IP Chamber Ver. 1

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K. Kanazawa
for
IR Technical Meeting Member
IR Installation Meeting Member
SVD/IR Mechanics Meeting Member

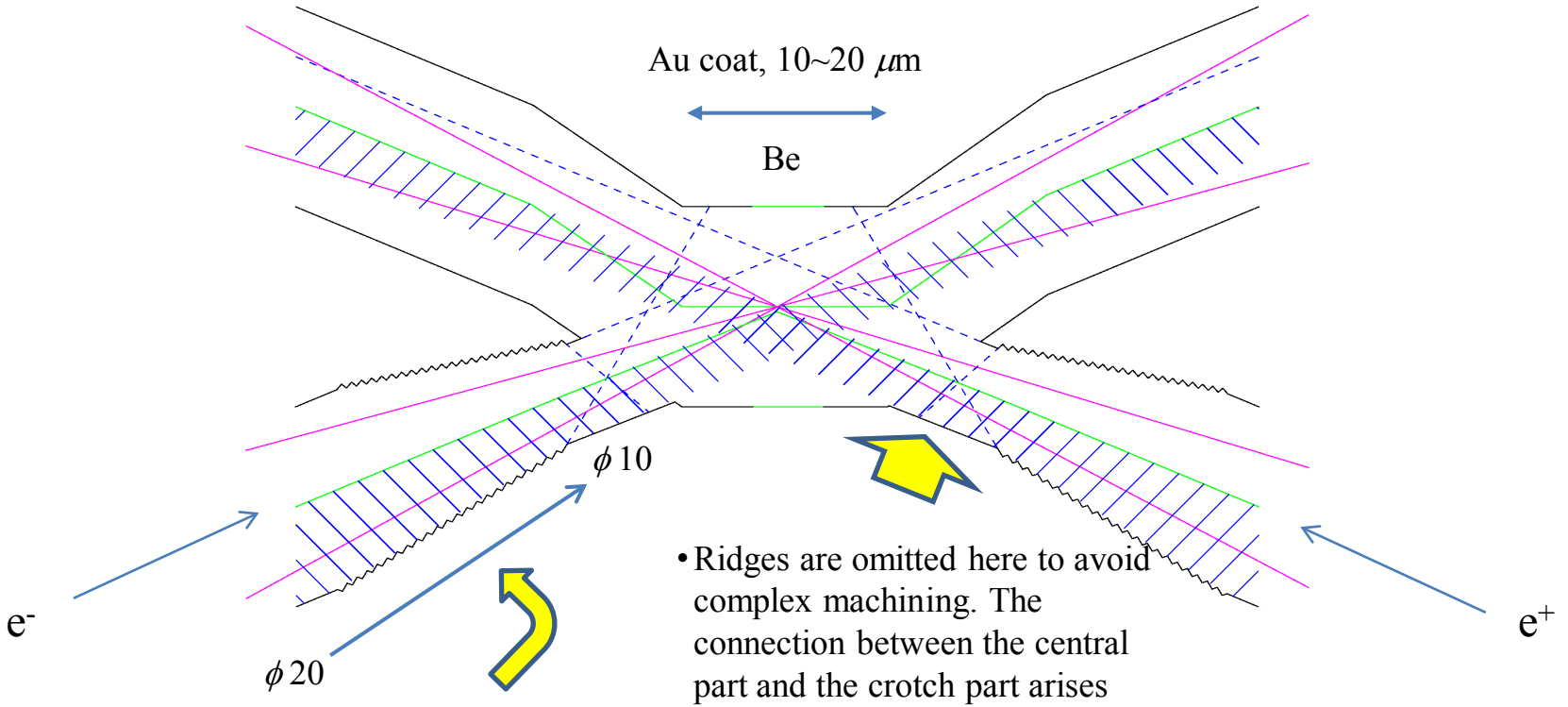
Introduction

The design and fabrication of the IP chamber has been proceeding through step-by-step technical tests, with reference to back ground simulation, and with the evaluation of beam-induced phenomena.

Recently the final design for the version 1 chamber (for BEAST II or Phase 2) was proposed.

The following explain the design features.

