Fast Ion Transport Studies using Beam Blips

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Motivation

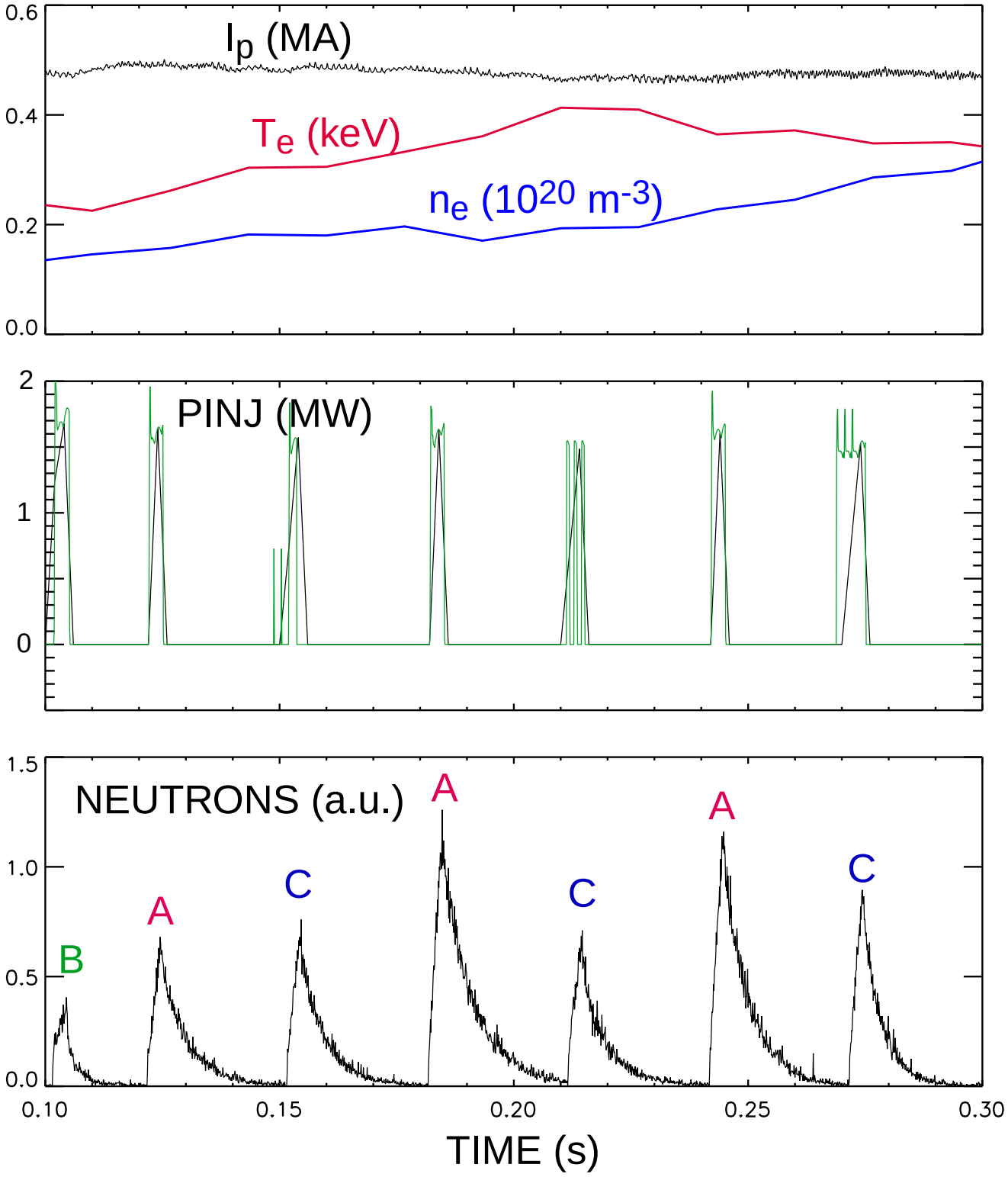
@ The beams are a major heating system--need to confirm their performance.

@ Beam ions in NSTX are like alphas in a ST reactor.

