CERN/SPSC 2001-024/
SPSC/I224 Add1
31 July 2001

Sw 200210

ADDENDUM TO THE LETTER OF INTENT I224

M. Ambrosio[3], V. Ammossov[2], L. Bergamasco[5,12], M. Bonesini[10], M. Calvi[10], D. Cundy[1], U. Dore[11], C. Gustavino[8], P. Loverre[11], G. Mannocchi[6,7], C. Matteuzzi[10], M. Musy[10], P. Negri[10], M. Paganoni[10], L. Periale[5,6], P. Picchi[6,7,12], F. Pietropaolo[1,4], A. Pullia[10], S. Ragazzi[10], N. Redaelli[10], G. Satta[7,11], T. Tabarelli[10], A. Tonazzo[10], G. Trinchero[5,6], F. Vannucci[9]

[1]CERN, Geneva, Switzerland
[2]IHEP, Protvino, Russia
[3]INFN, Sezione di Napoli, Napoli, Italy
[4]INFN, Sezione di Padova, Padova, Italy
[5]INFN Sezione di Torino, Torino, Italy
[6]Istituto di Cosmogeofisica, CNR, Torino, Italy
[7]Laboratori Nazionali di Frascati and INFN, Frascati, Italy
[8]Laboratori Nazionali del Gran Sasso and INFN, Assergi, Italy
[9]LPNHE, University of Paris VII, Paris, France
[10]University of Milano Bicocca and INFN, Milano, Italy
[11]University of Rome and INFN, Rome, Italy
[12]University of Torino, Torino, Italy

The I224 collaboration would like to send some additional remarks concerning the L.o.I. I224. Some of them, indeed were not written or not well stressed in that paper. These considerations concern four points:

- the neutrino beam;
- the excavation;
- the Physics;
- the detector.

The neutrino beam.

We would like to stress that CERN has a very good ν beam, with some characteristics unique in the world. This beam can be utilized for a rather low cost and put at disposal of the CERN community.
The main characteristics of the beam are:

- very narrow radial distribution (R $\simeq$ 1 m, see Fig. 1).
  This peculiarity of the beam is very useful in order to have a large fraction of the beam crossing the R.F. cavity and allows a detector of small radial size.
- strong correlation between ν energy and radial position of the events. The ν_π can easily be distinguished from the ν_K (see Fig. 2,3) and consequently the ν energy is well measured from its radial position.
  Fig. 4 shows the ν energy reconstructed from the measurement of the radial position of the vertex (dashed line) and the "true one" (continuous line) for CC events.
- what reported above is clearly valid also for NC events; hence the combined measurements of the hadron energy (in the detector) and the ν energy (from the radial position) , can provide the determination of the variable y of Bjorken (see in Fig. 5 the comparison between the measured neutrino energy and the "true one").

- the ν events, in at least 50 % of the cases, can be tagged with the corresponding μ (measured in COMPASS or downstream the end of the π FODO channel in a suitable detector);

- the tagged μ are not filtered by an iron shield, as it happens in the traditional ν experiments. This is indeed the ideal condition to measure a correlation between the arrival times of the ν and the μ, in order to perform a measurement of the ν velocity;

- the ν_e from K_{e3} are mostly in the energy region between 80 and 120 GeV where ν_μ are negligible (Fig. 6).

- finally there is no additional cost for this ν beam, while COMPASS is running (4-5 years).

Excavation.

An alternative solution, suggested by L. Gatignon, with the detector positioned 250 m downstream w.r.t. what reported in the L.o.I. is under study. This solution implies a 20% loss of the ν flux , but has two advantages:
i) a reduction by a factor 16 of the associated μ flux passing through the detector;
ii) the opportunity to carry out the excavation during the running time of COMPASS (Fig. 7). This hypothesis is being checked by the Radiation Protection Service at CERN.

Physics.

