

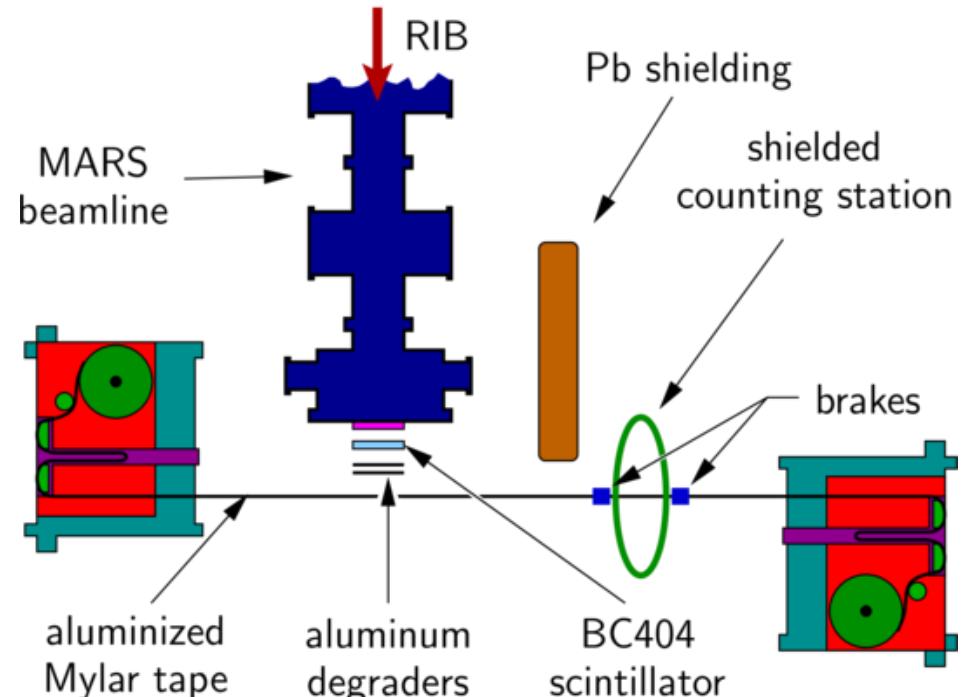
^{10}C Branching Ratio

Update on a new measurement

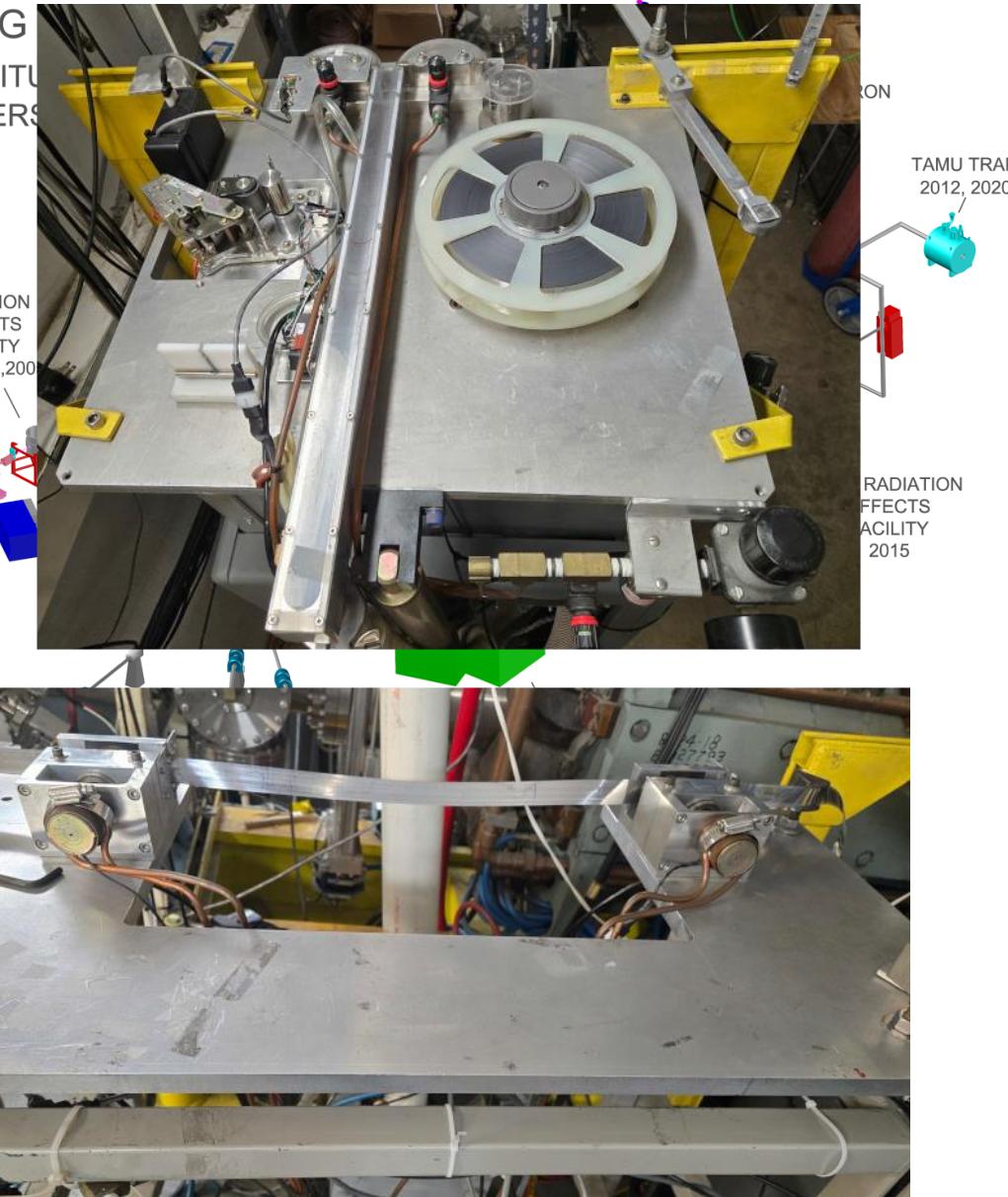
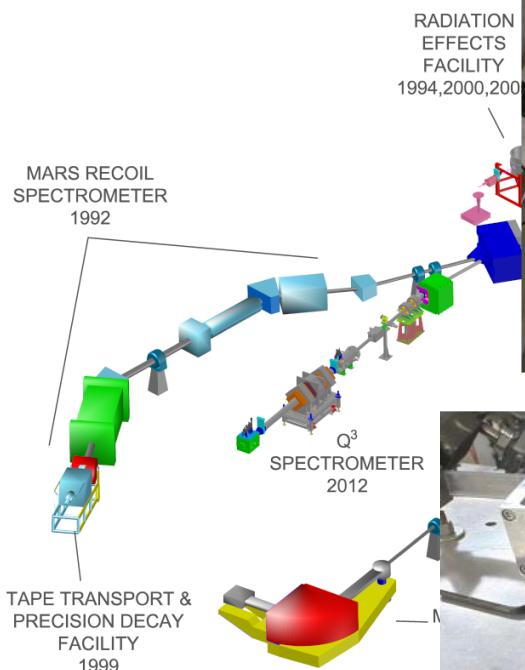
Dan Melconian

Fast-tape transport system (Hardy and Jacob)

- Fundamental symmetries:
fast-tape transport system
+ HPGe or 4π gas counter
- Lifetimes and branching
ratios (V_{ud})



