§6. Atomic Data Evaluation and Data Fitting

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Charge transfer process between impurity ions and neutral hydrogen from neutral beam injection (NBI) is used as one of plasma diagnostics tools. Spectrum from the impurity ion after capturing an electron from the neutral hydrogen (charge exchange recombination) is measured and gives us some information, such as abundance of the impurity ion, electron temperature, and etc. In order to derive such information, reliable atomic data which describe the atomic process are required. Data evaluation is quite important to provide good data for plasma diagnostics and modeling.

There were some experiments of pellet injections into plasmas of the LHD and the CHS by Sudo and his group. The tracer encapsulated solid pellets consist of polystyrene shell and solid core. Li is one of the solid elements. Such pellets were used to examine plasma transport. For analyzing spectra from Li ions, state-selective charge transfer cross sections are needed at NBI injection energy and also at low collision energy which is needed to remove background effect in the peripheral region where neutral hydrogen is produced near the wall.

We collected all available data for Li^{3+} + H → $Li^{2+}(nl)$ + H^{+} collision process for wide energy range, stored in the database, CHART[1], and evaluated them. Data assessment was carefully done with checking the calculation methods of data. Evaluated cross sections were fitted with an analytic formula which was proposed by Janev et al. (1993) [2]:

$$\sigma(E) = \frac{a_1 \exp[-(a_2/E)^{a_3}]}{1 + (E/a_4)^{a_5} + (E/a_6)^{a_7} + (E/a_8)^{a_9} + (E/a_{10})^{a_{11}}}$$

Fitting program of the nonlinear least mean square method was developed previously. The results of the fitting are summarized and will be published in NIFS-DATA report. In the report, results of data evaluation for ionization and excitation process for Li^{3+} ion, which is done by collaboration with R.K.Janev and J. Yang, are also included.

[1] NIFS database http://dbshino.nifs.ac.jp/

[2] R. K. Janev, et al., Atomic Data and Nuclear Data Tables, **55**, 201 (1993)

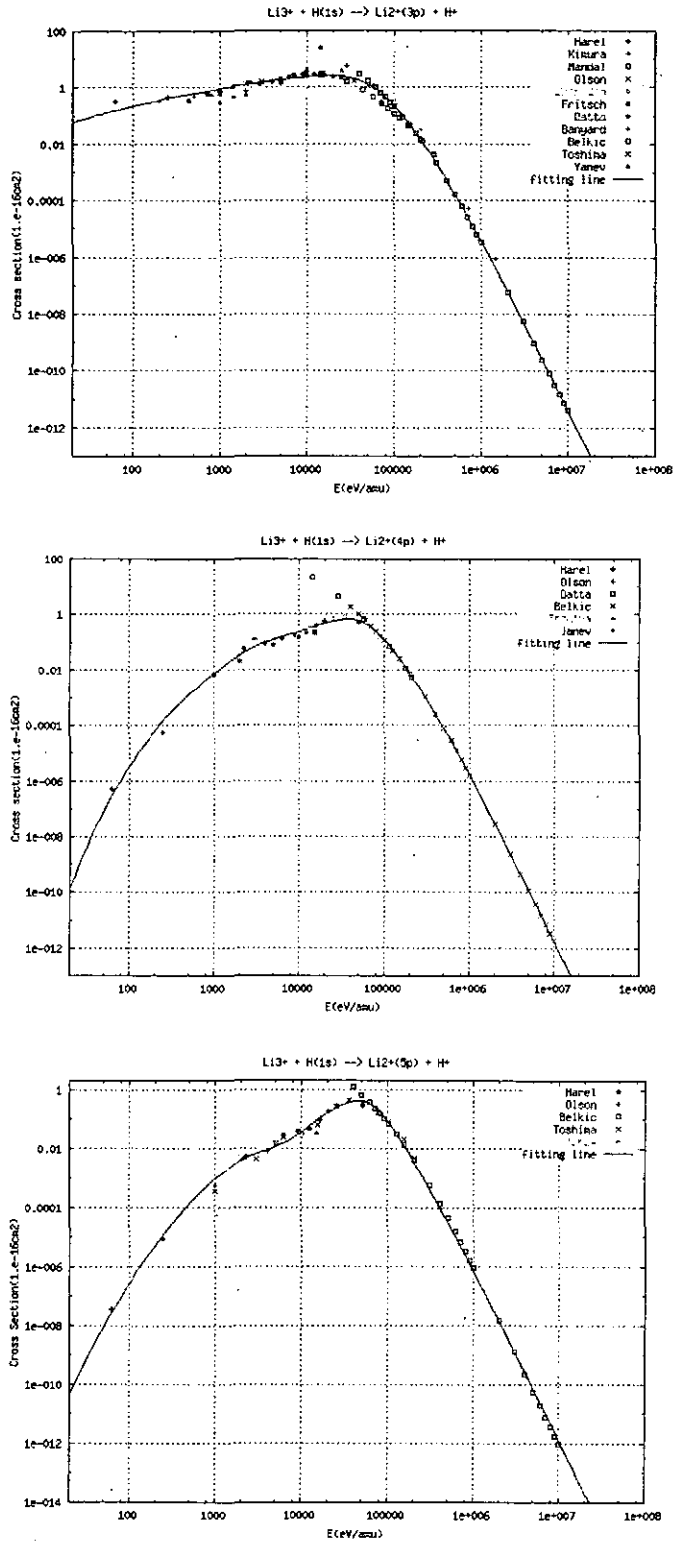

Fig. 1: Cross section for charge transfer process Li^{3+} + H → $Li^{2+}(nl)$+ H^{+} (nl=3p (top), 4p (middle), and 5p (bottom)) as a function of collision energy. Recommended data are shown as solid lines.