with measurements? Will the calculated fission barriers be in disastrous disagreement with measurements, as seemed to be the case in [21]? As described in Section 8, the sizes of the proton charge distributions are just fine when the optimum radius constant $r_0 = 1.14$ is used. To calculate fission barriers is much more difficult, because one needs to solve the Thomas-Fermi equations for shapes devoid of spherical symmetry.

12. Fission barriers

We solved the Euler-Lagrange equations on a three-dimensional lattice, without parameterizing the density distributions, as illustrated in Fig. 8 taken from [21]. This is a really tough proposition because even a fast computer runs out of steam when the lattice spacing is less than about 0.5 fm. This is of the order of the range of the effective interaction, and therefore not good enough for the required precision if straightforward numerical integrations are used. It is only after we applied special tricks to get solutions accurate to a fraction of an MeV (typically out of a thousand or so) that we could calculate saddle-point shapes and fission barriers despite the coarse grid. Three such saddle shapes are shown in Fig. 9. Figure 10 illustrates the calculation of a number of fission barriers, using the parameter set of [21]. Each point represents the energy of self-consistently iterated shapes, constrained to have a pre-assigned separation between the centers of mass of their two halves. Figure 11 shows a recent comparison of calculated and measured barriers (corrected for ground state shell effects) for 36 nuclei. In the region of the very heavy elements the agreement with measurements is perfect, with a slight overestimate in the lighter region. Figure 12 shows the calculations extended down to very light systems. For these nuclei unambiguous fission barrier measurements are difficult and, before making comparisons with measurements, one ought to allow for the virtual doubling of the Wigner term [27], as well as for the emergence of fragment shell and pairing effects in the severely necked-in saddle shapes in question.