CRIST Sensitivity Factors derived from Inorganic Compounds

Single Crystals, Poly-crystals, or Powders

Mar-Apr 2019

Inflection Point empirical SFs IP-SFs

Base SFs from **Single Crystals**: C (1s) = 1.0, O (1s) = 2.88, Ca (2p) = 5.80, F (1s) = 4.00, Li (1s) = 0.070, Si (2p) = 1.07, S (2p) = **xxx**, Na (1s) = 8.25, K (2p) = 4.85, Cl (2p) = 2.76, Br (3d) = 3.03, Se (3d) =2.09, Cu (2p3) = 18.7, Ti (2p) = 6.5, Zn (2p3) = 18.92, Ni (2p) =20.0, Cr (2p) = 9.50, Co (2p) = 18.0, Fe (2p) = 14.50, Mg (2p) = 0.44, Ga (3d) = 1.51, Pb (4d5) = 11.5

derived from **CaCO3 (n-xtl)**, **CaF2 (n-xtl)**, NaF (s-xtl), NaCl (s-xtl), NaBr (s-xtl), SiC (CVD), SiO2 (n-xtl), L2CO3 (pwdr), B2O3 (grains), p-BN (chip), LiF (s-xtl), ZnO (s-xtl), ZnSe (s-xtl) , PbCO3 (n-xtal)

Using "s" vs "s" orbitals to optimize SFs. e.g. 1s vs 2s to define base SF. When s vs s not available use largest signals.

Sulfides and Fluorides are useful, but a few high valence fluorides degrade under X-rays

Derived from 2 Scan (fast) Survey Spectra (min or no degradation) w PE = 200 eV, 90 e-TOA, 55 X-ray->Lens, Al Mono X-rays, step size: 0.5 - 1.0,
Single Crystals are best. Strong signal, easy charge control, slow to degrade. Single and natural crystals are broke (cleaned) in air, then loaded.
Powders are pressed onto holder, older salts are ground to homogenize any contaminants

using Thermo K-Alpha, Avantage Software, Shirley baseline, KE^0.6, TF removed,
ignoring substructures (except for a few transition metals, Cr, Mn, Fe, Co)
Confirmed that O (1s) = 2.88 by analyzing C:O ratio of several anhydrous Carbonates
Used CaCO3 n-xtal to define Ca SFs in CaF2 n-xtal, then produced SF for F (1s) = 3.97

Phosphates use POx to vacuum, Sulfates lose SOx to vacuum
Sulfides often have sulfate layers, which can be removed by rinsing with DI water, if that sulfide does not react with water.
Sulfates are often hydrated which lose H2O to vacuum
SeO2 is lost to vacuum. Some Fluorides react to X-rays to form lower oxidation state Fluorides
Carbonate, Fluorides, Oxides and Sulfides are generally stable to X-rays. In powder form Oxides and Carbonates often have H2O which is lost to UHV with time.

Chemistcl Ordered - Validity for Delivery
Have Data - Need to Process
Red lettering lists material used to define SFs
s-xtal and n-xtal yield most RELIABLE SFs
Need to order reliable chemical

Calcium Carbonate (Calcite) and Calcium Fluoride (Fluorite) provide baseline correlation for all SFs

Carbon			Oxygen			Calcium			Calcium			Fluorine		
defined	Scofield	defined	CaCO3	Scofield	n-xtal	CaCO3	Scofield	n-xtal	CaF2	Scofield	n-xtl	CaF2	Scofield	n-xtal
C 1s	Scofield	1.0	O 1s	2.93	2.88	Ca 2p	5.07	6.15	Ca 2p	5.07	6.15	F 1s	4.43	4.00
						Ca 2p	5.80	2.16	Ca 2s	2.59	2.16			

Lithium			Beryllium		
Li2CO3	Scofield	pwdr	Be2SiO4	Scofield	n-xtal
Li 1s	0.057	0.070	Be 1s	0.195	0.185
LiBF4	Scofield	pwdr			
Li 1s	0.057	0.070			
LiCl	Scofield	grains	BeO	Scofield	pressed
Li 1s	0.057	0.071	Be 1s	0.195	0.196
LiF	Scofield	s-xtl	BeO	Scofield	99.9% sntr
Li 1s	0.057	0.079	Be 1s	0.195	0.206
Base SF	F 1s	CaF2	4.00	O 1s	CaCO3	2.88
Base SF	O 1s	CaCO3	2.88	Si 2p	SiO2	0.97
Mack SF	1s	Mack	0.610	1s	Mack	0.180