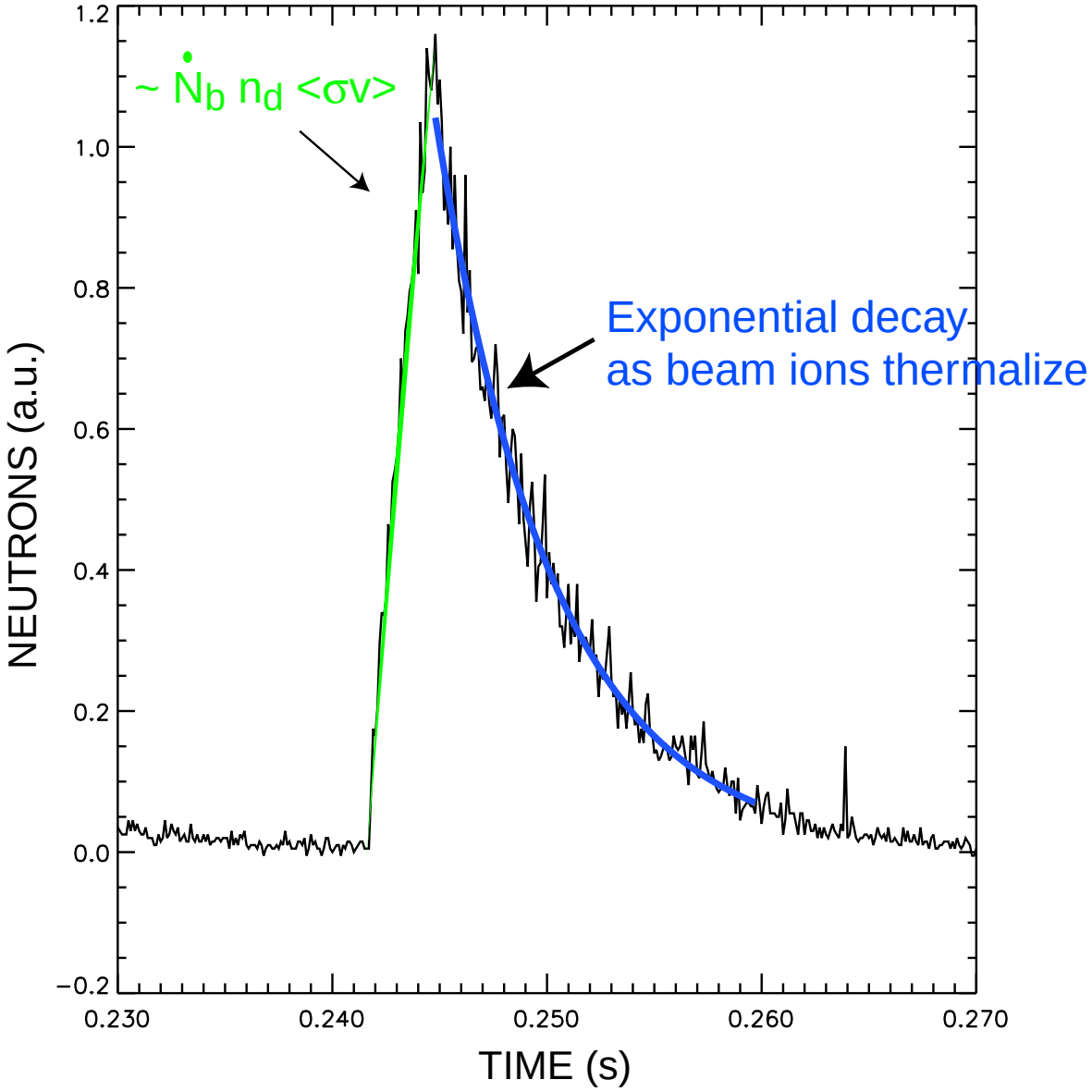
Technique

@ Short beam pulses ("beam blips") produce a convenient population of ~ monoenergetic beam ions => deconvolves confinement and thermalization.

