Production target and beam dump in the slow-extraction beam line

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On behalf of

Hadron Beam Line Group

Target and Monitor Group

KEK-JAERI Joint Project

Production target (T1)

Requirements in design

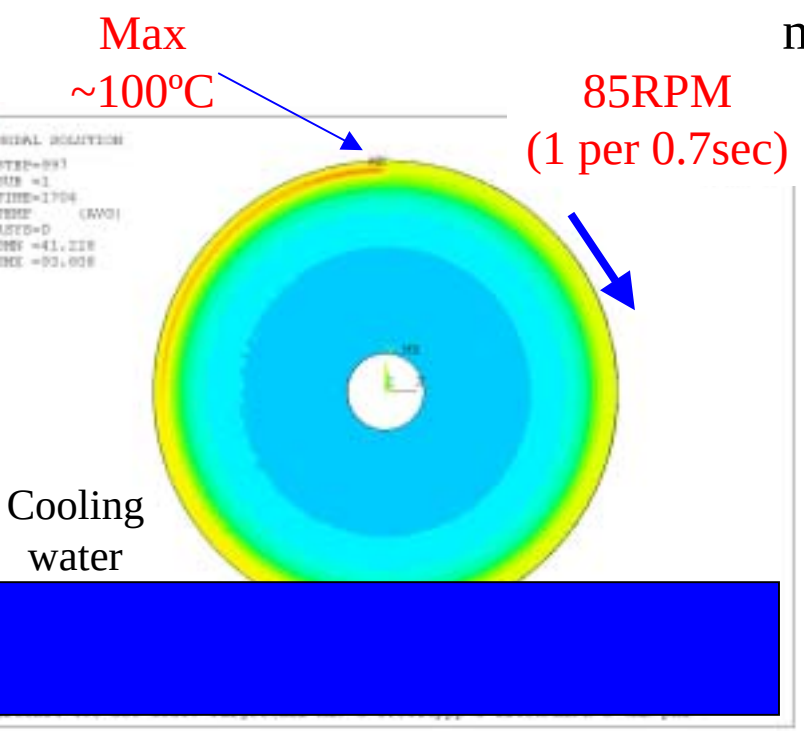
- Maximize yield of secondary particles
  - >5 MHz Kaon beam at 6 degree
- 30% Beam loss for 750kW
  - 220 kW as heat production, 12 kW in target
- As easy maintenance as possible
  - ~10 Sv/hr as residual dose rate at contact
- Radiation protection
  - <11 mSv/hr for soil activation
  - <12.5 μSv/hr in the controled area

Production target (T1)

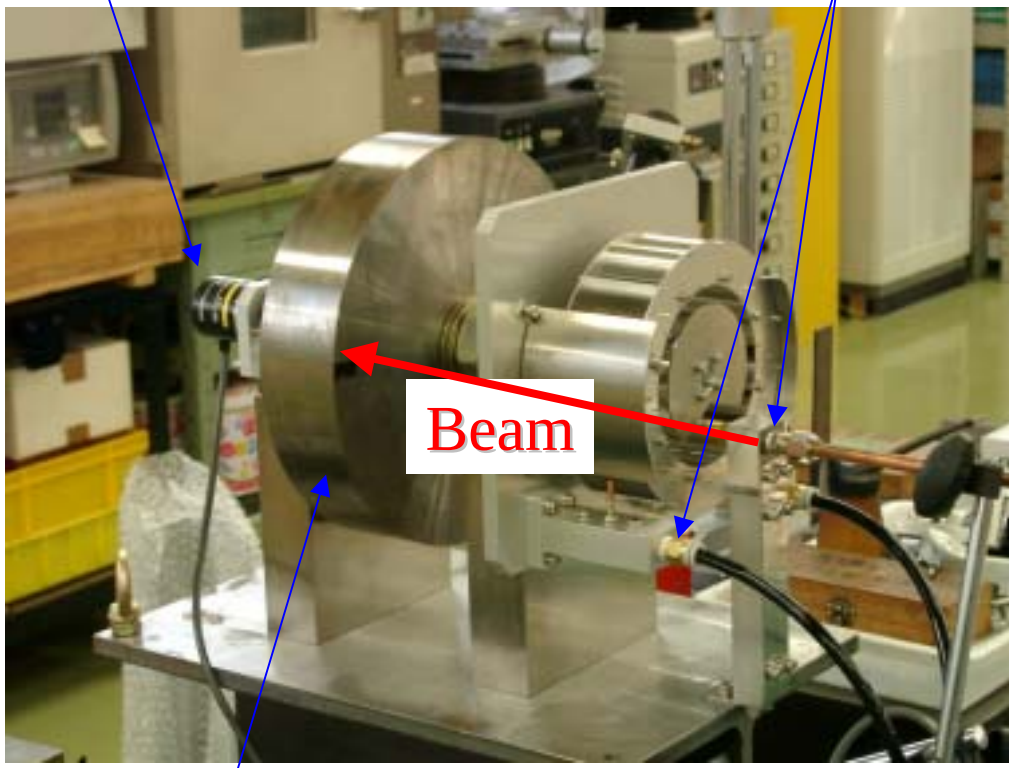
Rotating target and water cooling

Thermal evolution by ANSYS (M. Minakawa)

T1 prototype (Y. Yamanoi)



