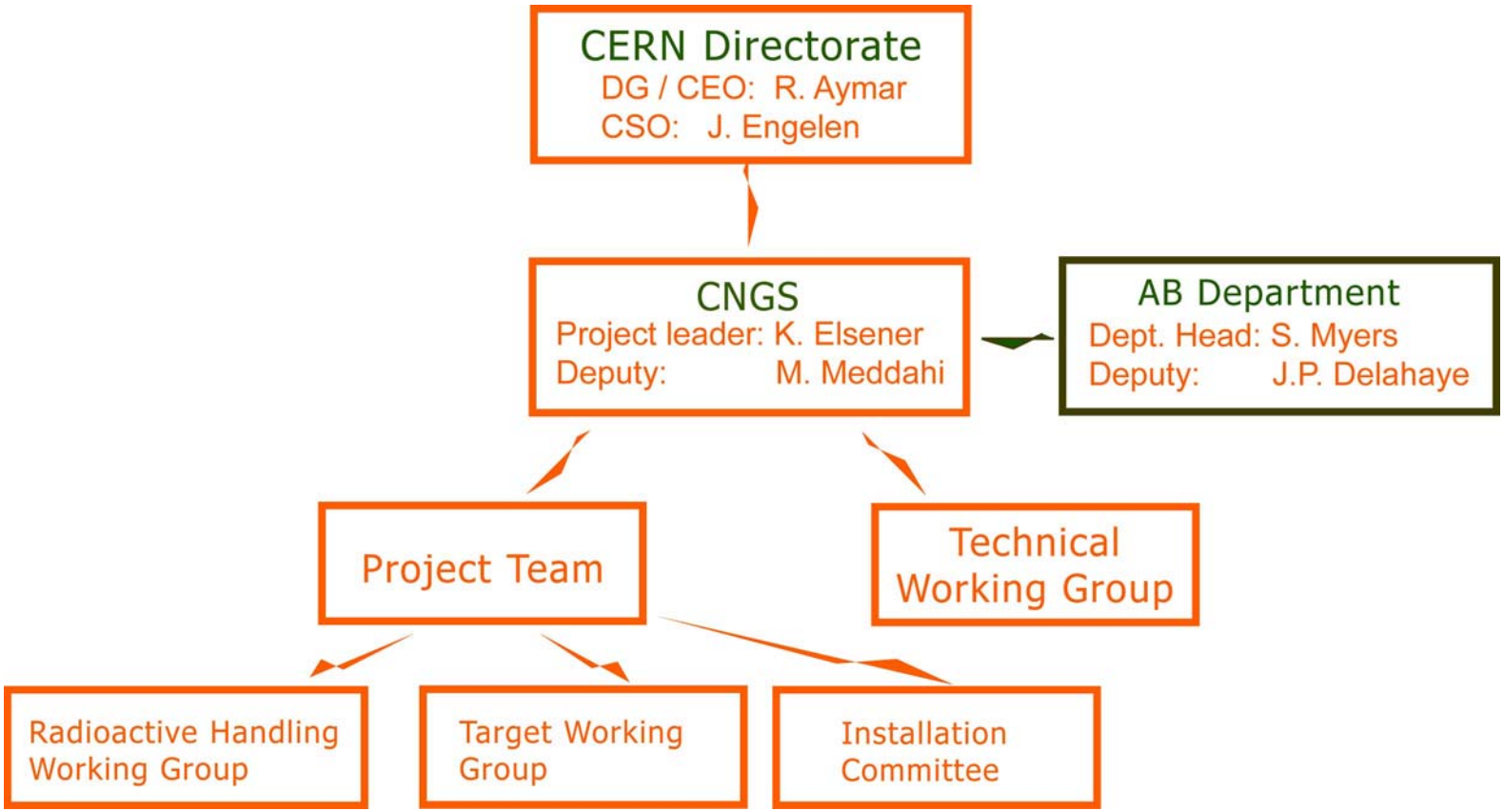
CNGS Project: Status report

OUTLINE

1. CNGS in the new CERN structure
2. Project Overview – main components
3. Civil Engineering / Hadron Stop / Decay Tube
4. Equipment design + procurement
5. Link to LNGS / timing
6. Link to CERN / muons from the rock
7. Summary

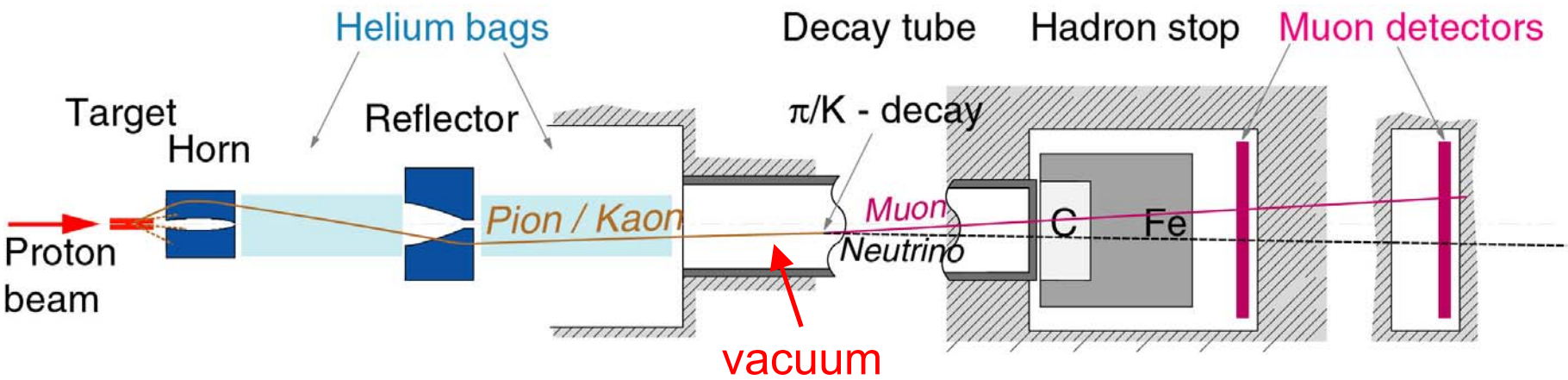
1. CNGS and the new CERN structure



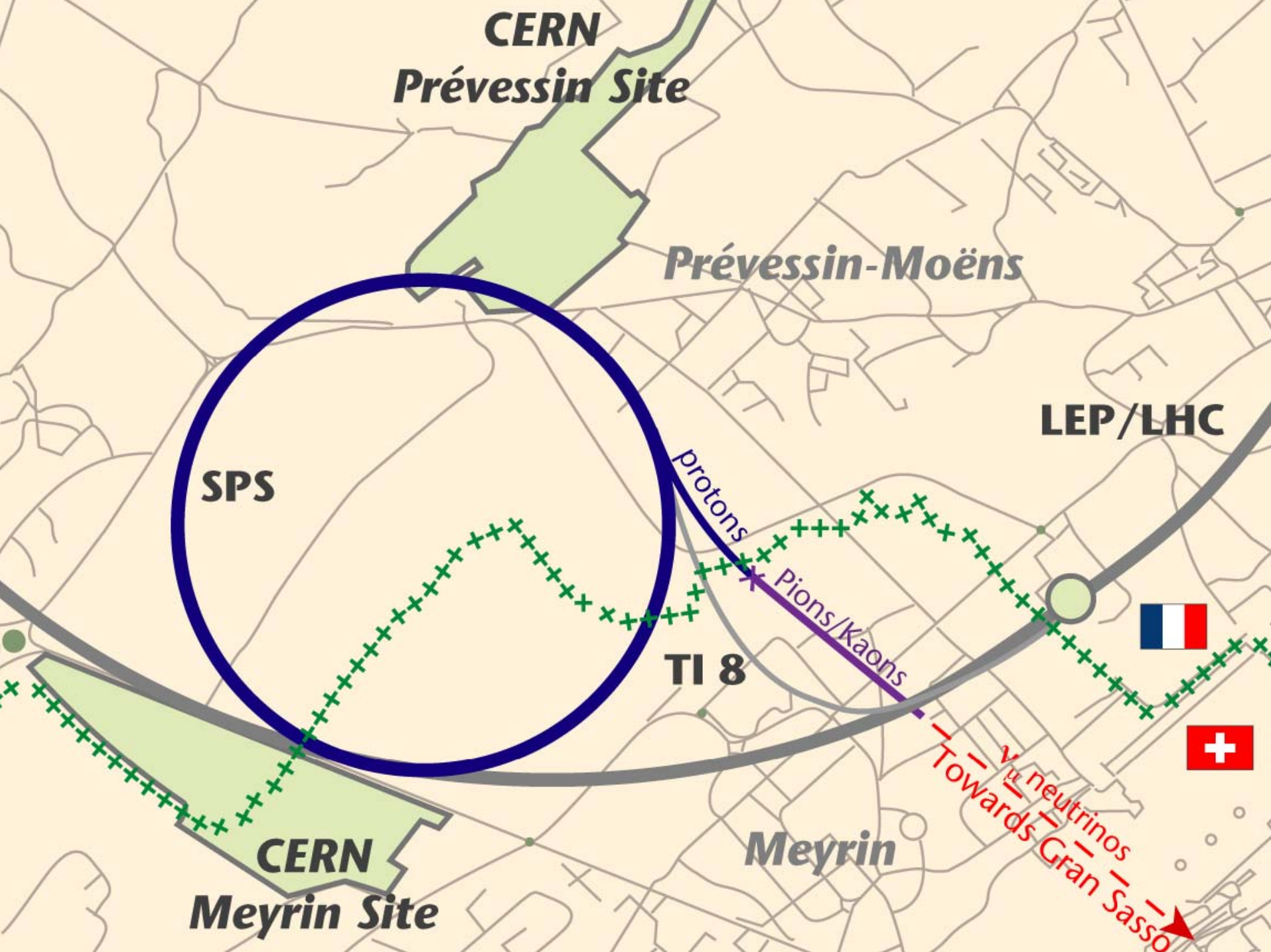
Note: J. Engelen represents CERN in the INFN/CERN bilateral committee

