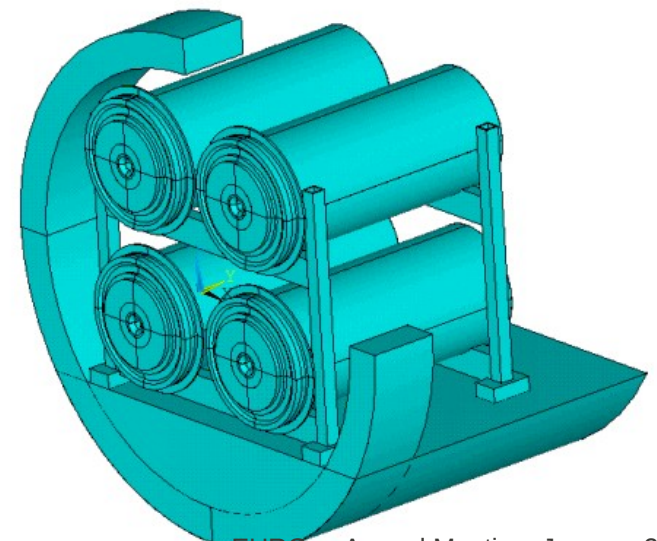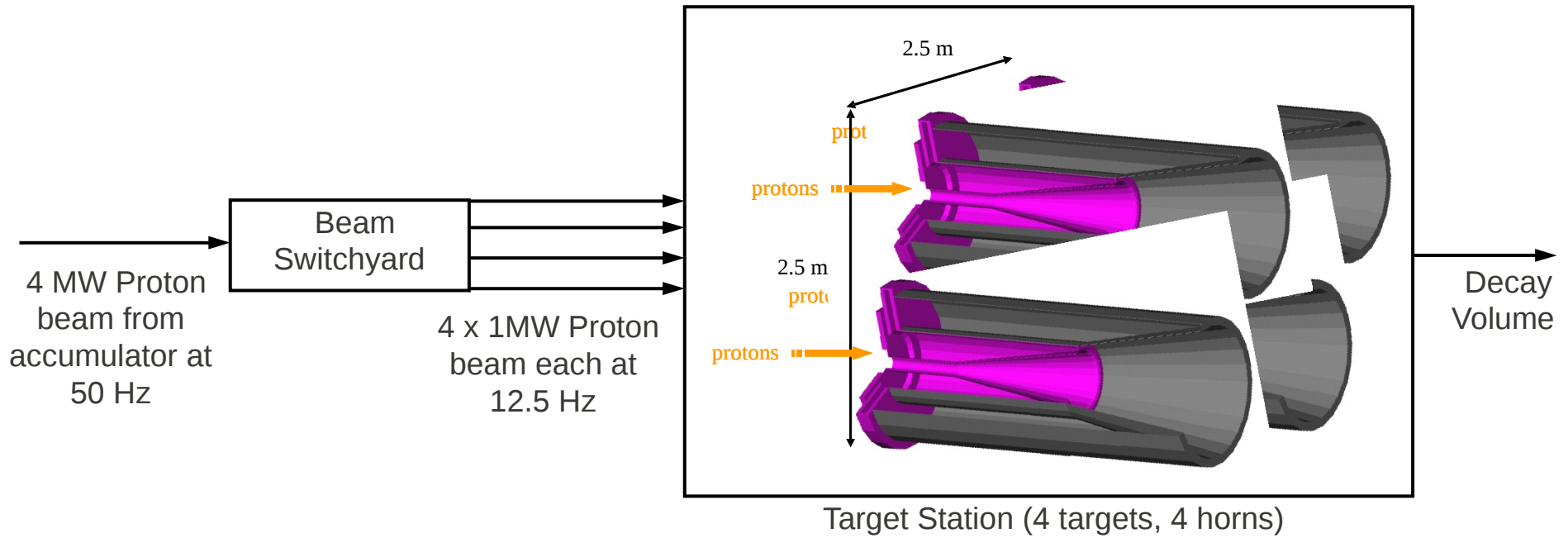# WP2 status

Marco Zito
(IRFU/CEA-Saclay)

For the EUROnu WP2 team

EUROnu CB March 29 2012

Overview

- In the past year we have successfully met our milestones and achieved an overall conceptual design of the Super Beam facility

- This has been reported in our preliminary design report EUROnu-WP2-11-01

- WP2 has completed ~90% of its planned work

Overall configuration

4 MW Proton beam from accumulator at 50 Hz

Beam Switchyard

4 x 1MW Proton beam each at 12.5 Hz

2.5 m

2.5 m

prot

protons

prot

protons

Decay Volume

Target Station (4 targets, 4 horns)

