TRIMS Tritium Recoil-Ion Mass Spectrometer

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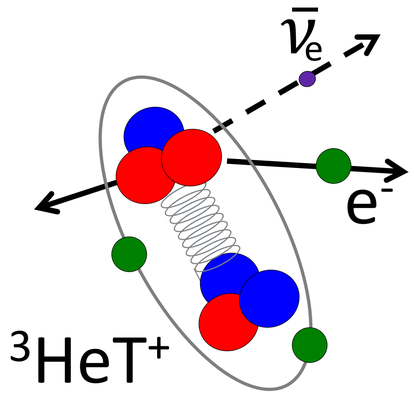
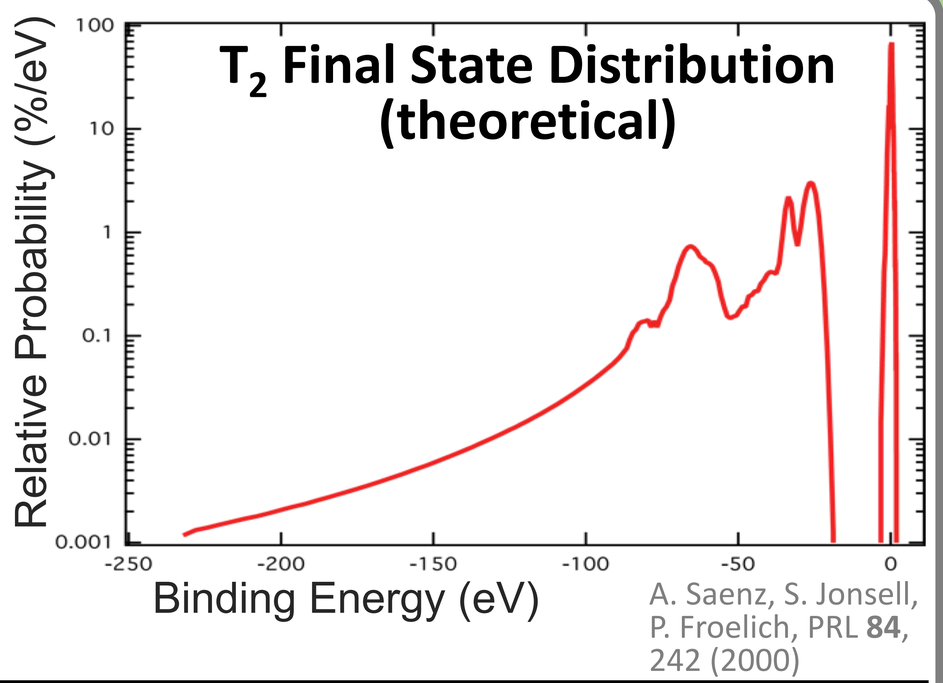
Branching-Ratio of Tritium Molecular Final States

The molecular tritium (T_2) beta spectrum, needed for analyzing neutrino-mass data from T_2 sources, depends on molecular final states involving electronic, rotational, and vibrational excitations

- Theory and experiment agree on energy levels
- Direct measurement of the final-state distribution is, however, impossible
- Theory and experiments from 1950s have an outstanding discrepancy on P_B!

