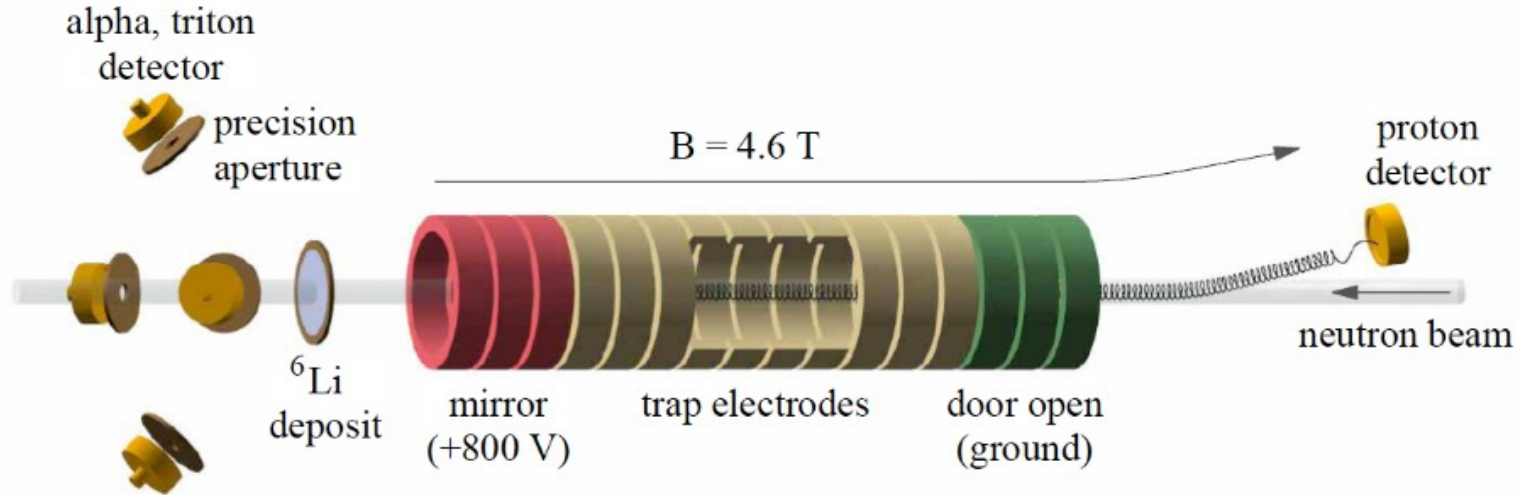


J-PARC 2025 Neutron Lifetime Preprint:
2412.19519

UT-ORNL Group Meeting
July 14th, 2025
Cary Rock

(Proton) Beam Experiments

- Catch β -decay protons in a Penning trap, count after some times

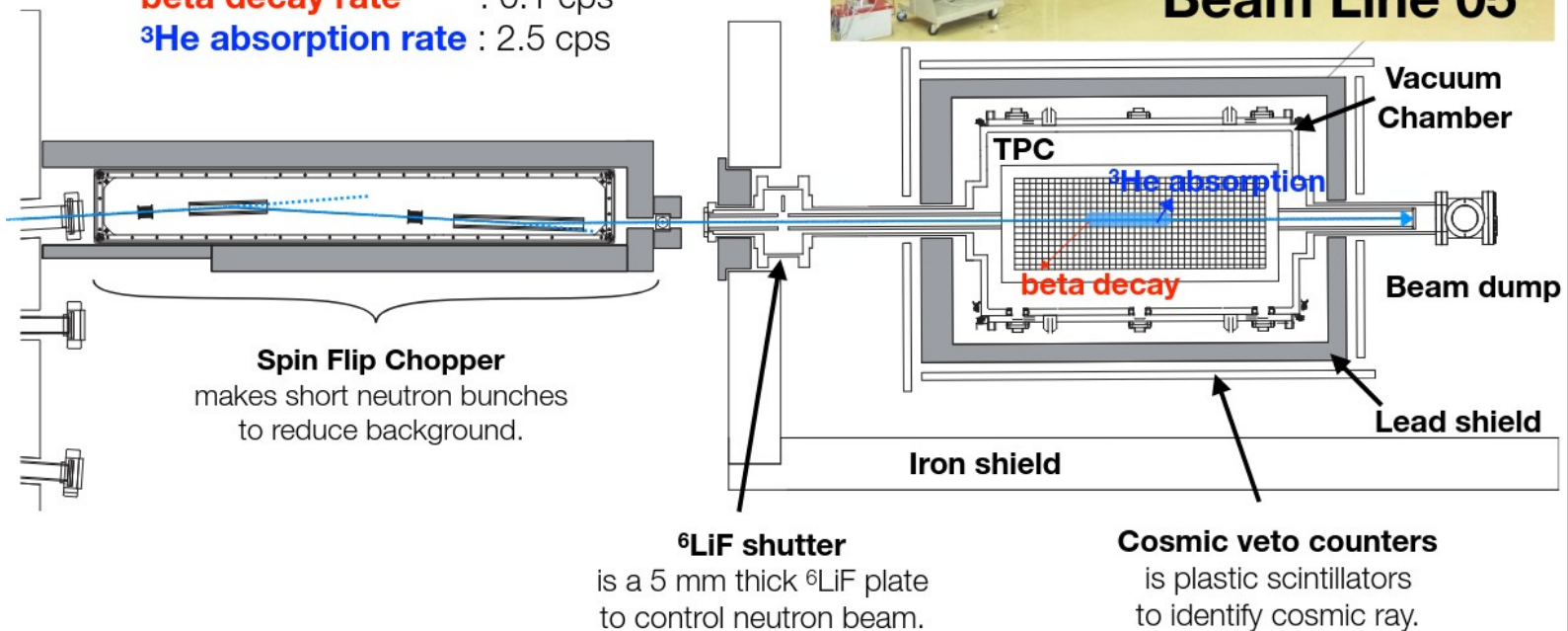


J-PARC MLF BL05

Neutron is produced
by injecting proton beam
to mercury target.

Beam line property

Neutron energy : ~10 meV
Neutron velocity : ~1000 m/s
beta decay rate : 0.1 cps
 ^3He absorption rate : 2.5 cps



Previous J-PARC Results

- 2020, published (10.7566/JPSCP.33.011056) claiming lifetime of $898 \pm 10_{stat} +15_{syst} -18_{syst}$ seconds
- Used chopped neutron beam w/ simultaneous measurement of e- from β decay & ${}^3\text{He}(n,p){}^3\text{H}$ reaction.

Experiment Improvements

- More beam time
