

High energy asymptotics of cross sections and multiparametric dependencies in effective data relevant for neutral beam injection

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The possible scope of a new CRP on atomic data relevant for neutral beam injection (NBI) should be to constrain and focus on the data issues to all processes relevant when the beam particles have left the sources, which include beam interacting Maxwellian electrons as penetrating plasma edge. The special attention is needed for cross-sections at high energy regions and asymptotic behaviors. Currently available data sets of some relevant processes such as heavy particle collisions involving He and metastable He are lacking the correct asymptotic behaviors at low and high energies.

It is recommended that underlying raw data of NBI important for ITER project should be publically exposed in a way as unprocessed as possible. Tools for producing multi-parametric beam stopping rates should be considered to be embedded into codes instead of reduced tables. The approximate method of scaling state resolved cross-sections for heavy particle data from electron impact data should be examined for its validity. It is important to benchmark collisional-radiative codes for NBI processes and the series of non-LTE kinetics workshops offer a good example. Sensitivity studies of 1D (time or 1 spatial coordinate) should be analytically possible as demonstrated by HYDKIN sensitivity module. For charge exchange process between diagnostic neutral beam of 100 keV (~ 1.5 MW) and impurities (C, Be, W, He, N, Ne, Ar) in ITER, it is necessary to identify W lines that are near the CX lines of interest.

3. Conclusions and Recommendations

The main outcome of this CM was a recommendation to proceed with a CRP with the focussed goal to provide comprehensive evaluated and recommended data for atomic processes of heating and diagnostic neutral beams of hydrogen (including the deuterium isotope) in fusion plasma. In part this is a data development activity and in part it asks for evaluation of existing data or of data that can be easily generated. The CM also advised about some topics in the vicinity of the main goal.

- Data for excitation and emission from neutral beam; BES (Beam Emission Spectroscopy), MSE (Motional Stark Emission)
- Data for CXRS (Charge Exchange Recombination Spectroscopy)
- High energy processes in the beam box
- Helium beams or helium gas injection
- Modelling
- Code comparison exercise on beam transmission and beam emission

It was recommended that low energy processes relevant for generation of the positively or negatively charged precursor beam should be outside the scope of the new CRP, as there is not much synergy between study of these low energy processes and study of the processes in the main plasma. It was also recommended that high energy collision processes in the beam neutralizer should be admitted in the scope of the CRP, but without requiring complete coverage. (The reason to de-emphasize study of these processes is that the design and operation of the neutralizer is likely to be driven by technology considerations without a critical role for detailed atomic data.) Concerning neutral beams of other elements, the CM advised to include data for processes of neutral beams of helium and lithium in the scope of the CRP, because in many cases similar methods are used and the same people are doing relevant work. However, the CRP would not set a goal to provide comprehensive data for elements other than hydrogen.

It was recommended that the CRP should provide data in as unprocessed a form as is reasonable in order to allow detailed kinetic modelling and to allow the development of applicable collisional-radiative models. Thus, for any collision process the CRP should provide density matrix elements or