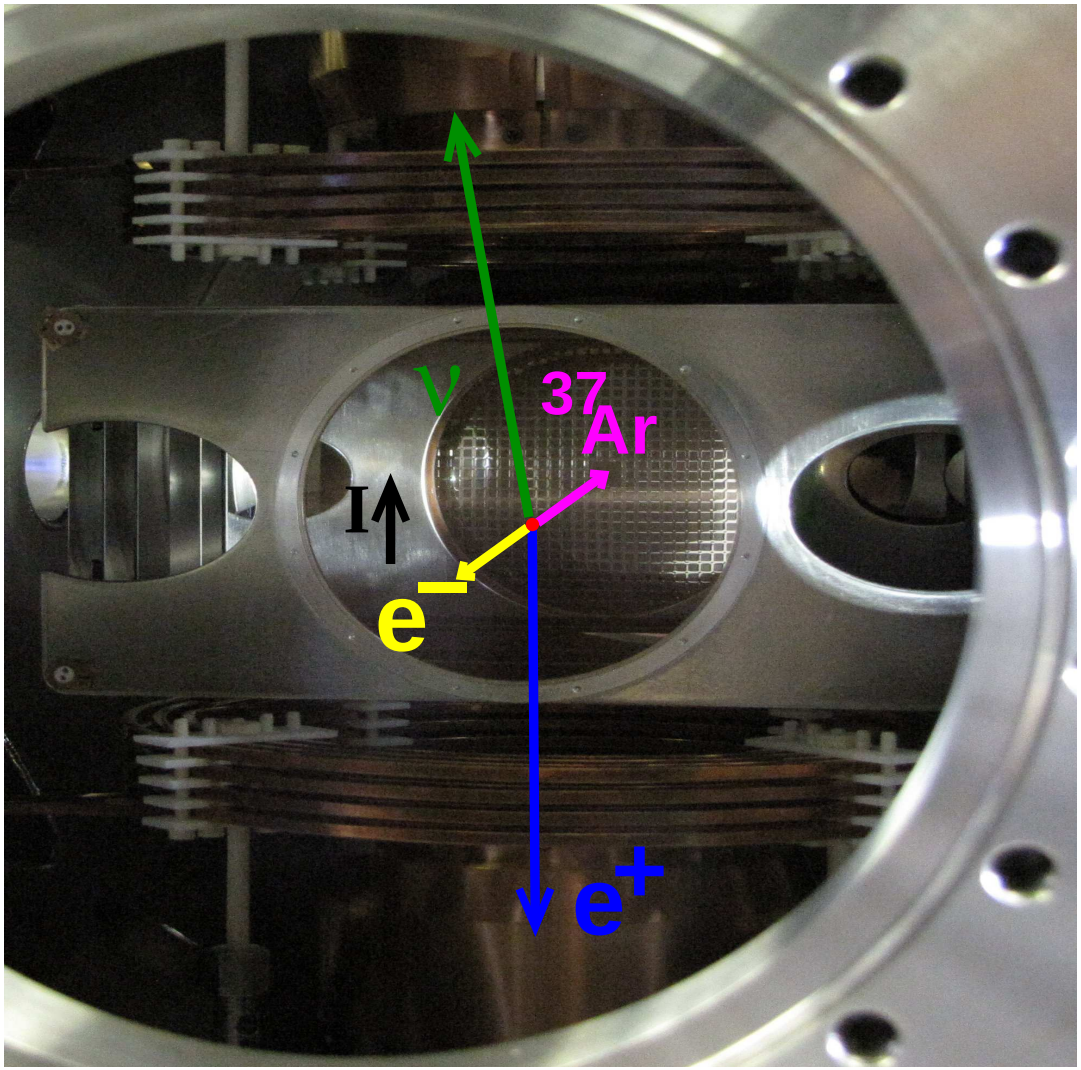
$^{37}\vec{K}$ β decay: what Spencer had no time for

- other motivation
- constraints on Ar^{-*} production, false β asymmetry
- Recoil asymmetry
- trap lifetime

