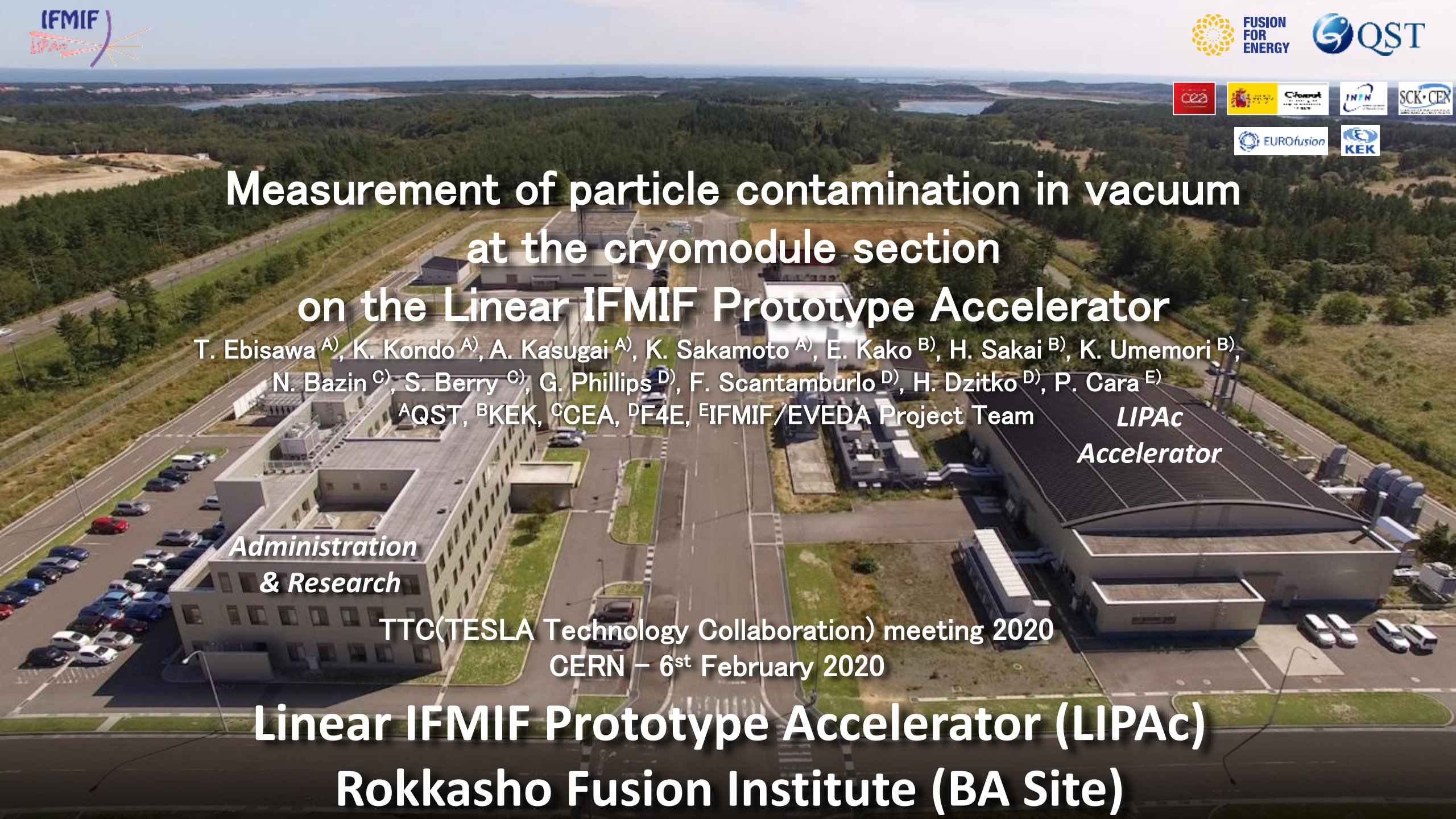

Measurement of particle contamination in vacuum at the cryomodule section on the Linear IFMIF Prototype Accelerator

