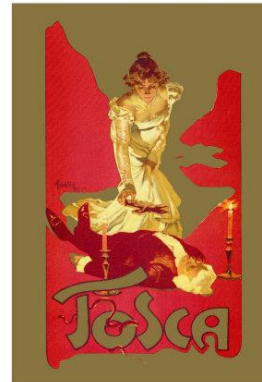


SCientific investigation of **Ad**vanced surface **tR**eatment to increase the
Performance of superconducting cavities using **In**novative **A**pproaches

SCARPIA

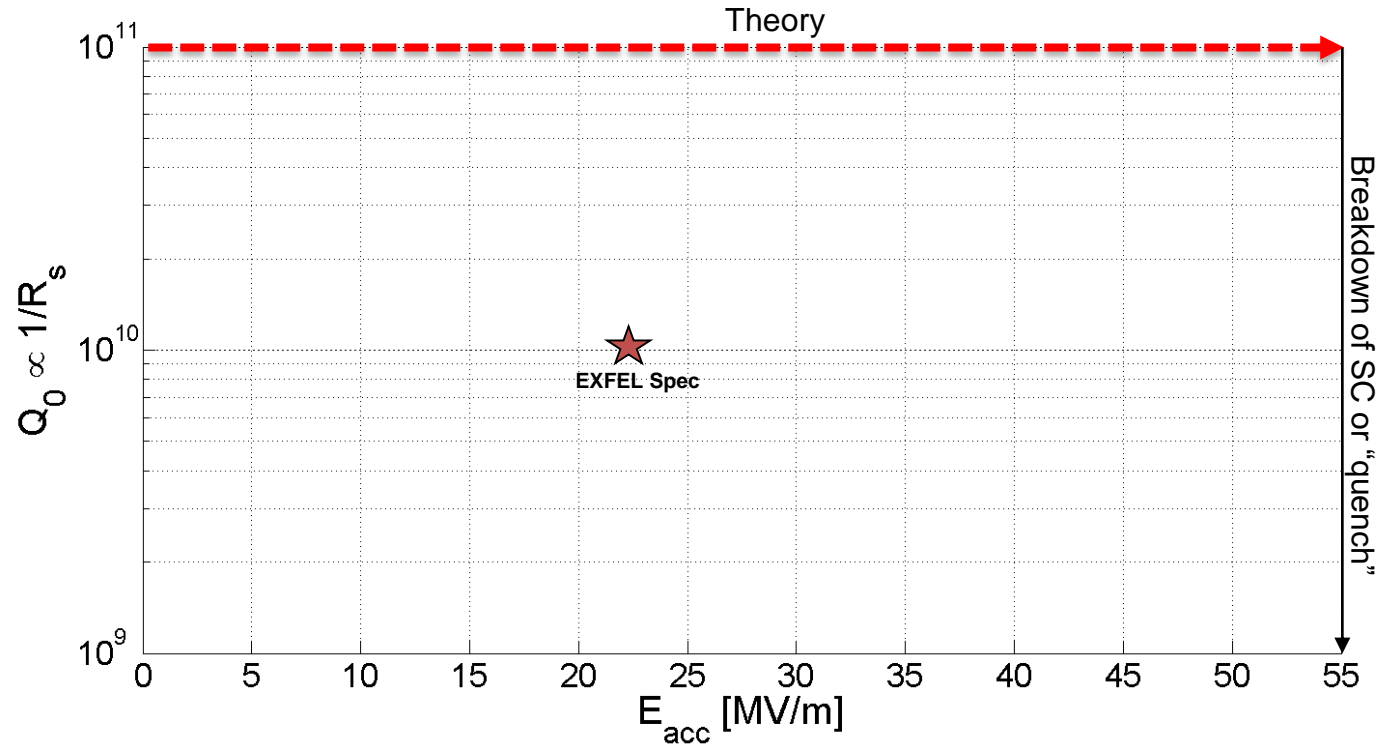