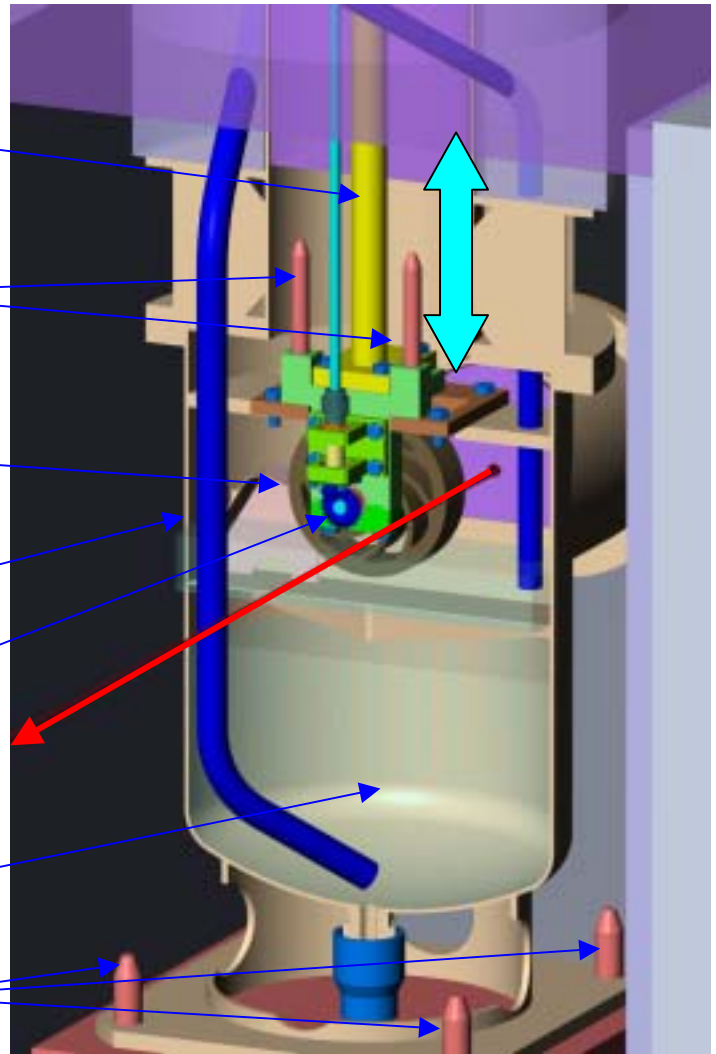
ϕ50cm x 6cm^{t} , Ni200



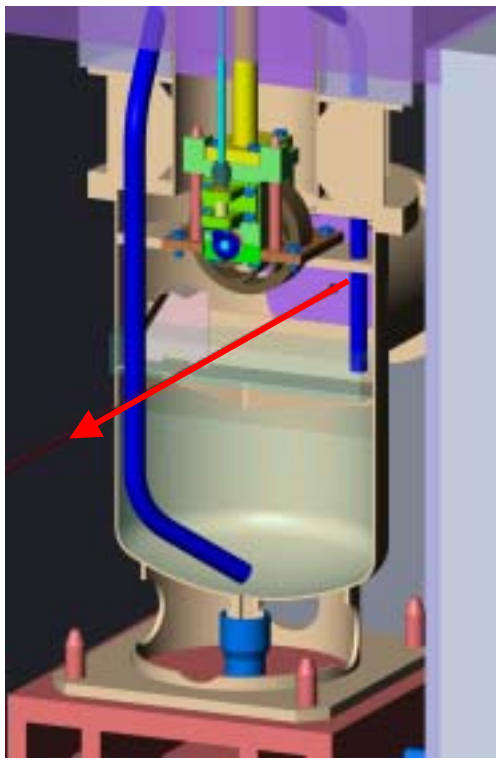
Nickel disk (ϕ24cm x 6cm^{t}, 24kg)

Production target (T1)