2. CNGS: the main components

700 m 100 m 1000m 67 m



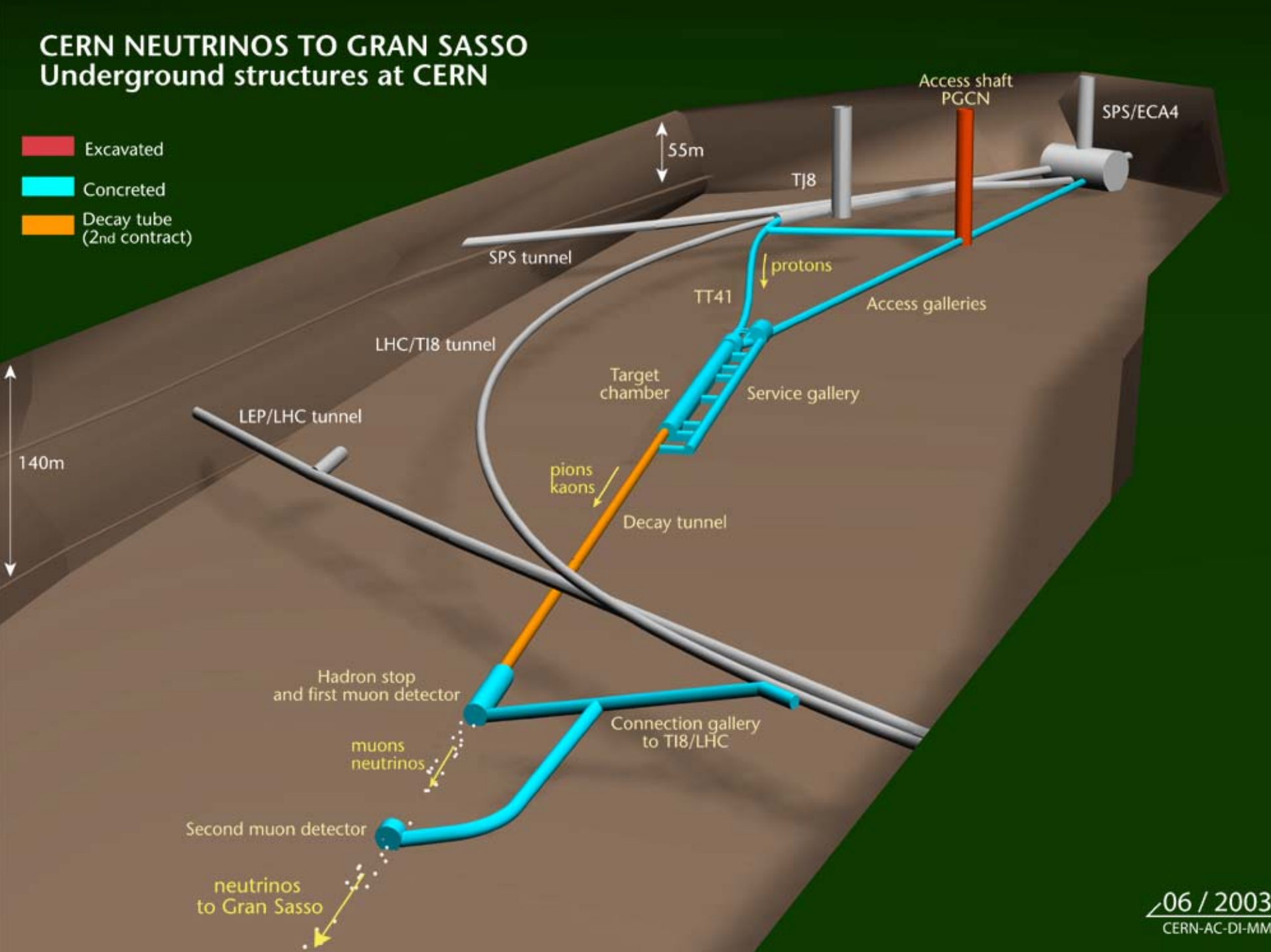
$p + C \rightarrow$ (interactions) $\rightarrow \pi^+, K^+, (\mu^+) \rightarrow$ (decay in flight) $\rightarrow \mu^+ + \nu_\mu$


CERN
Prévessin Site
Prévessin-Moëns
LEP/LHC
SPS
protons
Pions/Kaons
TI 8
CERN
Meyrin Site
Meyrin
Towards Gran Sasso

