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MHD induced fast ion loss

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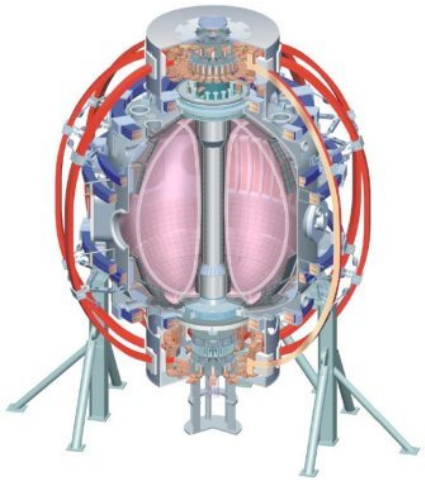
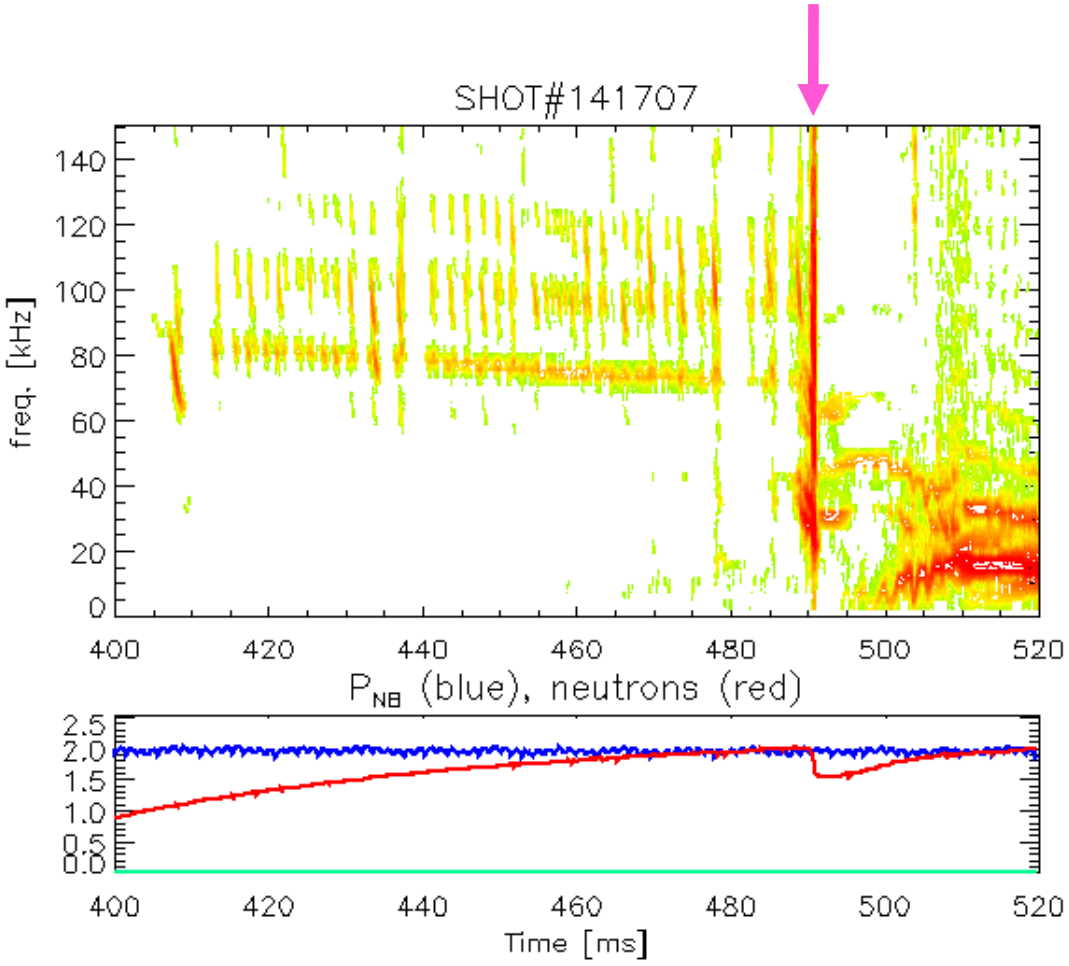
NSTX 2010 Results Review
December 2, 2010