On Synchrotron Radiation



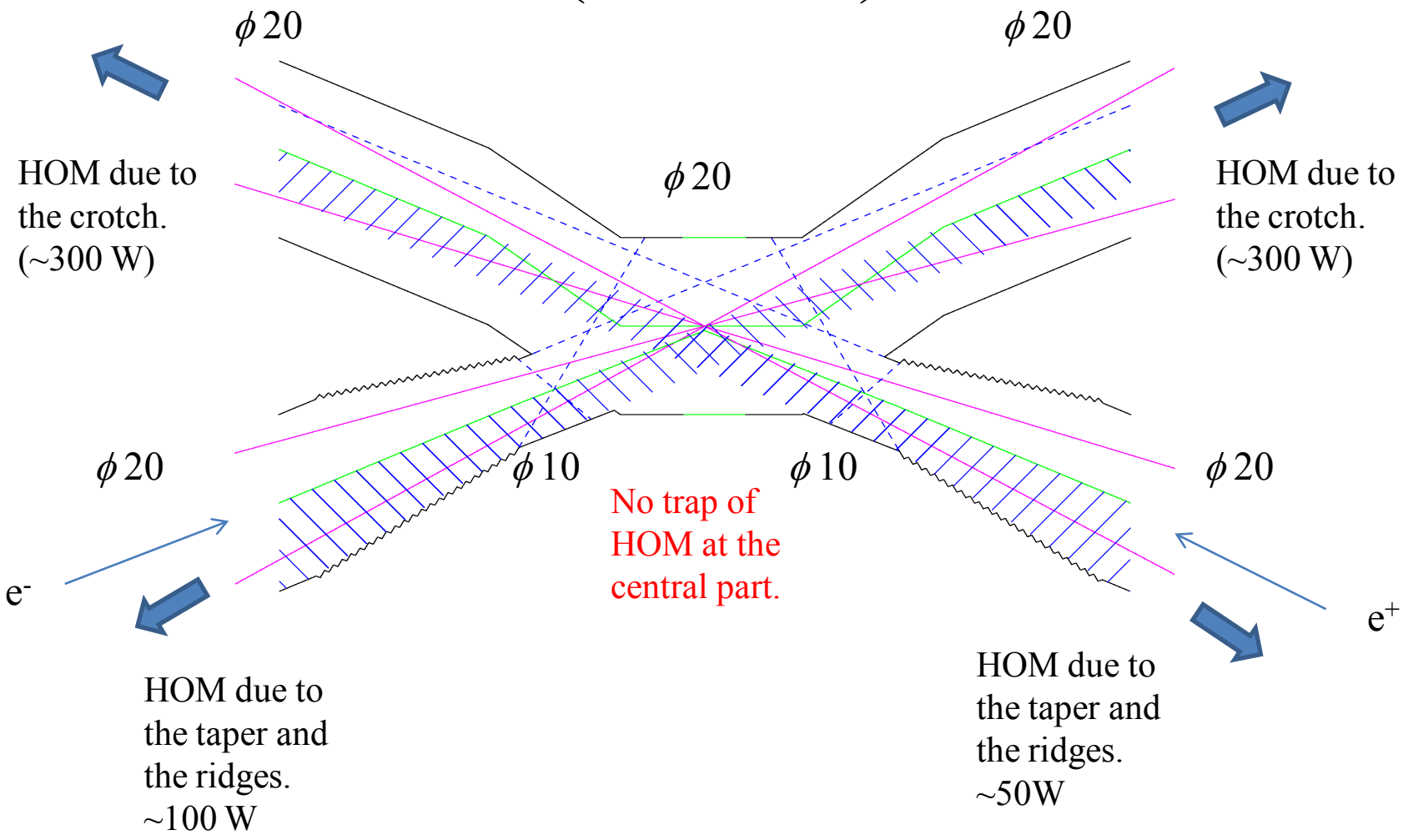
Taper: to reduce the number of photons entering into the central part