In addition to that which is written in the L.o.I. , at least two more subjects should be mentioned:

- Investigation of the $\bar{\nu_\mu} \rightarrow \bar{\nu_\tau}$ oscillation.
  NOMAD and CHORUS have studied $\nu_\mu \rightarrow \nu_\tau$, and the measurement of the CP symmetric channel can constitute a check of the CP invariance law. The sensitivity which can be reached for $\bar{\nu_\mu} \rightarrow \bar{\nu_\tau}$ by the proposed experiment is of the same order as the one of NOMAD and CHORUS for $\nu_\mu \rightarrow \nu_\tau$.

- Neutral Heavy Leptons.
  NuTeV has shown a signal of 3 events interpreted as Neutral Heavy Leptons, with a background of 0.04 ± 0.09. This effect could be investigated with a statistics 5 times larger, if there is no threshold effect.

Detector

The detector we propose for the NA neutrino beam is a simple digital sampling calorimeter based on well known detector principles and techniques.
At present we consider a detector with a fiducial volume of $2{\times}2$ m^2 in the transverse directions and 20 m along the beam.
It will be made of $2{\times}2$ m^2 iron slabs, 8 cm thick, interleaved with 2.2 cm gaps housing RPC glass chambers (GSC) with 3 cm pitch strip readout, following a technique already proposed by MONOLITH (Ref.1).
The total number of the GSC chamber planes will be 200, covering an area of 800 m^2, with in total 26000 readout channels.

The GSC chambers actually developed for the MONOLITH experiment are 110 cm long and 25 cm wide so that 16 chambers are needed to cover one plane of the proposed calorimeter.

The electrodes are built starting from commercially available float glass, the high voltage supply being applied to the glass by means of water based graphite varnish. The distance of 2 mm between the glass plates is kept uniform by Noryl spacers clamped at the edge of the electrodes.
The glass plates and the spacers are inserted in a 250 mm wide Noryl envelope and the detector is closed by two Noryl endcaps in which are located the gas connectors and the high voltages feed-throughs. The architecture of this detector has been thought in order to ensure a fast production on a massive scale.

The readout system makes use of flat cables as pick-up strips, with a digital readout.

Details about the performance of these GSC and related readout system can be found in " M. Ambrosio et al., Nucl. Instr. Meth. A 456 (2000) 67-72".

In order to improve the resolutions on time and hadronic energy, as requested by the physics goals of our proposal, we envisage also the insertion of some scintillator planes as active elements.