Schematic view of the T1 target



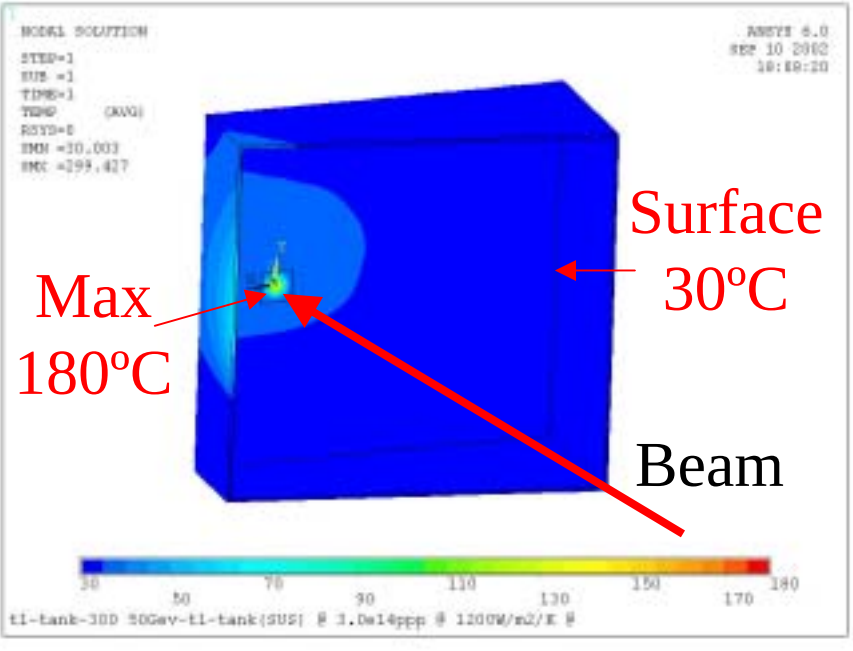
Target off



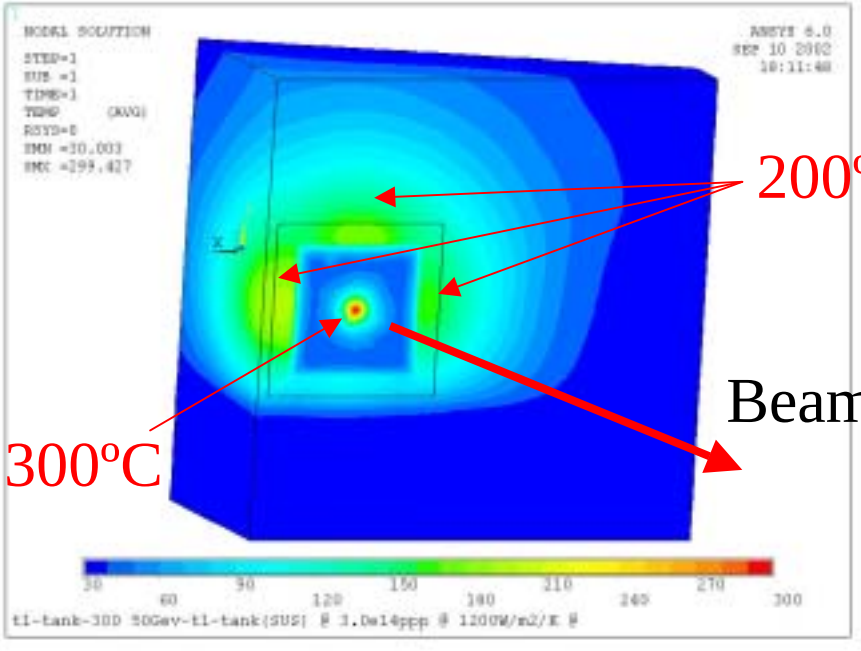
Target chamber and windows

Thermal evolution by MARS+ANSYS *(H. Takahashi & M. Minakawa)*

Upstream beam window
(SUS 6cm x 6cm, 0.2mm^t)

