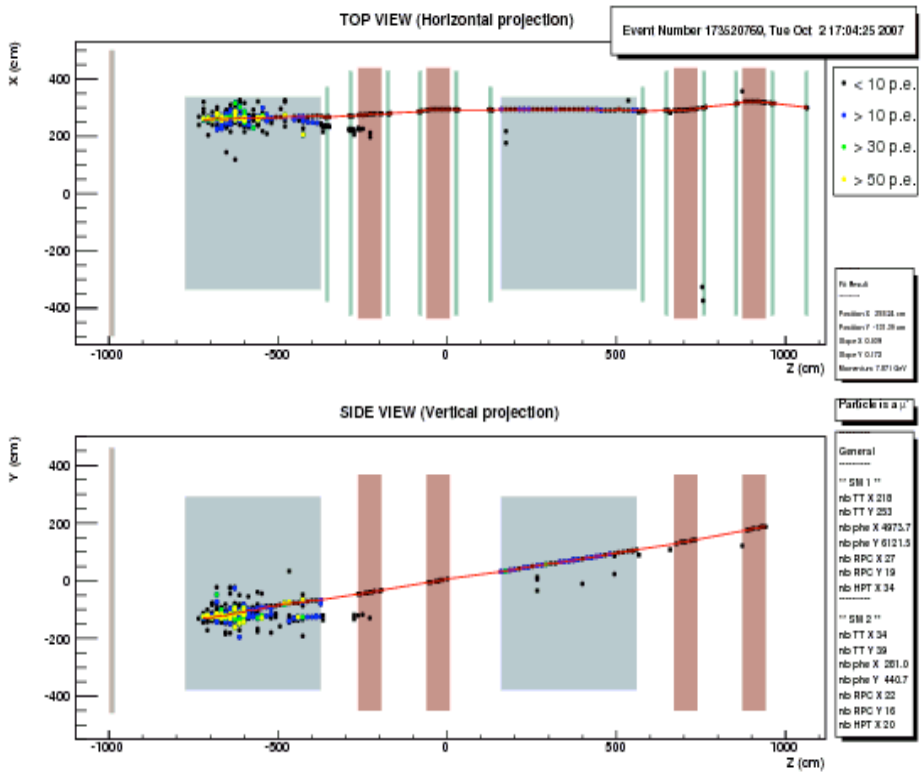
# Neutrinos sent from CERN in Geneva “photographed” at the Gran Sasso Laboratory after a travel of 730 km under the Earth crust.

There was a lot of excitement and joy among the neutrino physicists of the OPERA experiment, when the first neutrino event occurred on Tuesday October 2, at 5:04 p.m. (Central Europe Time). One of the many millions of neutrinos produced at the CERN accelerator complex (CNGS) during its operation hit the OPERA detector at the underground Gran Sasso Laboratory of the Italian Institute for Nuclear Research (INFN) 730 km away from CERN, a distance traveled by the neutrinos in about 2.4 milliseconds at the speed of light. The neutrino produced a cascade of other elementary particles detected by the complex electronics apparatus of the experiment, as shown in the picture below. On the left hand side one can see the visualization of the “smash” of a single neutrino with the detector with an emerging long penetrating track created by a particle called muon.



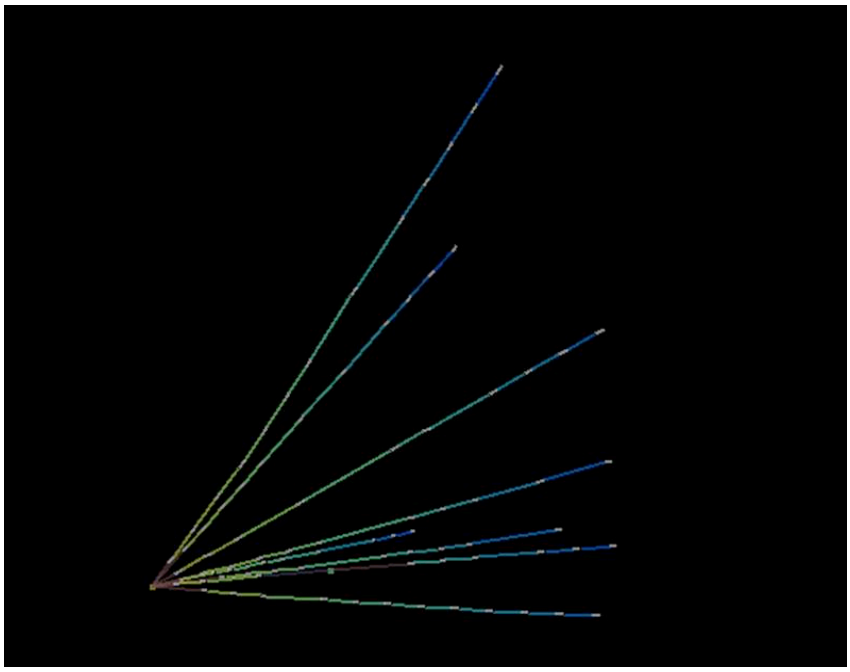

About 300 neutrino events were already collected last year by OPERA during the commissioning run of the CNGS facility. However, this time there is something drastically new: the detector is now progressively being filled day-by-day, with its “heart” made of more than 150000 small units called “bricks” (for a total mass of 1300 tons) each of them equivalent to a sophisticated photographic camera. Thanks to these bricks, of which each is made of a sandwich of lead plates and special photographic films, the OPERA researchers will be able to detect all the details of the “neutrino events” by measuring with high precision the elementary particles produced in the interaction of the neutrino with the brick. The neutrino of the event of October 2 hit one of the almost 60000 already installed bricks.

The scientific goal of the experiment is simple to say, although complicated to achieve: out of several thousands of such “neutrino pictures” one will look for very special events showing the interaction neutrinos of the “tau” type. “Tau” type neutrinos are different from the ones created in the original beam from CERN, which are only of muon-type. These have a different “flavor”, as scientists say. The observation of a few tau-neutrinos over a large number of conventional muon-neutrino events will be the long awaited proof of the direct conversion of one type of neutrino into another: the so called “neutrino oscillation” mechanism. The disappearance of the initial neutrino flavor has already been

observed by several experiments in the last 15 years, but the “direct appearance” has so far still been the outstanding missing tile of the puzzle.

OPERA has been designed and realized by a large team of researchers from all over the world (Belgium, Croatia, France, Germany, Israel, Italy, Japan, Korea, Russia, Switzerland and Turkey) with the specific goal of identifying the elusive tau-neutrino from the oscillation process.

The first event of October 2 has been then accompanied by about 10 more events occurred in the following days. The bricks containing these events were immediately removed from the detector and dispatched to the various laboratories of the OPERA Collaboration, which are equipped with automatic microscopes required to read these special pictures and to measure the relevant physics quantities. The display of one of these events analyzed by the microscopes is shown below. One can see a detail of the region around the point of interaction of the neutrino (coming from the left of the figure) producing several particles identified by their tracks in the brick. This represents a volume of only a few cubic millimeters, but rich of valuable information for the OPERA physicists.



This is just a crucial milestone of an enterprise that will last a few more years and that has been mandated, initiated and conducted thanks to the skill of a large number of scientists, engineers, technicians and students, and with the strong support of the various actors of the project: CERN, INFN, Japan and the main European funding agencies. Of course, also numerous high-tech industrial companies are involved in the supply of the many parts of the equipment necessary for building a large detector like OPERA.

The successful start-up of OPERA is one more confirmation that a truly international scientific cooperation is a required ingredient to successfully meet the challenge of modern research in fundamental and applied science.