



IR Beam Pipes and Assembly

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Contents

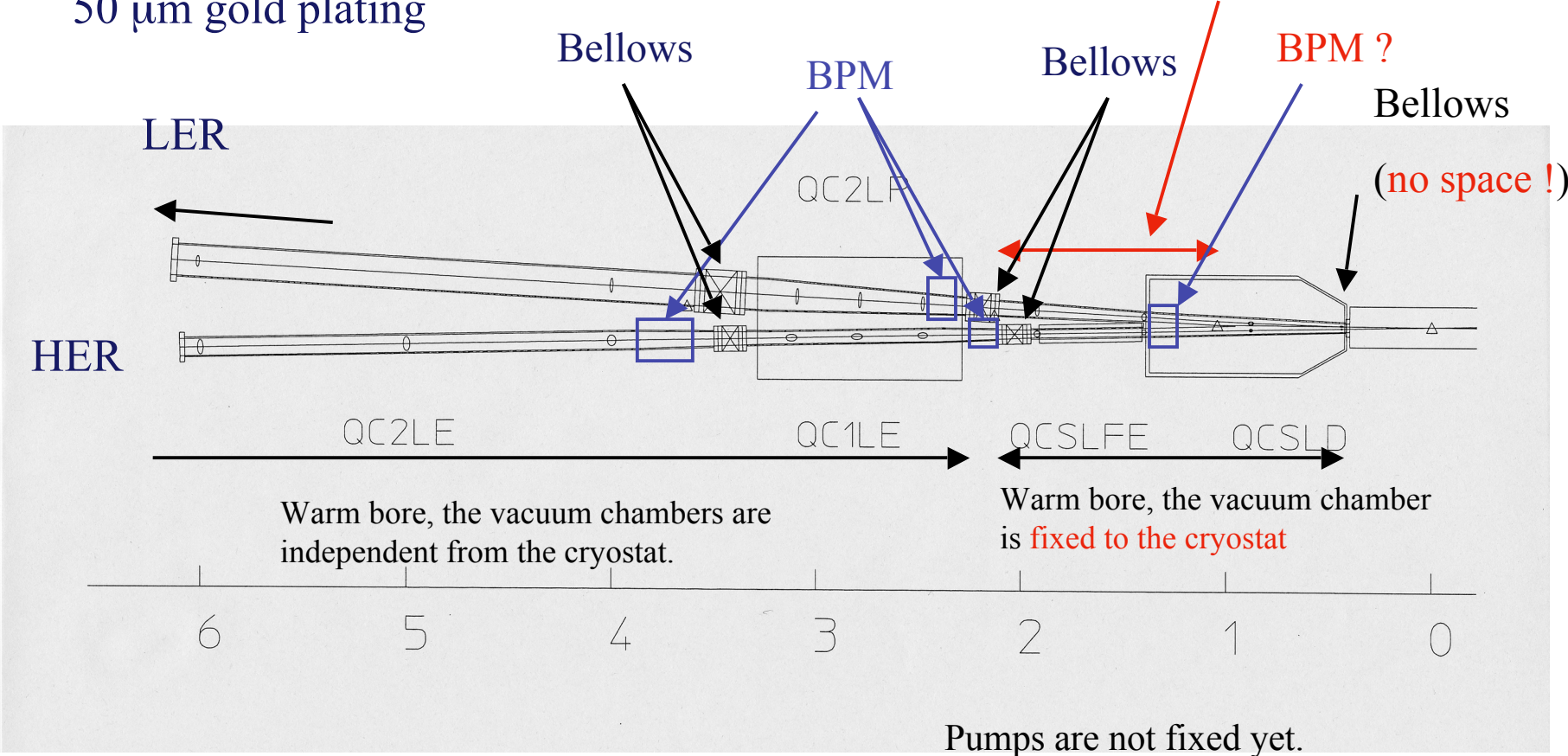
- Overview
- Possible assembling procedure
- 80K surface
- High power SR on a plated surface
- Remaining issues
- Summary

Overview (1)

Copper duct

50 μm gold plating

SR on the chamber wall
 $\sim 25 \text{ kW}$ ($\sim 1\text{m}$)