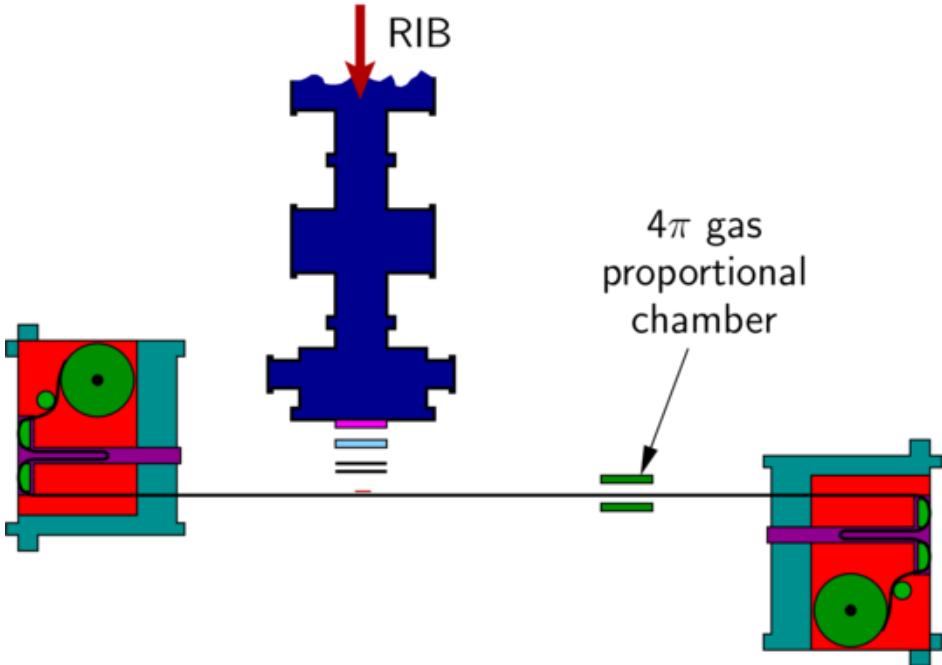
K500 SUPERCONDUCTING
CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY
50
慶祝建校50周年
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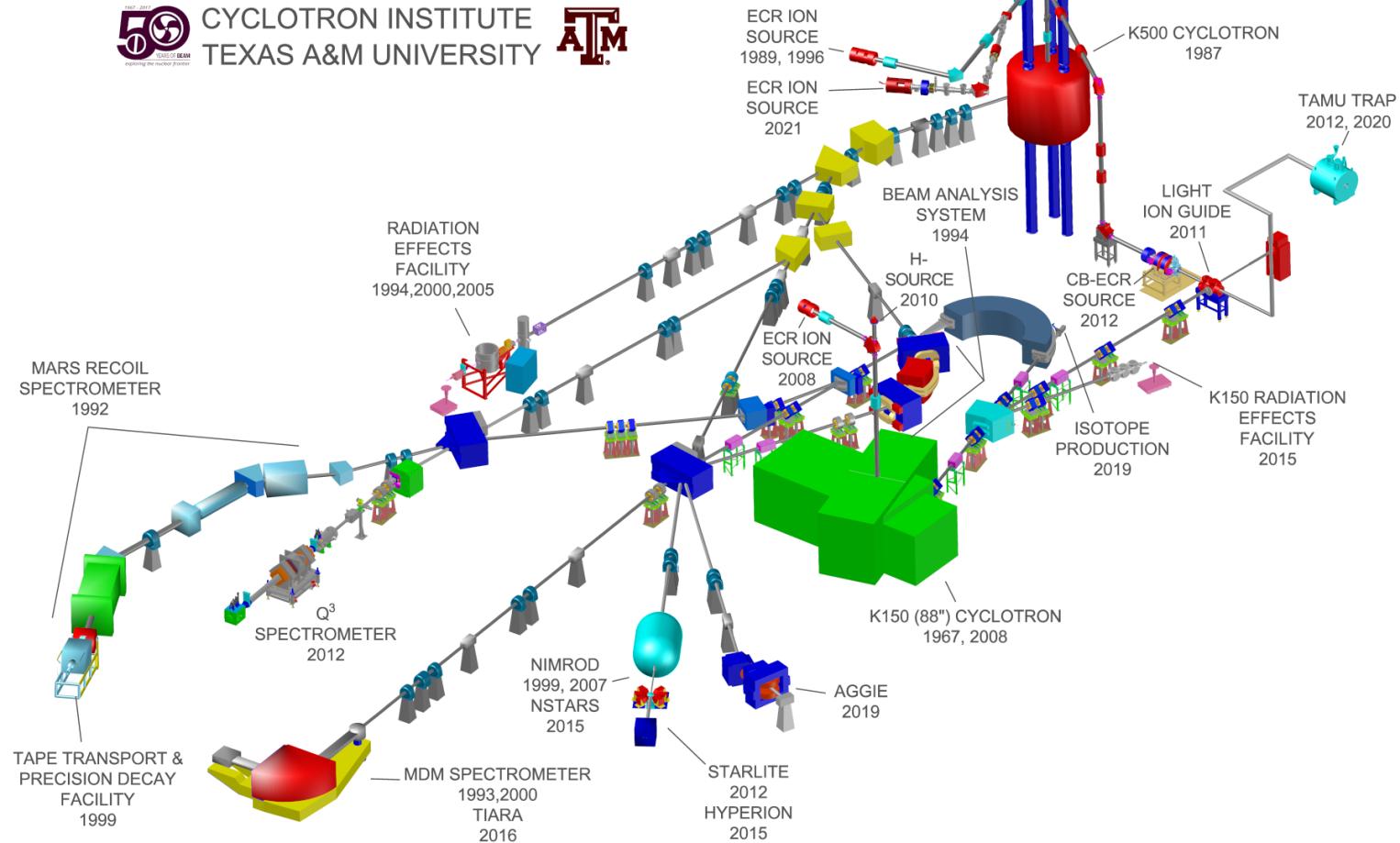
- Lifetimes and branching
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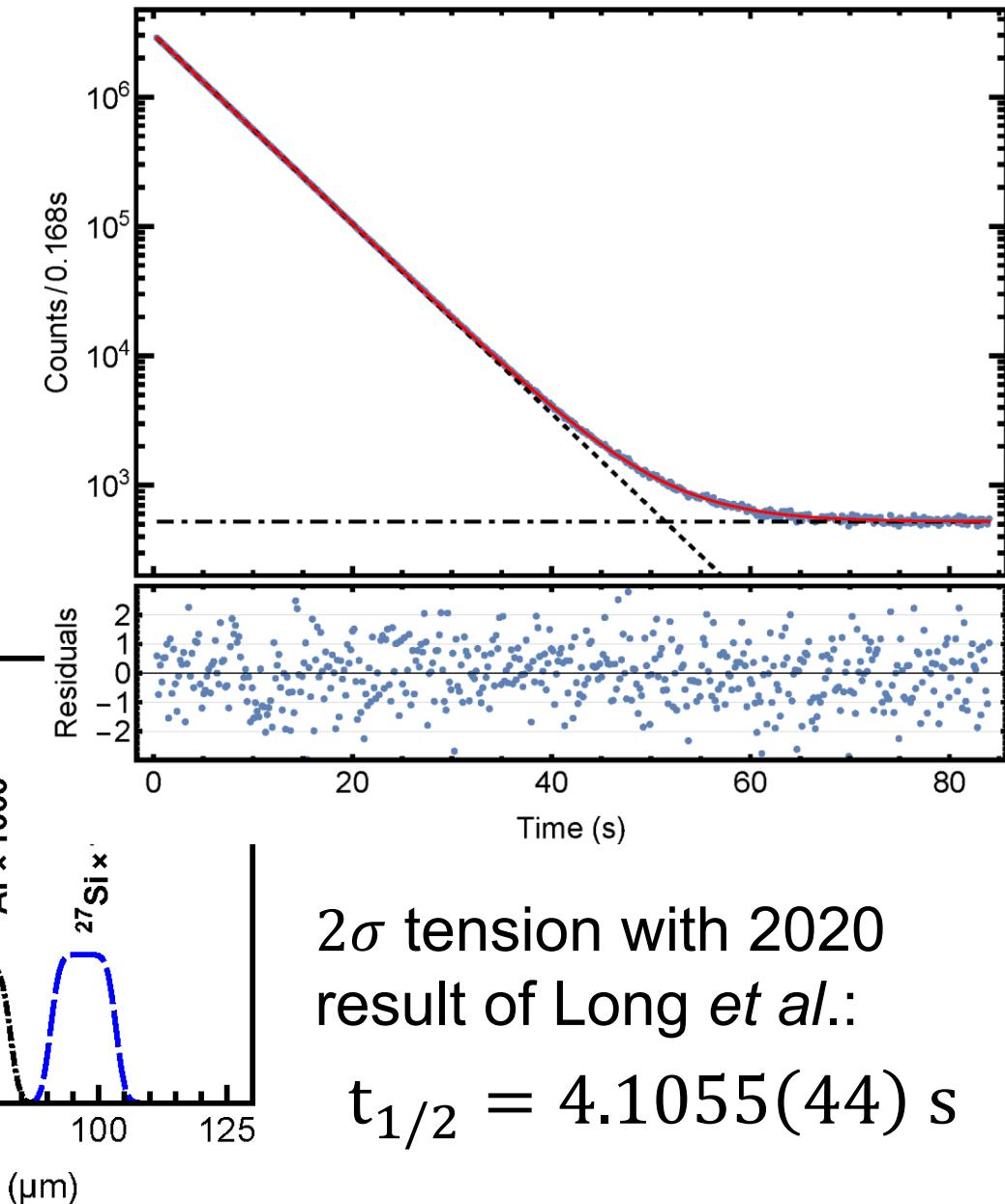
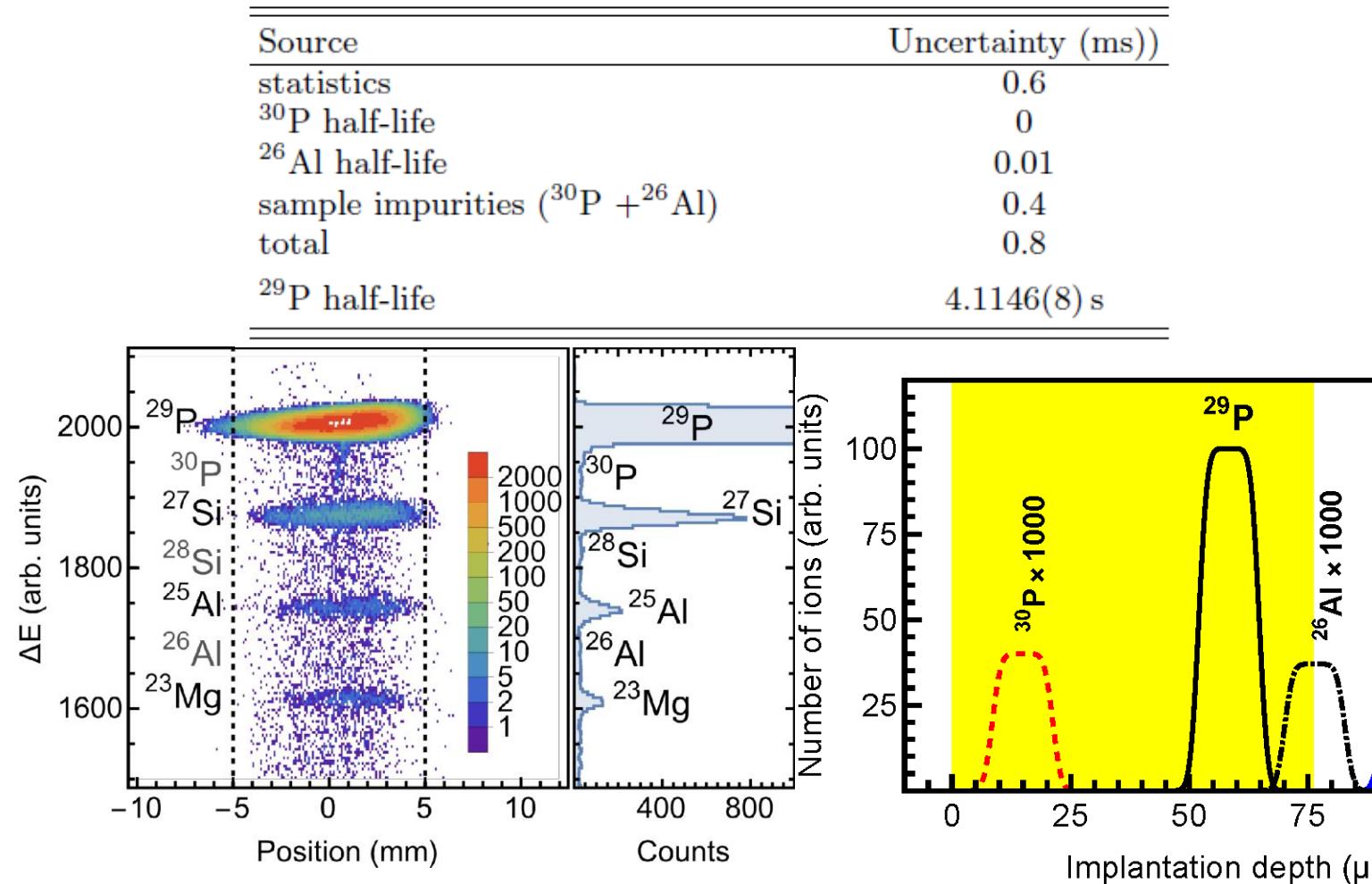


