NEUTRINO BEAM AT PS: LAYOUT AND REFURBISHMENT

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Neutrino Detector Studies and possible Experiment at CERN PS
17 – 18 March 2010

Contents

- Potential places for experiments
- The existing infrastructure
- PS Proton Beam Production
- Preliminary Ideas on the Proton Beam Line
- Target System and Decay Tube
- Work packages for Possible Project
- Concluding Remarks

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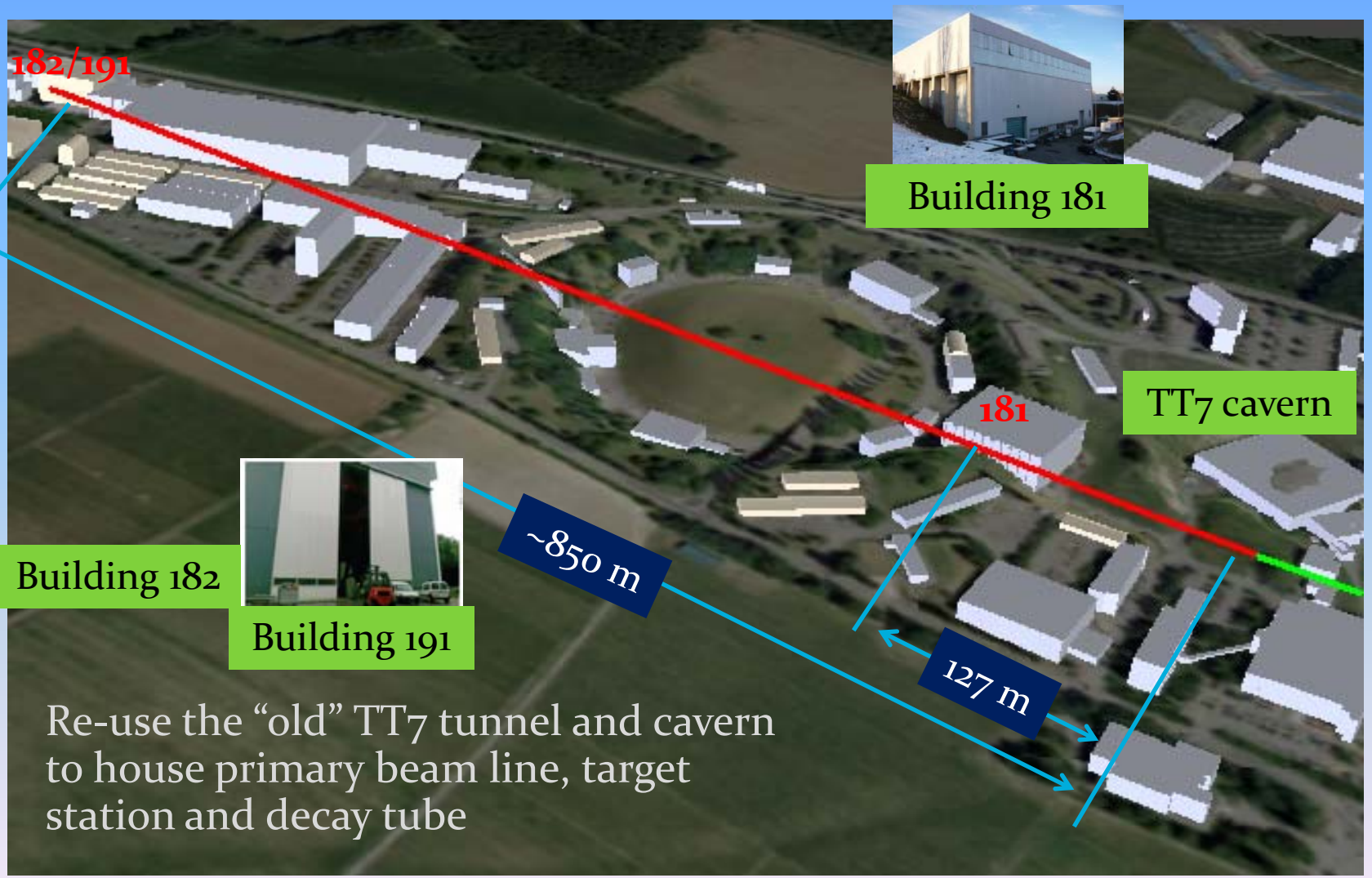
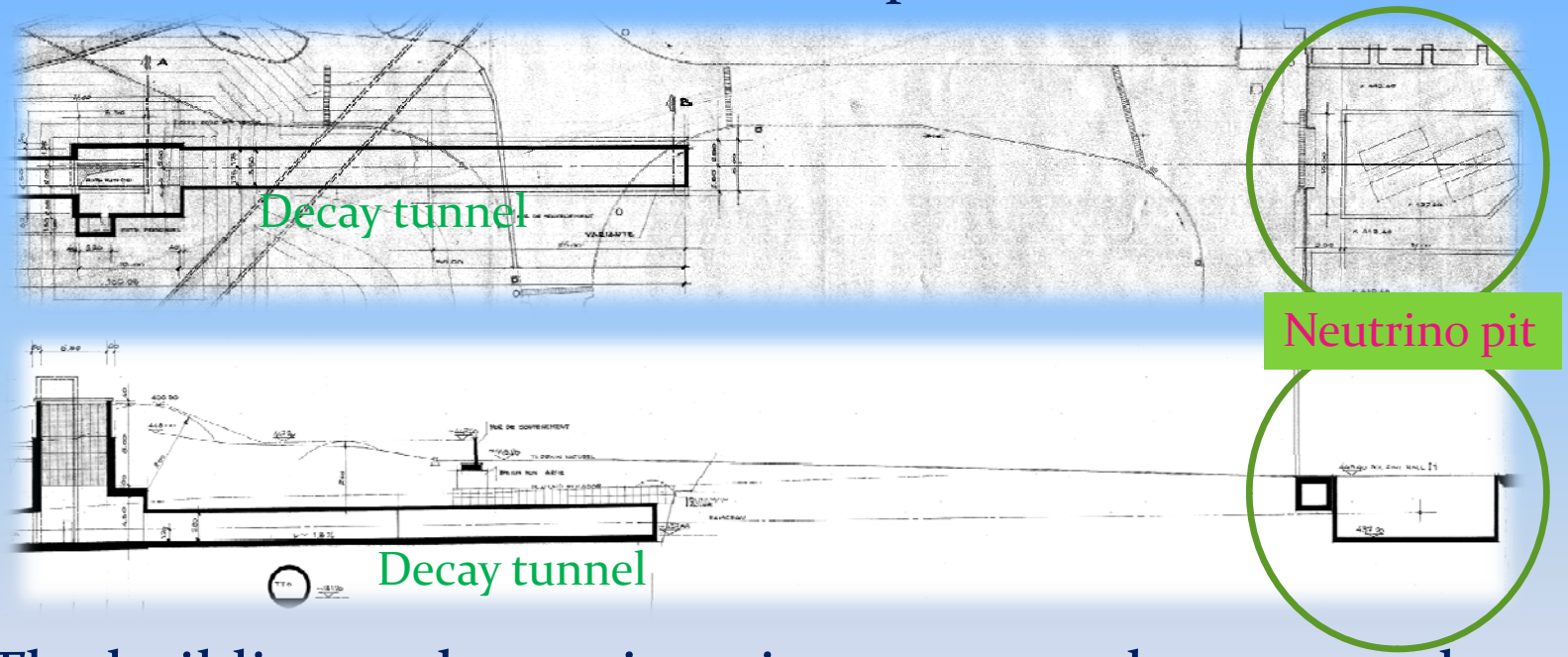
Potential Places for Experiments