Science & Technology
Facilities Council

C. Densham, T. Davenne

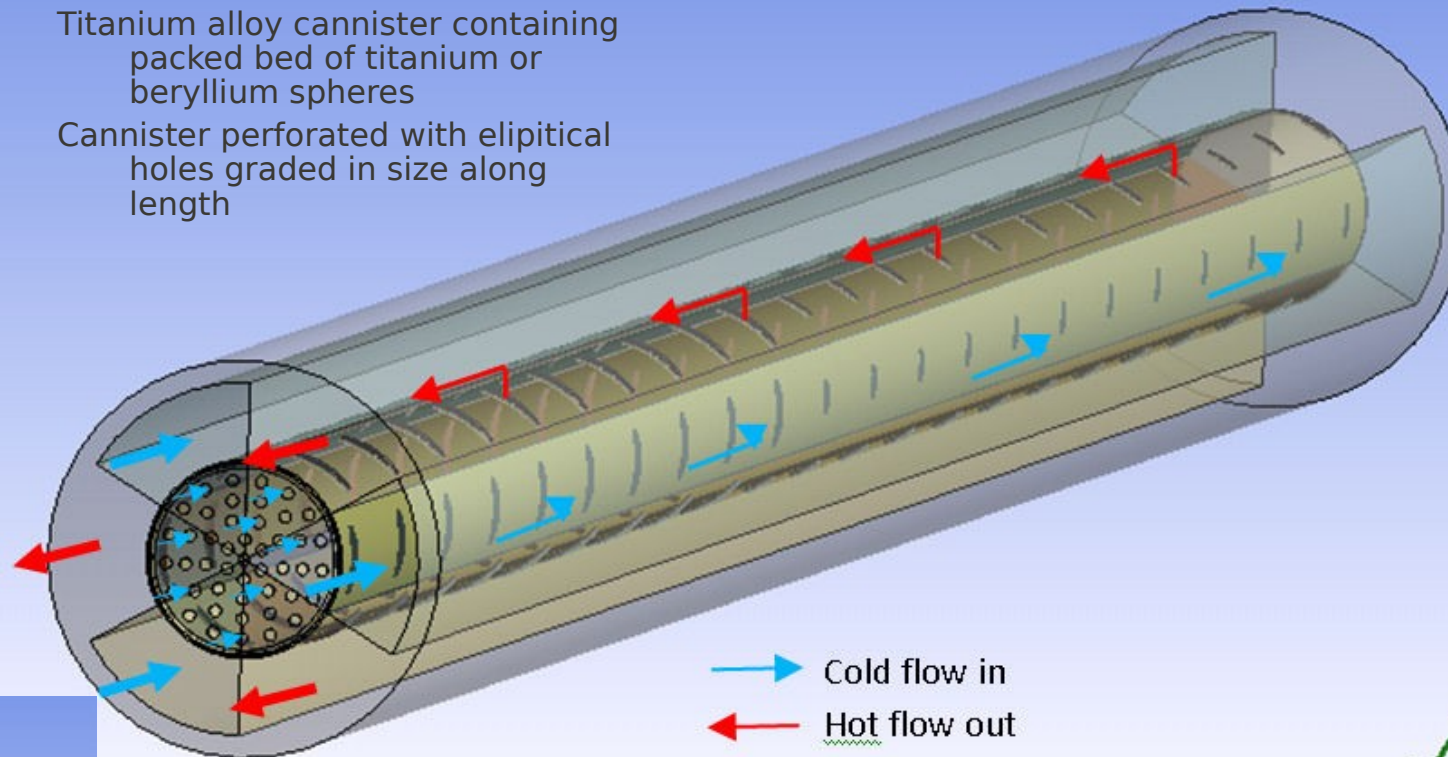# Packed Bed Target Concept for Euronu (or other high power beams)

Packed bed cannister in parallel flow configuration

Packed bed target front end
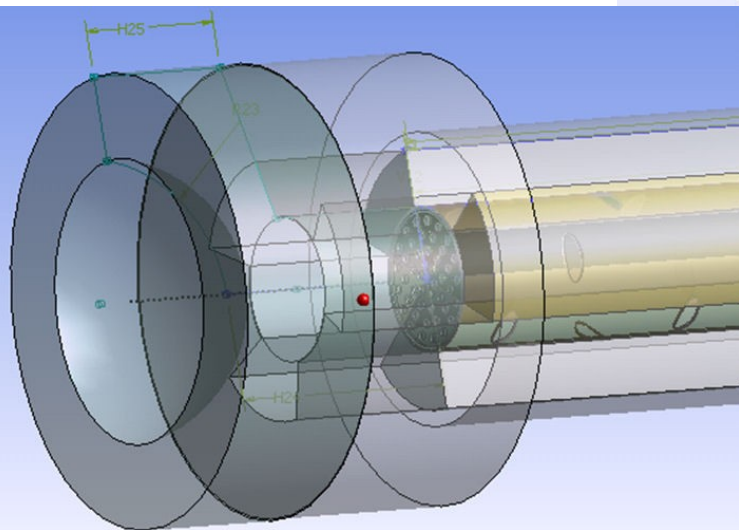
Titanium alloy cannister containing packed bed of titanium or beryllium spheres