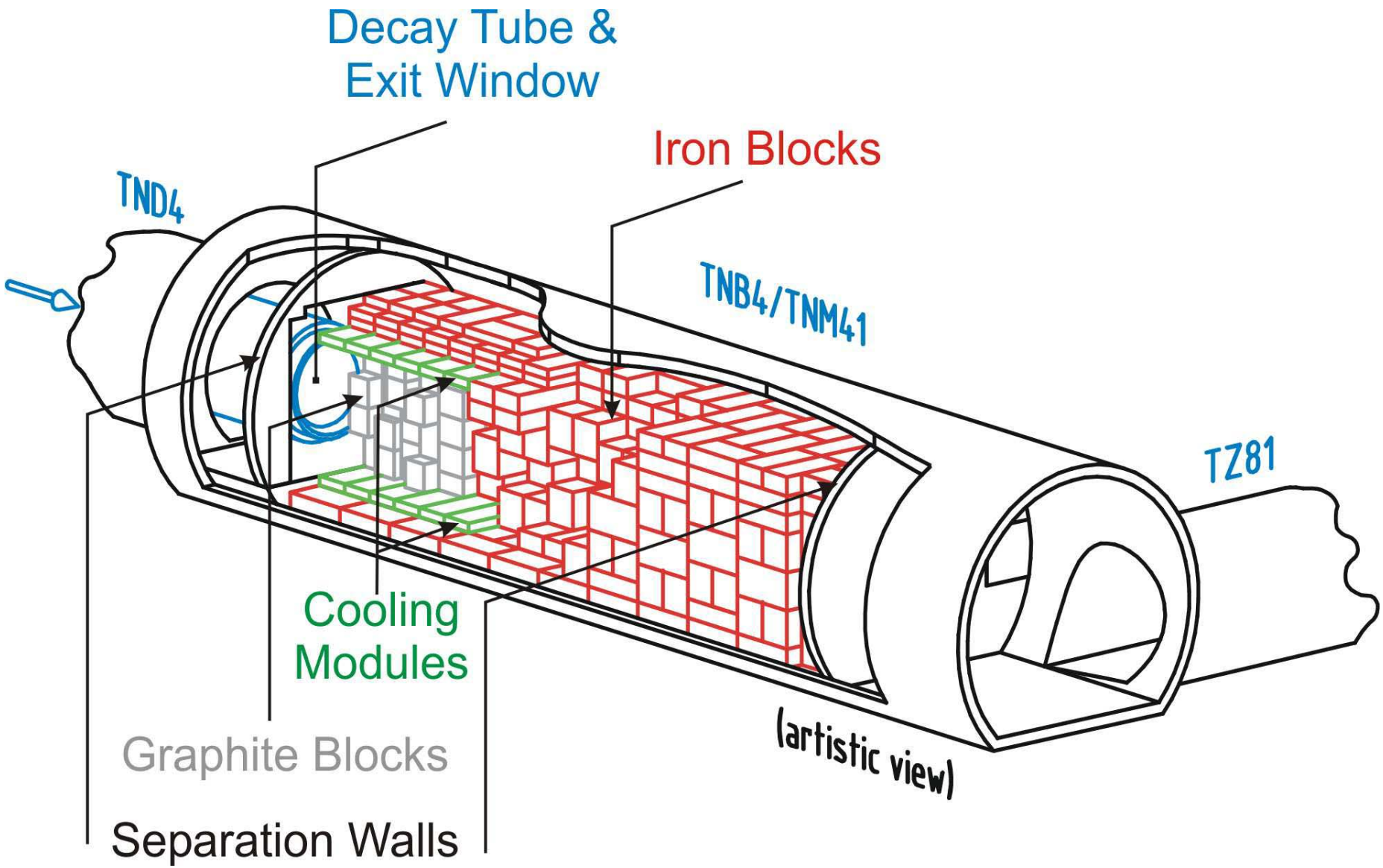
3a. Civil Engineering Works

NB. CE works started on 12 October 2000

Target Chamber, June 2003


CERN NEUTRINOS TO GRAN SASSO
Underground structures at CERN
Excavated
Concreted
Decay tube
(2nd contract)
55m
140m
Access shaft
PGCN
SPS/ECA4
TI8
SPS tunnel
protons
TT41
Access galleries
LHC/TI8 tunnel
Target
chamber
Service gallery
LEP/LHC tunnel
pions
kaons
Decay tunnel
Hadron stop
and first muon detector
Connection gallery
to TI8/LHC
muons
neutrinos
Second muon detector
neutrinos
to Gran Sasso
06 / 2003
CERN-AC-DI-MM

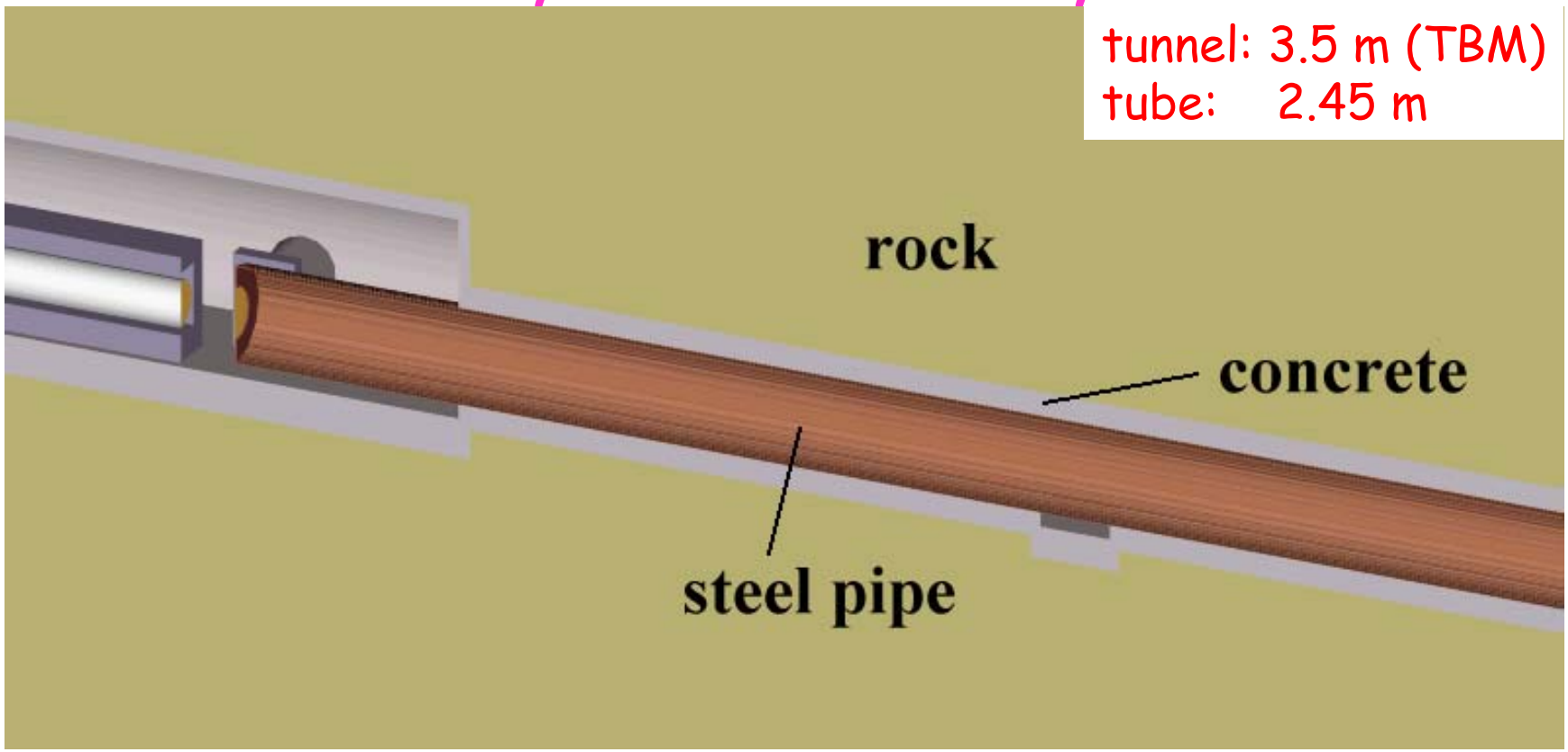
3b. Hadron Stopper (beam dump)