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Lifetime example: ^{29}P

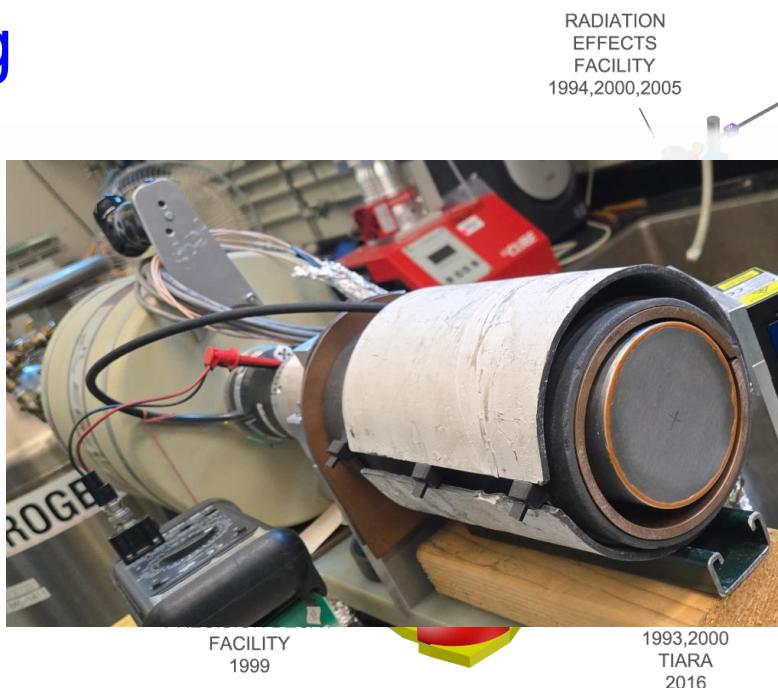
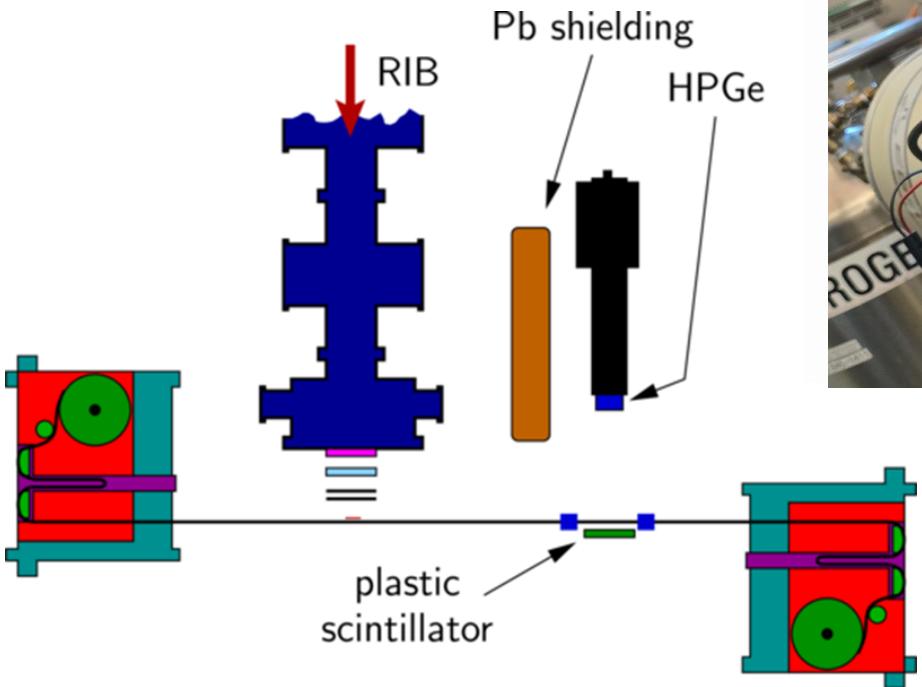
- ➊ Degraders let us tune where activity is implanted in the tape and further purify the beam out of MARS



Fast-tape transport system (Hardy and Jacob)

- Fundamental symmetries:
fast-tape transport system
+ HPGe or 4π gas counter

- Lifetimes and **branching ratios** (V_{ud})



