

Electron-impact collisions with Be⁺

Yuri Ralchenko and Dipti

National Institute of Standards and Technology
Gaithersburg, MD, USA

IAEA, Vienna, Austria
June 6, 2019

Followup to the June 2015 meeting

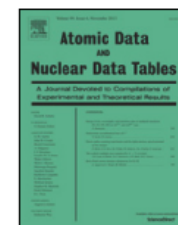
Atomic Data and Nuclear Data Tables 127–128 (2019) 1–21



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Atomic Data and Nuclear Data Tables

journal homepage: www.elsevier.com/locate/adt



Recommended electron-impact excitation and ionization cross sections for Be I



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^d Curtin Institute for Computation and Department of Physics, Astronomy and Medical Radiation Science, Curtin University, GPO Box U1987, Perth, WA 6845, Australia

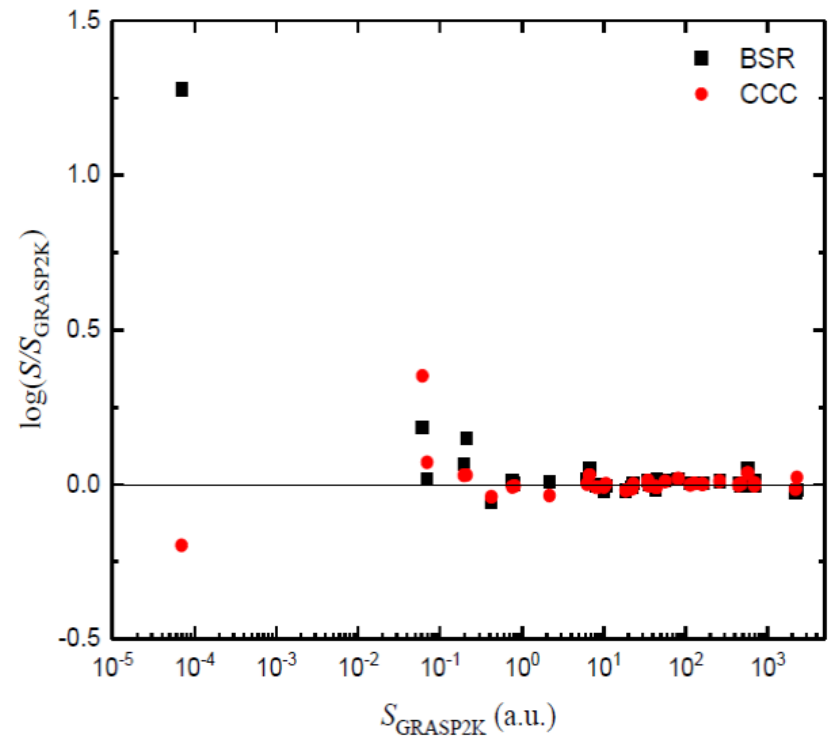
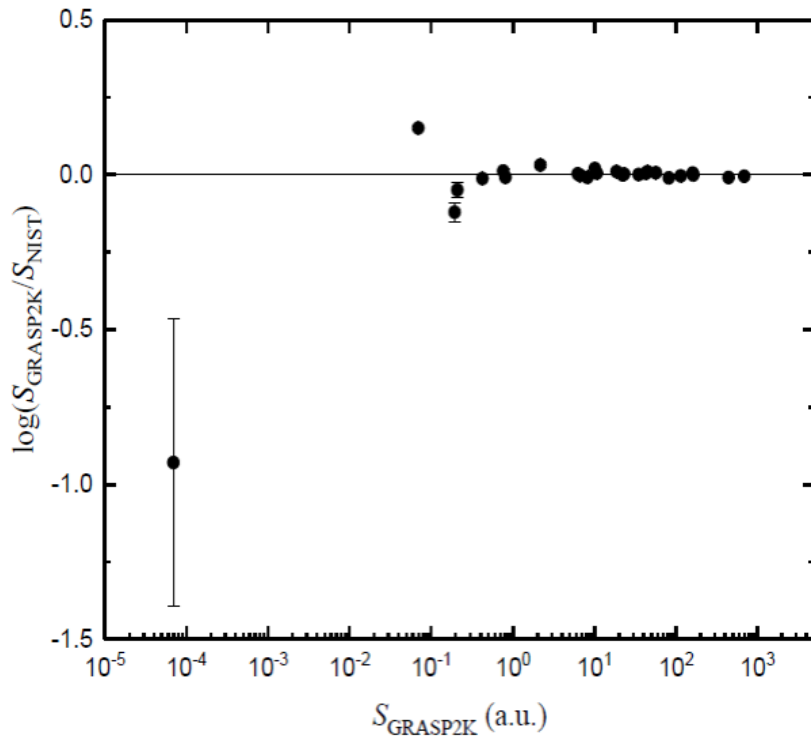
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Be I fits: excitation: CCC+BSR

