

Experiments on thermal cycling

Click to edit Master subtitle style

Measurements on selected cavities of the European XFEL production

Thanks to the following groups and colleagues for support, help and work on this topic:

All colleagues involved in cavity preparation, cavity handling and cavity transport.

J. Eschke and the Cryogenic Team,

The AMTF Team and my colleagues from FLA-ILC for RF tests / support

MHF-SL and MPY for general support

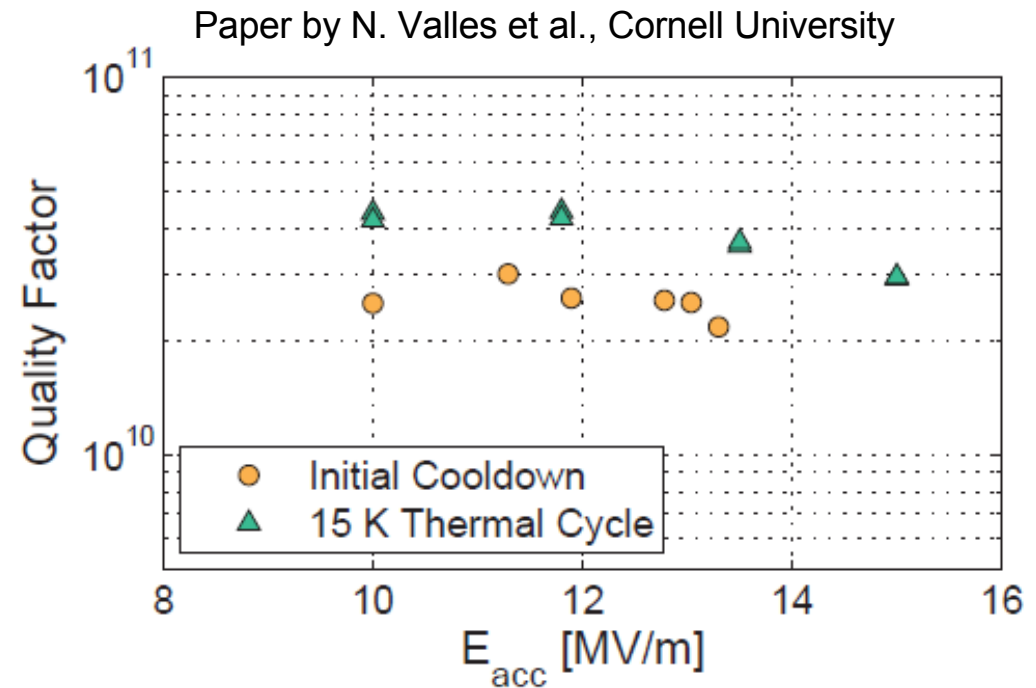
Ricarda Laasch

Hamburg, 25th March 2014



Role of thermal cycling of cavities

- Different cool down velocities in vertical tests and module tests show change of the quality factor
- Rise of quality factor Q_0 between 5% and 15%
- Thermal cycling as additional 'method' to standard cavity treatment?