+

Ridges: to keep the direction of scattered photons away from Be

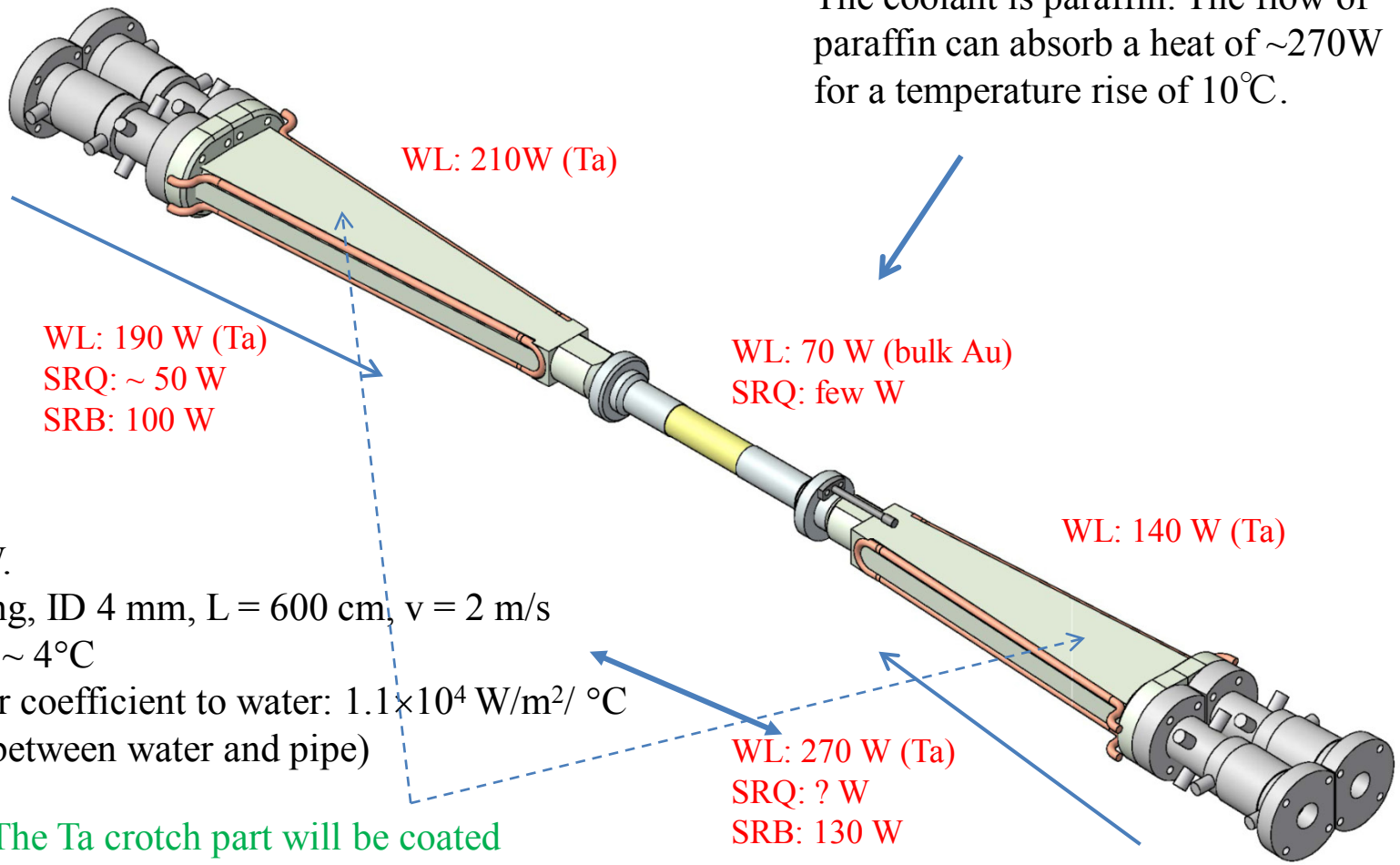
- Ridges are omitted here to avoid complex machining. The connection between the central part and the crotch part arises here.
- Instead, this part is slightly bent downward (in the drawing) to avoid the direct hit of SR from the last bend. At present, simulation shows no serious scattered photons from this part.

On Beam Induced Electro-magnetic Field (or HOM)



On Heat load

The coolant is paraffin. The flow of paraffin can absorb a heat of ~270W for a temperature rise of 10℃.