Cannister perforated with elipitical holes graded in size along length

Cold flow in

Hot flow out

Model Parameters
Proton Beam Energy = 4.5GeV
Beam sigma = 4mm
Packed Bed radius = 12mm
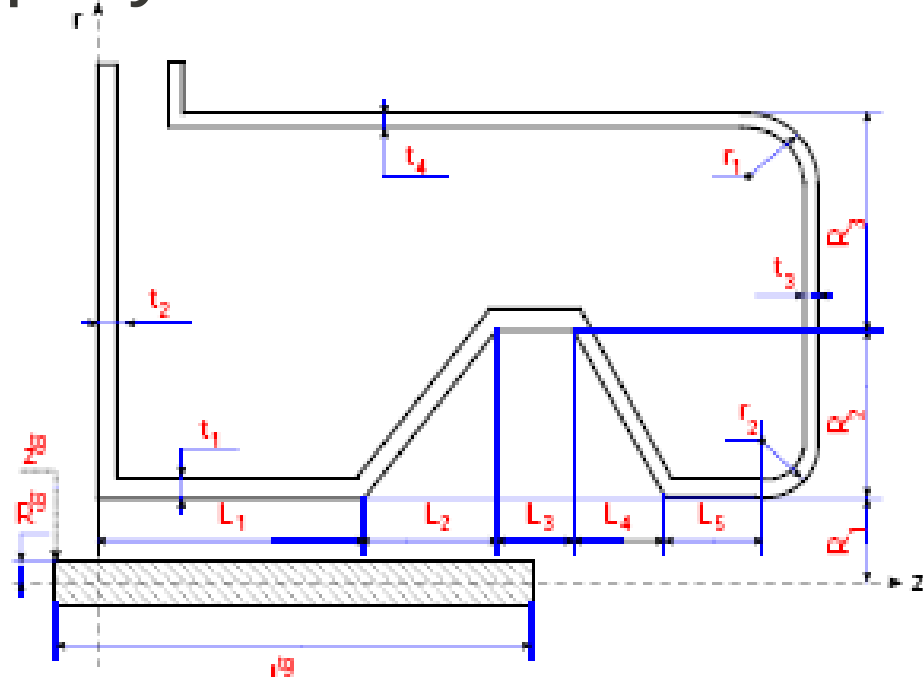Packed Bed Length = 780mm
Packed Bed sphere diameter = 3mm
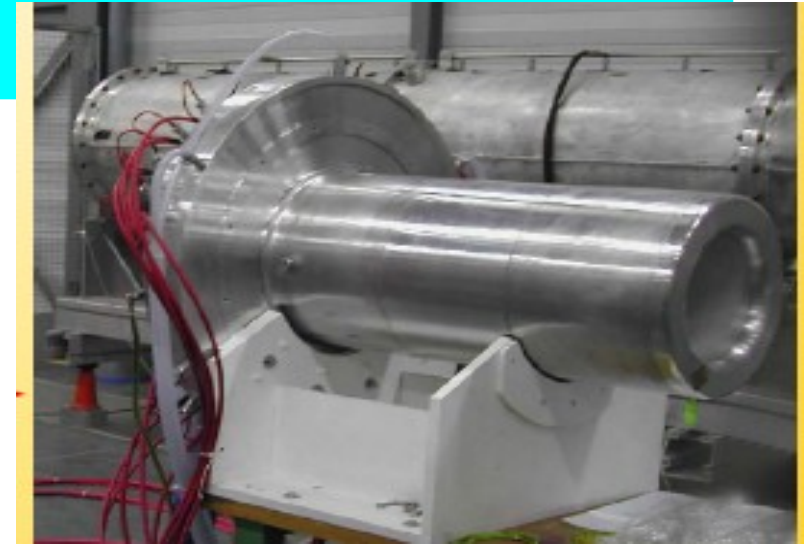Packed Bed sphere material : Beryllium or Titanium
Coolant = Helium at 10 bar pressure

High Power Targets

Horn

Baseline :

- Miniboone shape

- Aluminum

- Cooled with internal water sprays
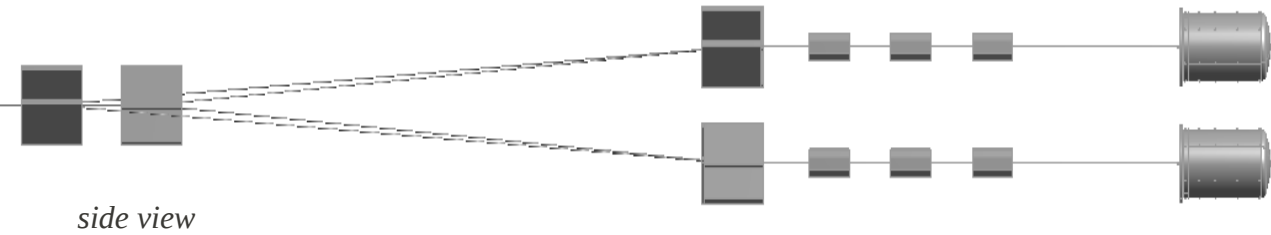
- Pulsed with 300-350 kA

