

§1. Ionization and Recombination Rate Coefficients for H, He, Li, Be, B-like Ions of S, Ca and Fe

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We have reviewed and evaluated the data of ionization and recombination rate coefficients for S, Ca and Fe ions for the analysis of BSC X-ray spectra of Yohkoh satellite..

I. Ionization

No experimental data are available for these ions. Arnaud and Rothenflug¹⁾ evaluated the ionization and recombination rate coefficients for astrophysical elements and gave parametrized formulae. Arnaud and Raymond²⁾ updated the data for Fe ions. They adopted the direct ionization cross sections calculated by Younger³⁾ for Fe XVII - Fe XXVI. Ref.1 pointed out the misprint in the Table 2 of Ref.3 that the coefficients are given in $\pi a_0^2 \text{Ryd}^2$ but not in $10^{14} \text{cm}^2 \text{eV}^2$ as stated. For Li-like ions, they included the contribution of autoionization by Sampson and Gold. Since the energy range of the recent calculations including autoionization is limited, we adopt the data Ref.1 for S and Ca ions, and Ref.2 for Fe ions.

II. Recombination

1) Total radiative recombination t

The data in Ref.1 for S and Ca, Ref.2 for Fe are recommended. The rate coefficients are fitted in the following formula and the coefficients are given.

$$\alpha_r(T) = A(1.16T(\text{eV}))^{(-\alpha-\beta \log_{10}(1.16T(\text{eV})))} \text{cm}^3 \text{s}^{-1} \quad (1)$$

2) Total dielectronic recombination

Recently the detailed theoretical calculation have been made by several authors. Generally the agreement of different theoretical data for H- and He-like ions are very good. The data by Nilsen⁴⁾ and

Romanik⁵⁾ are in good agreements for He-like ions. We adapted to use the data by Ref.4 for H and He-like ions, Ref.5 for Li-, Be-like ions.

We have derived the parameters α_{DR} for H-, He-, Li-, Be- like ions in the following formula.

$$\alpha_{\text{DR}} = (T(\text{eV}))^{-3/2} \sum A_i \exp(-\Delta E_i/T) \quad (2)$$

where T is in eV.

The total dielectronic recombination rate coefficients by several authors are compared in Fig. 1 for S ions as an example. The rate coefficients by Ref.1 for He-like S and Ca ions is about 20% and 10% smaller than those by Ref.4, respectively. However the rate coefficients for Li-like S and Ca ions by Ref.1 based on Jacobs et al. are quite smaller than those by Ref.5 by more than factor of 5 as shown in Fig.1 .

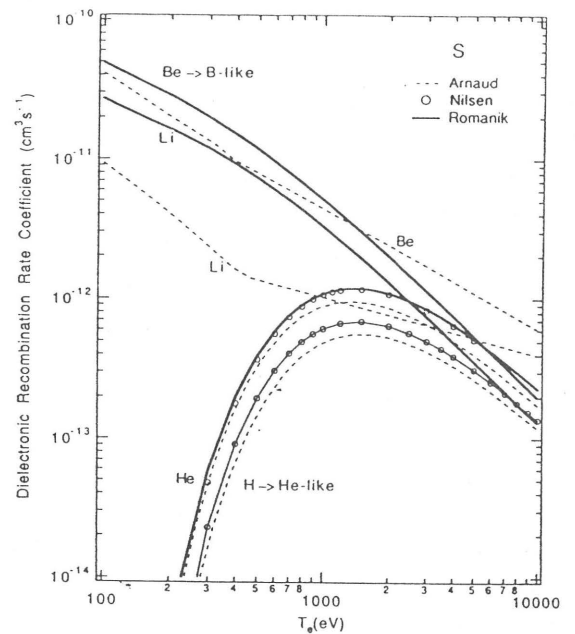


Fig.1 Comparison of the dielectronic recombination rate coefficients for S ions.

References

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