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LIPAc Accelerator

Administration & Research

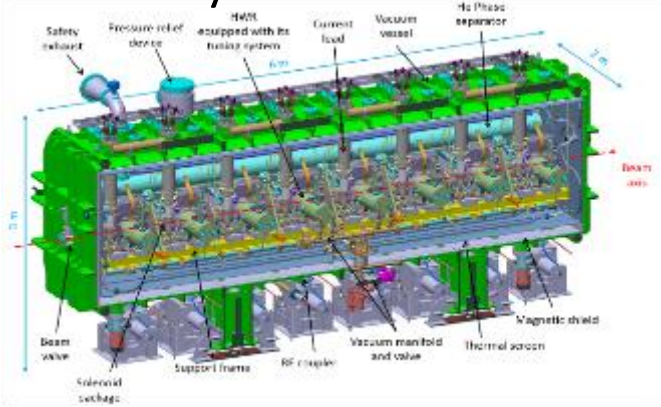
TTC(TESLA Technology Collaboration) meeting 2020
CERN – 6st February 2020

Linear IFMIF Prototype Accelerator (LIPAc)
Rokkasho Fusion Institute (BA Site)

IFMIF/EVEDA project

IFMIF(International Fusion Material Irradiation Facility) is an accelerator-based D-Li neutron source to test reactor material of the Fusion DEMO. The project is in the Engineering Validation and Engineering Design Activities (EVEDA) phase, the construction and the commissioning of the Linear IFMIF Prototype Accelerator (LIPAc) is ongoing at QST Rokkasho site.

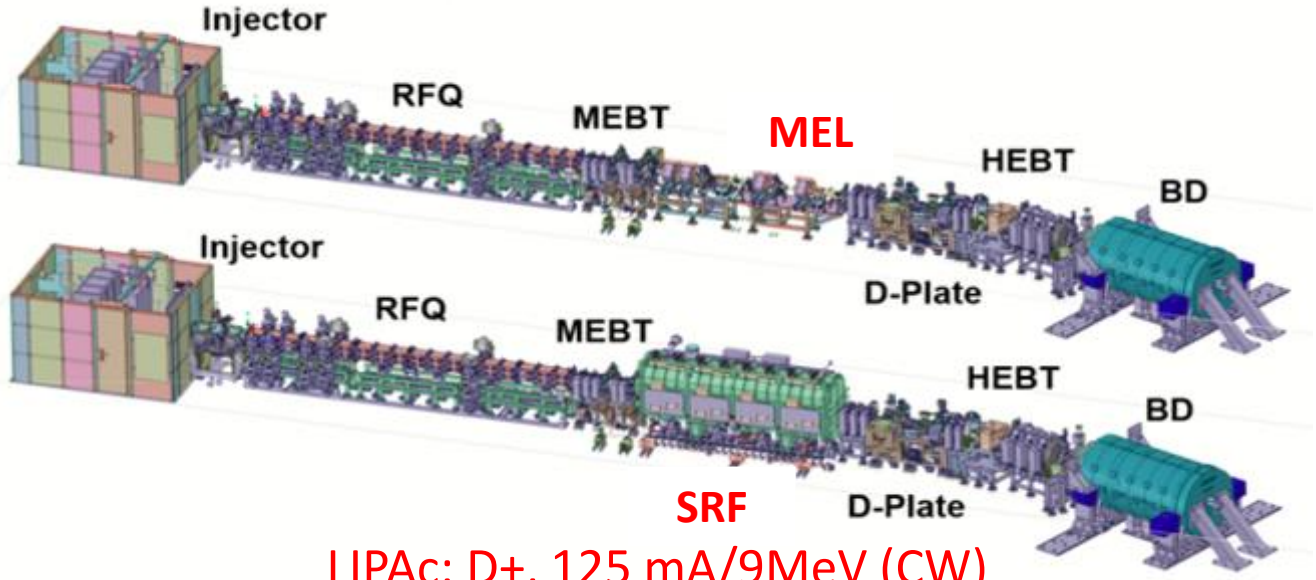
SRF Linac cryomodule of the LIPAc.



Cavity string assembly in ISO-class5 cleanroom.

N. Bazin *et al.*, “Status of the IFMIF-EVEDA superconducting linac”, SRF2019, Jun 2019.

Current status: Installing MEBT extension line(MEL) instead of the SRF to perform the beam commissioning.

