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Nuclear Physics B (Proc. Suppl.) 143 (2005) 540
NUCLEAR PHYSICS B PROCEEDINGS SUPPLEMENTS
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1992-2004: search for neutrino burst from collapsing objects with LVD

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The Large Volume Detector (LVD) in the INFN Gran Sasso National Laboratory, Italy, consists of an array of 840 scintillator counters, 1.5 m^3 each, arranged in a compact geometry, for a total active mass $M = 1000$ tons; a detailed description is in [1]. The detector, mainly sensitive to the inverse β-decay ($\bar{\nu_e}p, e^+n$), has been taking data, under different configurations, since 1992, and reached its final one during 2001. Its modularity allows to work at variable sensitive mass reaching very high duty cycle: $\geq 99\%$ in the last 3 years (90% mean value over 12 years data), always maintaining the necessary sensitivity (active mass) to observe core collapse supernovae within the whole Galaxy [2].

The analysis of the experimental data is performed on-line and off-line with different algorithms [3] and purposes. The goal of the on-line analysis is to select neutrino burst candidates in real time to be promptly notified to the SuperNova Early Warning System *SNEWS* [4], the international network of supernova neutrino detectors which, in case of coincidence, will provide a fast alert to the astronomical community.

On the other hand, the results of the off-line analysis in the search for neutrino bursts from Gravitational Stellar Collapse (GSC) in the Galaxy in the period 1992 - 2004 by LVD taken alone, have been reported [2] and upgraded in this conference. No burst candidate eligible for a true supernova signal has been detected so far. Taking into account the detector sensitivity during the whole period we obtain the following upper limit to the rate of core collapse Supernova in our Galaxy (within $D = 20$ kpc):

0.2 event/year at 90% c.l.

The absence of candidates in the LVD detector taken alone does not preclude the possibility of positive effects, when combining LVD data with those of another detector, since the joint measurement allows to increase the sensitivity. In particular we reprocessed the LVD data stream in two cases: (1) in correlation with the Gamma Ray Burst GRB990705 detected by BeppoSAX pointing the outskirts of the Large Magellanic Clouds [5], and (2) with the excess observed by the EXPLORER and NAUTILUS gravitational wave detectors in 2001, when the resonant bars were orthogonal to the galactic plane [6].
We carefully searched for neutrino signals in the LVD data, both in coincidence with the observations and in a 24 hours time interval scanned through a "sliding window" of variable duration from 1 up to 100 s. In both studies no evidence for a ν signal has been found, being data in very good agreement with background expectations. Therefore upper limits to the neutrino fluence at earth (or to the total emitted energy at the source, when hypothesis on the source characteristics are assumed) have been calculated and possible implications discussed [7,8].

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0920-5632/$ – see front matter © 2005 Published by Elsevier B.V.
doi:10.1016/j.nuclphysbps.2005.01.205