Title

D- Formation by Charge-Transfer Collisions of 0.3 to 10-keV Deuterium Ions and Atoms in Cesium, Rubidium, and Sodium Vapors

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Abstract

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D^- FORMATION BY CHARGE-TRANSFER COLLISIONS OF 0.3 TO 10-keV DEUTERIUM IONS AND ATOMS IN CESIUM, RUBIDIUM, AND SODIUM VAPORS

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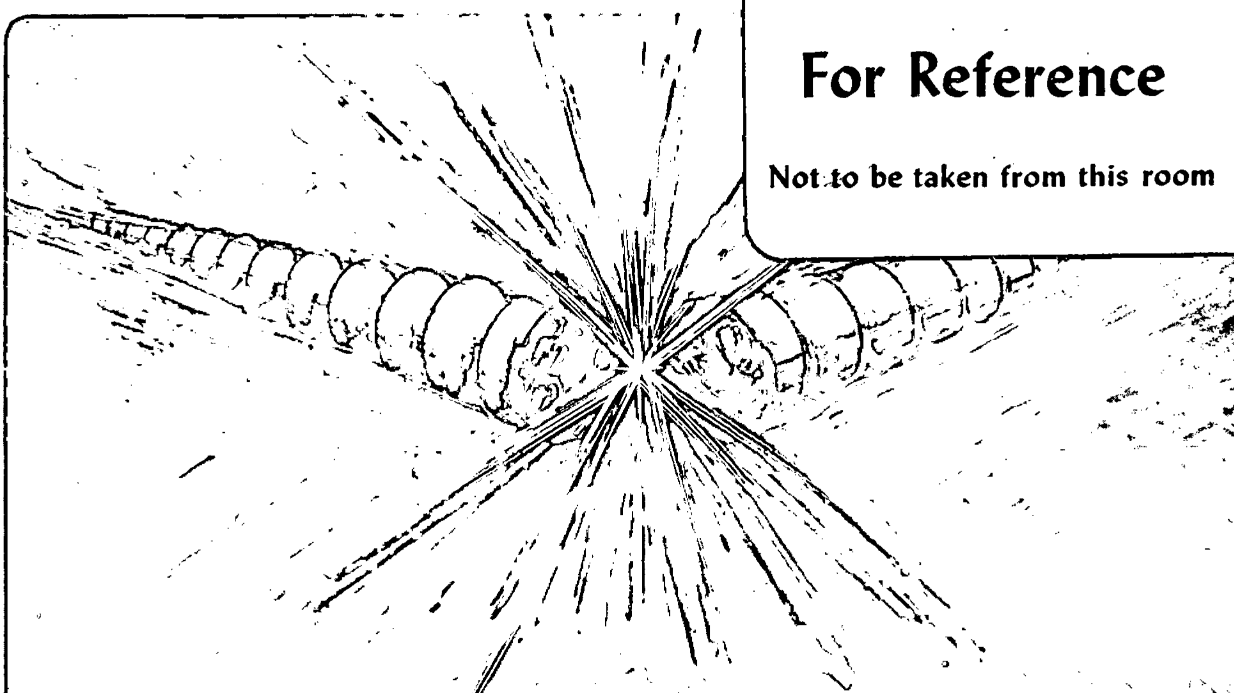
June 1979



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DISCLAIMER

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D^- formation by charge-transfer collisions of D^+ in a metal-vapor target is interesting both as a basic atomic-collision study and as a promising means of providing intense D^o atom beams at high energies for plasma heating and fueling. Alkali metals are often used as the target because of their high D^+ to D^- conversion efficiencies.[1] The thick-target D^- yield (equilibrium yield or F_-^{∞}) for Cs vapor has been previously reported[2]. We report here cross sections for electron capture by D^o and electron loss from D^- in collision with Cs vapor, as well as the D^- equilibrium yield in Cs, Rb, and Na vapors. Our results are in the D energy range 0.3-10 keV.

The equilibrium yield, F_-^{∞}, was measured by passing a momentum-analyzed beam of D^+ through a recirculating metal-vapor (heat-pipe) target. The beam after the target is analyzed in a transverse electric field; D^+ and D^- are measured with magnetically suppressed Faraday cups, D^o is measured with a pyroelectric detector. Our results for F_-^{∞} in Cs, Rb, and Na vapors are shown in Fig. 1. Also shown are our previous results for Mg and Sr vapors[1].

