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The Sudbury Neutrino Observatory: Observation of Flavor Change for Solar Neutrinos

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The Sudbury Neutrino Observatory (SNO) detector was developed by an international scientific collaboration (Canada, US, UK) to use 1000 tonnes of heavy water 2 km underground in ultra-clean conditions to observe flavor change for solar neutrinos from ^{8}B decay in the sun. A clear observation of neutrino change was obtained by comparing two neutrino reactions on deuterium, one sensitive only to electron flavor neutrinos and one sensitive equally to all active neutrino types. The design and construction and the operation and data analysis for the three separate phases of the experiment will be described. The initial phase with pure heavy water provided conclusive evidence for flavor change and hence finite mass for neutrinos. Subsequent phases within added NaCl and with an array of neutron detectors provided improved accuracy for the measurements of oscillation parameters. The observed total flux of ^{8}B solar electron neutrinos is in excellent agreement with and more accurate than solar models. Modification of the SNO detector to create SNO+ and expansion of the laboratory to create a long-term international underground laboratory, SNOLAB, will be briefly described.