Sources of monoenergetic electrons from decay of $^{83m}$Kr for KATRIN

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Motivation and requirements

- Energy scale distortions have impact on precise $m_\alpha$ measurements
- Accurate energy calibration of spectrometers and high voltage dividers
- $^{83m}$Kr (T$_{1/2}$ = 1.83 hours) generated in parent $^{83}$Rb (T$_{1/2}$ = 86.2 days) decay
- Source of isotopically emitted monoenergetic conversion electrons K-32 (17.8 keV), L$_{1,2}$-32 (30.4 keV), N$_{1,2}$-32 (32.1 keV) from the 32.2 keV $^{83m}$Kr transition; K-32 line has suitable energy just 750 eV below the tritium $\beta$-spectrum endpoint (18575 eV)
- Solid conversion electron sources developed to provide excellent energy stability which meets the requirements for KATRIN energy scale stability at a level of ±3 ppm/month (required high voltage stability is within ±60 mV at 18.6 kV)

Conversion electron sources for KATRIN

- **GKrS**: systematic studies of space charge effects in WGTs, energy calibration, voltages stability (incl. workfunctions) and check of the whole KATRIN electron beamline will be possible
- **CKrS**: systematic investigations and energy calibration of the main spectrometer will be possible during its operation
- **IKrS**: change of the K-32 line position detected in MoS spectra will indicate a possible instability of the common MoS and MS high voltage during a typical 2 month KATRIN run
- **EKs**: evaporated sources used for energy calibration and efficiency testing of the TRISTAN detector, which allows a higher count rate and will be used in keV-scale sterile neutrino search

Activity production

Cyclotron U-120M in NPI

- $^{83m}$Kr retention in substrate reaches 95%
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- Auxiliary spectrometer of the MAC-E filter type connected to common high voltage as the main spectrometer

Monitor spectrometer

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Conclusion

- $^{83m}$Kr sources of monoenergetic conversion electrons based on solid implanted or zeolite sources were developed in NPI CAS for the KATRIN energy calibration, voltage stability and systematic measurement purposes
- The gaseous krypton generator is an adjustable assembly that meets the ITEP-TLK safety requirements and is ready for the KATRIN tritium operations

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