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POSTER PAPERS

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Radiative data for Si-like ions: Si^0, S^{2+}, A^{4+}, Ca^{6+}

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Radiative data such as photoionization cross sections, oscillator strengths, energy levels for Si - like ions, Si^0, S^{2+}, A^{4+} and Ca^{6+} are obtained as a part of the Opacity Project (OP) [1]. Calculations are carried out in the close coupling (CC) approximation using the R-matrix method [2]. Partial photoionization cross sections of the ^3P ground state of each ion into various excited states of the residual ion are obtained.

Large number of bound states with $n \leq 10$, $\iota \leq 5$ are considered, amounting to a few hundred excited states for each atom and ion. Table I shows number of bound $SL\pi$'s and the corresponding number of excited bound states for each ion. All calculated energies for Si^0, S^{2+}, A^{4+} and Ca^{6+} agree in less than 5% with the observed values except for a few excited states of Si^0. Table I presents observed and calculated ionization energies (I.P.) of the ^3P ground state of each ion.

Detailed photoionization cross sections, including autoionizing resonances, of all the excited bound states, N_{bnd}, for each ion are obtained. Photoionization cross sections of the ^3P ground state of Si-like ions are presented in the lowest panels of Figs. 1(a) - (d). Presence of a wide resonance near the threshold for Si^0 can be observed in Fig. 1(a). The upper panels of Figs.1(a) - (d) exhibit partial photoionization cross sections of the ground state in to various exctied thresholds of the residiual ion. Partial cross sections are important in the determination of level populations under non-LTE conditions. The excited state photoionization cross sections usually show nonhydrogenic behavior. Excited states that are coupled to the ground state of the residual ion show wide PEC (photoexcitation-of-core) resonances in the cross section profile. PEC's are due to excitation of the core to dipole allowed states while the outer electron remain as a spectator. The PEC resonances can enhance the background cross sections significantly. Example of PEC features will be illustrated in poster presentation. Except for a number of states of Si^0, the photoionization cross sections detailed with autoionizing resonances and for a large number of states of S^{2+}, A^{4+} and Ca^{6+} are obtained for the first time as known to the authors.

Dipole oscillator strengths for transitions among all bound states with $n \leq 10$ are obtained in LS multiplets. Table I shows the number of oscillator strengths obtained for each ion. A short comparison is made with the available theoretical and experimental values in Table II. Oscillator strengths of Si^0 show good agreement with the values mesasured recently using laser induced flourescence, so are the oscillator strengths of S^{2+} with a number of measured values obtained using beam-foil technique. Good comparison of oscillator strengths of A^{4+} and Ca^{6+} is also found with the very little available data.

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Table I: Ionization potential, I.P., of the ions; $N_{SL\pi}$ is the total number of bound symmetries and N_{bnd} is the corresponding number of bound states with $n \leq 10$ and $\iota \leq 5$ for each ion; N_f is the number of oscillator strengths obtained for each ion.

Ion	I.P.(Ry) obs	I.P.(Ry) cal	$N_{SL\pi}$	N_{bnd}	N_f	Ion	I.P.(Ry) obs	I.P.(Ry) cal	$N_{SL\pi}$	N_{bnd}	N_f
Si^0	0.598	0.601	27	218	3149	A^{4+}	5.515	5.499	36	342	7863
S^{2+}	2.573	2.574	31	236	3973	Ca^{6+}	9.389	9.364	40	497	16961

Table II: Oscillator strengths of Si^0, S^{2+}, A^{4+}, and Ca^{6+}.

Transition		Si^0 f OP	Si^0 f expt	Transition		S^{2+} f OP	S^{2+} f expt
$3p^2$ - 3p4s	^3P - $^3P^o$	0.236	0.211[3]	$3p^2$ - 3s3p^3	^3P - $^3D^o$	0.024	0.022±.002[5],.022[6]
	^1D - $^1P^o$	0.195	0.163[3],0.170[4]		^3P - $^3P^o$	0.043	0.036[6]
	^1S - $^1P^o$	0.101	0.0913[3],0.098[4]		^1D - $^1D^o$	1.02	0.99±0.10[8]
$3p^2$ - 3p3d	^3P - $^3P^o$	0.053	0.0513[3]	$3p^2$ - 3p3d	^3P - $^3D^o$	1.670	0.96±0.19[7]
	^1D - $^1P^o$	0.0056	0.0029[3],0.0036[4]		^1D - $^1D^o$	0.021	0.0167±0.0005[5]
	^1D - $^1D^o$	0.041	0.040[3]	3p4p - 3p4d	^3D - $^3F^o$	0.947	0.685±0.05[5]
	^1D - $^1F^o$	0.358	0.318[3]	$3p^2$ - 3p4s	^1D - $^1P^o$	0.094	0.07±0.04[7]
	^1S - $^1P^o$	0.409	0.331[3],0.355[4]		^1S - $^1P^o$	0.066	0.08±0.05[7]
$3p^2$ - 3s3p^3	^3P - $^3D^o$	0.051	0.056[3]				

