nu TIMS

THERMAL IONISATION MS

APPLICATION NOTE **AN58**

HIGH PRECISION AUTOMATIC MULTI-DYNAMIC MEASUREMENTS OF NEODYMIUM ISOTOPES

- **Excellent reproducibility from general automatic operation of 300ng Neodymium standard JNDI**
- **4.0 ppm 2RSD Dynamic ^{143}Nd/^{144}Nd**
- **8.9 ppm 2RSD Dynamic ^{142}Nd/^{144}Nd**

The isotopic measurement of Neodymium by thermal ionisation mass spectrometry (TIMS), is often used as an indication of the performance of the TIMS instrument. In order to achieve high precision and accuracy, many factors, such as filament loading, amplifier gain, cup efficiencies, background noise and peak shape have to be considered and their effects reduced.

The use of a multi-dynamic analysis routine enables amplifier gain and cup efficiencies to be eliminated from the overall measurement uncertainty, leading to improved filament to filament precision of the isotopic measurement.

Utilising the Zoom lens system to perfectly align the peaks for each measurement line, ensures measurement reproducibility without compromise.

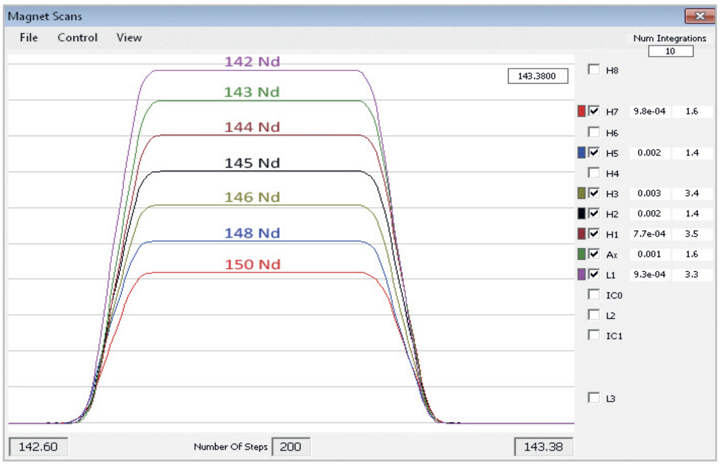
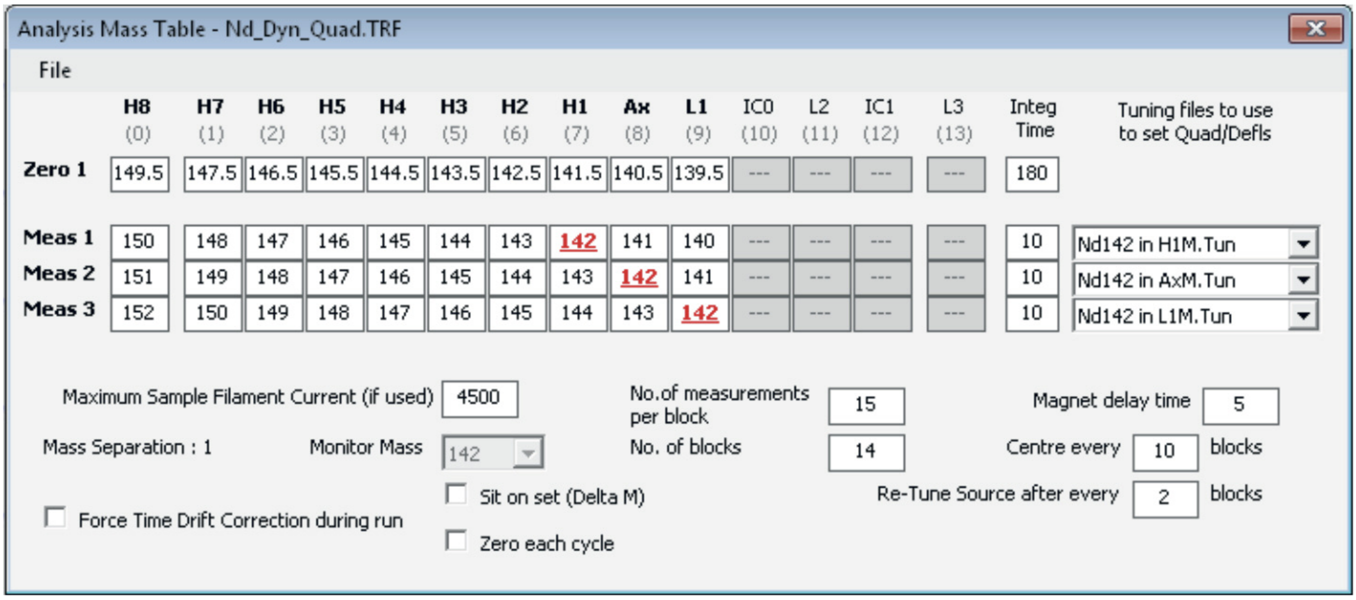


Fig 1: Peak scan of measurement line 3 of the Neodymium method showing peak alignment of the isotopes.



