Karlsruhe Institute of Technology

Tritium ion monitoring during KATRIN First Tritium

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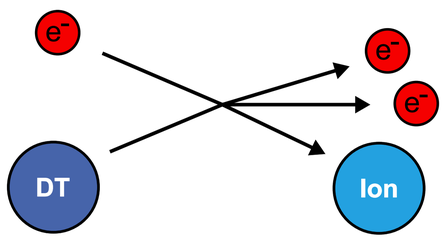
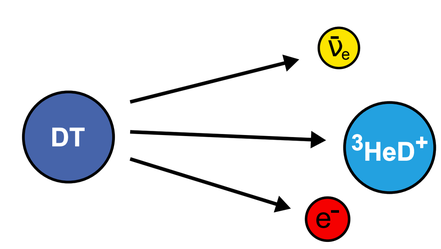
Ion creation in the tritium source



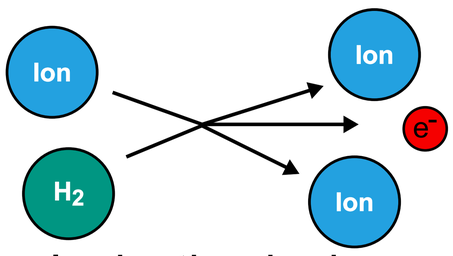
Ionisation by β electrons



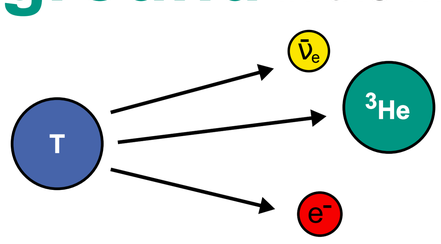
Tritium decay

Ion creation rate: 6·10⁹ ions/s

Ion induced background in the MS



Ionisation by ions



Decay of implanted ions

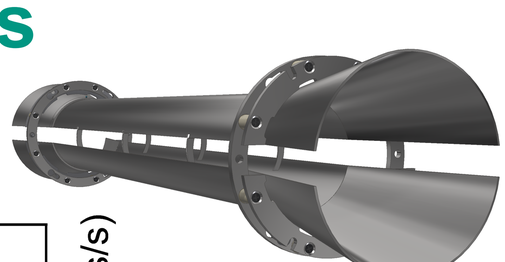
→ Ion flux limit into the PS: 10⁴ ions/s

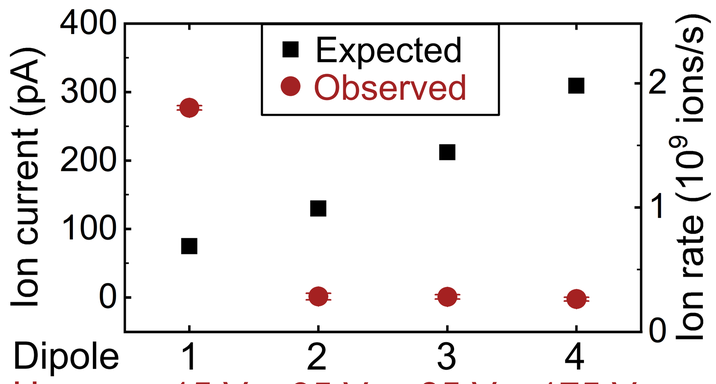
Ring electrodes

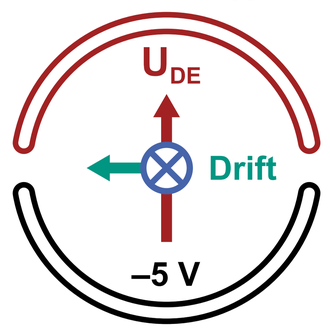
block ions with +200 V

Dipole electrodes

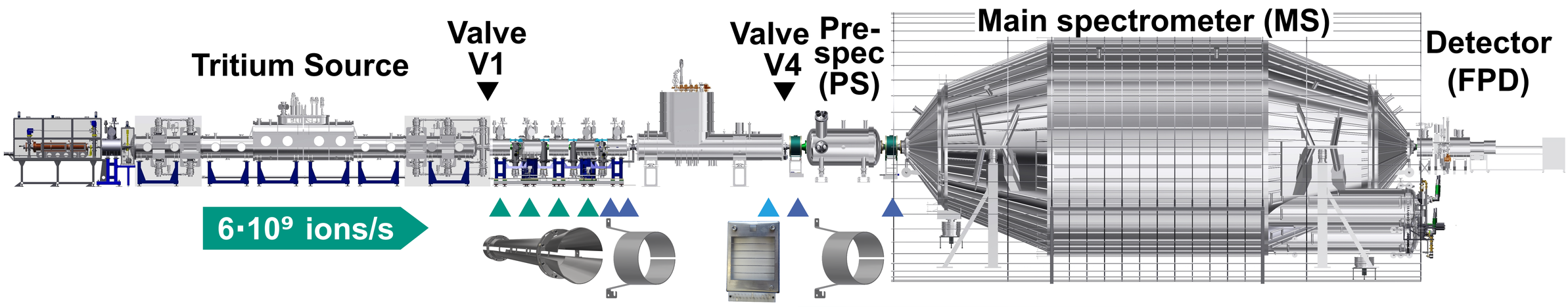
remove ions via E×B-drift
and measure the current
from ion neutralisation



