# Status of the All Superconducting Gun Cavity at DESY.

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## All Superconducting Gun

**for optimal integration of cathodes in an ultra-clean SC cavity**

**existing cathode insertion systems still face challenges**

- w.r.t. multipacting, field emission, cathode heating, cathode lifetime, etc.
- R&D still required and ongoing
- e.g. performed at HZDR and HZB

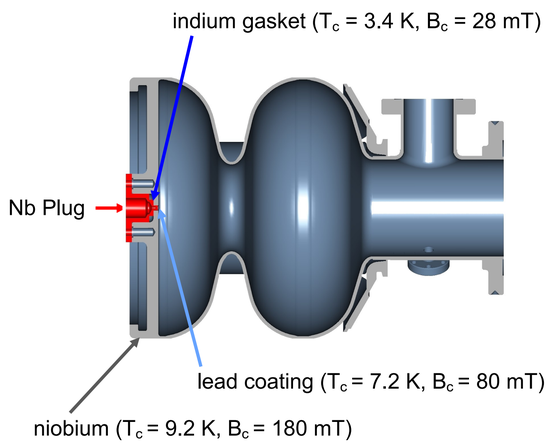
**DESY approach: superconducting (sc) cathode attached to the cavity backside**

☺ cleaning after cathode insertion in a clean room

☺ cathode particles (lead) should not heat and quench the cavity

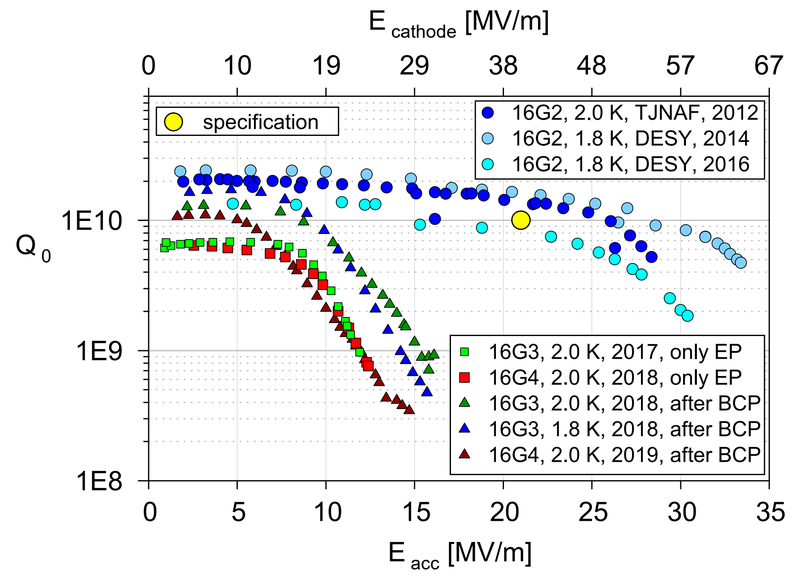
😐 exchanging the cathode

**this approach still face challenges, too** 😐

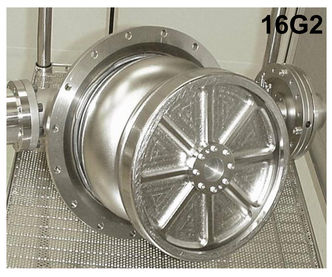



## Vertical Test Results

**from cavities '16G2', '16G3' and '16G4'**

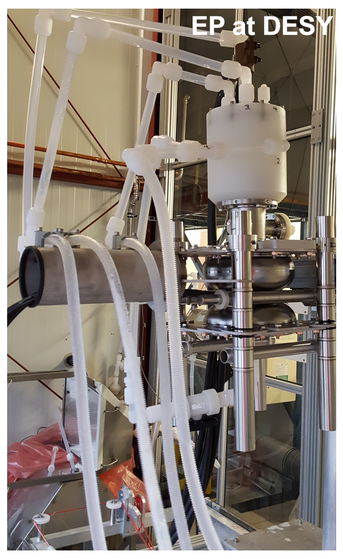



## Four Generations 1.6 Cell Cavities

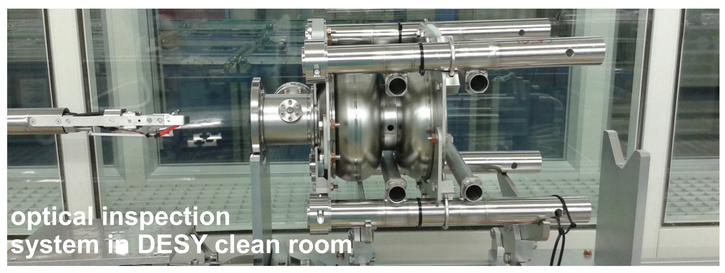


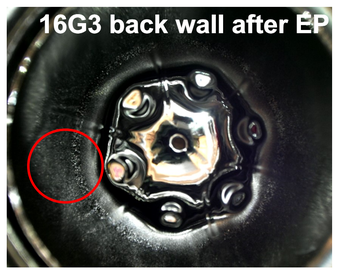

## Surface Treatment by EP & HPR

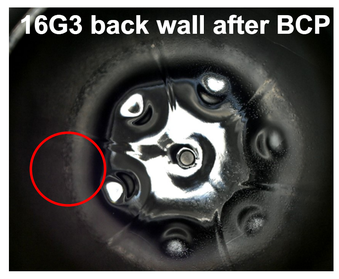




## Optical Inspection after EP & BCP

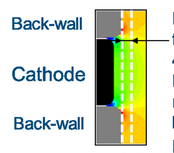


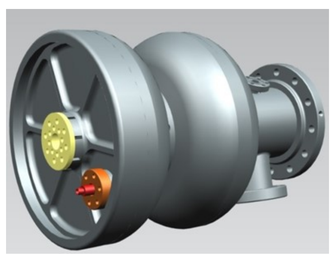

## The next Generation: 16G7/8/9

**retracted back wall**

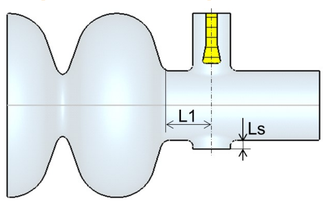



Modelling showed that placing cathode 450µm deeper in the back-wall opening makes emittance lower. Cathode position is further investigated by NCBJ team.