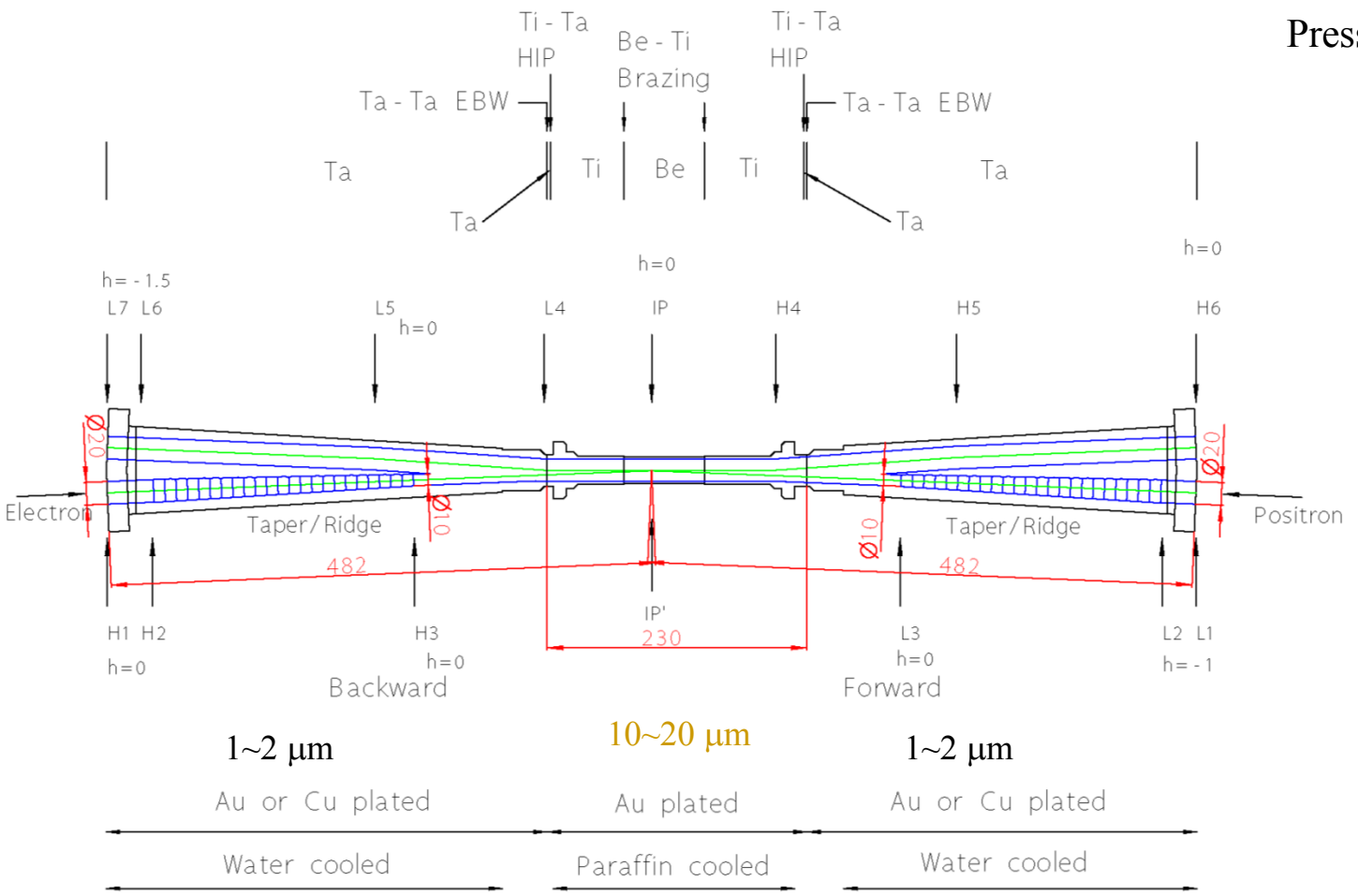


Heat: 400 W.
Water cooling, ID 4 mm, L = 600 cm, v = 2 m/s
ΔT of water ~ 4°C
Heat transfer coefficient to water: 1.1×10^4 W/m²/ °C
ΔT ~ 5 °C (between water and pipe)

The Ta crotch part will be coated with Au or Cu (1~2 μm) to reduce the wall loss.

T. Kohriki

On Fabrication



HIP = Hot Isostatic Pressing

- The central straight part consists of double tube. Paraffin runs between them.
- The connection between double tubes is done by Ti-Ti EBW.

