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Measurement of the neutrino mixing angle θ_{13} with the Double Chooz detector

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The θ_{13} parameter of the PMNS mixing matrix remained unknown until first hints and estimates by both Double Chooz and beam experiments in 2011. The Double Chooz reactor antineutrino experiment aims for a precise measurement of this parameter. Located at the Chooz nuclear power plant in France, it relies on a two identical detector measurement, canceling most of systematic uncertainties related to neutrino flux emission and detection. The near detector, located at a few hundred meters from the two reactor cores, aims to monitor the $\bar{\nu}_e$ flux from the cores. The far detector, located at a distance of about one kilometer from the reactor cores near the expected first maximum of the oscillation, measures an energy dependent deficit in the electron antineutrino spectrum. Different approaches are used to extract θ_{13}: A combined rate and spectral shape analysis as well as a background-model-independent analysis based on reactor power variations. A unique feature of the Double Chooz experiment is, that it was the only one of the currently running θ_{13} reactor experiments observing a phase with both reactors off. This provides access to the background only measurement, allowing to crosscheck the background modes used in the oscillation analysis. New analysis enhancements resulted in the latest results of the experiment, based on far detector only measurement, published in summer 2014. In total 467.90 live days with 66.5 GW-ton-years of exposure, twice as much data compared to the last publication, the value of θ_{13} is measured to be $\sin^2 2\theta_{13} = 0.090^{+0.032}_{-0.029}$. Data taking in the near detector is about to start, enabling a significant reduction of both reactor and detector related systematics uncertainties in a near future.

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