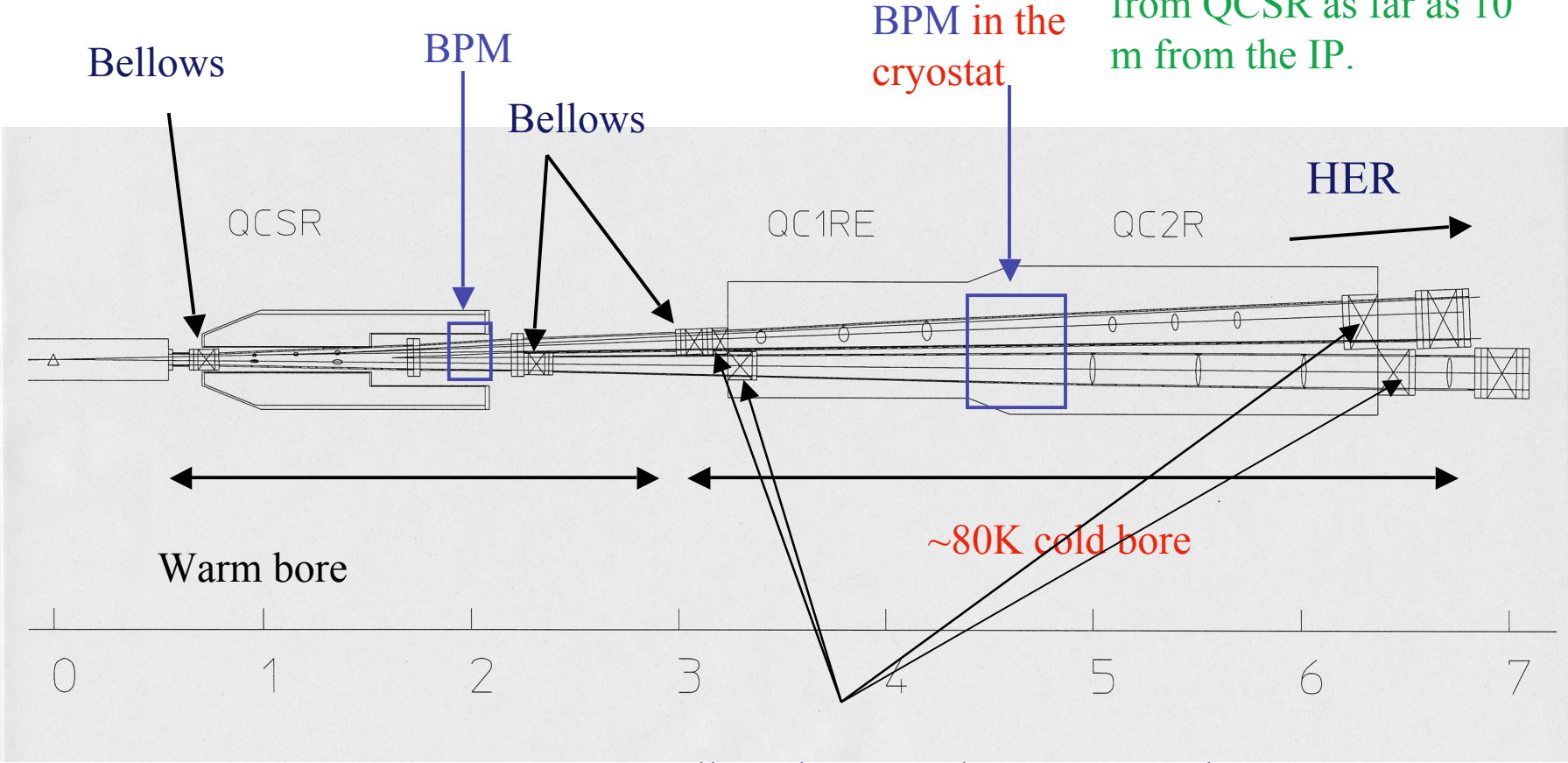


Overview (2)