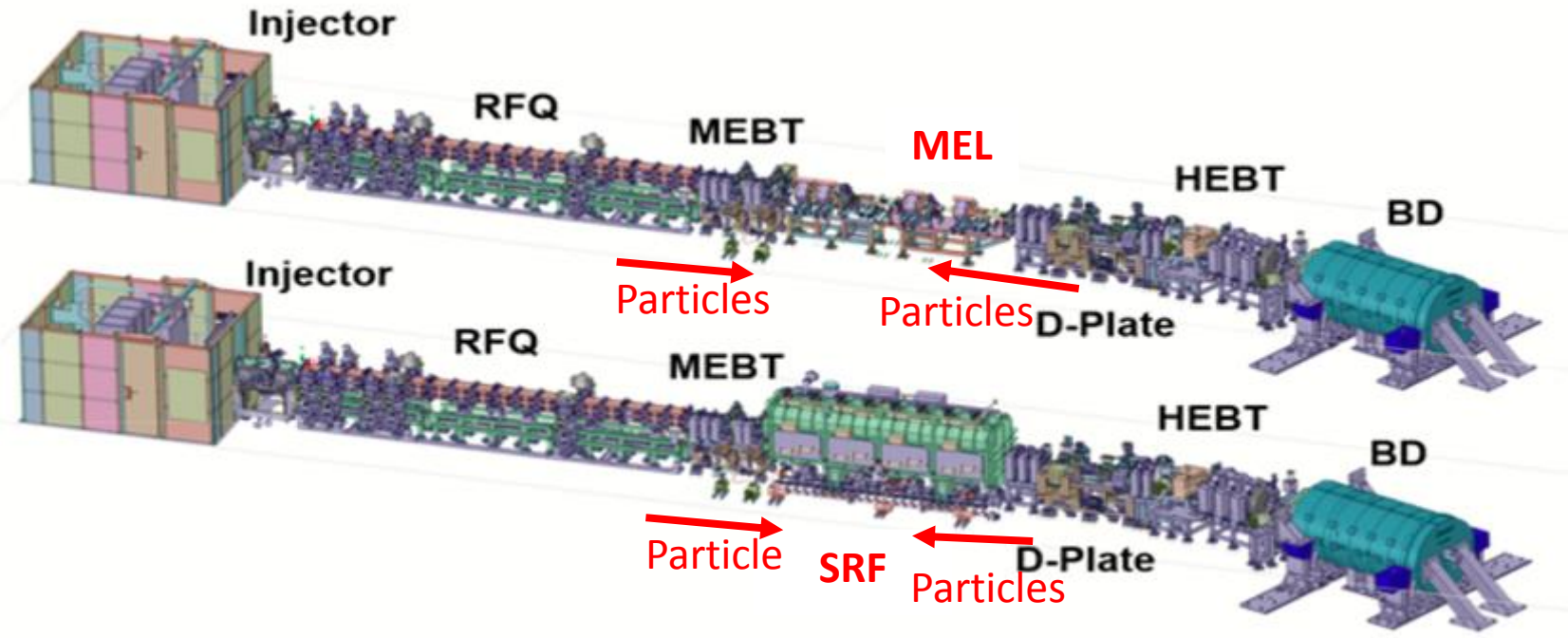


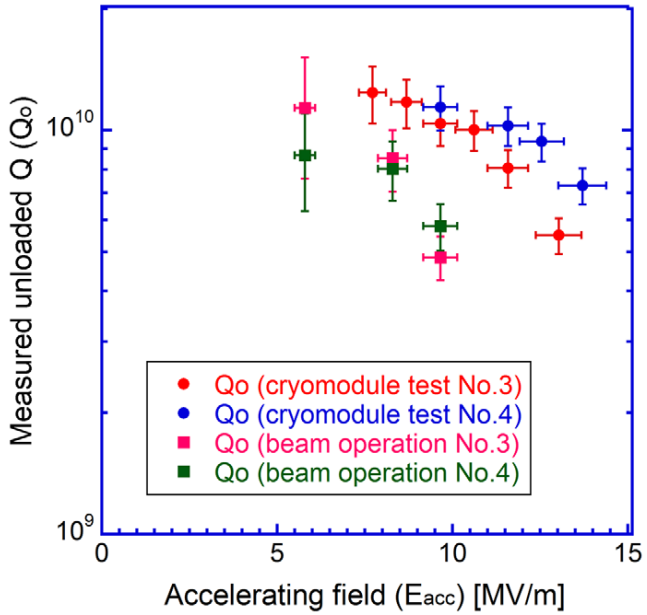
LIPAc: D+, 125 mA/9MeV (CW)

Future: SRF will be installed.

