

$$\gamma/10^7 \text{ rad T}^{-1} \text{ s}^{-1}$$

TABLE I (Continued)

Atomic weight/element	Spin	Natural abundance (%)	Sensitivity (versus ^{13}C)	Quadrupole moment (10^{-28} m^2)	Gyromagnetic ratio ($10^7 \text{ rad T}^{-1} \text{ sec}^{-1}$)	Resonance frequency ($^1\text{H TMS}$ 100 MHz)
^{40}Ca	$\frac{1}{2}$	0.145	5.27×10^{-2}	-0.05	-1.8001	6.729
^{41}Ca	$\frac{1}{2}$	100	1.71×10^3	-0.22	6.4982	24.292
^{42}Sc	$\frac{1}{2}$	7.28	0.864	0.29	± 1.5084	5.639
^{46}Ti	$\frac{1}{2}$	5.51	1.18	0.24	± 1.5080	5.638
^{50}V	6	0.24	0.755	± 0.21	2.6491	9.970
^{51}V	$\frac{1}{2}$	99.76	2.15×10^3	-5.2×10^{-2}	7.0362	26.303
^{53}Cr	$\frac{1}{2}$	9.55	0.49	$\pm 3 \times 10^{-2}$	-1.5120	5.652
^{55}Mn	$\frac{1}{2}$	100	9.94×10^2	0.55	6.6195	24.745
^{57}Fe	$\frac{1}{2}$	2.19	4.2×10^{-3}	-0.8611	0.8661	3.238
^{58}Co	$\frac{1}{2}$	100	1.57×10^3	0.40	6.3472	23.727
^{61}Ni	$\frac{1}{2}$	1.19	0.24	0.16	-2.3904	8.936
^{63}Cu	$\frac{1}{2}$	69.09	3.65×10^2	-0.211	7.0965	26.528
^{65}Cu	$\frac{1}{2}$	30.91	2.01×10^2	-0.195	7.6018	28.417
^{67}Zn	$\frac{1}{2}$	4.11	0.665	0.15	1.6737	6.257
^{69}Ga	$\frac{1}{2}$	60.4	2.37×10^2	0.178	6.420	24.001
^{71}Ga	$\frac{1}{2}$	39.6	3.19×10^2	0.112	8.158	30.497
^{73}Ge	$\frac{1}{2}$	7.76	0.617	-0.2	-9.331	3.488
^{75}As	100	1.43×10^2	0.3	0.3	4.5804	17.123
^{77}Se	$\frac{1}{2}$	7.58	2.98	—	5.1018	19.072
^{79}Br	$\frac{1}{2}$	50.54	2.26×10^2	0.33	6.7023	25.054
^{81}Br	$\frac{1}{2}$	49.46	2.77×10^2	0.28	7.2246	27.007
^{83}Kr	$\frac{1}{2}$	11.55	1.23	0.15	-1.029	3.848
^{85}Rb	$\frac{1}{2}$	72.15	43	0.25	2.5828	9.655
^{87}Rb	$\frac{1}{2}$	27.85	2.77×10^2	0.12	8.7532	32.721
^{87}Sr	$\frac{1}{2}$	7.02	1.07	0.36	-1.1593	4.334
^{89}Y	100	0.668	—	—	-1.3108	4.900
^{91}Zr	$\frac{1}{2}$	11.23	6.04	-0.21	-2.4868	9.296
^{93}Nb	100	2.740×10^3	-0.2	6.5476	24.476	24.476
^{95}Mo	$\frac{1}{2}$	15.72	2.88	-0.12	1.7433	6.517
^{97}Mo	$\frac{1}{2}$	9.46	1.84	± 1.1	-1.7799	6.654
^{99}Tc	$\frac{1}{2}$	—	1.562×10^{14}	-0.19 ^d	6.0211	22.508
^{100}Ru	$\frac{1}{2}$	12.72	0.83	7.6×10^{-2}	-1.2343	4.614
^{101}Ru	$\frac{1}{2}$	17.07	1.56	0.44	-1.3834	5.171
^{102}Rh	100	0.177	—	—	-0.8520	3.185
^{104}Pd	$\frac{1}{2}$	22.23	1.41	0.16	-0.756	4.576
^{107}Ag	$\frac{1}{2}$	51.82	0.195	—	-1.0828	4.048
^{109}Ag	$\frac{1}{2}$	48.18	0.276	—	-1.2448	4.654
^{111}Cd	$\frac{1}{2}$	12.75	6.93	—	-5.6714	21.201
^{113}Cd	$\frac{1}{2}$	12.26	7.6	—	-5.9328	22.178
^{113}In	$\frac{1}{2}$	4.28	83.8	1.14	5.8493	21.866
^{115}In	$\frac{1}{2}$	95.72	1.89×10^3	0.83	5.8618	21.913
^{117}Sn	$\frac{1}{2}$	0.35	0.695	—	-8.792	32.86
^{119}Sn	$\frac{1}{2}$	7.61	19.54	—	-9.5319	35.632
^{119}Sn	$\frac{1}{2}$	8.58	25.2	—	-9.9756	37.291
^{121}Sb	$\frac{1}{2}$	57.25	5.20×10^2	-0.53	6.4016	23.931
^{123}Sb	$\frac{1}{2}$	42.75	1.11×10^2	-0.68	3.4668	12.959
^{125}Te	$\frac{1}{2}$	0.89	0.89	—	-7.0006	26.170
^{127}Te	$\frac{1}{2}$	7.0	12.5	—	-8.4398	31.550
^{127}I	100	5.3×10^2	—	-0.79	5.3525	20.009
^{129}Xe	$\frac{1}{2}$	26.44	31.8	—	-7.4003	27.658
^{131}Xe	$\frac{1}{2}$	21.18	3.31	-0.12	2.1939	8.200
^{133}Cs	$\frac{1}{2}$	100	2.69×10^2	-3×10^{-3}	3.5087	13.116