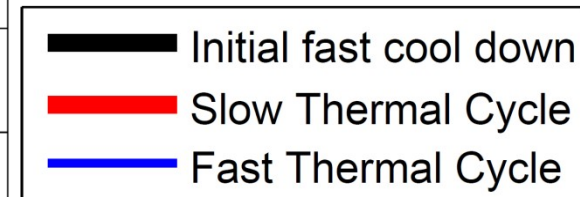
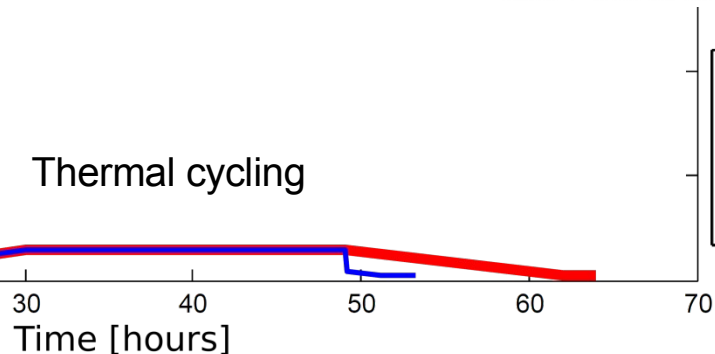
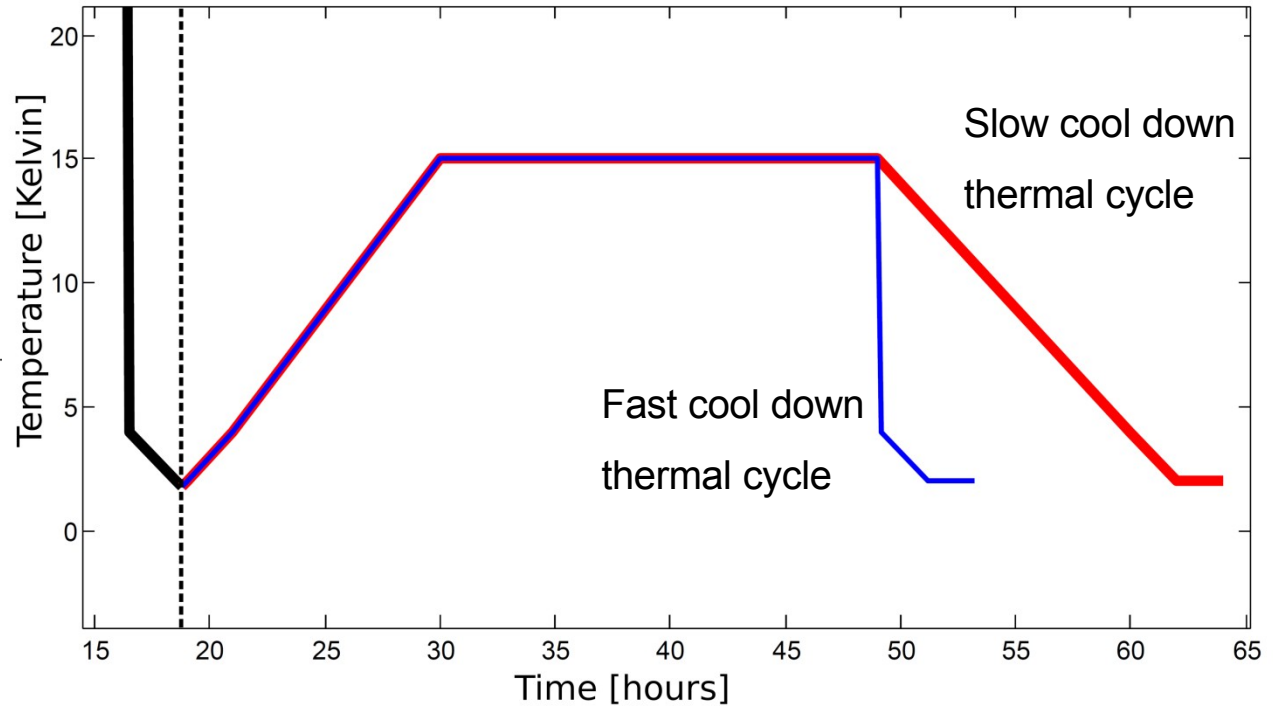
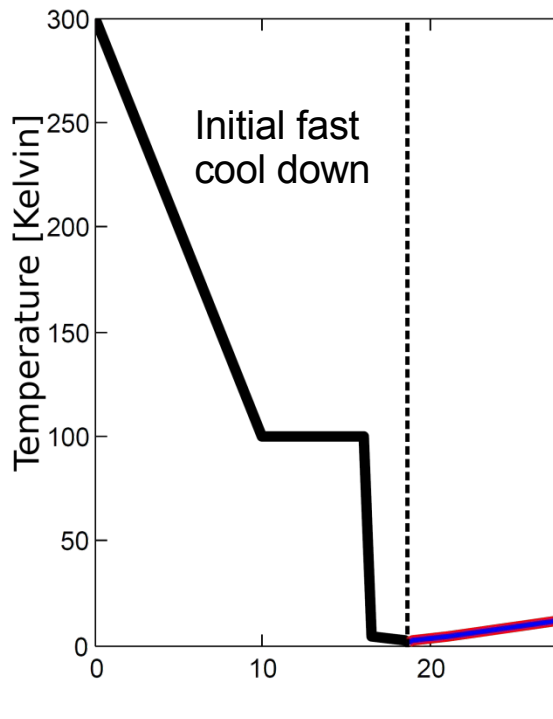
Quality factor in HTC-2 of the prototype cavity at 1.6K before and after thermal cycle. (Error bars 20%)

