Communications

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^{185}Re/^{187}Re quadrupole moment ratio

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In a "high-resolution" nuclear quadrupole experiment designed to detect nuclear hexadecapole interactions in solids, a series of ^{185}Re/^{187}Re quadrupole moment ratios were also determined. The compounds included NH_4ReO_4, ND_4ReO_4, and $KReO_4$ at a variety of temperatures. The weighted mean of our result is $Q(185)/Q(187) = 1.056709(17)$ where the error indicated is the standard error.

[Quadrupole moment ratio ^{185}Re, ^{187}Re.]

In a recent "high-resolution" nuclear quadrupole resonance experiment[1] designed to detect possible nuclear hexadecapole interactions in solids, we were able to measure the quadrupole moment ratio of ^{185}Re to ^{187}Re. In Table I we list the rhenium quadrupole frequencies appropriate to the compound, isotope, and temperature of measurement. The spectrometer used was a frequency swept crossed coil spectrometer[2]; an uncalibrated copper-Constantan thermocouple was used to measure

TABLE I. Rhenium quadrupole frequencies for the two isotopes in various compounds at indicated temperatures. The frequency errors indicated are two standard deviations and the frequency ratio errors are the root mean square errors. ν_2 is the $\frac{5}{2} \leftrightarrow \frac{3}{2}$ transition; ν_1 is the $\frac{3}{2} \leftrightarrow \frac{1}{2}$ transition.

Compound	T (K)	Transition	Isotope	Frequency (MHz)	Ratio
NH_4ReO_4	77	(ν_2)	^{185}Re	29.7117(12)	1.05664(6)
			^{187}Re	28.1190(12)	
		(ν_1)	^{185}Re	14.8611(32)	1.05686(32)
			^{187}Re	14.0616(32)	
ND_4ReO_4	77	(ν_2)	^{185}Re	30.2585(8)	1.05677(5)
			^{187}Re	28.6330(8)	
		(ν_1)	^{185}Re	15.1302(20)	1.05669(20)
			^{187}Re	14.3185(20)	
NH_4ReO_4	292.47	(ν_2)	^{185}Re	35.0791(12)	1.05671(5)
			^{187}Re	33.1966(12)	
	292.60	(ν_1)	^{185}Re	17.5400(32)	1.05669(19)
			^{187}Re	16.5990(32)	
$KReO_4$	296.88	(ν_1)	^{185}Re	28.34572(40)	1.056706(21)
			^{187}Re	26.82461(40)	

the temperature which was kept constant to 50 mK. Centering errors due to large line widths dominated all other systematic and measuring errors. The error indicated for the frequency measurement is two standard deviations. The error indicated for the frequency ratio is the root mean square error.

It seems reasonable to assume that the ^{185}Re/^{187}Re frequency ratios are proportional to the quadrupole moment ratio. Pyykko[3] has already indicated that in inorganic salts, any pseudoquadrupole interactions should be negligible. Assuming that this is correct we obtain a value of the weighted mean for $Q(185)/Q(187) = 1.056\,709(17)$ where the error indicated is the standard error. This value agrees with the previously measured[4] value but is at least one order of magnitude more precise.

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[3]P. Pyykko and J. Linderberg, Chem. Phys. Lett. 5, 34 (1970).
[4]S. L. Segel and R. G. Barnes, Phys. Rev. 107, 638 (1957).