VI Conference on Active Galactic Nuclei and Gravitational Lensing

(VI AGN&GL)

2 - 6 June 2024
Zlatibor Mt., Serbia

PROGRAM AND ABSTRACTS

eds. J. Kovačević Dojčinović and V. A. Srećković

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Belgrade 2024

PROGRAMME AND ABSTRACTS:

VI Conference on Active Galactic Nuclei and Gravitational Lensing

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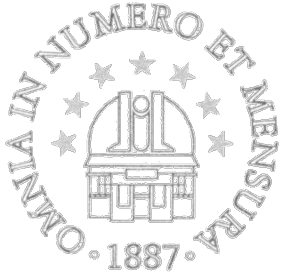
Editors: J. Kovačević Dojčinović
and V. A. Srećković



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ELECTRON IONIZATION CROSS SECTIONS FOR IRON IONS - REPRESENTATION IN DATA BASES

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Chemical abundances in active galaxies has been recently studied by Flury and Moran (2020). The Seyfert 2 galaxy NGC 6552 shows a reflected X-ray spectrum with strong Kα lines of many neutral atoms from O, Ne, Mg till Fe and Ni (Reynolds et al. 1994). Since iron is the most abundant of the heavier elements in the Universe, the study of its Kα profiles is a powerful tool for investigating the innermost regions of AGN. These profiles show characteristic double-horn structure influenced by gravitational and Doppler effects (Middei, 2018). The formation of the H-like iron (Fe XXVI) Lyα line at 6.97 keV in the framework of current models for accretion into a black hole have been studied by Bautista and Titarchuk (1999).

Iron Project (Hummer et al. 1993) has provided a vast amount of computed data on electron excitation cross sections and rates of astrophysical importance, together with radiative transition probabilities and photoionization cross sections mainly for ions of the iron-group elements. Within the scope of that project electron excitation of the

fine-structure transitions in hydrogen-like ions He II and Fe XXVI had been determined (Kisielius et al. 1996). Experimental electron-impact ionization cross sections have been obtained by measuring the equilibrium ionization balance from X-ray measurements of radiative recombination into the K-shell of hydrogen-like and bare iron ions within an electron beam ion trap (O'Rourke et al. 2001). Existing electron-impact ionization cross sections have been reviewed recently by Kynienė et al. (2019) together with the presentation of the new set of data for Fe IX ion. Some of these cross sections may be found in BEAM data base (Marinković et al. 2017) as well as in several other AMO data bases what will be discussed during the presentation.

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ELECTRON IONIZATION CROSS SECTIONS FOR IRON IONS : REPRESENTATION IN DATA BASES

Belgrade Electron-Atom/Molecule DataBase –BEAMDB

Bratislav Marinković and Stefan Ivanović

Institute of Physics Belgrade

MP2: Atomic & molecular processes and databases for investigation of physics of AGNs

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ELECTRON IONIZATION CROSS SECTIONS FOR IRON IONS : REPRESENTATION IN DATA BASES

***B**elgrade **E**lectron-**A**tom/**M**olecule **D**ata**B**ase* –BEAMDB

Bratislav Marinković and Stefan Ivanović

Institute of Physics Belgrade

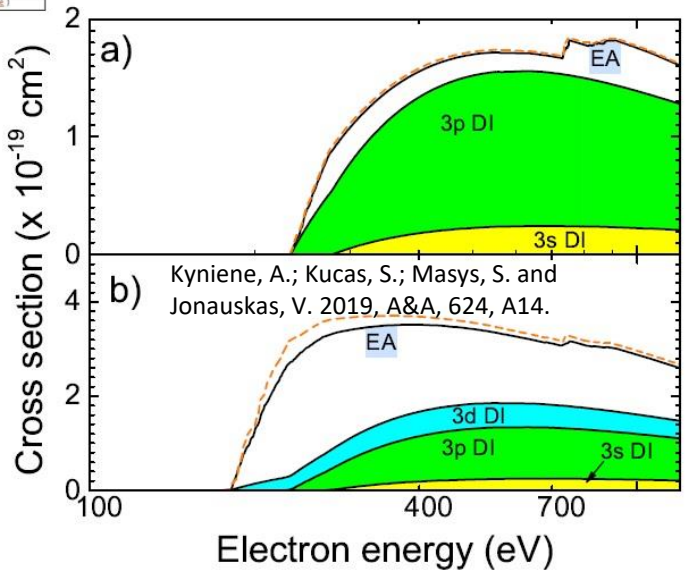
Belgrade electron/atom(molecule) database (BEAMDB) species

