

Neutral Beam Penetration and Photoemission Benchmark

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The benchmark was carried out in the scope of the IAEA Coordinated Research Project F43023 on Data for Atomic Processes of Neutral Beams in Fusion Plasma [1]. In the course of the benchmark, beam attenuation and beam emissivity (where applicable) were compared for the participating codes (RENATE, RENATE-OD, BBNBI, FIDASIM, SOS, CHERAB, CRM by O. Marchuk). These codes apply different level of detail and methodology to solve the governing rate equations.

Test cases were designed to evaluate the performance of underlying collisional radiative models with various constant plasma profiles. Emphasis was placed on the handling the isotope effects of the main plasma ions as well as handling a large variety of fusion plasma relevant impurities (He, Be, C, Ne, W). A small number of realistic plasma profiles were also considered, to evaluate the performance of the codes applied to different density gradient scenarios. The study focused on a wide energy range of beams of hydrogen isotopes.

We found that while all participating codes agreed in general trends, some differences exist that can be attributed to modelling details or different atomic data sources. The effect of modelling details was analysed and was compared to the effects of the uncertainties in the underlying atomic data. In most cases, uncertainties in the cross-sections of the atomic physics processes were found to be the leading cause of modelling inaccuracies, which stresses the importance of regular reviews of the relevant cross-section databases.

[1] IAEA: <https://www-amdis.iaea.org/CRP/NeutralBeams/>