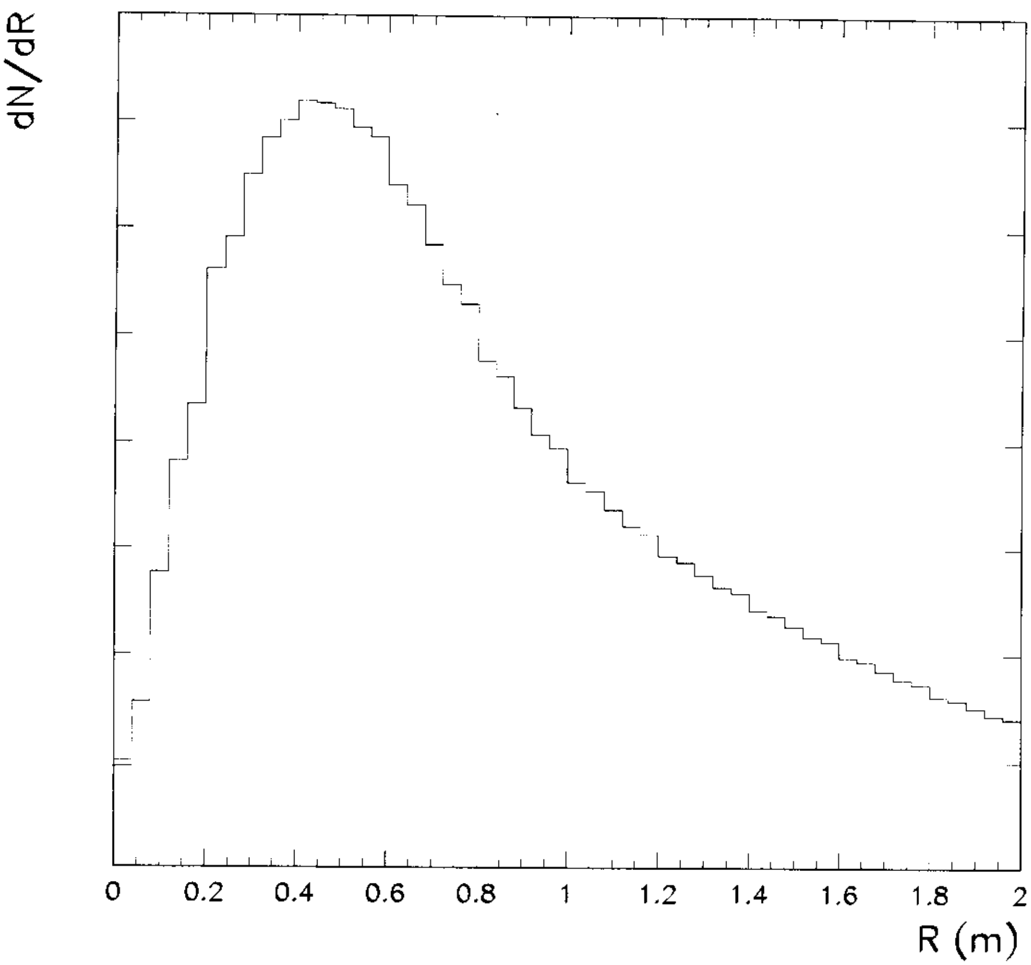

Figure 1: Radial distribution of the ν events in the detector position (Arbitrary units).

