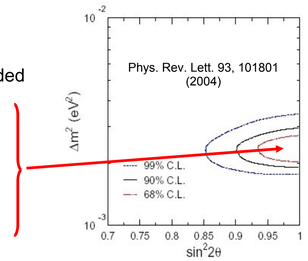
OPERA Precision Tracker

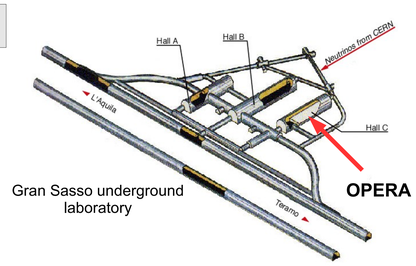
Status $\nu_\mu \rightarrow \nu_{\tau,s}$ oscillation

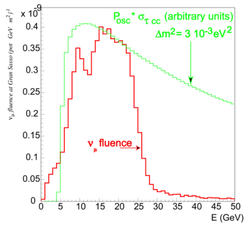
- so far only disappearance observed, appearance needed
- best fit value of Δm^2 from the new analysis of Superkamiokande (high L/E): 2.4 x 10^{-3} eV^2
- best fit value for $\sin^2(2\theta)$: 1 (maximal mixing)
- 90% C.L. range: Δm^2 = 1.9 - 3.0 x 10^{-3} eV^2, $\sin^2(2\theta) > 0.9$
- see also new MINOS results

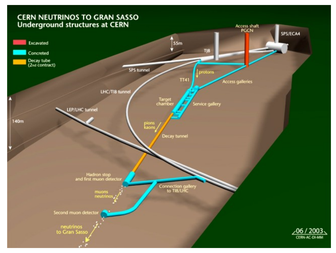


CNGS Neutrino Beam

- ν_μ beam from CERN to Gran Sasso
- beam commissioning in July 2006
- ν_μ flux 4.5x10^{19} pot/year
- energy spectrum optimised for ν_τ appearance at OPERA, $<E_\nu>$ = 17 GeV



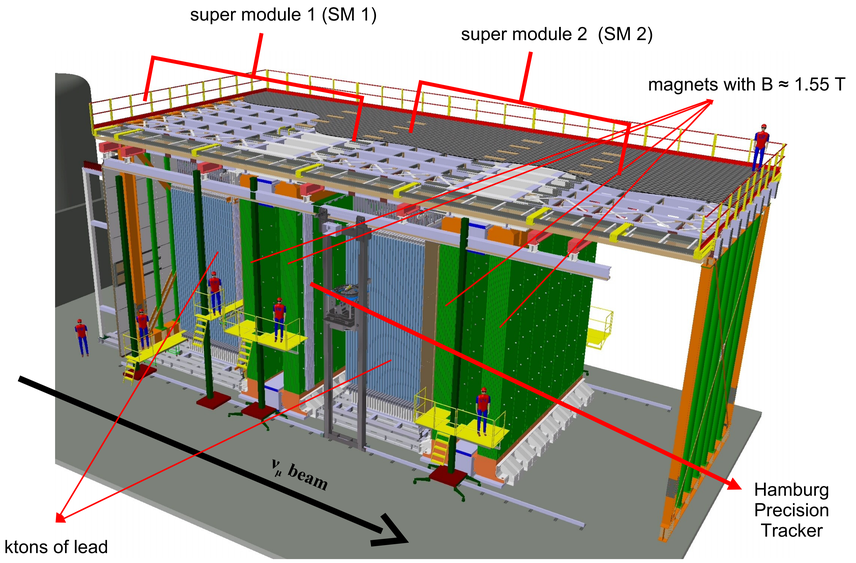




The OPERA Detector

Goals:

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

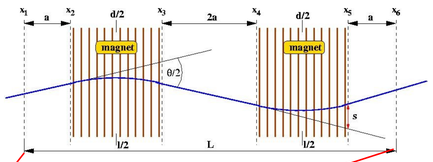


Hamburg – Precision Tracker

Goals:

- μ-identification
- momentum measurement: Δp/p ≤ .25
- measurement of the μ charge for background rejection

⇒ spatial resolution of 600 μm required



- total: 10000 drift tubes
- first 8 m drift tubes without wire support
- 6 layers per SM, 4 planes per layer
- track-efficiency of > 99 %
- spatial resolution of 300 μm
- system with high redundancy