11 July 2003 – near the CE shaft

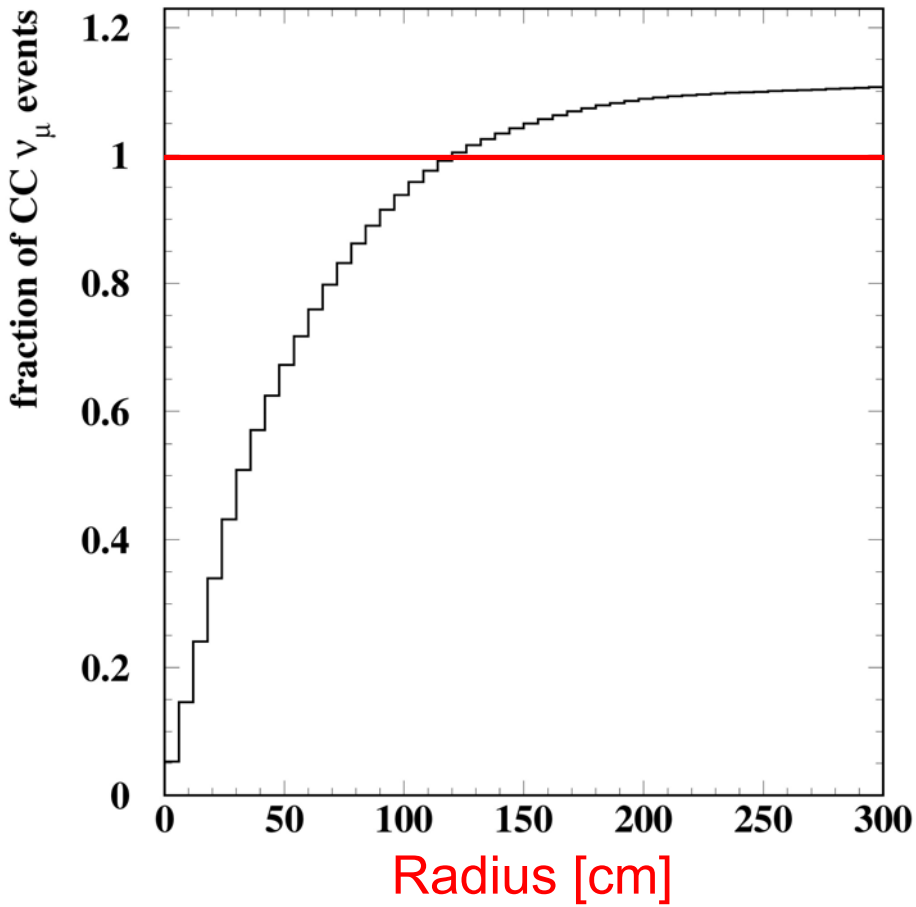
Hadron stop – 2 Sept 2003

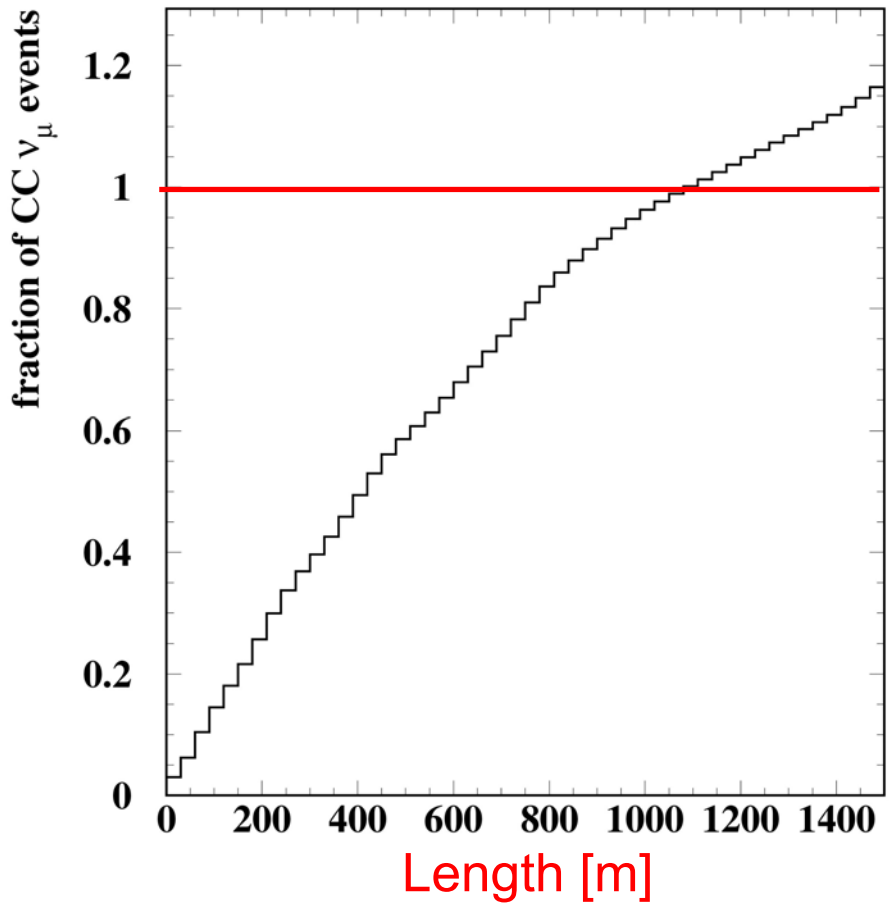
3c. CNGS Decay tunnel – Decay tube



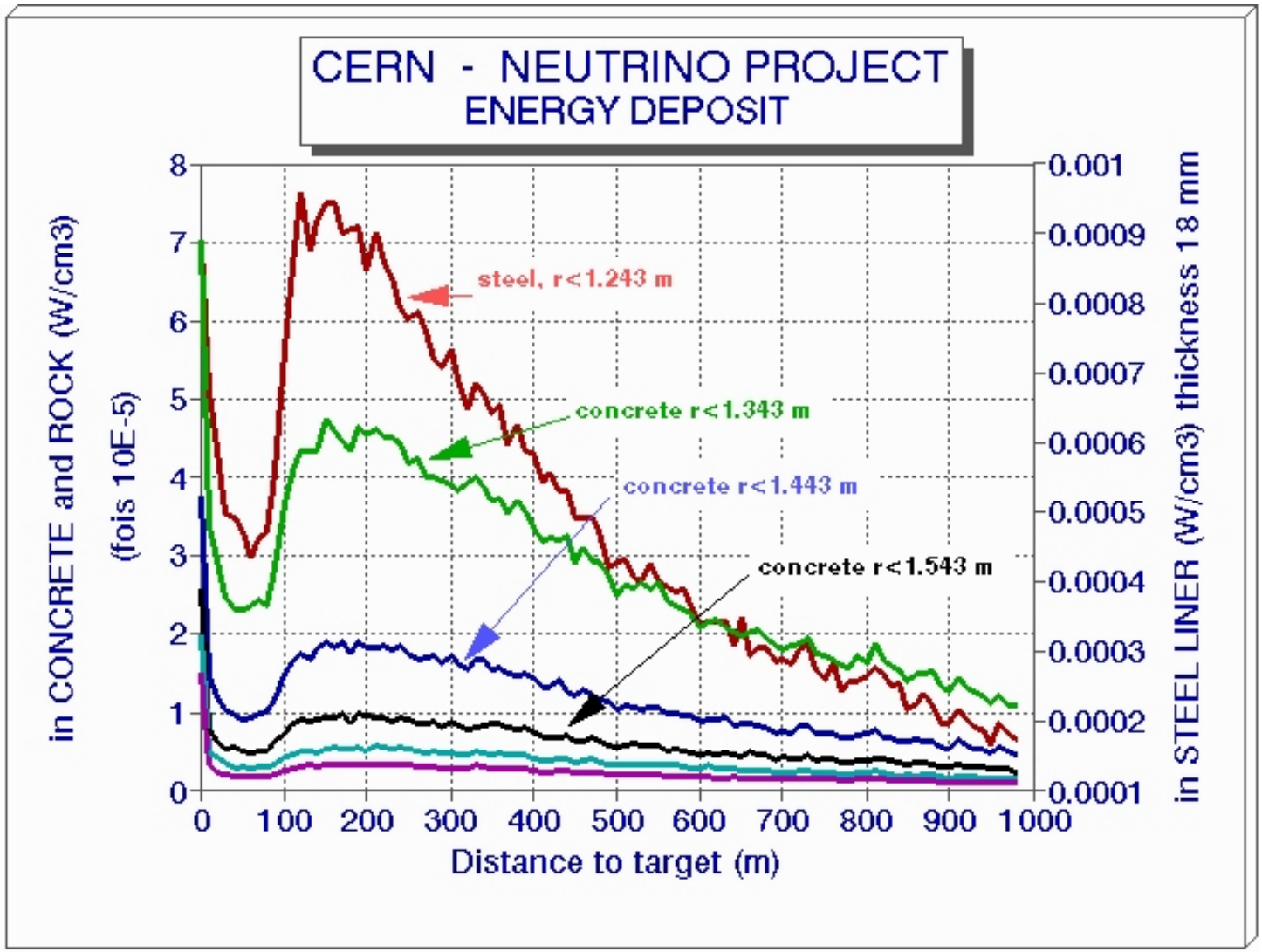
998 m long steel tube, surrounded by 50 cm of concrete evacuated to 1 Torr
tube has 2.45 m diameter, is 18 mm thick

