# Barrier Distributions from Fusion and Quasielastic Reactions: Some Puzzles, Questions and Answers

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Fusion is one of the most important classes of near-barrier reactions. There is a clear link between nuclear reaction mechanism and the structure of the interacting nuclei. For instance, strong enhancement of fusion cross-sections at sub-barrier energies can be understood as the result of coupling between various reaction channels: elastic and inelastic scattering, transfer reactions, break-up and fusion. This couplings give rise the Coulomb barrier height distributions [1].

The barrier distributions can be extracted both from the fusion excitation functions ($D_{fus)}$ and from the sum of the cross-sections of all quasielastic reactions ($D_{qe}$). The Coupled Channels method (CC) is often able to describe well the shape of the barrier distribution, there exist, however, some number of open questions which were addressed in series of our experiments.

We have chosen the $^{20}$Ne projectile because of its enormous ground state deformations ($\beta_2 = 0.46$ and $\beta_4 = 0.27$) that lead, according to CC calculations, to strongly structured barrier distribution. Surprisingly, the predicted structures were visible only for a few targets [2]. In our most recent experiments we have used $^{20}$Ne beam on various targets ($^{nat}$Ni, $^{90,92}$Zr, $^{118}$Sn, $^{208}$Pb) to address the following questions:

- Is the structure smoothing of barrier distribution caused by weak channels, which usually are not explicitly taken into account in the CC calculations?
- If yes - which of these weak channels are most relevant for smoothing?
- To what extent the $D_{fus}$ and $D_{qe}$ distributions are similar to each other?
- To what extent the $D_{qe}$ are independent of the scattering angle?

The first, preliminary answers to these questions will be given in the presentation.

[1] M.Dasgupta *et al*., Annu.Rev.Nucl.Part.Sci **42** (1998) 447.
[2] E. Piasecki *et al*., Phys. Lett. **B 615** (2005) 55