Brown and Beiersdorfer Reply:

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Reply to Nikulin & Trzhaskovskaya's comment on "Energy Dependent Excitation Cross Section Measurements of Diagnostic Lines of Fe XVII"

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We appreciate the comment by Nikulin & Trzhaskovskaya which presents a solution to the puzzling result that the measured cross sections of Brown et al. [1] are significantly smaller than the most advanced theoretical calculations. In Table 1 we compare the measurements of Brown et al. [1], the calculations of Chen & Pradhan [2], and the results of other recent models also constructed to solve the discrepancy using different methods.

Among the claims in Table 1, it is not clear which one, if any, resolves the discrepancy. In addition, it seems that the polarization of the bound electrons on target ions not only occurs during radiative recombination, but also in collisions resulting in direct electron impact excitation (DIE). The discrepancy may thus recur once this effect has been included in the calculations of DIE cross sections.

Until a calculation is completed that includes all effects mentioned in Table 1, the solution of this problem is still a work in progress.

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TABLE I: Comparison between theory and various calculations based on different theoretical methods and assumptions. $\%\Delta = 100*(\sigma_m - \sigma_T)/\sigma_T$ where σ_m are the measured cross sections given in [1], and σ_T refers to the results of theory or measurements renormalized to new cross section for radiative recombination. References for σ_T are given in column 1. E_1 = 910 eV and E_2 = 964 eV. Also included are a brief description of the theoretical method and the effect of the new calculation on the cross sections relative to the calculations of [2]. DW = distorted wave, RDW = relativistic distorted wave, RE = resonance excitation, MBPT = many body perturbation theory.

			3C		3D	
Ref.	Method/Description	Effect or cross section, σ in units of 10^{-20} cm^2	$\%\Delta_{E_1}$	$\%\Delta_{E_2}$	$\%\Delta_{E_1}$	$\%\Delta_{E_2}$
2002 [2]	Extensive set of Resonances and excitation channels	$\sigma_{E_1}^{3C}$=12.5, $\sigma_{E_2}^{3C}$=13.3, $\sigma_{E_1}^{3D}$=3.41, $\sigma_{E_2}^{3D}$ = 3.93	-32	-33	-9	-24
2006 [1]	Measurement	$\sigma_{E_1}^{3C}$=8.49 $\pm$ 1.6, $\sigma_{E_2}^{3C}$=8.88 $\pm$ 0.93, $\sigma_{E_1}^{3D}$= 3.10 $\pm$ 0.64, $\sigma_{E_2}^{3D}$ =2.98 $\pm$ 0.33	0	0	0	0
2006 [1]	FAC DW with cascades and RE	3C essentially unchanged, 3D increases by 17% and 8%	-33	-32	-26	-32
2006 [4]	R matrix w/ additional cascades	3C decreases by 5%, 3D increases by 11% at 910 eV; remains unchanged at 964 eV	-28	-27	-20	-25
2007 [5]	Dirac R matrix with improved convergence	3C decreases by 12 and 15%, 3D increases by 10% at 910, and remains unchanged at 964 eV	-20	-17	-19	-24
2008 [6]	RDW with pseudostates	3C decreases by 14% and 19%, 3D decreases by 5 and 17%	-18	-14	-4	-7
2008 [3]	Recalculate RR cross section onto 3d levels	Measured cross sections normalized to RR onto 3d levels raise by 24%, bring them into agreement with [5].	-19	-19	-19	-19
2008 [7]	Recalculate RR cross sections at 964 eV.[a]	Measured cross section decreases by ~ 6% on average	?	6	?	6
2009 [8]	MBPT w/improved atomic structure	3C decreases by 9 and 13%, 3D increases by 14% at 910 eV and 2% at 964 eV.	-23	-20	-23	-26
2009 [9]	Calculates polarization of 3C and 3D to be 20% higher than previous calculations.	Effect not given	?	?	?	?
2010 [10],[11]	Polarization calculation of [9] is incorrect, previous calculations are correct	No effect	...	...	...	...
2011 [12]	States [7] RR onto 3s is 35% lower than used in [1]. 3d and 3p same as quoted by [7].	If normalized to 3s, cross sections go down by 35%.	54	54	54	54
2012 [13]	Includes PRR	Raises RR cross sections by 20%	-17	-17	-17	-17

[a]RR cross sections decrease by 5, 6, and 7% for 3s, 3p, and 3d, respectively