Decay Tube: choice of dimensions
-> "good events" at Gran Sasso



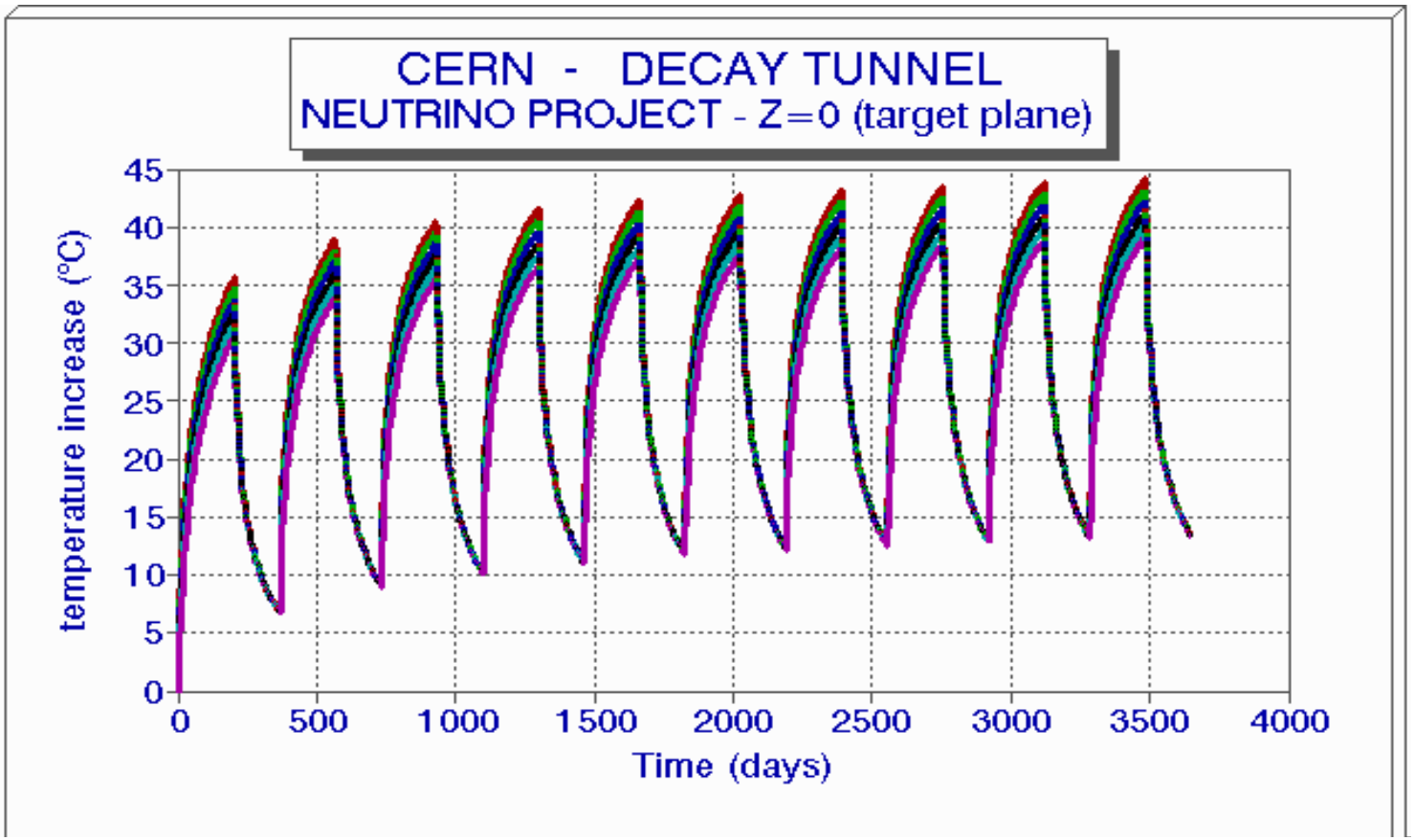


"A detail" : Energy deposition by particles



Temperature increase over 10 years – no cooling

(N.B. this is for 100% SPS efficiency and CNGS only user)



to test this model : 2 x 8 temperature probes installed

Decay tube installation

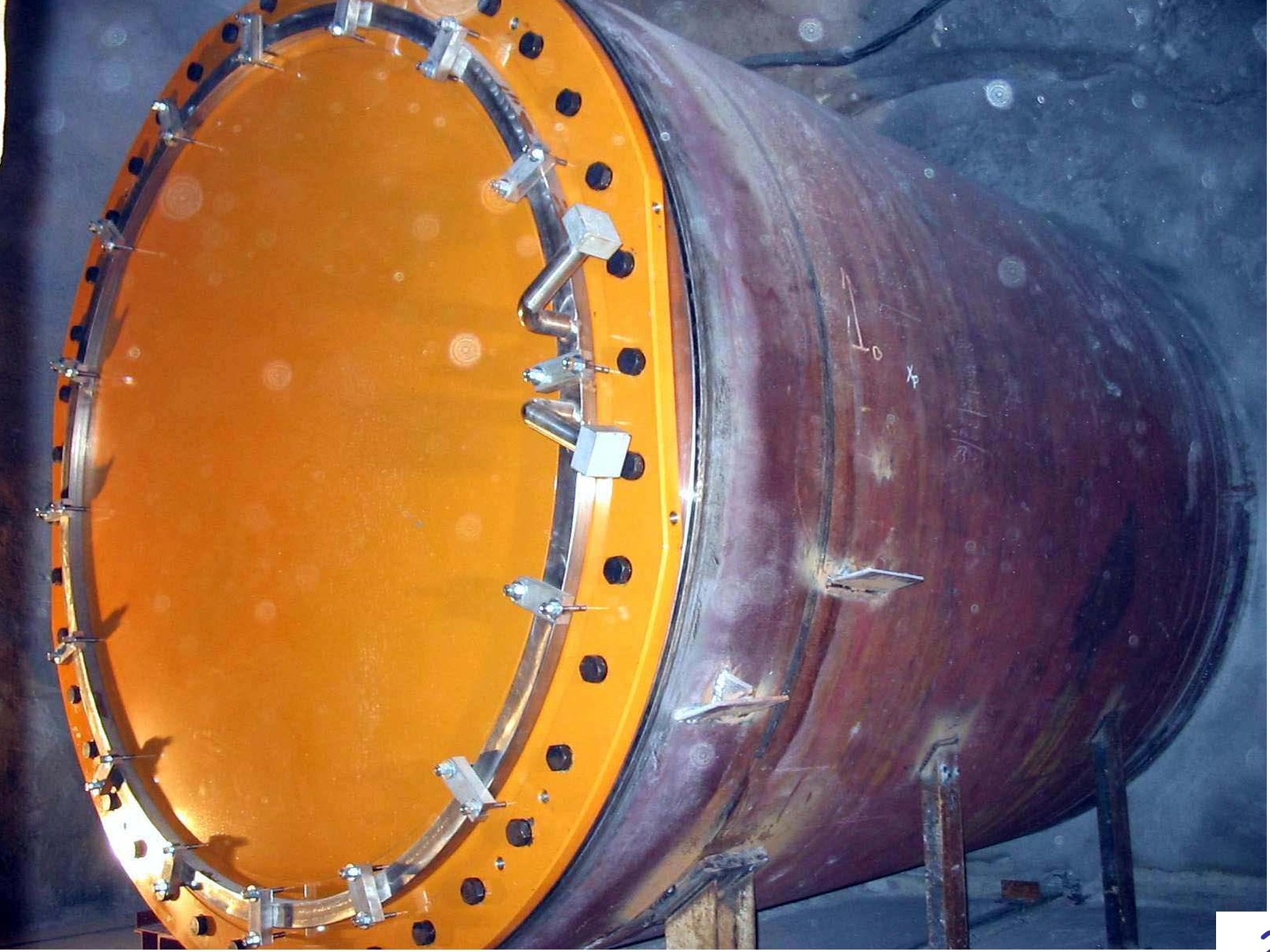

Mos

target chamber:
assembling the 18m
long sections

Welding inside decay tube

finished decay tube
(target chamber)

Inside decay tube: View towards hadron stop



25 March exit window installed

Decay tube status:

Decay tube installation completed: 16 March 2004
Install exit / entrance windows: 25 March + 1 April

Vacuum tests (by contractor): April 2004

--- keep fingers crossed ---

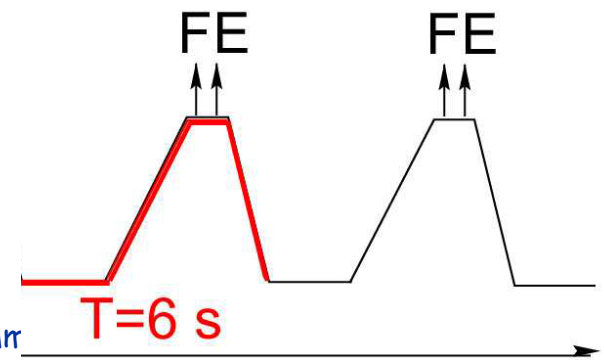
4. Equipment

4a. Proton beam

Nominal beam parameters

Beam parameters	Nominal CNGS beam
Nominal energy [GeV]	400
Normalized emittance [μm]	H=12 V=7
Emittance [μm]	H=0.028 V= 0.016
Momentum spread Δp/p	0.07 % +/- 20%
# extractions per cycle	2 separated by 50 ms
Batch length [μs]	10.5
# of bunches per pulse	2100
Intensity per extraction [10^{13} p]	2.4
Bunch length [ns] (4σ)	2
Bunch spacing [ns]	5