W. Hillert, M. Wenskat

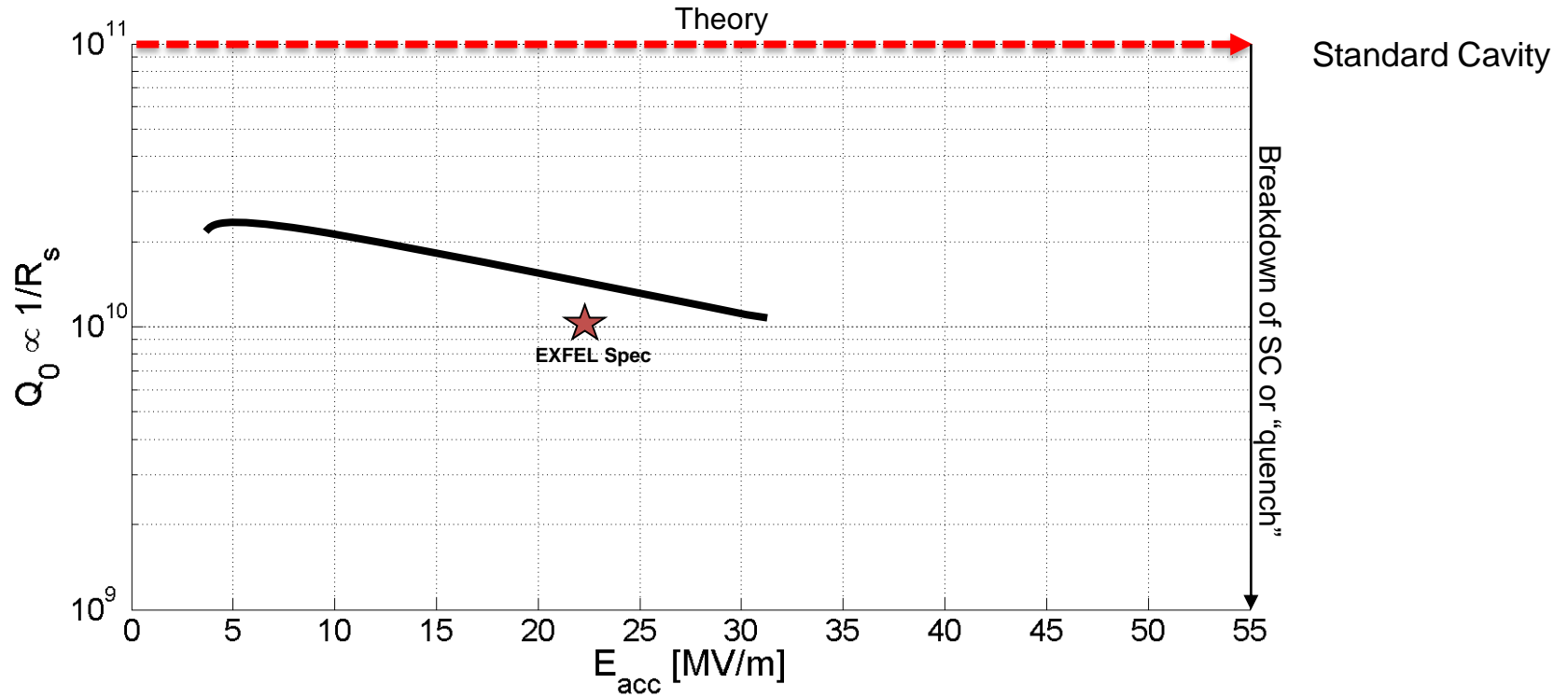
1st TOSCA Collaboration Meeting

23.07.2021

Motivation



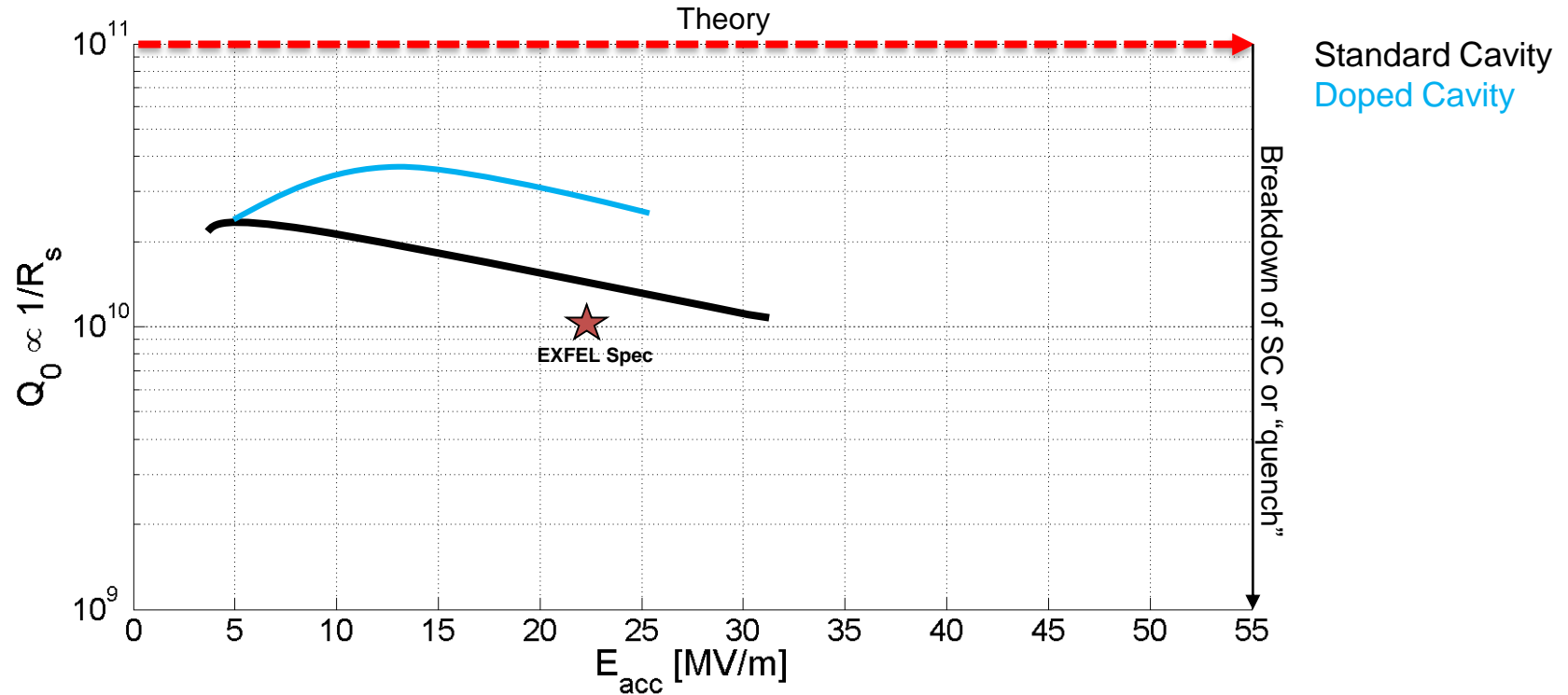
Motivation



[Reschke et al., Phys. Rev. Accel. Beams, 20, 042004 (2017)]