Atoms

Element symbol	Nuclear charge	Ion charge	InChI	InChIKey
Ag	47	0	1S/Ag	BQCADISMDOOEFD-UHFFFAOYSA-N (Search in NIST database)
Ar	18	0	1S/Ar	XKRFYHLGVUSROY-UHFFFAOYSA-N (Search in NIST database)
Bi	83	0	1S/Bi	JCXGWMGPZLAOME-UHFFFAOYSA-N (Search in NIST database)
Ca	20	0	1S/Ca	OYPRJOBELJOOCE-UHFFFAOYSA-N (Search in NIST database)
Cd	48	0	1S/Cd	BDOSMKKIYDKNTQ-UHFFFAOYSA-N (Search in NIST database)
Fe XXVI	26	25	1S/Fe/q+25	XEEYBQQBJWHFJM-UHFFFAOYSA-N (Search in NIST database)
He	2	0	1S/He	SWQJXJOGLNCZEY-UHFFFAOYSA-N (Search in NIST database)
Hg	80	0	1S/Hg	QSHDDOUJBYECFT-UHFFFAOYSA-N (Search in NIST database)
Kr	36	0	1S/Kr	DNNSSWSSYDEUBZ-UHFFFAOYSA-N (Search in NIST database)
Mg	12	0	1S/Mg	FYYHWMGAXLPEAU-UHFFFAOYSA-N (Search in NIST database)
Na	11	0	1S/Na	KEAYESYHFKHZAL-UHFFFAOYSA-N (Search in NIST database)
Ne	10	0	1S/Ne	GKAOGPIIYCISHV-UHFFFAOYSA-N (Search in NIST database)
Pb	82	0	1S/Pb	WABPQHHGFIMREM-UHFFFAOYSA-N (Search in NIST database)
Rb	37	0	1S/Rb	IGLNJRXAVVLDKE-UHFFFAOYSA-N (Search in NIST database)
Sb	51	0	1S/Sb	WATWJIUSRGPENY-UHFFFAOYSA-N (Search in NIST database)
Xe	54	0	1S/Xe	FHNFHKCVQCLJFQ-UHFFFAOYSA-N (Search in NIST database)
Yb	70	0	1S/Yb	NAWDYIZEMPQZHO-UHFFFAOYSA-N (Search in NIST database)