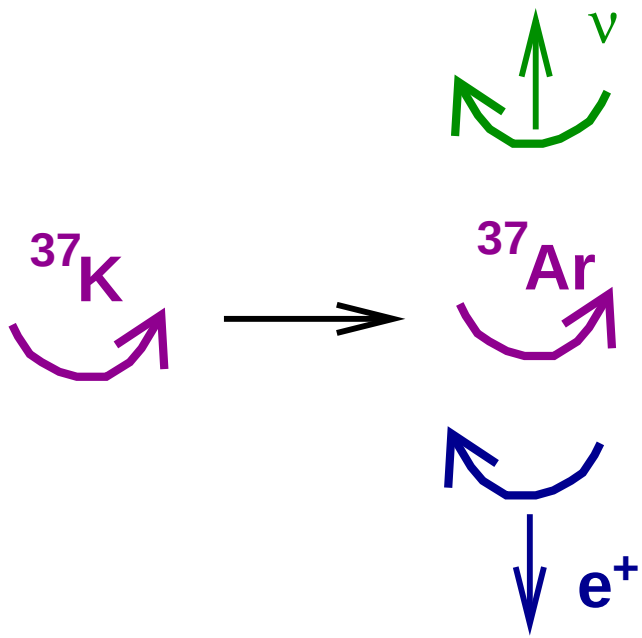


atomic e^- coincidence minimizes backgrounds from decay of untrapped atoms

one motivation

- **To get standard model predictions for most observables, need ratio of GT to Fermi matrix elements from the half-life.**
- **One observable that separates the GT piece experimentally $\rightarrow$**

sensitive to any new interaction producing non-standard lepton helicities



the webstory version highschool?

