

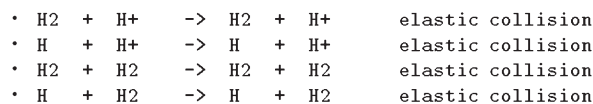
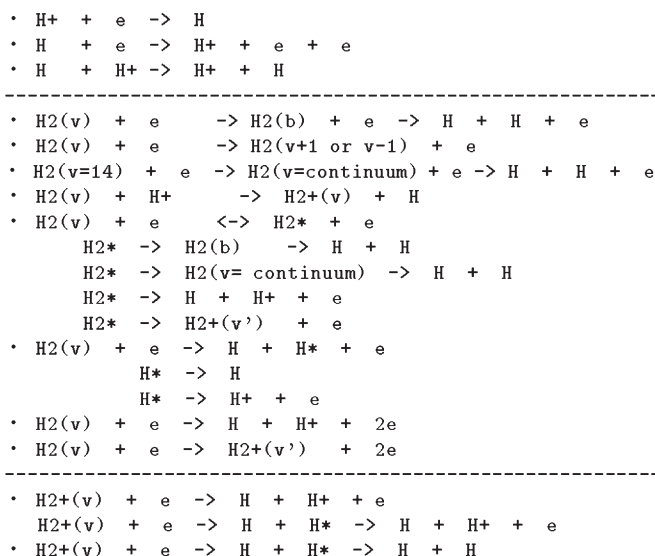
§18. Self-Consistent Computation of Radiation Transfer in Edge Plasmas Based on Collisional Radiative Model and Neutral Transport Model

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In divertor plasmas, radiation trapping is sometimes quite substantial. In applying the standard collisional-radiative model to such plasmas, we must properly include the effect of radiation trapping.

We have developed an iterative method which is based on the following algorithm: **(1)** Divide space into cubic cells of linear dimension Δl . **(2)** Give the ground state atom density $n(1)$, the ion density n_{H^+} , the electron density n_e , the electron temperature T_e , and the line profile function $g_{pq}(\nu)$ for the transition from upper level p to lower level q for each cell. Set the frequency interval $\Delta\nu$ for the following calculation of emission and absorption. **(3)** Compute the population distribution of excited levels for each cell using the ordinal optically thin collisional-radiative model assuming no radiation trapping. **(4)** Compute the emission intensity radiated in each cell and the absorption in other cells using the population distributions obtained in step (3). **(5)** Compute the population distributions for each cell using the collisional-radiative model considering the absorption of photons. **(6)** Compute the emission intensity radiated in each cell and the absorption in other cells using the population distributions obtained in step (5). **(7)** Repeat steps (5)-(6). This iterative process is continued until the above values converge.

In order to calculate $n(1)$ and the Doppler profile $g_{pq}(\nu)$, we have constructed a neutral transport code for hydrogen species which includes the following list of atomic and molecular processes.



We have applied our code to a RF cylindrical plasma ($P_{rf} \leq 2.0\text{kW}$, $f = 13.56\text{MHz}$) at Shinshu university. The gas pressure was 0.005Torr . Figure 1 shows calculated densities of atom and molecule, and atom temperature.

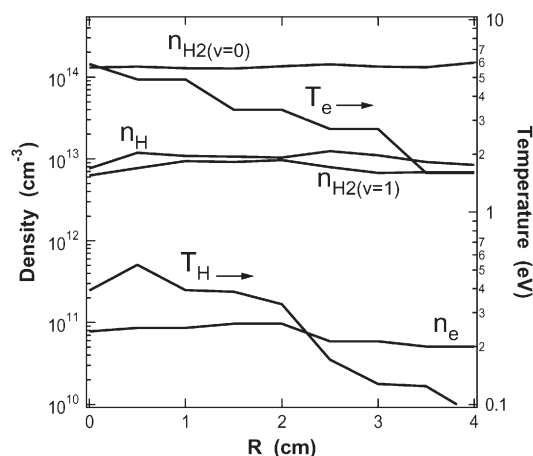


Fig.1. Calculated densities of atom and molecule, and atom temperature. Electron density and temperature measured by a double probe are also shown.

Figure 2 shows calculated populations of excited atom of the principal quantum number $n = 3$. Figure 2 also shows populations determined from measured intensities of the Balmer α . The calculated values agree precisely with the measured ones.

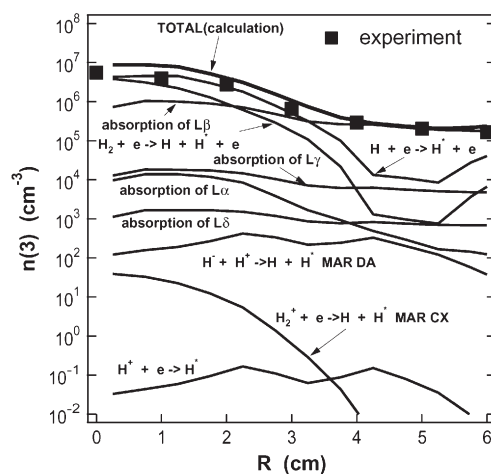


Fig.2. Calculated and measured populations of excited atom of the principal quantum number $n = 3$. The origins of the calculated populations of the excited atom are also shown.