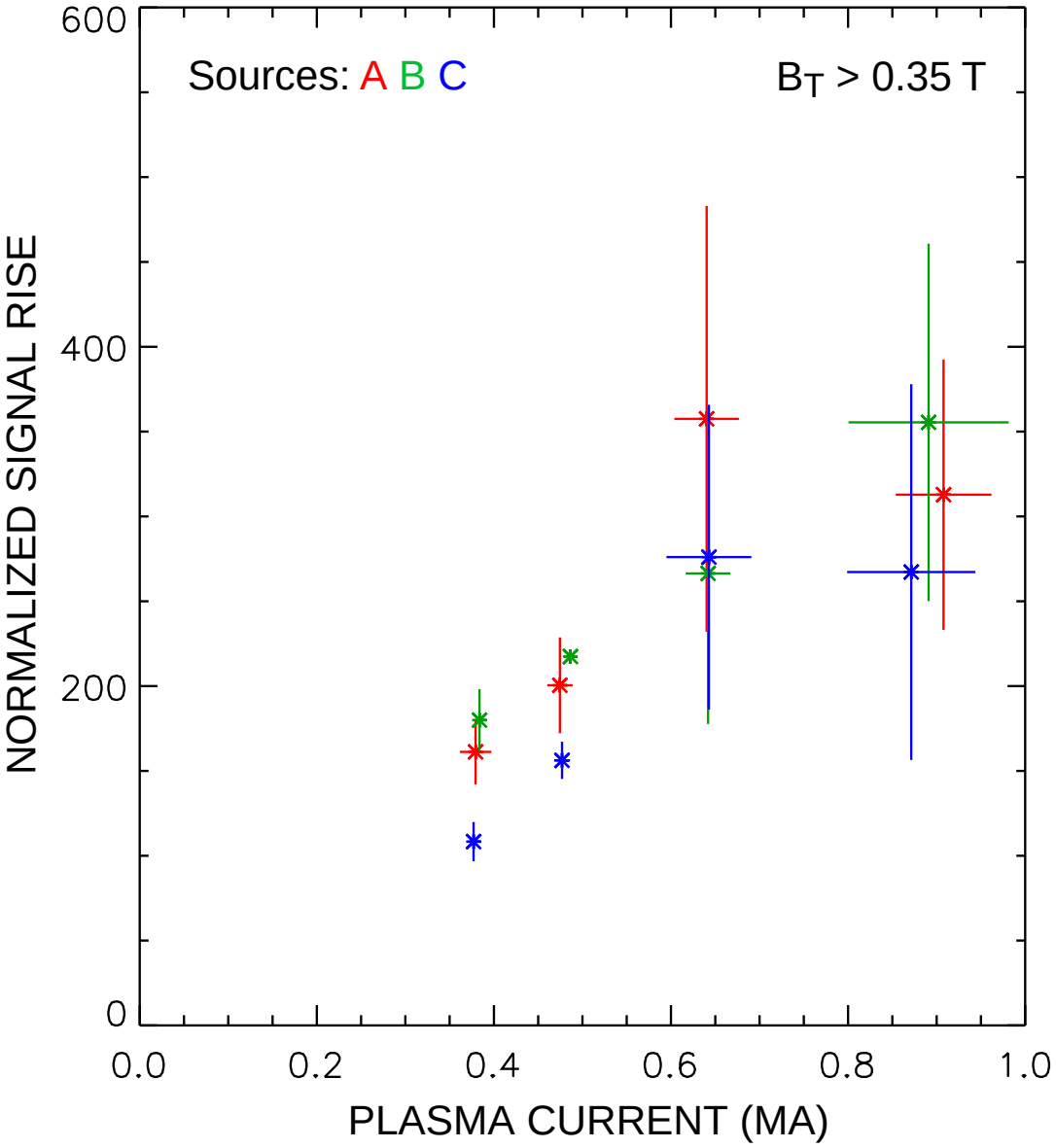
~ 3 ms Beam Blips Injected into Ohmic Plasma to study Beam-Ion Confinement



