

Superconducting Cavity

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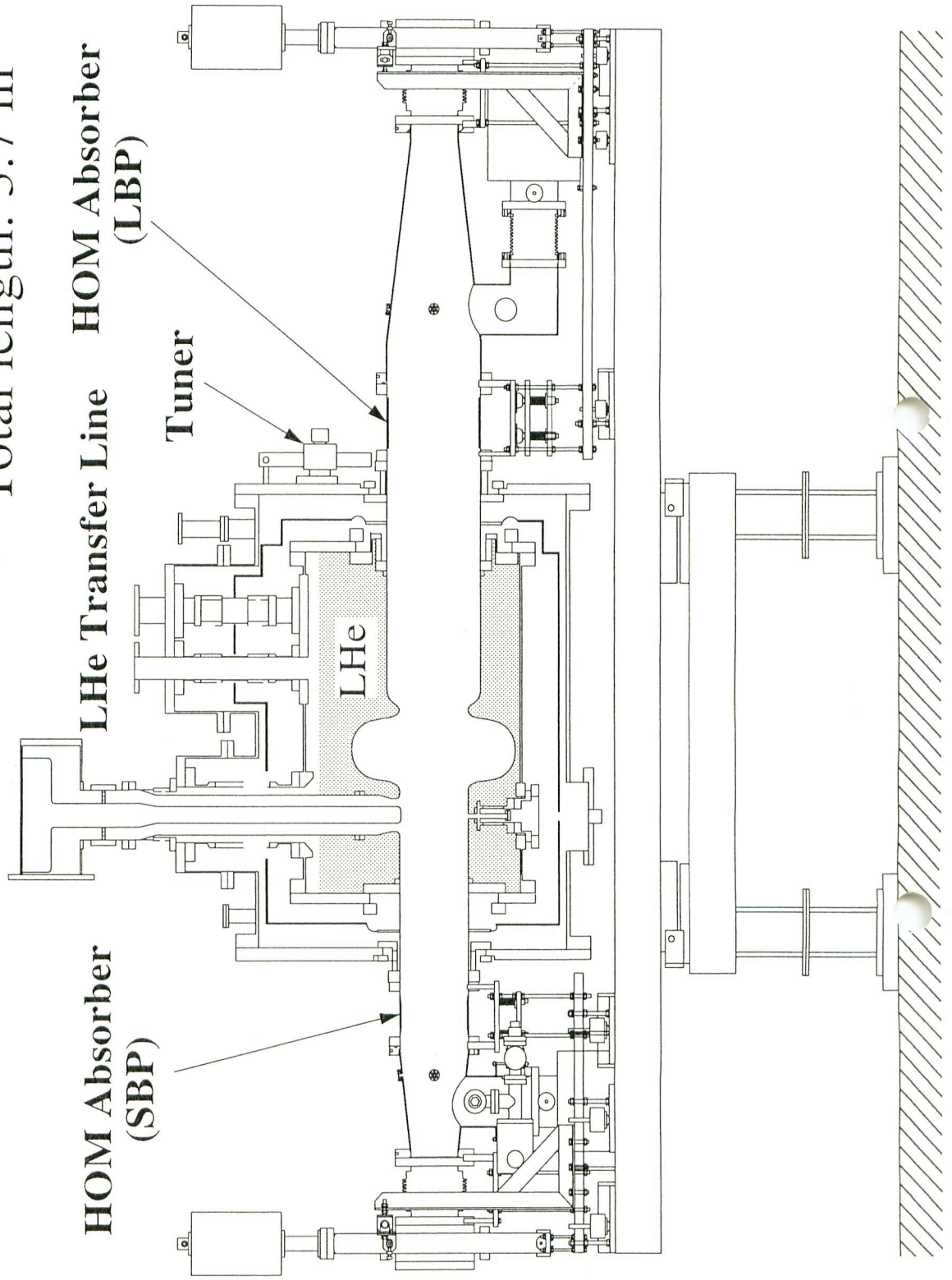
Outline

- Brief recollection of the construction
- Performance of the four cavities
- Monitors and coupler aging
- Present status of operation with beam
- Problems
- Schedule for the next four modules
- Summary