(continues)

TABLE I (Continued)

Atomic weight/element	Spin	Natural abundance (%)	Sensitivity (versus ^{13}C)	Quadrupole moment (10^{-28} m^2)	Gyromagnetic ratio ($10^7 \text{ rad T}^{-1} \text{ sec}^{-1}$)	Resonance frequency ($^1\text{H TMS}$ 100 MHz)
^{135}Ba	$\frac{1}{2}$	6.59	1.83	0.18	2.6575	9.934
^{137}Ba	$\frac{1}{2}$	11.32	4.41	0.28	2.9728	11.113
^{138}La	5	0.09	0.43	-0.47	3.5295	13.194
^{139}La	$\frac{1}{2}$	99.91	3.36×10^2	0.21	3.7787	14.126
^{141}Pr	$\frac{1}{2}$	100	1.66×10^3	-5.9×10^{-2}	7.836	29.291
^{143}Nd	$\frac{1}{2}$	12.17	2.31	-0.48	1.455	5.438
^{145}Nd	$\frac{1}{2}$	8.3	0.37	-0.25	0.895	3.346
^{147}Sm	$\frac{1}{2}$	14.97	1.26	-0.21	1.104	4.128
^{149}Sm	$\frac{1}{2}$	13.83	0.59	6×10^{-2}	0.880	3.289
^{151}Eu	$\frac{1}{2}$	47.82	4.83×10^2	1.16	6.634	24.801
^{153}Eu	$\frac{1}{2}$	52.18	45.3	2.9	2.930	10.952
^{155}Gd	$\frac{1}{2}$	14.73	0.23	1.6	1.022	3.820
^{157}Gd	$\frac{1}{2}$	15.68	0.48	2	1.277	4.775
^{159}Tb	$\frac{1}{2}$	100	3.31×10^2	1.3	6.067	22.679
^{161}Dy	$\frac{1}{2}$	18.88	0.45	1.4	0.881	3.295
^{163}Dy	$\frac{1}{2}$	24.97	1.59	1.6	1.226	4.584
^{165}Ho	$\frac{1}{2}$	100	1.03×10^3	2.82	5.487	20.513
^{167}Er	$\frac{1}{2}$	22.94	0.66	2.83	0.773	2.890
^{169}Tm	$\frac{1}{2}$	100	3.21	—	-2.21	8.272
^{171}Yb	$\frac{1}{2}$	14.27	4.05	1.4	1.72	17.612
^{173}Yb	$\frac{1}{2}$	16.08	1.14	— ^b	4.32	4.852
^{174}Lu	1	—	—	—	—	—
^{175}Lu	$\frac{1}{2}$	97.41	1.56×10^2	5.68	3.05	11.407
^{176}Lu	7	2.59	5.14	8.1	2.10	7.872
^{177}Hf	$\frac{1}{2}$	18.50	0.88	4.5	0.95	4.008
^{179}Hf	$\frac{1}{2}$	13.75	0.27	5.1	-0.609	2.518
^{181}Ta	$\frac{1}{2}$	99.988	2.04×10^2	3	3.2073	11.990
^{183}W	$\frac{1}{2}$	14.28	5.89×10^{-2}	—	1.1145	4.166
^{185}Re	$\frac{1}{2}$	37.07	2.8×10^2	2.8	6.0255	22.525
^{187}Re	$\frac{1}{2}$	62.93	4.90×10^2	2.6	6.0862	22.752
^{187}Os	$\frac{1}{2}$	1.64	1.14×10^{-3}	—	0.6105	2.282
^{189}Os	$\frac{1}{2}$	16.1	2.13	0.8	2.0773	7.765
^{191}Ir	$\frac{1}{2}$	37.3	2.3×10^{-2}	1.5	0.539	1.718
^{193}Ir	$\frac{1}{2}$	62.7	5.0×10^{-2}	1.4	0.391	1.871
^{195}Pt	$\frac{1}{2}$	33.8	19.1	—	5.7412	21.462
^{197}Au	100	6.0	10×10^{-2}	0.58	0.357	1.729
^{199}Hg	$\frac{1}{2}$	16.84	5.42	—	4.7912	17.911
^{201}Hg	$\frac{1}{2}$	13.22	1.08	0.5	-1.7686	6.612
^{203}Tl	$\frac{1}{2}$	29.50	2.89×10^2	—	15.3078	57.224
^{205}Tl	$\frac{1}{2}$	70.50	7.69×10^2	—	15.4584	57.787
^{207}Pb	$\frac{1}{2}$	22.6	11.8	—	5.5797	20.858
^{209}Bi	100	7.77	10^2	-0.4	4.2986	16.069
^{209}Po	$\frac{1}{2}$	—	—	—	—	—
^{215}U	$\frac{1}{2}$	0.72	4.9×10^{-3}	4.1	0.479	1.791

