Detector session Summary

Talks by:

H. Aihara
S. Centro
Y. Declais
A. Marchionni
M. Messier
T. Nakaya
J. K. Nelson
N. Spooner

Dario Autiero
IPNL, Lyon

Anselmo Cervera
IFIC, Valencia

European Strategy for Future Neutrino Physics

CERN, 3 October 2009

Introduction

14:00	Introduction (15 + 5 min) (20') (Slides)	Y. Declais (*IPNL, Lyon*)
14:20	Magnetized iron calorimeter (20 + 10 min) (30') (Slides)	J. K. Nelson (*William & Mary, Virginia*)
14:50	Fully active scintillator detectors (20+10 min) (30') (Slides)	M. Messier (*Indiana University*)
15:20	Liquid Argon R&D (20 + 10 min) (30') (Slides)	A. Marchionni (*ETH Zurich*)
15:50	Coffee break (20')	
16:10	Water Cerenkov experience from Japan + R&D (20 + 10 min) (30') (Slides)	H. Aihara (*University of Tokyo*)
16:40	Underground facilities technological challenges (15 + 5 min) (20') (Slides)	N. Spooner (*University of Sheffield*)
17:00	Photodetectors R&D for cost effective PMs, MPPC (15+5 min) (20') (Slides)	T. Nakaya (*Kyoto University*)
17:20	Cost effective electronics for LAr and photodetectors readout (15 + 5 min) (20') (Slides)	S. Centro (*University Padova*)
17:40	Round table (1h00') (Slides)	

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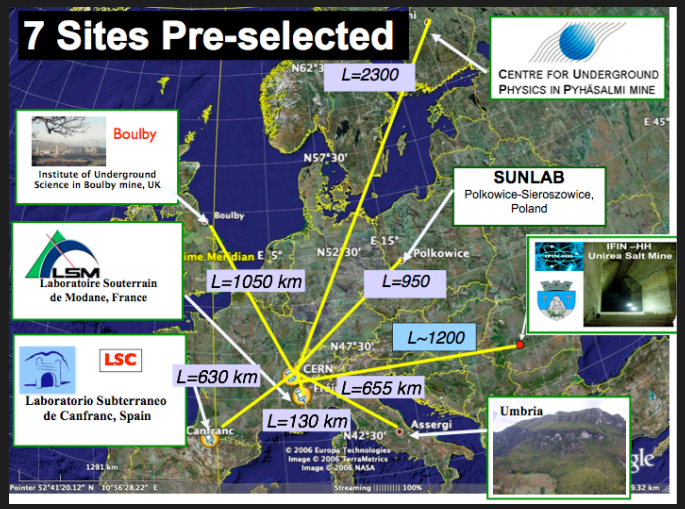
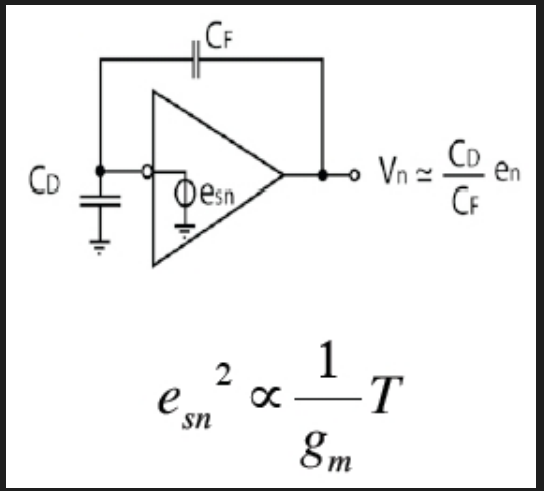
Underground sites
N. Spooner