Proceedings of IPAC2013, Cornell ERL Main Linac 7-Cell cavity performance in horizontal test cryomodule qualifications, N. Valles et al.

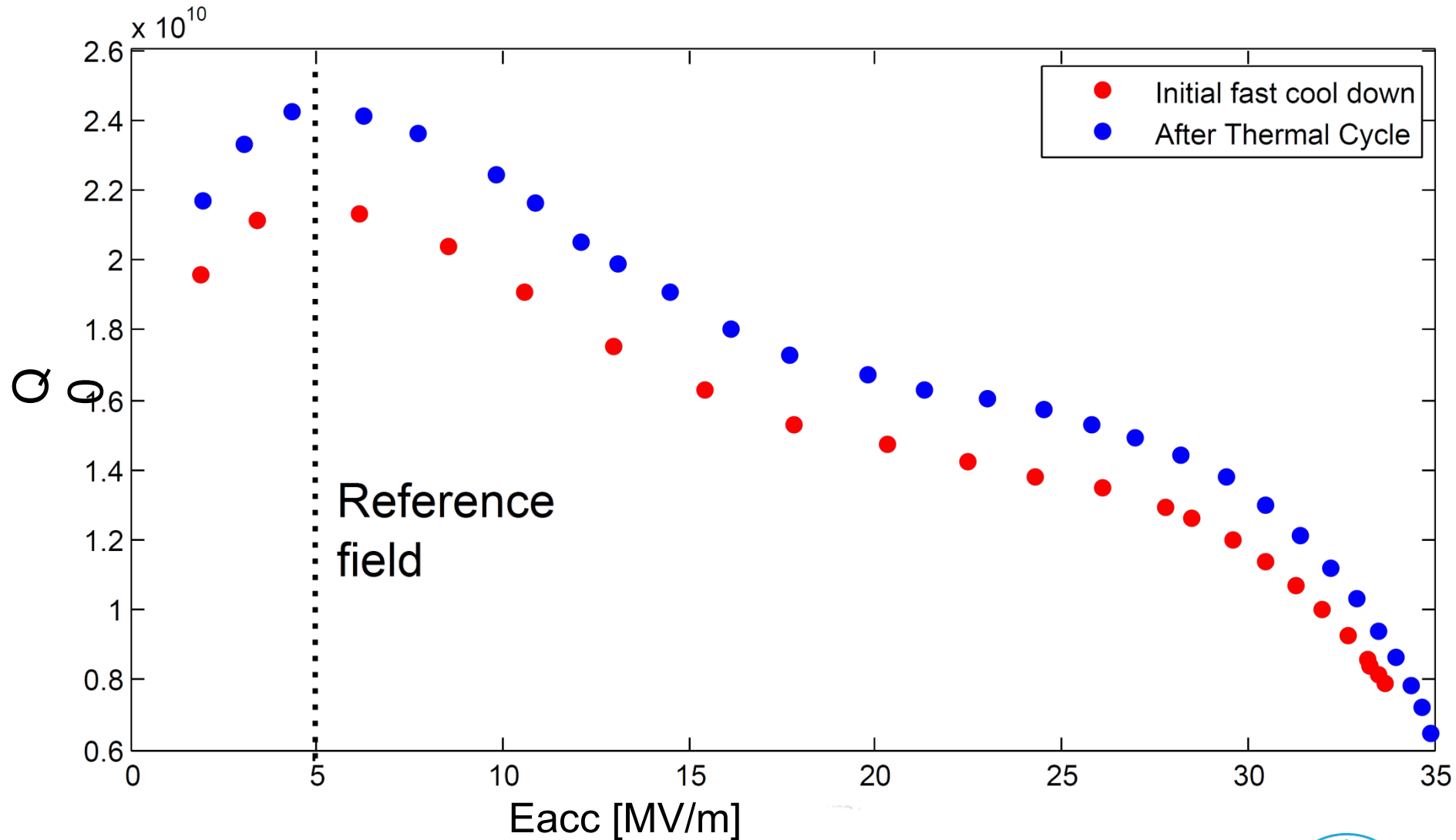
Cool downs and thermal cycles