$$P_B = \frac{N_{Bound}}{N_{Bound} + N_{Dissociated}}$$





A. Saenz, S. Jonsell, P. Froelich, PRL **84**, 242 (2000)

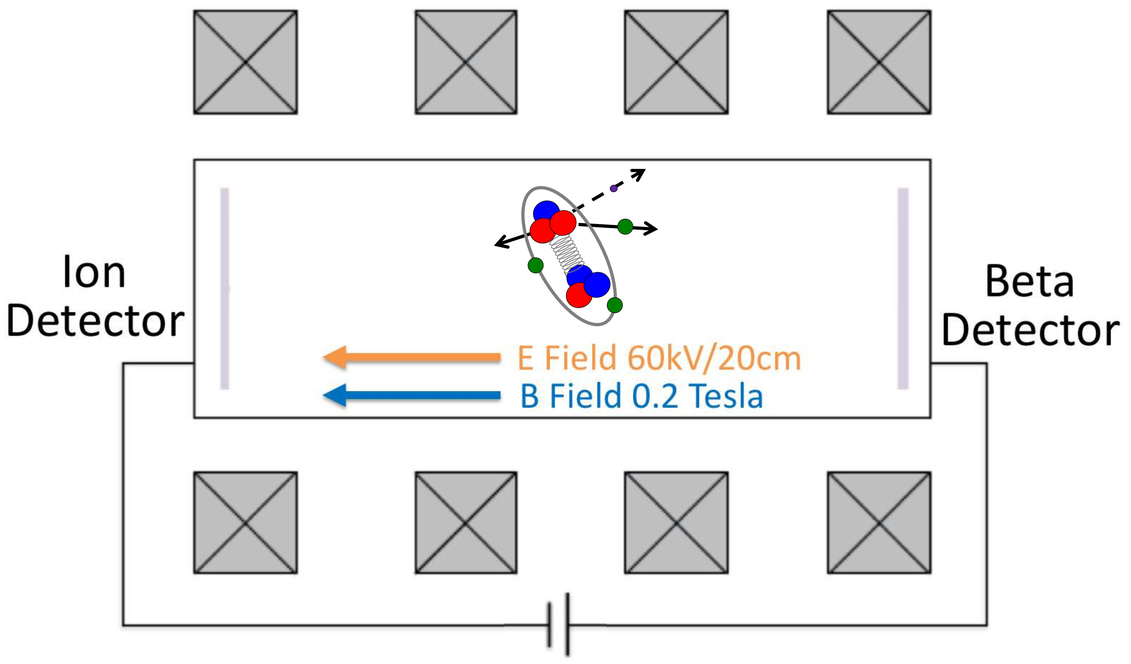
	Theory	Wexler Experiment	Snell Experiment
$P_B(T_2)$	0.39-0.57	0.945 ± 0.006	
$P_B(HT)$	0.55-0.57	0.895 ± 0.011	0.932 ± 0.019

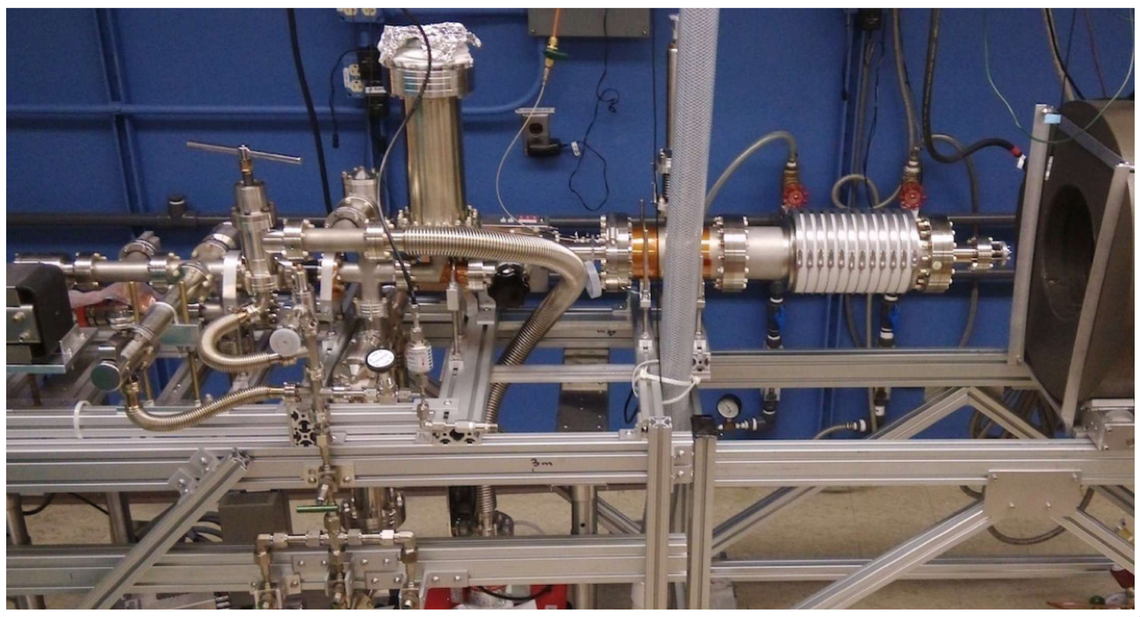
Direct comparison is difficult:

- Theory applies to the beta spectrum near the end point, but the experiments measure the integral
- Radiative vs dissociative lifetime is not well understood