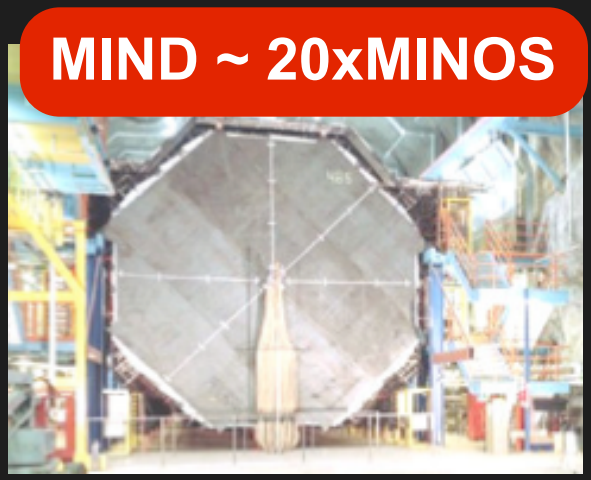
Photodetectors
T. Nakaya

	Area (cm²)	Gain	Voltage (V)	Noise or Dark Current	QE or PDE (%)	B-field	Exp.	Commercial
20" PMT	2000	1E7	~2000	~10kHz	~20	×	Super-K	○
High QE PMT	~500	1E7	~2000	~5kHz	30~40	×	IceCube	○
13" HAPD	~800	1E5	18k	~PMT	>~25	×	R&D	△
Gas PMT	~900	1E6	~2000	<PMT	~20	△	R&D	×
LAPD	---		???	---	---	△	R&D	×
MA-PMT	0.1×256	1E6	~1000	<1kHz	10~20	×	Many exp.	◎
MA-MCP-PMT	0.1×64	1E6	~2500	<1kHz	10~20	○		○
APD	0.2×32	~100	~300	<3000e	70~80	◎	NOvA	○
PPD (MPPC, ..)	~0.1	1E6	<100	~1MHz	30~45	◎	T2K ND280	○
MC-HAPD	0.3×144	1E5	8k	~1μA	~25	○	R&D	△

Electronics
S. Centro



Magnetised Iron calorimeters

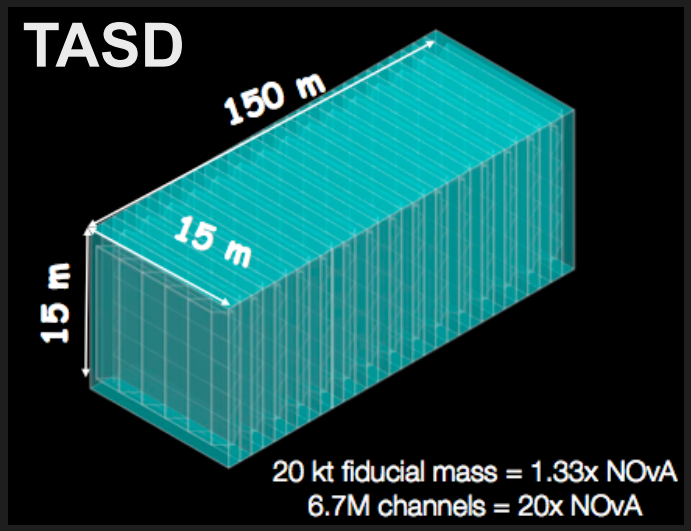


- Performance
  - ~10^{-4} charge mid-id seems possible in MINOS
  - Need test beam to understand
    - Charge mis-id
    - Shower profiles and angular resolution
- Need to reduce threshold (4 ⇒ 2 GeV), less charge mid-id
  - better segmentation, higher B field (+20% feasible)
- Shape of scintillators:
  - Space resolution (triangular) vs light yield (rectangular)
- Cost: ~230 M$ for 100 Kton
  - Driven by scintillators, PD and electronics
- No intermediate step needed

Totally Active Scintillating Detectors

- NOvA (the ~perfect prototype) under construction
- TASD motivated by the LENF (<5 GeV)
- Performance:
  - Electron charge study (need test beam !!!)
  - Is statistical tau appearance possible ?
- Cost: NOvA =145 M$, TASD ~ 6xNOvA
  - Driven by scintillator, PD and electronics
  - Solid (6-10 $/Kg) vs liquid (~3 $/Kg)
- Feasibility: R&D on magnet
- Synergies: Limited by mass. To be studied
- No intermediate step needed