**pick up in back wall?**



**coupler kick compensation**




**items under investigation**

- HOM damping
- Changed backwall design for improved cooling?

## Summary and Outlook

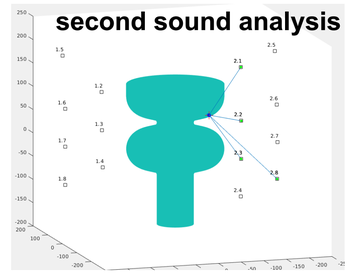
Initial component tests of an all superconducting RF gun showed promising results. SRF gun cavities surpassed the required gradients in vertical tests, the QE is sufficient for the specified bunch charge and does not degrade over periods examined so far. The design of a mechanically stable SRF gun cavity with a leak tight cathode plug directly screwed to the back wall turned out being more challenging than expected. The special design feature of the half cell with closed back wall requires the adaptation of many techniques used for the fabrication and treatment of single and 9-cell accelerating cavities. Furthermore, the design of the back wall seems requiring special attention w.r.t. cooling and heat transfer. The time needed for the fabrication of superconducting cavities and also the time needed for the development of new and the adaptation of existing infrastructure to the special needs of SRF gun cavities determines the progress. Nevertheless, we are confident overcoming these challenges. It is time to address additional design issues like the need for power coupler kick compensation, the possibility for HOM suppression, and the pick-up antenna in the back wall for improved RF control.

### Acknowledgements

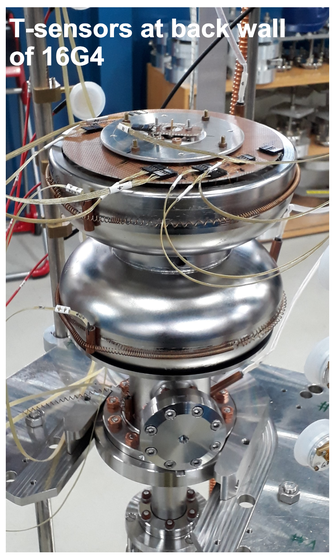
The authors acknowledge the significant contributions from numerous colleagues at all institutes joining the effort for an all superconducting RF gun. Many people from industry contribute to this effort as well.

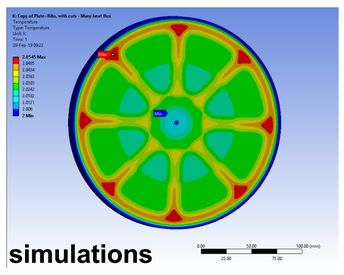
## Vertical Tests

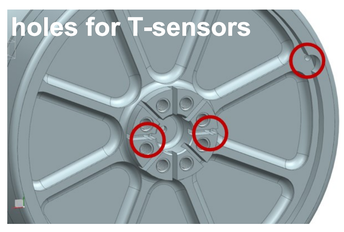




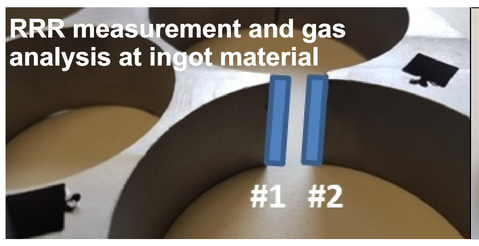

## Thermal Properties of 16G3/4

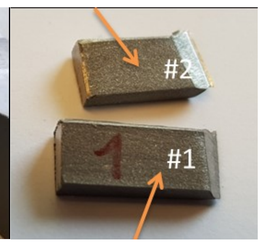


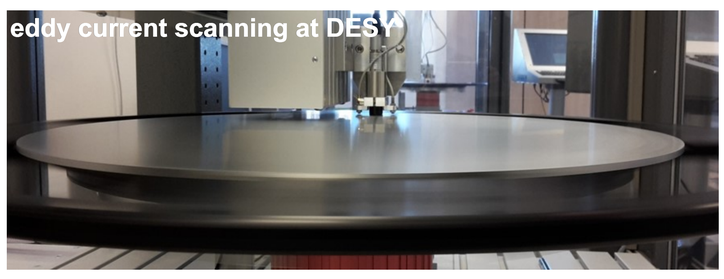



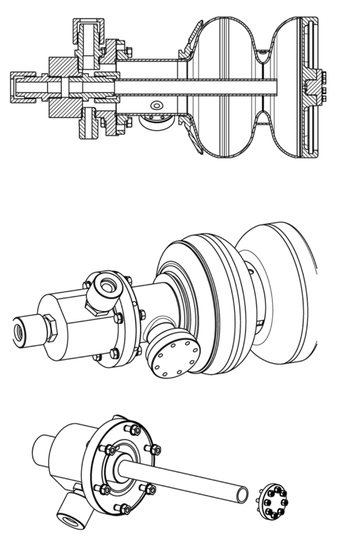

## Material Examinations




## Surface Treatment by BCP

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