- Dipole-allowed
- Dipole-forbidden
- Spin-forbidden

Correct asymptotic and threshold behavior

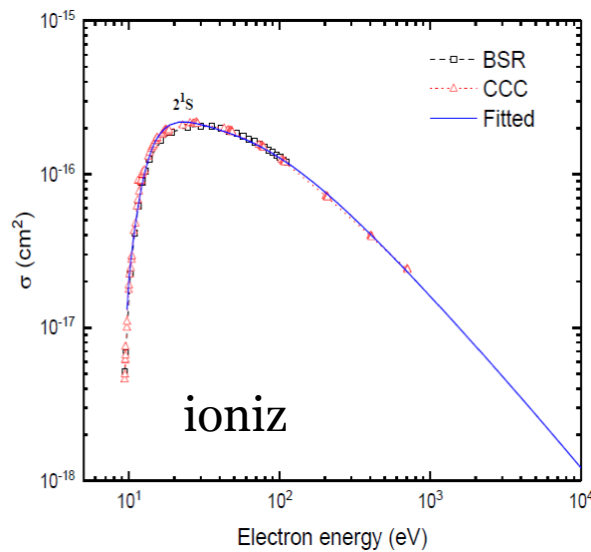
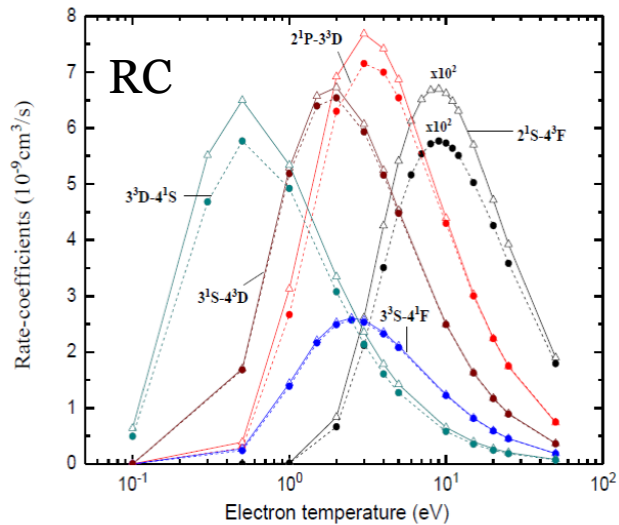
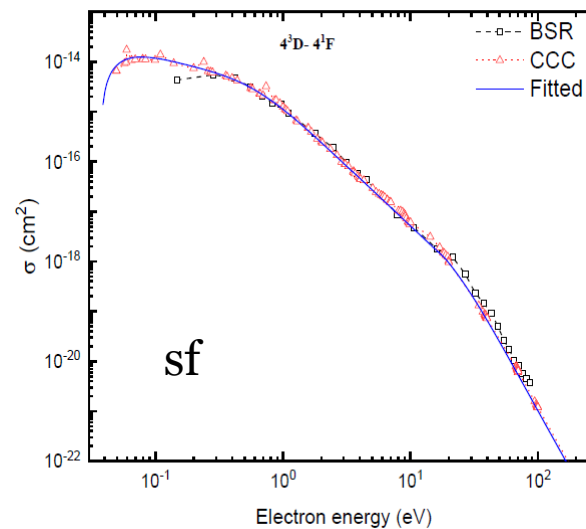
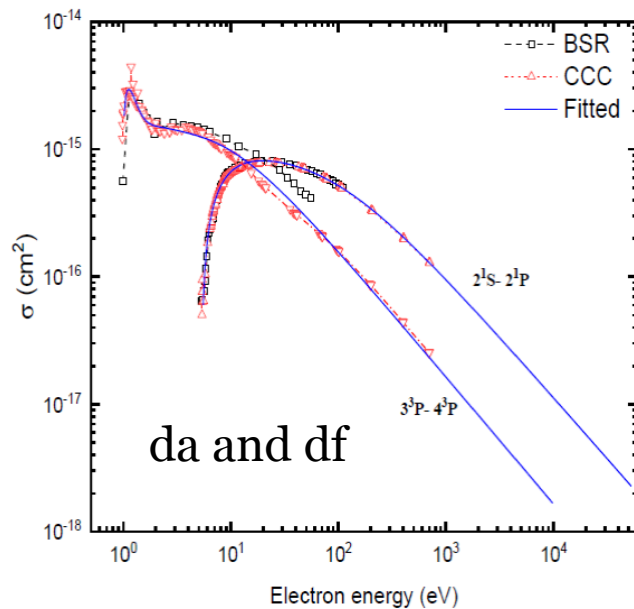
Structure calculations: line strengths



