Unexpected transparency in the scattering of fragile ^{6}Li and ^{6}He

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We have studied ^{6}Li + ^{12}C elastic scattering angular distributions for incident energies ranging from a few MeV to 318 MeV in the optical model. It is found that this fragile projectile is found to display a surprising transparency in the scattering inspite of the important breakup effects. We decomposed the scattering amplitude into the internal wave, which penetrates deep into the internal region of the potential, and the barrier wave reflected at the barrier. It is shown that a substantial part of the internal waves re-emerges in the elastic channel, and typical refractive effects, like Airy minima, which are well known in α particle scattering from ^{40}Ca [1] and ^{16}O+^{16}O scattering [2] where absorption is moderate, are clearly identified in the angular distributions.

It is also shown that the Airy structure persists in inelastic scattering of ^{12}C(^{6}Li,^{6}Li')^{12}C. The existence of the Airy structure has been recently confirmed typically in inelastic scattering from ^{40}Ca [3,4]. Coupled channel calculations were performed for ^{12}C(^{6}Li,^{6}Li')^{12}C*(J$^\pi = 2^+$, E$_x = 4.44$ MeV) inelastic scattering and it is found that angular distributions extending on the whole angular range confirm the existence of an important internal-wave contribution in the backward hemisphere.

A similar transparency is observed in other systems of this mass region, like ^{7}Li + ^{12}C or ^{6}Li + ^{16}O.

We have also investigated the angular distribution of elastic ^{6}He + ^{12}C scattering data at 18 MeV [5]. Our potential obtained in the analysis of ^{6}Li + ^{12}C scattering can reproduce the observed angular distribution which extends up to $\theta_{c.m.} \simeq 85^\circ$, which may suugest that transparecy may persist in this system. It is highly desired to measure the angular distribution beyond this angle, which could ascertain whether some transparency persists in the scattering of ^{6}He.

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