XENON100 sets record limits for dark matter

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Scientists from the XENON collaboration announced a new result from their search for dark matter. The analysis of data taken with the XENON100 detector during 13 months of operation at the Gran Sasso Laboratory (Italy) provided no evidence for the existence of Weakly Interacting Massive Particles (WIMPs), the leading dark matter candidates. Two events being observed are statistically consistent with one expected event from background radiation. Compared to their previous 2011 result the world-leading sensitivity has again been improved by a factor of 3.5. This constrains models of new physics with WIMP candidates even further and it helps to target future WIMP searches. A paper with the results is going to be submitted to *Physical Review Letters* and on the *arXiv*.

Cosmological observations consistently point to a picture of our Universe where ordinary matter as we know it makes up only about 4%, while new, yet unobserved forms of so-called dark matter and dark energy make up the rest. This fits to expectations from subatomic physics where extensions of the Standard Model of particle physics suggest that new particles must exist, which have properties making them perfect dark matter candidates. Both cosmology and particle physics provide consistent hints on the existence of dark matter. A search for WIMP particles is therefore well motivated and a direct detection of such particles is the central missing piece of information to confirm this new picture of our Universe.

In 2011, the XENON100 collaboration published results from 100 days

of data taking. The achieved sensitivity pushed the limits for WIMPs already by a factor 5 to 10 compared to the previous XENON10 results. During the new run a total of 225 live days of data were accumulated in 2011 and 2012 with lower background and hence improved sensitivity. Again no signal was found. The two observed events are statistically consistent with the expected background of one event. The new data improve the bounds to 2.0×10^{-45} cm^2 for elastic interaction of a WIMP mass of 50 GeV, which is another factor of 3.5, cutting already significantly into the expected WIMP parameter region. Continued measurements with XENON100 and the new experiment XENON1T, currently under construction, should either find evidence for WIMPs or other forms of dark matter would have to be considered.

XENON100 is an ultra-sensitive device using 62 kg of liquid, ultra-pure xenon as a WIMP target, and measures the tiny charge and light signals that are expected from rare collisions between WIMPs and the nuclei of xenon atoms. The detector is operated deep underground at the Gran Sasso National Laboratory of the INFN, in Italy, in order to shield it from cosmic rays which constantly bombard the Earth. To avoid false events due to residual radiation from the detector's surroundings, only data from the inner 34 kg of liquid xenon are taken as candidate events. The detector is in addition shielded by specially designed layers of copper, polyethylene, lead and water, to reduce the background noise even further.

The XENON collaboration consists of scientists from 15 institutions in the USA (Columbia University New York, University of California Los Angeles, Rice University Houston, Purdue University), France (Subatech Nantes), Germany (Max-Planck-Institut für Kernphysik Heidelberg, Johannes Gutenberg University Mainz, Westfälische Wilhelms-Universität Münster), Israel (Weizmann Institute of Science), Italy (Istituto Nazionale di Fisica Nucleare, Università di Bologna), Netherlands (Nikhef Amsterdam), Portugal (Universidade de Coimbra),

Switzerland (Universität Zürich), and China (Shanghai Jiao Tong University).

More information: xenon.astro.columbia.edu/
arxiv.org/abs/1207.3458

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