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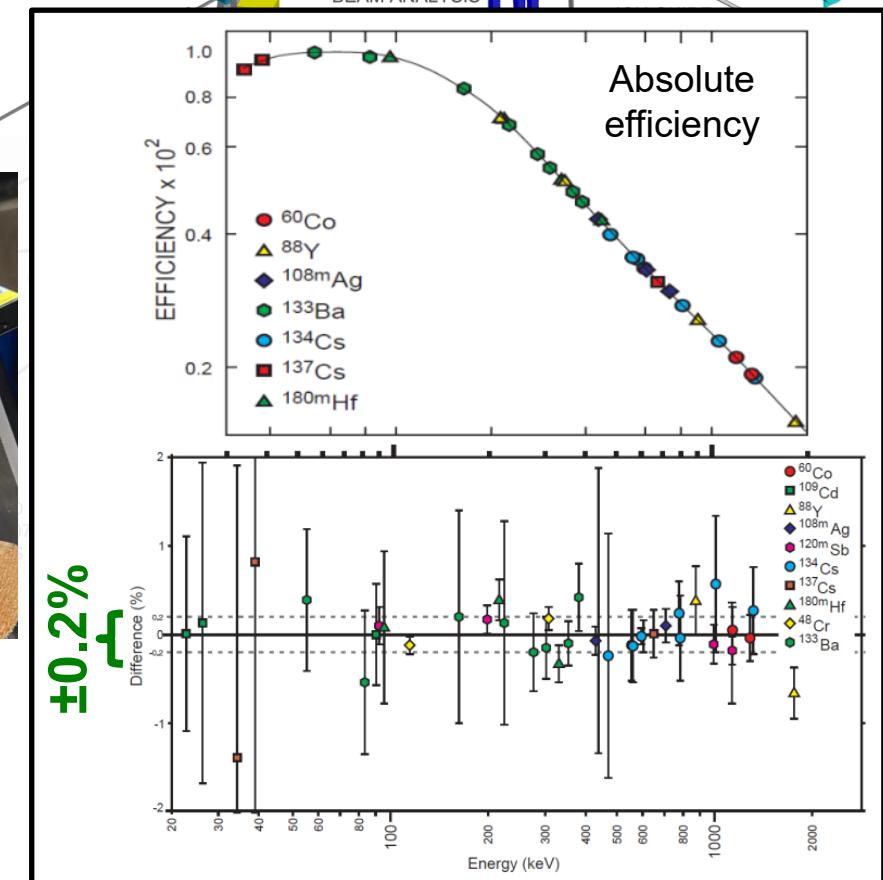
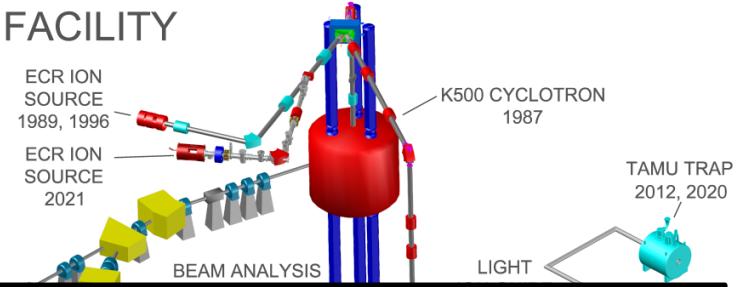


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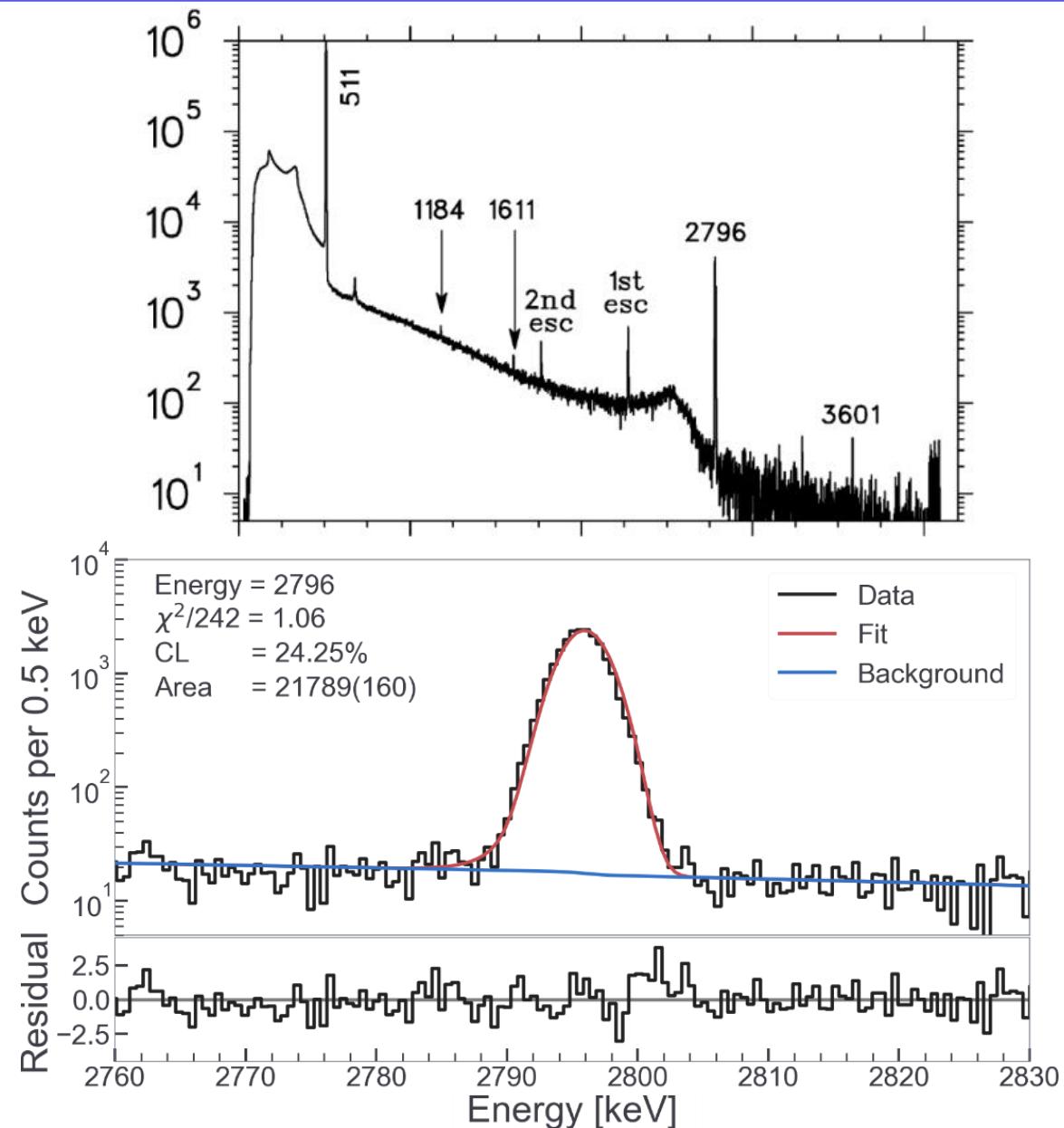
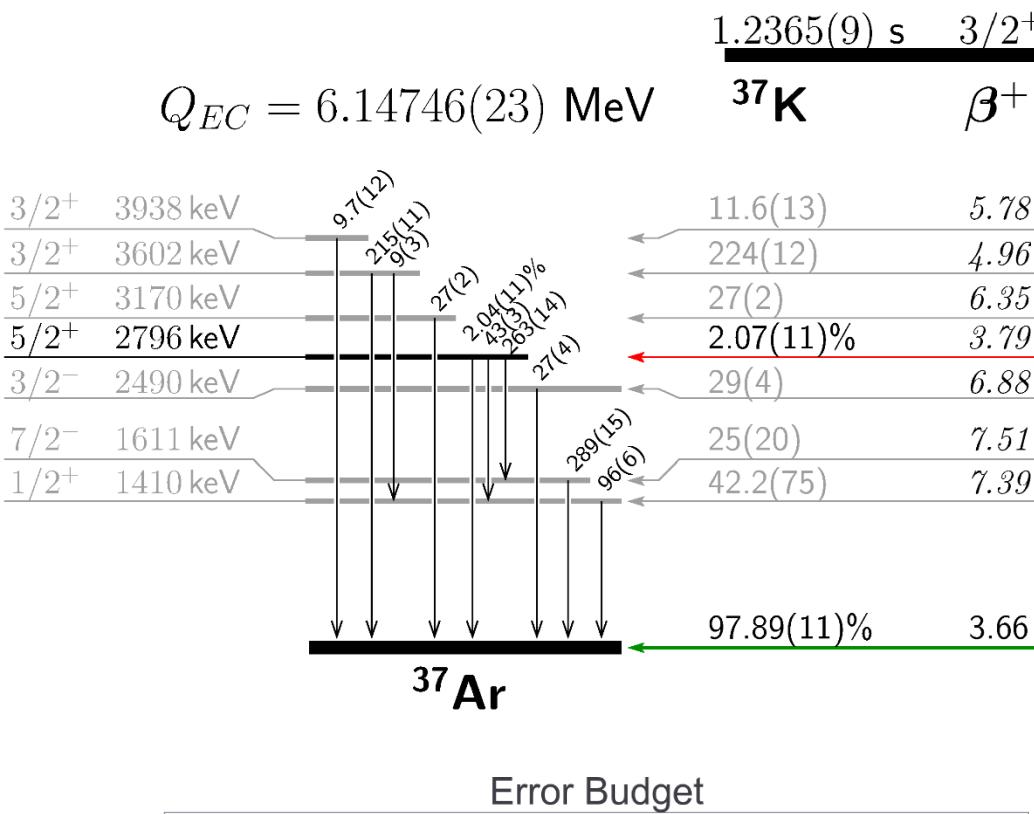