Analysis Mass Table - Nd_Dyn_Quad.TRF

File

	H8 (0)	H7 (1)	H6 (2)	H5 (3)	H4 (4)	H3 (5)	H2 (6)	H1 (7)	Ax (8)	L1 (9)	IC0 (10)	L2 (11)	IC1 (12)	L3 (13)	Integ Time	Tuning files to use to set Quad/Defls
Zero 1	149.5	147.5	146.5	145.5	144.5	143.5	142.5	141.5	140.5	139.5	---	---	---	---	180	
Meas 1	150	148	147	146	145	144	143	**142**	141	140	---	---	---	---	10	Nd142 in H1M.Tun
Meas 2	151	149	148	147	146	145	144	143	**142**	141	---	---	---	---	10	Nd142 in AxM.Tun
Meas 3	152	150	149	148	147	146	145	144	143	**142**	---	---	---	---	10	Nd142 in L1M.Tun

Maximum Sample Filament Current (if used) 4500

No.of measurements per block 15

Magnet delay time 5

Mass Separation : 1

Monitor Mass 142

No. of blocks 14

Centre every 10 blocks

Sit on set (Delta M)

Re-Tune Source after every 2 blocks

Force Time Drift Correction during run

Zero each cycle

Fig 2: Detector configuration and measurement parameters for multi-dynamic measurements of Neodymium.

EXPLANATION

The above analytical method shows the detector configuration for the multi-dynamic routine, including the saved zoom lens files that ensure perfect peak alignment is reproduced for each measurement line. Each zoom lens change is performed in milliseconds, within the magnet delay time. The numbers in red indicate which isotope is used for the peak centring of each line.

The dynamic analysis technique is explained further in the Thirwall Publication: Chemical Geology (Isotope Geoscience Section), 94 (1991) 85 - 104.

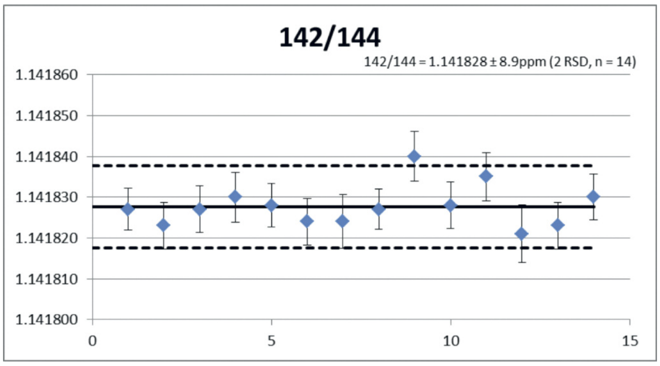
PARAMETERS						
Sample	Filament Double	Analysis Mode	Target beam intensity	Warm up	Measurement duration	Baselines
300ng JNdi loaded with H_3PO_4 activator	- Tantalum (EVAP) - Rhenium* (IONI) *Zone refined	Automatic, Multi-dynamic, 14 blocks of 15 measurements (210 total)	^{142}Nd at 4V	~ 1 hour	~ 3.5 hours	180 s before each block

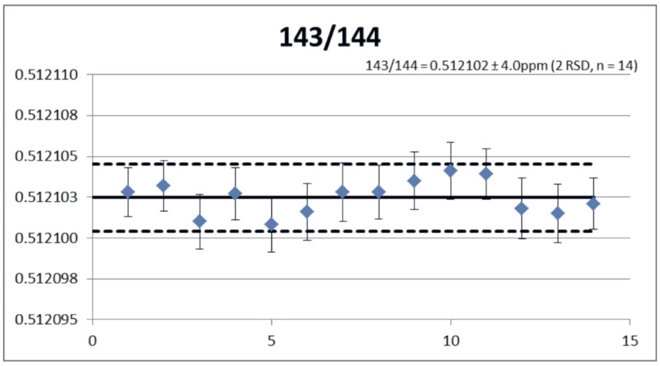
Table of data all normalised to $^{146}Nd/^{144}Nd = 0.7219$

