The Fate of Magnetic Monopoles in the Early Universe

The standard model of particle physics is a good approximation for lower energy scales. In the early hot universe, however, it is assumed that there was a so-called grand unified theory, which unifies the three fundamental forces of particle physics: the electromagnetic, the weak, and the strong force. However, all attempts to unify these three forces lead to a possible overabundance of 't Hooft-Polyakov magnetic monopoles.

But why magnetic monopoles haven't been observed so far? In my presentation, I will discuss the so-called magnetic monopole problem and present two solutions for this in more detail. First, I will present our numerical study on monopole interactions with domain walls. We observe that the collision leads to the erasure of the magnetic monopoles and thus may solve the monopole problem (Dvali, Liu, and Vachaspati 1997).

Second, I will present monopoles connected by cosmic strings (Langacker, Pi 1980). The strings pull the monopoles together until they collide an annihilate. Here, I will particularly focus on the “slingshot effect” that describes monopoles traversing the boundary between Coulomb and confining phases. This passage causes the gauge field to be confined in a cosmic string connected to the domain wall separating the two phases.

These two phenomena, relevant in the early universe, could leave observable imprints such as gravitational radiation.