The TRIMS Experiment

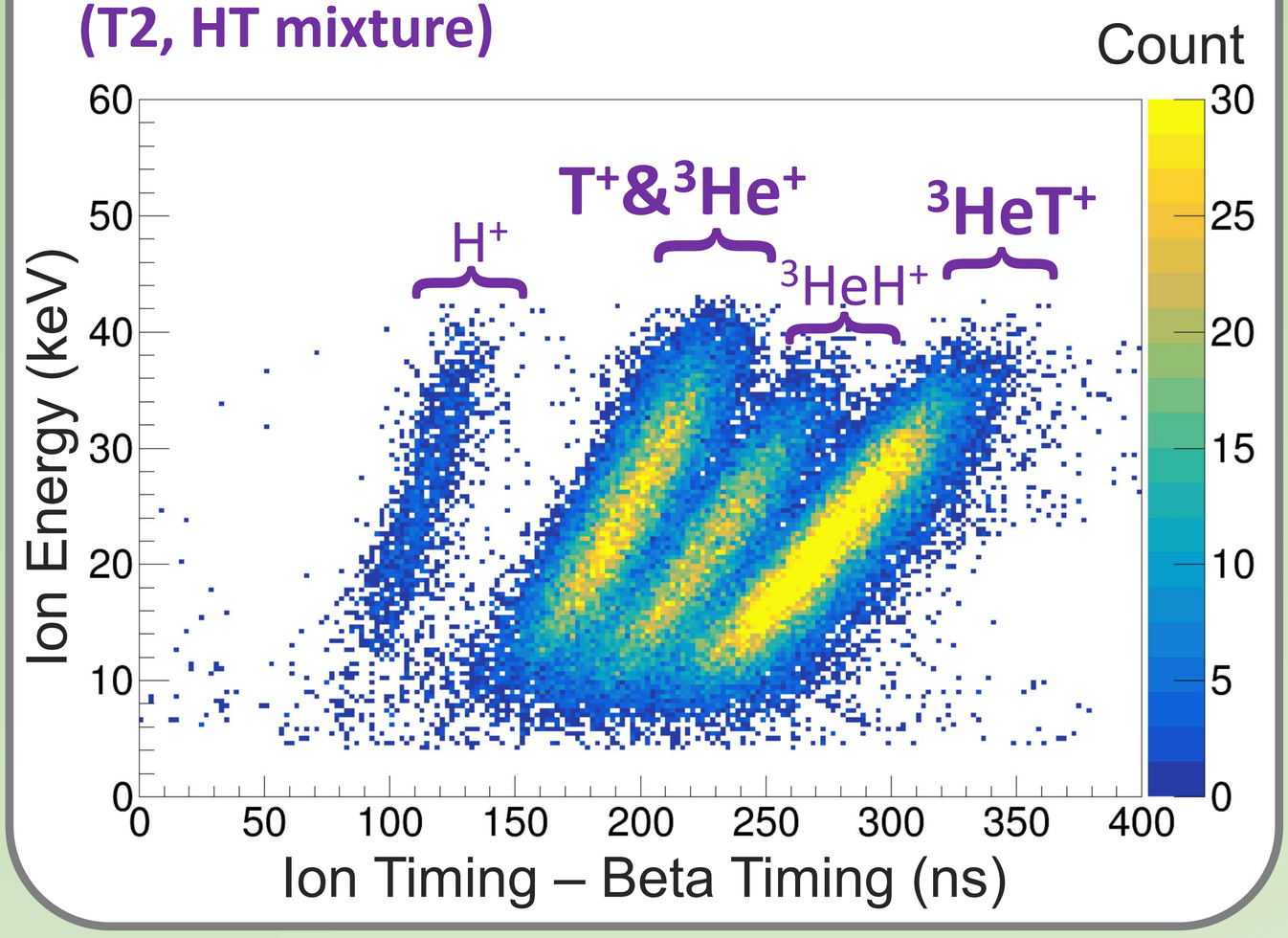
- **Project goal: obtain the branching-ratio to the bound molecular state $^3HeT^+$**
- By comparing the ion energy and the time of flight (TOF), we can distinguish the ion species by their masses





Physics Data

(T2, HT mixture)



Outlook

- TRIMS addresses the only known experimental disagreement with T_2 final-state theory
- We are currently recording data for a percent-accuracy branching-ratio measurement for both T_2 and HT
- We will measure the branching-ratio of doubly charged final states

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U.S. DEPARTMENT OF ENERGY

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