STUDIES OF VALIDITY OF QUASICLASSICAL APPROACH TO THREE-BODY DECAYS

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Conventional method of width determination for resonant states, such as elastic phase shift energy dependence, or via *S*-matrix pole position in the complex energy plane could be technically complicated for very small widths $\Gamma \ll E$. Therefore studies of radioactive decays require specific methods for the decay width determination. Among them are "natural" width definition via WF with pure outgoing asymptotics [1], Kadmensky type integral formulas [2], and quasi-classical approach of Gamow type [3].

Use of quasi-classical approach of Gamow type for the decay width evaluation $\Gamma \sim exp\left[-\int_{r_1}^{r_2} p\, dr\right]$; requires reduction of few-body problem to a single-channel formalism of some form, where Gamow integral over the sub-barrier trajectory $\{r_1; r_2\}$ can be defined. Here both the validity of the few-body problem reduction and the applicability of the quasiclassical approximation for barriers of specific shape can be questioned.

Formalism of the Gamow type has been repeatedly used in the recent years for determination of three-body decay widths (e.g. [3,4]). We examine the validity of this approximation by example of the width of the first excited $3/2^-$ state of ^{17}Ne, which is known to decay via so-called "true" two-proton decay mechanism. The width of this state is important for determination of the astrophysical capture rate for $^{15}O + p + p \rightarrow {}^{17}Ne + \gamma$ reaction [5]. Theoretical calculations of this width so far have produced considerable controversy [2–4, 6]. Recently this issue was revisited experimentally [7] providing improved limits for the width value and looking for realistic methods to further improve measurements of this quantity. This activity also urges improved theoretical treatment of the case.

Our results question validity of the widths obtained in [4].

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