Copper duct

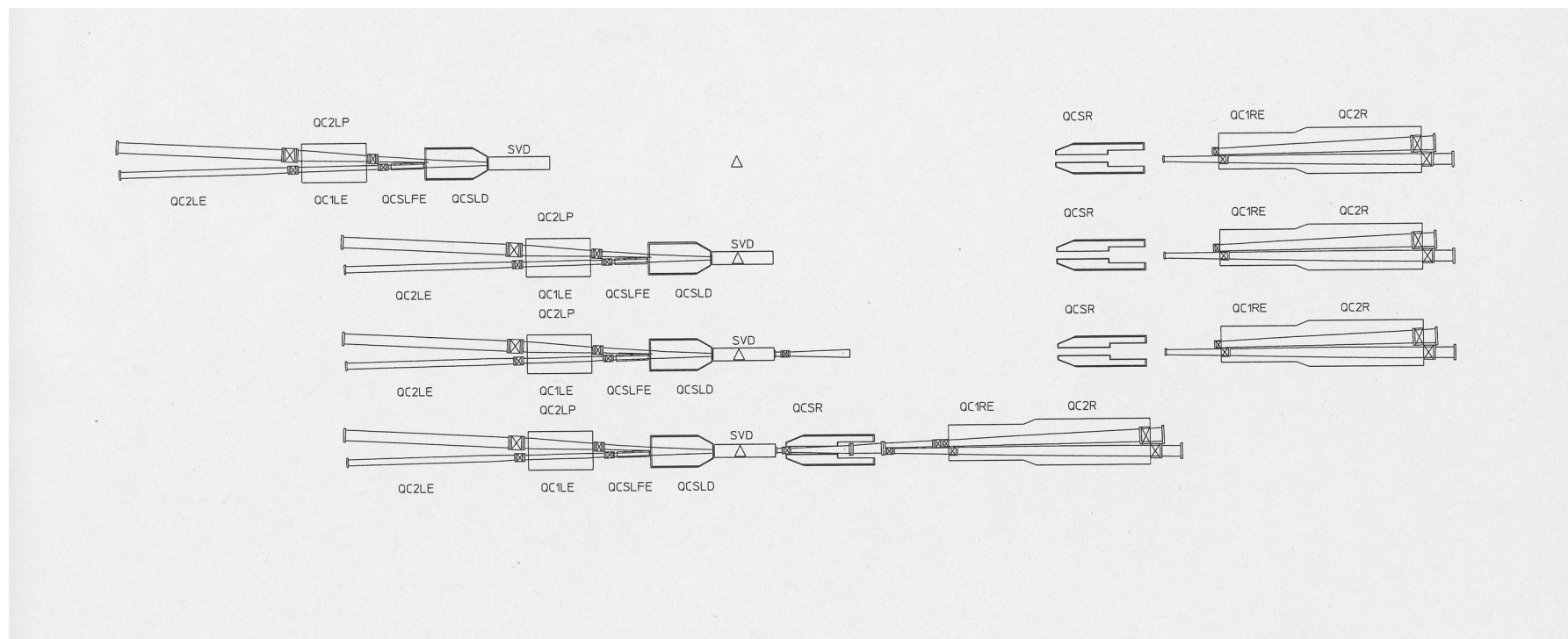
50 micron gold plating

HER vacuum chamber must have a clearance against the direct SR from QCSR as far as 10 m from the IP.



Bellows between the cryostat and the vacuum ducts

Possible assembling procedure



The connecting flanges of QCSLD chamber and IP chamber become inaccessible during assembling. IP chamber and SVD must be assembled in front of QCSLD outside the Belle detector.

80K surface (1)

- Basic property
 - If an ambient pressure of a gas is lower than the vapor pressure at 80 K, vacuum property of the surface is governed by adsorption isotherm.
 - If an ambient pressure of a gas is higher than the vapor pressure at 80 K, the gas condenses on the surface. The surface works as a cryopump for the gas.
 - If the temperature of the triple point of a gas (melting temperature) is higher/lower than 80K, the surface is covered with solid/liquid.

80K surface (2)

Interaction with gas species.

Gas	Vapor pressure at 80K (Pa)	80K surface in vacuum ($\sim 10^{-8}$ Pa)	With SR gas load ($\sim 10^{-5}$ - 10^{-7} Pa)	Exposed to atmosphere ($\sim 10^5$ Pa)
H ₂	(Tc.p. = 33.6 K)	AI	AI	AI
CH ₄	10^3 (S-G)	AI	AI	AI or Growth of solid methane
H ₂ O	$\ll 10^{-17}$ (S-G)	Cryopumping	Cryopumping	Growth of ice
CO	8×10^4 (L-G)	AI	AI	AI
N ₂	1.4×10^5 (L-G)	AI	AI	AI
O ₂	3×10^4 (L-G)	AI	AI	AI
CO ₂	10^{-5} (S-G)	AI Gas source if dry ice exists	AI Gas source if dry ice exists	Growth of dry ice

