Atomic data for beams – for modelling the beam and its diagnostic capabilities

Hydrogen (H/D/T) beams

Current status:

- many codes in use for modelling beam stopping and emission.
- well established CXRS analysis on plasma impurities (for light elements).
- all draw from similar database of fundamental processes.
- primarily n-resolved for beam model.
- nl-resolved for the CX model.

- MSE spectral feature interpretation requires nlm cross sections.
- These are not readily available.

- Data in use may not be the latest. Does this mean that it is incorrect?
- No routine use of data uncertainty in the fundamental data.
- Building experience with high-Z CXRS – models and observations.

- work on synthetic diagnostics is addressing the complications of halo, plume, overlapping features from multiple beams and geometry effects.

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Hydrogen (H/D/T) beams – data needs in 10keV – 1MeV energy range

Processes in model:

- atomic structure and A-values: known to very high precision.
- electron impact ionisation from n=1: data is good but not a significant process.
- ion impact ionisation from n=1
  - the principal process in stopping.
  - recent publications show progress in refining the cross section
  - a recommended cross section with error bars is a priority.
- electron impact excitation (between n=1-5): good data but not a significant process.
- ion impact excitation data (between n=1-5).
  - could be better and recommended data is essential.
- ion impact ionisation from excited levels
  - very poorly known from n=2,3,4,5 (observable from BES)
  - recommended data for these processes is essential.
- ion and electron impact excitation data between high-n levels

- Ion impact collidors required are protons, He^{2+}, Be^{4+}, C^{6+}, Ne^{10+} , Ar^{18+} and Z^{z+}

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Charge exchange recombination spectroscopy and MSE:

- MSE spectral feature modelling to complement/replace polarization methods
  - nlm cross sections with density matrix elements for 2s, $2p_0$, $2p_1$
  - No easily available data for these exists but the capability for producing it is in the codes.

- CXRS/CHERS required nl partial cross sections.
- Review of existing light elements (He, Li, Be, C, N, Ne, Ar) to identify any gaps in coverage or precision.
- High-Z CX, ie tungsten, is almost a new field of study. Need to assess the data, the models and the observations.

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Lithium and sodium beams – data needs in 50keV energy range

Processes in model:

- atomic structure and A-values: known to very high precision.
- electron process are more important than for H beams.
- High n contributions are also less significant.
- Ion impact collidors required are protons, He^{2+}, Be^{4+}, C^{6+}, Ne^{10+} , Ar^{18+} and Z^{z+}