About enhancement of nuclear reactions in plasmas - changing the Coulomb barrier by quantum effects

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The possible enhancement of nuclear reactions, e.g. proton-deuteron plasmas belong since the work of Gamow to the crucial problems of plasma physics. The late Andrey Starostin developed with coworkers the idea, that changes of the momentum distributions by quantum effects may supprt the rate of fusion reactions. Here we work out this idea by studying quantum effects influencing transitions over the Coulomb barrier. Our appoach is based on the theory of twoparticel density operators of quantum plasmas developed by Kelbg and Klimontovich. Studying the exact solutions in first order perturbation theory we show the existence of quantum effects which modify the distributions in space and momenta. We use the fact, that Kelbgs work as well as the Klimontovich theory are valid for any interaction potential having a Fourier transform. Contructing a model which includes Coulomb forces and nuclear forces we use the density operators for studying how to penetration through the Coulomb barrier may be enhanced. Our results show that there exist quantum effects pointing to the direction of reaction enhancement.

Figure 1. The schema shows the nuclear potential bottom and the Coulomb barrier and that effects depressing the Coulomb barrier may help to enhance transitions.

