Abstract

We study quantum effects on moduli dynamics arising from the production of particles which are light at special points in moduli space. The resulting forces trap the moduli at these points, which often exhibit enhanced symmetry. Moduli trapping occurs in time-dependent quantum field theory, as well as in systems of moving D-branes, where it leads the branes to combine into stacks. Trapping also occurs in an expanding universe, though the range over which the moduli can roll is limited by Hubble friction. We observe that a scalar field trapped on a steep potential can induce a stage of acceleration of the universe, which we call trapped inflation. Moduli trapping ameliorates the cosmological moduli problem and may affect vacuum selection. In particular, rolling moduli are most powerfully attracted to the points with the largest number of light particles, which are often the points of greatest symmetry. Given suitable assumptions about the dynamics of the very early universe, this effect might help to explain why among the plethora of possible vacuum states of string theory, we appear to live in one with a large number of light particles and (spontaneously broken) symmetries. In other words, some of the surprising properties of our world might arise not through pure chance or miraculous cancellations, but through a natural selection mechanism during dynamical evolution.