Ar^{-*} ions and β asymmetry

$^{37}K \rightarrow {}^{37}Ar + \beta^+ + \nu$

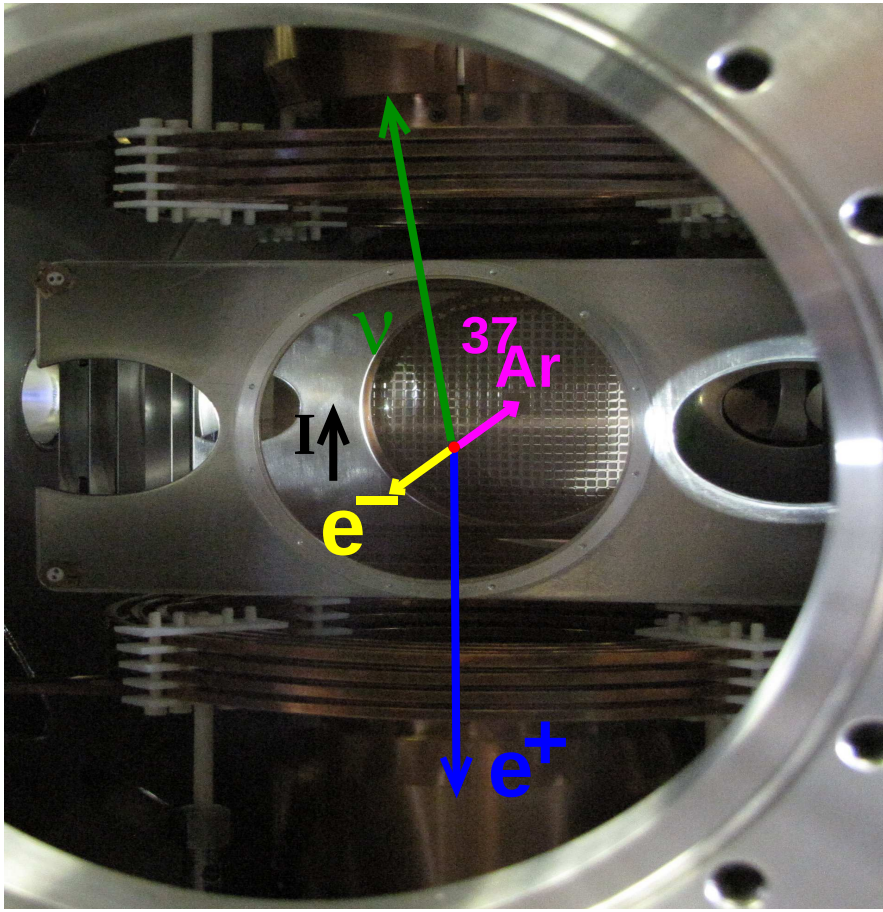
Naively makes Ar^- ion

Ground state is known to be unbound and unstable

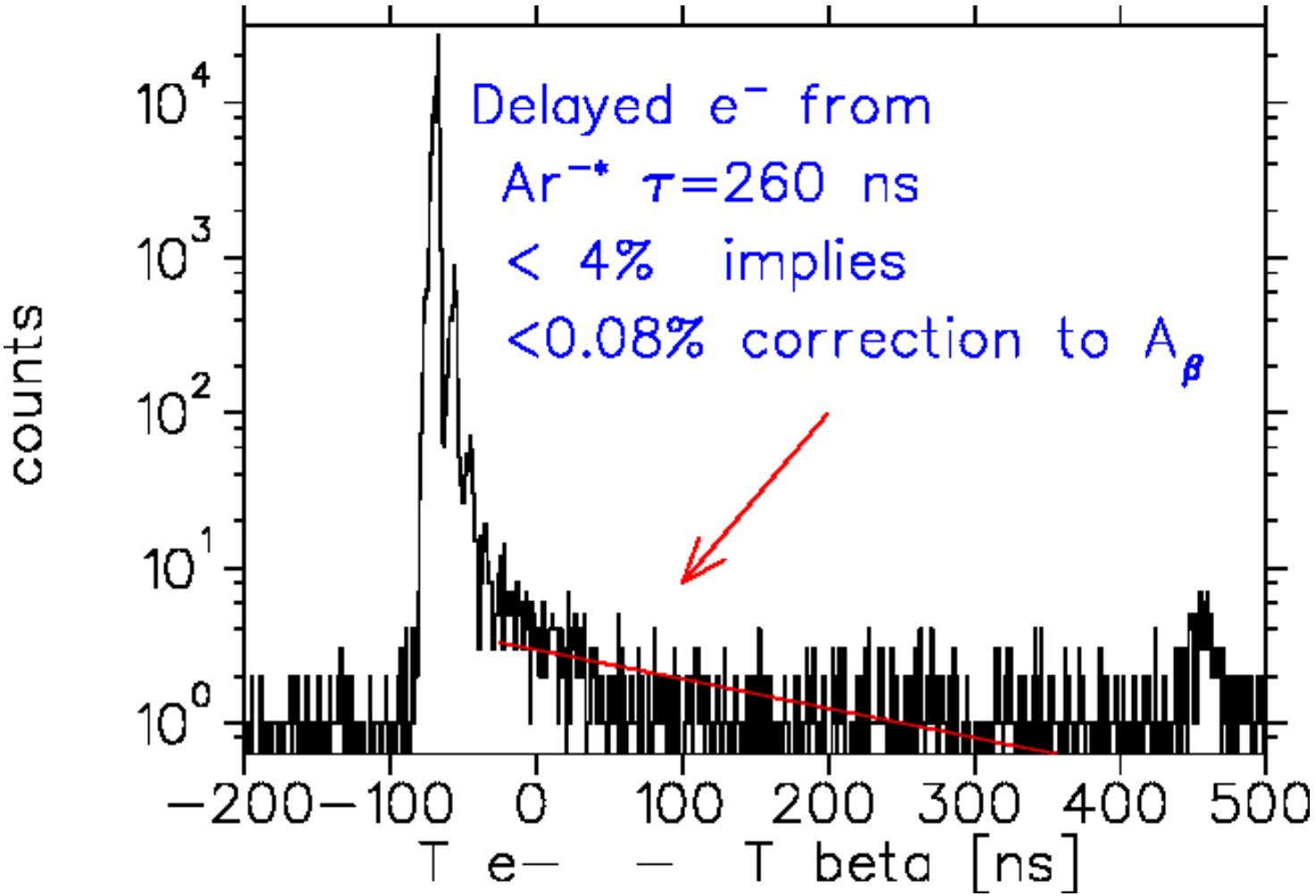
- Excited state Ar^{-*} $3s^2 3p^5 4s4p$ bound w.r.t. Ar* $3s^2 3p^5 4s + e^-$ (Bunge NIM 202 299 (1982))

Measured $\tau = 260 \pm 25$ ns (Ben-Itzhak PRA 38 4870 (1988))

Could produce false β asymmetry from biased e^- detection. Sims $\Rightarrow$ 4% false asymmetry if metastable produced 100%.



