NuTIMS - UPDATED MULTI-IC SYSTEM

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Overview

Introducing enhanced options for the NuTIMS detector system: now with **9 full-size Secondary Electron Multipliers (SEMs)**. This advanced design allows for the measurement of masses from 232 to 246 within a single, streamlined analysis routine. This system has been developed with input from the TIMS community to deliver an instrument that has improved precision, efficiency and the large mass range our users need.

Key enhancements include:

- **Electrostatic Peak Alignment:** The unique zoom lens system enables rapid switching of peak alignment without relying on motorized adjustments.
- **Improved Accuracy:** Additional filters have been integrated to minimize tailing effects on up to 5 SEMs, enhancing measurement precision.
- **Low-Noise Faradays:** Newly developed Faradays ensure accurate results even during smaller TE Faraday runs, improving sensitivity for specific applications.
- **Enhanced Pumping Capacity:** A significant increase in pumping efficiency supports better overall performance, particularly under demanding conditions.

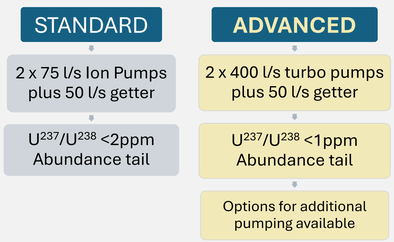
This upgraded system reflects a commitment to delivering robust and reliable solutions, prioritizing both functionality and innovation

Improved Analyzer Pumping

Enhanced Pumping Capacity: Increased from 200 l/s to 850 l/s, effectively halving the abundance sensitivity of the instrument to less than 1 ppm (U-237 relative to U-238). Refer to Fig.1.

Additional Pumping options:

- Boost capacity up to 1510 l/s using all 9 SEMs.
- Alternatively, achieve higher pumping by replacing one SEM with one 75 l/s ion pump, pushing the abundance tail even closer to SEM noise levels for a multi-ion counting method.
- Option to increase source pumping up to 730 l/s for enhanced performance.



Pumping Comparison Chart

Method Examples

The latest configuration offers a versatile range of run methods, tailored to meet diverse analytical needs. These include the option of utilizing a pre-determined gain (Table 1) which provides consistency and reliability for the smallest sample measurements with less than 1000cps. Additionally, the configuration supports a "within run gain" approach (Table 2), enabling real-time adjustments during the measurement process for those slightly larger samples with more than 1000cps. This flexibility ensures optimized performance across different sample types and experimental conditions.

Measurement	IC0	L1 (Faraday)	IC1 (Filter)	IC2	IC3 (Filter)	IC4	IC5 (Filter)	IC6	IC7 (Filter)	L2 (Faraday)	Optional slot	IC8 (Filter)
Line 1	238		236	235	234	233	232	231	230			227
Line 2	246		244	243	242	241	240	239	238			235

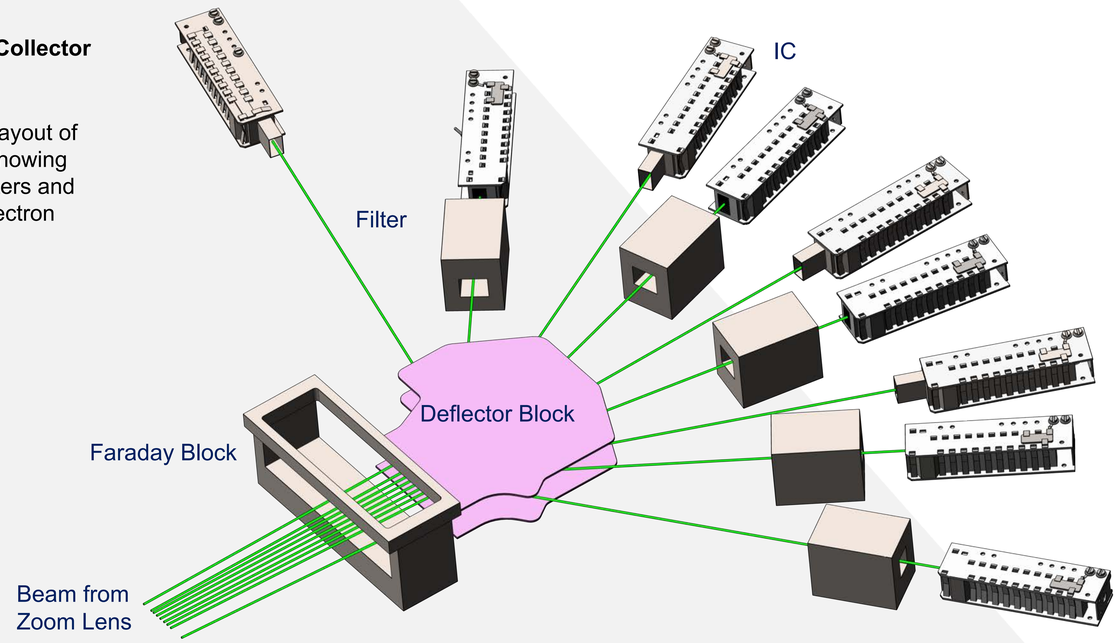
Table 1: Method that uses a pre-determined gain - for samples that produce less than 1000cps