$$A \propto \Delta E^3 \cdot S$$

Examples of fits

IAEA, June 6, 2019



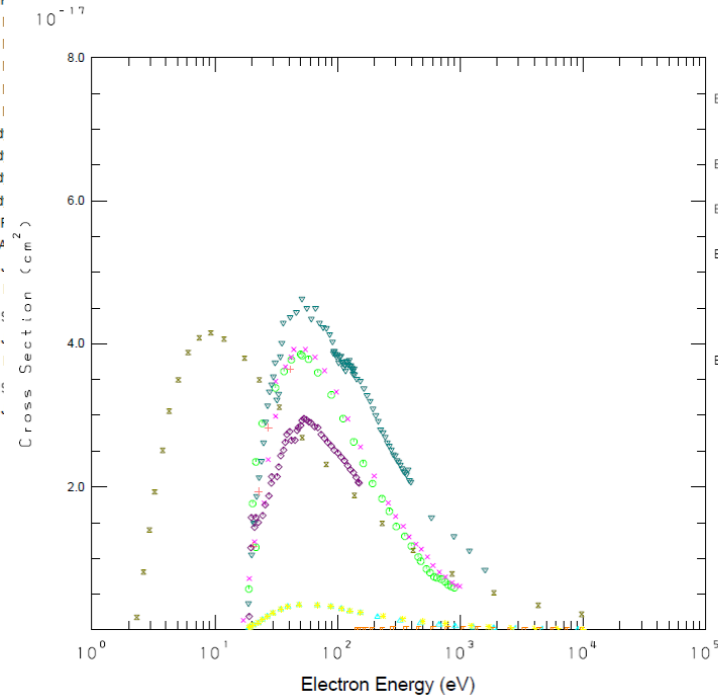
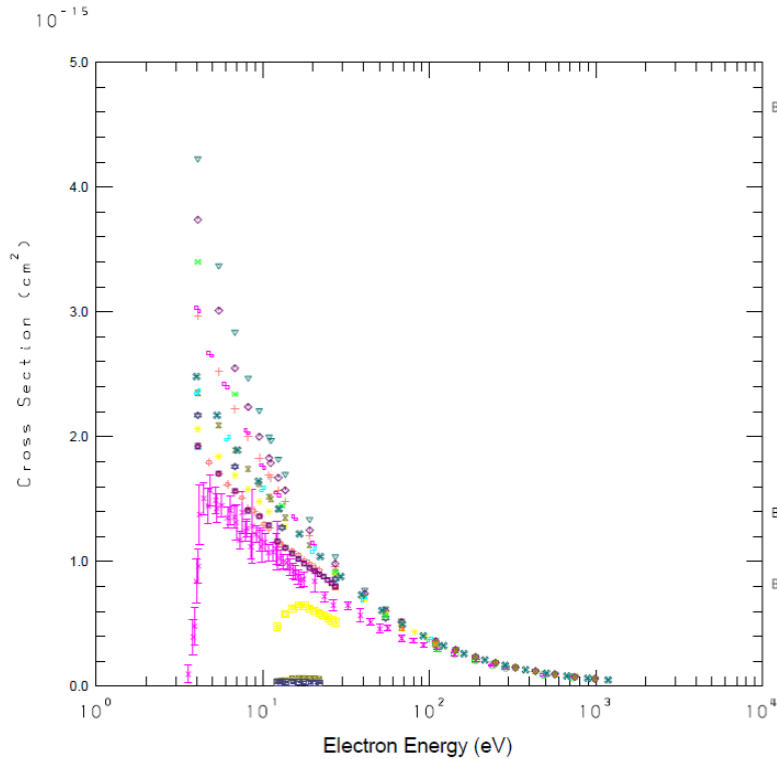
Fit coefficients