PS Neutrino Facility



Building 181

- Building 181 would be ideal for a near detector.
  - It contains the "old" neutrino pit.



- The building and neutrino pit were recently converted:
  - LHC magnet repair facility
  - NEG coating facility

Building 181 Occupation

CERN NEG Coating Plant

Courtesy of Jose-Miguel Jimenez

CERN LHC Magnet Repair Facility

Courtesy of Paolo Fessia

Building 191 & 182

- Building 191 and/or 182 could house “far” detectors
- Building 191 is used for storage of ATLAS components
- Building 182 is used by the ArDM collaboration
- The survey team is verifying the exact geometrical position of the TT7 tunnel within the CERN coordinate system
- They will extrapolate the TT7 tunnel until the end of the Meyrin site:
  - Check which buildings are crossed
  - Check the beam position entry and exit in the buildings 181, 191 and/or 182, but perhaps also other.

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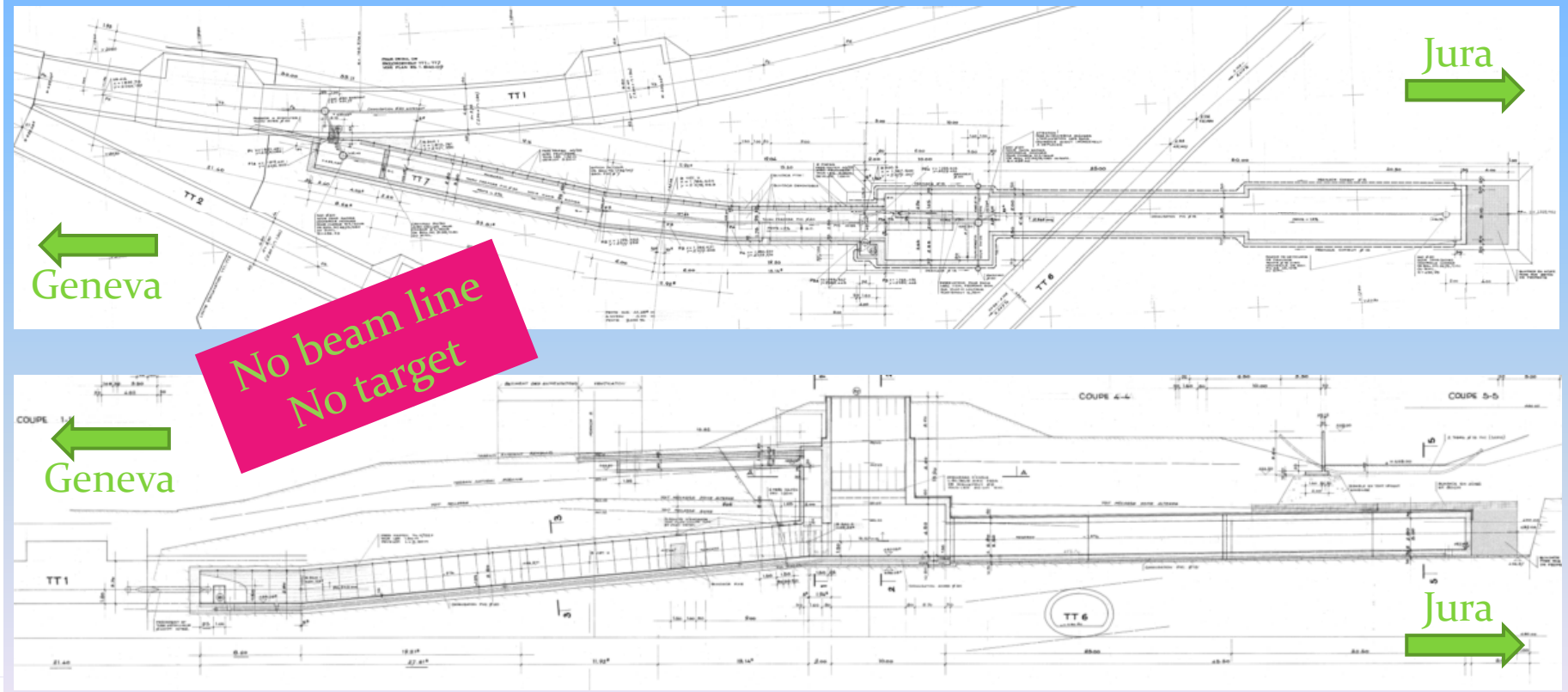
The TT7 Tunnel

- The TT7 tunnel was used in the past for neutrino oscillation experiments (PS180, BEBC in early 80's)