Marco Z
NUFAC

Main ongoing studies

- Beam switch-yard and transport line

- Target-horn integration

- Irradiation and contamination studies ->shielding

- Target station design

side view

K2
K1
p
3D view

0.00   250.00   500.00 (cm)
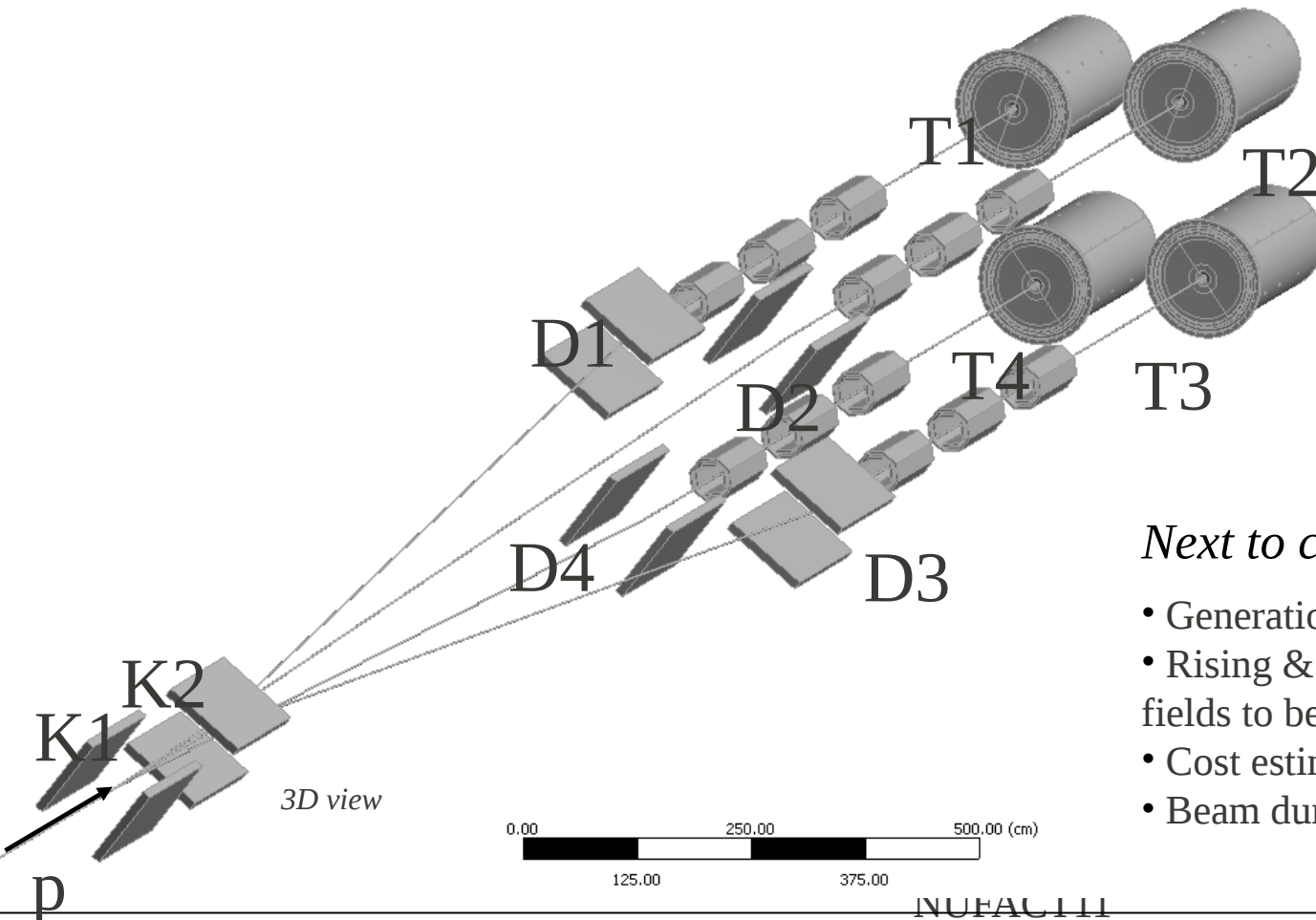125.00   375.00

D1
D2
D4
D3
T1
T2
T4
T3

Layout of configuration 3

If quadrupoles after the compensating dipoles
    -> possibility of having a **beam dump** between the second kicker and the compensating dipoles

Use of **collimators** to suppress eventual halo from the beam and avoid any particles from hitting the outside of each target (1.5cm radius)
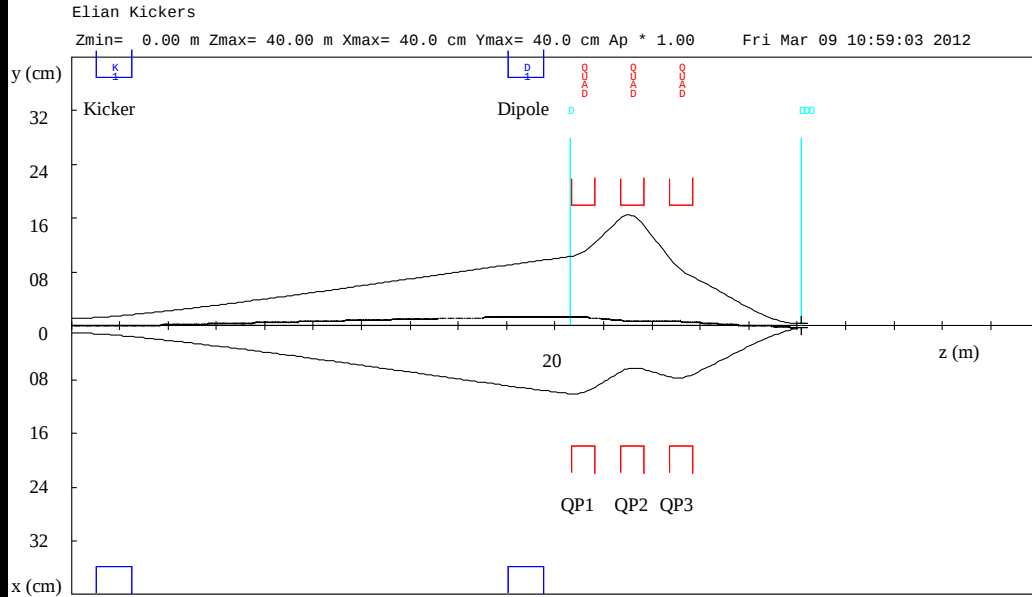
Next to come…

• Generation of magnetic field maps
• Rising & falling times of the magnetic fields to be defined
• Cost estimations
• Beam dumps…