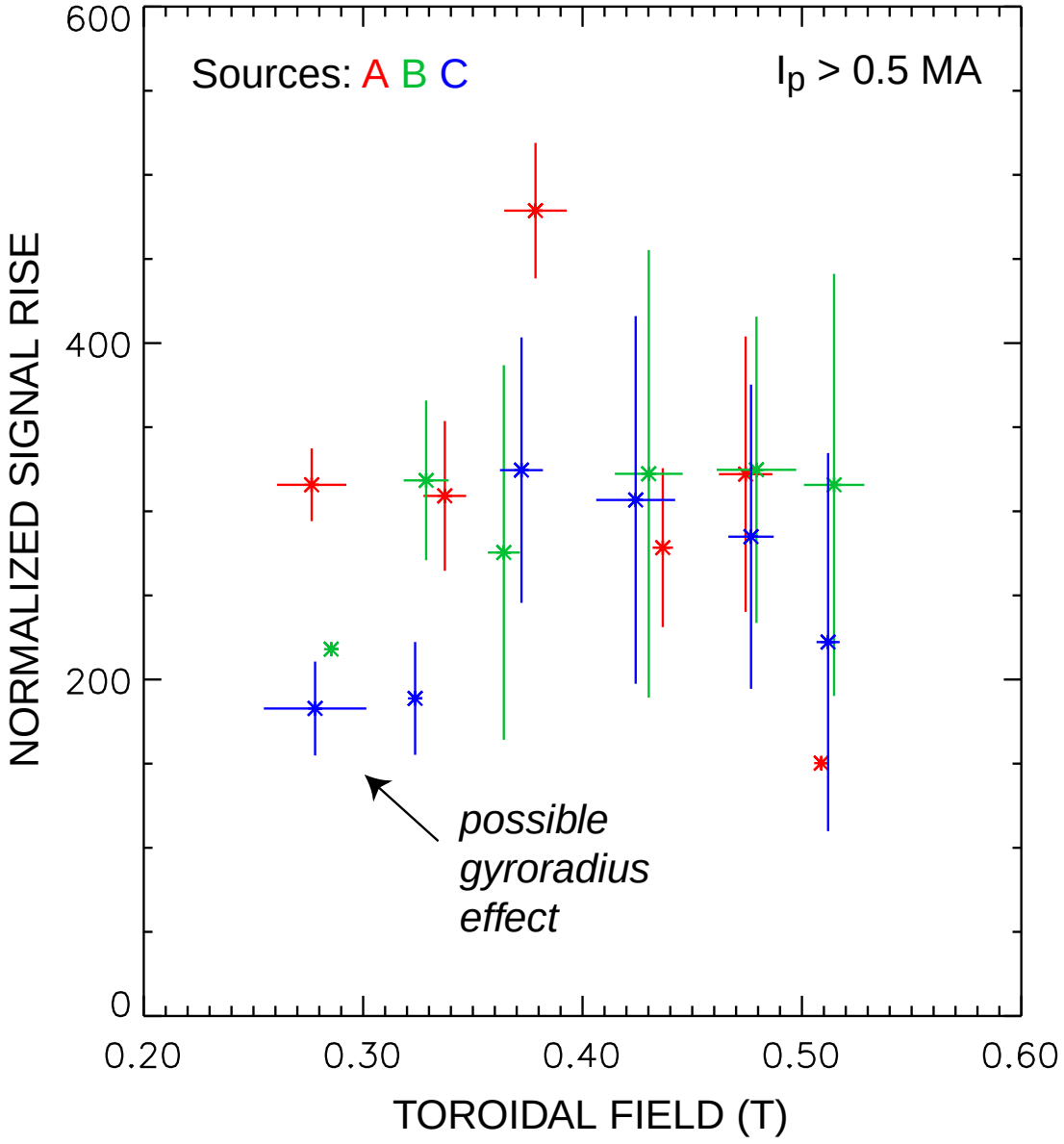
Prompt Confinement from Initial Rise; Delayed Losses from Subsequent Decay