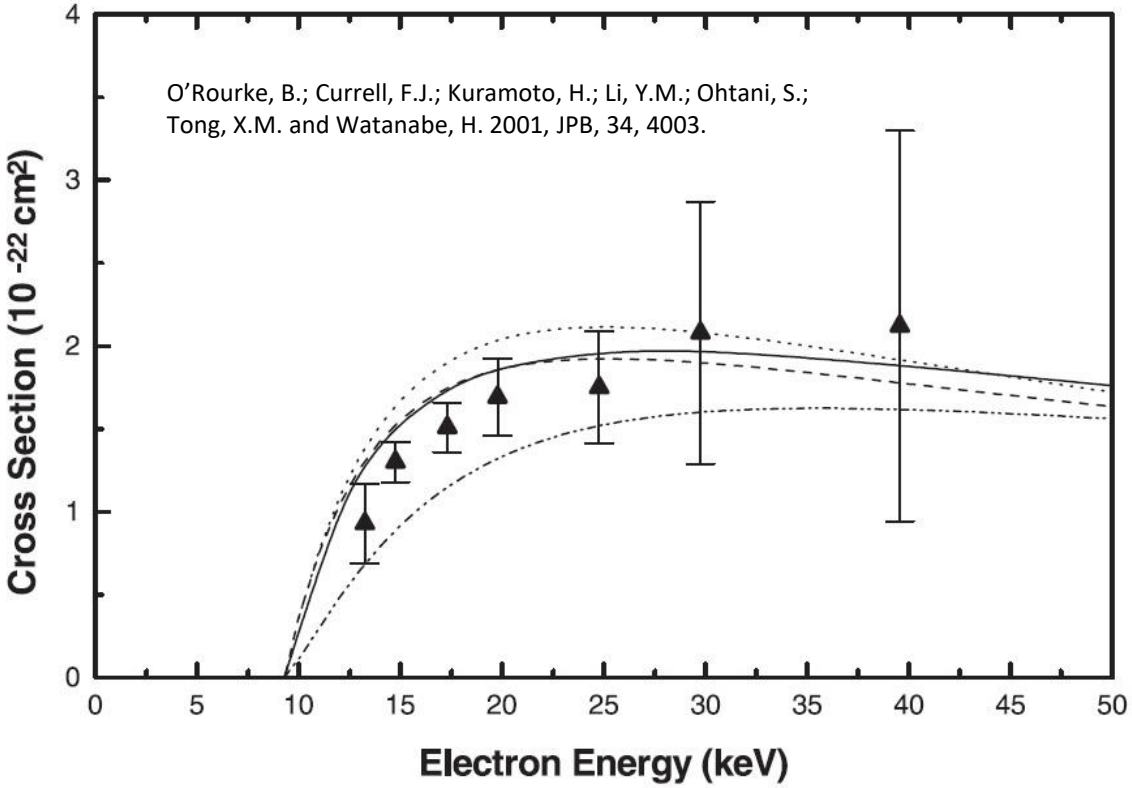
Index	Level	He II	Fe XXVI
1	$1s_{1/2}$	0.000000000	0.0000000
2	$2p_{1/2}$	3.000113769	510.9519822
3	$2s_{1/2}$	3.000118044	510.9949940
4	$2p_{3/2}$	3.000167149	512.5109778
5	$3p_{1/2}$	3.555712294	606.0908759
6	$3s_{1/2}$	3.555713560	606.1038432
7	$3d_{3/2}$	3.555728079	606.5523105
8	$3p_{3/2}$	3.555728106	606.5531434
9	$3d_{5/2}$	3.555733356	606.7038123
10	$4p_{1/2}$	3.750169601	639.3257232
11	$4s_{1/2}$	3.750170139	639.3311999
12	$4d_{3/2}$	3.750176263	639.5202350
13	$4p_{3/2}$	3.750176272	639.5205885
14	$4f_{5/2}$	3.750178487	639.5840838
15	$4d_{5/2}$	3.750178487	639.5841977
16	$4f_{7/2}$	3.750179599	639.6159335

Energy levels (in Ry) of He ii and Fe xxvi ions



Kyniene, A.; Kucas, S.; Masys, S. and Jonauskas, V. 2019, A&A, 624, A14.

Electron-impact ionization cross sections for a) ground $3s^2\ 3p^6\ ^1S_0$ and b) metastable $3s^2\ 3p^5\ 3d\ ^3F_4$ levels of Fe^{8+}. The configuration average DW data are presented by a dashed line for the total cross sections. The shaded areas show contributions from subshells for the DI process: 3s (yellow), 3p (green), 3d (blue).



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The measured ionization cross sections for hydrogen-like iron along with our theoretical calculation based on a distorted-wave method (——). Also included are the semiempirical Lotz formula (– – –), the universal shape parametrization due to Aichele *et al* (1998) (· · ·) and the treatment due to Deutsch *et al* (1995) (— · —).

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