Upgrade phase: 3.5 10^{13} p



Expected number of protons delivered on CNGS target:

For 1 year of CNGS operation (200 days):

4.5×10^{19} protons on target / year ("nominal")

based on 1998 performance:
4.8×10^{13} protons in SPS, 55% overall efficiency;
(+ mixed cycles with LHC and other fixed target experiments)

higher proton intensities (very much requested by OPERA and ICARUS):

High Intensity Protons Working Group ;
+ "machine" studies under way

High Intensity Protons Working Group:
Recommendations 26 February 2004

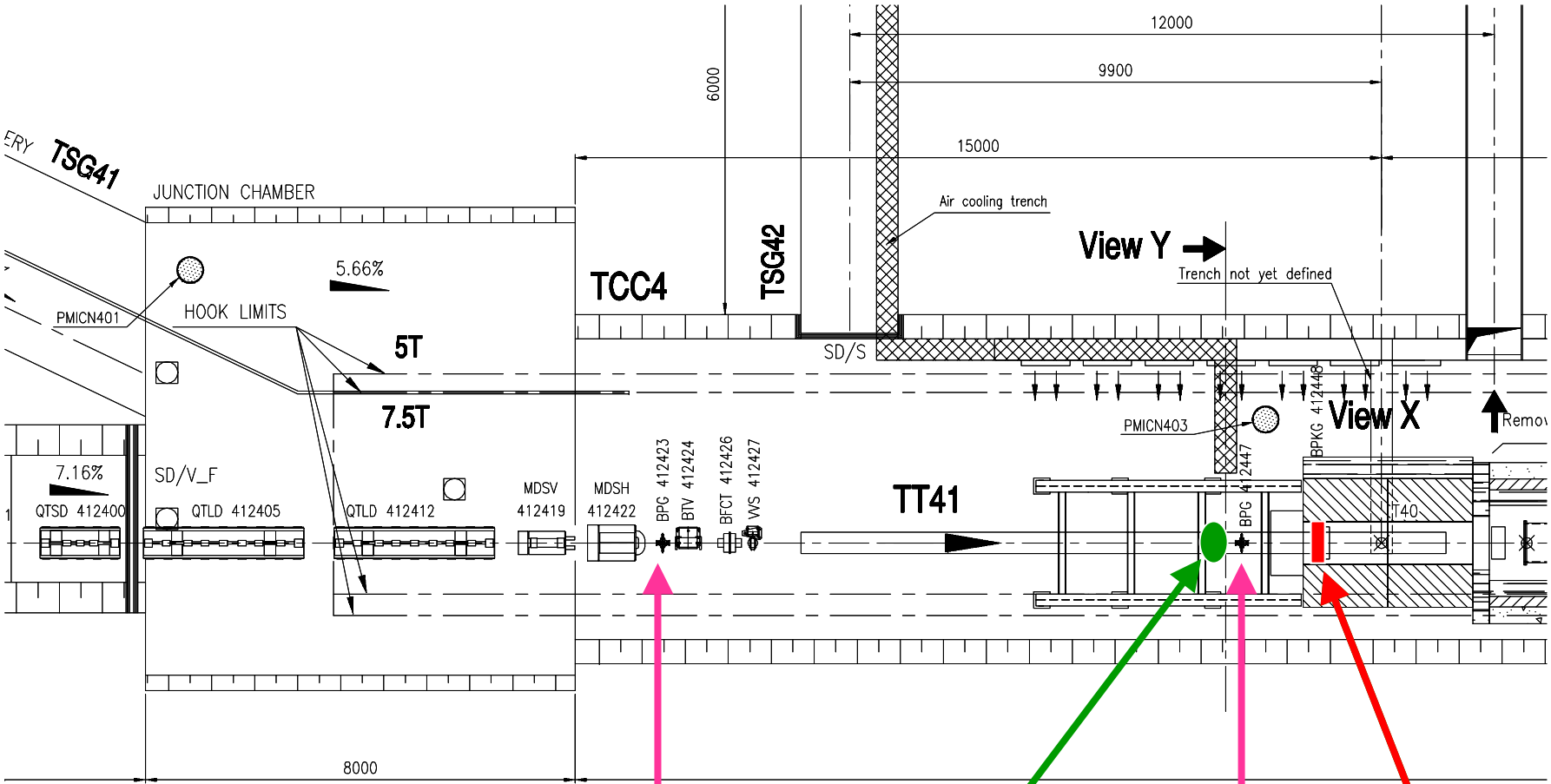
launch 3 projects (define in 2004, start in 2005):

(1) low loss extraction at the PS
(2) increase CNGS intensity
(3) 0.9 seconds for PS Booster basic period

Comments by the WG:

(1) irradiation of accelerators is a major concern
(2) increase for CNGS only possible via increase per extracted beam pulse
(3) in the analysis, "other SPS fixed target expts." were given low priority

Proton beam – last 100 metres



Beam monitoring

Problem: fast extracted, very intense proton beam, focused into a very small beam spot is too hot for standard Ti windows

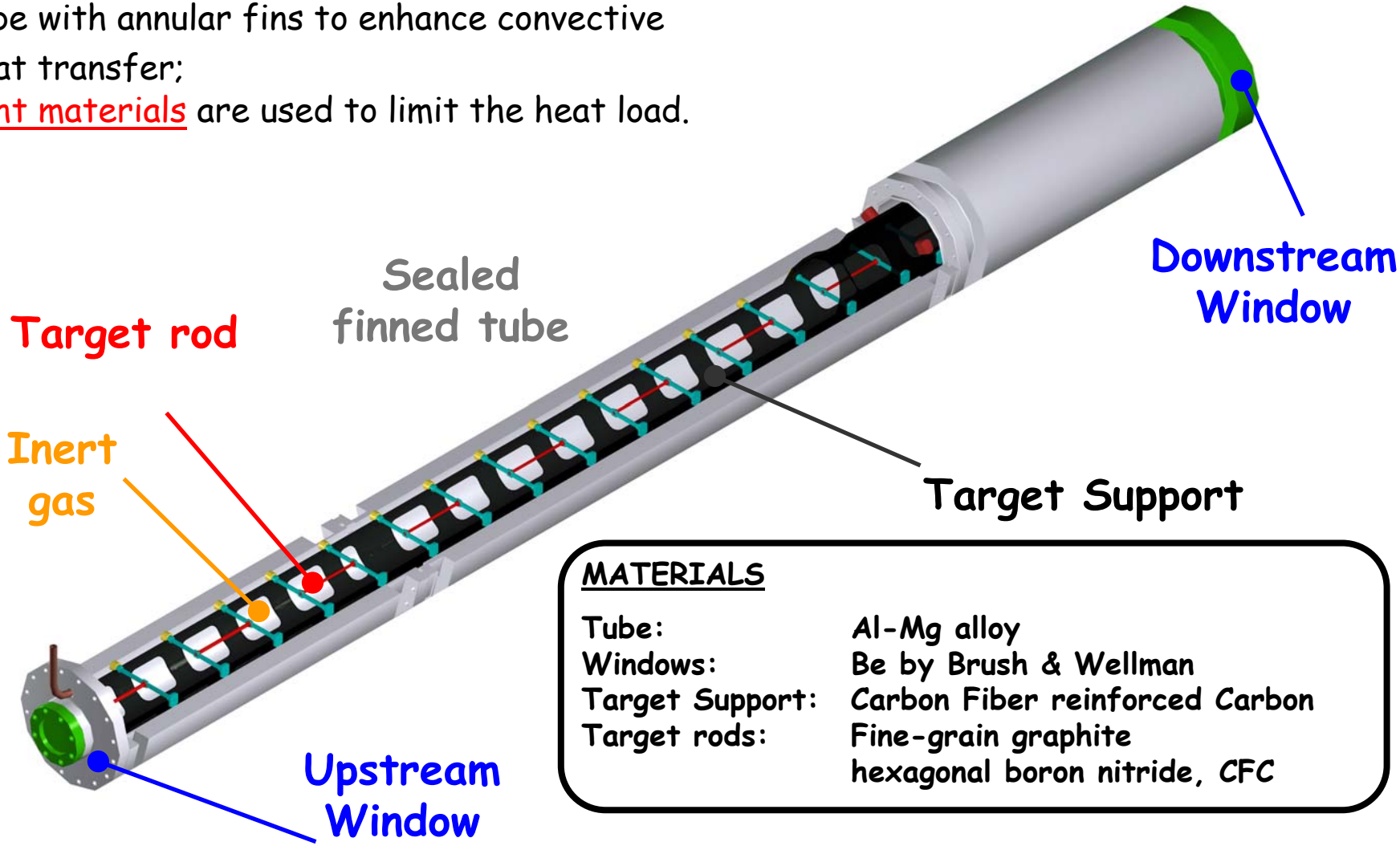
→ Secondary Emission Monitors don't work

Question: beam position monitor **operated in air** ?

