The Project 8 collaboration has recorded its first tritium spectrum using the CRES technique.

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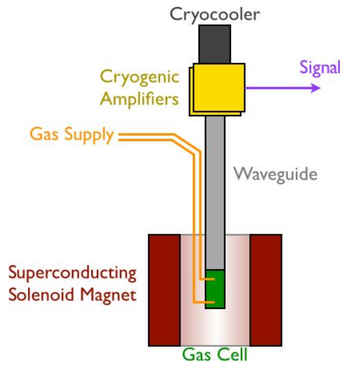
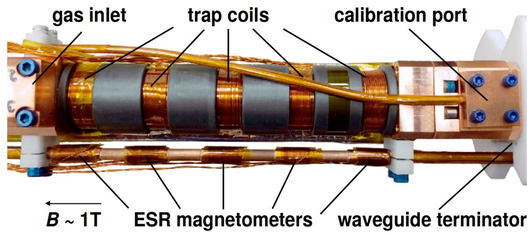
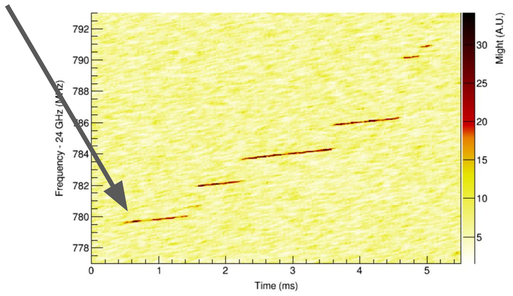
Tritium CRES* setup

- Magnetically trapped electrons from T2 decay emit cyclotron radiation inside a microwave guide.
- Amplification → Mixing → Digitization → Fourier Transformation → Track identification
- Initial cyclotron frequency (prior to radiative or scattering losses) encodes the decay energy







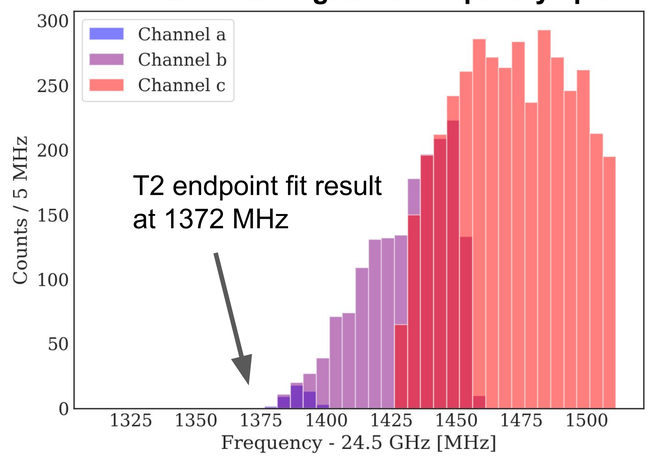
*CRES: Cyclotron Radiation Emiision Spectroscopy

Data set characteristics

- 3 overlapping frequency bands to cover 16.2 - 18.6 keV
- 82 net days, 5694 total counts
- 3594 unique counts
- **No events beyond endpoint** → background rate:

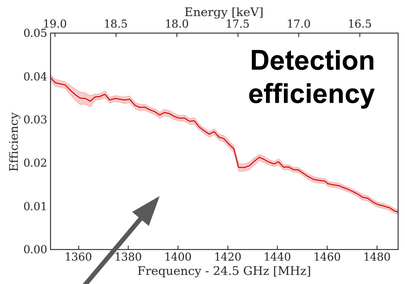
  $\leq 3 \cdot 10^{-10}$ /eV/s (90% C.I)

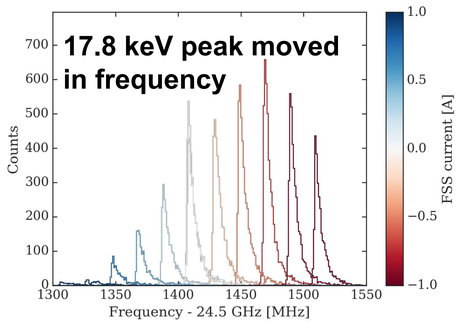
Event histogram in frequency space

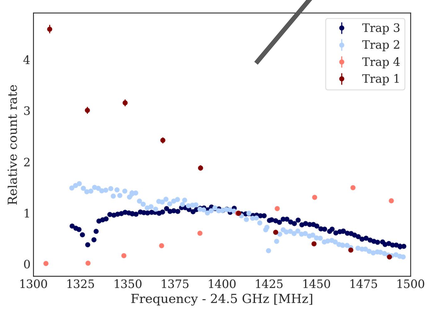


Detection efficiency, energy resolution and gas scattering induced line shape variation

- Frequency dependent event detection efficiency
- Field shifting solenoid: move monoenergetic ^{83m}Kr K-line across frequency region of interest for T2







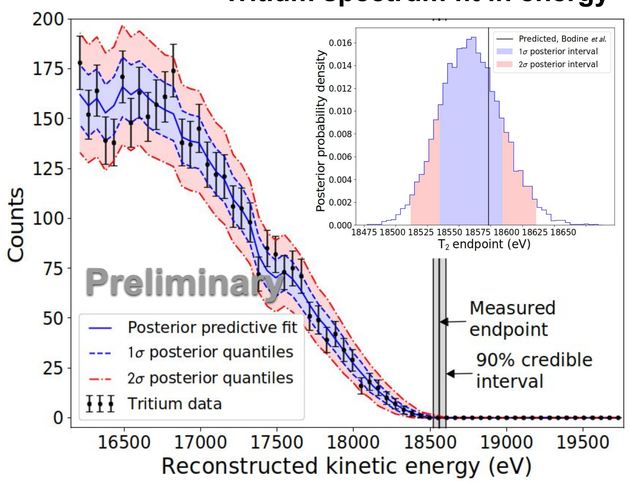
Weighted sum of single trap count rates give multi trap efficiency

Spectrum reconstruction and analysis

- Validation of analysis chain with MC generated data sets
- Spectrum model accounts for line-shape (convolution) and detection efficiency (multiplication).
- Bayesian and frequentist analyses ongoing
- **Preliminary bayesian endpoint result* with 92% coverage:**

  $18559.4^{+42.4}_{-39.6}$ eV (90% C.I.)

Tritium spectrum fit in energy



*Contribution from helium scattering not yet included. Expected effect is a few eV endpoint shift.

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