Temperature dependence of nuclear fission time in heavy-ion fusion-fission reactions [Phys. Rev. C 96, 054611 (2017)]

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In the preceding comment, Gontchar and Chusnyakova (GC) [1] point out that our previous contribution Ref. [2] contains misleading statements. Although there were indeed some wording issues and some typos in our article (which have been corrected in [3]), our article is technically valid and presents a fully analytical amendment of Kramers' formula for nuclear fission which solves the long-standing problem of applicability of Kramers' approach, in closed form expressions, to nuclear fission at high excitation energies.

The preceding Comment by GC addresses the mean-first passage time (MFP) expression,

$$\tau_f = (T/\eta) \int_{q_0}^{q_s} dy \exp\left(\frac{U(y)}{T}\right) \int_{q_0}^{y} dz \exp\left(-\frac{U(z)}{T}\right), \tag{1}$$

which is Eq. (3) in our article Ref. [2]. Here, η is the nuclear friction, T is the nuclear temperature, q_0 is the deformation coordinate relative to the undeformed compound nucleus (minimum of the well), q_s is the saddle point at the fission barrier along the deformation coordinate, and U is the fission energy landscape.

In our article it was stated that this equation has not been used before to analyse the breakdown of the Kramers' formula for the dependence of fission time on nuclear temperature (Ref. [6], which contains a similar formula, was mentioned earlier in our article [2] in the context of the Langevin dynamics and inertia and friction parameters). GC point out that this equation has been used, in a slightly different form, also in Ref. [4] and earlier in Ref. [7]. We apologise for having missed those relevant references and we do acknowledge that the MFP approach in the integral form of Eq. (1) above has been used before to model nuclear fission, namely in Ref. [4] and also in Ref. [5].

The MFP approach is a standard tool in stochastic physics, and its application to nuclear fission goes back to the 1980's [8]. In all references that pre-date ERGZ [2], the MFP is used in integral form, which requires numerical evaluation of integrals in Eq. (1) above. The main contribution of Ref. [2] is the derivation of a closed-form fully analytical version of the MFP formula (Eq. (6) in Ref. [2]), which remains valid at high excitation energies, and its successful benchmarking against fission lifetimes based on/adjusted to experimental information.

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