K. Kondo *et al.*, "Validation of the Linear IFMIF Prototype Accelerator (LIPAc) in Rokkasho", ISFNT 14, September 2019.

Motivation



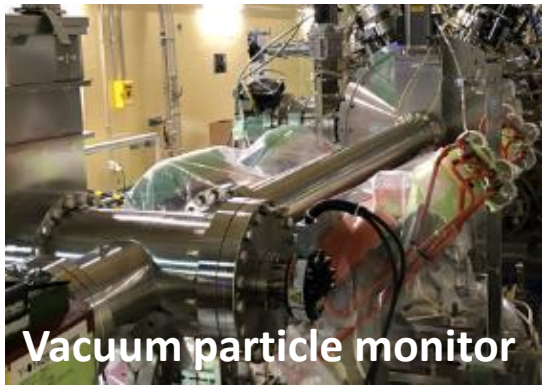


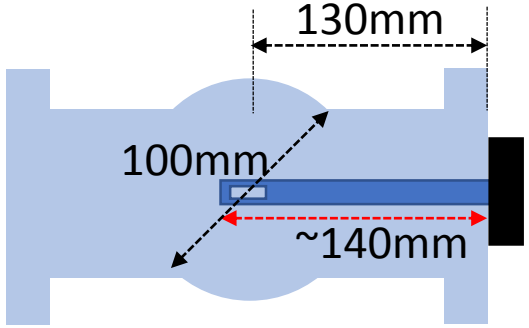
H. Sakai *et al.*, "Field emission studies in vertical test and during cryomodule operationusing precise x-ray mapping system", Phys. Rev. Accel. Beams **22**, 022002 (2019).

SRF cavity performance will be degraded by Field Emission(FE) due to the particle contamination.
In LIPAc-SRF operation, similar problem can occur after the installation of the cryomodule.
We tried to measure the particle moving in the MEL instead of the cryomodule to understand how the cavities could be contaminated in the future. This result could be very helpful for the FE study.

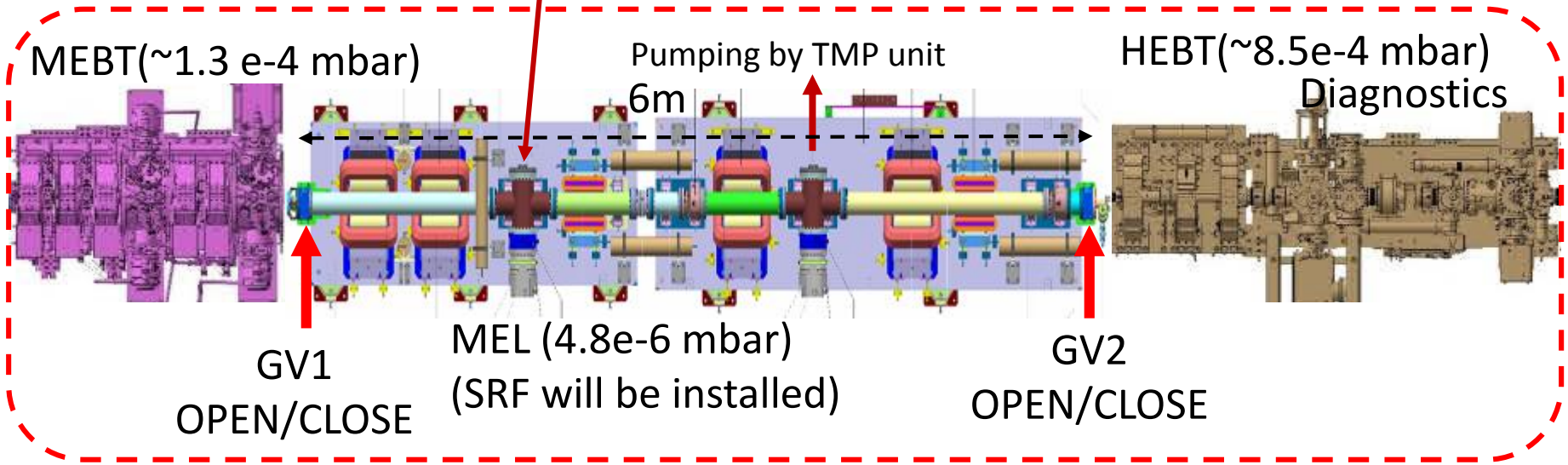
Setup and experiment

Vacuum particle monitor
Principle: Laser scattering
Resolution: 0.3~3.6 μm
Developed by Wexx Company





