Maxwell's demon on the nuclear level[1]

We have discovered that two warm nuclei set in contact behave in a very counterintuitive way. Heat keeps flowing from the warmer to the colder nucleus until the thermal energy of the warmer nucleus is completely exhausted. In contrast, all other objects in nature reach thermal equilibrium before complete thermal energy sorting is achieved.

Maxwell pointed out that energy sorting of gas molecules would violate the Second Law of thermodynamics. He imagined a demon that sorted molecules according to their speeds by opening and closing a trap door between two compartments of a chamber containing gas.

In our paper we demonstrate that Maxwell's demon manifests itself in nuclear fission in the mass dependent neutron yields. Energy sorting explains why an increase of excitation energy is translated into an increase of the number of emitted neutrons from the heavy fission fragment, only. This observation already made in the 1960s remained unexplained up to now. However, our article shows that energy sorting at the nuclear level increases entropy and, thus, it does not violate the Second Law of thermodynamics.

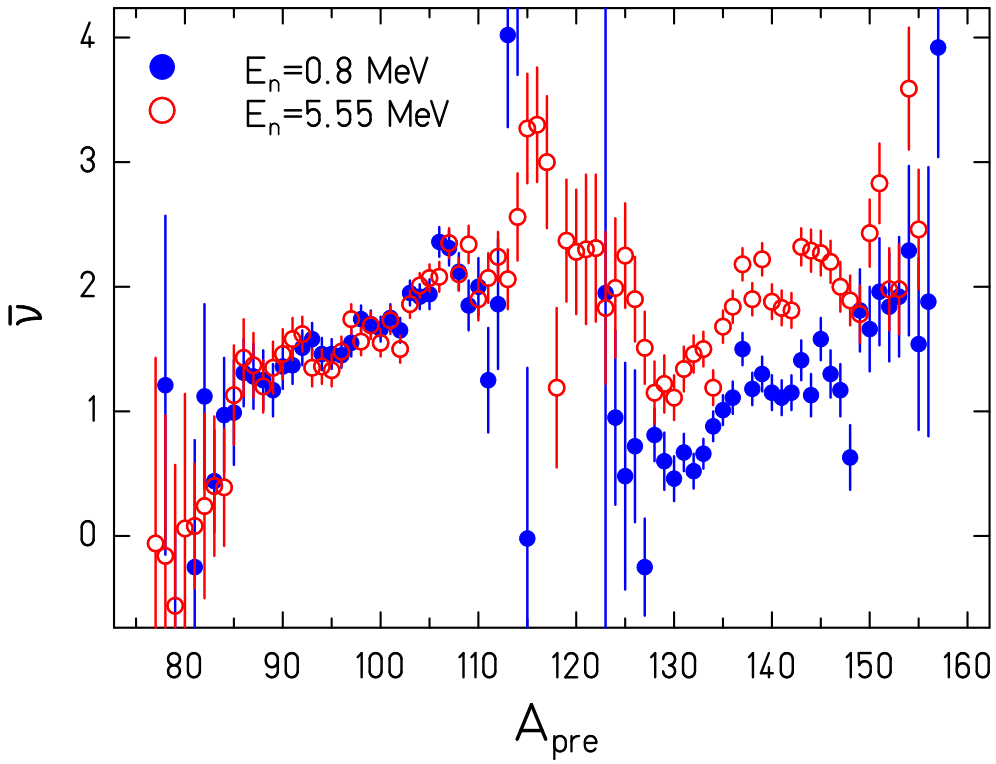

Figure 1 : Average number of prompt neutrons as a function of the primary fragment mass (before neutron emission) for the neutron-induced fission of 237Np at two incident neutron energies, data taken from Ref. [A. A. Naqvi, F. Käppeller, F. Dickmann, R. Müller, Phys. Rev. C 34, 218 (1986)]. The data reveal that in asymmetric fission ($90<A_{light}<108$ and $130<A_{heavy}<148$) all the additional energy of the incident neutron appears in the heavy fragment.

[1] Spotlight to the article "Entropy driven excitation energy sorting in superfluid fission dynamics" by K.-H. Schmidt and B. Jurado, accepted for publication in Phys. Rev. Lett.