Boron			Carbon		
NH4BF4	Scofield	xtal	defined	Scofield	defined
B 1s	0.486	0.505	C 1s	Scofield	1.0
B2O3	Scofield	grains	Unity	Scofield	1.0
B 1s	0.486	0.501			
p-BN	Scofield	chip			
B 1s	0.486	0.510			

Nitrogen			
p-BN	Scofield	chip	
N 1s	1.80	1.76	
N 2s	0.0065	0.050	
AlN	Scofield	LPCVD	SiO2
N 1s	1.80	1.65	O 2s
TiN	Scofield	IBED	B2O3
N 1s	1.80	1.80	O 2s
NH4BF4	Scofield	grains	
N 1s	1.80	1.65	
F 1s	CaF2	4.00	O 1s
B 1s	NH4BF4	3.505	
Mack	1s	Mack	1.48

Oxygen			Fluorine		
CaCO3	Scofield	n-xtal	CaF2	Scofield	n-xtal
O 1s	2.93	2.88	F 1s	4.43	4.00
CrO3	0.131		F 2s	0.21	
SiO2	Scofield	fused	Na2	Scofield	n-xtl
O 2s	0.141	0.115	F 1s	4.43	4.00
B2O3	Scofield	grains	KF	Scofield	grains
O 2s	0.141	0.109	F 1s	4.43	4.00
			LiF	Scofield	s-xtal
			F 2s	0.21	0.172
O 1s	CaCO3	2.88	F 1s	CaF2	4.00
1s	Mack	1.48	1s	Mack	4.118

Sodium			Magnesium				
NaF	Scofield	n-xtal	MgO	Scofield	s-xtal		
Na 1s	8.52	8.25	Mg 1s	11.18		MgSO4	Crist
Na 2s	0.42	0.52	Mg 2s	0.575	0.76	Mg 2s	0.75
NaCl	Scofield	s-xtl	Mg 2p	0.334	0.44	Mg 2p	0.48
Na 1s	8.52	8.25	MgF2	Scofield	xtal		
Na 2s	0.42	0.52	Mg 2s	0.580	0.70		
Na 2p	0.19	0.27	Mg 2p	0.333	0.455		
NaF	Scofield	s-xtl	MgF2	Scofield	coating		
Na 1s	8.52	8.25	Mg 2s	0.580	0.638		
Na 2s	0.42	0.52	Mg 2p	0.333	0.408		
Base SF	F 1s	CaF2	4.00	O 1s	CaCO3	2.88	
Base SF	Cl 2p	NaCl	2.65	F 1s	CaF2	4.00	
Base SF	Na 1s	NaF	8.25				
Mack SF	1s	Mack	10.580	1s	Mack	14.94	
Mack SF	2s	Mack	0.529	2s	Mack	0.767	
				2p	Mack	0.429	

Aluminum			Silicon			Phosphorus			Sulfur			Chlorine		
Al2O3	Scofield	s-xtal	SiO2	Scofield	fused	LiFePO4	Scofield	pwdr	BaSO4	Scofield	n-xtal	NaCl	Scofield	s-xtal
Al 2s	0.753	0.93	Si 2s	0.955	1.06	P 2s	1.18	1.11	S 2s	1.43	1.40	Cl 2s	1.69	1.60
Al 2p	0.537	0.65	Si 2p	0.817	0.97	P 2p	1.19	1.30	S 2p	1.67	2.16	Cl 2p	2.28	2.76
AlF3	Scofield	pwdr												
Al 2s	0.753	0.98	SiO2	Scofield	s-xtal	P2O5	Scofield	s-xtal	K2S	Scofield	target	KCl	Scofield	s-xtal
Al 2p	0.537	0.65	Si 2s	0.955	1.07	P 2s	1.18	1.30	S 2p	1.43	1.54	Cl 2s	1.69	1.55
Al2O3	Scofield	fused	Si 2p	0.817	0.97	P 2p	1.19	1.39	S 2p	1.67	2.30	Cl 2p	2.28	2.79
Al 2s	0.753	0.85	SiC	Scofield	CVD film	GaP	Scofield		Ag2S	Scofield	n-xtal	LiCl	Scofield	grains
Al 2p	0.537	0.60	Si 2s	0.955	1.07	P 2s	1.18		S 2p	1.43	1.40	Cl 2s	1.69	1.53
			Si 2p	0.817	0.98	P 2p	1.19		S 2p	1.67	2.16	Cl 2p	2.28	2.75
O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	Na 1s	NaCl	8.25
F1s	CaF2	4.00	C 1s	SiC	1.00	P 2p	InP	1.39	Cu 2p3	CuO	18.70	K 2s	KCl	1.90
									Zn 2p3	ZnCO3	16.50			
									S 2p	Ag2S	2.16	Li 1s	Li2CO3	0.070
Mack SF	2s	Mack	0.801	2s	Mack	0.967	2s	Mack	1.118	2s	Mack	1.294	2s	Mack	1.548
Mack SF	2p	Mack	0.560	2p	Mack	0.900	2p	Mack	1.353	2p	Mack	1.881	2p	Mack	2.741