		A^{4+} OP	A^{4+} expt			Ca^{6+} OP	Ca^{6+} Ref. 9
$3p^2$ - 3s3p^3	^3P - $^3P^o$	0.061	0.057±0.002[8]	$3p^2$ - 3s3p^3	^3P - $^3S^o$	0.268	0.249
	^3P - $^3S^o$	0.306			^1D - $^1P^o$	0.250	0.236
	^3P - $^3D^o$	0.042			^1D - $^1D^o$	0.088	0.096
$3p^2$ - 3p3d	^3P - $^3P^o$	0.581			^1S - $^1P^o$	0.175	0.191
	^3P - $^3D^o$	1.411		$3p^2$ - 3p3d	^3P - $^3D^o$	1.133	1.082
	^1D - $^1F^o$	1.212			^3P - $^3P^o$	0.460	0.399
	^1S - $^1P^o$	2.270			^1D - $^1D^o$	0.678	0.504
$3p^2$ - 3p4s	^3P - $^3P^o$	0.147			^1D - $^1F^o$	0.974	0.896

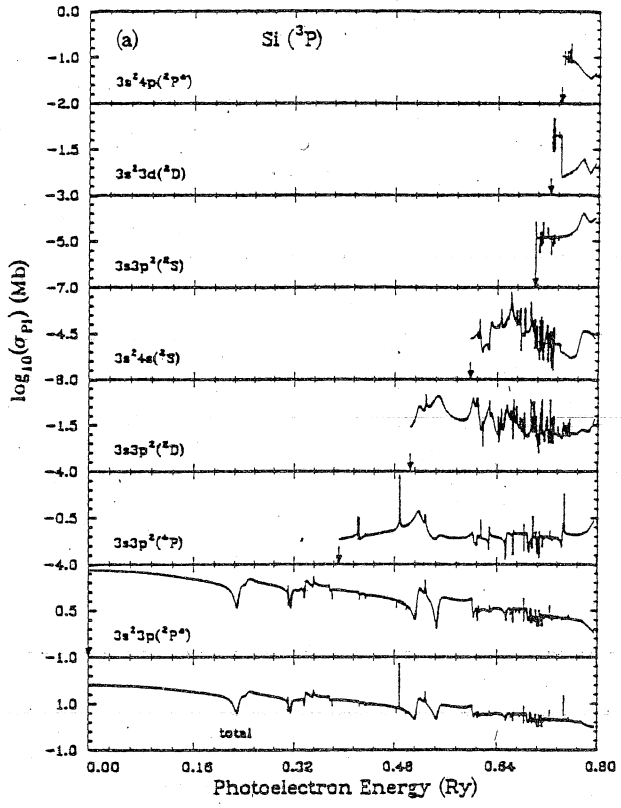

Fig. 1(a)