Under progress…

NUFACT11

Configuration 3: K-D-Q-Q-Q-T

Elian Kickers

Zmin= 0.00 m Zmax= 40.00 m Xmax= 40.0 cm Ymax= 40.0 cm Ap * 1.00   Fri Mar 09 10:59:03 2012

y (cm)

32 Kicker   Dipole

24

16

08

0

08   20   z (m)

16

24   QP1   QP2 QP3

32

x (cm)

Advantages:

- Beam waist values close to the needs (rx 0.38cm; ry 0.37cm)
- No quadrupole between the kicker and the dipole
- Total length 30.2m
- Reasonable magnetic fields

Disadvantages:

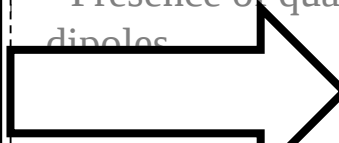- High dispersion value (0.42 cm/%) at the middle of the target

Configurat

Advantages:
- Beam waist value   cm)
- Total length of 30
- Small dispersion

Disadvantages:
- Use of 6 quadrup
dysfunction)
- Presence of quad   the
dipoles

Suitable solution
up to now

Zmin= 0.00 m Zma   40.00 m X   :29 2012

y (cm)

32   K1   QUAD   QUAD   QUAD

24   Kicker

16

08

0   z (m)

08

16   QP1 QP2 Q

24

32

x (cm)