Potassium			Calcium			Scandium			Titanium			Vanadium			Chromium			Manganese			Iron			Cobalt			Nickel			Copper			Zinc			Gallium			Germanium			Arsenic			Selenium			Bromine		
KF	Scofield	s-xtal	CaCO3	Scofield	n-xtal	Sc2O3	Scofield	pwdr	TiO2	Scofield	s-xtal	V2O5	Scofield	s-xtal	Cr2O3	Scofield	s-xtal	MnO2	Scofield	s-xtal	Fe2O3	Scofield	s-xtal	CoO	Scofield	s-xtal	NiO	Scofield	s-xtal	CuO	Scofield	s-xtal	ZnO	Scofield	pwdr	Ga2O3	Scofield	pwdr	GeO2	Scofield	pwdr	As2O5	Scofield	pwdr	SeO2	Scofield	s-xtal	KBr	Scofield	s-xtal
K 2p	3.97	4.85	Ca 2p	5.07	6.15	Sc 2p	6.38	5.55	Ti 2p	7.910	6.50	V 2p	9.66	8.15	Cr 2p	11.67	9.50	Mn 2p	13.91	12.00	Fe 2p	16.42	14.50	Co 2p	19.16	18.00	Ni 2p3	14.61	11.70	Cu 2p3	16.73	18.70	Zn 2p3	18.92	18.92	Ga 2p3	21.40		Ge 2p3	24.15		As 2p3	27.19		Se 3s	1.43	1.04	Br 3s	1.53	1.41
K 2s	2.27	2.03	Ca 3s	0.35	0.37	Sc 3s	0.41	0.31	Ti 3s	0.473	0.37	V 3s	0.538	0.44	Cr 3s	0.60	0.41	Mn 3s	0.674	0.72	Fe 3p3	10.82	10.00	Co 3s	0.818	0.75	Ni 2p1	7.57	5.80	Cu 2p1	8.660	7.95	Zn 2p1	9.80	8.50	Ga 3s	1.13	1.35	Ge 3p	3.63		As 3d	1.82	2.73	Se 3d	0.90	5.03	4.80
K 3p	0.36	0.49	Ca 3p	2.59	2.16	Sc 3p	0.65	0.65	Ti 3p	0.813	0.75				Cr 3p	1.17	0.80	Mn 3p	1.423	1.10				Co 3p	1.93	1.60	Ni 2p3	14.61	11.70	Cu 2p3	16.73	18.70	Zn 3s	1.04	1.30	Ga 3p	3.21	4.15	Ge 3d	1.42		As 3p	4.07	5.00	Se 3d	2.29	2.09	Br 3d	2.84	3.08
KCl	Scofield	s-xtal				Sc 2s	2.91	1.63	Ti 2s	3.24	1.36	V 3s	3.57	2.25							Fe 3s	0.745	0.69				Ni 3p	2.22	2.30	Cu 3p	2.478	3.25	Zn 3p	2.83	3.90	Ga 3d	1.08	1.51	Ge 3s	1.23					As 3s	1.32	1.29							
K 2s	2.27	1.90																			Fe 3p	1.669	1.40				Ni 2p	22.18	20.00																							
KF	Scofield	s-xtal	CaF2	Scofield	n-xtal	Sc	Scofield	???	TiN	Scofield	IBED	V	Scofield	???	CrZrO3	Scofield	Thermal	MnF3	Scofield	pwdr	CoF2	Scofield	pwdr	CuO	Scofield	pwdr	NiF2	Scofield	pwdr	ZnCO3	Scofield	pwdr	GaAs	Scofield	pwdr	Ge	Scofield		As2O3	Scofield	pwdr	PbSe	Scofield	pwdr	NaBr	Scofield	s-xtal	Se	Scofield	
K 2p	3.97	4.85	Ca 2p	5.07	6.15	Sc 2p	6.38		Ti 2p	7.91	6.95	V 2p	9.66		Cr 2p	11.67	8.70	Mn 2p3	13.910	14.70	Fe 2p	16.42	15.00	Co 2p	19.16	15.95	Ni 2p3	14.61	12.95	Cu 2p3	16.73	18.70	Zn 2p3	18.92	16.50	Ga 3s	1.13	1.75	Ge 3p	3.63		As 3d	1.82	2.80	Se 3s	1.43	1.4	Br 3s	1.53	1.21