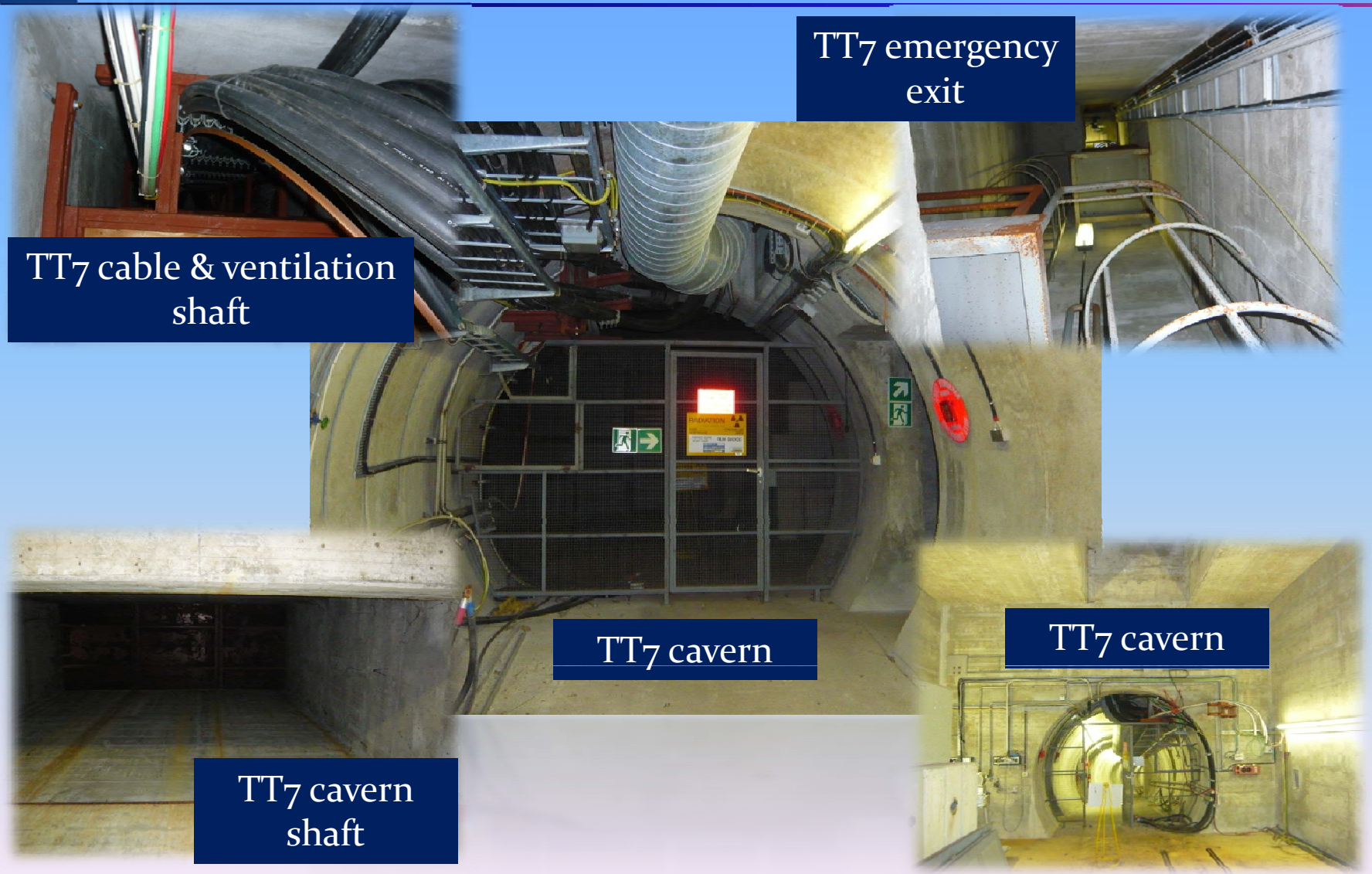


The TT7 Tunnel Towards the Target

PS Neutrino Facility

The TT7 Target Cavern

PS Neutrino Facility