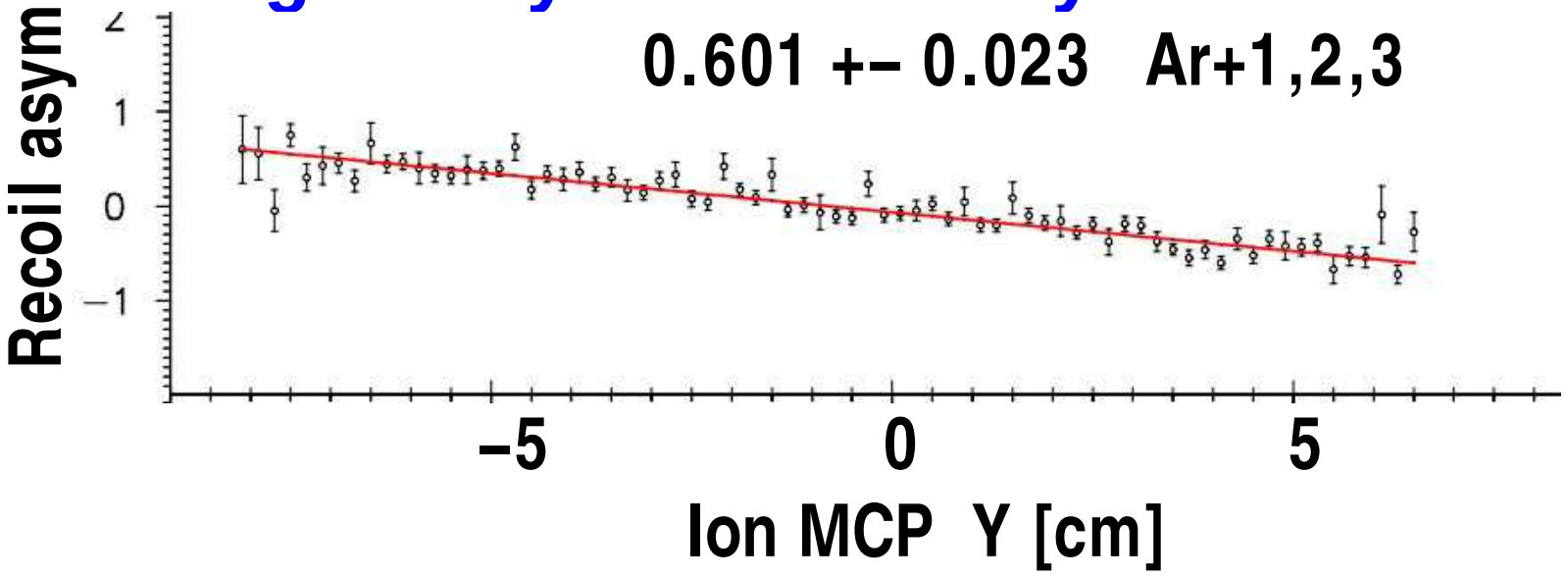
Ar^{-*} ions and β asymmetry



Trap light excites 4s $\rightarrow$ 4p

Does formation rate change?