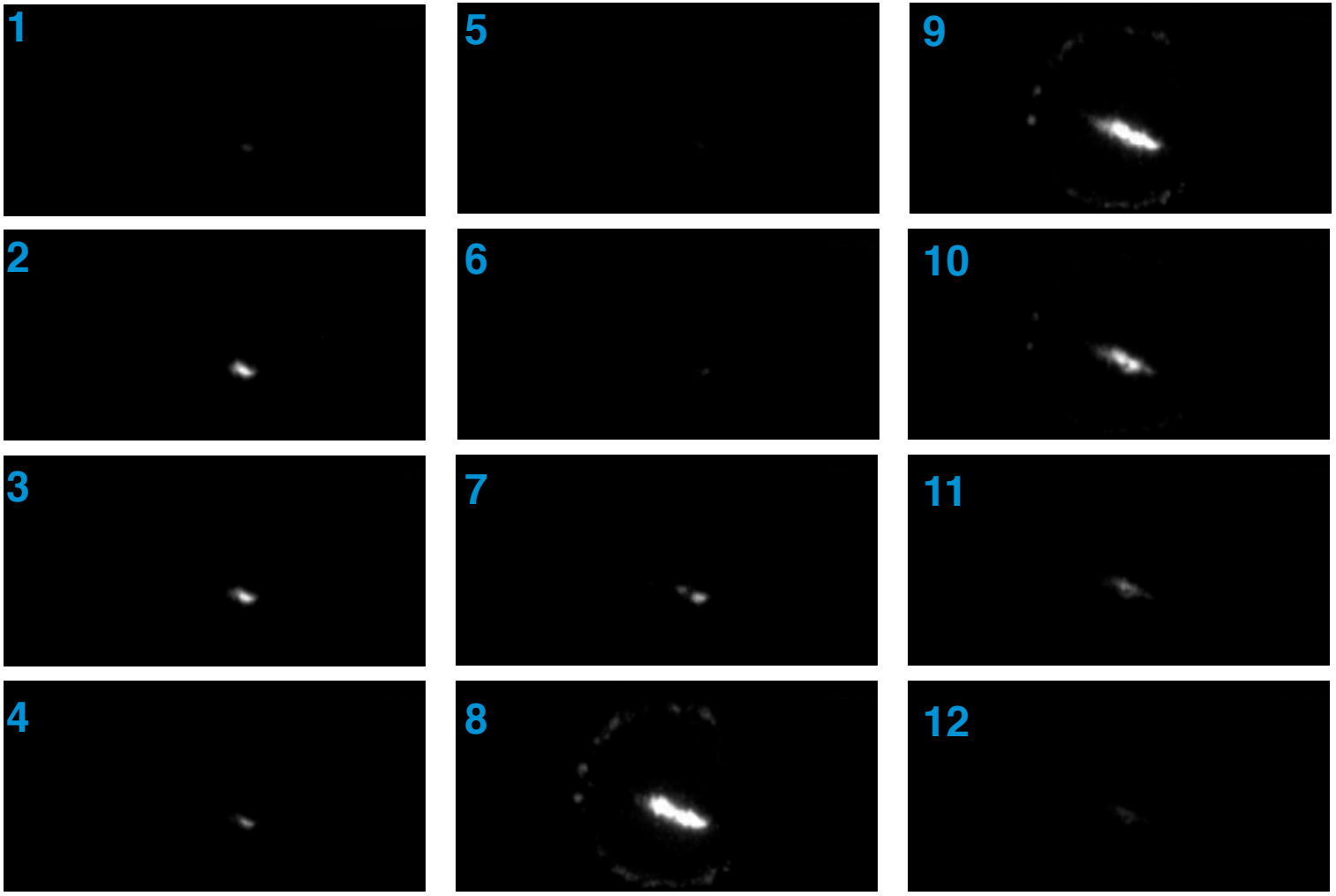
TAE avalanches cause large NBI loss



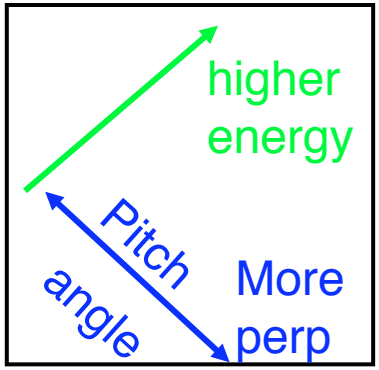
- Multiple TAEs of differing n simultaneously present
- Large neutron drop, ΔS_n=26%
- Follows interval of repetitive bursting TAEs