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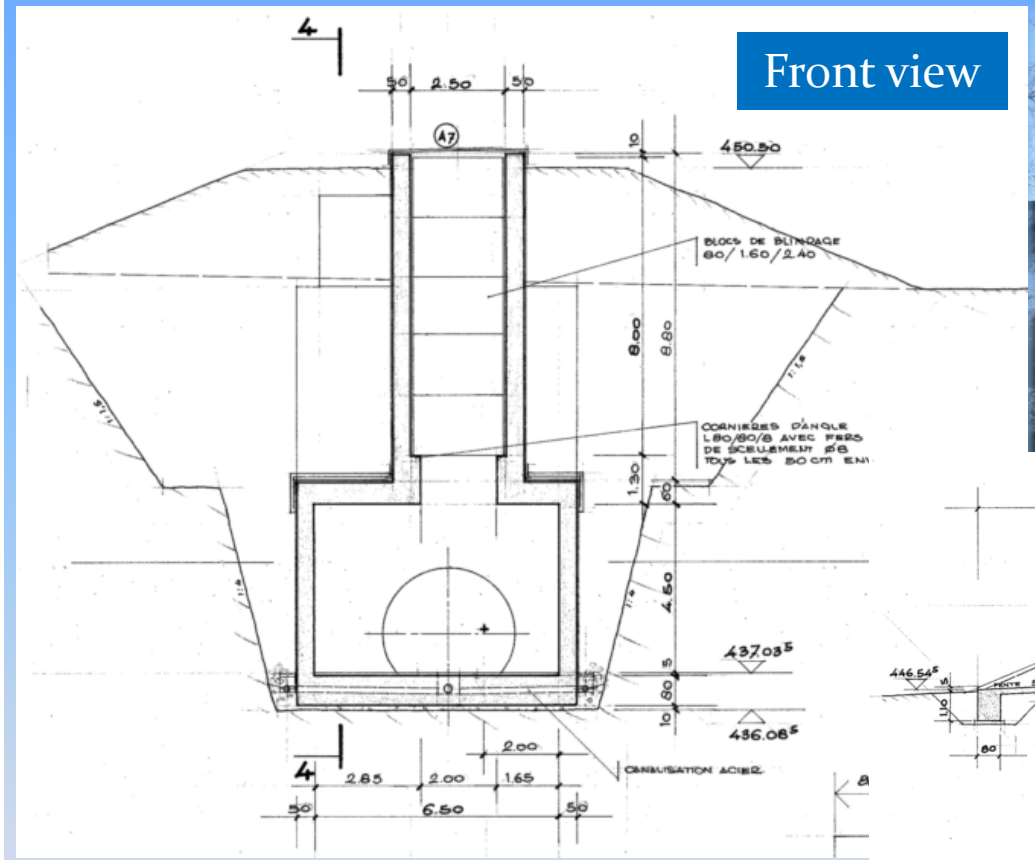
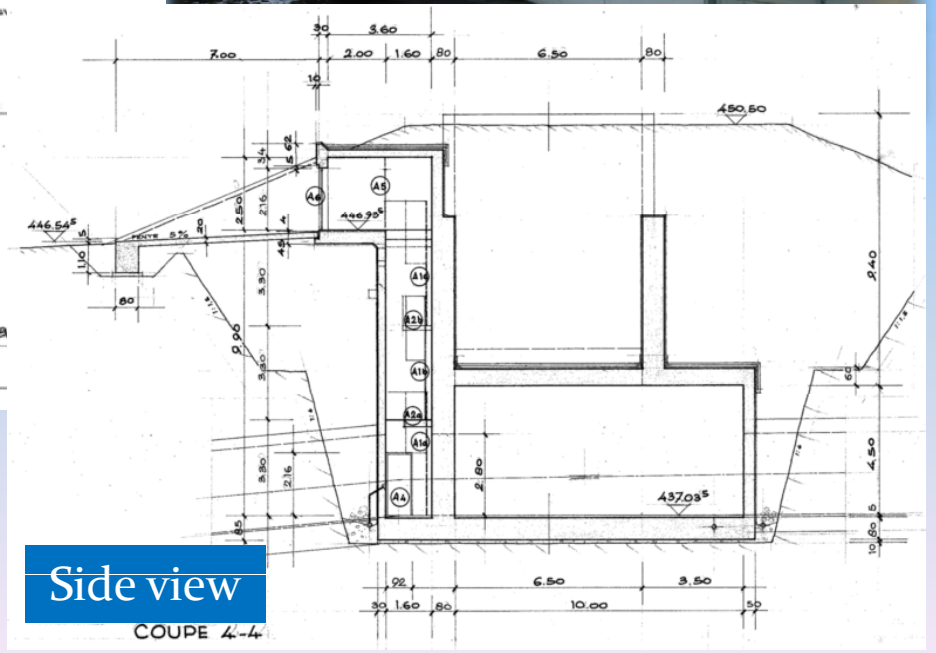
TT7 Cavern

