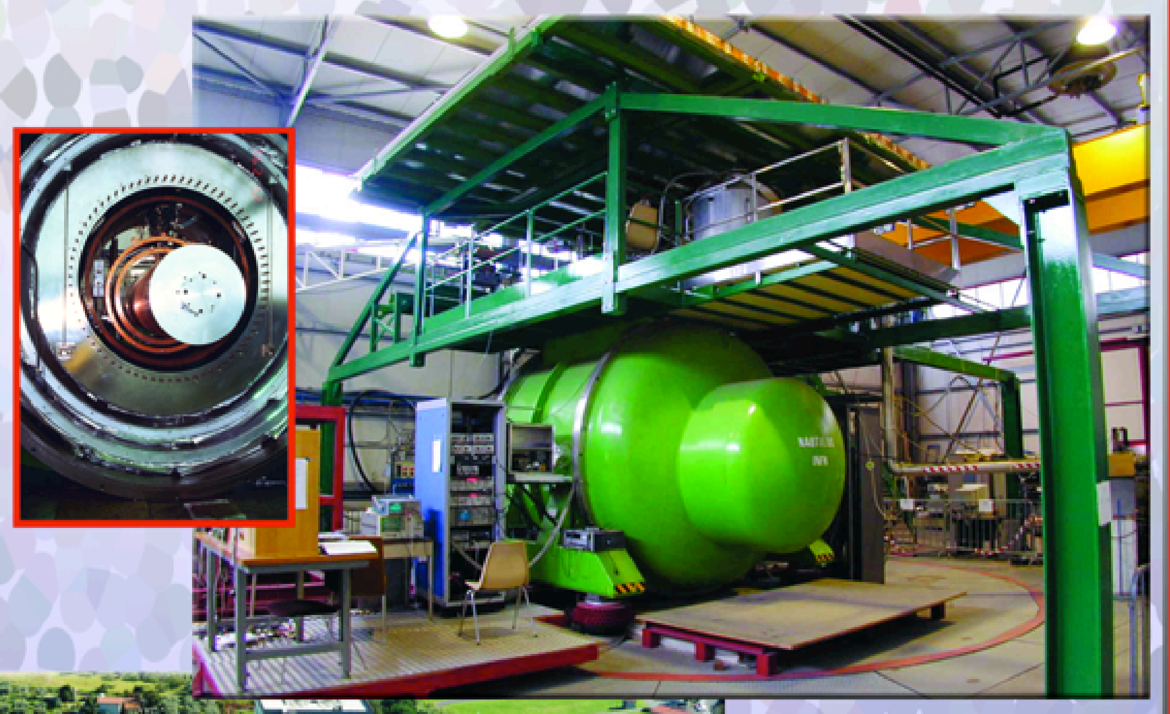
Laboratori Nazionali di Frascati

INFN Istituto Nazionale di Fisica Nucleare

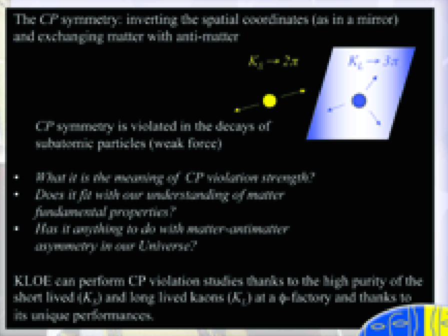
Understanding Nature from Quarks to Stars