•900 kA, 5.5 kG, NB source A only at 90 kV

sFLIP measures large beam ion losses during avalanche

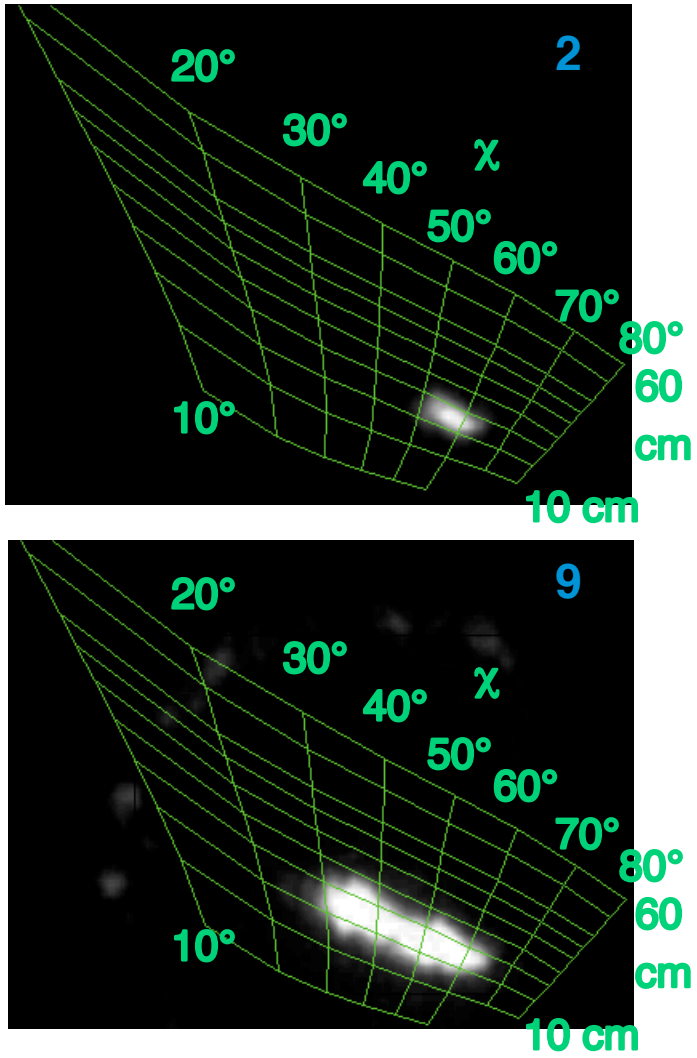


- Loss at full injection energy