i	f	A_0	A_1	A_2	A_3	A_4	A_5
2^1S	2^1P	1.386[+01]	3.961[+00]	6.437[+01]	5.310[+01]	4.848[+01]	-6.883[+01]
	3^1P	-9.986[-01]	4.029[-01]	2.030[-01]	4.799[-01]	-1.013[+00]	4.148[-01]
	4^1P	-9.990[-01]	7.001[-02]	2.649[-03]	3.992[-01]	-5.288[-01]	1.516[-01]
	4^1F	-9.995[-01]	1.621[-05]	1.498[-02]	1.164[-01]	-3.429[-01]	2.331[-01]
2^3P	3^3S	-8.669[-01]	1.545[+01]	-2.277[+01]	3.767[+01]	-2.411[+01]	1.646[+01]
	P^3P	6.003[+00]	3.697[+01]	1.074[+02]	1.107[+02]	3.442[+02]	-5.622[+02]

i	f	A_0	A_1	A_2	A_3	A_4	A_5
2^1S	3^1S	-9.947[-01]	1.311[+00]	-5.716[+00]	1.491[+01]	-1.609[+01]	5.729[+00]
	P^1D	-9.899[-01]	3.798[+00]	-1.815[+01]	5.682[+01]	-7.308[+01]	3.104[+01]
	3^1D	-9.979[-01]	6.209[-02]	1.875[+00]	-3.485[+00]	8.006[-01]	8.741[-01]
	4^1S	-9.980[-01]	3.083[-01]	-1.074[+00]	2.490[+00]	-2.615[+00]	9.781[-01]
	4^1D	9.195[+00]	6.174[-02]	5.900[-01]	6.950[+00]	-2.233[+01]	1.890[+01]

i	f	x	A_0	A_1	A_2	A_3	A_4	A_5
3^3D	3^1D		3.022[+00]	5.302[+05]	8.982[+03]	-5.747[+05]	3.894[+07]	-1.479[+07]
	4^1S		3.100[+00]	1.722[+05]	7.570[-01]	1.288[+04]	1.779[+05]	2.487[+06]
	4^1P		4.762[+00]	1.163[+08]	3.792[+05]	-3.230[+07]	9.048[+08]	1.875[+09]
	4^1F		3.886[+00]	2.420[+05]	3.649[+03]	-5.495[+04]	3.193[+06]	9.448[+06]
	4^1D		3.336[+00]	5.780[+04]	4.359[+02]	-1.217[+03]	2.048[+05]	1.487[+06]
3^1D	4^3S	1-95	2.727[+00]	1.860[+04]	7.113[+03]	-2.701[+04]	1.013[+05]	1.843[+04]
		95-∞	1.377[+00]	1.503[+04]	3.110[-04]	-5.359[+01]	3.699[+06]	-7.794[+06]

NIFS database contents: exc+ion



Recent important publications ($n \leq 4$)

