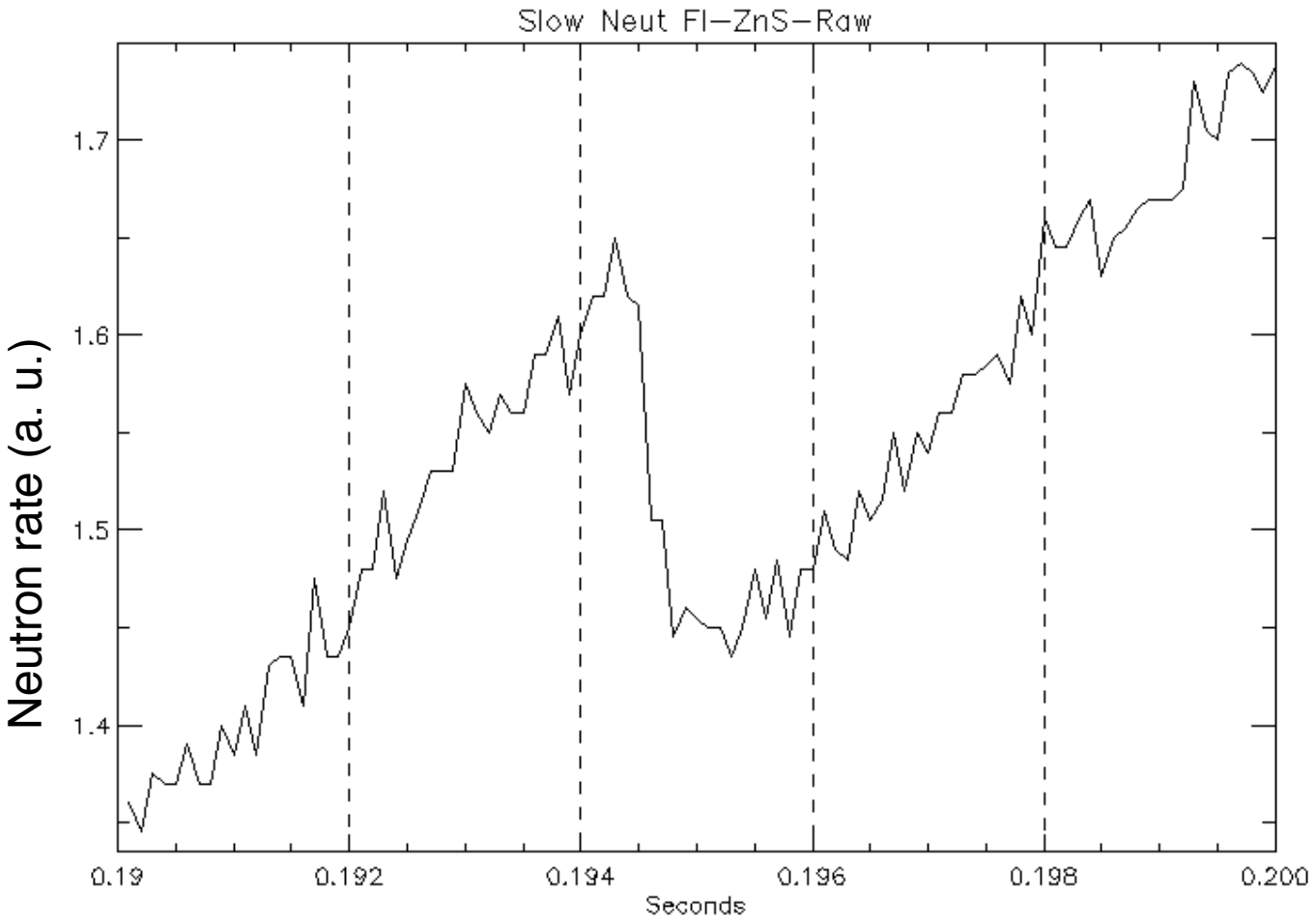
# Fishbones produce strong loss

119624

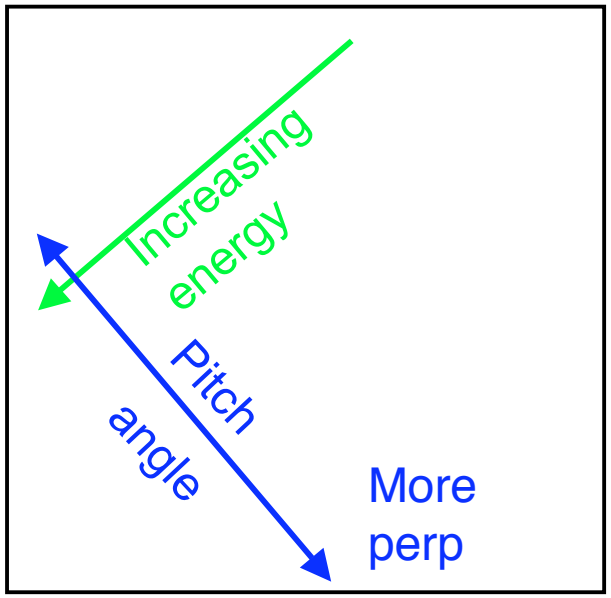



shot 119624, device: \bdot_l1dmivvhn2_raw
Mirnov coil spectrogram
NSTX shot 119624
Fishbone type modes
Event in still Frames (194 ms)
freq (kHz)
250
200
150
100
50
0
0.05
0.10
0.15
0.20
0.25
0.30
volts
5
−5
time

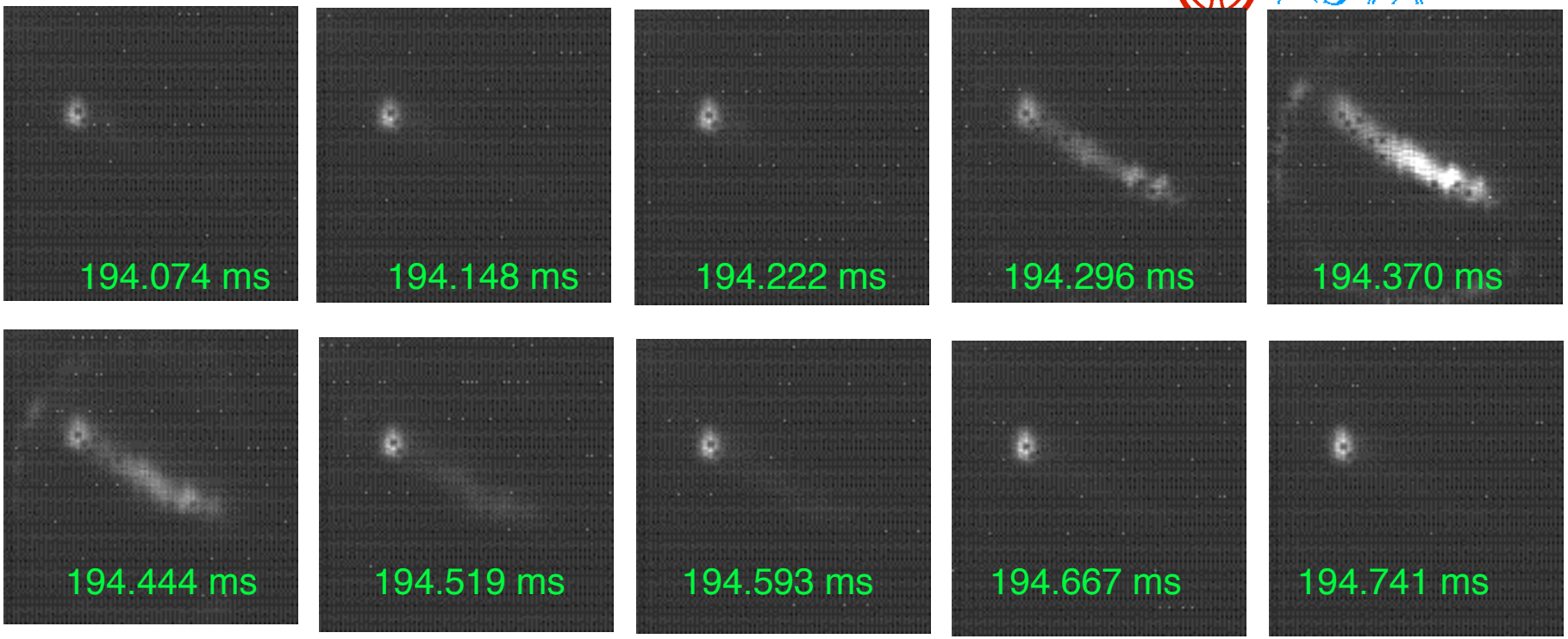
# Event at 194 ms reduces neutron rate by 13 %



# Scintillator image interpretation



# Loss varies rapidly in time




- 13,500 frames/s
- Full beam energy loss only (80 keV D)

# Broad range of pitch angles lost

- Range of pitch angles lost in single frame (<100 μs)
- No evidence of sweeping in pitch angle at this time scale

# Retraction


- The claim made in the abstract of this poster, that a loss associated with error correction or resistive wall mode fields was observed has, upon closer examination of the data, proven to be unfounded.

# Future plans


- Apply ($\rho$, $\chi$) grids to images
- Obtain another fast camera for ‘07 campaign
- Make absolute calibration of loss rate with internal Faraday cups

# Reprints