Photodissociation dynamics of H_2 along the Feshbach resonance: angular-resolved line profile and anisotropy parameter profile

Yuxiang Mo
[1]E-mail ymo@mail.tsinghua.edu.cn
[2] Department of Physics, Tsinghua University, Beijing 100084, China

The Fano profiles usually refer to the line profiles due to the total photon absorption cross sections. We have measured the angle-resolved line profiles of the D(2*s*, 2*p*) fragments from the predissociation of D_2 near the second threshold using the D-atom Rydberg tagging time-of-flight method. The line profiles of the fragments recoiling at the parallel and perpendicular directions to the polarization direction of the excitation laser were found to be significantly different with each other, as well as with the Fano profiles of total absorption cross sections. Based on the previous theoretical results, we found that the angle-resolved line profiles can be expressed as a summation of Fano and Lorentzian profiles. Using the formula and the previously determined parameters from the so-called β-profiles, we calculated the angle-resolved line profiles, which are found to be in good agreement with the experimental data.

The anisotropy parameters (β) of photofragments near a Fano resonance vary with the excitation energies. We call the curve describing such a relationship as a β-profile. We reported measurements of the β-profiles for the H(2*l*) and D(2*l*) fragments along several Fano resonances in the predissociation of H_2 and D_2 near the second dissociation threshold. The measured β-profiles are found to be asymmetric. An analytical expression of the β-profile was derived based on the Fano formula, and was used to fit the measured β-profiles. The β-profiles were found to be more sensitive than the Fano profiles to the Fano q-parameters, as well as to the intensity ratios between the interacting and noninteracting continuum states. The β values due to the resonance state, the continuum state and the interference between the resonance and the continuum states in the Fano resonance were also determined. The β-profile would not only provide us with a new tool to measure the parameters characterizing the Fano resonance, but also to gain an invaluable physical insight into the Fano resonances.

References:

1 J. Wang and Y. Mo, "Asymmetry profiles of the fragment anisotropy parameters along the Fano resonances in the photodissociation of H_2", Phys. Rev. A 102, 050803(R), (2020).

2. J. Wang and Y. Mo, Angle-resolved line profiles in the predissociation of D2: A summation of Fano and Lorentzian profiles, Phys. Rev. A **105**, 023102(2022).