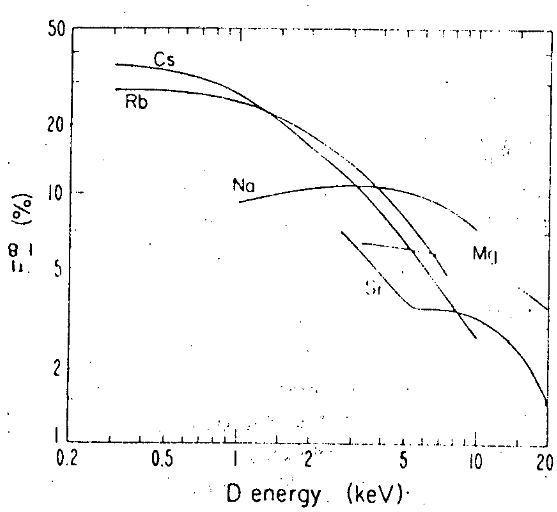

Fig. 1. Equilibrium yield F_-^{∞} for deuterium after passage through thick targets of cesium, rubidium, sodium, magnesium, or strontium vapor. (All results are by the present authors.) Maximum uncertainties are ±10%.

The cross sections σ_{0-} and σ_{-0} were measured in cesium vapor using the same apparatus. For σ_{-0} we used a D^- beam from a duoplasmatron source; for σ_{0-} we stripped D^- in Ar. Results are shown in Fig. 2. The ratio of σ_{0-} to the sum of σ_{0-} and σ_{-0} should give F_-^∞ in the 2-state approximation[1] (assuming ground-state D^0). Our results for σ_{0-} and σ_{-0} give a ratio which is consistent with our F_-^∞ measurements.

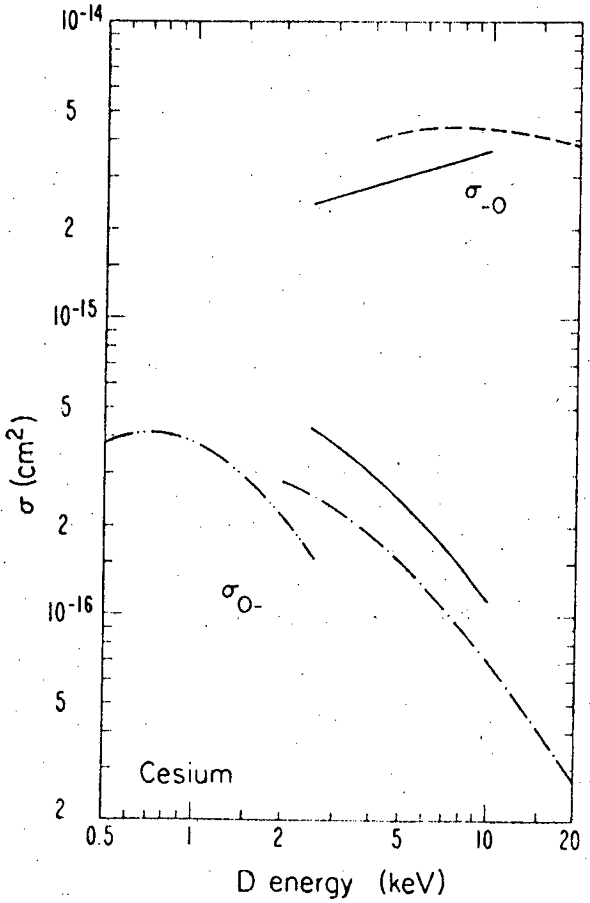

Fig. 2. Charge transfer cross sections for $D^0 \rightarrow D^-$ (σ_{0-}) and for $D^- \rightarrow D^0$ (σ_{-0}) in cesium vapor. Solid line, present results (absolute uncertainty 35%); dashed line, ref. 3 (renormalized upward by a factor of 2 from published values); dot-dashed line, ref. 4; 2-dot-dashed line, ref. 5.

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