1.12: Extraterrestrial Particle Physics

One of the problems is that it is difficult to see how e can actually build a microscope that can look a a small enough scale, i.e., how we can build an accelerator that will be able to accelerate particles to high enough energies? The answer is simple – and has been more or less the same through the years: Look at the cosmos. Processes on an astrophysical scale can have amazing energies.

Balloon experiments

One of the most used techniques is to use balloons to send up some instrumentation. Once the atmosphere is no longer the perturbing factor it normally is, one can then try to detect interesting physics. A problem is the relatively limited payload that can be carried by a balloon.

Ground based systems

These days people concentrate on those rare, extremely high energy processes (of about 10^{29} eV), where the effect of the atmosphere actually help detection. The trick is to look at showers of (lower-energy) particles created when such a high-energy particle travels through the earth's atmosphere.

Dark matter

One of the interesting cosmological questions is whether we live in an open or closed universe. From various measurements we seem to get conflicting indications about the mass density of (parts of) the universe. It seems that the ration of luminous to non-luminous matter is rather small. Where is all that "dark mass": Mini-Jupiter's, small planetoids, dust, or new particles....

(Solar) Neutrinos

The neutrino is a very interesting particle. Even though we believe that we understand the nuclear physics of the sun, the number of neutrinos emitted from the sun seems to anomalously small. Unfortunately this is very hard to measure, and one needs quite a few different experiments to disentangle the physics behind these processes. Such experiments are coming on line in the next few years. These can also look at neutrinos coming from other astrophysical sources, such as supernovas, and enhance our understanding of those processes. Current indications from Kamiokande are that neutrinos do have mass, but oscillation problems still need to be resolved.