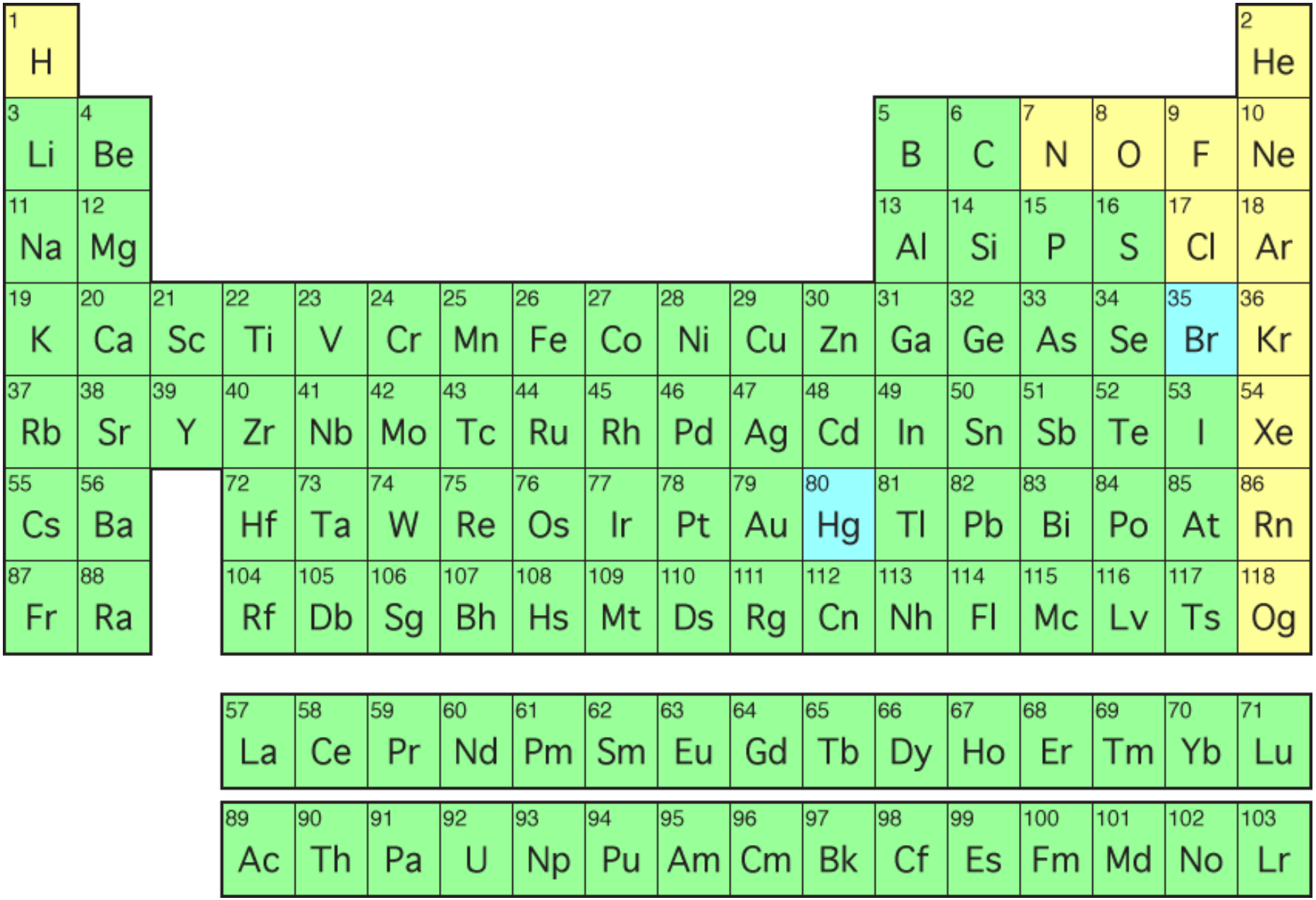

http://education.jlab.org/itselemental/

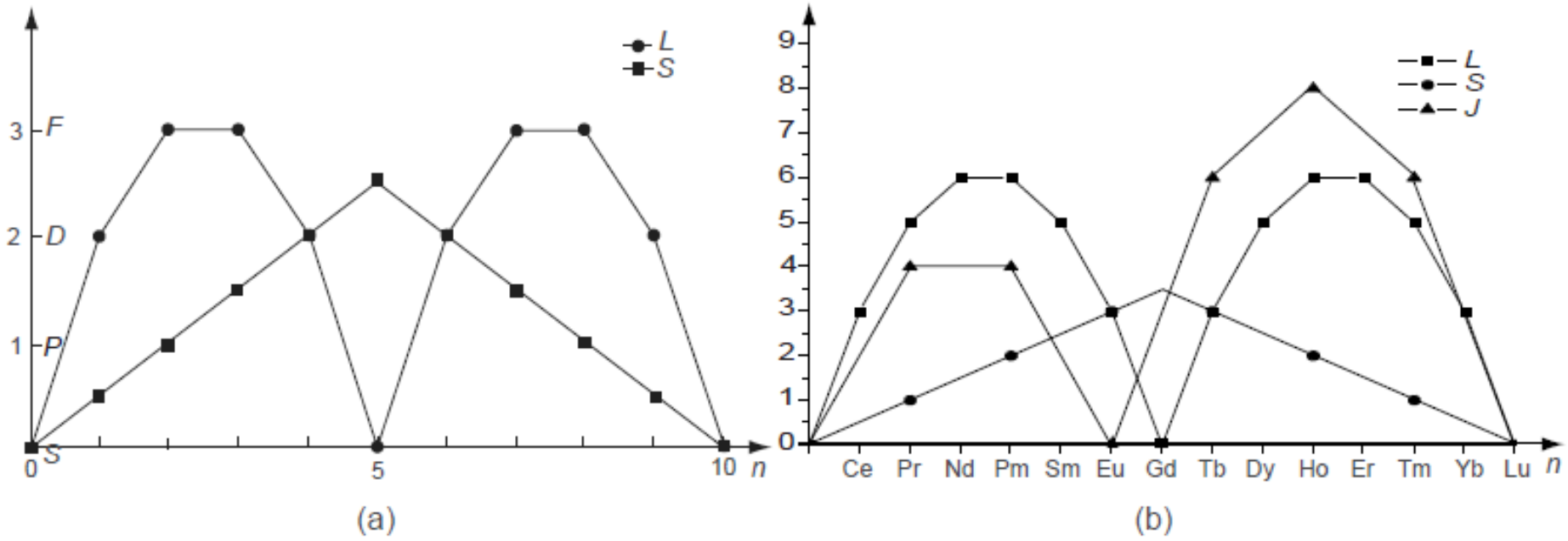

Figure 4.4

(a) L and S for the series of $3d^n$ ions; (b) L, S and J for the series of trivalent $4f$ ions.

interesting phenomena in magnetism, including magnetocrystalline anisotropy, magnetostriction, anisotropic magnetoresistance and the anomalous planar and spin Hall effect.

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Table 4.5. Spin-orbit coupling constants for ions in the 3*d* and 4*f* series, in kelvin. $\Delta\varepsilon$ is the energy of the first excited multiplet

	Ion	λ	Λ	$\Delta\varepsilon$
$3d^1$	Sc^{2+}	124	124	310
$3d^2$	Ti^{2+}	176	88	264
$3d^3$	V^{2+}	246	82	205
$3d^4$	Cr^{2+}	340	85	85
$3d^6$	Fe^{2+}	656	−164	656
$3d^7$	Co^{2+}	818	−272	1224
$3d^8$	Ni^{2+}	987	−494	3948
$4f^1$	Ce^{3+}	920	920	3220
$4f^2$	Pr^{3+}	1080	540	2700
$4f^3$	Nd^{3+}	1290	430	2365
$4f^4$	Pm^{3+}	1540	380	1900
$4f^5$	Sm^{3+}	1730	350	1225
$4f^6$	Eu^{3+}	1950	330	330
$4f^8$	Tb^{3+}	2450	−410	2460
$4f^9$	Dy^{3+}	2730	−550	4125
$4f^{10}$	Ho^{3+}	3110	−780	6240
$4f^{11}$	Er^{3+}	3510	−1170	8775
$4f^{12}$	Tm^{3+}	3800	−1900	11400
$4f^{13}$	Yb^{3+}	4140	−4140	14490