PS Neutrino Facility





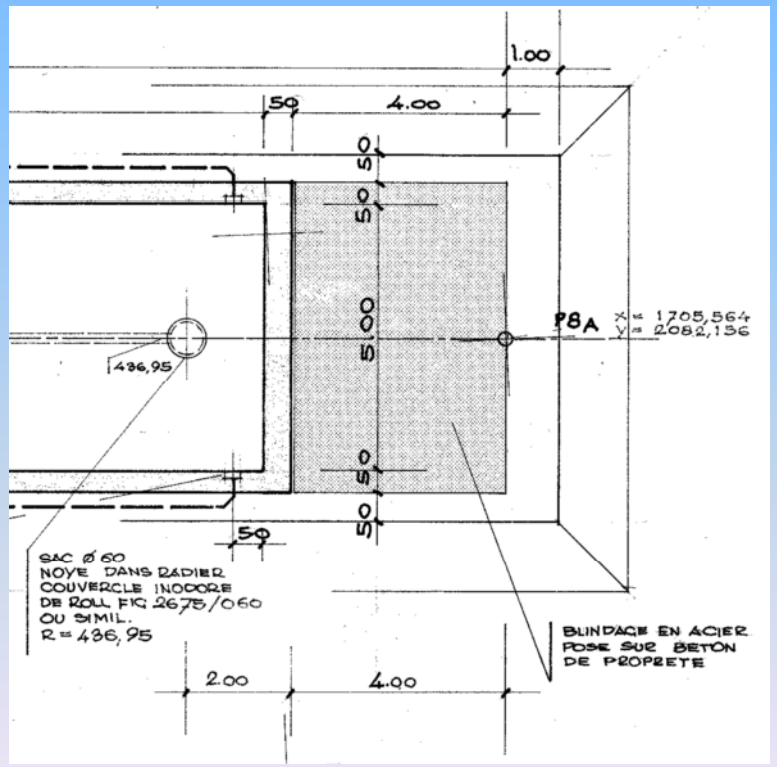
- 8 meter under ground
- Material access shaft

