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Submicroscopic Nature Needs Megascience

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The history of "submicroscopic nature," that is, the history of particle physics, begins in the early 1950's and builds on the construction of a post WWII series of particle accelerators developed to study nuclear physics had been applied to the collisions, in the earth's atmosphere, of cosmic rays. These were high energy particles generated in cosmological events and colliding with oxygen and nitrogen in our atmosphere to create new particles. These studies discovered muons, pions, kaons and lambdas—the beginnings of a vast "zoo." Clearly, studies of the inhabitants of the zoo required energetic collisions, the higher the energy of the accelerator, the more extensive was the range of masses that could be produced and studied. Our paper will review the developments over the past 50 years. As accelerators grew, so did the particle detectors and the sizes of the experimental groups. This will bring us to Fermilab in 2005. Finally, we will describe the ∼900 physicist groups that are cheerfully collaborating, building particle detectors designed to peer deeply into the structure of matter, based upon the "Large Hadron Collider" (LHC), an accelerator of unprecedented size, cost, and complexity. The story then takes us from the 100 MeV (10^8 eV) "atom smashers" of 1950, to the ∼10 TeV (10^{13} eV) behemoth now under construction in Europe. Thus, we move from dozens of machines often on University campuses around the world, to one single megascience device shared by physicists around the world. The motivation for this evolution is physics, as we shall attempt to explain.