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ion	shell	S	L	J	term	p	p_{exp}
Ce^{3+}	$4f^1$	$\frac{1}{2}$	3	$\frac{5}{2}$	$^2F_{5/2}$	2.54	2.51
Pr^{3+}	$4f^2$	1	5	4	$^3H_4$	3.58	3.56
Nd^{3+}	$4f^3$	$\frac{3}{2}$	6	$\frac{9}{2}$	$^4I_{9/2}$	3.62	3.3–3.7
Pm^{3+}	$4f^4$	2	6	4	$^5I_4$	2.68	–
Sm^{3+}	$4f^5$	$\frac{5}{2}$	5	$\frac{5}{2}$	$^6I_{5/2}$	0.85	1.74
Eu^{3+}	$4f^6$	3	3	0	$^7F_0$	0.0	3.4
Gd^{3+}	$4f^7$	$\frac{7}{2}$	0	$\frac{7}{2}$	$^8S_{7/2}$	7.94	7.98
Tb^{3+}	$4f^8$	3	3	6	$^7F_6$	9.72	9.77
Dy^{3+}	$4f^9$	$\frac{5}{2}$	5	$\frac{15}{2}$	$^6H_{15/2}$	10.63	10.63
Ho^{3+}	$4f^{10}$	2	6	8	$^5I_8$	10.60	10.4
Er^{3+}	$4f^{11}$	$\frac{3}{2}$	6	$\frac{15}{2}$	$^4I_{15/2}$	9.59	9.5
Tm^{3+}	$4f^{12}$	1	5	6	$^3H_6$	7.57	7.61
Yb^{3+}	$4f^{13}$	$\frac{1}{2}$	3	$\frac{7}{2}$	$^2F_{7/2}$	4.53	4.5
Lu^{3+}	$4f^{14}$	0	0	0	$^1S_0$	0	0

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ion	shell	S	L	J	term	p_1	p_{exp}	p_2
Ti^{3+}, V^{4+}	$3d^1$	$\frac{1}{2}$	2	$\frac{3}{2}$	$^2D_{3/2}$	1.55	1.70	1.73
V^{3+}	$3d^2$	1	3	2	$^3F_2$	1.63	2.61	2.83
Cr^{3+}, V^{2+}	$3d^3$	$\frac{3}{2}$	3	$\frac{3}{2}$	$^4F_{3/2}$	0.77	3.85	3.87
Mn^{3+}, Cr^{2+}	$3d^4$	2	2	0	$^5D_0$	0	4.82	4.90
Fe^{3+}, Mn^{2+}	$3d^5$	$\frac{5}{2}$	0	$\frac{5}{2}$	$^6S_{5/2}$	5.92	5.82	5.92
Fe^{2+}	$3d^6$	2	2	4	$^5D_4$	6.70	5.36	4.90
Co^{2+}	$3d^7$	$\frac{3}{2}$	3	$\frac{9}{2}$	$^4F_{9/2}$	6.63	4.90	3.87
Ni^{2+}	$3d^8$	1	3	4	$^3F_4$	5.59	3.12	2.83
Cu^{2+}	$3d^9$	$\frac{1}{2}$	2	$\frac{5}{2}$	$^2D_{5/2}$	3.55	1.83	1.73
Zn^{2+}	$3d^{10}$	0	0	0	$^1S_0$	0	0	0