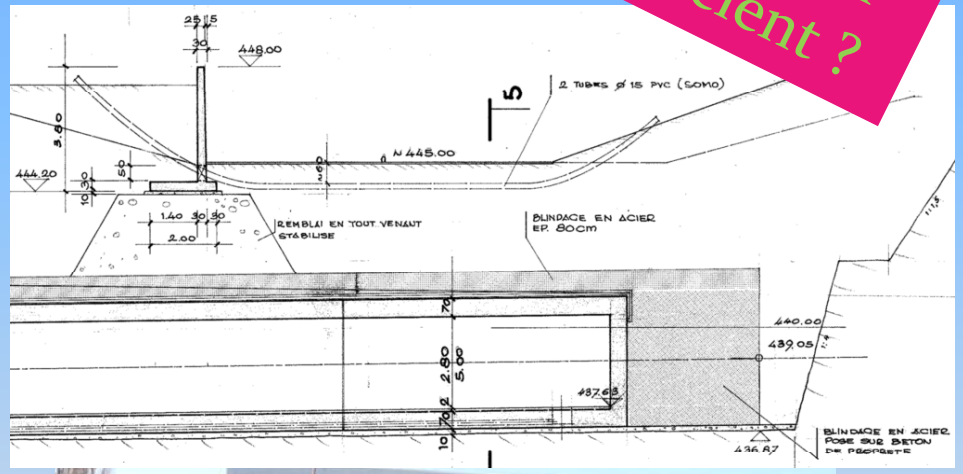
Beam Dump / Hadron Stopper

PS Neutrino Facility

- 4 meter thick iron beam dump
- ~60 meters of earth

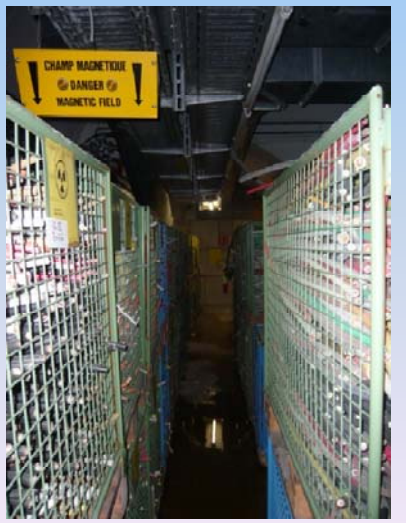
Is this still sufficient ?





Present Status of the TT1/TT7

- The TT1 tunnel is rather humid and is used as storage for radio-active cables.
  - Separation and disposal project is being planned , but will most probably not start before 2014
- TT7 tunnel and cavern are in very good shape
- TT7 decay tunnel is full with radio-active waste, which need to be treated and disposed (under consideration)



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Primary Proton Beam

- Primary proton beam momentum of ~ **20 GeV/c**
- 2.6E13 to 3E13 protons per pulse (1.2 seconds)
- 7 or 8 bunches of each ~50 ns in ~2 μs
- PS super cycle is very occupied (many users)
  - DIRAC has ideas to move to SPS after 2011
- **Combine nTOF and PSNF** protons beam production on a single cycle
  - Double batch or single batch extraction ?
  - Clean beam production and efficient use of the PS
  - **Average duty cycle of 20%** or more is possible
- Assuming **180 days of physics run** per year this can lead to approximately **6.8E19 p.o.t/year**

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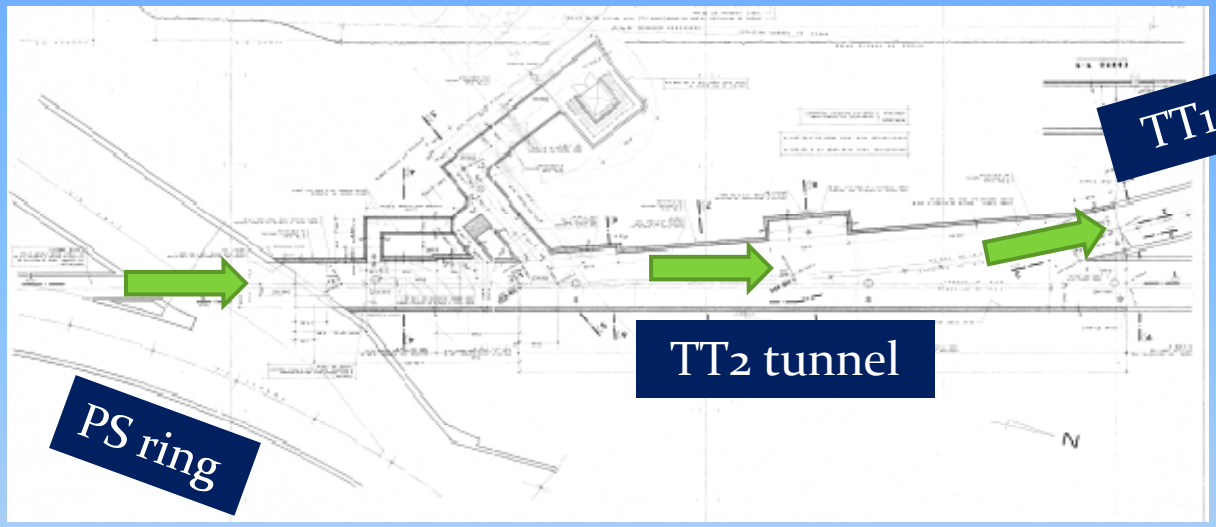
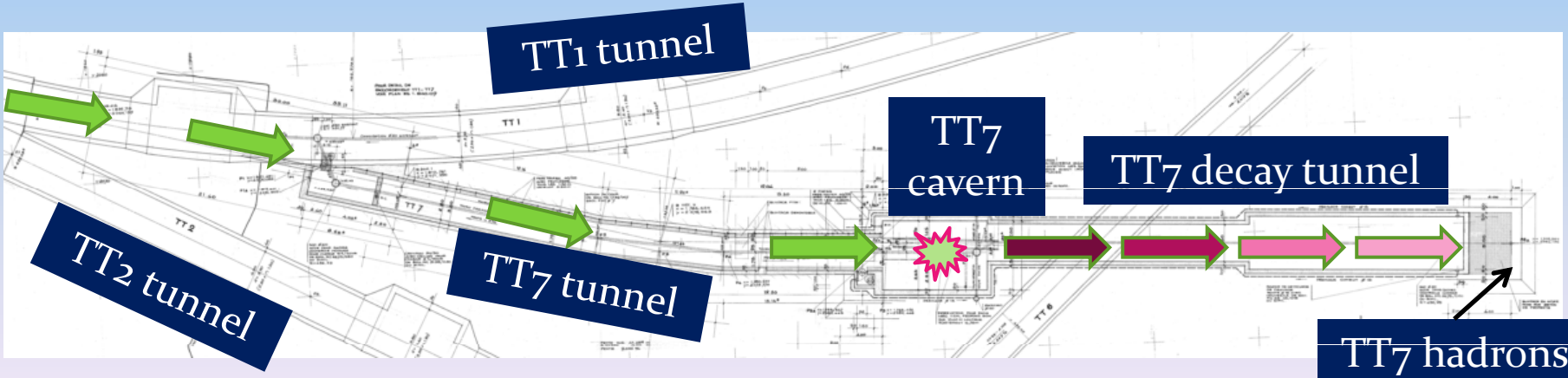
How to go From PS to TT7 ?