Cross section of the vacuum chamber

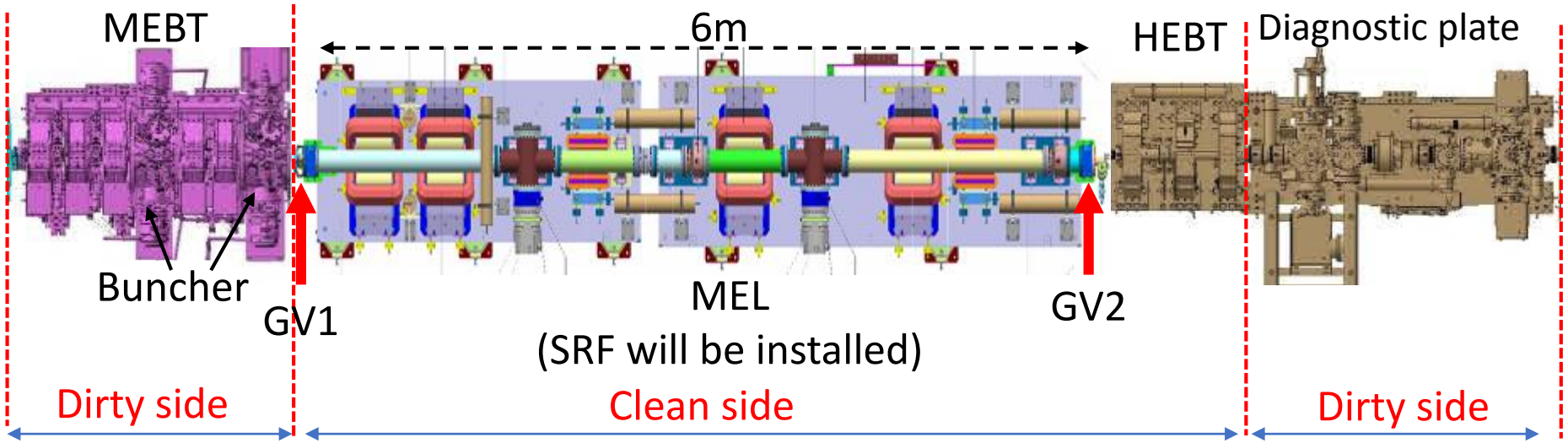


To visualize particle moving in beam transport line, a vacuum particle monitor was installed in vacuum chamber. Detector was located around the center of the beam axis. After pumping the beam line and open GV, we measured particle counting in vacuum.

Setup and experiment

Washing and assembling in clean room.

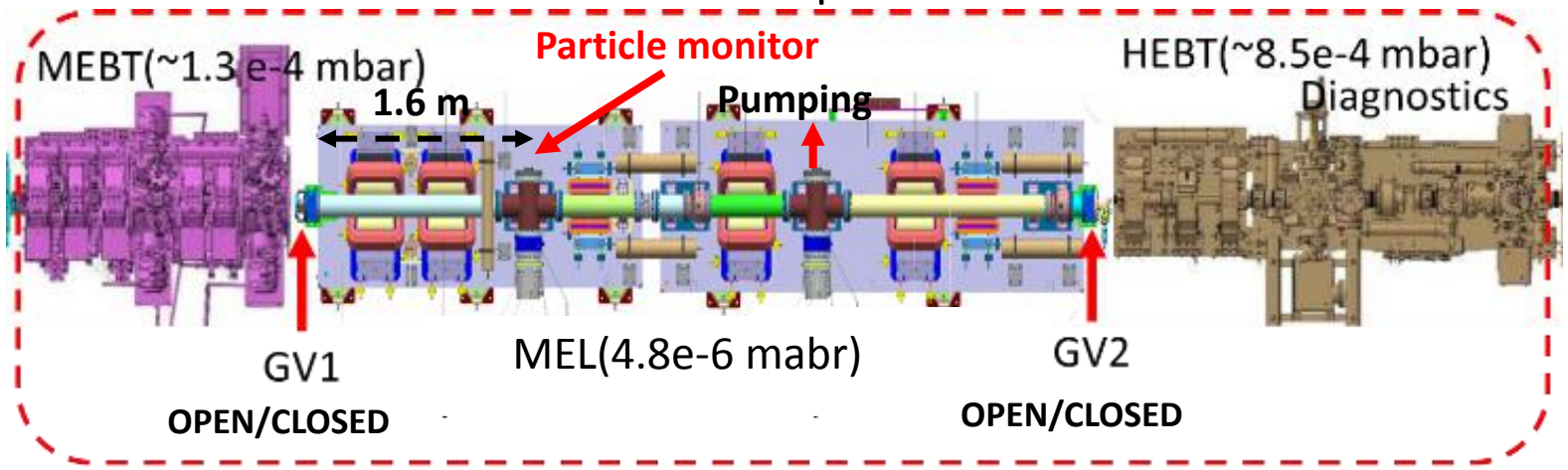
Construction of the beam line in local clean unit.