K 2s	2.27	2.03	Ca 2s	0.35	0.37	Sc 3s	0.41		Ti 2s	0.81	0.83	V 2p3	6.37		Cr 3s	0.60	0.39	Mn 3s	0.674	0.61	Fe 2p3	10.82	9.00	Co 3s	0.818	0.835	Ni 2p1	7.57	7.10	Cu 2p1	8.66	10.05	ZnS	Zn 3s3	16.50	Ga 3s	1.13	1.42	Ge 3d	1.42		As 3p	4.07	5.50	Se 3d	2.29	2.1	Br 3p	3.84	3.95
K 3p	0.36	0.49	Ca 3p	2.59	2.16	Sc 2s	2.91		Ti 2p	3.24	1.50	V 2p1	3		Cr 3p	1.17	0.72	Mn 3p	1.423	1.26	Fe 2p1	5.60	4.00	Co 3p	1.93	1.47	Ni 2p	22.18	21.30	Cu 3p	2.48	3.32	ZnF2	Scofield	pwdr	Ga 3p	3.21	4.25	Ge 3d	1.42		As 3s	1.32	1.45	Se 3d	2.29	2.09	Br 3d	2.84	3.38
KI	Scofield	s-xtl				Sc 3p	0.65		TiF4	Scofield	pwdr	V 3s	0.538		CrF3-H2O	Scofield	pwdr	MnCO3	Scofield	pwdr	Fe 3s	0.745	0.81				Ni 3p	2.22	1.72				Zn 2p1	9.80	9.30	GaF3	Scofield	pwdr	Ge	Scofield		As2S3	Scofield	n-xtal	CdSe	Scofield	pwdr	LiBr	Scofield	grains
K 2p	3.97	4.85							Ti 2p	7.91	7.00	V 2s	3.57		Cr 2p	11.67	10.30	Mn 2p	13.910	10.80	Fe 2p	16.42	13.90	Co 2p	19.16	14.50							Zn 2p3	18.92	14.50	Ga 3s	1.13	1.44	Ge 3p	3.63		As 3d	1.82	2.58	Se 3s	1.43	1.2	Br 3s	1.53	1.51
K 2s	2.27	2.03							Ti 3p	0.81	0.89				Cr 3s	0.60	0.46	Mn 3s	0.674	0.445													Zn 3s	1.04	1.23	Ga 3p	3.21	4.25	Ge 3d	1.42		As 3p	4.07	4.95	Se 3p	5.03	5.14			
K 3p	0.36	0.49							Ti 2p	3.24	1.93				Cr 3p	1.17	0.84	Mn 3p	1.423	1.09													Zn 3p	2.83	3.65	Ga 3d	1.08	1.70	Ge 3s	1.23		As 3s	1.32	1.27	Se 3d	2.29	2.09	Br 3d	2.84	3.38
Base SF	F 1s	CaF2	4.00	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88
Base SF	Br 3d	NaBr	2.95	F 1s	CaF2	4.00																																												
Mack SF	2p	Mack	4.670	2p	Mack	5.970	2p	Mack	5.882	2p	Mack	6.470	2p	Mack	9.280	2p	Mack	11.76	2p	Mack	12.350	2p	Mack	14.353	2p	Mack	18.235	2p3	Mack	14.176	2p3	Mack	18.147	2p3	Mack	21.390	2p3	Mack	22.70	2p3	Mack	28.26	2p3	Mack	28.00	3s	Mack	1.11	3s	Mack	1.19
Mack SF	2s	Mack	1.918	2s	Mack	2.106	3s	Mack		3s	Mack		3s	Mack	0.396	3s	Mack	0.44	3s	Mack	0.479	3s	Mack	0.540	3s	Mack	0.606	2p1	Mack	8.588	2p1	Mack	8.366	2p1	Mack	10.479	3s	Mack	1.294	3s	Mack	1.67	3s	Mack	1.54	3d	Mack	6.22
Mack SF							3p	Mack	0.636	3p	Mack	0.766	3p	Mack	0.917	3p	Mack	1.08	3p	Mack	1.282	3p	Mack	1.494	3p	Mack	1.741	3s	Mack	0.670	3s	Mack	0.732	3s	Mack	0.800	3p	Mack	3.176	3p	Mack	3.426	3p	Mack	3.80	3d	Mack	1.60	3d	Mack	2.73
																													3p	Mack	2.01	3p	Mack	2.32	3p	Mack	2.60	3d	Mack	1.412	3s	Mack	0.949	3s	Mack	1.03				