PS Neutrino Facility





PS to TT7 Transfer Line

- Some information on the old TT7 line is available
- For the ~150 meter beam line we would need roughly:
  - ~ 14 Main Dipoles
  - ~ 12 Quadrupoles
  - ~ 4 Corrector Dipoles
- Single batch or double batch extraction from PS?
- It should contain precise proton beam intensity, positioning and profile monitors
- Can we re-use magnets or do we need new ones ?
- Beam line optics study needed (manpower)
- Building to house power converter, ventilation and cooling needed

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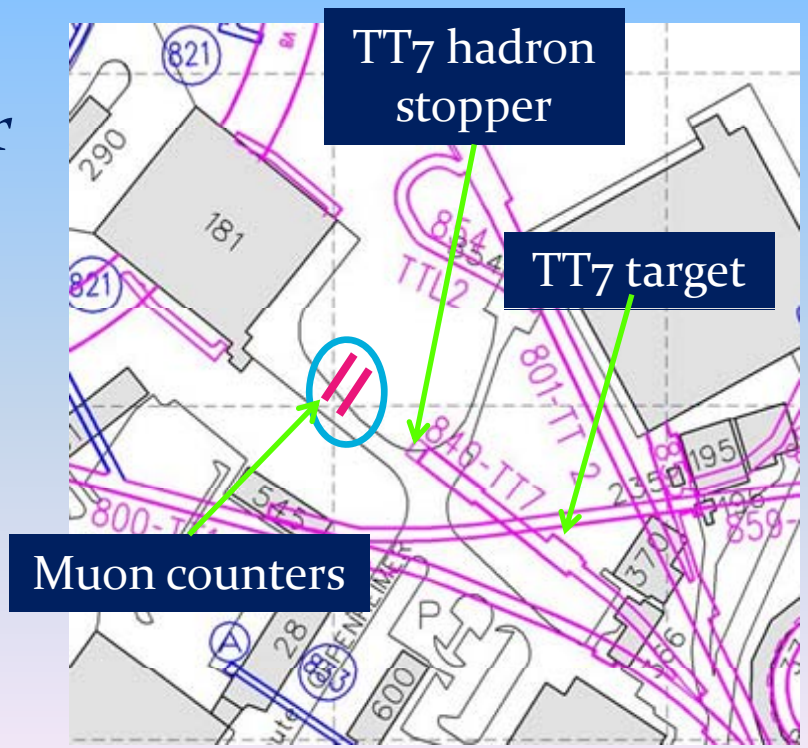
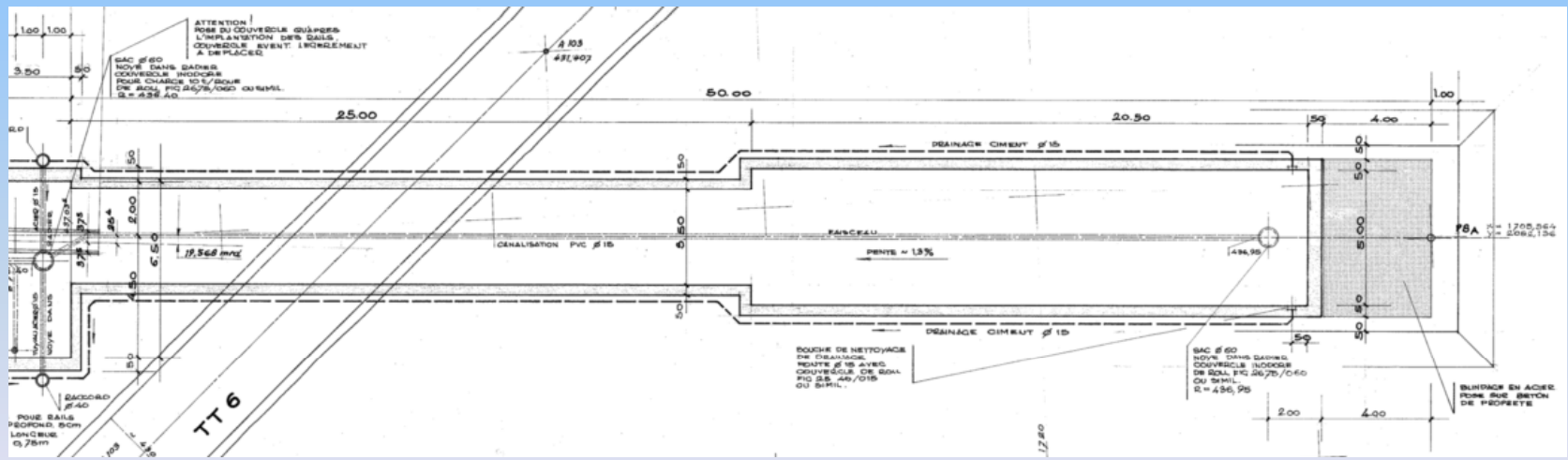
Secondary Beam

