Physics in Collision - Zeuthen, Germany, June 26-28, 2003

EXOTIC PARTICLE DETECTION WITH THE AMANDA DETECTOR

Marek Kowalski* for the AMANDA Collaboration
**DESY Zeuthen, Platanenallee 6, D-15738 Zeuthen*

ABSTRACT

Results of an indirect search for neutralino dark matter with AMANDA (Antarctic Muon And Neutrino Detector Array) are presented. Additionally, the capability of AMANDA to detect relativistic magnetic monopoles will be reviewed.

1 Introduction

Neutrino telescopes are a unique astronomy tool, designed for detection of high-energy neutrinos from astrophysical sources. Additionally they have large sensitivities to exotic particles such as neutralino dark matter and magnetic monopoles. Here, we review the current experimental bounds obtained by the AMANDA experiment. AMANDA is presently the largest operating Cherenkov neutrino detector. Located at the geographical South Pole, AMANDA makes use of the Antarctic glacier as detector medium. The complete AMANDA-II detector was commissioned in the year 2000, and consists of 19 strings holding 677 Optical Modules, each containing an 8 inch Photomultiplier tube. In the years 1997-1999 it was operated in a smaller 10 string version named AMANDA-B10.

2 Search for Neutrinos from Neutralino Annihilation

If cold dark matter is constituted of supersymmetric particles in the form of neutralinos, than these accumulate gravitationally in e.g. the center of the Earth and annihilate with each other. The indirect search for neutralinos with the AMANDA detector is based on a possible signal of nearly vertically upward going neutrino-induced muons, exceeding the flux of muons from atmospheric neutrinos [1]. With no significant excess observed in the 1999 data, we derive improved preliminary upper limits on the flux of muons from the direction of the center of Earth related to neutralino annihilation [2]. Figure 1 compares our limits to those obtained by other experiments. Additionally shown are muon flux predictions due to neutralino annihilation [3]. A currently ongoing analysis of data from the larger AMANDA-II

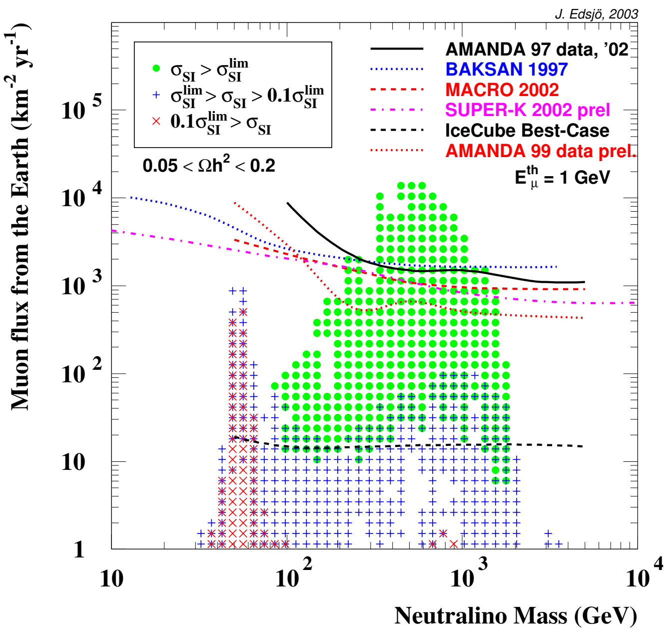

Figure 1: *Experimental bounds on the muon flux from the center of the Earth. Additionally shown are muon flux predictions from neutralino dark matter annihilation in the center of the Earth. The filled circles represents models excluded by current direct searches. Crosses represent models which could be excluded by direct searches ten times as sensitive as the present ones. Details concerning the predictions as well as references to other experiments can be found in [3].*

detector aims at detection of a muon-neutrino signal from the direction of the sun. Because of the improved capabilities of AMANDA-II to reconstruct muon tracks from horizontal directions, this analysis became feasible. The sensitivity of the detector is thereby competitive with the results of direct searches.

3 Search for Relativistic Magnetic Monopoles

Magnetic monopoles with unit magnetic Dirac charge and velocities greater than the Cherenkov threshold in ice ($\beta > 0.75$) emit 8300 times more Cherenkov light than a minimal ionizing particle of equal velocity. Hence events due to relativistic monopoles are distinguished by their high light output, allowing identification of events beyond the geometrical boundaries of the detector. No event in the data sample of 1997 has passed the dedicated selection criteria [4]. The upper limits on the flux of relativistic monopoles have been calculated as a function of β and are shown in figure 2. As can be seen they are currently among the most stringent.

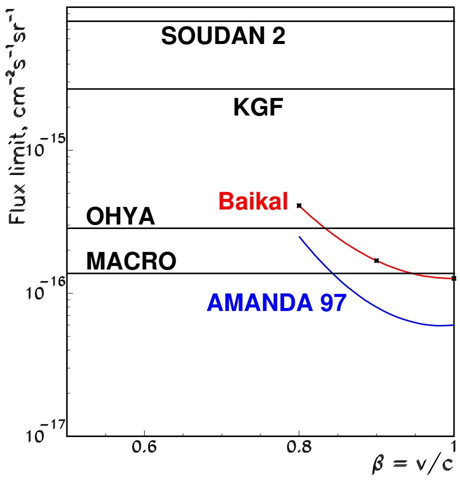

Figure 2: *Experimental limits on the flux of relativistic magnetic monopoles as a function of velocity $\beta = v/c$. References to other experiments can be found in [4].*

References

1. J. Ahrens, *et al* [AMANDA Collaboration], Phys. Rev. **D66**, 032006 (2002).
2. P. Olbrechts *et al* [AMANDA Collaboration], in proceedings of 28th International Cosmic Ray Conference, HE3.3 1677, (Tsukuba, 2003).
3. J. Edsjo, arXiv:astro-ph/0211354.
4. P. Niessen *et al* [AMANDA Collaboration], in proceedings of 27th International Cosmic Ray Conference, HE.3.4 1496, (Hamburg, 2001).