Rubidium			Strontium			Yttrium			Zirconium			Niobium			Molybdenum			Tc	Ruthenium			Rhodium			Palladium			Silver			Cadmium			Indium			Tin			Antimony			Tellurium			Iodine		
Rb2CO3	Scofield		SrF2	Scofield	pwdr	Y2O3	Scofield	lump	ZrO2	Scofield	pwdr	Nb2O5	Scofield	pwdr	MoO3	Scofield	pwdr		RuO2	Scofield	pwdr	Rh2O3	Scofield	pwdr	PdS	Scofield	pwdr	Ag2CO3	Scofield	pwdr	CdS	Scofield	pwdr	In(OH)3	Scofield	pwdr	SnO2	Scofield		Sb (GaSb)	Scofield	s-xtal	TeO2	Scofield	s-xtal	KI	Scofield	s-xtal
Rb 3s	1.75	1.40	Sr 3s	1.860	1.57	Y 3s	1.950	1.15	Zr 3s	2.100		Nb 3s	2.220	1.40	Mo 3s	2.340	1.70		Ru 3p1	3.44			Rh 3p1	3.64		Pd 3p1	3.83		Ag 3p1	4.03	5.18	Cd 3p1	4.22	3.80	In 3p1	4.40	4.20	Sn 3p1	4.76	2.80	Te 3p1	4.92	2.20	I 3p1	5.06	3.55
Rb 3p	0.67	7.50	Sr 3p	6.600	7.90	Y 3p1	2.440	2.43	Zr 3p1	2.640		Nb 3p1	2.840	3.10	Mo 3p1	3.040	3.80		Ru 3p3	6.78			Rh 3p3	7.21		Pd 3p3	7.63		Ag 3p3	8.06	10.00	Cd 3p3	8.50	8.65	In 3p3	8.93	9.30	Sn 3p3	9.35	8.50	Te 3p3	10.21	4.50	I 3p3	10.62	6.90
Rb 3d	4.21	5.50	Sr 3d	5.050	6.77	Y 3p3	4.750	3.97	Zr 3p3	5.140		Nb 3p3	5.530	5.53	Mo 3p3	5.940	6.80		Ru 3d3	5.10			Rh 3d3	5.80		Pd 3d3	6.56		Ag 3d	18.04	18.04	Cd 3d	20.22	29.20	In 3d	22.54	32.20	Sn 3d3	10.25	11.50	Sb 3d3	11.35	6.80	Te 3d5	18.06	10.60	I 3d3	13.77	18.50
			Sr 4p	0.291	0.255	Y 3d	5.980	6.45	Zr 3d	7.040		Nb 3d	8.210	9.65	Mo 3d	9.500	13.60		Ru 3d5	7.39			Rh 3d5	8.39		Pd 3d5	9.48		Ag 4d	0.64	0.61	Cd 4s	0.69	0.48	In 4s	0.74	0.65	Sn 3d5	10.25	16.39	Sb 3d5	16.39	15.50	Te 3d	28.27	18.3	I 3d5	19.87	22.50
			Sr 4p	0.775	1.04				Zr 4s	0.367		Nb 4s	0.402	0.36	Mo 4s	0.440	0.35		Ru 4s	0.52			Rh 4s	0.55		Pd 4s	0.60		Ag 4p	0.726	2.45	Cd 4p	2.25	1.80	In 3s	2.45	1.90	Sn 3d	25.05	30.20	Sb 3d	27.14	29.00	Te 4d	3.63	3.2	I 4d	4.13	6.20
Rbl	Scofield	s-xtal	SrO	Scofield	s-xtal	YCl3	Scofield	s-xtal	ZrF4	Scofield	pwdr	LiTaO3	Scofield	s-xtal	WO3	Scofield	pwdr	Re4O7	Scofield	???	OsO2	Scofield	pwdr	IrO2	Scofield	pwdr	PtO2	Scofield	pwdr	Au	Scofield	???	HgS	Scofield	n-xtal	Tl2CO3	Scofield	pwdr	PbCO3	Scofield	n-xtal	Bi2S3	Scofield	n-xtal						
Rb 3d	4.21	5.50	Sr 3d	5.050	6.85	Y 3d	5.98	10.10	Zr 3d	7.040		Nb 3d	8.210		Mo 3d	9.500	12.55		Ru 3d5	7.39			Rh 3d5	8.39		Pd 3d5	9.48		Ag 4d	0.64	0.48	Cd 4d	0.69		In 4d	0.74	0.26	Sn 3d5	14.80		Sb 3d5	16.39	15.50	Te 4d	3.63	3.60	I 4d	4.13	7.30
Base SF	O 1s	CaCO3	2.88	F 1s	CaF2	4.00	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88	O 1s	CaCO3	2.88		S 2p	Zn3	2.30																													
Base SF	Rb 3d	Rb2CO3	5.50	O 1s	CaCO3	2.88				F 1s	CaF2	4.00																																							