→ a challenge

Target unit

static sealed system filled with inert gas;
tube with annular fins to enhance convective heat transfer;
light materials are used to limit the heat load.



MATERIALS

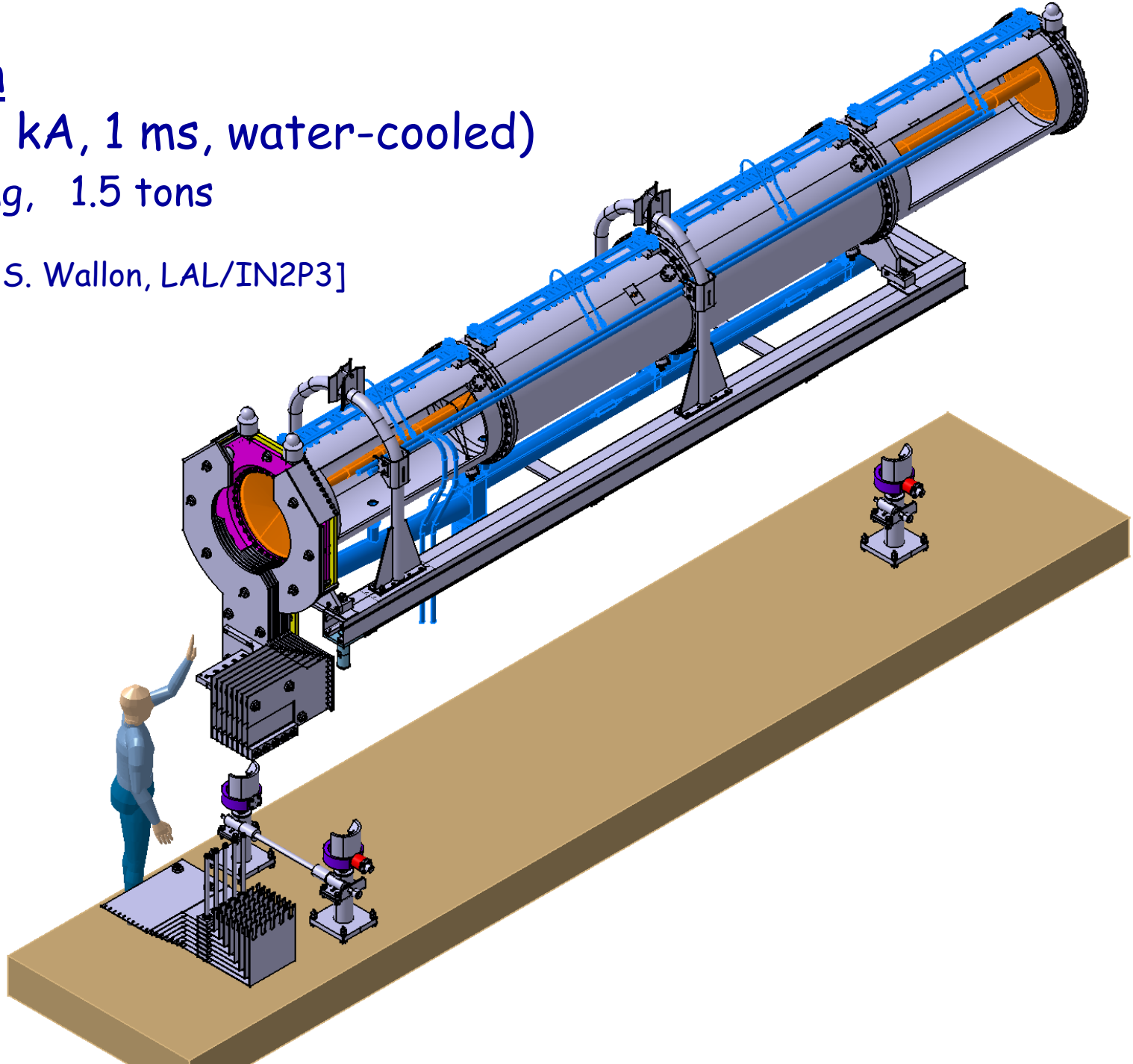
Tube:	Al-Mg alloy
Windows:	Be by Brush & Wellman
Target Support:	Carbon Fiber reinforced Carbon
Target rods:	Fine-grain graphite hexagonal boron nitride, CFC

CNGS Horn

(pulsed: 150 kA, 1 ms, water-cooled)