R&D

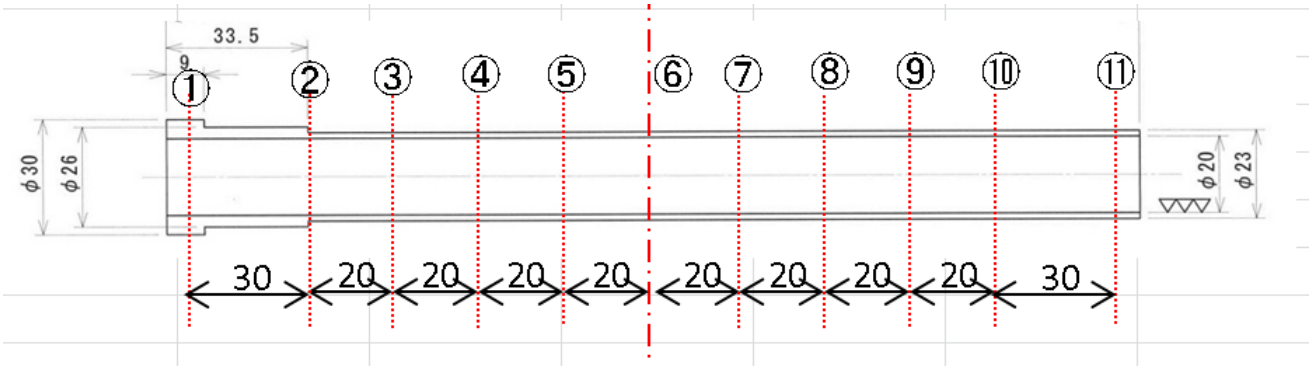
Fabrication issue

- Cleared
  - Stress analysis
    - For the temperature difference between the two tubes at the center.
    - Changing support position of beam pipe
  - Fabrication test
    - Precise machining of Be pipes
    - NC machining of ridges
    - Be-Ti brazing
    - Ti-Ta HIP
    - EBW near by HIP
    - Pulsed sputter coating of Cu inside 2 cm Al pipe and its uniformity check
- To be done (in preparation)
  - Stress analysis
    - Check the strength under dynamic force
  - Fabrication test
    - Au coating on Ti pipe
    - Effect of EBW on the coating
    - Simulation welding between inner and outer Ti pipe