- ▶ Initial fast cool down (DESY standard):

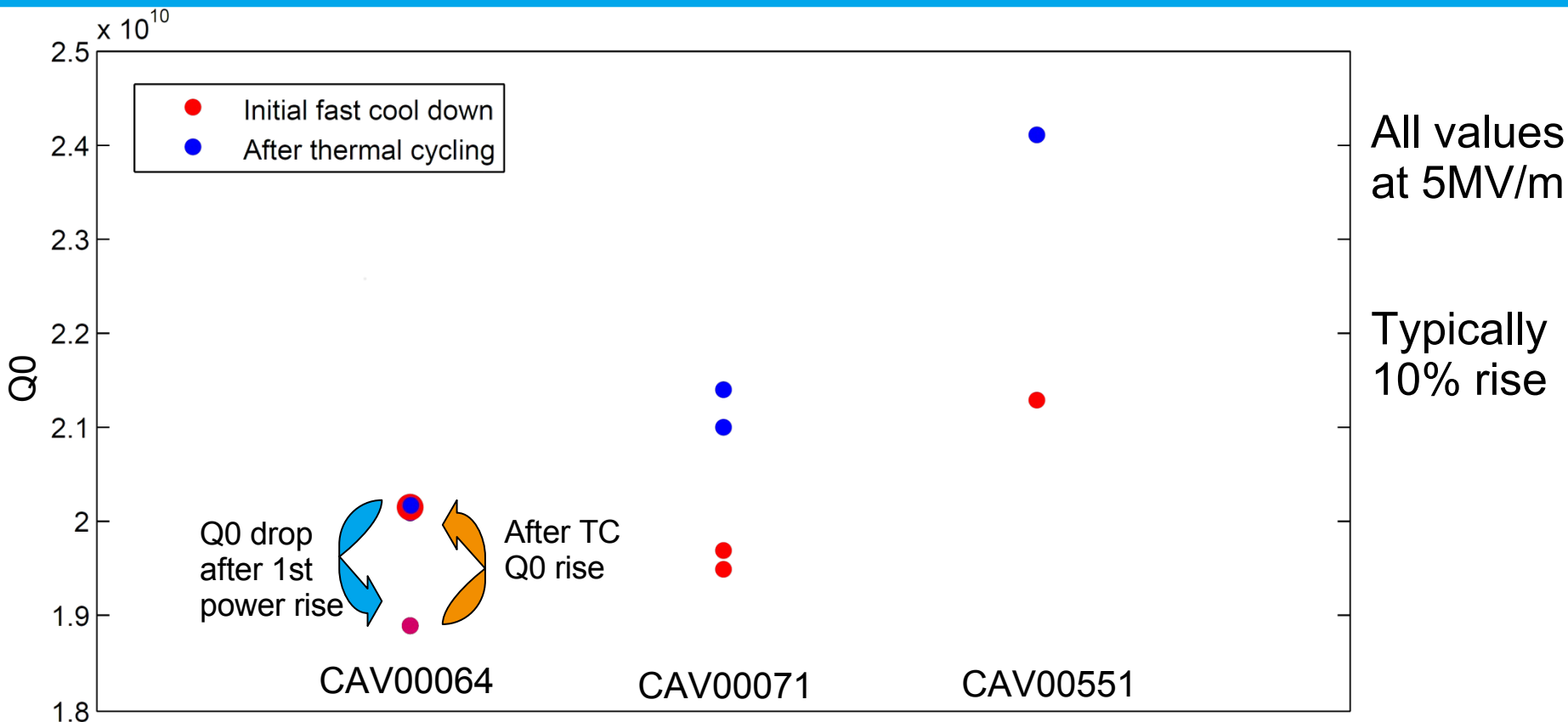
- ▶ From 300K slow to 100K
- ▶ At 100K for 6h (Q-disease)
- ▶ From 100K fast to 4K (~30min)
- ▶ Pumping to 2K (~ 2h)
- ▶ Pumping to 1.8K (~ 20min)