20 Kton mass = 1.33xNOvA
6.7 M channels = 20xNOvA



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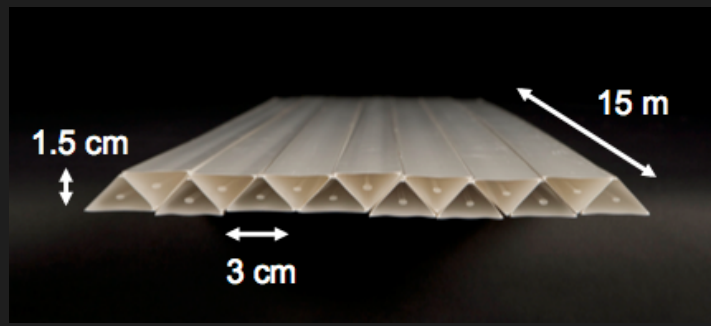
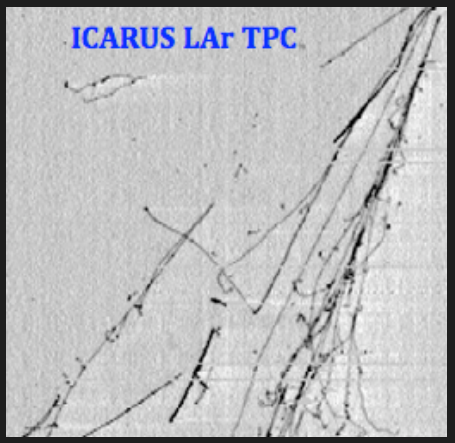


Talk by M. Messier

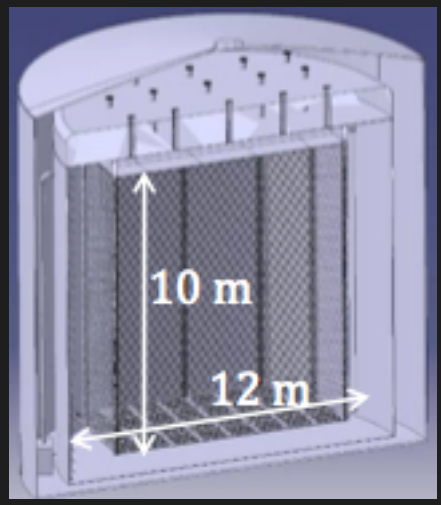
Liquid Argon TPCs

GLACIER = 150 x ICARUS T600

- Efforts in US, Japan and Europe
- Important achievements:
  - Double phase readout, purity, magnetic field, etc
- Critical R&D items:
  - Long drift distances, purity, tanks
  - Magnetisation for NF
- Performance:
  - Need to complete MC studies for a NF
  - Need test beam: to be proposed in 2010 (6 m^3)
- At least one intermediate step needed →
- Important synergies with non accelerator physics



