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LNGS-LOI 19/99, Addendum 1

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Addendum to the OPERA Progress Report

1. Introduction

We give the cost estimate and the planning for the construction of the OPERA detector as well as the milestones for the main decisions to be taken in order to have the detector ready at the beam start-up. In the Progress Report [1] different options were considered for the main components of the detector. The estimate given in this addendum refers to a “baseline” configuration.

2. Baseline detector configuration

As described in the Progress Report, two options are open for the configuration of the basic cell in the brick (*compact* and *spacer*). The compact cell is taken as the baseline for the cost estimate.

With both cell options, only decays outside of the lead plate where the interaction occurred are considered for the performance estimate [1]. The decay topology is thus directly observed in both cases. With the spacer configuration all 1-prong decay modes are characterised by a low background. For the compact configuration only the leptonic decays are considered; the higher target density however compensates the lower observed branching ratio, so that a similar number of τ is observed. We are also presently investigating the capability of the compact configuration for the observation of hadronic decays.

For the target trackers and for the inner trackers of the muon spectrometer, the baseline retained consists of plastic scintillators with optical fibre read-out. For the spectrometer outer trackers we have considered drift tubes.

Both magnet options described in the Progress Report (toroidal or dipole magnets) use conventional techniques. The cost estimate is based on the dipole option.

3. Cost estimate

The cost for the construction of the OPERA detector has been estimated for all options. The cost presented here refers to the baseline configuration. Other options under investigation may lead to lower costs. We give below a synthetic breakdown of the cost estimate. Table 1 gives the construction cost of one supermodule. Table 2 shows the construction cost of the detector, consisting of five supermodules. Equipment, instrumentation and tools comprise brick assembling machines, robots for brick handling, equipment for emulsion development, tools for magnet assembly, cabling and slow control.

Table 1. Cost estimate for the construction of one supermodule (MCHF)

Brick walls	Emulsion	8.2	
	Lead and mechanics	3.5	
	Total		11.7
Target trackers			1.7
Spectrometer	Magnet		0.9
	Trackers		2.0
Total cost			***16.3***

Table 2. Cost estimate for the construction of five supermodules (MCHF)

Equipment, instrumentation and tools	4.7
Supermodules	81.5
Total cost	***86.2***

Apart from the standard expenditure, the running cost has to account for the replacement of the bricks where interactions have taken place.

We request the support of the LNGS for infrastructure such as safety installations, cooling and ventilation, uninterruptible power supplies, an additional small crane, control room and emulsion laboratories. For these items, a cost of about 3 MCHF is estimated.

4. Schedule and milestones

A detailed construction schedule has been estimated taking into consideration about 500 activities, starting from the assembly of the basic components of OPERA. The schedule is essentially determined by technical constraints. The final assembly will take place in the cavern. A serial supermodule installation has been considered, using two cranes. Fig. 1 gives the overall schedule for detector construction.