Example: CAV00551 Q(E) curve



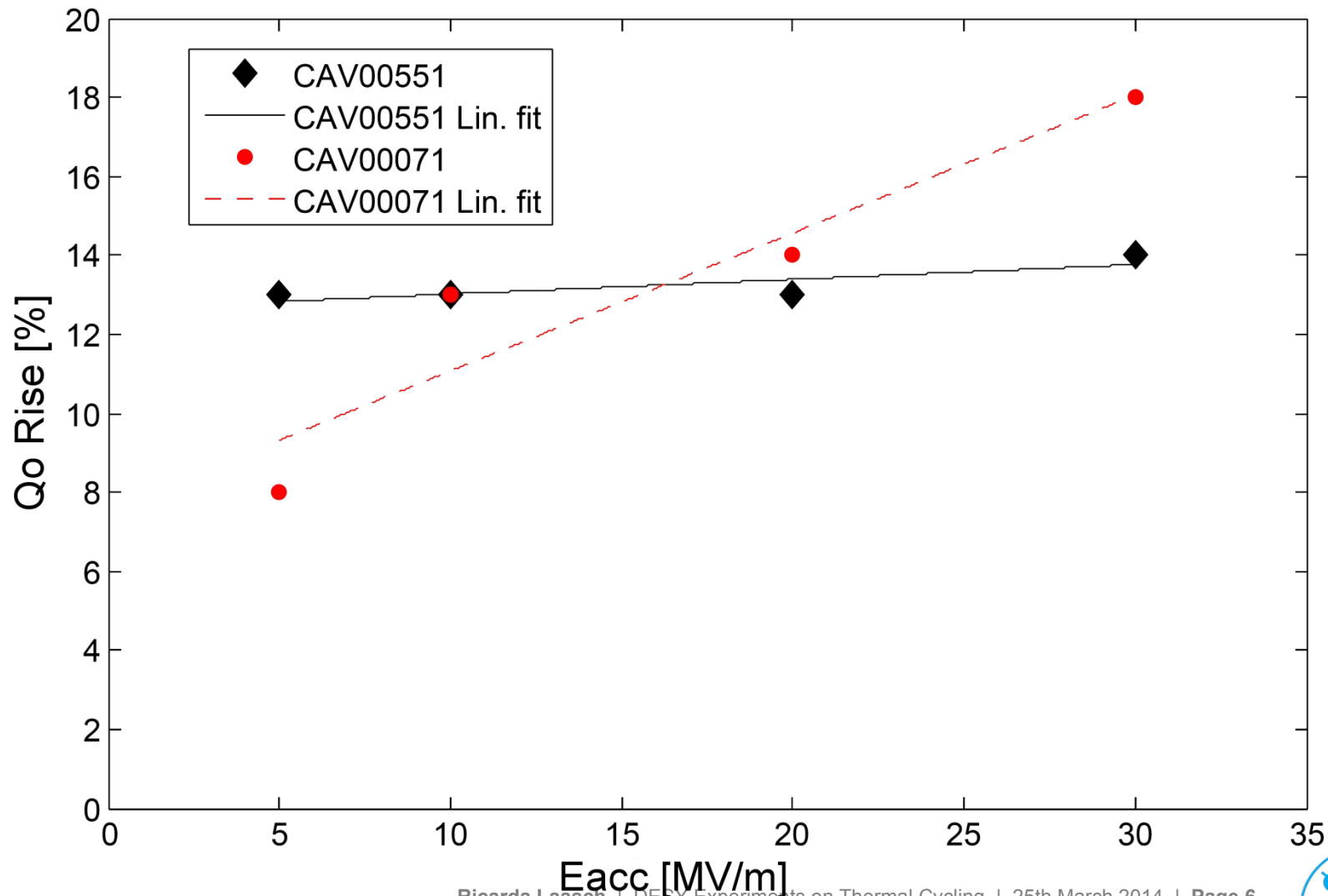
Comparison of different cavities



- CAV00551 slow cycle
- CAV00071 slow cycle, no He-vessel
- CAV00064 fast cycle, but Q0 drop in-between two power rises in initial measurement