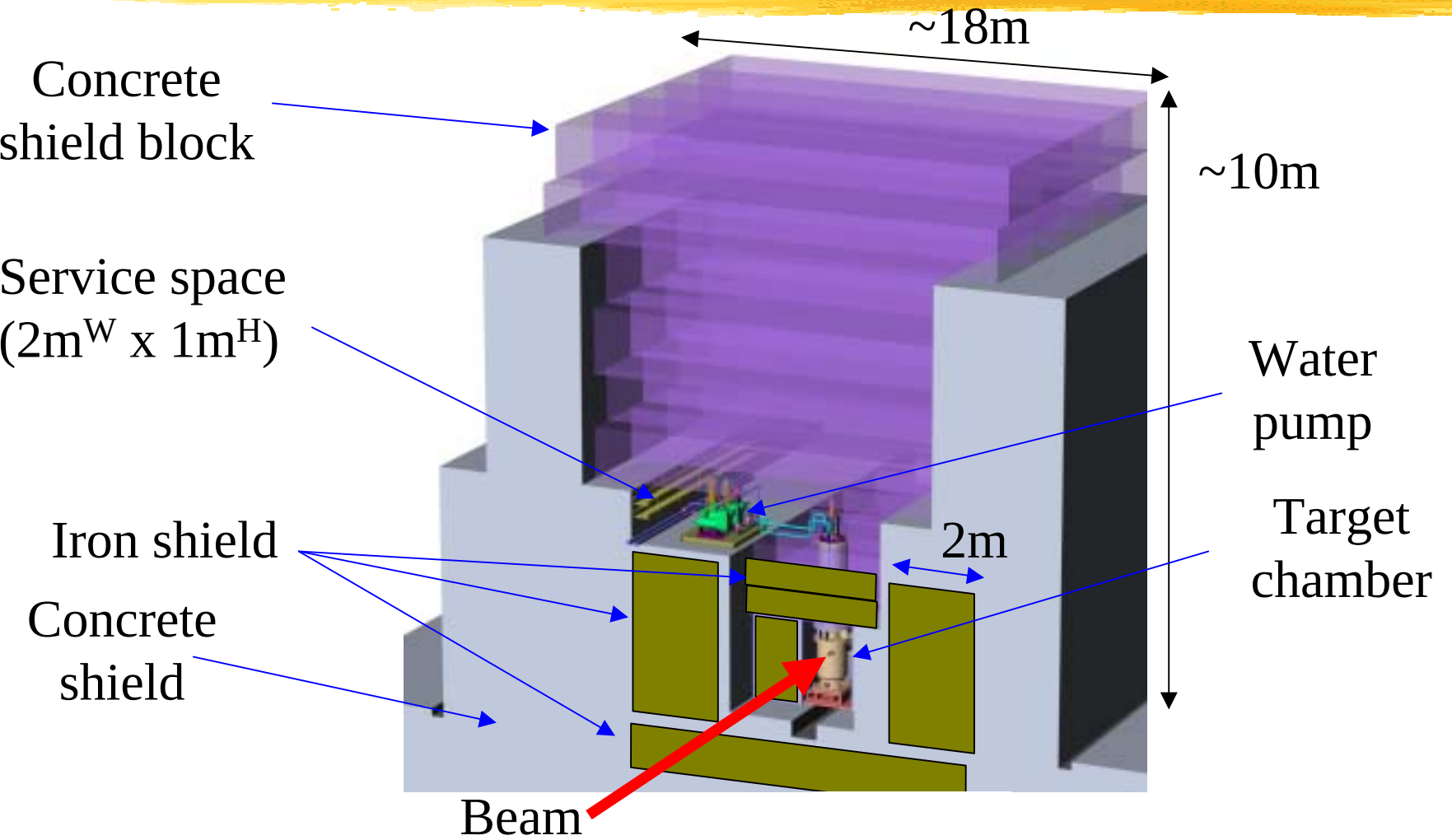


Downstream beam window
(SUS 20cm x 20cm, 0.2mm^t)



Production target (T1)

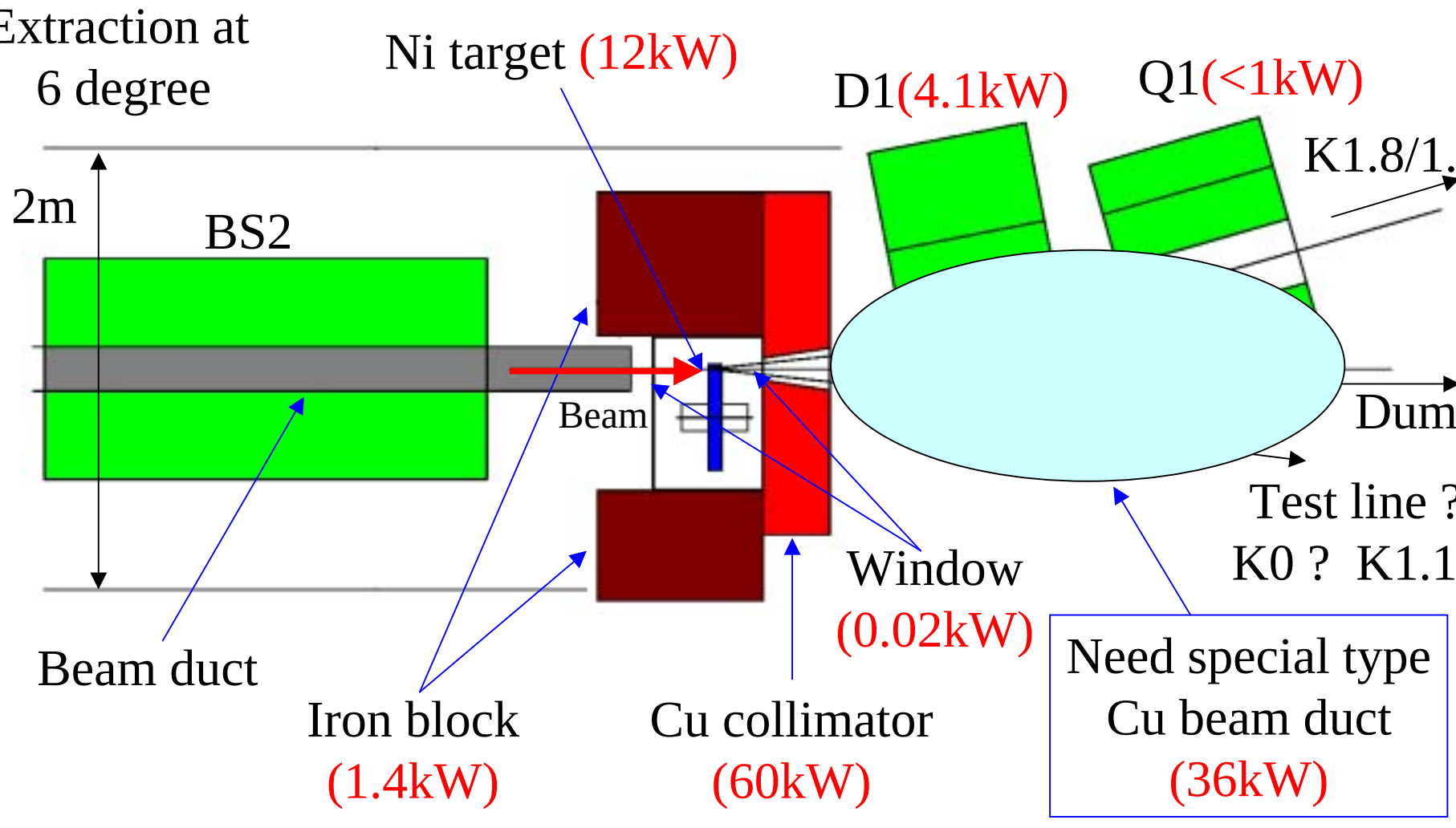
Schematic view of the whole system



The whole system will be tested by the T1 mock-up.