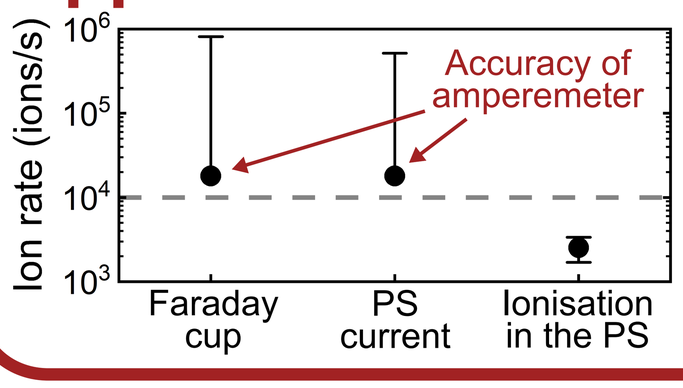




Ions are inadvertently blocked, partially in front of and behind dipole 1!

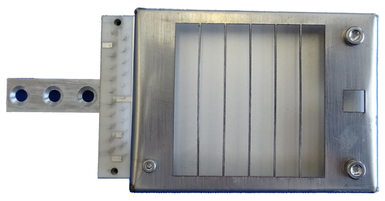


Upper limit on residual ion flux



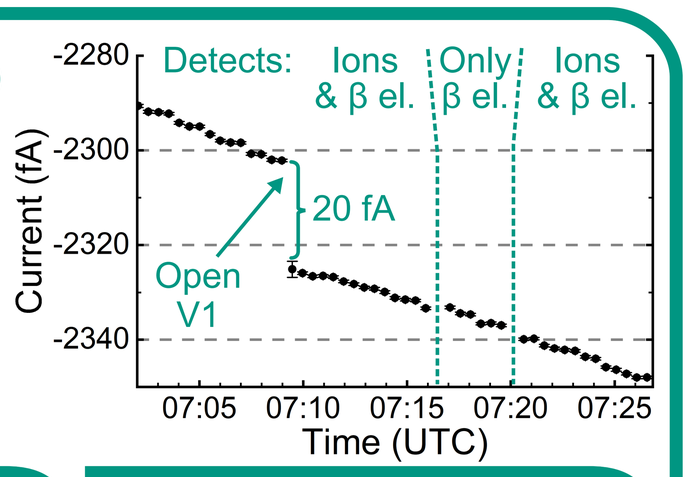
Ion blocking successful!

Faraday Cup



β electron current

Expected: 900 fA
Observed: 20 fA



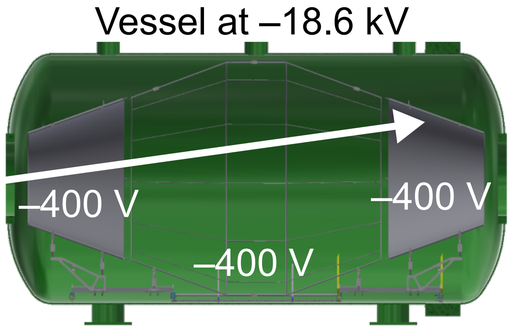
Missing beta rate

No ions observed

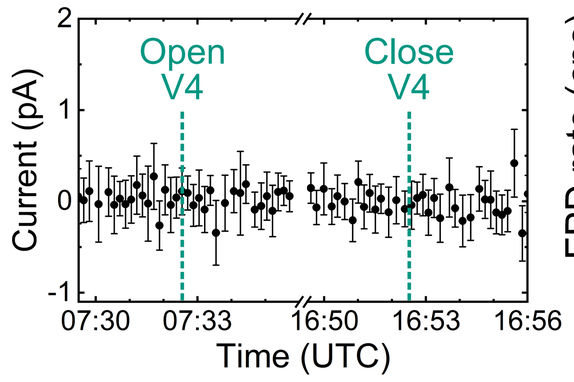
Pre-spectrometer at –19 kV

Ion tracking simulations

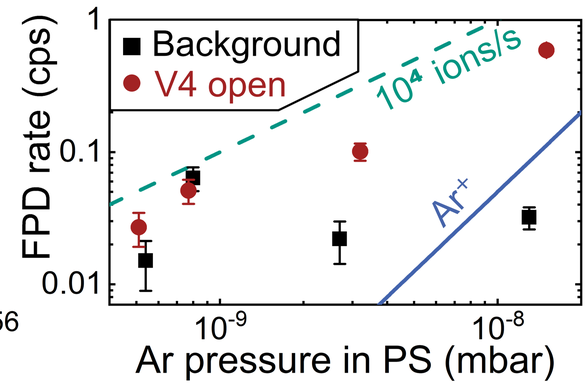
- $<10^{-4}$ of ions reach the MS
- 98% of ions hit cone electrode
- $1 \cdot 10^{-6}$ FPD counts per ion at 10^{-10} mbar Ar



Neutralisation current



Ionisation rate



Continuous ion monitoring

< 10⁴ ions/s from the source

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