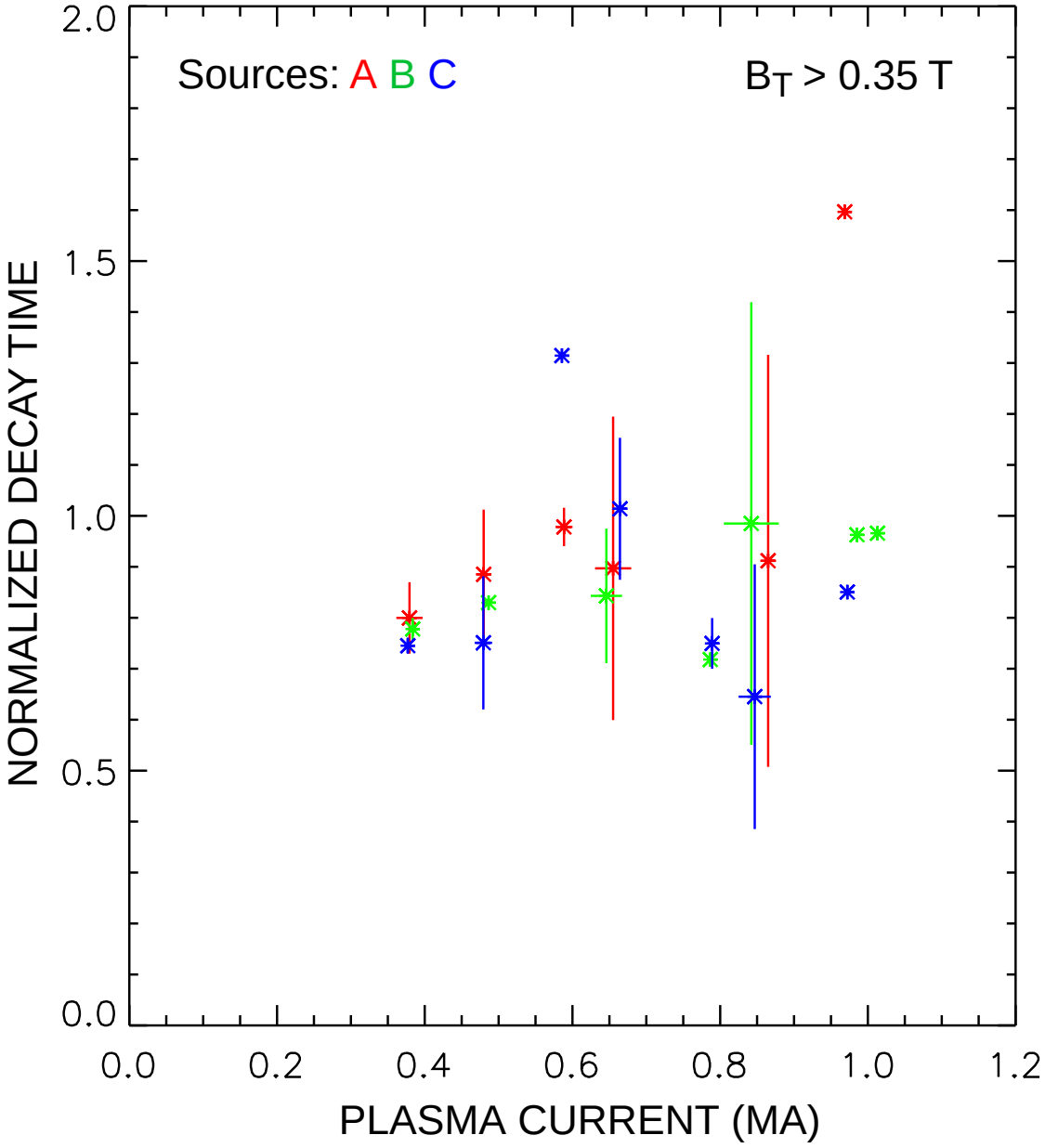
More Prompt Losses at Low Current: Expected Drift Orbit Effect