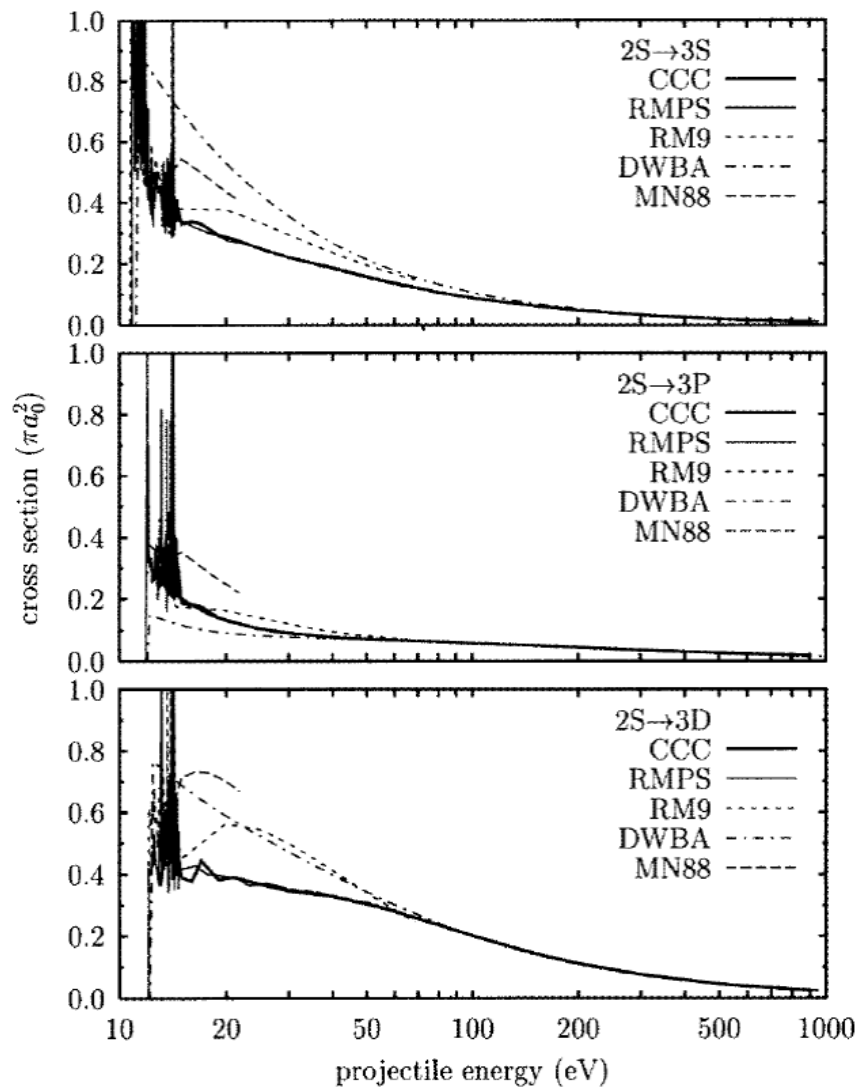
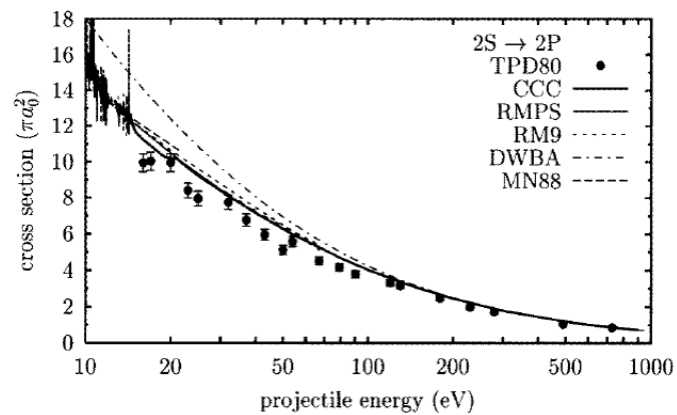
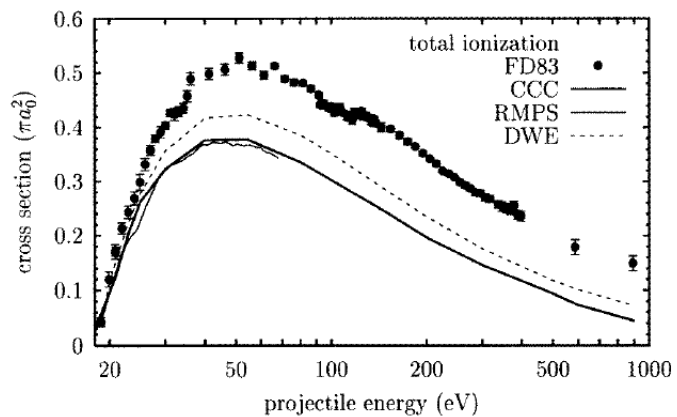
- 1997: Bartschat and Bray
 - RMPS (26 states), CCC, n
 - exc, ion, **CS**
- 2003: Ballance et al
 - DW, R-matrix, RMPS (41 states), TDCC
 - exc, ion, **CS**, RC
- 2011: Liang and Badnell
 - ICFT R-matrix
 - **Exc**, effective collision strengths

LETTER TO THE EDITOR

Calculation of electron impact excitation and ionization of Be^+

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Electron-impact excitation of beryllium and its ions