Superconducting Cavity Module

Wave guide, input coupler

Total length: 3.7 m

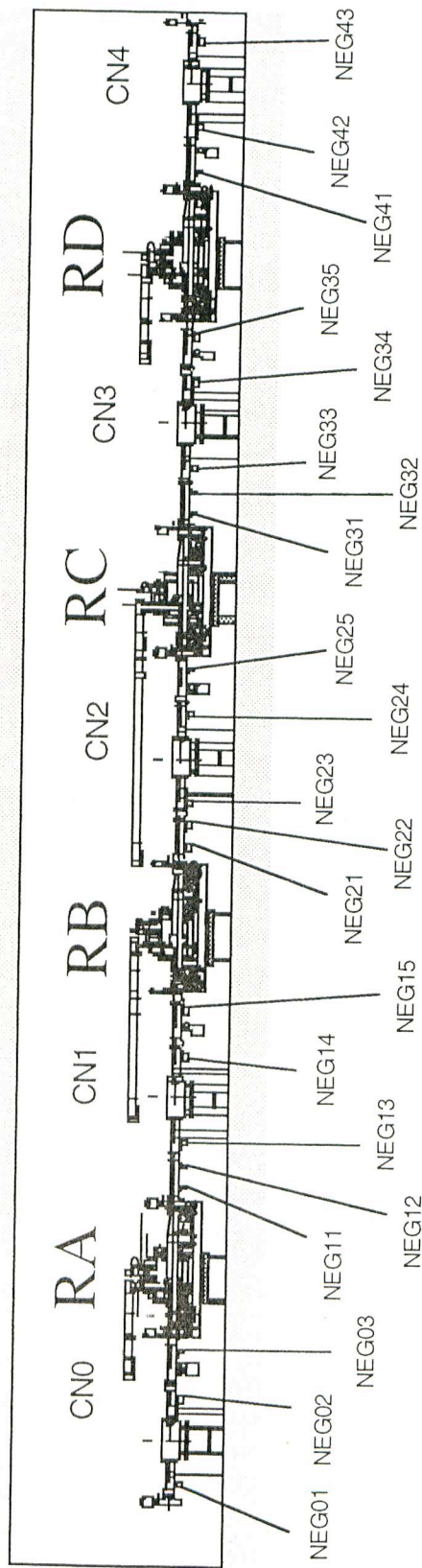


Troubles during assembly with cryostat

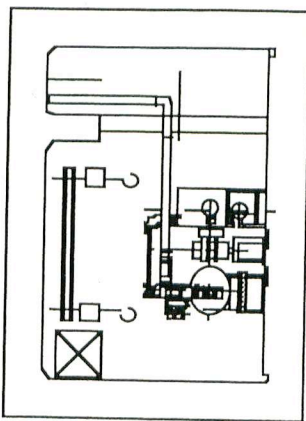
- Leak of Helicoflex seal of LHe vessel during assembly (once): trouble with Indium coating>>Used newly coated seal
- A couple of leaks at the joints of LN2 cooling line (copper pipe, Cajon connector) : Less torque due to the difficulty in screwing the connector >> Retrieved till success