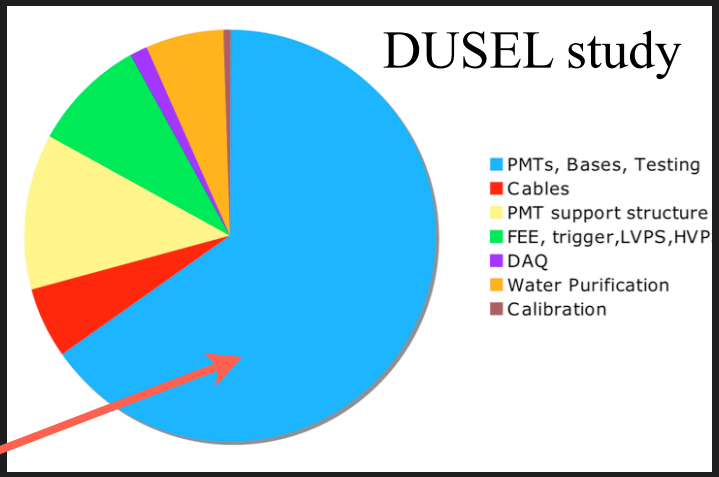
1Kton



Large Water Cerenkov detectors

10-20 x SK

- Performance:
  - high energy showers ?
- Feasible !! Main R&D items
  - Cavern, liner and PD support structure
  - Water purification
- Cost: ~700 M$ for HK incl. cavern
- Cost drivers: Photodetectors (65% of instrumentation cost)
  - Important developments in HAPDs (ready by 2013)
- No intermediate step needed
  - Caveat: if HAPDs, need to test them at some large scale
- Well known synergies with non accelerator physics



R&D planning

- MC simulations: EUROnu for near, MIND and WC.
- Technical R&D: **missing in Europe,** except for LAr
- Prototyping: **missing for MIND and TASD. More for LAr**
- Dedicated test beams: **missing**
- Intermediate steps

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wish

The role of CERN

- EU FP projects and networks are very useful...
- But more support from CERN would be very welcomed:
  - Technical R&D: electronics, PD, scintillators, LAr, ...
  - Test beams
  - R&D followup

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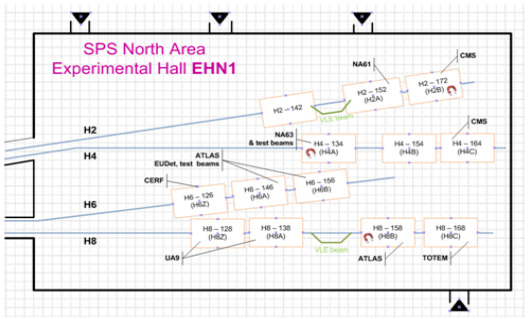
TEST BEAMS AT CERN FOR DETECTOR R&D

2 SPS North Area

- H2, H4, H8 : 10 ÷ 400(450) GeV/c
  - H8 : attenuated proton beam
  - H2 and H8 : have a VLE branch → beams 1-9 GeV/c
- H6 10-200 GeV/c
- Particle types: electrons, hadrons, muons
- Intensity : max 1÷2 × 10^8 particles/spill
  - Flat top : 4÷9 sec
  - Cycle : 16.8 ÷49s



I.Efthymiopoulos, CERN

Courtesy of I. Efthymiopoulos (CERN)

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example for LHC detector R&D

Detector Research and Development Committee (1990-1995)

R&D projects and proposals

RD1, ..., RD50, ...

RD-1 (P1)
Scintillating fibre calorimetry at the LHC.
RD-2 (P3)
Proposal to study a tracking/preshower detector for the LHC.
RD-3 (P5)
Liquid argon calorimetry with LHC-performance specifications.
RD-4 (P6)
Study of liquid argon dopants for LHC hadron calorimetry.
RD-5 (P7)
Study of muon triggers and momentum reconstruction in a strong magnetic field for a muon detector at LHC.
RD-6 (P8)
Integrated high-rate transition radiation detector and tracking chamber for the LHC.
RD-7 (P4)
Proposal for Research and Development on a central tracking detector based on scintillating fibres.
RD-8 (P13)
Proposal to develop GaAs detectors for physics at the LHC.
RD-9 (P21)
A demonstrator analog signal processing circuit in a radiation hard SOI-CMOS .

http://committees.web.cern.ch/Committees/DRDC/Projects.html

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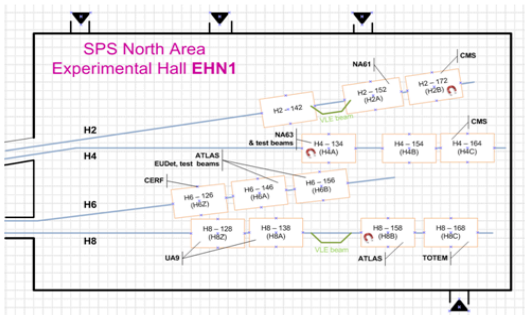

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