Collimator and beam duct

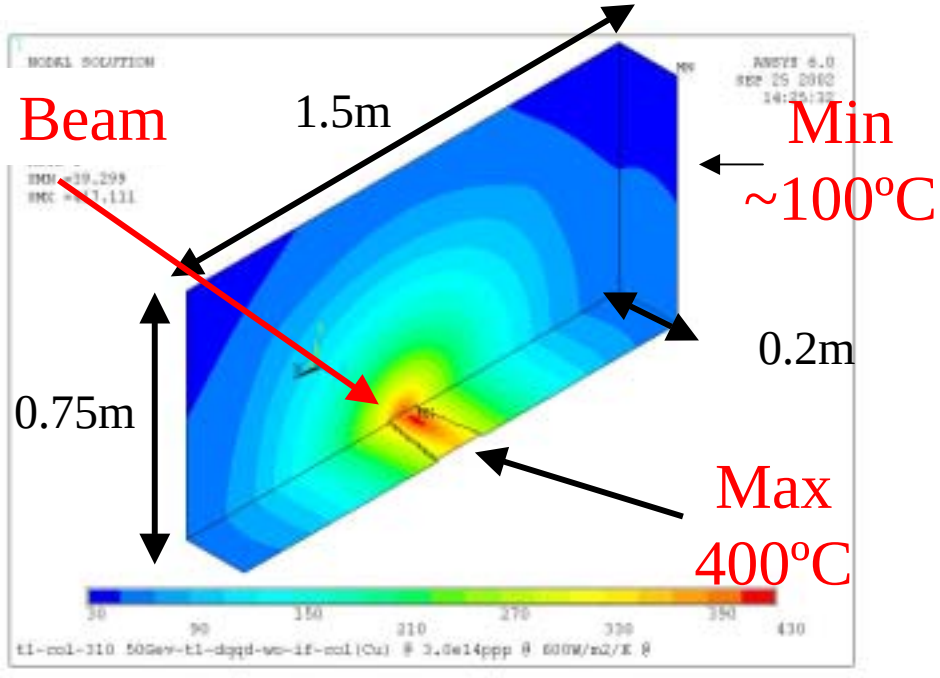
Schematic view of the T1 target area



Collimator

Thermal evolution by MARS+ANSYS *(H. Takahashi & M. Minakawa)*

Cu collimator ($1.5m^H$ x $1.5m^W$ x $0.2m^T$)