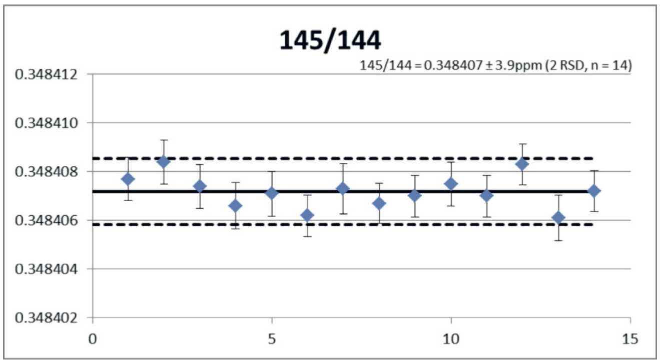
Run no	142/144 Corr	2 RSE (ppm)	143/144 Corr	2 RSE (ppm)	145/144 Corr	2 RSE (ppm)	148/144 Corr	2 RSE (ppm)	150/144 Corr	2 RSE (ppm)
1	1.141827	4.5	0.512103	2.9	0.348408	2.6	0.241586	7.8	0.236453	12.3
2	1.141823	5.0	0.512103	3.0	0.348408	2.6	0.241581	7.2	0.236448	12.4
3	1.141827	5.0	0.512101	3.2	0.348407	2.6	0.241583	7.6	0.236452	12.7
4	1.141830	5.3	0.512103	3.1	0.348407	2.7	0.241590	6.9	0.236457	11.4
5	1.141828	4.7	0.512101	3.3	0.348407	2.6	0.241585	7.1	0.236458	10.6
6	1.141824	5.0	0.512102	3.4	0.348406	2.5	0.241584	6.9	0.236456	12.8
7	1.141824	5.7	0.512103	3.5	0.348407	2.9	0.241585	9.9	0.236454	16.4
8	1.141827	4.3	0.512103	3.2	0.348407	2.4	0.241585	6.7	0.236454	11.7
9	1.141840	5.3	0.512104	3.5	0.348407	2.4	0.241584	6.6	0.236455	12.3
10	1.141828	5.0	0.512104	3.4	0.348408	2.6	0.241582	7.4	0.236452	12.9
11	1.141835	5.1	0.512104	3.0	0.348407	2.5	0.241583	6.9	0.236456	11.6
12	1.141821	6.2	0.512102	3.7	0.348408	2.4	0.241584	12.5	0.236451	17.5
13	1.141823	5.0	0.512102	3.5	0.348406	2.7	0.241584	7.0	0.236452	12.5
14	.141830	5.0	0.512102	3.1	0.348407	2.4	0.241584	6.8	0.236452	11.8
Average	**1.141828**	**5.1**	**0.512102**	**3.3**	**0.348407**	**2.6**	**0.241584**	**7.7**	**0.236453**	**12.8**
2 SD	**1.01E-05**		**2.07E-06**		**1.35E-06**		**4.26E-06**		**5.17E-06**	
2 RSD ppm	**8.9**		**4.0**		**3.9**		**18**		**22**	

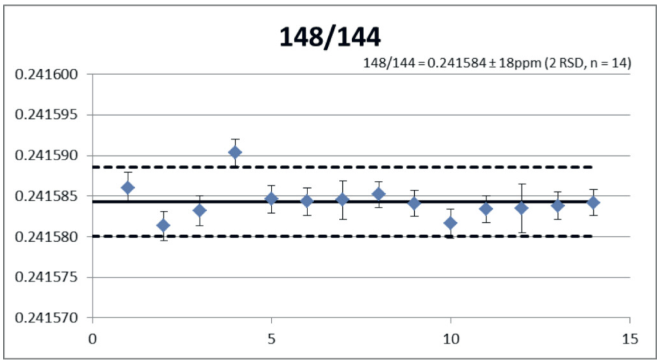
CONCLUSION

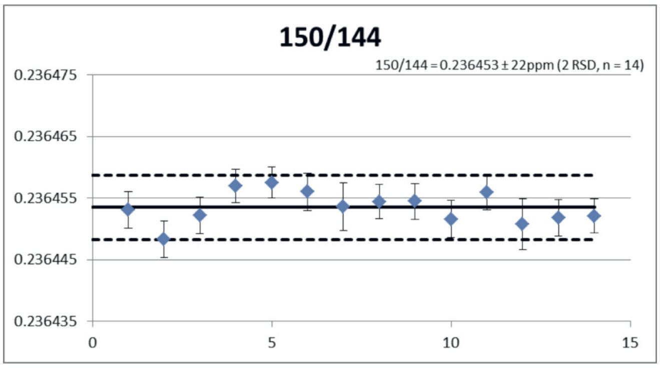
In conclusion, automatic multi-dynamic measurement of 300ng loads of Neodymium standard JNdi have been demonstrated to give excellent, reproducible results.











All error bars are 2 standard errors. Dotted lines represent 2 sigma of the data.