Mario Zit
NuFACT11
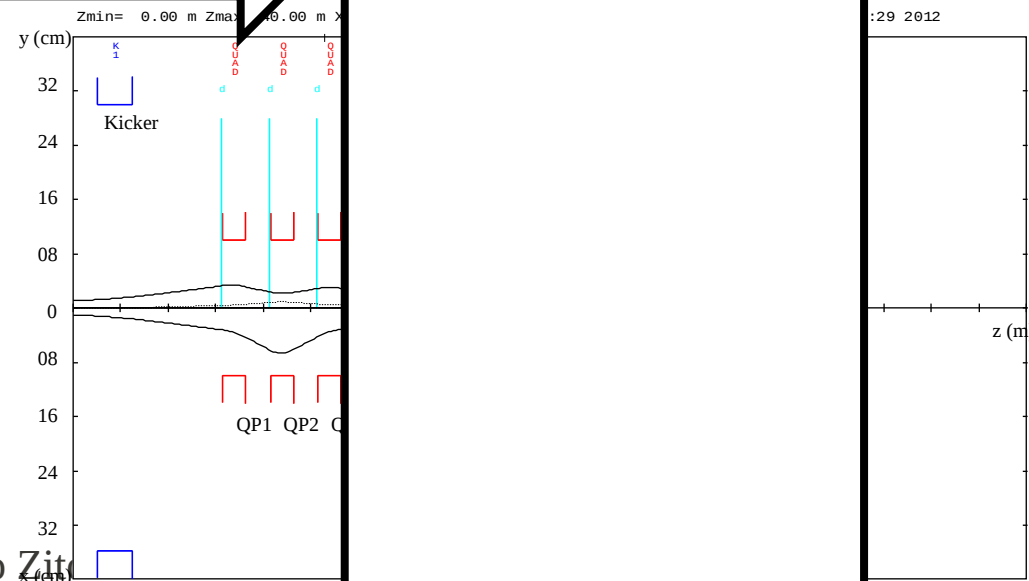
horn/target gallery

D. Wilcox, RAL
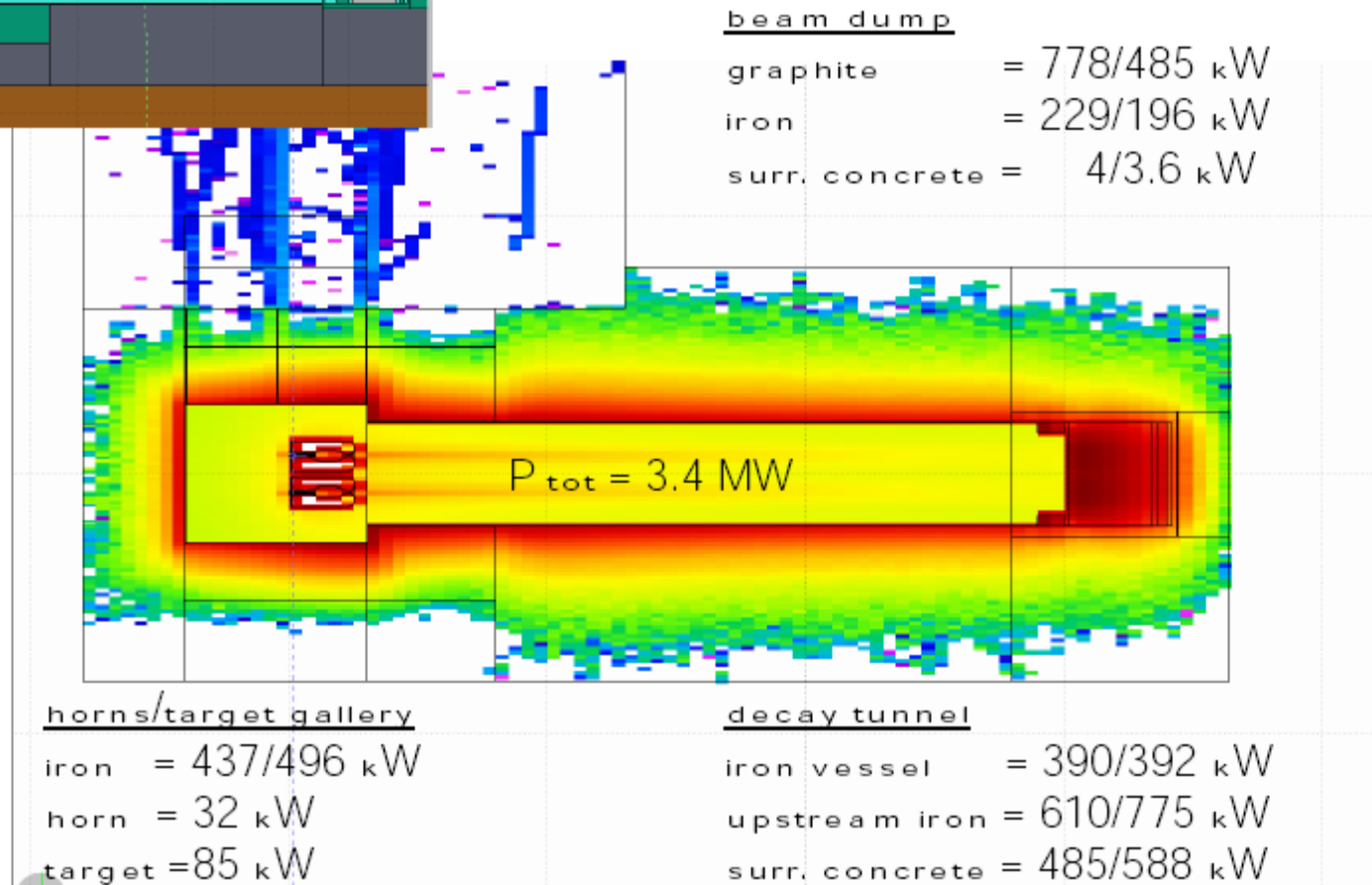
Dan's geometry for horn/target gallery — including holes:

DETAIL D   DETAIL E   DETAIL F

transversal 3 cm see-through holes —
to see the effect

5 cm longitudinal holes

DETAIL C

N. Vassilopoulos, IPHC
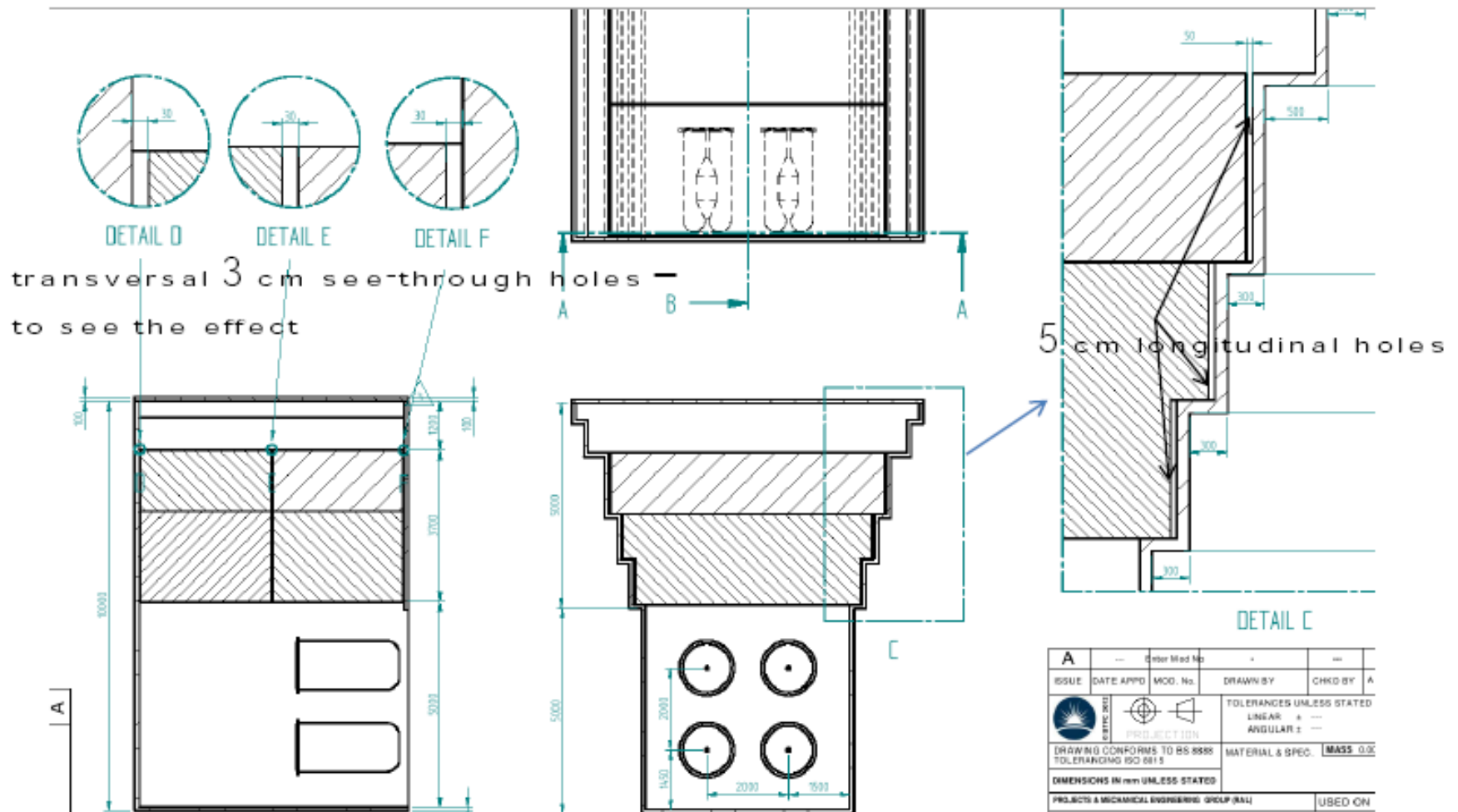
ν/anti-ν power distribution
iron, concrete, molasse, He

beam dump
graphite = 778/485 кW
iron = 229/196 кW
surr. concrete = 4/3.6 кW

P_{tot} = 3.4 MW

horns/target gallery
iron = 437/496 кW
horn = 32 кW
target = 85 кW

decay tunnel
iron vessel = 390/392 кW
upstream iron = 610/775 кW
surr. concrete = 485/588 кW

IPHC Strasbourg, EUROnu - 03/2012   thanks   12

Marco Zito
NUFACT11

10

Overview

D. Wilcox, RAL

Control Room

Office Space