Cesium			Barium			Lanthanum			Hafnium			Tantalum			Tungsten			Rhenium			Osmium			Iridium			Platinum			Gold			Mercury			Thallium			Lead			Bismuth		
CsBr	Scofield	grains	BaF2	Scofield	n-xtl	LaF3	Scofield	xtal	HfO2	Scofield	coating	Ta2O5	Scofield	coating	WO3	Scofield	pwdr	Re4O7	Scofield	???	OsO2	Scofield	pwdr	IrO2	Scofield	pwdr	PtO2	Scofield	pwdr	Au	Scofield	???	HgS	Scofield	n-xtal	Tl2CO3	Scofield	pwdr	PbCO3	Scofield	n-xtal	Bi2S3	Scofield	n-xtal			
Cs 3d3	16.46	16.20	Ba 3d3	17.92	21.40	La 3d3	19.50		Hf 4p1	2.06	1.33	Ta 4p1	2.08	1.60	W 4d	16.33	16.00	Re 4s	1.84		Os 4s	1.86		Ir 4s	1.88		Pt 4s	1.90		Au 4s	1.92		Hg 4s	1.94	1.42	Tl 4s	1.95	1.40	Pb 4s	1.96	0.70	Bi 4s	1.96	1.80			
Cs 3d5	23.76	29.50	Ba 3d5	25.84	29.50	La 3d5	28.12		Hf 4p3	4.88	3.85	Ta 4p3	5.02	4.40	W 4p1	2.10	1.65	Re 4p1	2.12		Os 4p1	2.13		Ir 4p1	2.14		Pt 4p1	2.14		Au 4p1	2.14		Hg 4p1	2.14	1.64	Tl 4p1	2.13	1.57	Pb 4p1	2.12	0.90	Bi 4p1	2.10	2.60			
Cs 4s	1.08	0.87	Ba 4s	1.13	1.09	La 4s	1.19		Hf 4d	14.97	13.40	Ta 4d	15.64	16.50	W 4p3	5.16	5.00	Re 4p3	5.30		Os 4p3	5.45		Ir 4p3	5.59		Pt 4p3	5.74		Au 4p3	5.89		Hg 4p3	6.04	5.85	Tl 4p3	6.19	5.85	Pb 4p3	6.33	4.00	Bi 4p3	6.48	8.90			
Cs 4p3	2.56	2.10	Ba 4p1	1.34	na	La 4p1	1.42		Hf 4f	7.52	7.45	Ta 4f	8.62	10.30	W 4d3	6.68	5.40	Re 4d3	6.65		Os 4d3	7.23		Ir 4d3	7.51		Pt 4d3	7.78		Au 4d3	8.06		Hg 4d3	8.33	9.90	Tl 4d3	8.60	9.00	Pb 4d3	8.87	7.70	Bi 4d3	9.14	18.40			
Cs 4d	5.25	8.40	Ba 4p3	2.73	2.50	La 4p3	2.91								W 4d5	9.65	9.00	Re 4d5	10.06		Os 4d5	10.48		Ir4d5	10.90		Pt 4d5	11.32		Au 4d5	11.74		Hg 4d5	12.17	13.90	Tl 4d5	12.60	14.00	Pb 4d5	13.02	11.50	Bi 4d5	13.44	22.65			