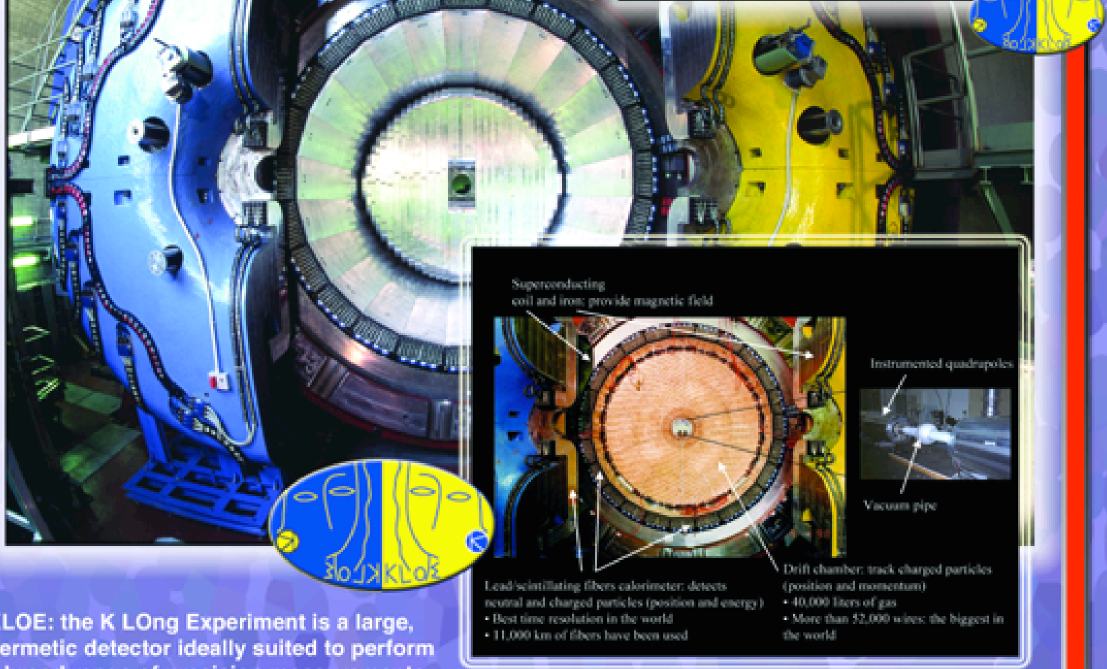
Experiments DEAR, FINUDA, KLOE, and NAUTILUS are exploring the frontiers of knowledge with cutting-edge detectors and technology.

The DEAR (DaΦne Exotic Atom Research) experiment studies exotic atoms that do not exist in nature. They are made of an ordinary nucleus and a K meson which momentarily replaces an atomic electron.
By producing and studying such kaonic atoms, DEAR aims to investigate low-energy nuclear interactions and fundamental symmetries called chiral symmetries.



NAUTILUS searches for gravitational waves, the detection of which would represent a fundamental step forward in our understanding of the structure of space and time, and would potentially give rise to a new branch of astronomy. Gravitational waves can be observed by the extremely small deformation that they induce when passing through extended objects. A gravitational wave from a nearby supernova, for example, would change the length of a 1-meter long "antenna" by an amount less than one-thousandth the scale of an atomic nucleus. At the heart of NAUTILUS is a 3-meter long, 2.3-ton aluminum cylinder. For sensitivity to the tiny deformations induced by gravitational waves, the entire cylinder is cooled to just 0.1 °C above absolute zero, at which point atomic vibrations in the aluminum have virtually ceased.





FINUDA (FIsica NUcleare a DAΦne) studies nuclear matter and the forces that bind it together. Normal nuclear matter is composed of nucleons (protons and neutrons) that are in turn composed of up and down quarks. In the FINUDA experiment, a K meson is used to replace one of the down quarks in a target neutron with a strange quark, creating a Λ-hypernucleus.
This technique opens new possibilities for the study of nuclear matter at the quark level.

KLOE: the K LOng Experiment is a large, hermetic detector ideally suited to perform a broad range of precision measurements that test various aspects of our understanding of particle physics. KLOE has special design features to allow the study of the subtle differences between matter and antimatter that are found in the decay of K mesons, and is contributing to our understanding of the weak interaction by measuring the parameters which govern the decays of strange quarks (such as V_{us}). KLOE is also investigating the products of φ-meson decays, such as scalar-meson states, which provide information about the quark model of the hadrons, and is even performing studies of low-energy $e^+ e^-$ interactions that will assist in understanding the physics at the energy frontier of the Standard Model (for example, by helping to understand the value of the anomalous magnetic moment of the muon).

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