MEL and HEBT beam duct were processed in clean room to keep cleanliness of the beam line .
MEBT and Diagnostics were not installed in clean environment… But, Bunchers were well conditioned.

Result

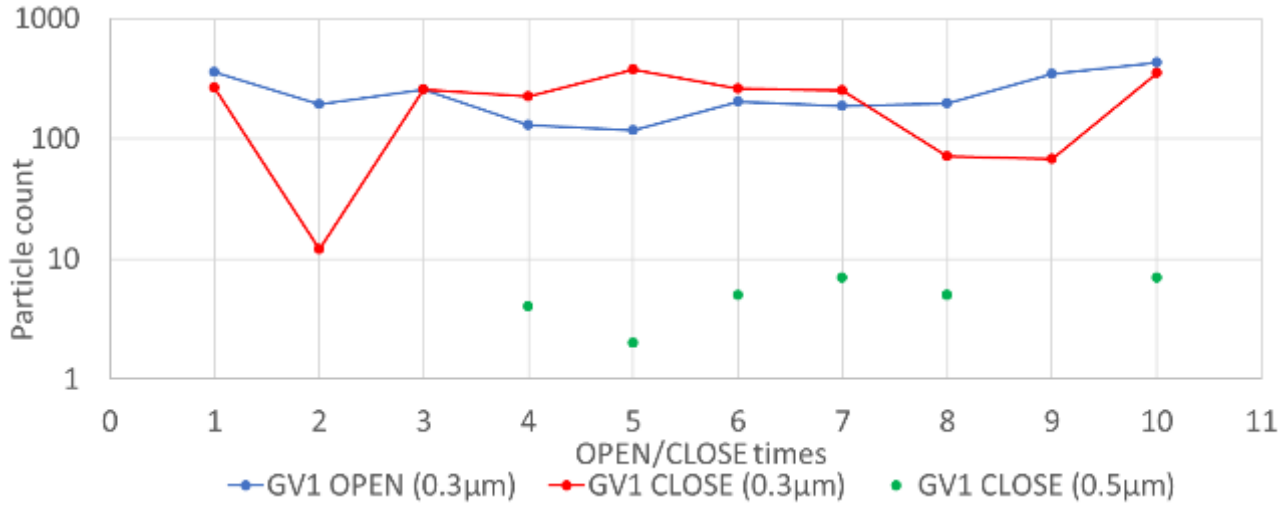
Measured at upstream side



First operation of the GV

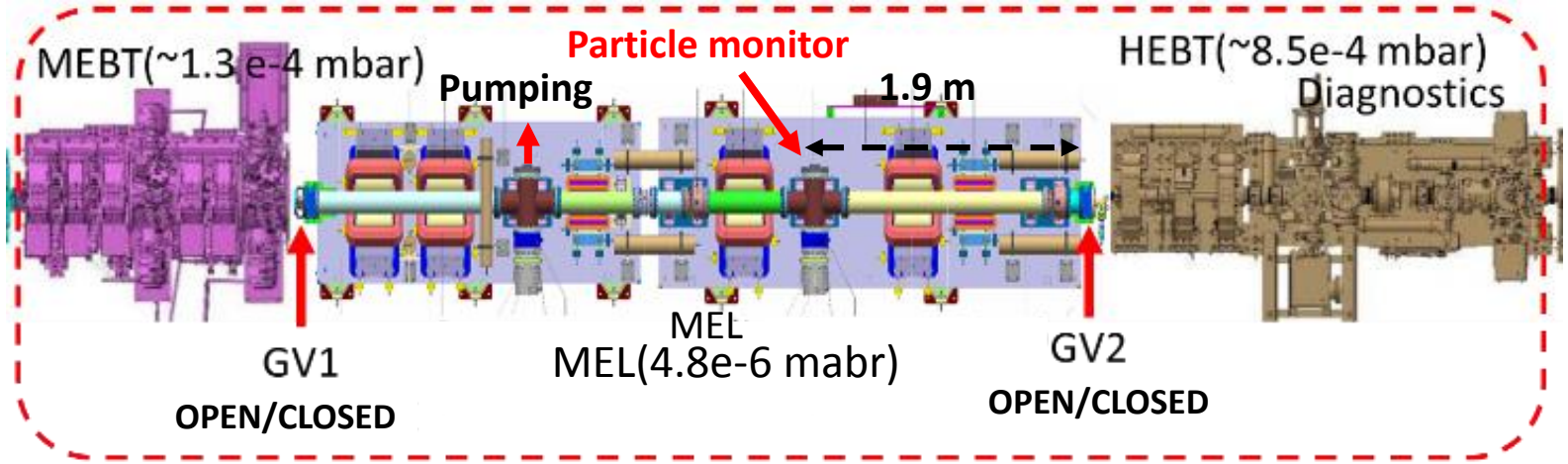
GV	OPEN	CLOSE
GV1 (MEBT side)	0.3μm x 356	0.3μm x 264
GV2 (HEBT side)	No count	No count

