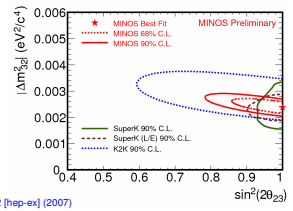
OPERA Precision Tracker

Status $\nu_\mu \rightarrow \nu_{\tau,s}$ oscillation

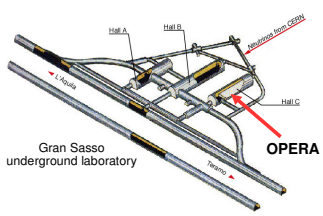
- so far only disappearance observed, appearance needed
- best fit value for Δm^2 from new analysis of MINOS (preliminary): 2.38 x 10^{-3} eV^2
- best fit value for $\sin^2(2\theta)$: 1 (maximal mixing)
- 68% C.L. range: Δm^2 = 2.22 – 2.58 x 10^{-3} eV^2, 90% C.L. range: $\sin^2(2\theta) > 0.84$

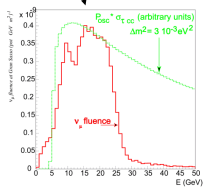


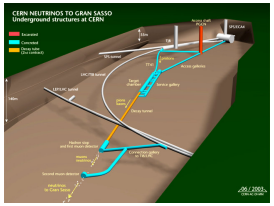
arXiv:0708.1495v2 [hep-ex] (2007)

CNGS neutrino beam

- ν_μ beam from CERN to Gran Sasso
- first beam data taken in October 2007
- ν_μ flux: 4.5 x 10^{19} pot/year
- energy spectrum optimised for ν_τ appearance at Gran Sasso, $\langle E_\nu \rangle$ = 17 GeV



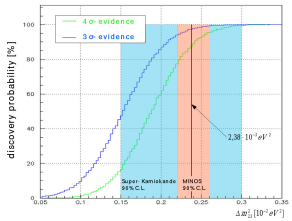




OPERA performance

Expected number of signal and background events under the assumption of full mixing in five years with a neutrino flux of 4.5 x 10^{19} pot/year:

τ decay	signal events		background events (charm, hadronic, muon scattering)
	Δm^2 = 2.5 x 10^{-3} eV^2	Δm^2 = 3.0 x 10^{-3} eV^2	
$\tau \rightarrow \mu$	2.9	4.2	0.17
$\tau \rightarrow e$	3.5	5.0	0.17
$\tau \rightarrow h$	3.1	4.4	0.24
$\tau \rightarrow 3h$	0.9	1.3	0.17
ALL	**10.4**	**15.0**	**0.76**