- Lower gas pressure in TPC (fewer scatterings) + improved electronics → better sensitivity & discrimination
- More precise TPC gas composition
- Better MC simulations (more accurate/predictive)
- Upgraded SFC

New Results

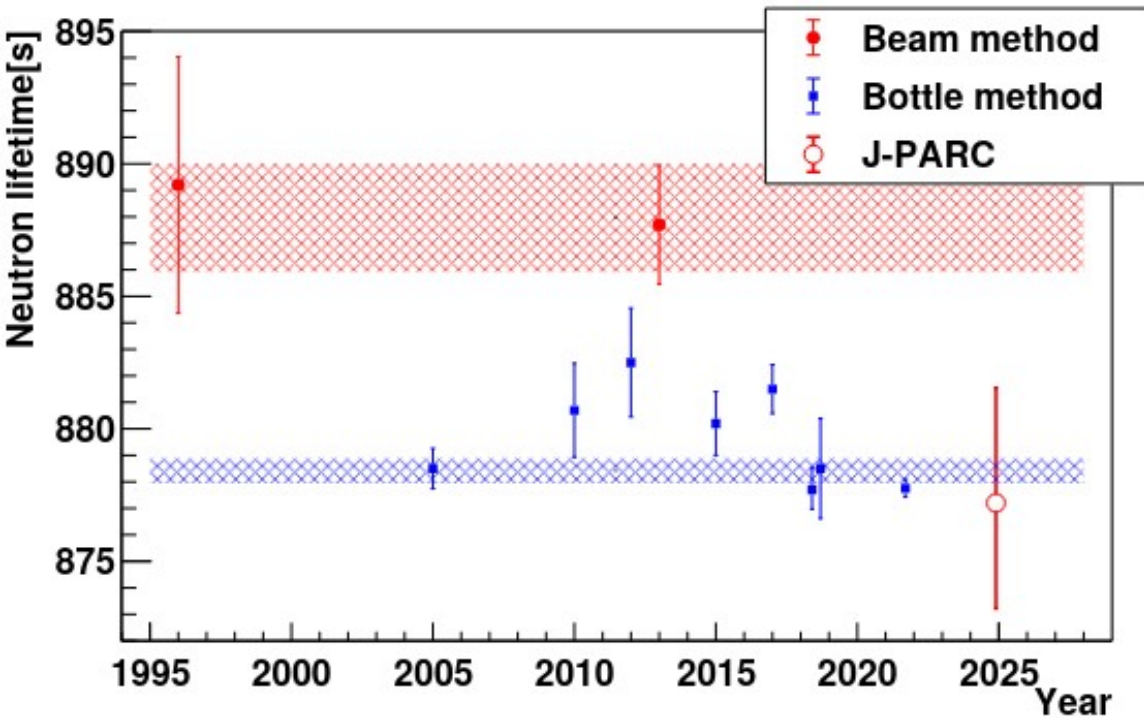


TABLE II. Neutron lifetime values for each gas pressure (100 kPa, 50 kPa) and SFC configuration (new, old), with averages. Units in seconds.

Conditions	Value	Stat.	Cut position	Other sys.
100 kPa/old SFC	870.9	3.5	+1.8/-2.8	+5.5/-4.9
100 kPa/new SFC	868.3	4.0	+1.5/-2.9	+3.8/-3.2
50 kPa/old SFC	868.2	7.7	+2.7/-0.9	+4.8/-3.9
50 kPa/new SFC	884.8	2.4	+0.8/-1.3	+3.2/-3.0
Combined	877.2	1.7		+4.0/-3.6

- $877.2 \pm 1.7_{(stat)}^{+4.0}_{(sys.)}$ s
- Used mix of old & new conditions and hardware, but new data
- Suggests (as Frank mentioned previously): unknown systematic in p^+ beam experiments