Ground Level

Crane

Delivery Access

Truck unloading area

Power supply room

Main Hall

Pump House

Hot cell operator room

Hot cell

Morgue

Ground Level

Beam Direction

Beam dump building here

Horns and collimators

D. Wilcox, RAL

All dimensions in mm

Horn-Target support structure

Total mass:

2850 [*kg*]

Mass of support
system:

1560 [*kg*]

6

Fluxes and sensitivity

All the following results are summarized in

http://arxiv.org/abs/1106.1096

Discovery of $\theta_{13} \neq 0$

θ_{13} discovery at 3σ ($\Delta\chi^2 = 9$). 5% sys.

Legend:
- C FLUKA
- C G4-QGSP
- C FLUKA+HARP
- HG published

y-axis: $\log_{10}(\sin^2 2\theta_{13})$
x-axis: δ_{CP} ($^\circ$)
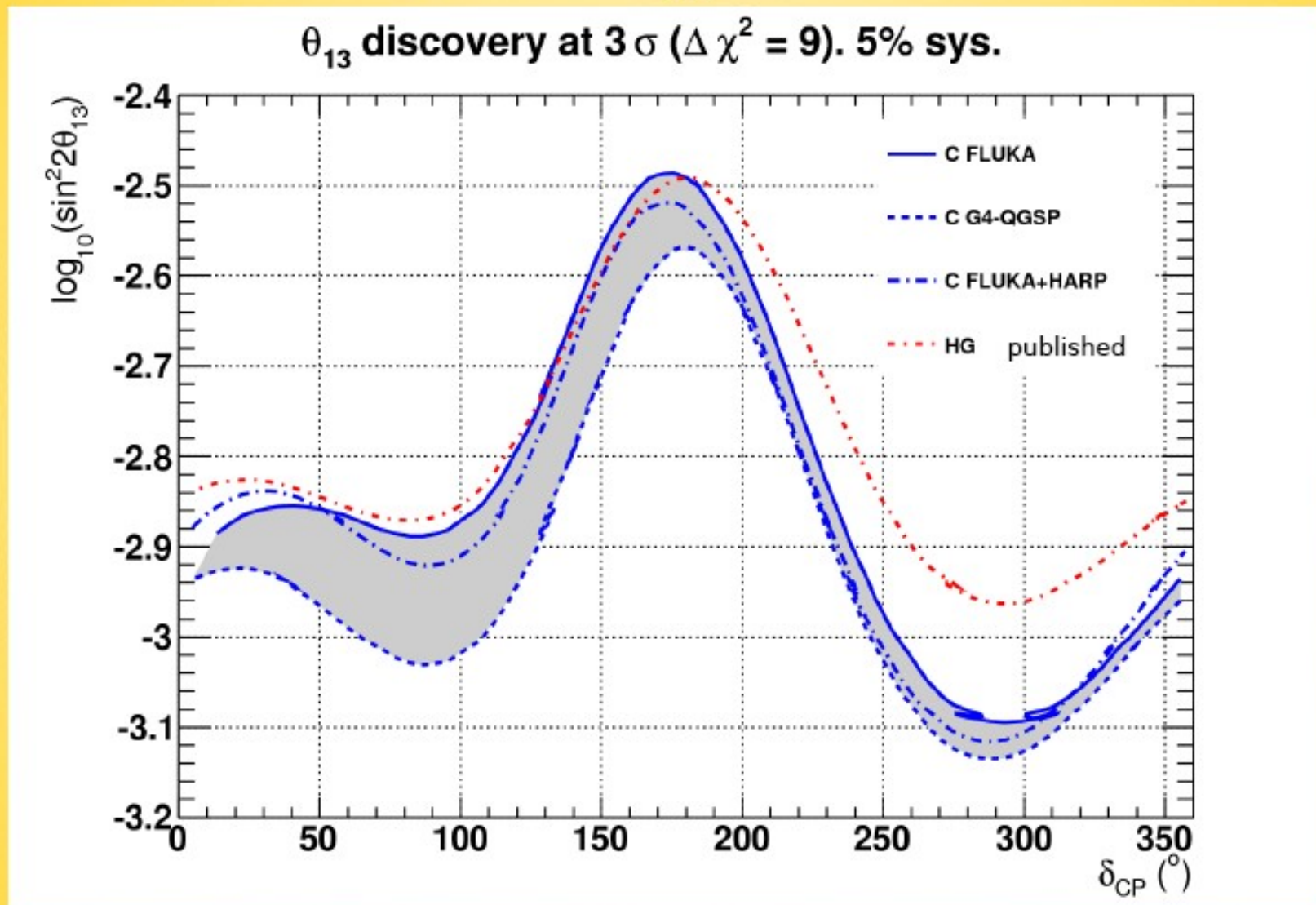
Using GEANT4 for p-target interactions or reweighting FLUKA to HARP data yields better limits