Several hundreds of 0.3 μm particles were detected by GV operation of MEBT side.
Repeating the valve operation, 0.5μm particles were detected.
No detection by GV operation of HEBT side.



Result

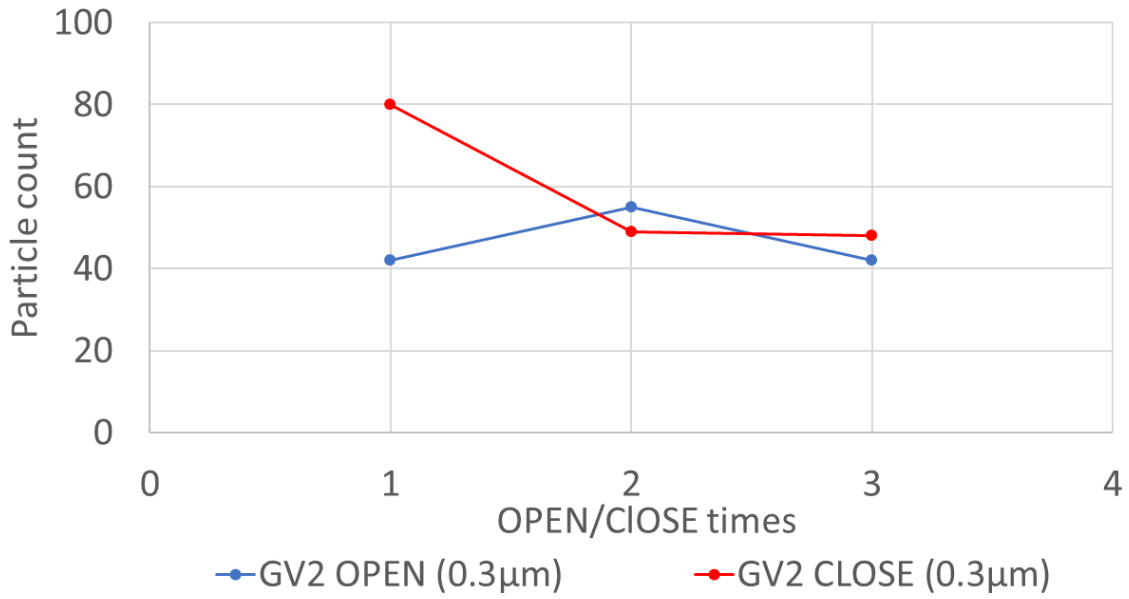
Measured at downstream side



First operation of the GV

GV	OPEN	CLOSE
MEBT side	No count	No count
HEBT side	0.3μm x 42	0.3μm x 80

Several tens of 0.3 μm particles were detected by GV operation of HEBT side.
No detection by GV operation of MEBT side.



Summary

・Using vacuum particle monitor, we could visualize the particle moving under vacuum by GV operation in a MEL corresponding to the SRF section.

・Comparing up/downstream, particle count was significantly different. Due to a distance? With/without clean work? There is a controversial discussion about the factor of the difference.

・Considering the results, the cavities of the superconducting linac could be seriously contaminated during the operation of the GV. Further tests are needed to reduce the number of particles released during the opening/closing of the GV.

Cross section of the LIPAc-SRF