Cavity Train and NEG Pumps

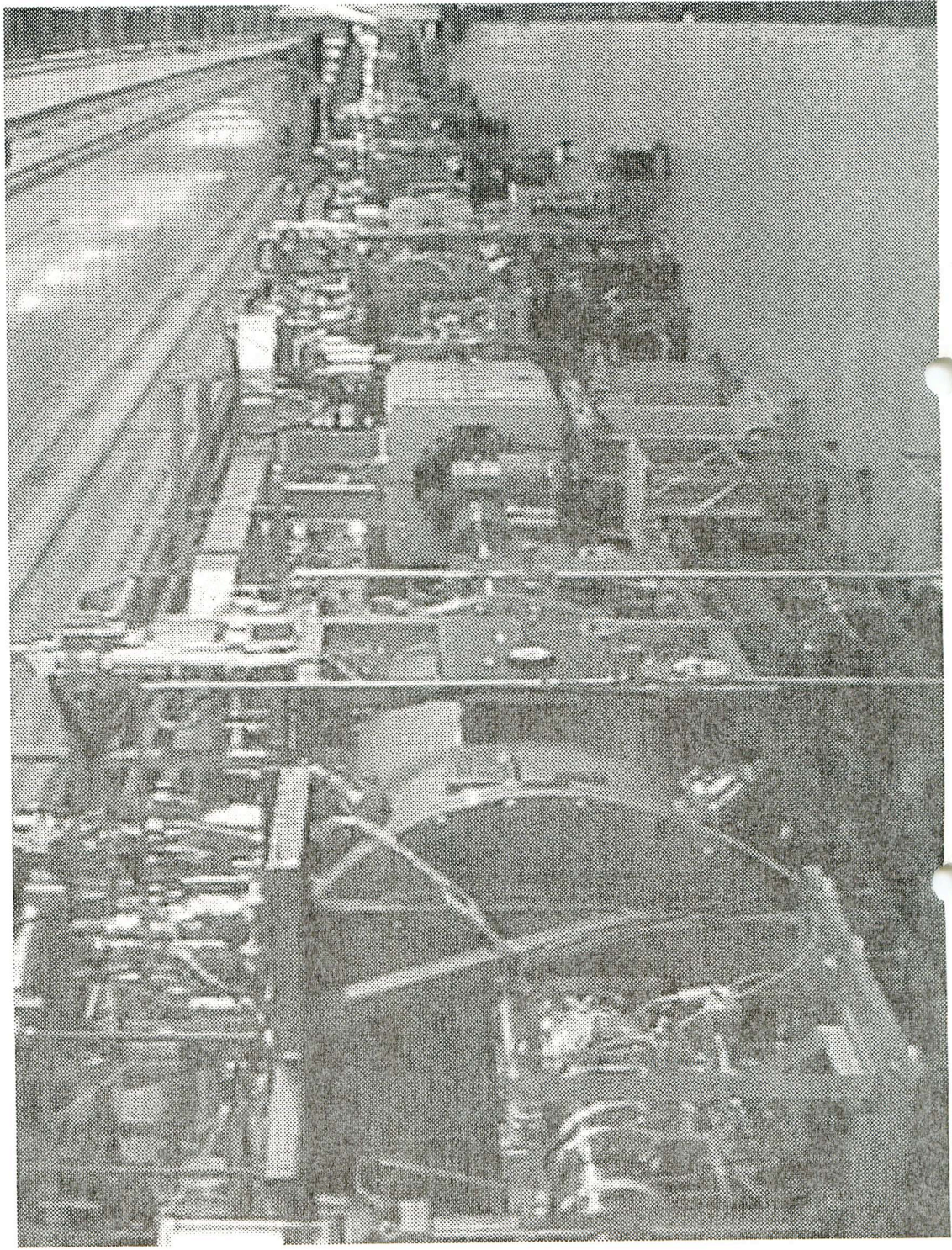
Side View from the Corridor



Cross Section



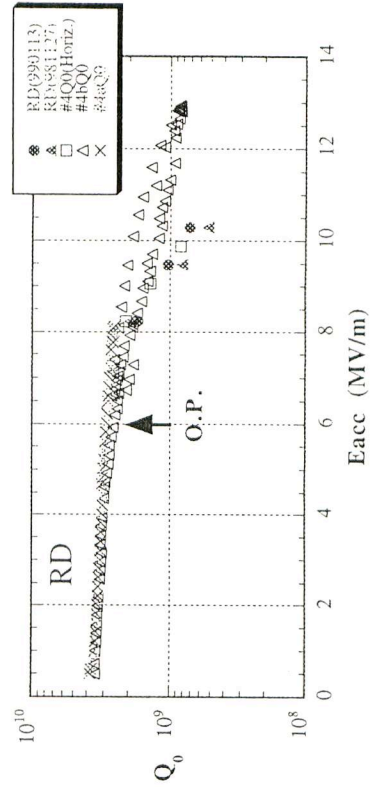
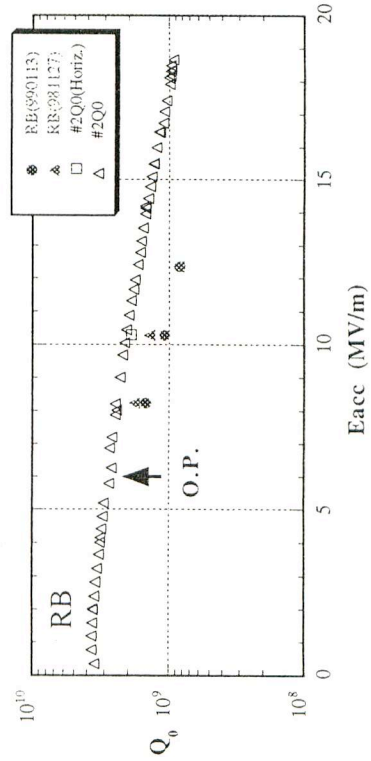
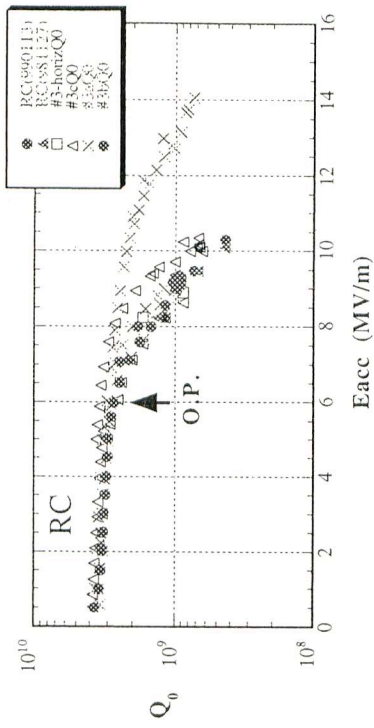
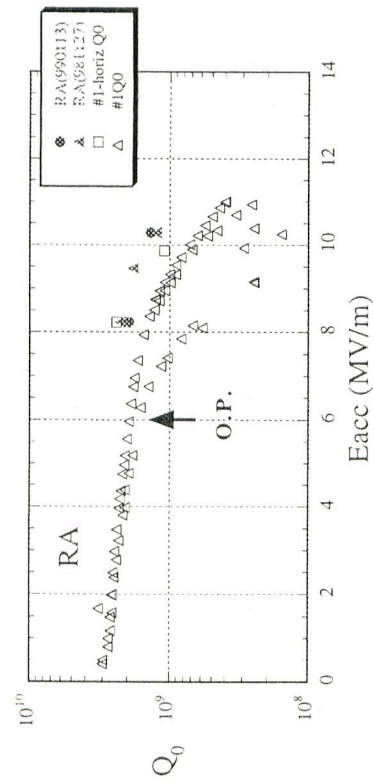
Four modules installed in Nikko D11 tunnel



Four modules installed in Nikko D11 tunnel



Performance of the 4 cavities



Q_0 , $E_{\text{acc,max}}$ and static loss

Cavity Name	RA	RB	RC	RD
Q_0 at 2MV(8MV/m)	2.0E9	1.5E9	1.2E9	1.7E9
$E_{\text{acc,max}}$ (MV/m)	12.3	13.2	10.9	10.9 ¹⁾
Static loss (W)	30	67 ²⁾	27	27

¹⁾Lowered from 11.8 by pulse-aging, which was rare before.

²⁾Due to insufficient insulation vacuum caused by leak

Monitors and data recording

- Power (Klystron input, reflected), V_c
- Temperature (cavity, cryostat, HOM damper, tapers, gate valves, in/out of cooling water, etc.)
- Water flow rate (input couper, HOM dampers)
- RF pick-ups for HOM at tapers
- Monitor with 30 ch. Recorders. GP-IB (EPICS)
- Real-time display on the internet browser

