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Seminário

"Isotope effect in cross sections of NX_3 molecules (X = H and D) by low energy electron impact"

28 de Junho de 2022, 14:00-15:00 anfiteatro da Biblioteca

60 min. including question and answer session (45 min. talk)

Abstract.

A few groups have reported the isotope effect observed in the electron collision cross sections with several molecules upon exchanging hydrogen for deuterium (H→D). To our knowledge, however, there has not been a more detailed discussion nor a quantitative measurement on the isotope effect that appears in the cross sections, because the electron interactions with atoms and molecules are often approximated by the mass-independent single center potential. Therefore, our first motivation in the present study is to verify the isotope effect in the electron scattering processes quantitatively. We measured absolute cross sections for elastic scatterings, vibrational excitations and dissociative electron attachments of NX3 molecules (X = H and D) in lower impact energy region.

The conventional electron spectrometer was used to measure the elastic and vibrational cross sections in the electron energy range between 1.5 eV and 15 eV, whereas a newly developed mass spectrometry technique was employed to observe negative ions formed via the dissociative electron attachment processes.

In the present study, no isotope effect was observed for the elastic scattering. This result could reflect the prediction based on the mass-independent single-center potential due to the Coulomb interaction. In contrast, some differences were clearly observed in the vibrational and dissociative electron attachment cross sections of deuterium ND3 comparing with NH3 molecules of around 10 eV where is known as the shape resonance region. This result suggested that at the resonant state in which the temporary negative ion is formed by trapping the incident electron, its lifetime becomes much longer than the typical interacting time of direct scattering, so that the nuclear motion cannot be ignored.