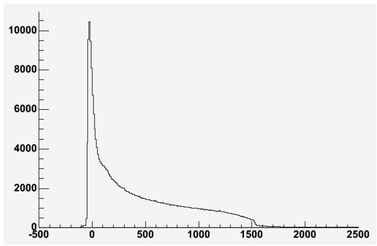
HPT-wall 5

Gassystem

- gas mixture: 80 % Ar, 20 % CO_2
- total volume 80,000 l
- flux of 1100 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

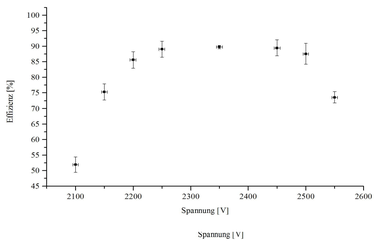
TDC

- time resolution 0.5 ns
- 96 channels/board
- readout via Ethernet
- zero compression on board

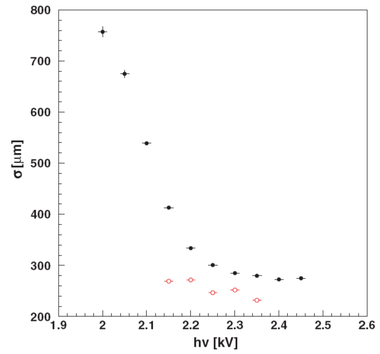


drift time spectrum of OPERA TDC

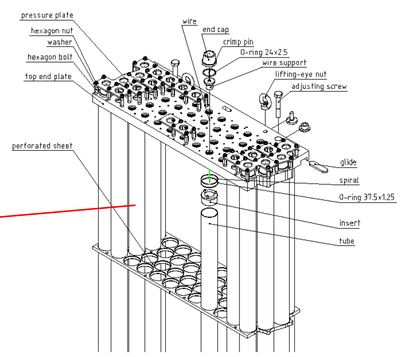
Track reconstruction/results



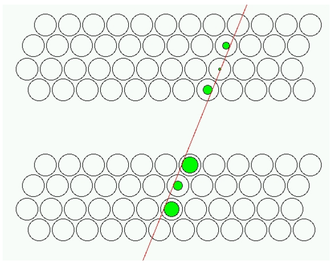
track efficiency (small prototype)



spatial resolution of small (black circles) and large prototype (red circles)



modul in detail (upper side)



track reconstruction with 2 layers of modules (test setup)

OPERA performance

Expected number of signal and background events under the assumption of full mixing in five years with a neutrino flux of 4.5x10^{19} pot/year:

(...) = with increased beam intensity (x 1.5)	signal (Δm^2 = 1.9 x 10^{-3} eV^2)	signal (Δm^2 = 2.4 x 10^{-3} eV^2)	signal (Δm^2 = 3.0x 10^{-3} eV^2)	BKGD
OPERA 1.8 kton fiducial	**6.6 (10)**	**10.5 (15.8)**	**16.4 (24.6)**	**0.7 (1.06)**

Main background sources:

(...) = possible improvements	τ → e	τ → μ	τ → h	total
Charm background	**.210 (.117)**	**.010 (.007)**	**.162 (.160)**	**.382 (.284)**
Large angle μ scattering		**.116 (.023)**		**.116 (.023)**
Hadronic background		**.093 (.093)**	**.116 (.116)**	**.209 (.209)**
Total per channel	**.210 (.117)**	**.219 (.123)**	**.278 (.276)**	**.707 (.516)**

OPERA Collaboration

Belgium
IIHE(ULB-VUB) Brussels

Bulgaria
Sofia University

China
IHEP Beijing, Shandong

Corea
Gyeongsang University

Croatia
Zagreb University

France
LAPP Annecy, IPNL Lyon, LAL Orsay, IRES Strasbourg

Germany
Berlin, Hamburg, Münster, Rostock

Israel
Technion Haifa

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

Russia
INR Moscow, ITEP Moscow, JINR Dubna, Obninsk

Japan
Aichi, Toho, Kobe, Nagoya, Utsunomiya

Switzerland
Bern, Neuchâtel

Turkey
METU Ankara

See also: "The precision tracker of the OPERA detector", NIM A555, 15 December 2005, Pages 435-450

http://www-opera.desy.de