Weak Dependence of Prompt Confinement on Toroidal Field



Little Evidence of Delayed Losses



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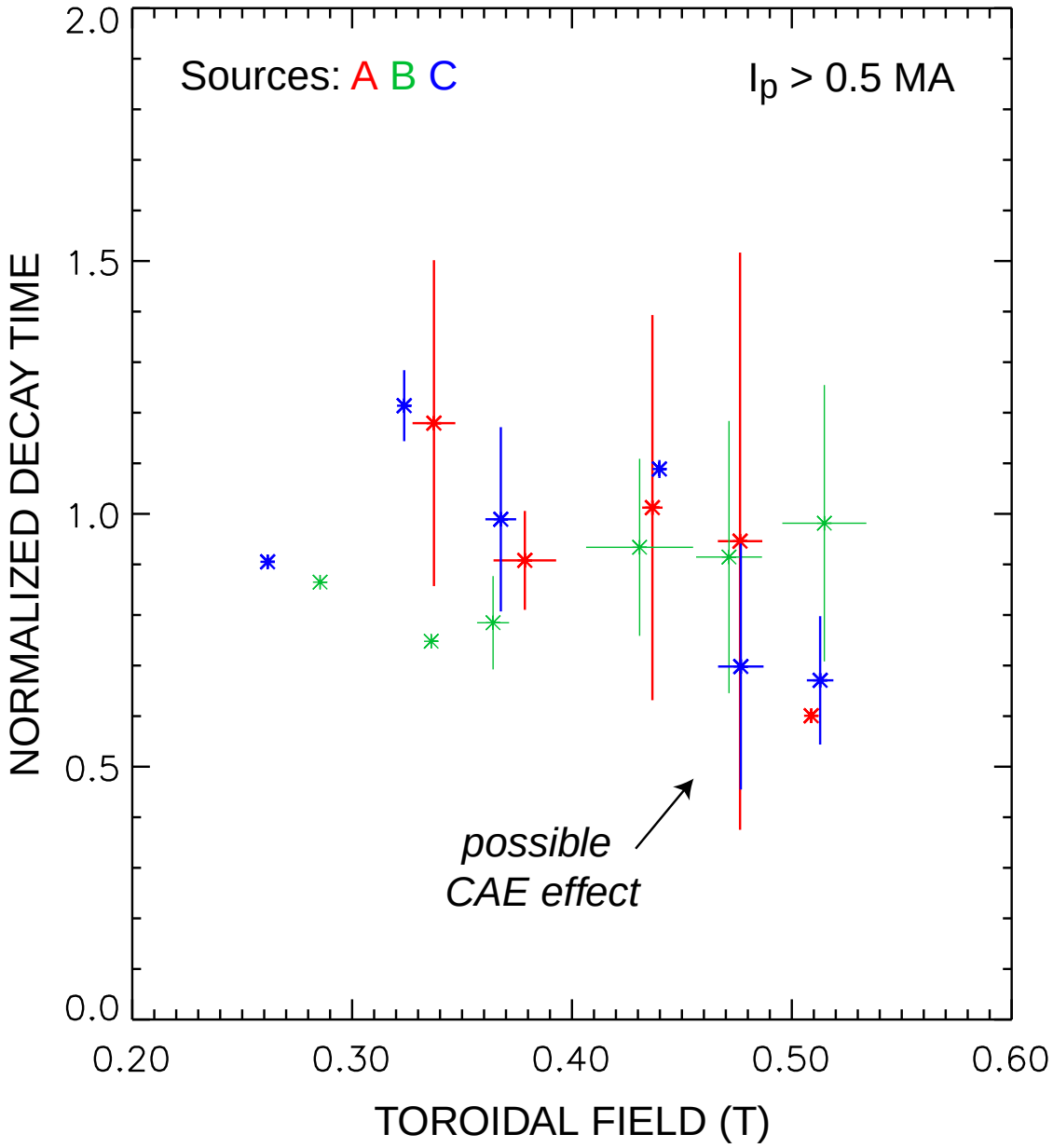

Preliminary Results

@ Fast neutral beam waveforms unreliable.

@ For all three injection angles, confinement is degraded for currents below 0.5 MA, as expected.

@ The effect is strongest for the most perpendicular injection angle, as expected.

@ The dependence of the prompt losses on toroidal field is generally weak, as in conventional tokamaks.

@ Possible evidence of additional prompt losses when $\rho > 20$ cm.

@ Decay time consistent with classical theory for all parameters => delayed losses relatively unimportant (as expected for classical scattering).

Future Work

Data Reduction

@ Understand outliers; categorize MHD.

@ Z_{eff} data? (Need deuterium density).

@ Neutral particle and foil data.

@ Compressional Alfven Eigenmode correlation.

Comparison with Theory

@ Semi-analytical calculations for every blip.

@ TRANSP runs for many discharges.

@ Full orbit calculation (for different beam angles) for one or two cases.