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## Dielectronic recombination of berylliumlike $\text{Si}^{10+}$ ions at the heavy-ion storage ring TSR

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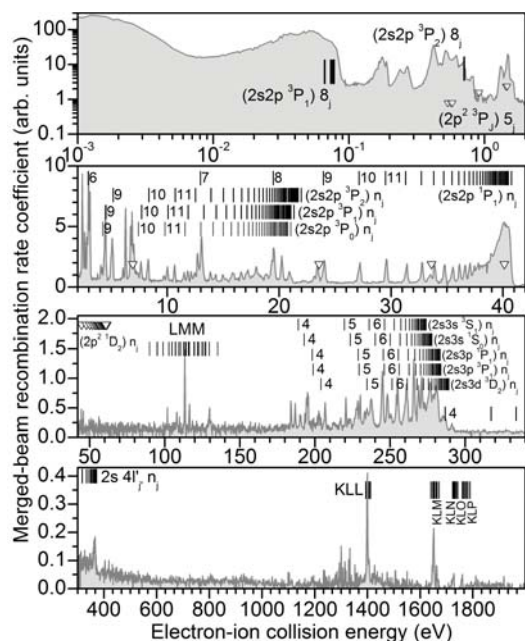
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**Synopsis** Absolute recombination rate coefficients of Be-like  $\text{Si}^{10+}$  have been measured employing the electron-ion merged-beams method at the storage ring TSR. The experimental center-of-mass energy range 0–2000 eV covers dielectronic recombination (DR) resonances associated with K- and L-shell excitations.

Motivated by astrophysical data needs [1], we have measured absolute electron-ion recombination rate coefficients for  $\text{Si}^{10+}$  forming  $\text{Si}^{9+}$ . To this end, an electron-ion merged-beam configuration was used at the heavy-ion storage ring TSR, located at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany.

The rate coefficient was measured for electron-ion collision energies ranging from 0 to 2000 eV and will be compared with previous results published by Orban *et al.* [2] ranging from 0 to 43 eV. Figure 1 shows the measured merged beams rate coefficient and calculated DR resonance positions. For energies below 42 eV, the spectrum is dominated by  $\text{Si}^{10+}(2s^2) + e^- \rightarrow \text{Si}^{9+}(2s2p^2S^{+1}P_J)n_j$  DR resonances. In addition, resonances associated with trielectronic recombination (TR)  $2s^2 + e^- \rightarrow 2p^2 n_j$  [3] are found. For energies between 100 and 300 eV, we observe DR resonances associated with  $2s^2 \rightarrow 2s3l$  excitations. The positions of resonances associated with 2→2 and 2→3 core excitations were estimated from theoretical excitation energies [4] and hydrogenic Rydberg binding energies for the captured electron. For energies above 1400 eV, resonances (labeled KLL, KLM, ... in figure 1) associated with K-shell excitations are observed. The corresponding DR resonance positions were calculated using the Los Alamos atomic physics program package based on the work of Cowan [5].



**Figure 1.** The measured  $\text{Si}^{10+}$  recombination spectrum is displayed as grey shaded curve. Calculated DR and TR resonance positions are represented as black vertical bars and open triangles, respectively.

### References

- [1] S. Schippers 2009 *J. Phys. Conf. Ser.* **163** 012001
- [2] I. Orban *et al.* 2010 *Astrophys. J.* **721** 1603
- [3] M. Schnell *et al.* 2003 *Phys. Rev. Lett.* **91** 043001
- [4] M. S. Safronova *et al.* 1996 *Phys. Rev. A* **53** 4036; 1997 *J. Phys. B* **30** 2375
- [5] R. D. Cowan 1981 *The Theory of Atomic Structure and Spectra* (University of California Press, Berkeley)

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