ECR ION SOURCE
1989, 1996

ECR ION SOURCE
2021

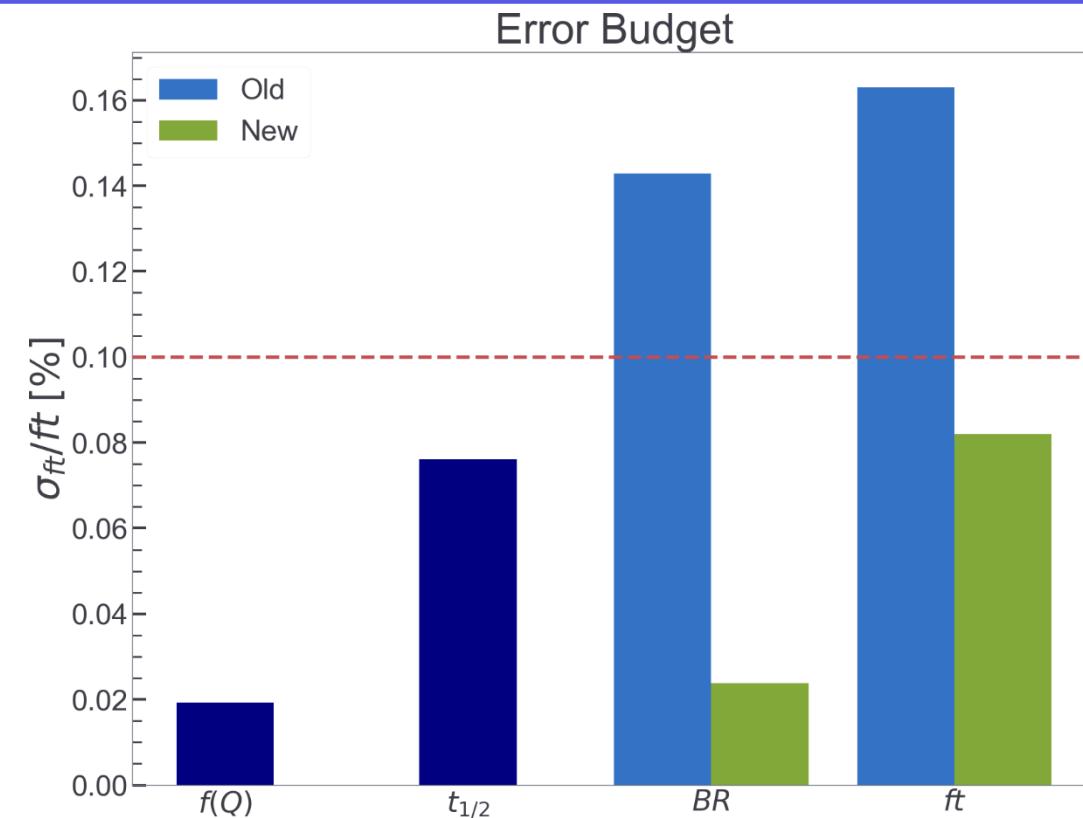


Branching ratio example: ^{37}K



Branching ratio example: ^{37}K

Source	Uncertainty, $\sigma_{\text{BR}} [\%]$			
	$E_\gamma = 1184 \text{ keV}$	1611 keV	2796 keV	3601 keV
γ efficiencies	0.0001	0.0002	0.012	0.0002
$t_\beta - t_\gamma$ cuts	0.0006	0.0007	0.006	0.0012
Preemption	0.0001	0.0001	0.005	< 0.0001
β/HI cuts	0.0011	0.0002	0.004	< 0.0001
Fitting range	0.0002	0.0002	< 0.001	< 0.0001
Total systematics	0.0013	0.0008	0.015	0.0013
Statistical	0.0032	0.0030	0.017	0.0024
Total uncertainty	0.0035	0.0031	0.022	0.0027



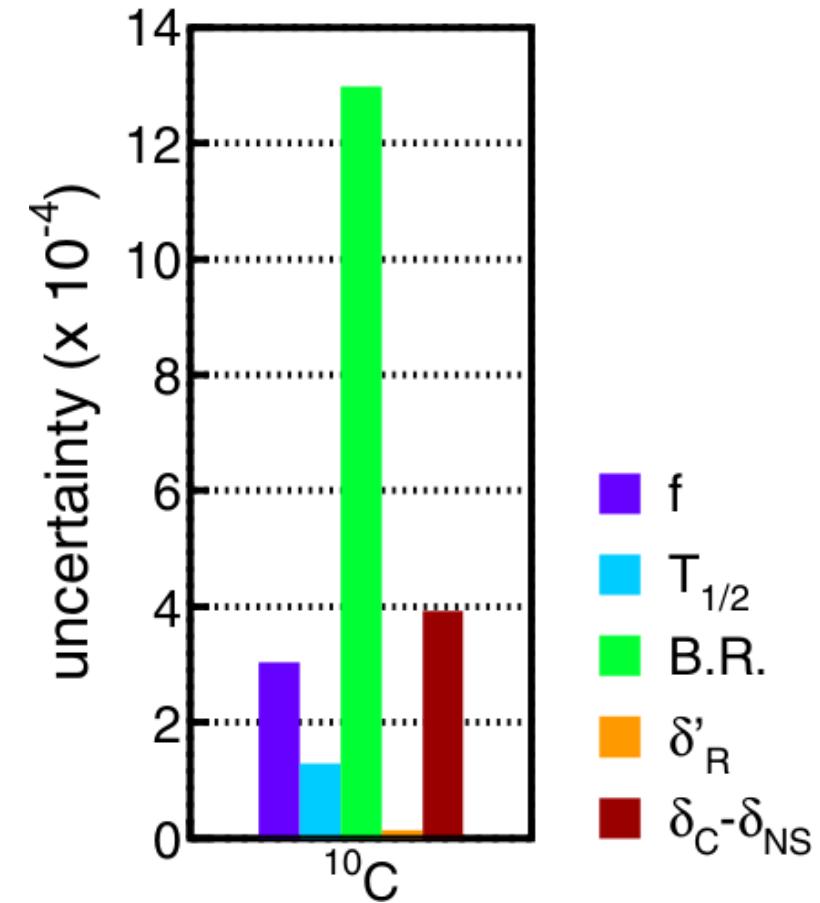
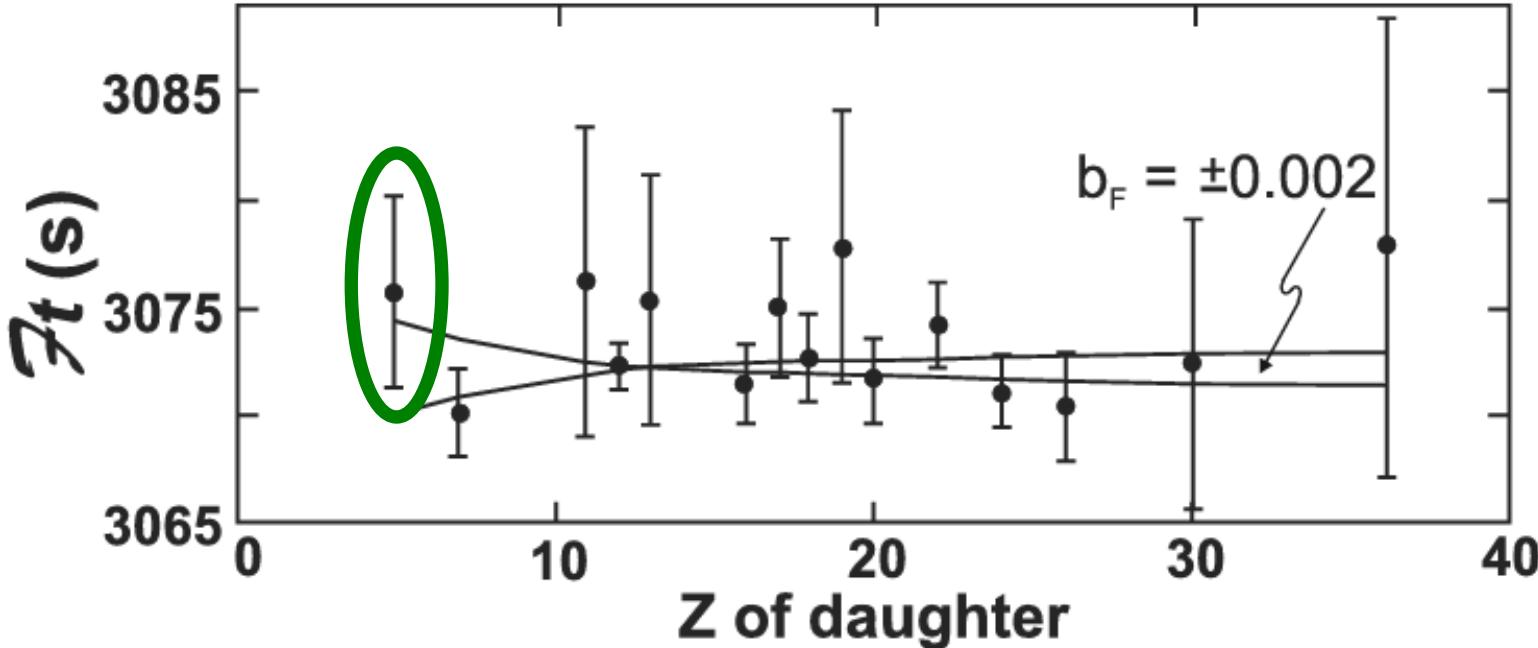
$\text{BR}: 97.99(14)\% \rightarrow 97.81(2)\%$