- The target and secondary beam focusing design can be inspired on the CNGS and/or T2K design
- The primary beam power:
  - 100% duty cycle ~ 80 kW
  - 20% duty cycle ~ 16 kW
- Installing muon counters after the hadron dump will allow:
  - Monitoring the intensity
  - Measure the distribution
  - Steering with primary beam
  - Target alignment



Decay Tunnel

- The available ambient air decay tunnel is 50 meters long
- Cross section:
  - 3.5 x 2.8 m2 for the 1st 25 m
  - 5.0 x 2.8 m2 for the remainder



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Work Packages (1)

- Primary Beam Production & Transfer:
  - **PS Primary beam production and extraction**
  - **Beam line optics**
  - **Magnets**
  - **Power converters**
  - **Vacuum**
  - Collimation
  - Beam Instrumentation
  - Controls
- Secondary beam production and measurement:
  - **Target** (including cooling, ventilation, target protection and target disposal after use)
  - **Pulsed Horn and Reflector**
  - Decay Tube
  - Muon counters
  - Power Converters

Work Packages (2)

PS Neutrino Facility

- Experimental zones:
  - **Selection of suitable buildings and allocation**
  - Building cleaning and consolidation
  - Infrastructure
  - Counting rooms
- Infra-structure & General services:
  - Cleaning & **Consolidating** TT1-TT7 Tunnel (waste disposal)
  - **Cooling and ventilation**
  - Surface building for power converters, etc.
  - Transport and handling in cavern and TT7 tunnel
- Safety:
  - **Radiation protection & shielding**
  - Access Control & Personnel Safety System
  - Fire detection system
  - **Overall safety**

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Concluding Remarks

- It is well possible to revive the **PS Neutrino Facility**
  - Large parts of the required infrastructure are available, but need consolidation
  - The primary beam line needs to be developed and constructed
  - Target station, secondary beam focusing and measurement needs to be designed and constructed
  - Infrastructure for the experiment(s) will need to be provided/put in place
  - Safety needs to be addressed (more strict than in the 80's)
- PS can provide ~ 6.8E19 p.o.t./year, provided:
  - DIRAC moves to SPS North Area
  - Proton beam production for nTOF and PSNF are combined in a single cycle
- For the moment this is a **pre-study** and not a study or project
  - For a more detailed study stronger commitment from CERN management is required (some manpower needed)
- Potential work packages are identified

Lots of interesting work ahead, but no resources allocated yet

Acknowledgements

- Alain Blondel for organizing the workshop and providing time for this presentation
- Ilias Efthymiopoulos and Edda Gschwendtner for discussions on the neutrino facilities, etc.
- Massimo Giovannozzi for sharing his knowledge and documentation on the old TT7 beam line
- David Nisbet for his help on the technical aspects for powering a possible double extraction scheme
- Jan Borburgh for his information on the use of the PS extraction septum for the double and single batch extraction scheme
- Dominique Missiaen for studying the survey aspects

Thanks for your attention

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