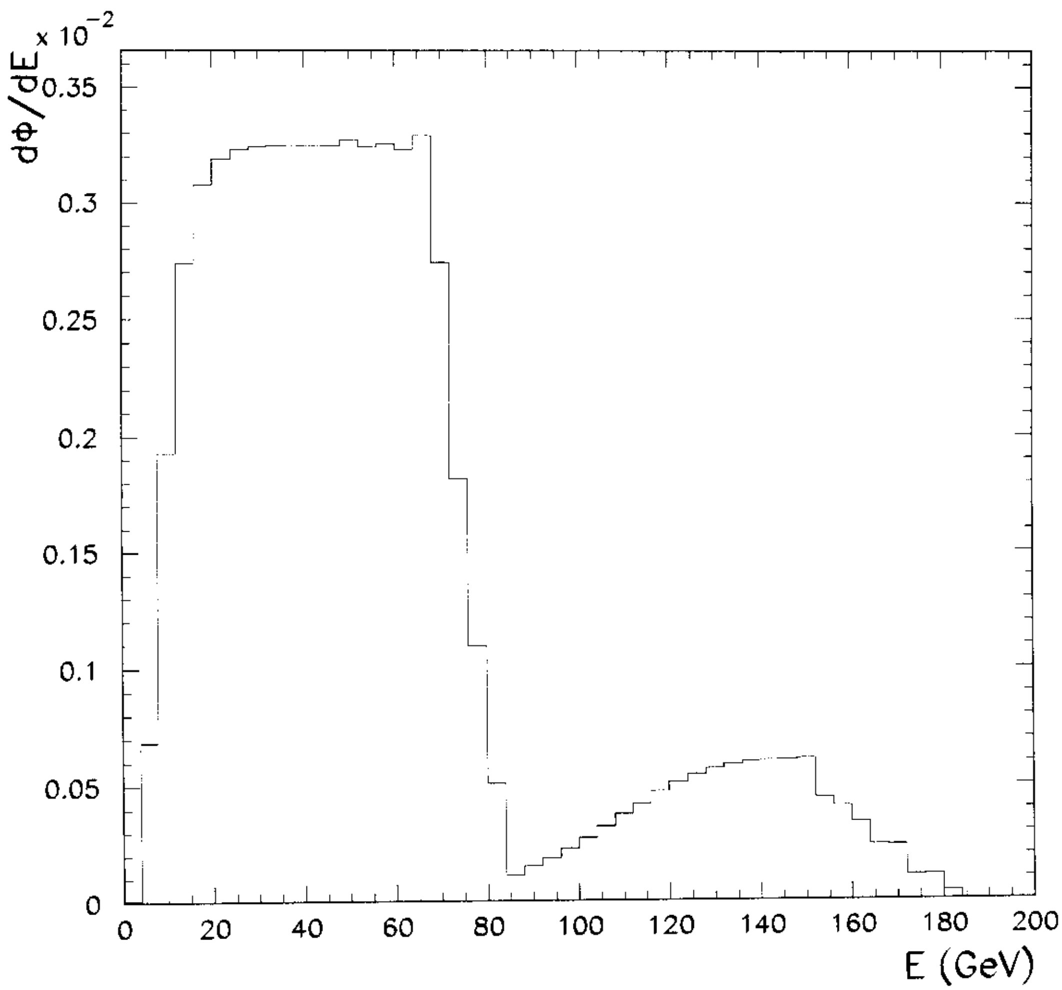

Figure 2: Energy spectrum of the ν flux.

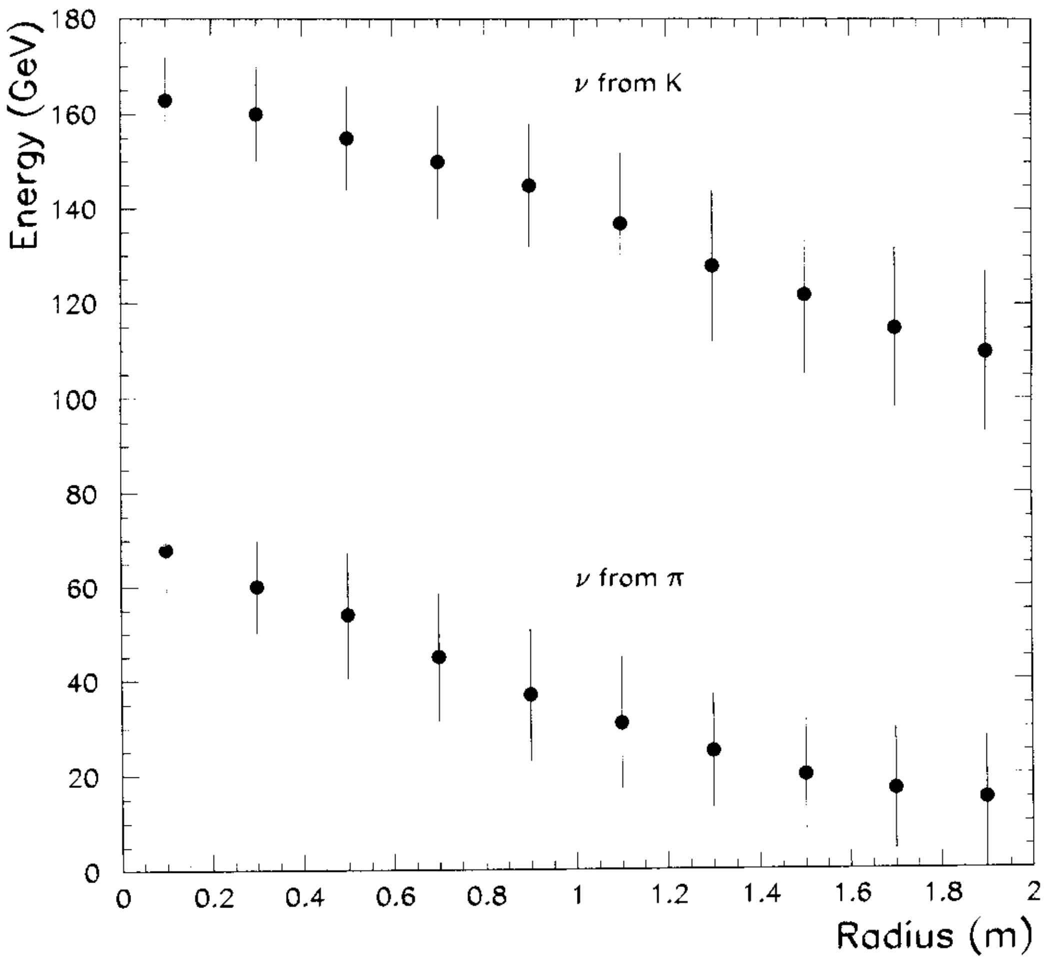

Figure 3: Correlation between the ν energy and the radial position in the two cases: ν_π and ν_K. The bars represent the spread of the distribution at each point.

