Exotic PeV particle detection using Direct Cerenkov Light

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Highly charged nuclei will emit `Direct Cerenkov' (DC) light before their first primary nuclear interaction with the atmosphere. This light is able to provide a high resolution measurementof the primary charge for PeV cosmic rays observed by ground based Cerenkov arrays, independent of any assumed primary interaction model. Simulation of the properties of DC light indicates a charge resolution of delta Z/Z ~ 5 % for Z > 10. This unique capability not only should allow one to determine the primary composition around the knee with unpreceidented accuracy, independent of any assumed interaction model. It should also provide an unambiguous signature for unusual charge states in the cosmic ray flux, such as trans-iron nuclei (92>Z>26). These nuclei are important for examining the energy dependence of the propogation pathlength at the knee of the energy spectrum. Measuremnts of the flux of `quark matter, with Z >> 92 as well as magnetic monopoles is also possible. Measurement of nuclear-interaction cross sections and nuclear fragementations well above accelerator energies can be done using the DC light to provide a `tagged Z' nuclear beam. In this talk, I will describe this new detection window and the possible exotic particles and processes that may be examinined using this technique.