- Wide range of pitch angles lost



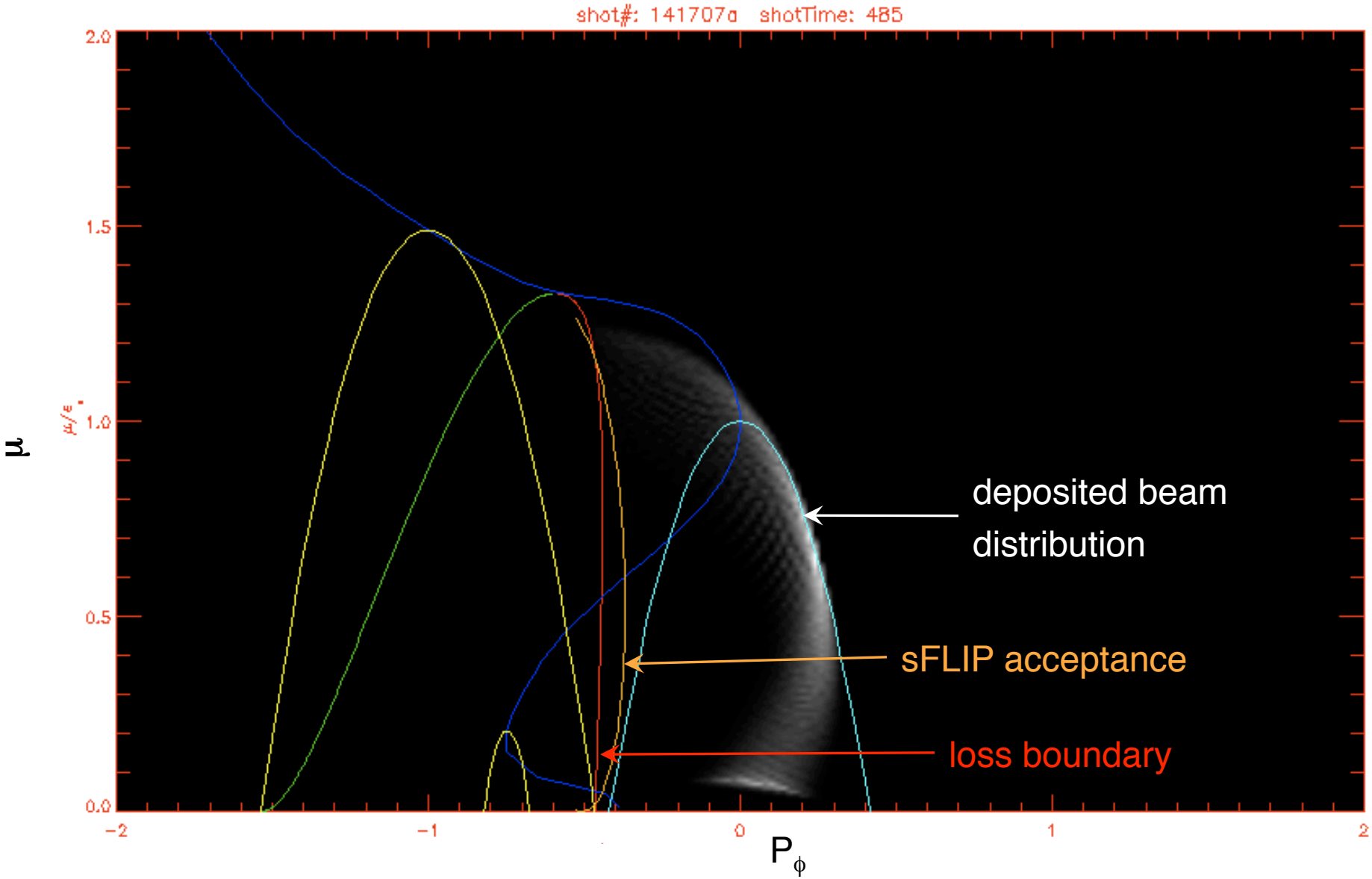
•33 μs/frame

Loss starts with more perpendicular particles, adding more parallel going ions later as avalanche proceeds