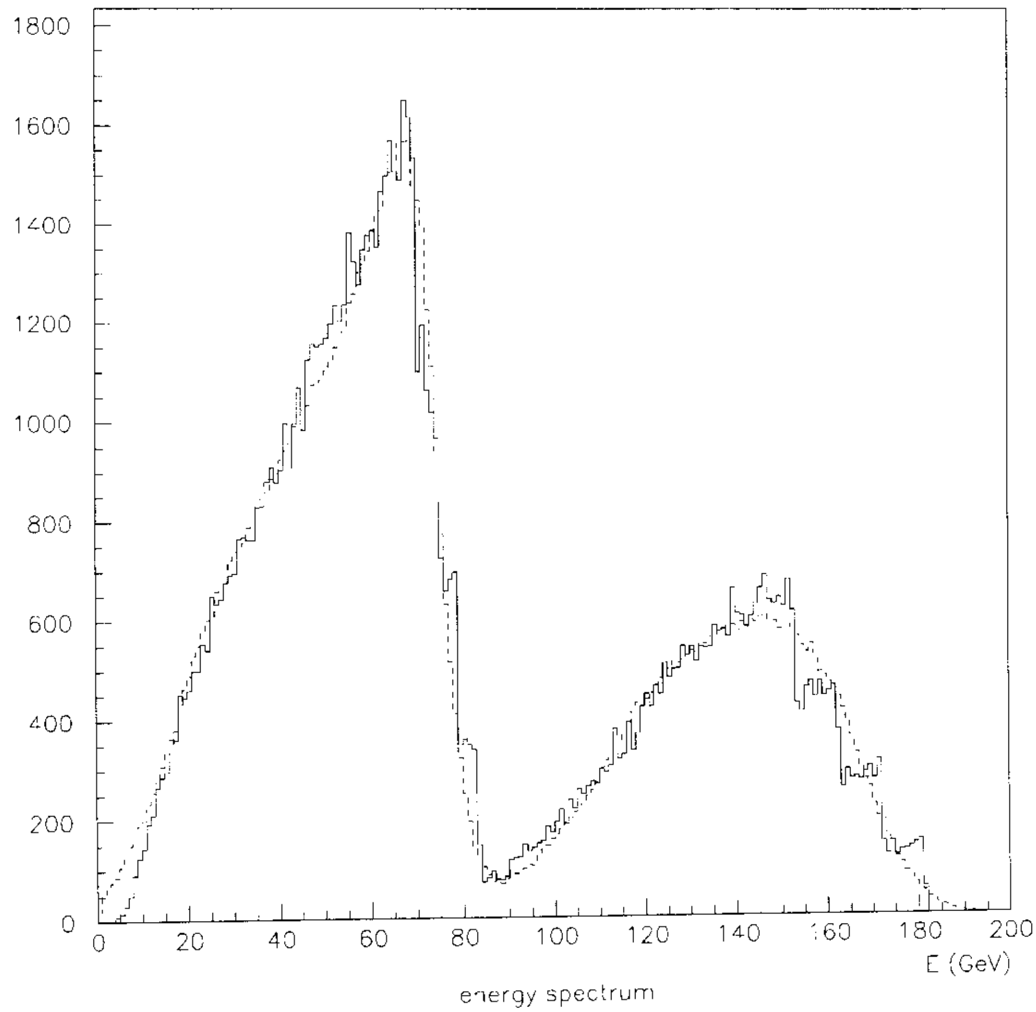

Figure 4: Comparison between the true neutrino energy (continuous line) and the neutrino energy determined by the radial position (dashed line), for CC events.