Q0 rise depending on accelerating field

- CAV00551 with He-vessel, CAV00071 without He-vessel



Cavity with He-vessel and cavity without He-vessel

Cavity with He-vessel in insert



Photo: D. Noelle

Insert materials:

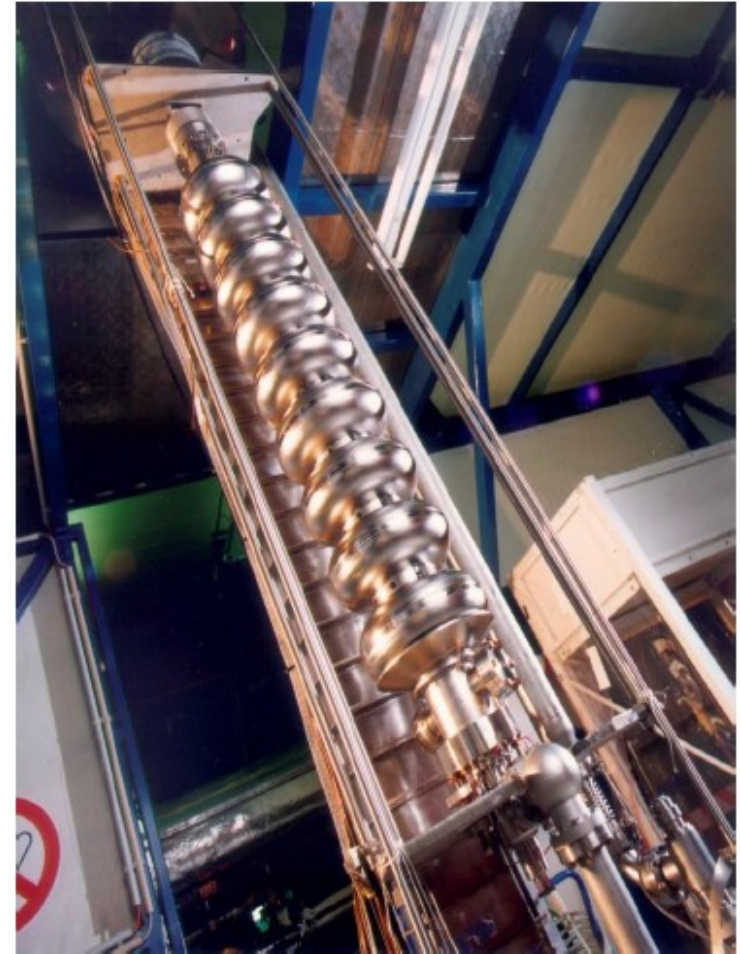
Holding plates:

Stainless steel

Connecting rod:

Titanium

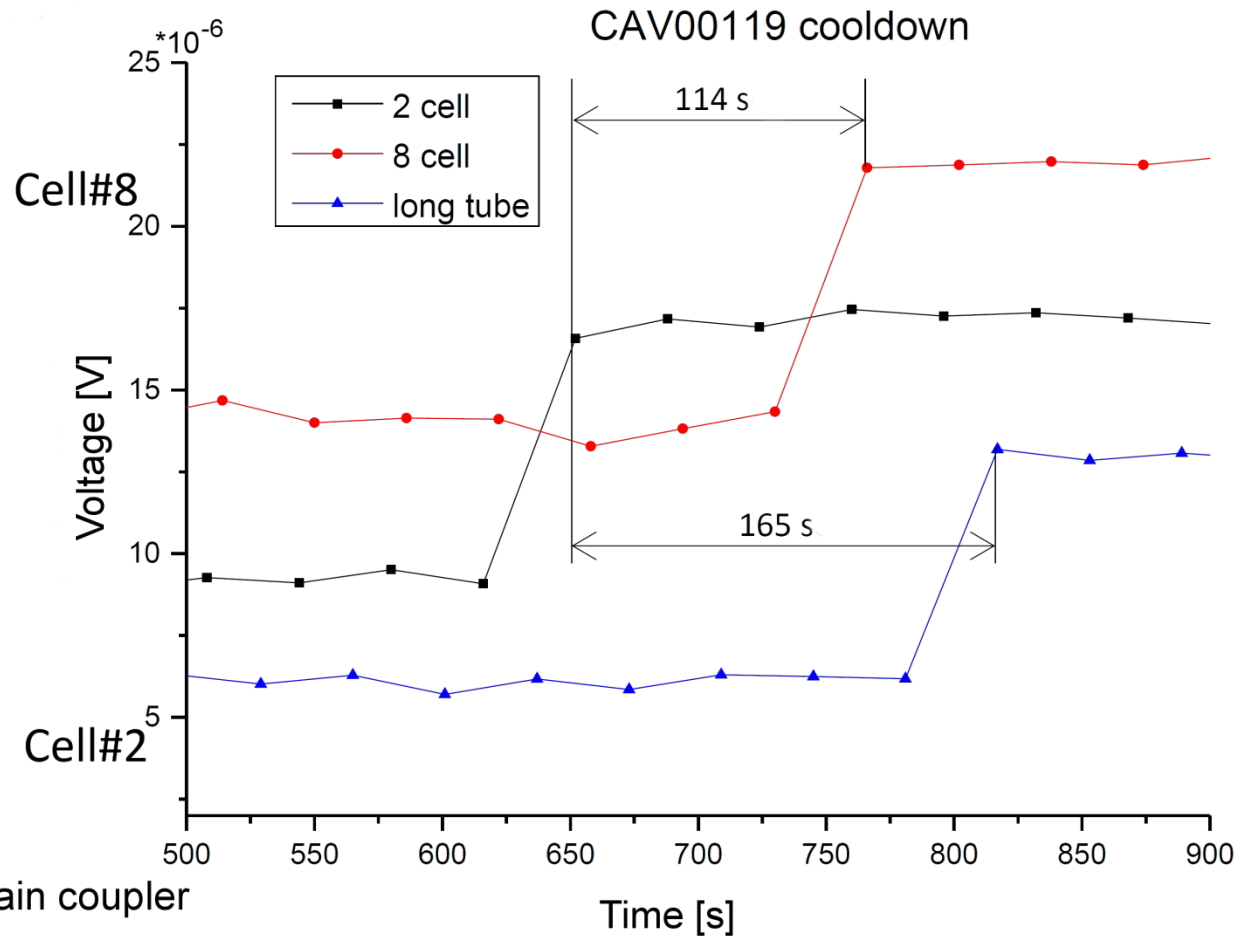
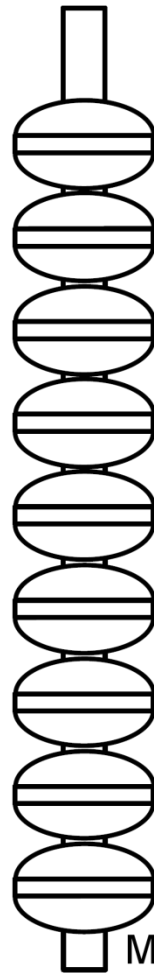
Cavity without He-vessel in insert



Thanks to D. Reschke

Temperature difference in cool down

- Measurement during standard fast cool down
- Eddy current measurement with coils to determine transition from NC to SC state
- Critical temperature reached at different point in time



Summary and Outlook

- Q0 rise after thermal cycling (~10%)
 - Possible field dependency for cavities without He-vessel
 - Further measurements are planned
-
- Explore the role of the current induced by the metal-metal junction
 - Explore cooldown rates
 - Combining measurement with an Eddy Current System