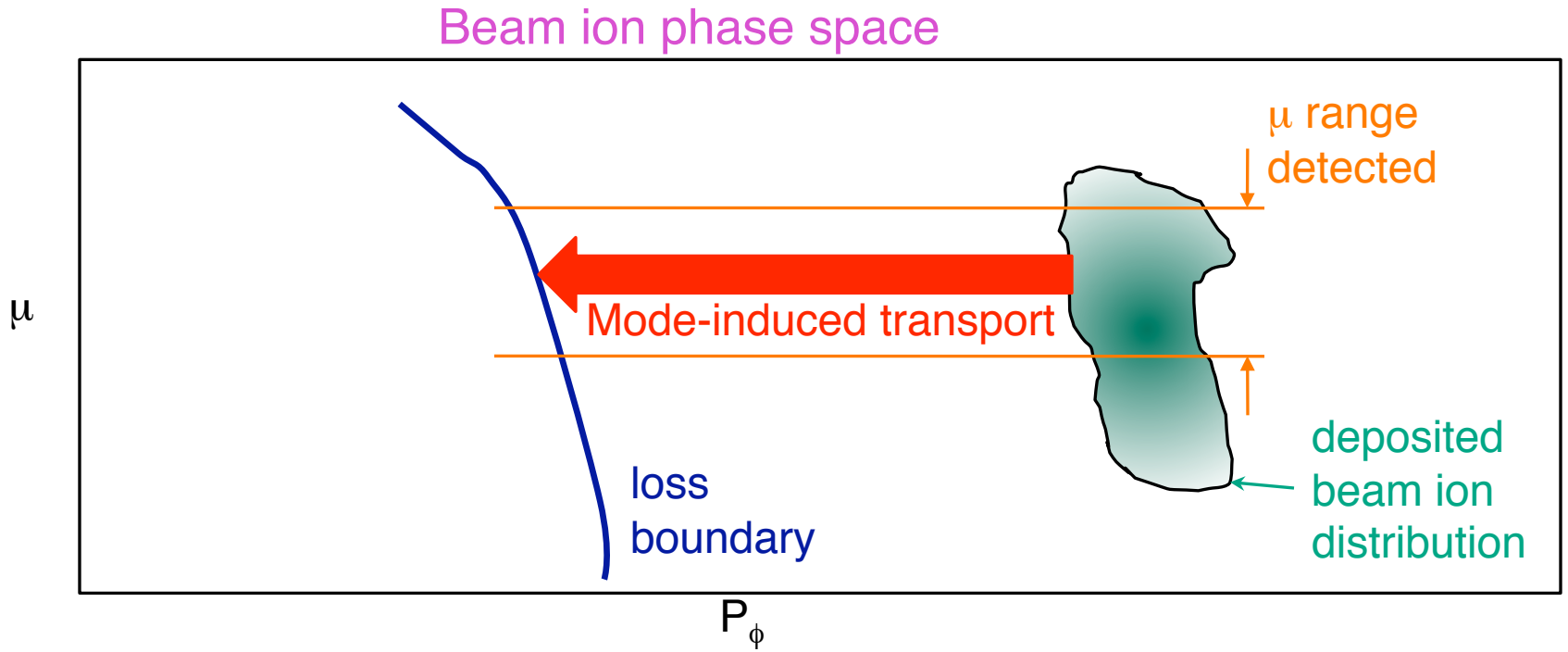
- $\chi=\arccos(v_{||}/v)$
- Observed gyroradius matches that of full energy beam ions
- 2 separate pitch angles seen in some frames, e.g. 7 & 10

Phase space of full energy beam ions can be modeled



Phase space model helps understand avalanche loss

- Observed MHD frequencies $<<\Omega_{ci}$, so μ will be conserved
- Modes destroy toroidal symmetry, so P_ϕ no longer constant
- $E_{loss} = E_{inj}$, so avalanche convects ions at constant μ to detector (and across loss boundary)
- Distance displaced in P_ϕ indicates strength of transport



Proximity of beam ions to detector at high χ (high μ) indicates why loss appears there first