Curves are exemplary representations
Cavities limited by quench

Motivation

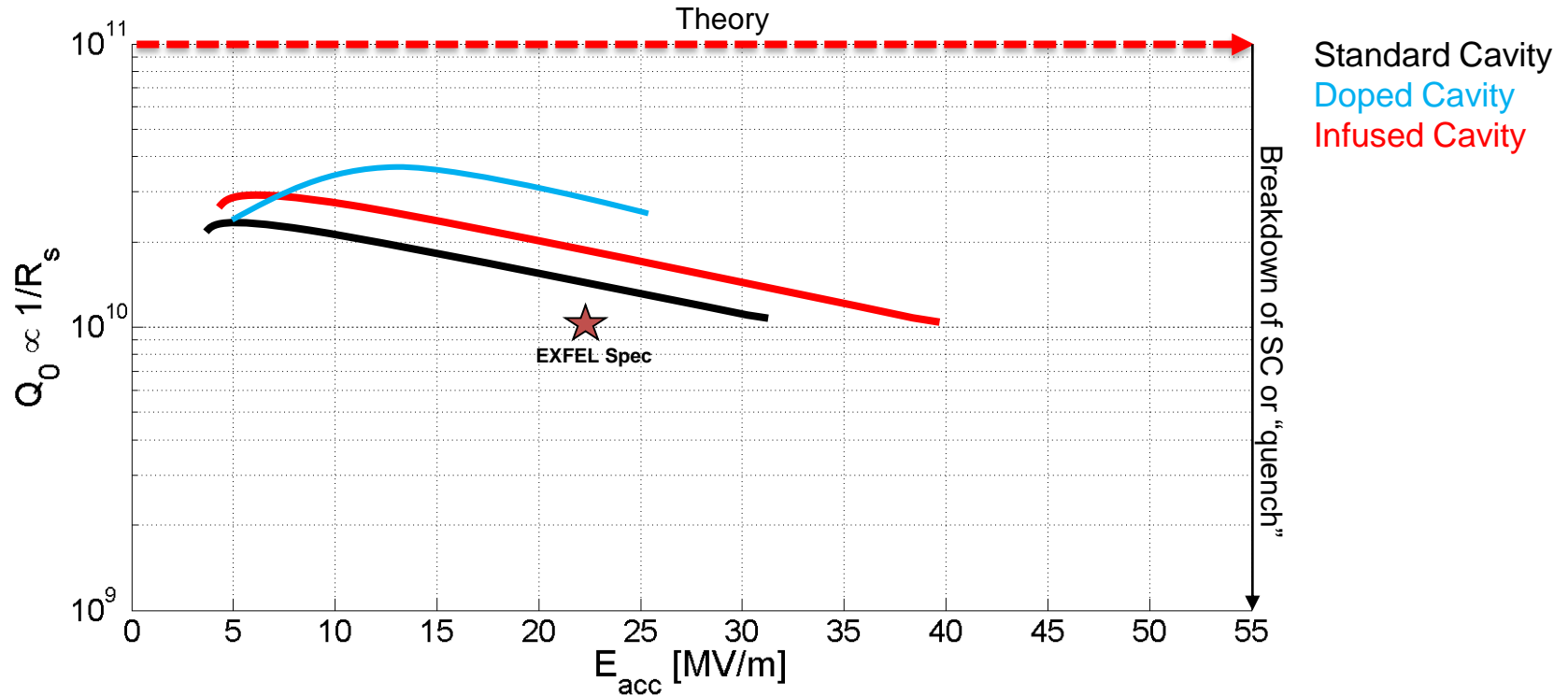


[Reschke et al., Phys. Rev. Accel. Beams, 20, 042004 (2017)]