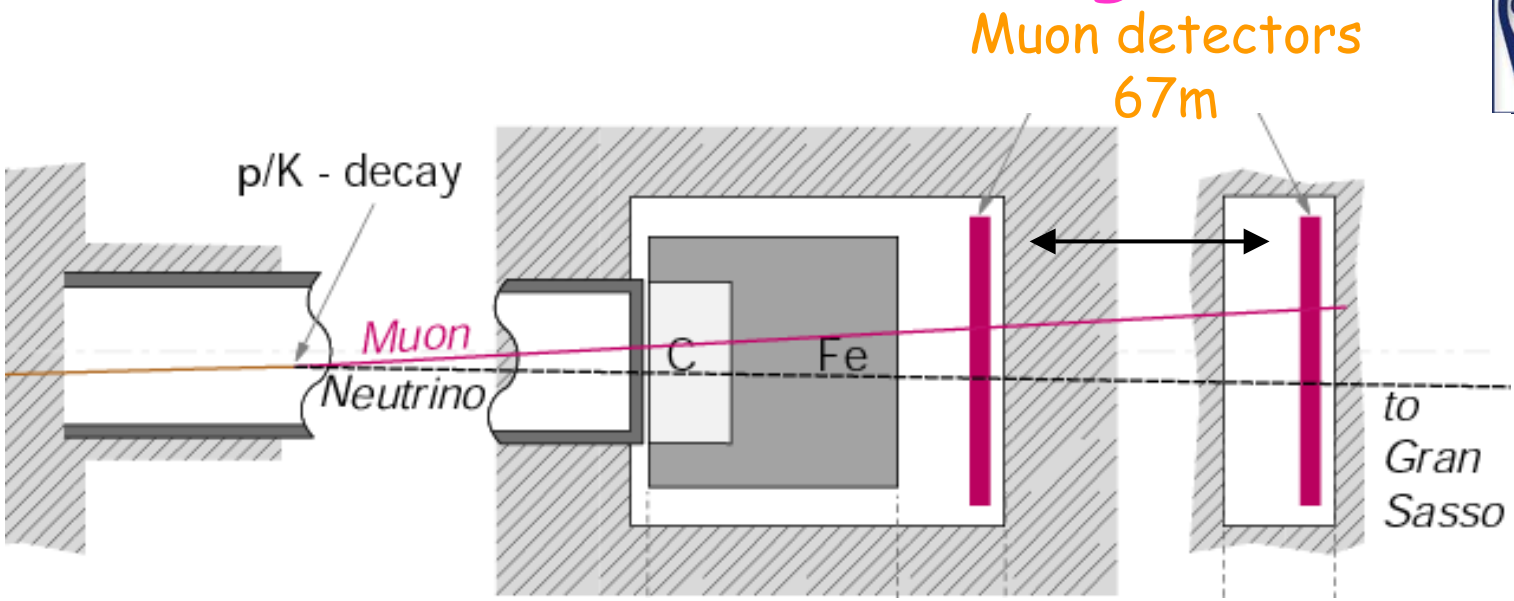
6.5 metres long, 1.5 tons

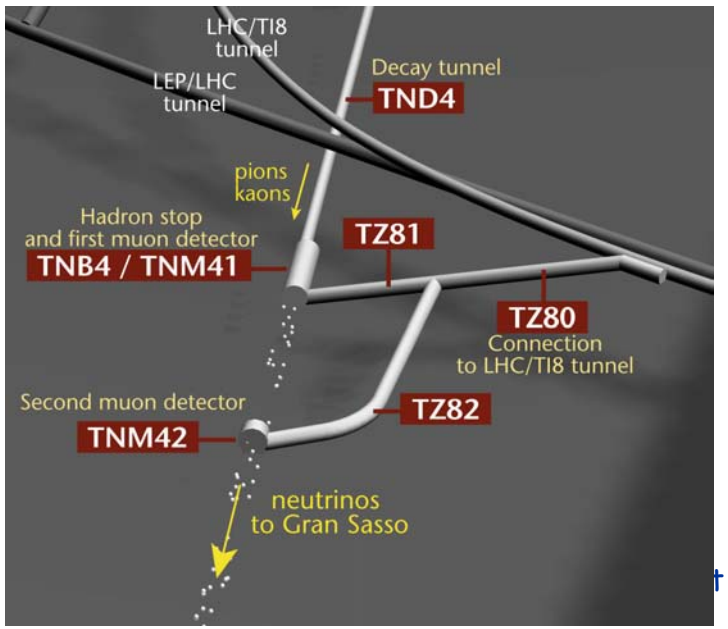
[picture courtesy S. Wallon, LAL/IN2P3]



In-kind contribution by LAL/IN2P3:
first horn ready, to arrive at CERN 7 April

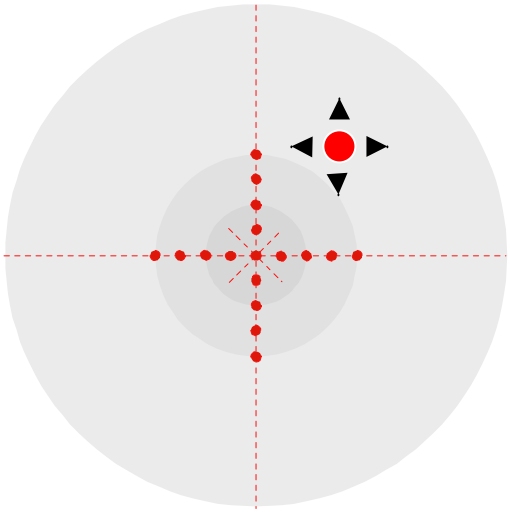
CNGS Muon Monitoring





Access to muon monitoring stations very rare !

t to LNGS Scientific Committee
presented by K. Elsener



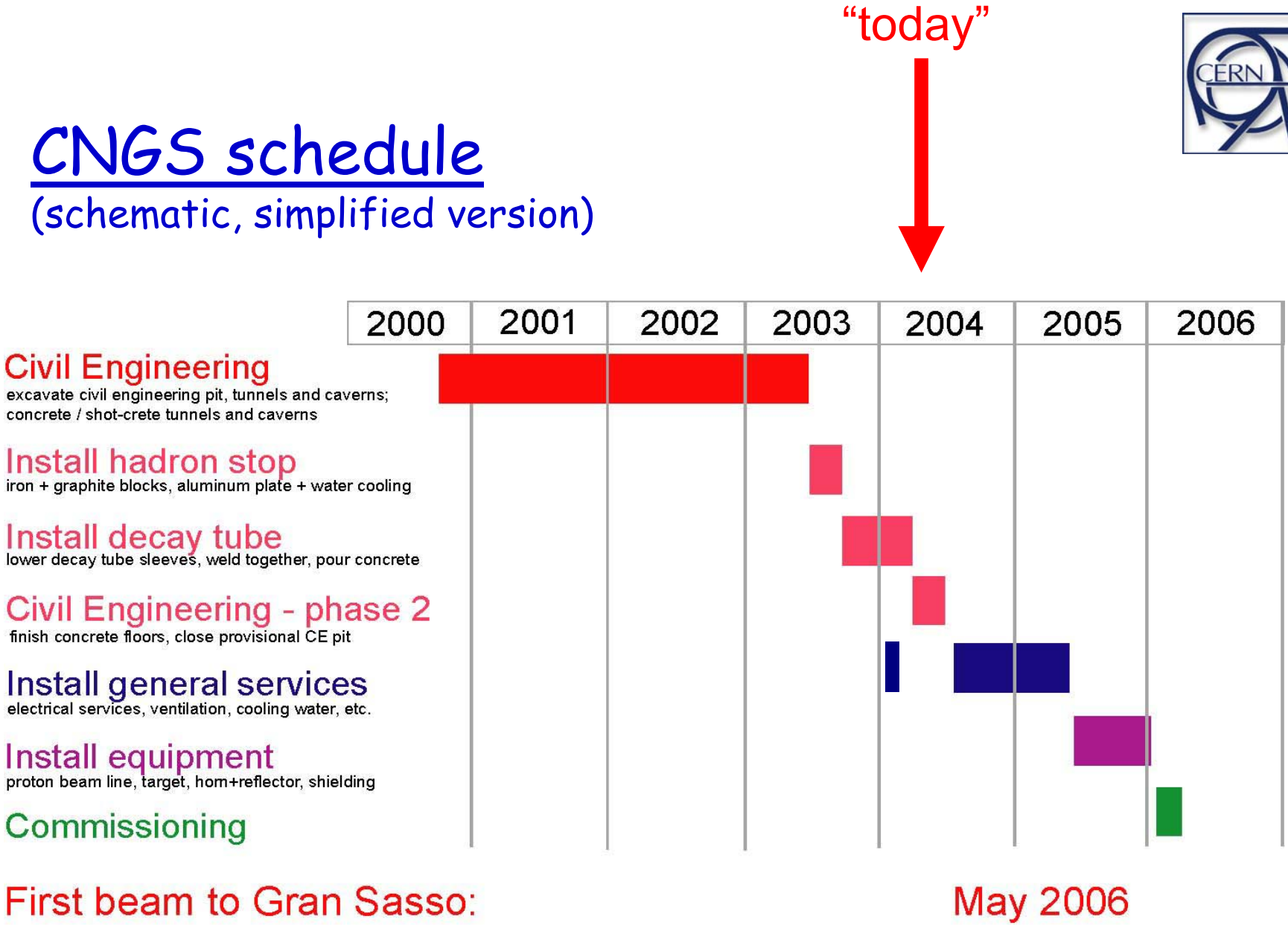
17 BLM (fixed cross centered on beam axis)
+ 1 motorised monitor

SPS Type Beam Loss Monitor

Ionisation Chamber

CNGS schedule

(schematic, simplified version)



5. Link to LNGS / timing

reminder:

- timing between beam extraction at CERN and event at LNGS to be done with GPS "time-stamp"
- data sent via Internet – for every extraction, or after every 6 s cycle (i.e. 2 extractions)

(N.B. data transfer takes less than 30 ms "round trip" – expt. in 2001)

GPS timing at CERN: start tests with final equipment in June 2004

- accuracy expected: < 40 ns
- available for demonstration (visit) + discussion end of 2004
- available "on loan", if LNGS is interested

expert for timing at CERN: Gary.Beetham@cern.ch
expert at LNGS: name please, thanks !

In addition to the (most important) timing information, we are planning to send

- an early warning (few seconds) to indicate whether the next cycle will have beam or not
- any data files on the beam parameters (protons, muons) as required by LNGS – please specify !

(CNGS controls co-ordinator: Veronique.Paris@cern.ch)

Note:
Information on the status of the SPS is available on the "page-1", on the Web (longer stop, problems, etc.)

5. Link to CERN / muons from the rock

reminder (CERN-EP/2001-037):

in a 100 m^2 detector at LNGS, about
80 CNGS muons per day
can be measured coming from the rock
upstream of the caverns

CERN's wish: please measure these muons,
and give us fast feedback (every hour ?)
(+ ... if possible:
please give us the GPS timestamp, for every muon ...)

Summary:

- CNGS on schedule for beam in spring 2006
- Infrastructure installations will start in June
- Equipment well advanced - but still a lot of work ahead !

  [main issues: (1) radioactive handling
  (2) small, intense 10.5 μs proton beam bursts]

- PS + SPS tests with high intensity are scheduled for 2004 – LNGS experiments must continue to make their physics case for more protons clear to everybody !


Thank you!