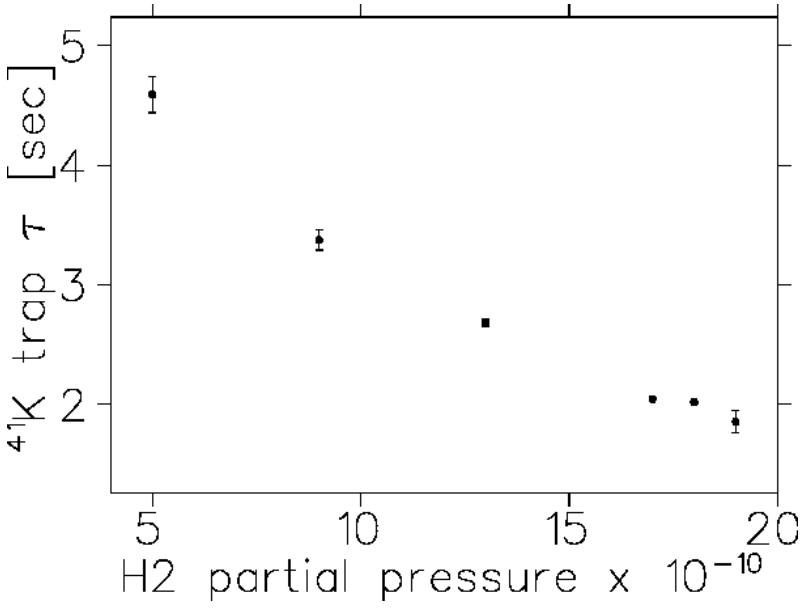
Recoil singles asym under analysis

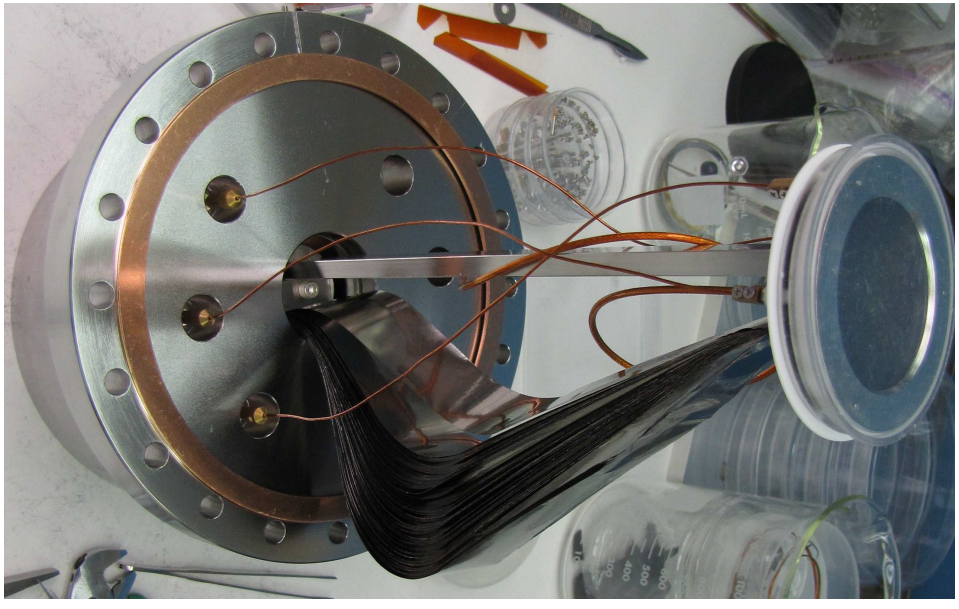


Deduced from TOF of ^{37}Ar +1, +2, +3 w.r.t. e^- trigger
Pitcairn et al. PRC 79 015501 (2009) in ^{80}Rb
$0.015 \pm 0.029 \pm 0.019$

- **Insensitive to wrong-handed V$\pm$A interactions, so can be used to normalize β asymmetry (depending on how our spin-polarization atomic measurements turn out)**
- **Recoil momentum dependence is sensitive to polarization and to 4-fermi 'tensor' interactions simultaneously**

Trap Lifetime





In 2005: trap $t_{1/2}$=15 s, limited by vacuum

2013: offline in ^{41}K $t_{1/2}$= 6 s in new apparatus

For trapped ^{37}K $t_{1/2}$= 0.6 s

AC MOT, 6 hrs at full duty cycle, heats chamber

Plans:

Improve hydrogen pumping conductance, add pumping

Replace the low-inductance ground (50 thin foils of Ti) with twisted pair