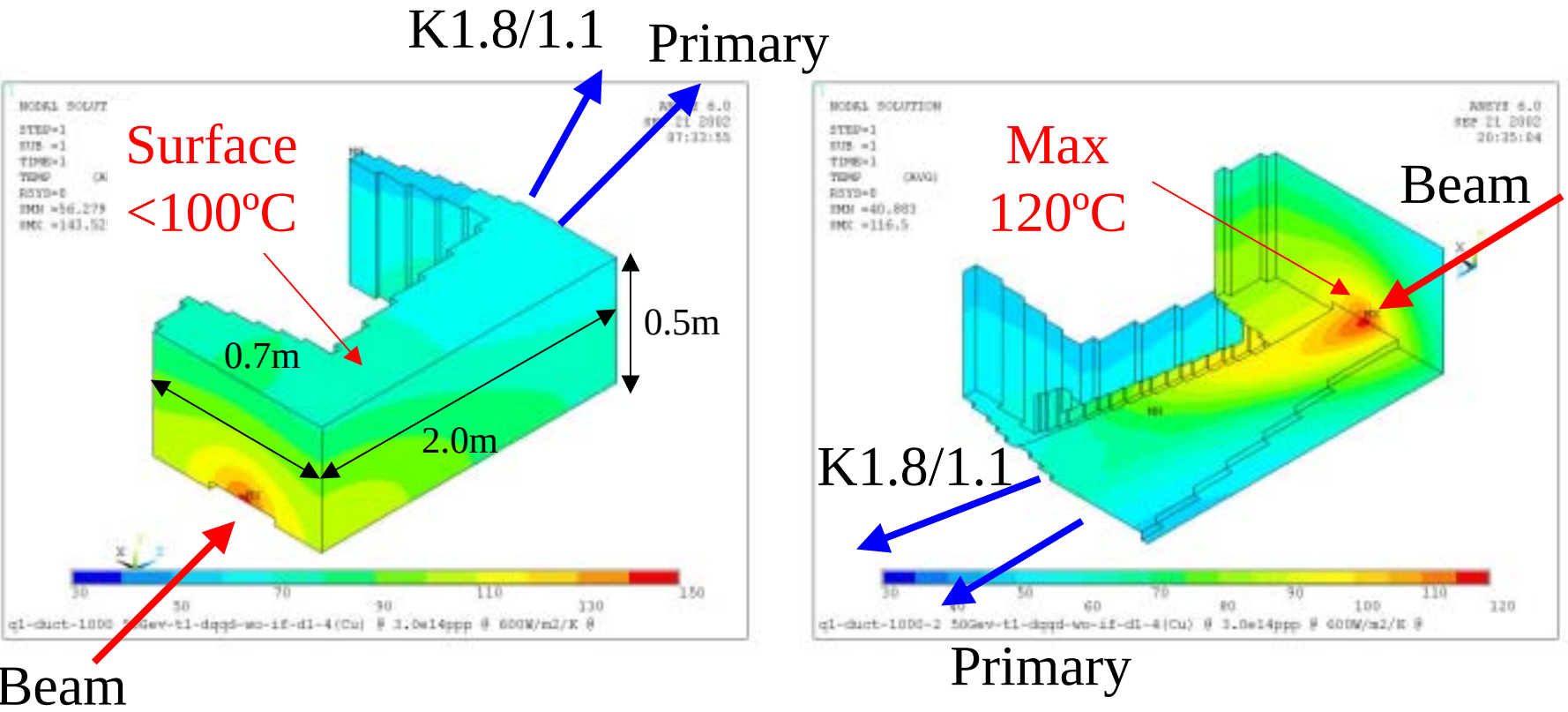


- Aperture size
  - H=±10 cm (16cm)
  - V=±0.8cm (0.8cm)
- Acceptance
  - x=±50mrad
  - y=±10mrad
- 30cm away from T1

To be optimized

Copper beam duct for D1

Thermal evolution by MARS+ANSYS *(H. Takahashi & M. Minakawa)*



Can the Cu duct keep its strength over 100ºC ?

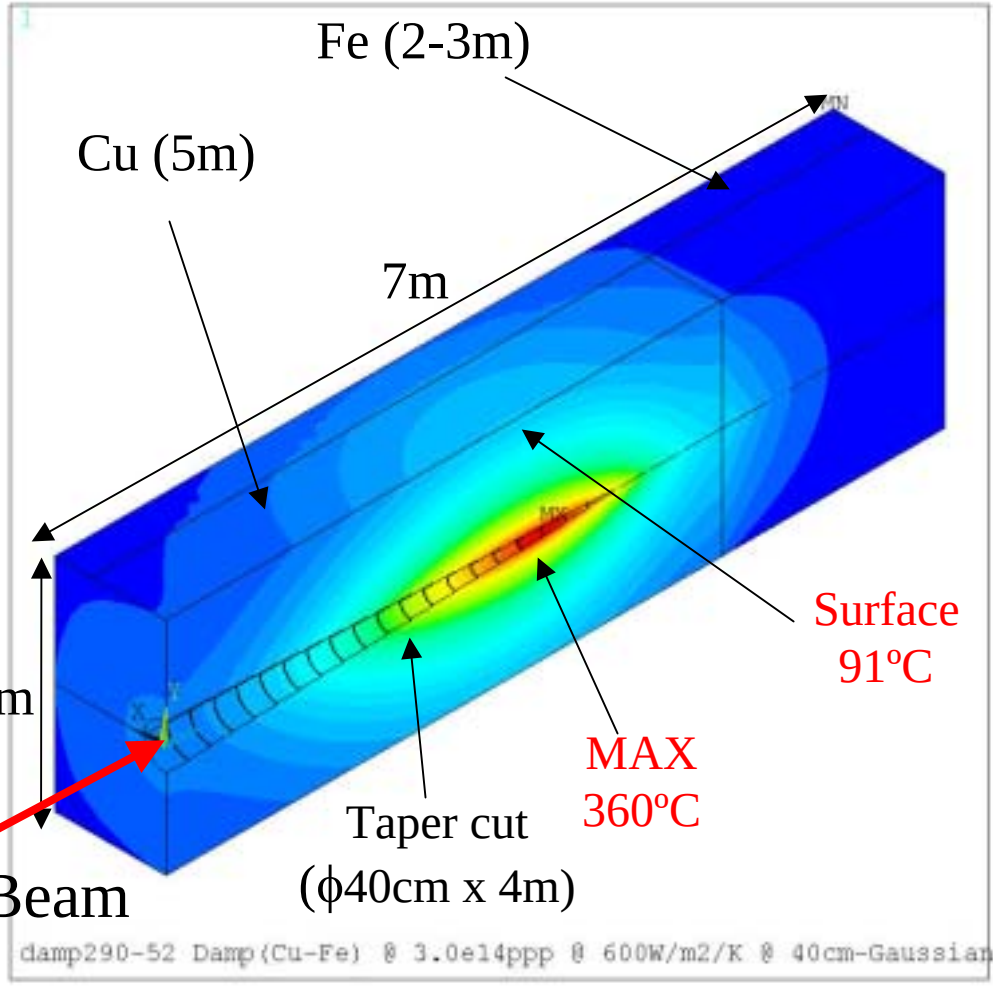
K-hall Beam dump

Requirements in design

- 750kW beam loss (100%)
  - Maximum temperature < 400ºC
  - Temperature at the surface <100ºC
- Movable at the 2nd phase
  - Total weight ~1000 t
  - Distance ~50 m
- Easy maintenance
  - Dose rate <1 mSv/hr at contact
- Radiation protection
  - <11(0.5) mSv/hr for soil activation
  - <12.5 μSv/hr at the ground level
  - <30 Bq/cc/month for ^{3}H production in cooling water
- As cheap as possible
  - <100 M Japanese yen