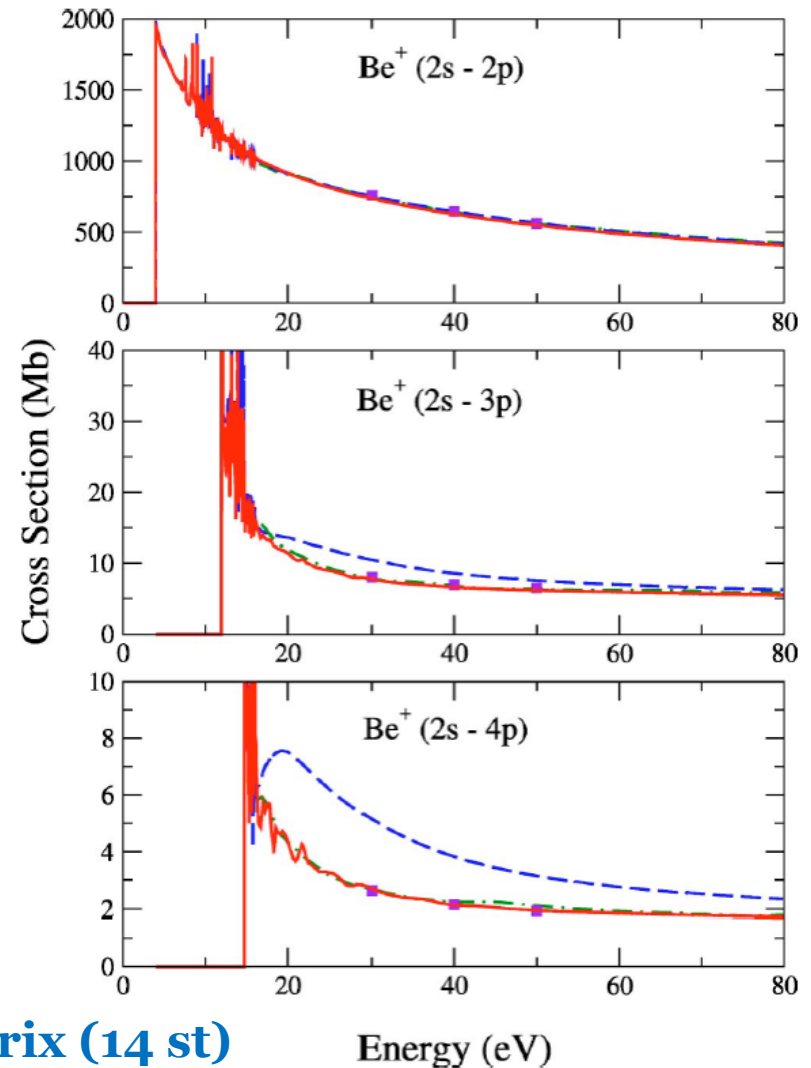
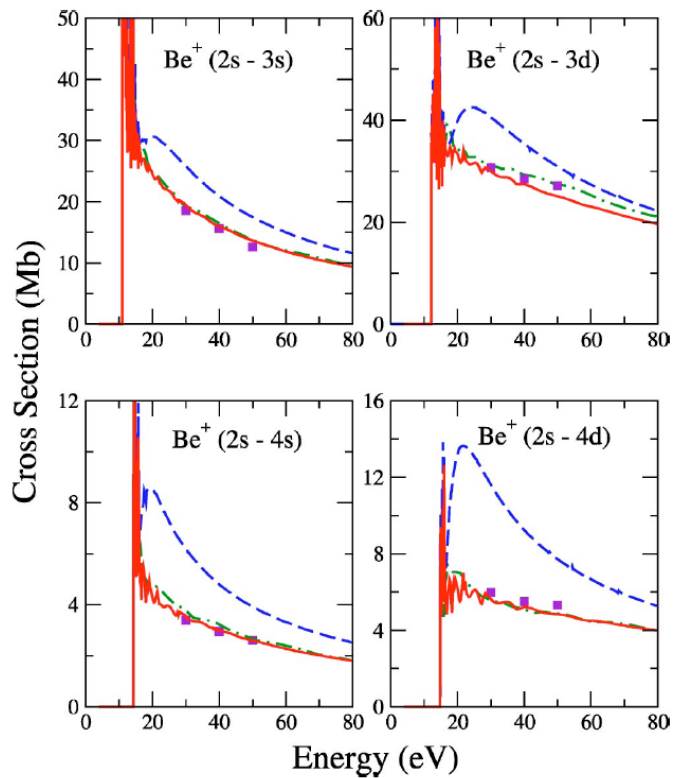
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(Received 24 August 2003; published 18 December 2003)