OPERA collaboration

Belgium
IIHE Brussels

Bulgaria
Sofia

Croatia
IRB Zagreb

France
LAPP Annecy, IPNL Lyon, IReS Strasbourg

Germany
Hamburg, Münster, Rostock

Israel
Technion Haifa

Italy
Bari, Bologna, LNF Frascati, L'Aquila, LNGS, Naples, Padova, Rome, Salerno

Japan
Aichi, Toho, Kobe, Nagoya, Utsunomiya

Russia
INR Moscow, NPI Moscow, ITEP Moscow, SINP MSU Moscow, JINR Dubna, Obninsk

South Korea
Jinju

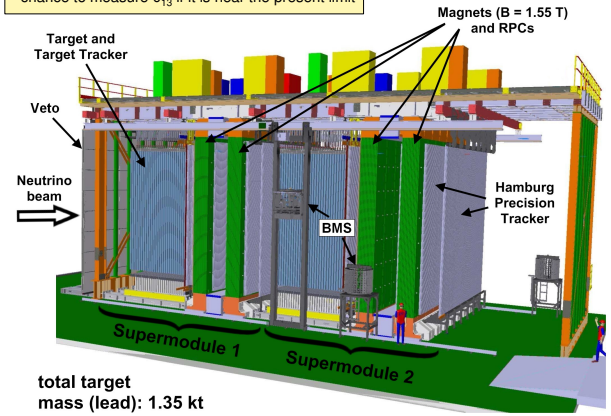
Switzerland
Bern, Neuchâtel, ETH Zürich

Tunisia
Tunis

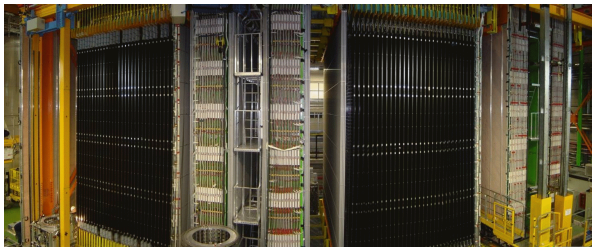
Turkey
METU Ankara

OPERA detector

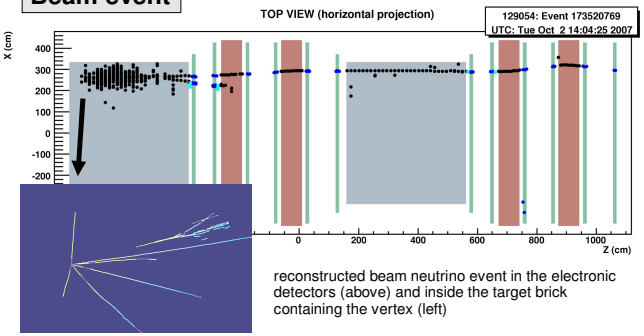
Goals:
- prove of ν_τ appearance, $\nu_\mu \rightarrow \nu_\tau$ oscillation
- chance to measure θ_{13} if it is near the present limit



total target mass (lead): 1.35 kt



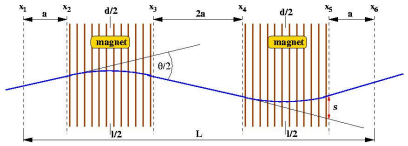
Beam event



reconstructed beam neutrino event in the electronic detectors (above) and inside the target brick containing the vertex (left)

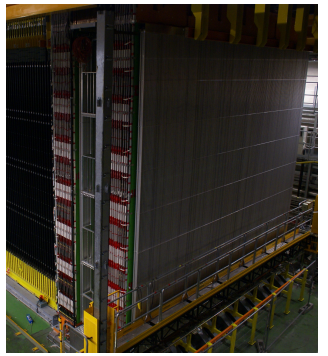
Hamburg – Precision Tracker

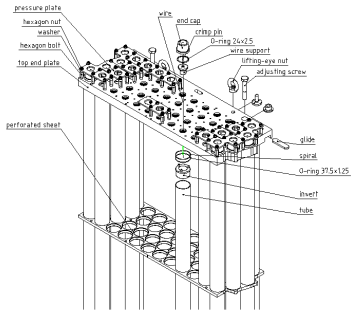
Goals:
- μ-identification
- momentum measurement: Δp/p ≤ 0.25
- measurement of μ charge for background rejection



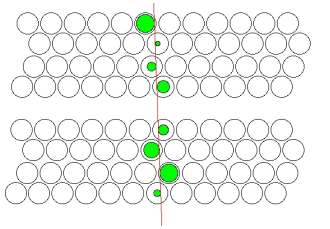
⇨ spatial resolution of 600 μm required

- total: 10,000 drift tubes
- first 8 m drift tubes without wire support
- 6 layers per Supermodule, 4 planes per layer
- track-efficiency of > 99%
- spatial resolution of 300 μm
- system with high redundancy





module in detail (upper side)



track reconstruction with two modules (test setup)

Gas system

- gas mixture: 80% Ar, 20% CO_2
- total volume: 80,000 l
- flux of 1,100 l per hour
- working at constant absolute pressure

- continuous O_2 - monitoring for gas quality control
- detailed leakage-control by focussed O_2 - monitoring of module groups

See also:

"The precision tracker of the OPERA detector"
NIM A555, 15 December 2005, pages 435-450

"First events from the CNGS neutrino beam detected in the OPERA experiment"
New J. Phys. 8, 5 December 2006, page 303

Acknowledgment

(in alphabetical order)

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http://www-opera.desy.de