^a Most values taken from Brevard, C., and Grager, P. (1981). "Handbook of High Resolution Multinuclear NMR." Wiley (Interscience), New York, pp. 80-211.

^b Some values taken from the Bruker NMR-NQR Periodic Table; Harris, R. K., and Mann, B. E. (1978). "NMR and the Periodic Table." Academic Press, London, pp. 5-7; Pople, J. A., Schneider, W. G., and Bernstein, H. J. (1959). "High-Resolution Nuclear Magnetic Resonance." McGraw-Hill, New York, pp. 480-485; Harris, R. K. private communication.

^c Poorly known or unknown.

^d Franklin, K. J., Lock, C. J. L., Sayer, B. G., and Schrobilgen, G. J. (1982). *J. Am. Chem. Soc.* **104**, 5303-5306.

TABLE I. Properties of Magnetically Active Nuclides^{a,b} $\gamma/10^7 \text{ rad T}^{-1} \text{ sec}^{-1}$

Atomic weight/ element	Spin	Natural abundance (%)	Sensitivity (versus ¹³ C)	Quadrupole moment (10 ⁻²⁸ m ²)	Gyromagnetic ratio (10 ⁷ rad T ⁻¹ sec ⁻¹)	Resonance frequency (¹ H TMS 100 MHz)
¹ H	$\frac{1}{2}$	99.985	5.68×10^3	—	26.7510	100.0000
² H	1	0.015	8.2×10^{-3}	2.73×10^{-3}	4.1064	15.351
³ H	$\frac{1}{2}$	—	—	—	28.5335	106.663
³ He	$\frac{1}{2}$	0.00014	3.26×10^{-3}	—	-20.378	76.178
⁶ Li	1	7.42	3.58	-8×10^{-4}	3.9366	14.716
⁷ Li	$\frac{3}{2}$	92.58	1.54×10^3	-4.5×10^{-2}	10.3964	38.864
⁹ Be	$\frac{3}{2}$	100	78.8	5.2×10^{-2}	-3.759	14.052
¹⁰ B	3	19.58	22.1	7.4×10^{-2}	2.8740	10.744
¹¹ B	$\frac{3}{2}$	80.42	7.54×10^2	3.55×10^{-2}	8.5794	32.072
¹³ C	$\frac{1}{2}$	1.108	1.00	—	6.7283	25.145
¹⁴ N	1	99.63	5.69	1.6×10^{-2}	1.9331	7.226
¹⁵ N	$\frac{1}{2}$	0.37	2.19×10^{-2}	—	-2.7116	10.137
¹⁷ O	$\frac{5}{2}$	0.037	6.11×10^{-2}	-2.6×10^{-2}	-3.6264	13.556
¹⁹ F	$\frac{1}{2}$	100	4.73×10^3	—	25.181	94.094
²¹ Ne	$\frac{5}{2}$	0.257	3.59×10^{-2}	9×10^{-2}	-2.1118	7.894
²³ Na	$\frac{3}{2}$	100	5.25×10^2	0.12	7.0761	26.452
²⁵ Mg	$\frac{5}{2}$	10.13	1.54	0.22	-1.6375	6.122
²⁷ Al	$\frac{5}{2}$	100	1.17×10^3	0.149	6.9704	26.057
²⁹ Si	$\frac{3}{2}$	4.70	2.09	—	-5.3146	19.867
³¹ P	$\frac{1}{2}$	100	3.77×10^2	—	10.8289	40.481
³³ S	$\frac{3}{2}$	0.76	9.73×10^{-2}	-5.5×10^{-2}	2.0534	7.676
³⁵ Cl	$\frac{3}{2}$	75.53	20.2	-8.0×10^{-2}	2.6210	9.798
³⁷ Cl	$\frac{3}{2}$	24.47	3.8	-6.32×10^{-2}	2.1817	8.156
³⁹ K	$\frac{3}{2}$	93.1	2.69	5.5×10^{-2}	1.2483	4.666
⁴⁰ K	4	0.012	3.52×10^{-3}	(—) ^c	-1.552	5.801
⁴¹ K	$\frac{3}{2}$	6.88	3.28×10^{-2}	6.7×10^{-2}	0.6851	2.561