$ft: 4576(8) \text{ s} \rightarrow 4585(4) \text{ s}$

$|V_{ud}|:$ stay tuned

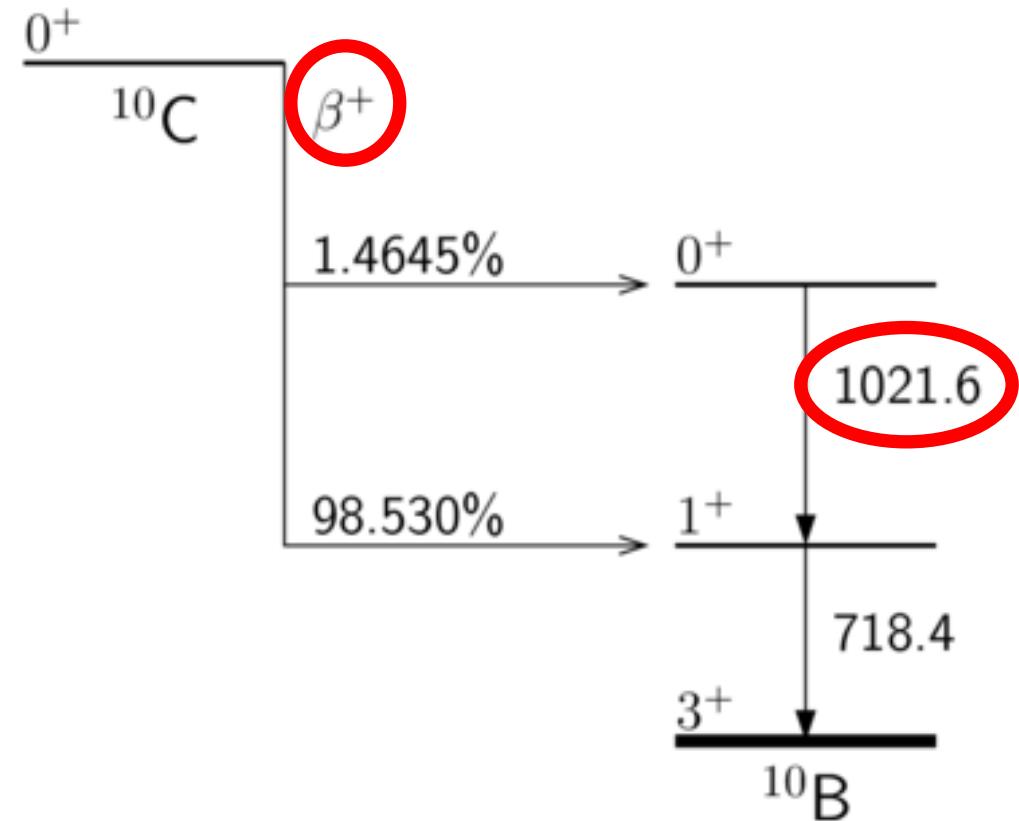
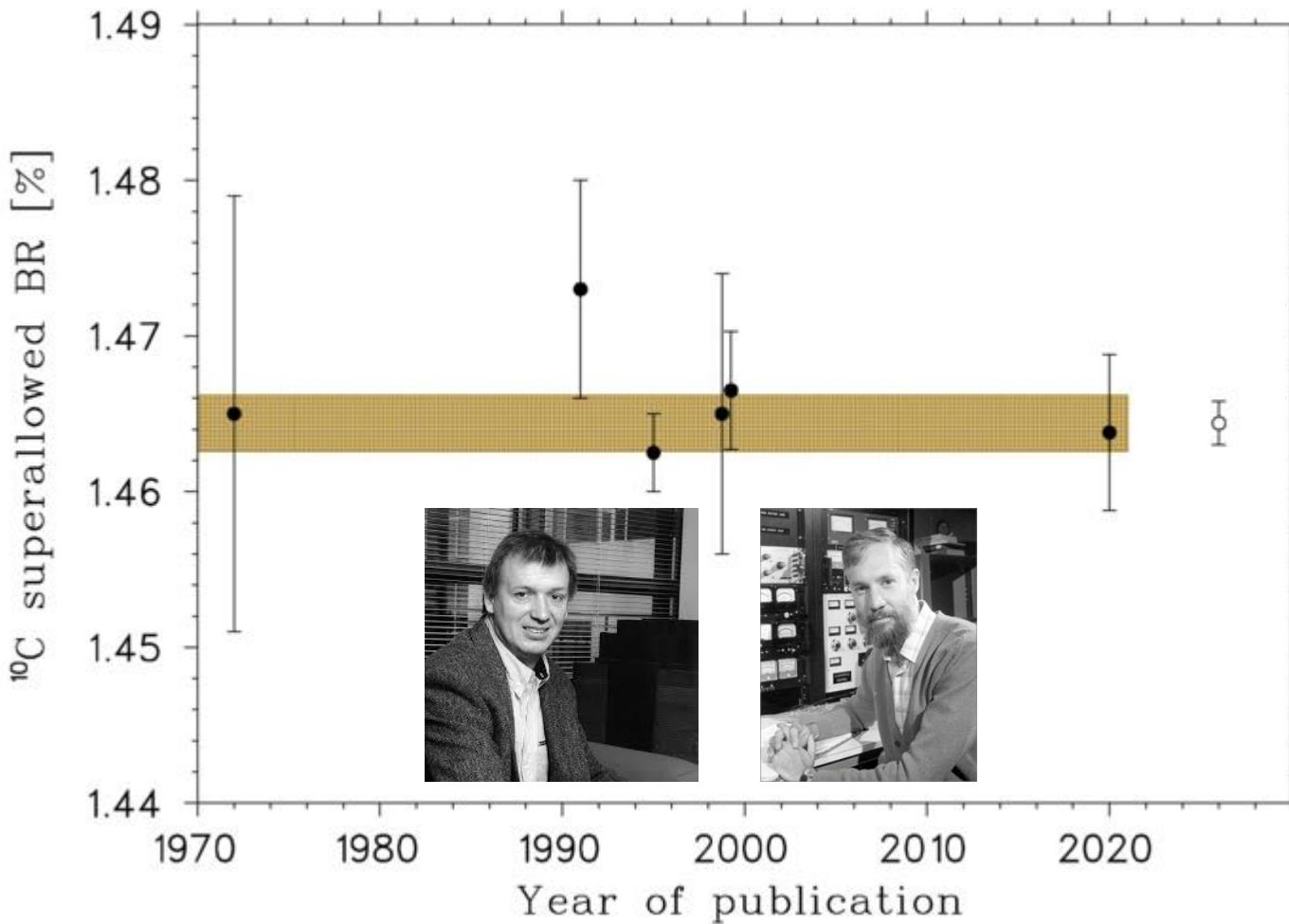
Another branching ratio – ^{10}C