[Grassellino et al., SUST, 26, 102001 (2013)]

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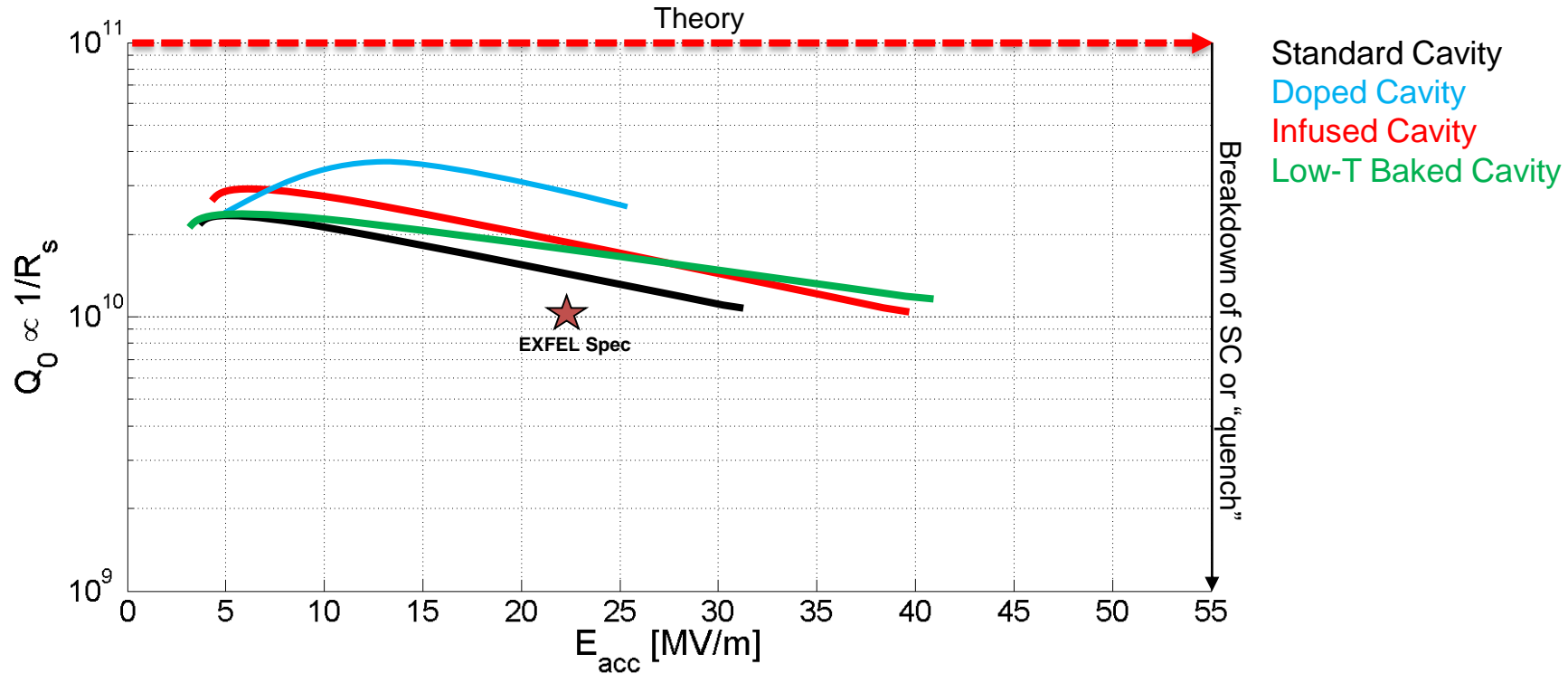
[Reschke et al., Phys. Rev. Accel. Beams, 20, 042004 (2017)]