R-matrix (14 st)

RMPS (41 st)

CCC

TDCC

Electron-impact ionization of all ionization stages of beryllium

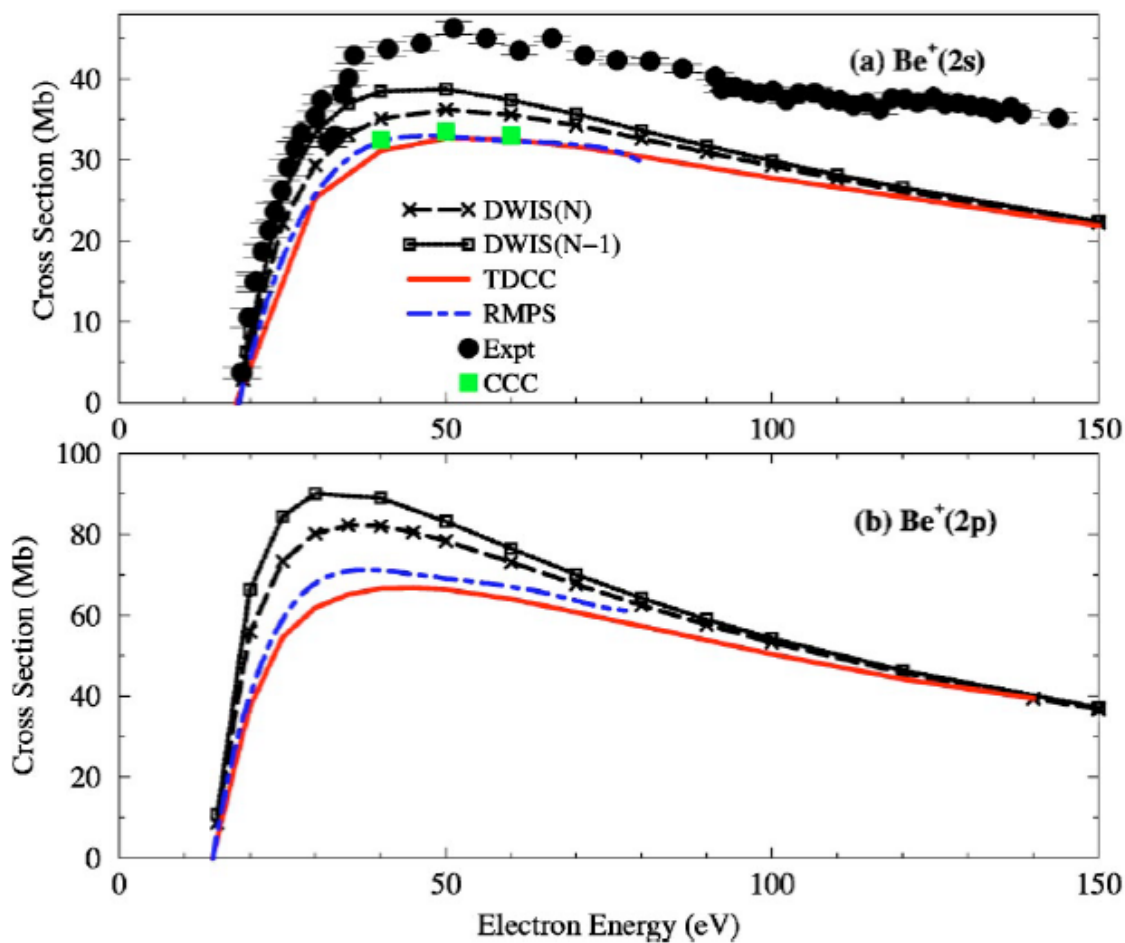
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(Received 19 June 2003; published 15 September 2003)



Plan

- D. Fursa (Curtin) agreed to perform new calculations with CCC
- Approach C. Ballance, J. Colgan,... for the older data
- Evaluate radiative parameters (should be very straightforward, Li-like ion)
- Fit the cross sections (collision strengths)
 - Similar formulas but without $(x-1)$ factor
- Publish in ADNDT