- One of if not the most important $0^+ \rightarrow 0^+$ decays to be improved



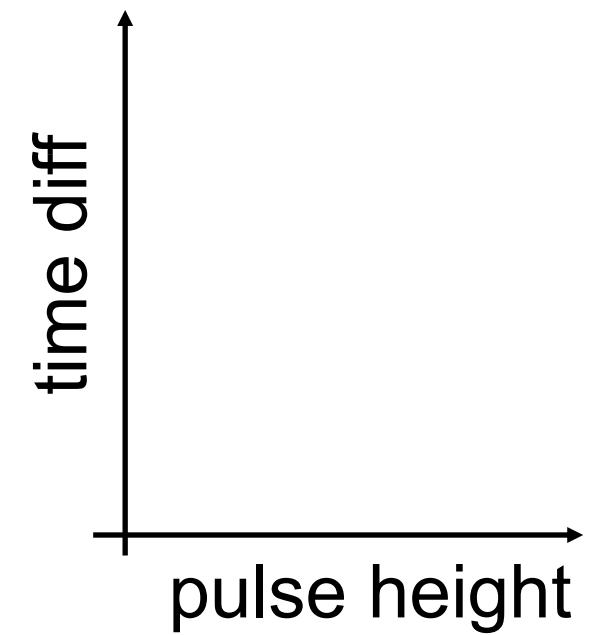
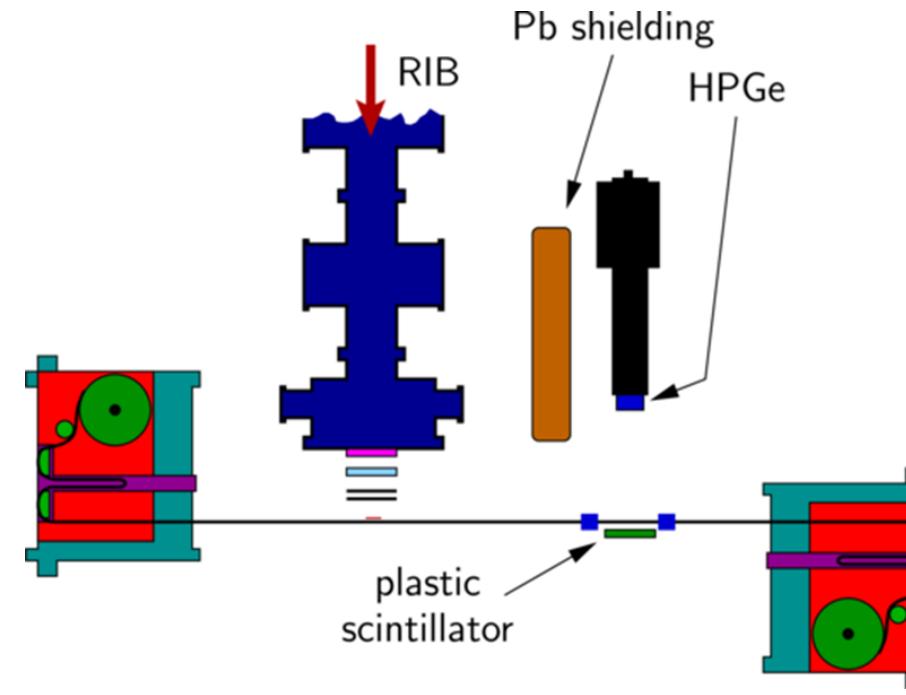
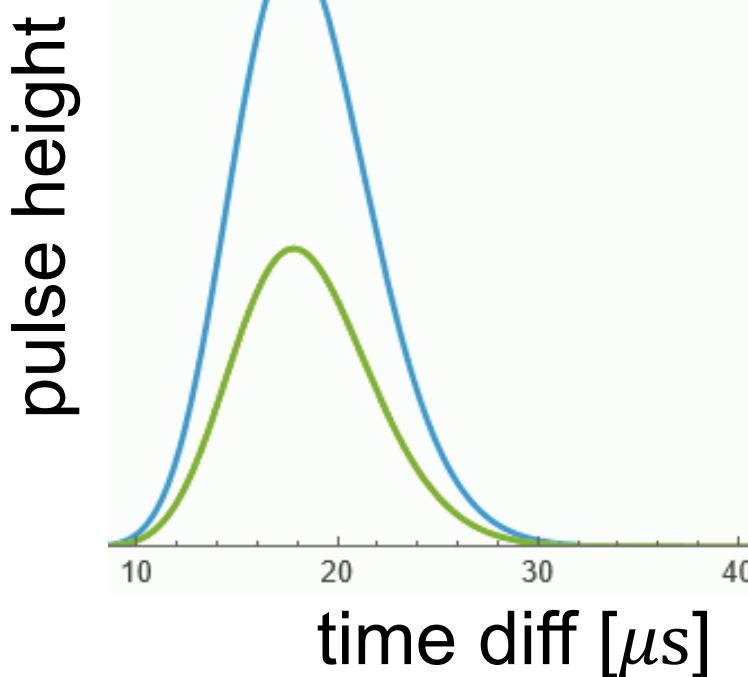
Another branching ratio – ^{10}C

- One of if not the most important $0^+ \rightarrow 0^+$ decays to be improved
- Sometime, nature can be cruel...



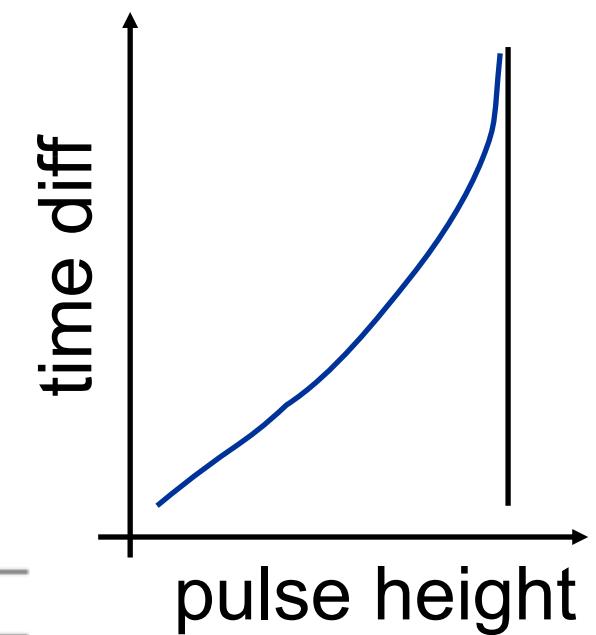
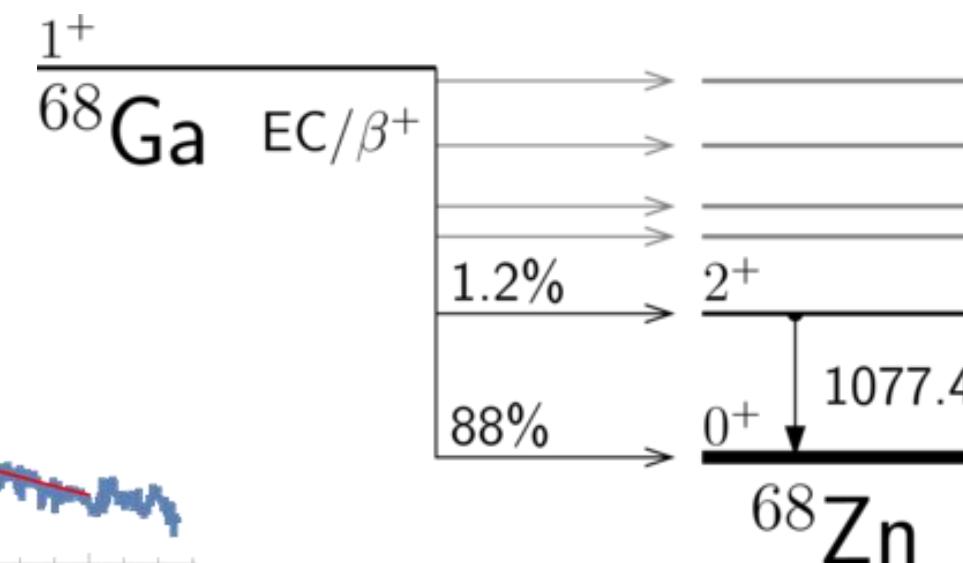
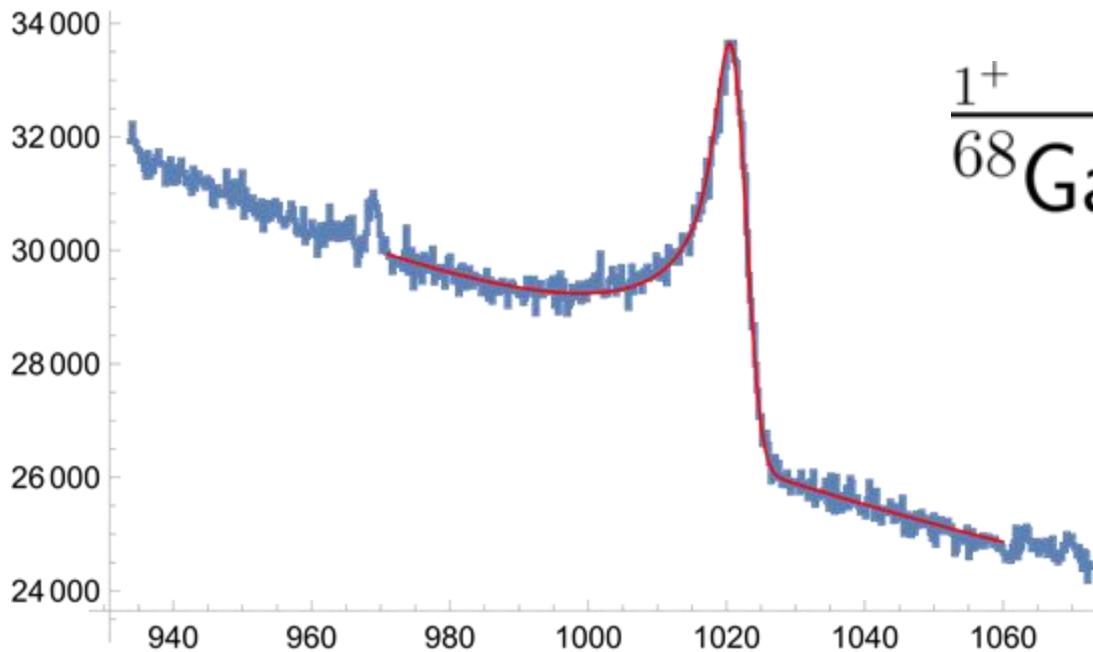
Victor's idea