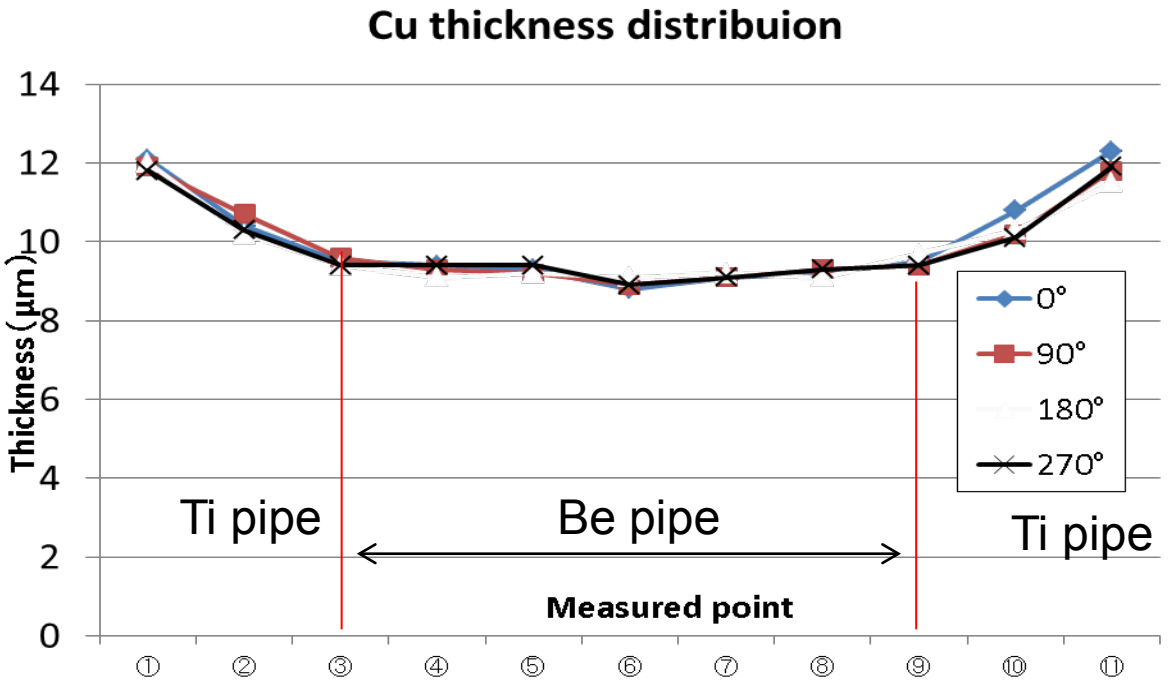
Scientific issue

- Background simulation
- Understanding tip-scattering of photon on a ridge

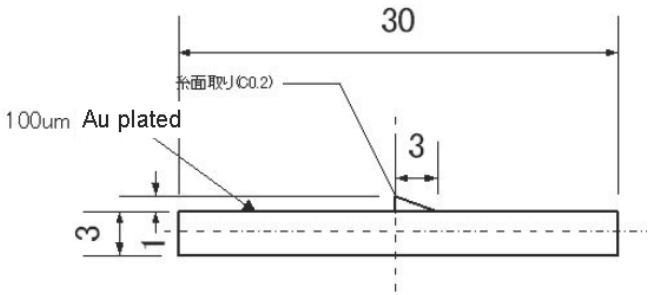
Cu Sputter Coating Test (S. Tanaka)



- Gas: Ar
- Pressure: ~10^2 Pa
- Pulse repetition: 50 Hz
- Pulse width: 1.6 μs
- Pulse height: ~500 V

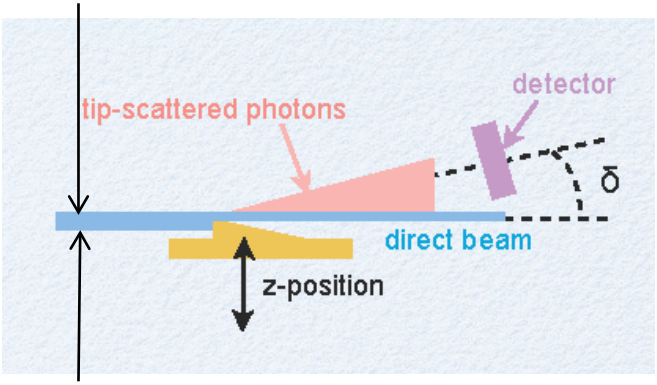


Tip-scattering on a ridge (T. Ishibashi et al)



Ta sample

~0.14 mm
(due to scattering on air)