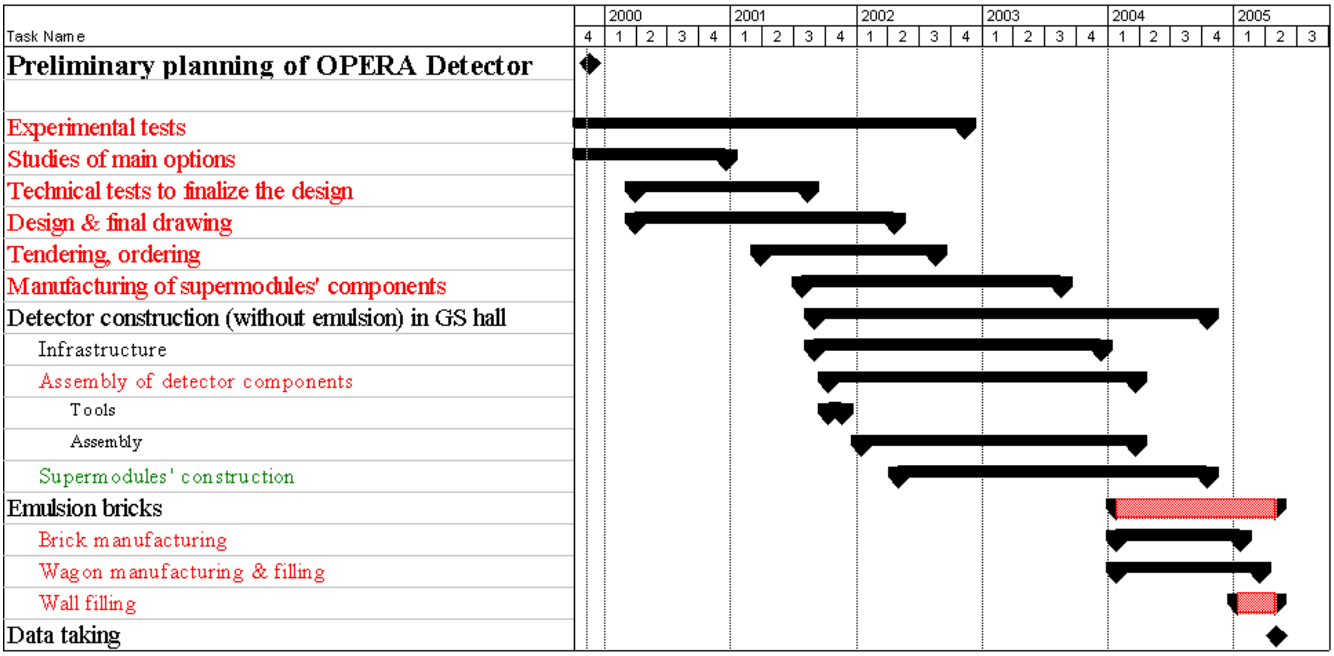

Fig. 1 Schedule for detector construction

The milestones for the main choices in the detector design are:

- April 2000 Emulsion temperature and humidity requirements
- July 2000 Brick configuration
- October 2000 Magnets
  Wall support structure
  Trackers

Together with the cost estimate and the schedule, the funding profile is being produced. The emulsions make up almost half the cost. A substantial fraction of this expenditure is delayed until 2004-2005. The other payments are distributed over the forthcoming five years.

The sensitivity quoted in the Progress Report is based on the present central SuperKamiokande parameter values, $\Delta m^2 = 3.5\text{x}10^{-3}$ eV^2 with maximal mixing. In a five year run, five OPERA supermodules will detect about 18 ν_τ events with a background of 1 event thus providing a measurement of the ν_μ -ν_τ oscillation probability. Because of the low background, the disclosure of ν_μ -ν_τ oscillation as the explanation of the SuperKamiokande observations can already come from a smaller number of events. As the oscillation signal scales with $(\Delta m^2)^2$ a squared mass difference of, for instance, $4.5\text{x}10^{-3}$ eV^2 would result in 30 ν_τ events (with unchanged background) or in 18 ν_τ events (0.6 background events) with 3/5 of the effort. Should in the forthcoming years a Δm^2 higher than the present central value be favoured by experimental results, the construction strategy could be reviewed.

5. Collaboration, management and responsibilities

At present, the Collaboration consists of physicists belonging to 21 Institutions from Europe and Japan. The definitive management structure will be defined around the time of the proposal with the participation of new collaborators joining following the approval of the beam. Until then, the management is under the responsibility of an executive board with Kimio Niwa, Jean Paul Repellin and Paolo Strolin as members. Jean-Paul Fabre is acting as technical co-ordinator. The contact-person is Antonio Ereditato.

A preliminary sharing of responsibilities for the detector construction is given in Table 3.

Table 3. Sharing of responsibilities (preliminary)

Installation	CERN, LNF, LNGS, other Institutions
Emulsion	Ankara, Bari, Kobe, Nagoya, Naples, Rome, Salerno, Toho
Target	CERN, Israel, LNF, Münster, Nagoya, Naples
Trackers	Bern, Brussels, CERN, Hamburg, IN2P3, Israel, LNF, Moscow
Magnets	Brussels, CERN, LNF
Trigger, DAQ, Controls	Bern, Hamburg, IN2P3, Moscow
Scanning	Ankara, CERN, Bari, Bern, IN2P3, Münster, Nagoya, Naples, Rome, Salerno, Toho, Utsunomiya
Offline Architecture	CERN, IN2P3
Analysis	All Institutions

References

[1] OPERA. A long baseline ν_τ appearance experiment in the CNGS beam from CERN to Gran Sasso, CERN/SPSC 99-20, SPSC/M635, LNGS-LOI 19/99, August 27 1999