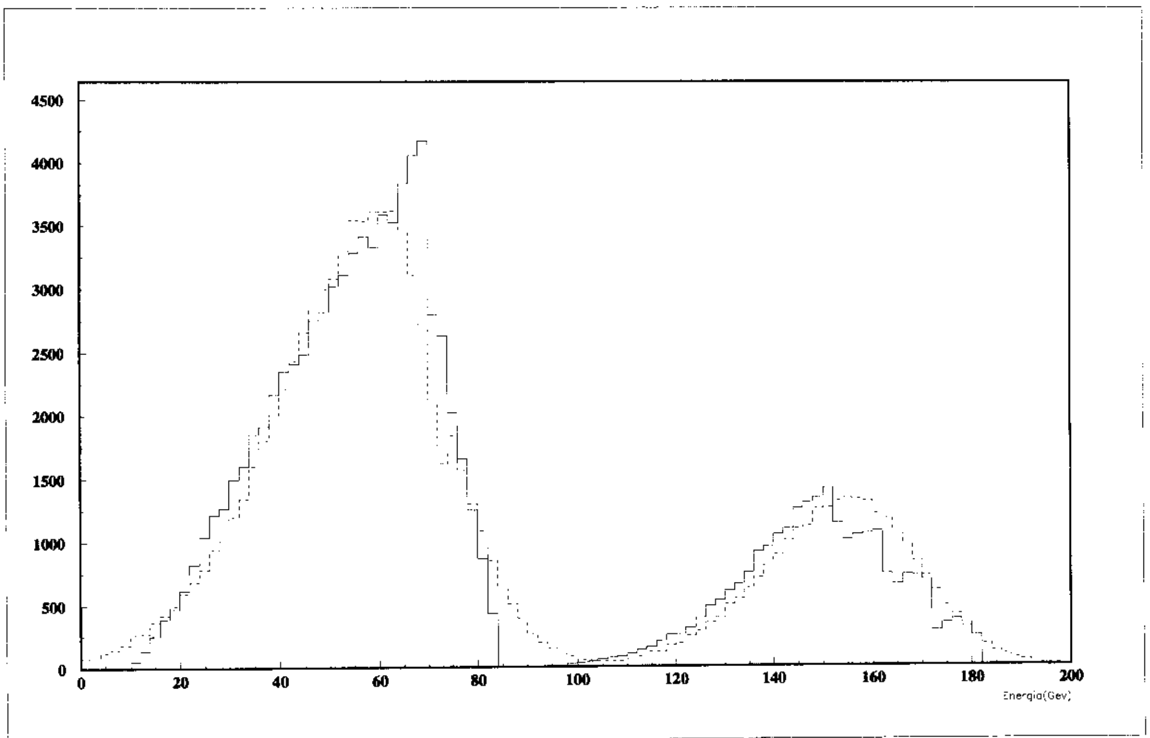

Figure 5: Comparison between the true neutrino energy (continuous line) and the neutrino energy determined by the radial position (dashed line), for NC events.