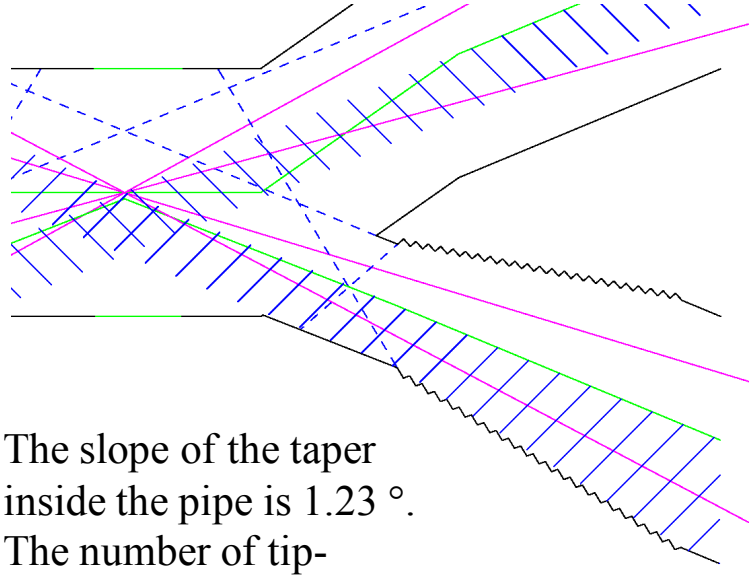


Set up

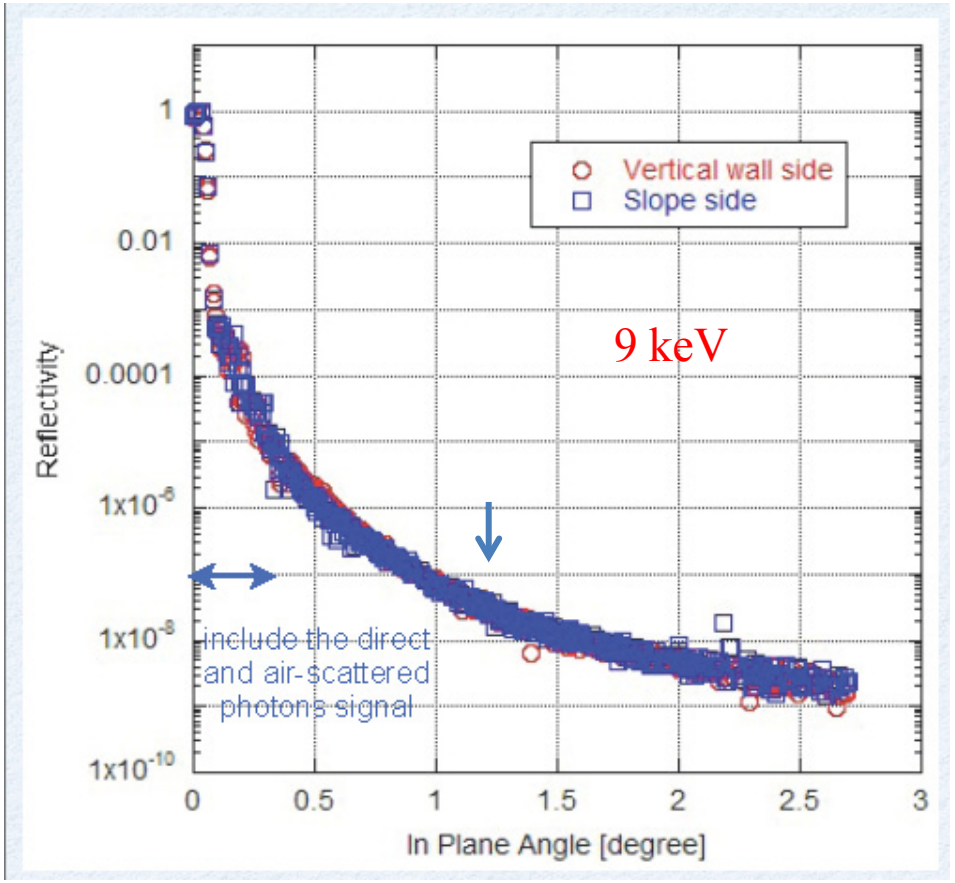
Half of photons hit the ridge
and
the other half pass over.

- CHESS (Cornell Univ.) G2 beam line
- Photon energy : 9 keV
- Slit : 2 mm (H) by 0.05 mm (V)
- Detector angular resolution : 0.2 ° (FWHM)

Tip-scattering on a ridge



- The slope of the taper inside the pipe is 1.23 °.
- The number of tip-scattered photons that enter the central part is less than ~10^{-7} of those hit the ridge.
- Assuming the shape of the ridge, we will be able to estimate the actual number.



Ratio of the scattered photon.

Ver. 1 Beam Pipe Production Schedule (S. Tanaka)

	Start	End	2012. 11	12	2013. 1	2	3	4	5	6	7	8	9	10	11	12
Cupper plating test (for IP inner tube) (Done)	2012. 9	2012. 12														
Tantalum and titanium part connection and cutting test (Done)	2012. 1	2012. 12														
Crotch part machining (forward)	2013. 4	2013. 7														
Crotch part machining (backward)	2013. 4	2013. 7														
Tooling production for connection of IP chamber and crotch part	2012. 12	2013. 3														
IP inner chamber production	2013. 1	2013. 3														
Gold plating of inner tube	2013. 4	2013. 4														
connection of IP chamber inner and outer tube (EBW for Ti-Ti)	2013. 5	2013. 8														
Thermal stress test with EBW and brazing	2012. 11	2013. 3														
Crotch part connection (EBW or brazing)	2013. 8	2013. 10														
connection of IP chamber and crotch part	2013. 10	2013. 12														

Yellow: Test
Blue: Central chamber
Green : Crotch part

The outer tube was already fabricated.

Concluding remark

- The design of the first IP chamber for Phase 2 commissioning is almost completed.
- The total fabrication time will be about 1.5 year, since it contains many step-by-step fabrication tests.
- The second version can be completed within much shorter period.
- It will be quite fruitful if we can have a feedback from the experiences during Phase 2 run before completing the production of the second version.