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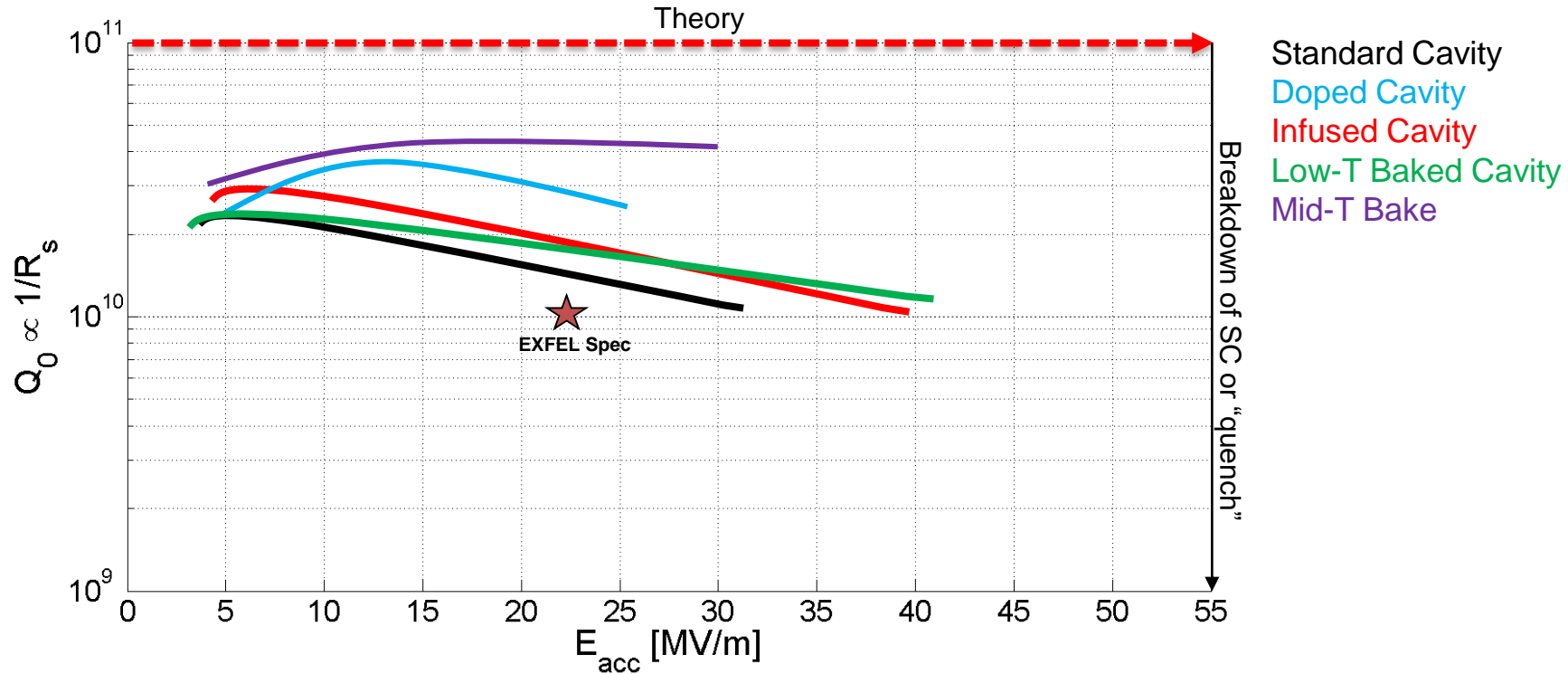
[Grassellino et al., SUST, 26, 102001 (2013)]