			Ba 4d	5.96	10.90	La 4d	6.52								W 4f	9.80	12.20	Re 4f	11.08		Os 4f	12.44		Ir 4f	13.90		Pt 4f	15.46		Au 4f	17.12		Hg 4f	18.90	28.00	Tl 4f	20.78	28.80	Pb 4f	22.74	20.00	Bi 4f	24.83	na			
CsI	Scofield	s-xtal	BaSO4	Scofield	n-xtal	La2S3	Scofield	???	Hf4	Scofield	pwdr	LiTaO4	Scofield	s-xtal	WS2	Scofield	pwdr	Re	Scofield	???	Os	Scofield	???	Ir	Scofield	???	Pt	Scofield	???	Au	Scofield	???	HgO	Scofield	pwdr	Tl	Scofield	???	PbSe	Scofield	xtal	Bi2F3	Scofield	pwdr			
Cs3d3	16.46		Ba 3d3	17.92	20.10	La 3d3	19.50		Hf 4p1	2.06	1.55	Ta 4p1	2.08		W 4d	16.33	10.15	Re 4s	1.84		Os 4s	1.86		Ir 4s	1.88		Pt 4s	1.90		Au 4s	1.92		Hg 4s	1.94		Tl 4s	1.95		Pb 4s	1.96	0.95	Bi 4s	1.96	0.72			
Cs 3d5	23.76		Ba 3d5	25.84	28.50	La 3d5	28.12		Hf 4p3	4.88	4.25	Ta 4p3	5.02		W 4p1	2.10	1.71	Re 4p1	2.12		Os 4p1	2.13		Ir 4p1	2.14		Pt 4p1	2.14		Au 4p1	2.14		Hg 4p1	2.14		Tl 4p1	2.13		Pb 4p1	2.12	0.95	Bi 4p1	2.10	0.80			
Cs 4s	1.08		Ba 4s	1.13	1.09	La 4s	1.19		Hf 4d	14.97	14.80	Ta 4d	15.64		W 4p3	5.16	5.60	Re 4p3	5.30		Os 4p3	5.45		Ir 4p3	5.59		Pt 4p3	5.74		Au 4p3	5.89		Hg 4p3	6.04		Tl 4p3	6.19		Pb 4p3	6.33	5.60	Bi 4p3	6.48	na			
Cs 4p3	2.56		Ba 4p1	1.34	na	La 4p1	1.42		Hf 4f	7.52	7.30	Ta 4f	8.62		W 4d3	6.68	4.10	Re 4d3	6.65		Os 4d3	7.23		Ir 4d3	7.51		Pt 4d3	7.78		Au 4d3	8.06		Hg 4d3	8.33		Tl 4d3	8.60		Pb 4d3	8.87	7.90	Bi 4d3	9.14	14.00			
Cs 4d	5.25		Ba 4d3	2.73	2.15	La 4d3	2.91								W 4d5	9.65	6.05	Re 4d5	10.06		Os 4d5	10.48		Ir4d5	10.90		Pt 4d5	11.32		Au 4d5	11.74		Hg 4d5	12.17		Tl 4d5	12.60		Pb 4d5	13.02	11.00	Bi 4d5	13.44	19.80			
			Ba 4d	5.86	9.40	La 4d	6.52								W 4f	9.80	13.28	Re 4f	11.08		Os 4f	12.44		Ir 4f	13.90		Pt 4f	15.46		Au 4f