K-hall Beam dump

Thermal evolution by MARS+ANSYS *(Y. Sato & M. Minakawa)*



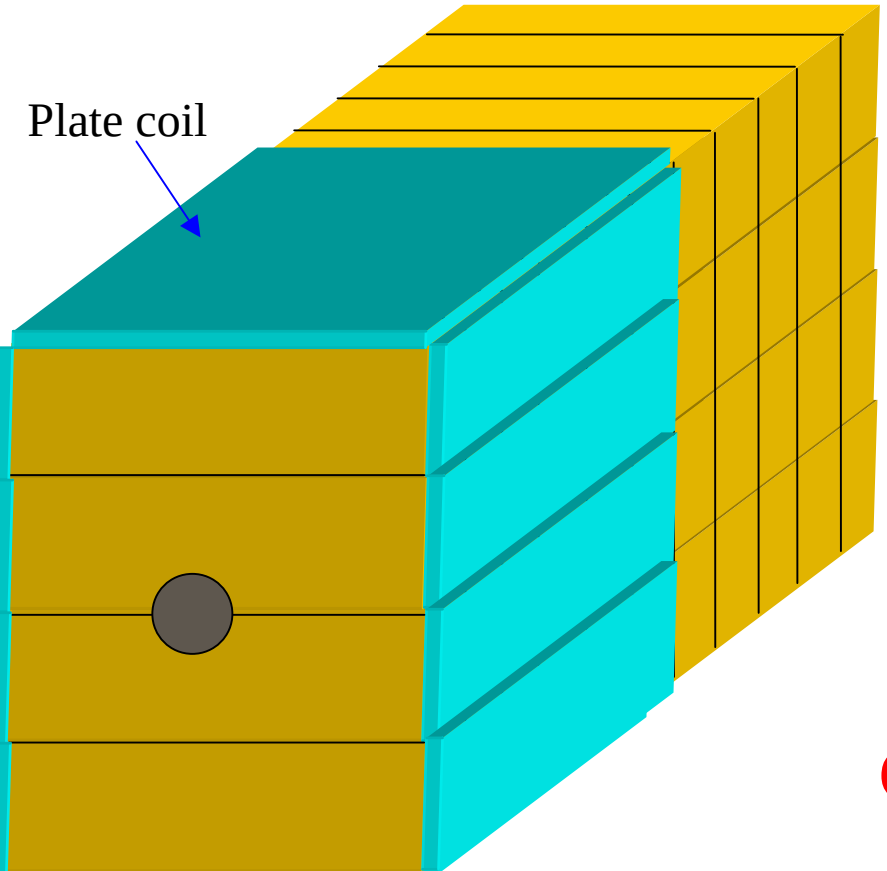
- Cu core with taper cut
  - ρ=8.9 g/cm^3
  - heat conductivity: 360 W/m/K
- De-focused beam
  - 50GeV, 3x10^{14} ppp
  - 40cm x 40cm Gaussian type
- Cooling at the surface
  - Heat convection: 600 W/m^2/K (safe side)
- Total weight:
  - Core(264 t)+Shield(400t) =~700t

Basic design is O.K.