Discovery of CP violation

CP violation discovery at $3\,\sigma$ ($\Delta\chi^2 = 9$). 5% sys.

y-axis: $\log_{10}(\sin^2 2\theta_{13})$

x-axis: δ_{CP} (°)

CPV discovery at 3σ here inside

CPV discovery here inside

- C FLUKA
- C G4-QGSP
- C FLUKA+HARP
- HG
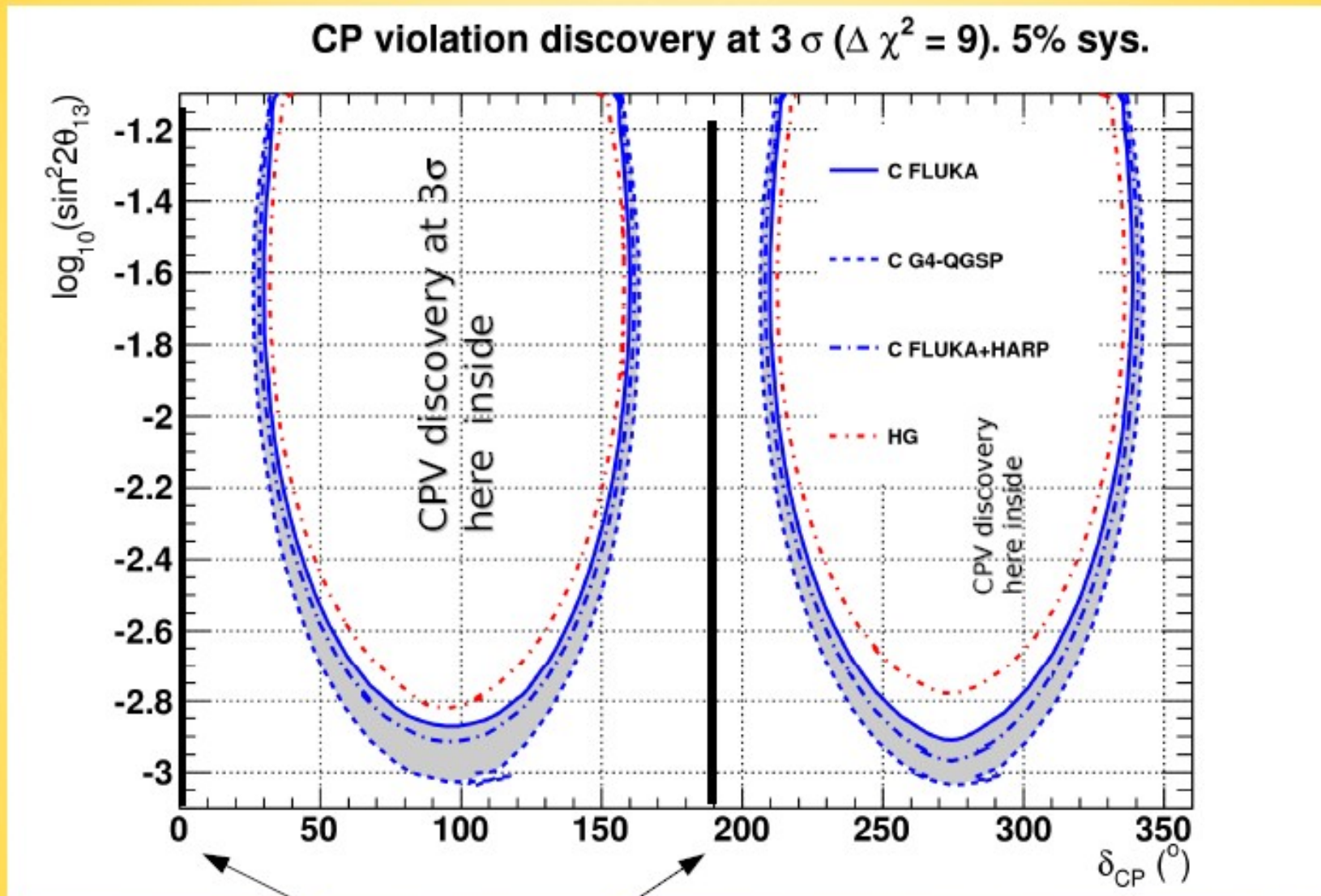
No CPV

Next steps

- Timescale ~ 1 month:

  - Complete the horn-target support structure study

  - Complete the beam transport line study

  - Complete the WBS for the costing

- Write final report : aim for preliminary version for the June Paris general meeting

Summary of main parameters

Parameter	Value
Beam Power	4 MW
Beam energy	4.5 GeV
Target length	78 cm
Target radius	1.2 cm
Decay tunnel radius	2m
Decay tunnel length	25m

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