Proceedings of ICRC 2001: 1294 © Copernicus Gesellschaft 2001

ICRC 2001

Two-channel optical module for the Lake Baikal Neutrino Experiment

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Abstract. Two-channel optical module has been developed for the lake Baikal Neutrino Experiment. Pilot sample of this module has been successfully tested at the lake Baikal. Some results of these tests are presented.

1 Introduction

The lake Baikal Neutrino Telescope *NT–200* operates successfully since April 1998. One of the underlying issues of this success is an optical module pairwise ideology pursued in *NT–200* (Belolaptikov et al., 1997) In *NT–200* optical modules are grouped in pairs along strings. The optical module incorporates *QUASAR-370* (Bagduev et al., 1999) hybrid phototube developed especially for *NT–200*. Two optical modules in a pair are switched in coincidence and form one *optical channel*. Such ideology allows to suppress effectively individual optical module counting rate due to water luminescence and phototubes dark current, to eliminate phenomena deteriorating phototubes time resolution namely prepulses, late pulses and afterpulses. Moreover such approach facilitates trigger system designing, data acquisition system etc. Unfortunately there is just one but substantial drawback. It's too expensive to have two optical module for one *optical channel*.
To overcome this problem we have developed two-channel optical module based on two-channel version of *QUASAR-370* phototube (Lubsandorzhiev et al., 1997)

2 Two-channel *QUASAR-370* phototube

Two-channel *QUASAR-370* phototube uses the same electron optical preamplifier and two channel small pmt instead of conventional one. Characteristics of the latter one has been improved conspicuously. The main points of improvements are the following:

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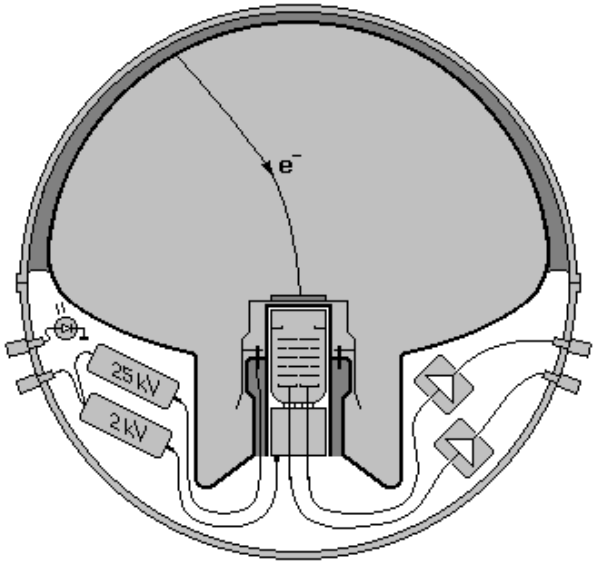

Fig. 1. Two-channel optical module

a) photoelectron transit time distribution – σ=340ps;
b) peak-to-valley ratio of single photoelectron distribution – 1.5;
c) cross-talks – 1%;

3 Two-channel optical module

Two-channel optical module (fig.1) incorporates two-channel *QUASAR-370* phototube and two fast transimpedance preamplifiers and uses the same glass pressure house and the same penetrators as conventional Baikal optical module.

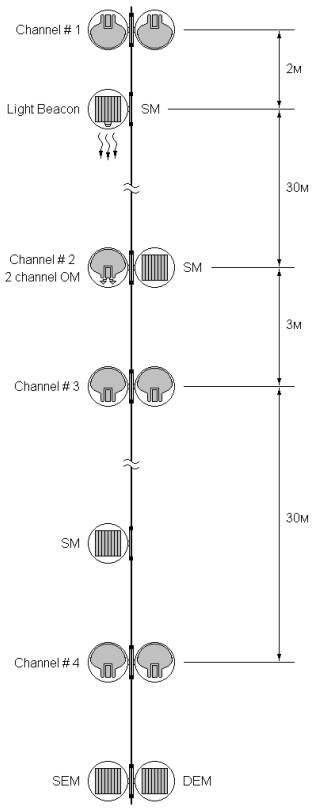

Fig. 2. Schematic view of the experimental string.