K-hall Beam dump

How to build it cheaply

Stacking Copper bulk

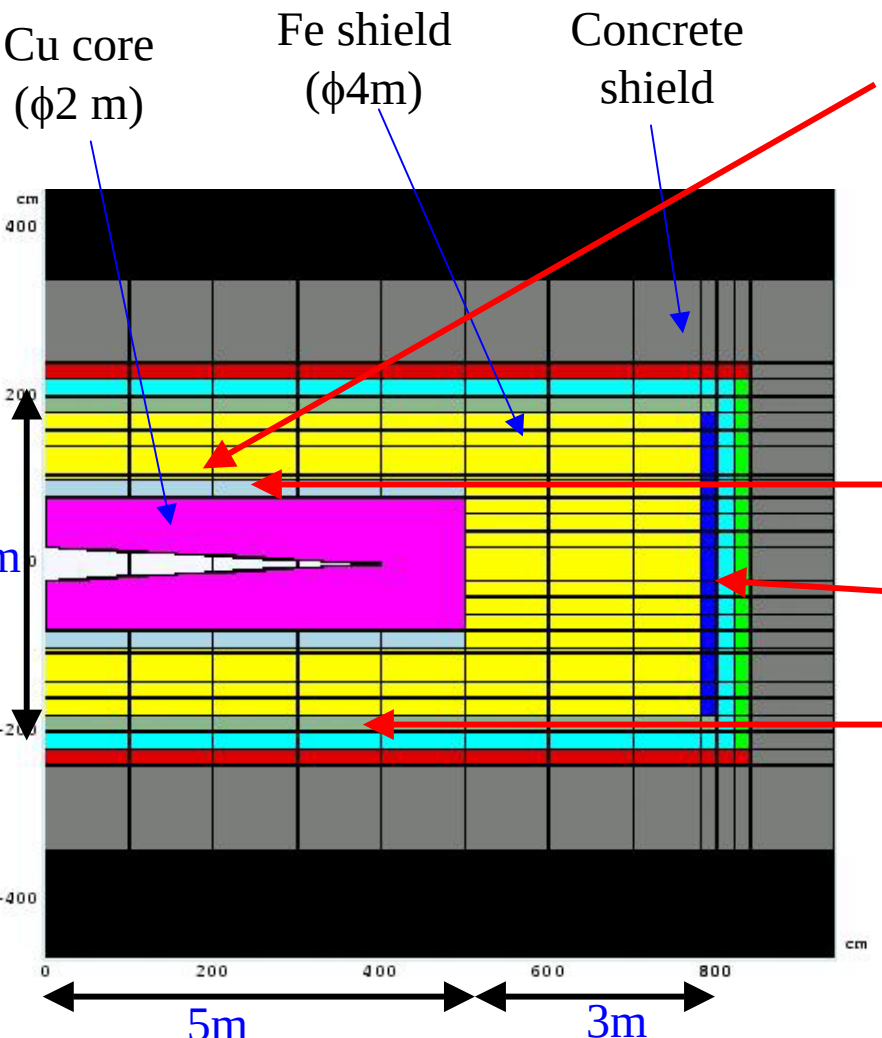


- Available Copper bulk in Japan
  - $0.62m^{W} \times 0.23m^{T} \times 6.0m^{L}$ 8t
    (Hitachi cable co.)
  - $1.07m^{W} \times 0.18m^{T} \times 6.4m^{L}$ 11t
    (Furukawa-denko co.)
  - $1.05m^{W} \times 0.26m^{T} \times 6.0m^{L}$ 15t
    (Mitsubishi material co.)
- Cooling system
  - Plate coil
  - Friction soldering
- Heat exchanging system
  - Closed/Open type

Guarantee $600W/m^2/K$ at least

K-hall Beam dump

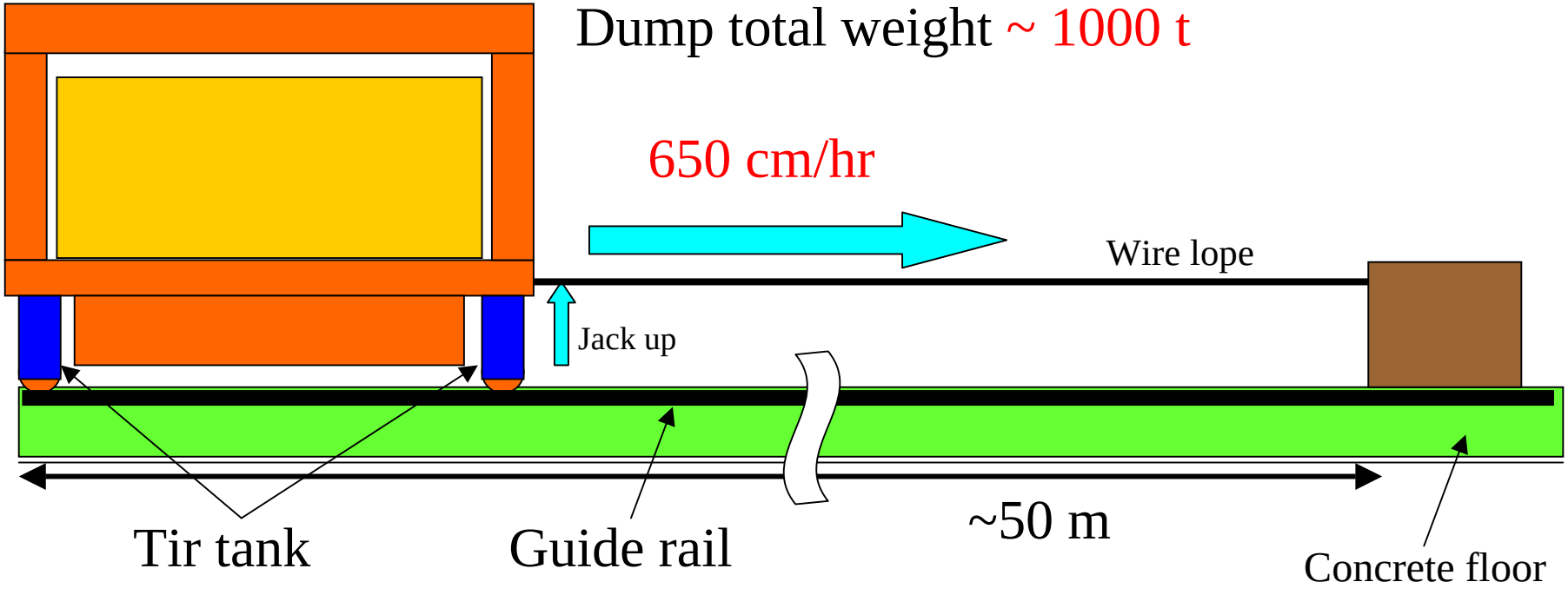
Radiation protection (preliminary)



- ^{3}H ($T_{1/2}$=12.3 year) production at the surface of Cu core
  - ~100 Bq/cc/1 month for 11 m^3 Volume (Notice: 20 cm thick cooling water)
- Residual dose rate at contact after 1 year irradiation and 0.5 year cooling (KEK safety limit: 500 μSv / day)
  - 90 mSv/12 hr (averaged) at Cu surface (R=0.8-1.0m)
  - 0.12 μSv/12 hr (averaged) at Fe end (Z=7.8-8.0m)
  - 320 μSv/12 hr (averaged) at Fe surface (R=1.8-2.0m)

K-hall Beam dump

How to move it safely



- Need to be balanced carefully
- Guarantee flatness of the floor

Summary

- Heat analysis of the T1 target will be finalized soon. A prototype of T1 target is under construction. The whole system will be tested by the T1 mock-up.
- Detailed design work for the most upstream part of secondary beam lines has been started. Cooling beam duct is one of crucial issues.
- Heat analysis of beam dump is completed. Realistic design and shield structure will be determined soon.
- Design details of our facility and equipment can be found in our Technical Design Report (**中間報告書**) .

We need more help and feedback from users !