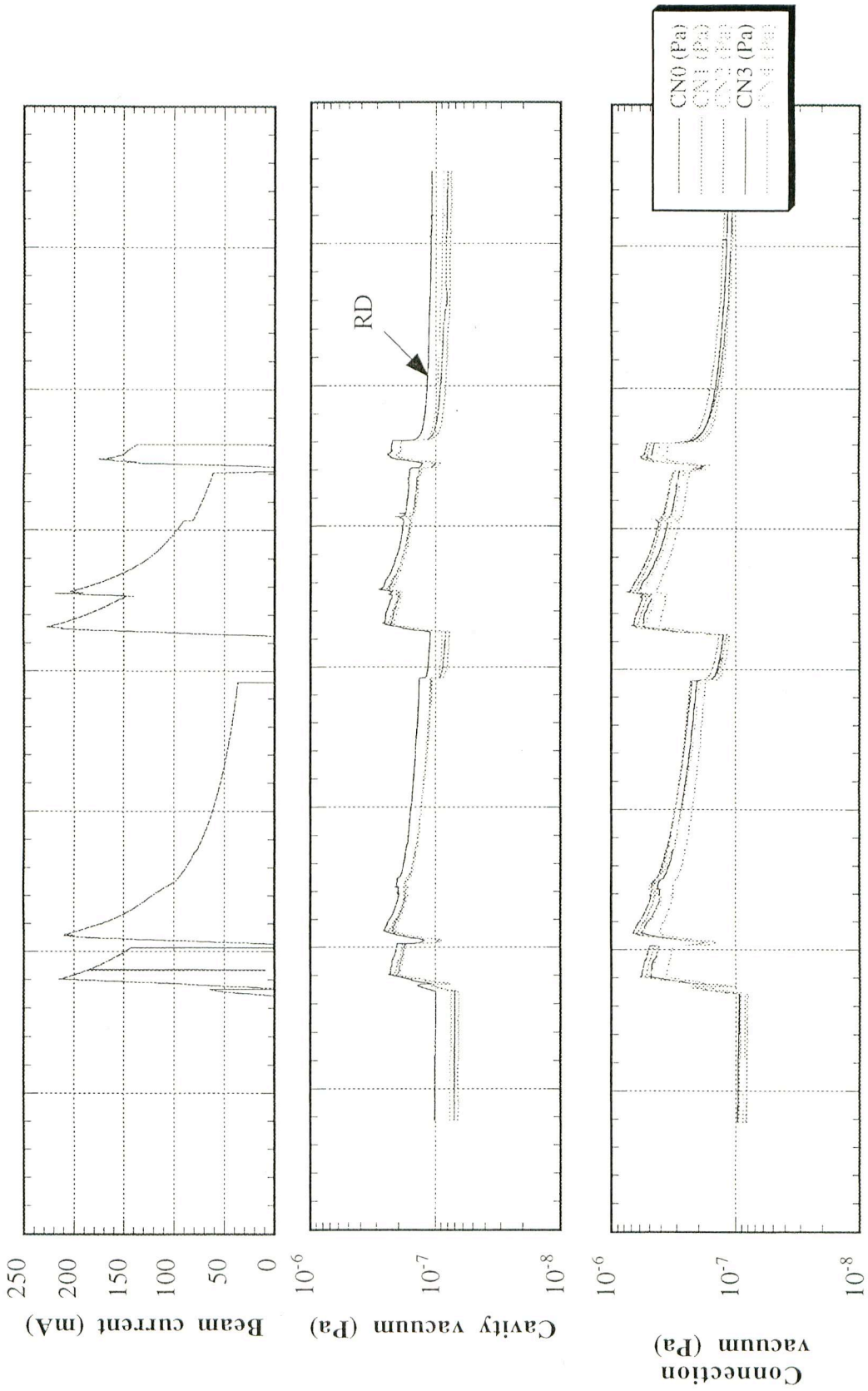
Coupler aging

- Normal aging with perfect reflection up to ~ 300 kW before cooldown
- Bias aging up to ~200 kW, applying up to ± 2 kV on inner conductor. Gas bursts occur at certain bias voltages.
- Similar aging after cooldown before beam operation

Present status of operation with beam

- Since Nov. 1998, there have been two periods at 4.4 K for beam operation. (Nov. 19 - Dec. 27, 1998 and Jan. 8 - Feb. 28, 1999)
- There have been very few trips (twice) so far.
- Max beam current is ~ 240 mA
- There have been no degradation due to beam operation.

