Available online at www.sciencedirect.com

SCIENCE DIRECT®

Nuclear Physics B (Proc. Suppl.) 143 (2005) 547

NUCLEAR PHYSICS B
PROCEEDINGS
SUPPLEMENTS

www.elsevierphysics.com

Limit on Solar antineutrino flux obtained with the prototype of the Borexino detector

On behalf of the Borexino collaboration A. Derbin[a]*, A. Ianni[b] †, and O. Yu. Smirnov[c] ‡

[a]St. Petersburg Nuclear Physics Inst., Gatchina, Russia

[b]INFN, Gran Sasso Laboratory, S.S. 17-bis Km 18+910 67010 Assergi, Italy

[c]Joint Inst. for Nuclear Research, 141980 Dubna, Russia

The possible manifestation of large neutrino magnetic moment would be the presence of antineutrinos in the Solar neutrino spectrum. The mechanism of neutrino-antineutrino conversion due to spin-flavour precession induced by neutrino transition magnetic moment was actively discussed as a possible solution of the Solar neutrino deficit problem. Recently the interest in a large neutrino magnetic moment was revived, mainly because of new experimental data available from the KamLAND detector and in view of new lower-threshold Solar neutrino detectors, such as the Borexino detector, built at the LNGS laboratory with the aim of measuring ^{7}Be Solar neutrino flux [1]. The Borexino detector will start the data taking within two years, meanwhile its 4-ton prototype is continuing to take data. A detailed description of the CTF detector can be found in [2].

The inverse beta-decay of the antineutrino $\overline{\nu}_e + p \rightarrow n + e^+$ is a dominant type of antineutrino interactions in a large volume Cherenkov or liquid scintillator detector. The cross section for this process is two orders of magnitude higher than that of the antineutrino-electron elastic scattering. The capture of the thermalized neutron on the proton $n + p \rightarrow d + \gamma$ with a mean life-time of $\sim 200\ \mu s$ and energy release $E_\gamma = 2.2$ MeV is providing a tag for this reaction in LS detectors, allowing measurements at practically zero background. The most stringent constraint on the Solar antineutrino flux $\phi_{\overline{\nu}_e}$ from KamLAND data is $\phi_{\overline{\nu}_e} < 2.8 \times 10^{-4}\, \phi_{SSM}(^8B)$ at 90% CL in the energy region $8.3 < E_{\overline{\nu}_e} < 14.8\, MeV$.

The 2 $t \cdot y$ exposion of the CTF has been used to limit the antineutrino flux in the low energy region starting at the inverse beta-decay threshold, $E > 1.81$ MeV. The efficiency of the double events detection $\epsilon = 0.54$ have been found using a Monte Carlo simulation. After the rejection of the muon induced background no candidate events have been observed at practically zero expected background. This fact limits the antineutrino production at the Sun by no more than 5% of the Standard Solar Model ^{8}B flux. The limit, being weaker than that of other experiments, is the first one valid in the low energy region.

The future Borexino detector will have the sensitivity to antineutrinos comparable to that of the KamLAND detector in the high energy part of the spectrum above the reactor antineutrino energies. At the lower energies, due to its distant location from the nuclear reactors ($\simeq$ 800 km), the Borexino detector will have much lower background then the one at the KamLAND site.

REFERENCES

1. Borexino collaboration, A. Alimonti et al., Astrop. Phys. 16(2002)205-234.
2. Borexino collaboration, A. Alimonti et al., NIM A406 (1998)411.

*derbin@mail.pnpi.spb.ru
†aldo.ianni@lngs.infn.it
‡osmirnov@jinr.ru

0920-5632/$ – see front matter
doi:10.1016/j.nuclphysbps.2005.01.212