Measurement	IC0	L1 (Faraday)	IC1 (Filter)	IC2	IC3 (Filter)	IC4	IC5 (Filter)	IC6	IC7 (Filter)	L2 (Faraday)	Optional slot	IC8 (Filter)	Integration Time (sec)
Line 1	238		236	235	234	233	232	231	230			227	10
Line 2			238			235							1
Line 3				238			235						1
Line 4					238			235					1
Line 5	238		236	235	234	233	232	231	230			227	10
Line 6	246		244	243	242	241	240	239	238			235	10

Table 2: Method that uses a within run gain - for the samples that produce signals above 1000cps for more than 10minutes

Layout of NuTIMS 9IC Collector

Diagram displaying the layout of the NuTIMS Collector; showing the combinations of 5 filters and 9 full-size Secondary Electron Multipliers (SEMs).



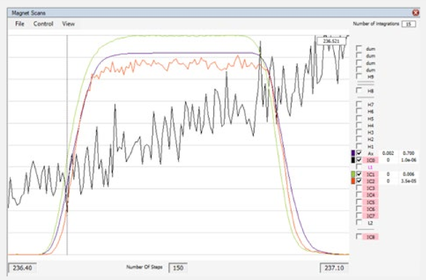


Fig. 1: Magnet scan showing - 800 ppb U^{237} wrt U^{238}

IC1(cps)	IC2(cps)	IC3(cps)	IC4(cps)
0.080	0.023	0.008	0.013
0.002	0.007	0.005	0.007
0.020	0.015	0.002	0.018
0.022	0.018	0.002	0.012
0.007	0.012	0.007	0.003
0.005	0.007	0.005	0.003
0.005	0.013	0.012	0.005
mean			
0.020	**0.014**	**0.006**	**0.009**

Table 3: 600 s noise measurements on SEMs

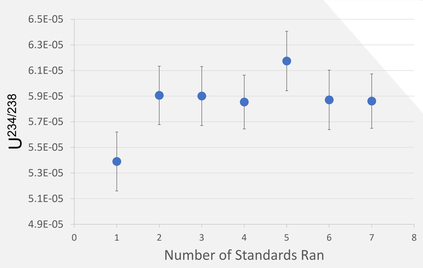


Fig. 2: 45 min static measurements with 0.9 cps on U^{234}

Noise

SEM noise is specified below 0.1 cps but typically approaches 0.01 cps (Table 3), enabling seamless 1 cps measurements (Fig. 2). Paired with these ultra-low noise SEMs are advanced low-noise Faradays, offering significant gains over older amplifiers (Fig 3, Fig 4) and supporting smaller sample sizes in Total Evaporation (TE) runs (Fig. 5, 50 ng).

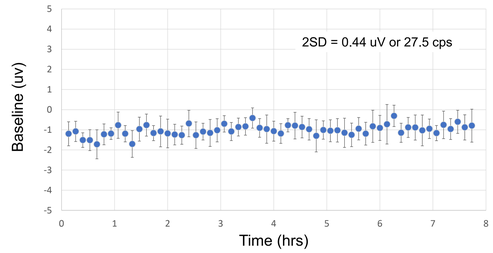


Fig. 3: Faraday long term noise at 480 second Integrations

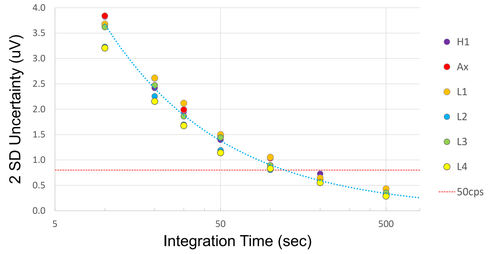


Fig. 4: 2SD uncertainty of 10^{13} amplifiers

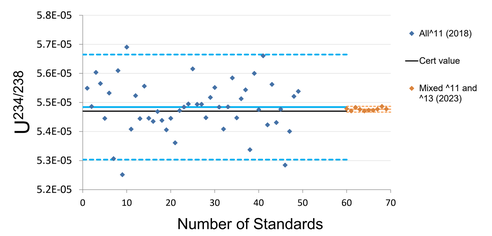


Fig. 5: 50 ng TE runs, highlighting low noise amplifier improvements

Conclusion

The NuTIMS 9IC detector system delivers precise, efficient mass measurements (232–246) with 9 SEMs. Key features include quick electrostatic peak alignment, improved accuracy via additional filters, low-noise Faradays for smaller samples, and enhanced pumping for reduced tailing effects.