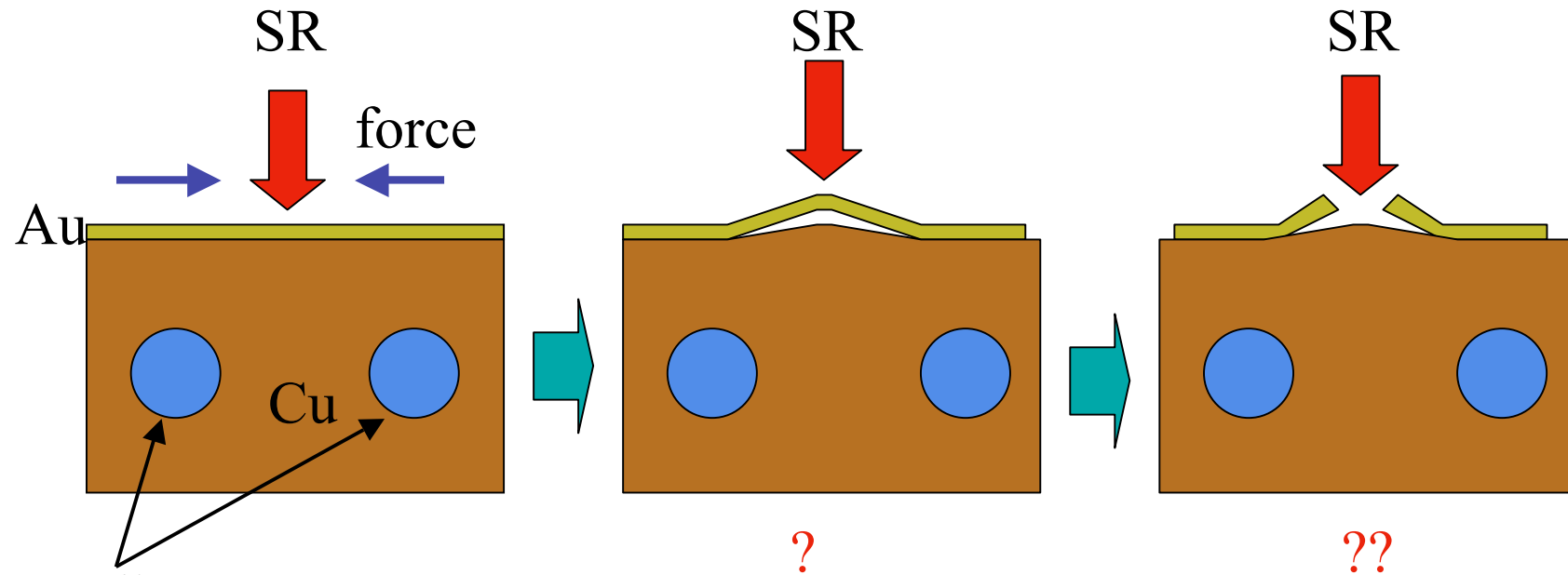
AI means that the interaction follows the adsorption isotherm.

S/L-G means the vapor pressure is given by solid/liquid-gas equilibrium.

80K surface (3)

- 80K surface does not work as a cryopump for main gases during photodesorption such as H₂, CH₄, CO, CO₂.
- An **accidental exposure to air** results in a growth of **ice** on the surface. This ice may be a gas source if the temperature of the surface of the ice is much higher than 80K. For safety, a mild bake-out system should be supplied.

High power SR on a plated surface (1)



Cooling
water

Localized SR induces temperature gradient and resulting compressing force to the central part.

The central part will swell and plated gold comes off to release the force.

A part of gold evaporate due to the heat from SR.

High power SR on a plated surface (2)

- Vertically localized SR will induce a **temperature gradient** near the heated region. This results in a **compressing force** to the heated part. This is a mechanically **unstable** condition for the plated layer if strong sticking force does not exist.
- If the plated gold gets a damage or not, a model **test using electron beam** will be necessary.

Remaining issues

- BPM in a cryostat.
- More realistic vacuum chamber design.
- Pumping scheme and pressure estimation.

Summary

- All vacuum chambers in IR are required to be made of **copper** and with an inside **gold plating of 50 μm** .
- In HER downstream IP, direct synchrotron radiation from QCS should avoid vacuum chambers as far as 10m.
- In the present design, **IP chamber and SVD must be assembled in front of QCSLD outside the Belle detector**.
- An **accidental exposure to air** results in a growth of **ice on the 80K surface**. For safety, a mild bake-out system or equivalent procedure should be supplied.
- The **stability of the gold plating under intense synchrotron radiation** needs experimental verification.
- There is no experience for **BPM in a cryostat** at KEK. Useful information is needed.
- Consideration on a pumping scheme is still remaining.