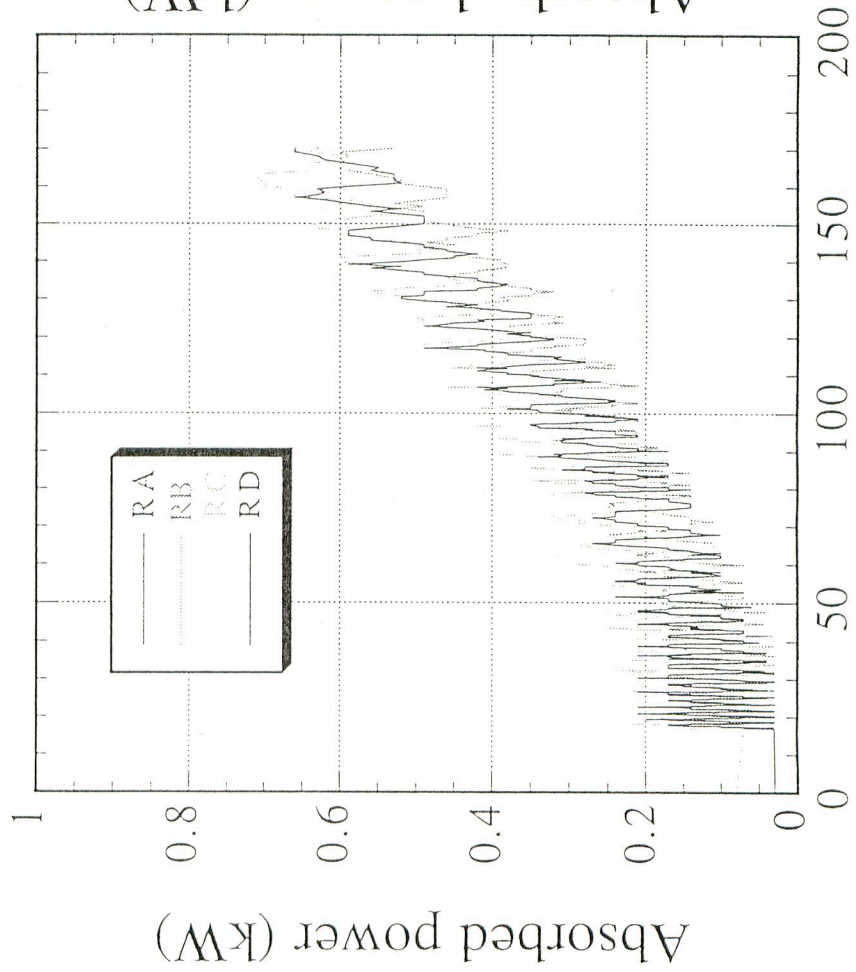
Typical trend of vacuum with beam



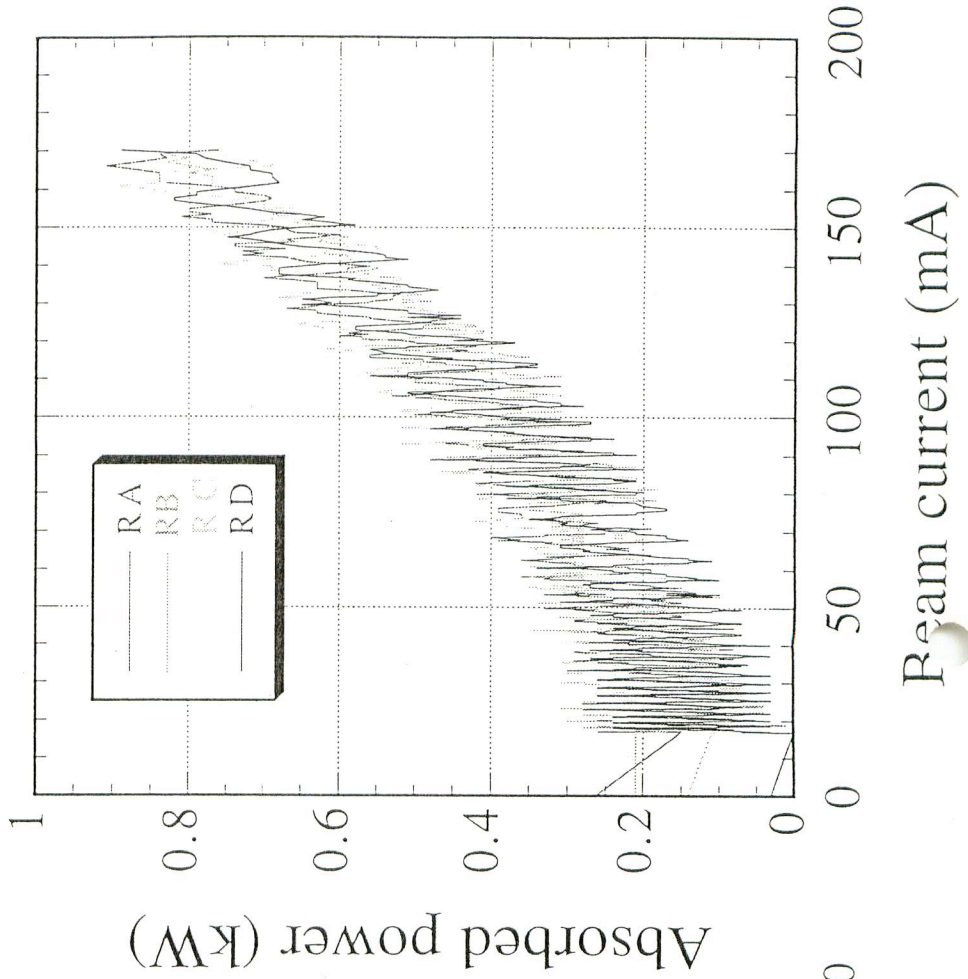
Power at damper vs. beam current

(An example: Feb. 19 22:23 - Feb. 20 00:59, 8 trains, 40 bunches/train, 5 buckets each)
Lower envelopes of the lines are the true values. Fluctuations due to inlet temperatures.

SBP



LBP

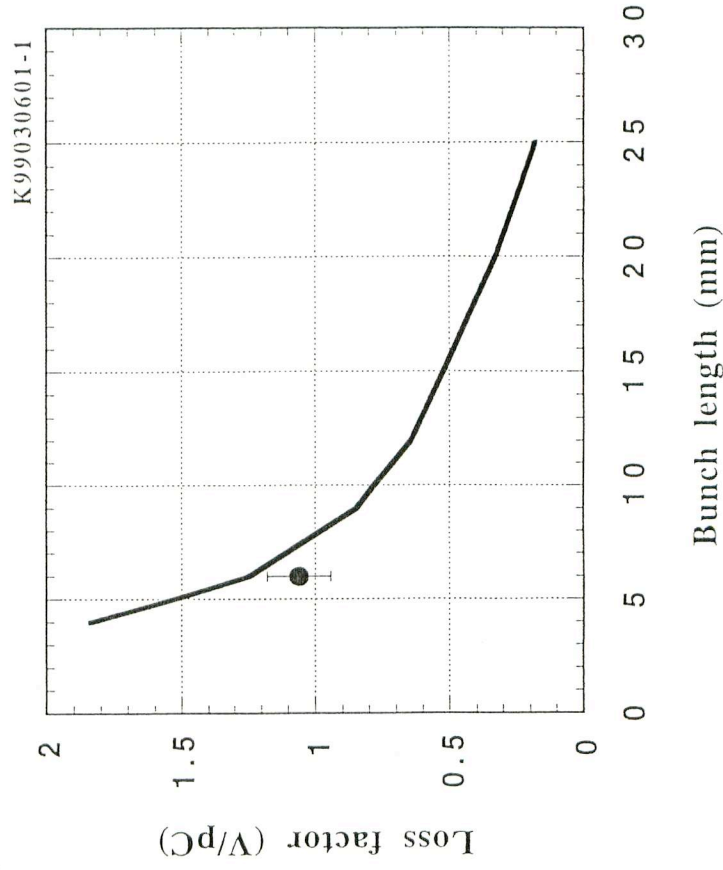


Beam current (mA)

Beam current (mA)

Loss factor vs. bunch length

- Prediction with ABCI and analytic calculation for ferrite absorber
- Measurement with absorbed power



$$k \text{ [V/pC]} = \frac{P_{\text{loss}} \text{ [kW]} \cdot N_b \cdot f_r \text{ [kHz]}}{\{I_b \text{ [mA]}\}^2}$$

Problems

- One cryostat leaked during cooldown after installation >> being used with reinforced pumping >> will be fixed during shutdown starting mid April
- Not an apparent problem as yet, but micron-size cracks are present in HOM dampers. Baking was found to be the cause of cracks. >> Further bench tests of cracked dampers to be planned, looking for preventive measures for the next construction.

Summary

- Four superconducting cavity modules have been working stably with very few trips since the start of commissioning.
- Absorbed power at the dampers is close to the prediction and little difference between modules.
- Should watch the degradation of vacuum to see the correlation with trips in the future.