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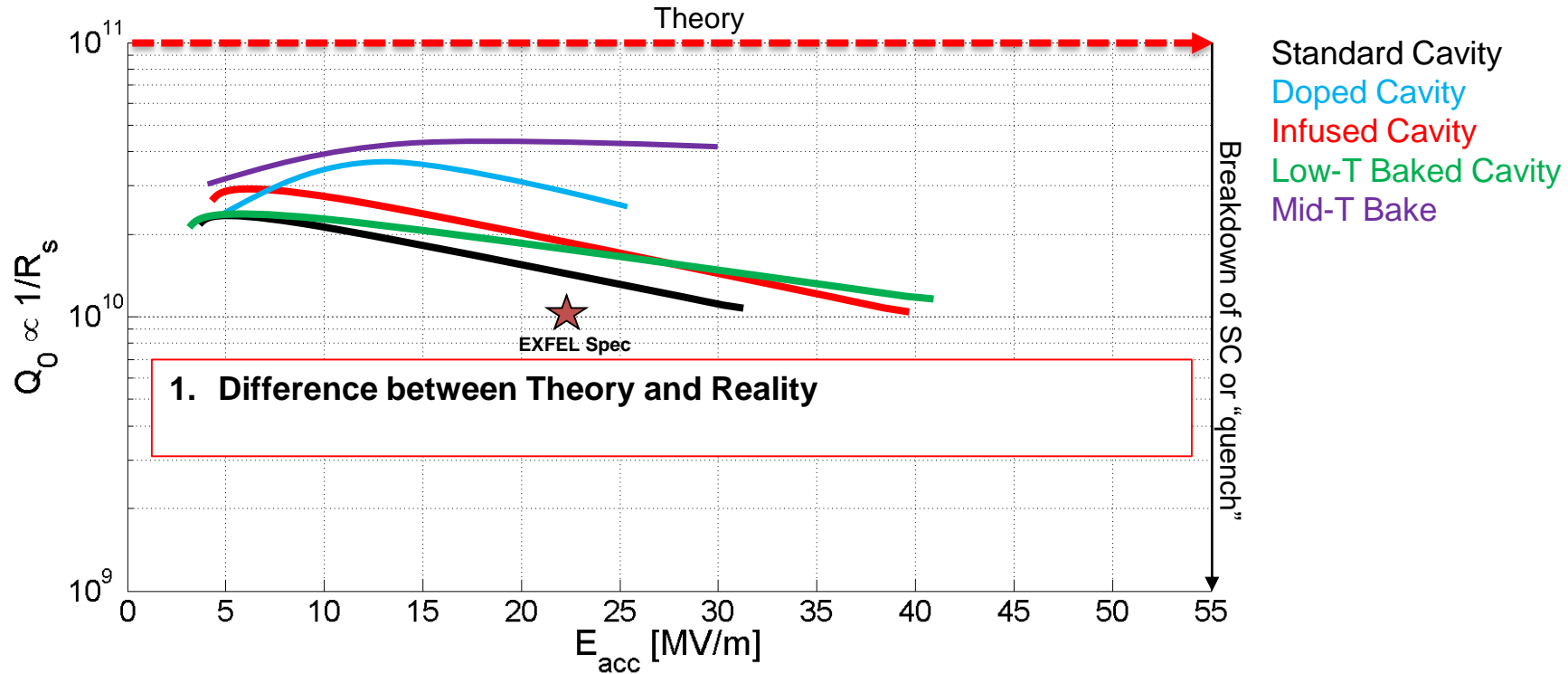
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[Posen et al., Phys. Rev. Applied 13, 014024 (2019)]