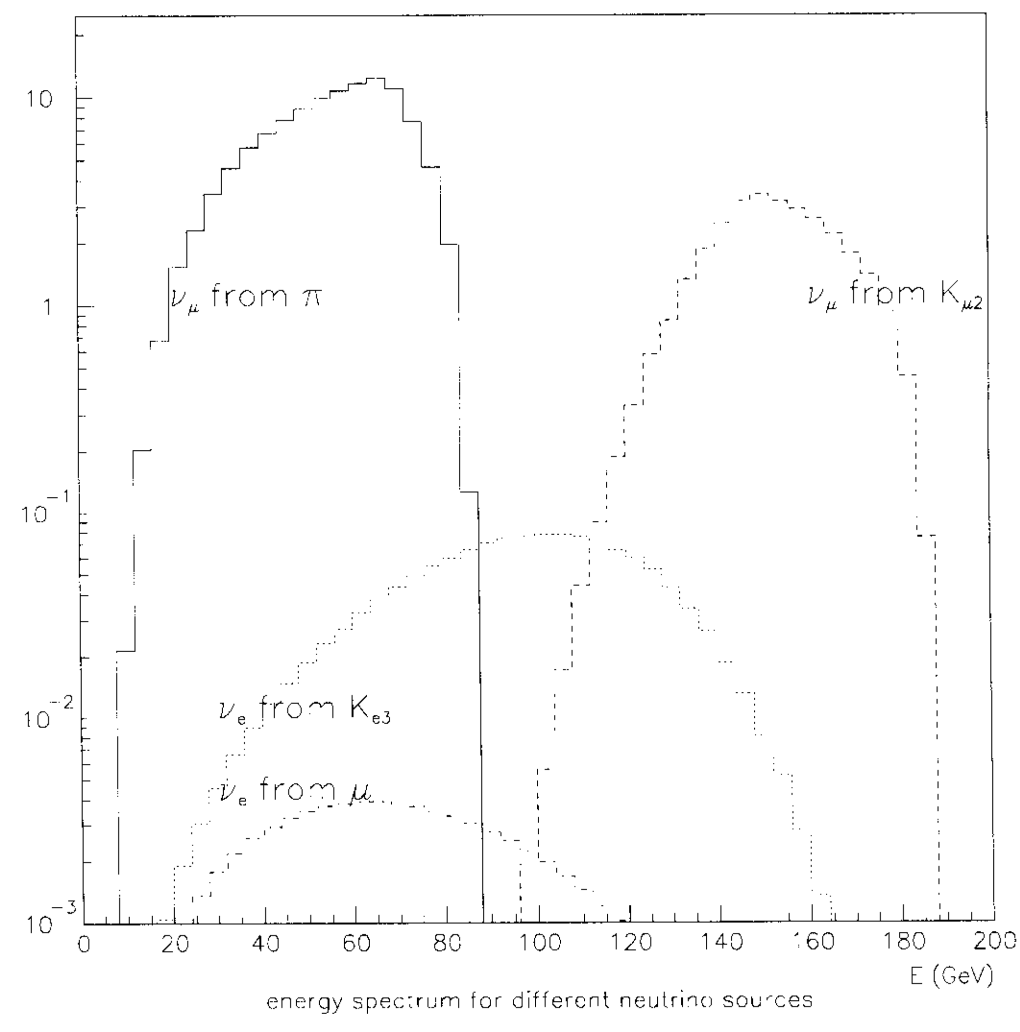

Figure 6: ν energy spectra from different ν sources.

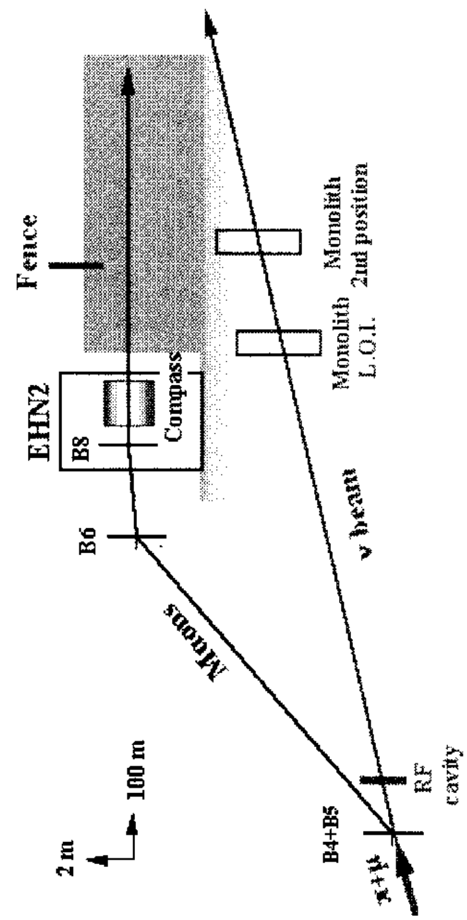

Figure 7: Schematic layout of the two proposed positions for the detector.