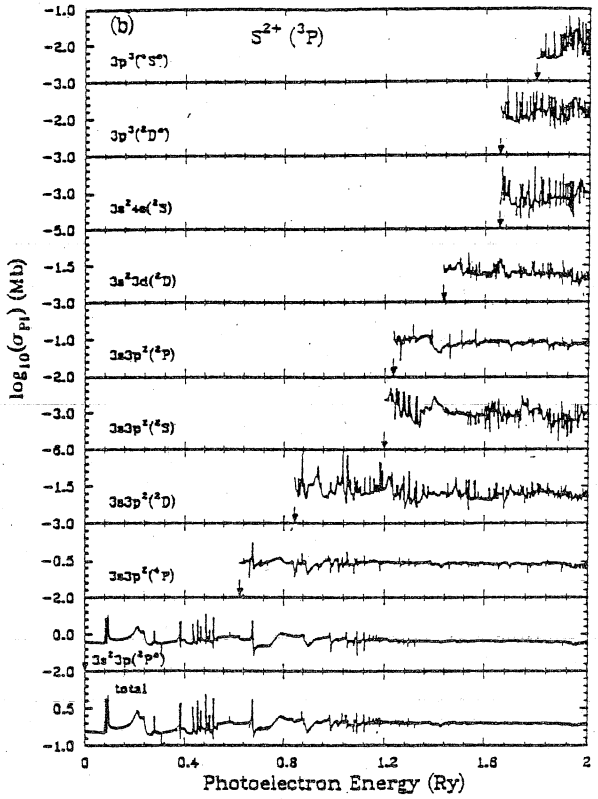

Fig. 1(b)

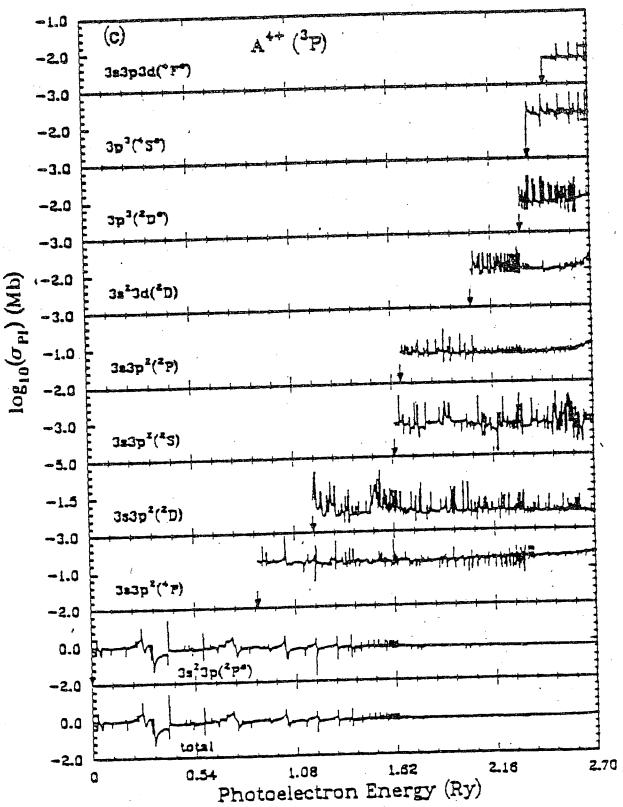

Fig. 1(c)

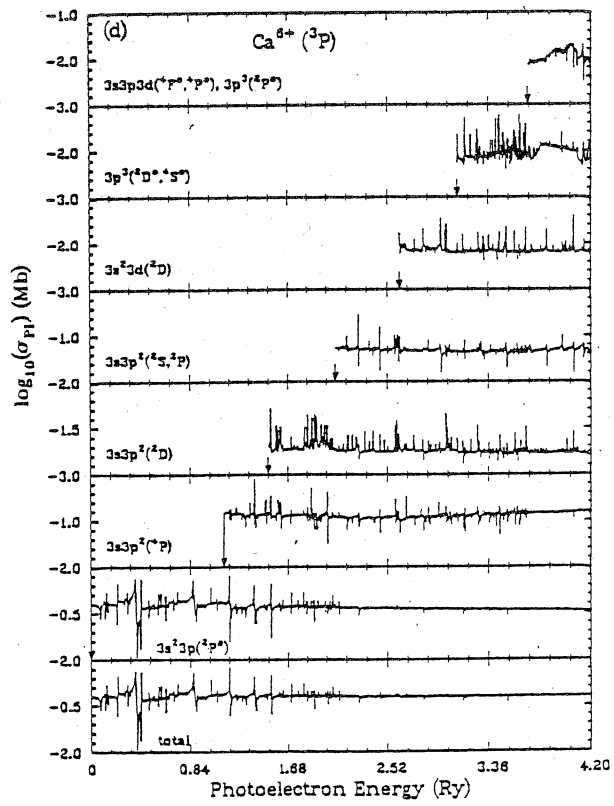

Fig. 1(d)

Fig.1 Partial photoionization cross sections of the ground state of Si-like ions into various excited states of the residual ions.