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Measurement of the neutrino velocity with the OPERA detector in the CNGS neutrino beam

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The OPERA neutrino experiment at the underground Gran Sasso Laboratory measured the velocity of neutrinos from the CERN CNGS beam over a baseline of about 730 km with much higher accuracy than previous studies conducted with accelerator neutrinos. The measurement was based on high statistics data taken by OPERA in the years 2009, 2010 and 2011. Dedicated upgrades of the CNGS timing system and of the OPERA detector, as well as a high precision geodesy campaign for the measurement of the neutrino baseline, allowed reaching comparable systematic and statistical accuracies and limiting the overall uncertainty on the neutrinos time of flight measurement to 10 ns. The time of flight was measured by comparing the time distributions of neutrino interactions in OPERA and of protons hitting the CNGS target in 10.5 μ s long extractions. The above result, indicating an early arrival time of about 60 ns of CNGS muon neutrinos with respect to the one computed assuming the speed of light in vacuum, was confirmed by a test performed using a beam with a short-bunch time-structure allowing to measure the neutrino time of flight at the single interaction level. The OPERA neutrino velocity measurement will be review as well as the latest developments and perspectives.