Time of flight identification of ions for ERL

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Why an Ion TOF Spectrometer?

• Scattering on the dilute gas by the beam produces positively charged ions
• Ions can then accumulate in the beam potential
• Possible ‘cascade’ effect
  – Disturb the motion of the beam
  – Widen the cross section (especially undesirable in ERL)
How this can happen, 1

• Fast ion instability
  – Ions oscillate in the electron beam and vice versa
  – Coupled system becomes unstable
  – Large oscillations or increase in transverse beam size

Raubenheimer and Zimmerman
How this can happen, 2

- Nonlinear focusing
  - Accumulated ions focus electrons non-linearly as a function of the electron’s distance from the beam center
  - Emittance growth

Hoffstaetter and Spethmann
http://arxiv.org/abs/0706.2897
TOF Spectrometer

- Measure the composition of the ion gas near the beam
- Determine charge state and type of ions
  - Ions enter the TOFS chamber, are accelerated through a well-defined potential, then their velocities are measured
  - Determine mass to charge ratio
Timeline

• Electronics assembly
  – Gate ring circuit, HV divider -> finished
• Ion source for characterization
  – June 20
• Characterize detector
  – Correlation of measured voltages to measured ion density
• SIMION simulation of ion optics
• Trial installation on CESR?
• Test in ERL prototype injector