NARROW RESONANCES IN DISSOCIATIVE ELECTRON ATTACHMENT AND VIBRATIONAL EXCITATION IN H_2

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H_2^- is the most fundamental and simple molecular anion imaginable. It has long been believed to be a very short-lived, with the life-time of the order of fempto-seconds. However, it is established as an important transient species responsible for high inelastic cross sections in electron-H_2 and in H^-+H scattering (see for example a recent review [1] and references therein).

Recently we noticed [1] that narrow shape resonances found in H^-+H cross sections [2] have its counterpart also in electron H_2 scattering. Subsequent analysis has shown [3], that the highly rotating H_2^- molecule can support states with the life-time of the order of microseconds. Preliminary values of the parameters for these rotationally-stabilised states are shown in Table 1.

H_2^- resonances			D_2^- resonances		
J	$E_{\rm res}$	τ	J	$E_{\rm res}$	τ
21	-136	2.4 ps	31	-118	0.13 ns
22	-105	12 ps	32	-97	0.70 ns
23	-75	0.11 ns	33	-76	6 ns
24	-47	0.9 ns	34	-55	39 ns
25	-20	12 ns	35	-35	0.51 μs
26	5	0.52 μs	36	-16	5.7 μs
27	28	2 ns	37	2	14 μs
			38	19	7.2 μs
			39	34	41 ps

Tab. 1. Parameters of the lowest long-lived resonance for each rotational quantum number J. Energies (relative to H^-+H dissociation threshold) are given in meV.

The existence of the molecular hydrogen anions has also been confirmed experimentally [4] by producing these species by sputtering of TiH_2 and TiD_2 targets with Cs^+ ions. The H_2^- were identified by subsequent accelerator mass spectrometry.

In this progress report I will review the most recent theoretical work within the framework of nonlocal resonance theory [5] on the properties of these states. I will also try to analyse possible paths for creation and destruction of the states in gas phase.

References

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