- If you can know how many 511+511s are in your peak, you can still make a precision measurement
- Model summing with HPGe response
 - Normalize to times prior to coincidence window
 - Subtract random summing from true 1022-keV peak



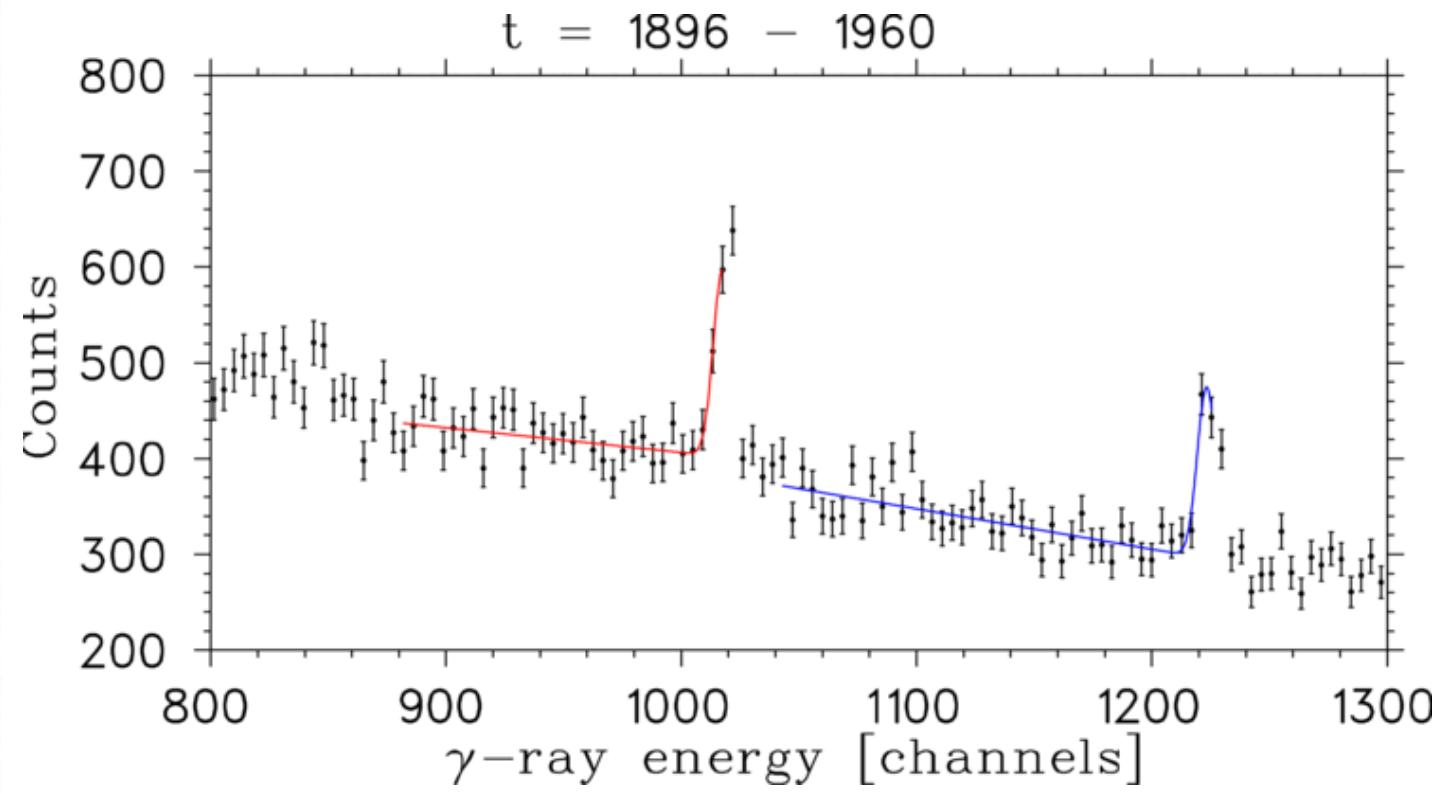
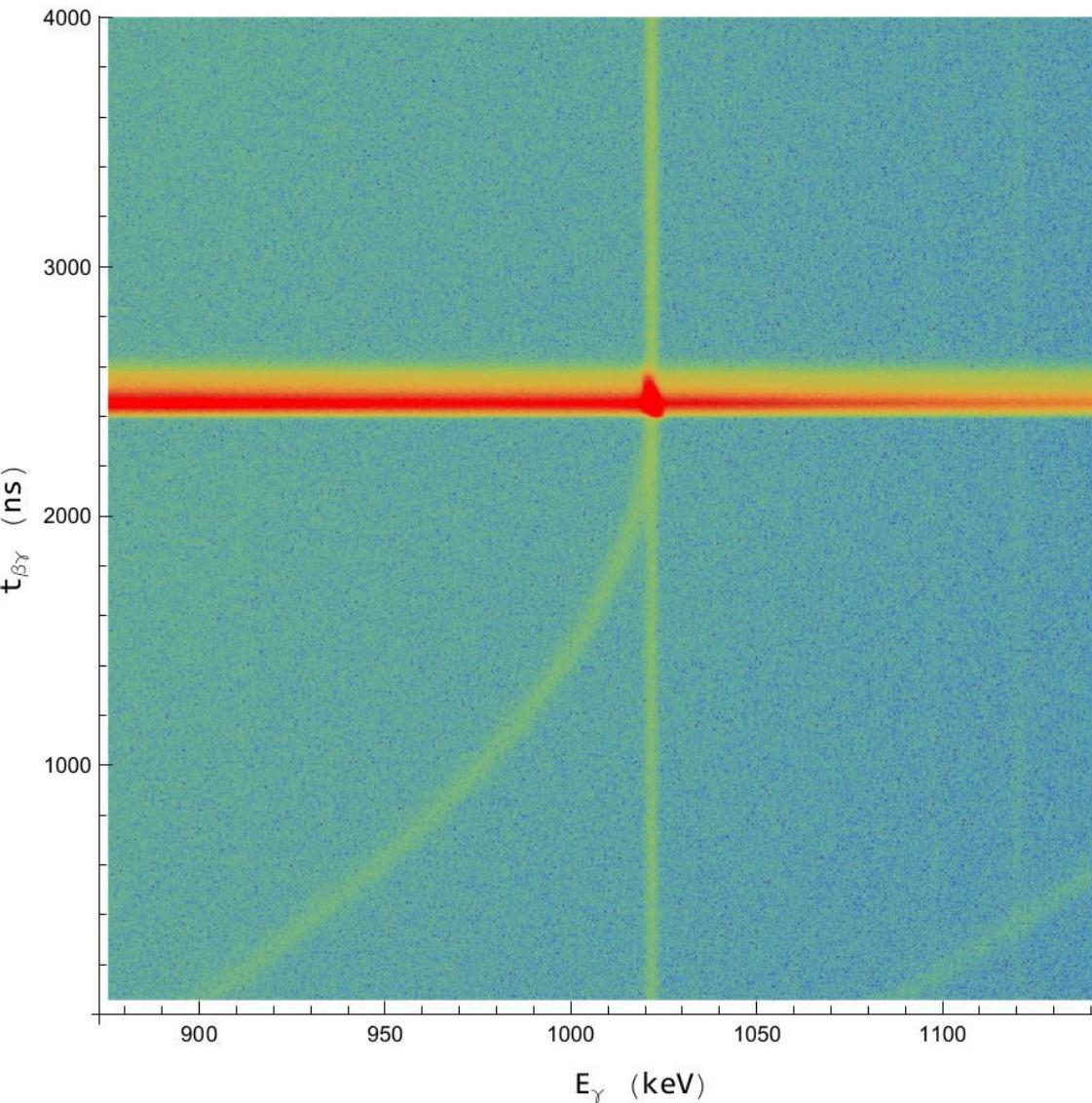
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 - Normalize to times prior to coincidence window
 - Subtract random summing from true 1022-keV peak
- Tested with $^{68}\text{Ge}/\text{Ga}$



We got a few 2-week beamtimes – and good data!

- Better than expected, really



Recent ^{10}C – first runs (more data this spring)

- ➊ Pile-up is a concern, but at 3 kHz in the HPGe correction is <0.2%
 - ✳ Can test this by making different cuts on the time in the cycle as the intensity drops
- ➋ Dominant systematic will be the HPGe efficiency; expect 0.1% uncertainty
- ➌ In 2 weeks of actual beamtime, we got 4 full days of counting. Ended up with 10^5 counts in the 1022 peak with a statistical uncertainty of 0.3%
 - ✳ Analysis \Rightarrow no show-stoppers
 - ✳ 3 runs for $\sim 650\text{k}$ events; one more two-week run should do it
 - ✳ Expect to get statistical uncertainty under 0.1%, about 0.15% overall?

Best: $B = 1.4625(25)\%$ $\pm 0.17\%$

Average: $B = 1.4644(18)\%$ $\pm 0.12\%$