Magnetism in Condensed Matter

By S. Blundell

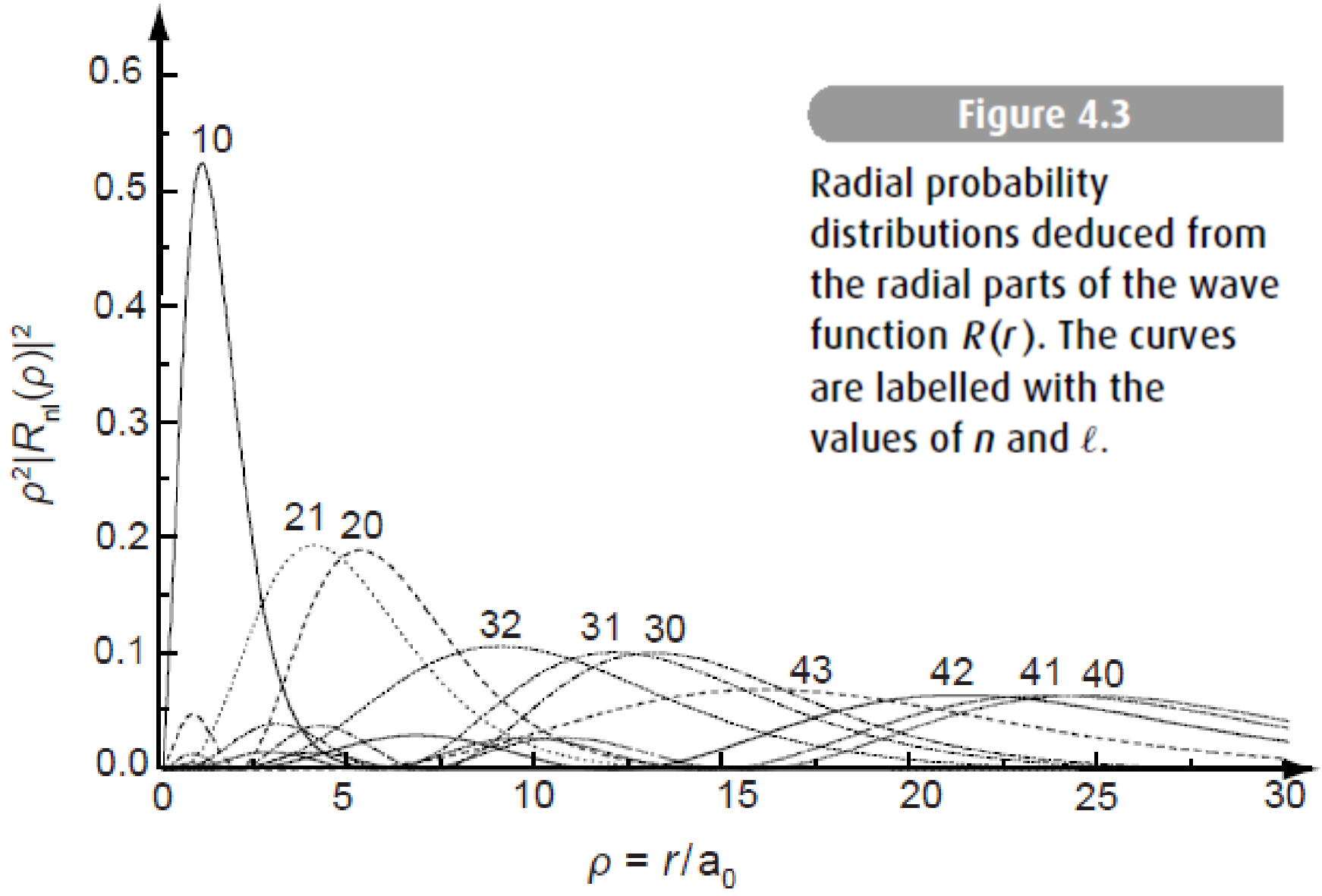

Figure 4.3

Radial probability distributions deduced from the radial parts of the wave function $R(r)$. The curves are labelled with the values of n and ℓ.

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