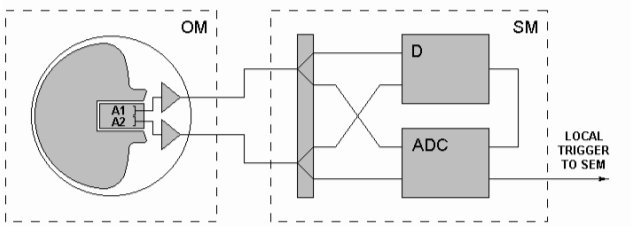

Fig. 3. Scheme of front-end electronics for two-channel optical module

4 Test of two-channel optical module at the lake Baikal

In the course of last expedition at the lake Baikal we tested one pilot sample of two-channel optical module (fig.2) in frame of tests of new experimantal string which is designed especially for tests of technological innovations for future neutrino telescopes at the lake. The scheme of front-end electronics is shown in fig.3. For new optical module we used usual but slightly modified *NT–200* electronics. The output signals of two channels are switched in coincidence just in the same way as in *NT–200*. It results in *local trigger* counting rate of 100-300Hz. Fig.4 presents time dependence of muon trigger rates for two conventional Baikal optical channels and new optical channel based on two-channel optical module. One can see that new optical channel has a comparable to conventional Baikal optical channels sensitivity to muons. Fig.5 shows amplitude spectra due to muons (left part) and *light beacon* pulses (right part) for this new optical channel.

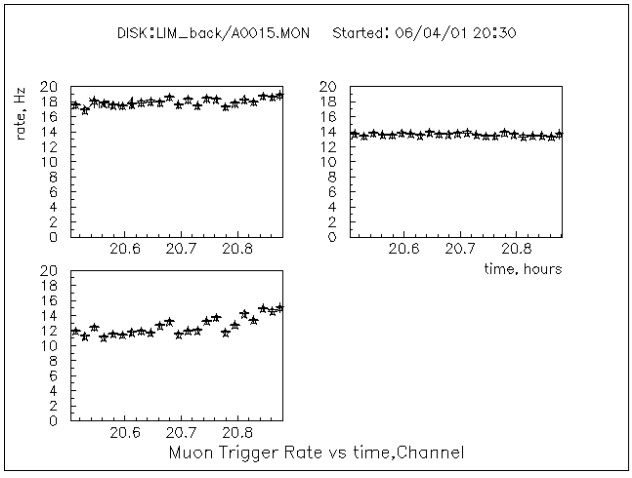

Fig. 4. Muon Trigger rate versus time. Left up and left bottom – for conventional Baikal optical module; Right up – for new optical channel based on two-channel optical module

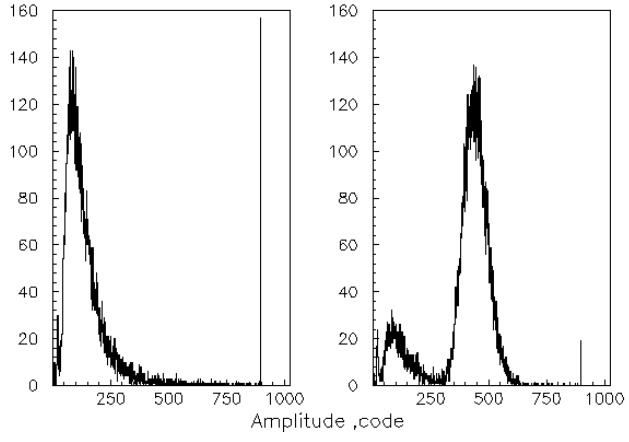

Fig. 5. Amplitude spectra of two-channel optical module. Left – muon amplitude spectrum; right – amplitude spectrum of *light beacon* pulses detected by new optical channel based on two-channel optical module

5 Conclusion

Tests of the pilot sample of two-channel optical module has been successfully carried out at the lake Baikal. This module has demonstrated rather good characteristics but it's just first step in development of multichannel optical modules for future large scale Neutrino Telescopes.

Acknowledgements. This work was supported by the Russian Ministry of Research (contract 102-11(00)-p), the German Ministry of Education and Research and the Russian Fund of Basic Research

(grants 99-02-1837a,01-02-31013 and 00-15-96794) and by the Russian Federal Program ”Integration”(project 346).

References

Belolaptikov,I. et al., *Astropart. Phys.* **7** P.263, 1997
Bagduev,R. et al., *Nucl. Instr. Meth.* **A420** P. 138, 1999
Lubsandorzhiev,B et al., Proc. of 25th ICRC V.7 P. 269–272, 1997