Curves are exemplary representations
Cavities limited by quench

Motivation



1. Difference between Theory and Reality

[Reschke et al., Phys. Rev. Accel. Beams, 20, 042004 (2017)]

[Grassellino et al., SUST, 26, 102001 (2013)]

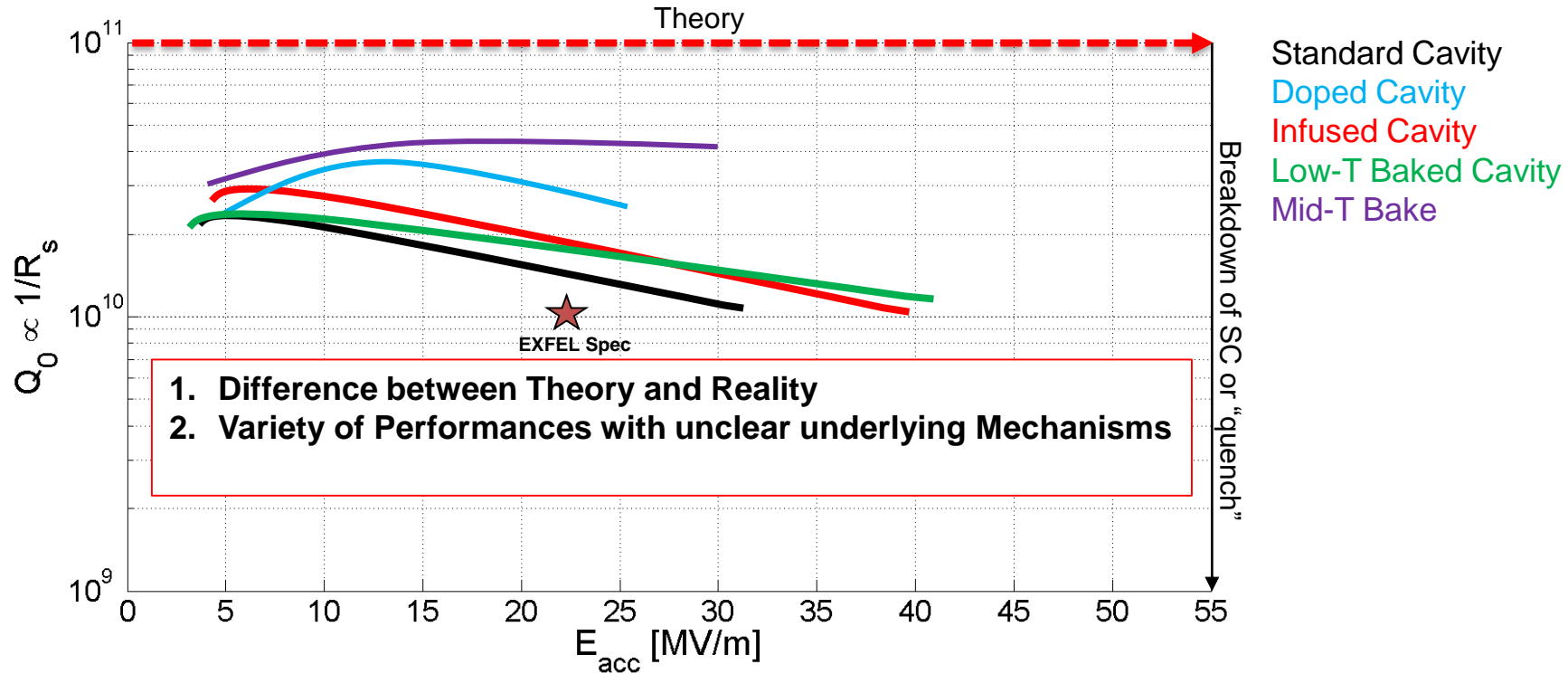
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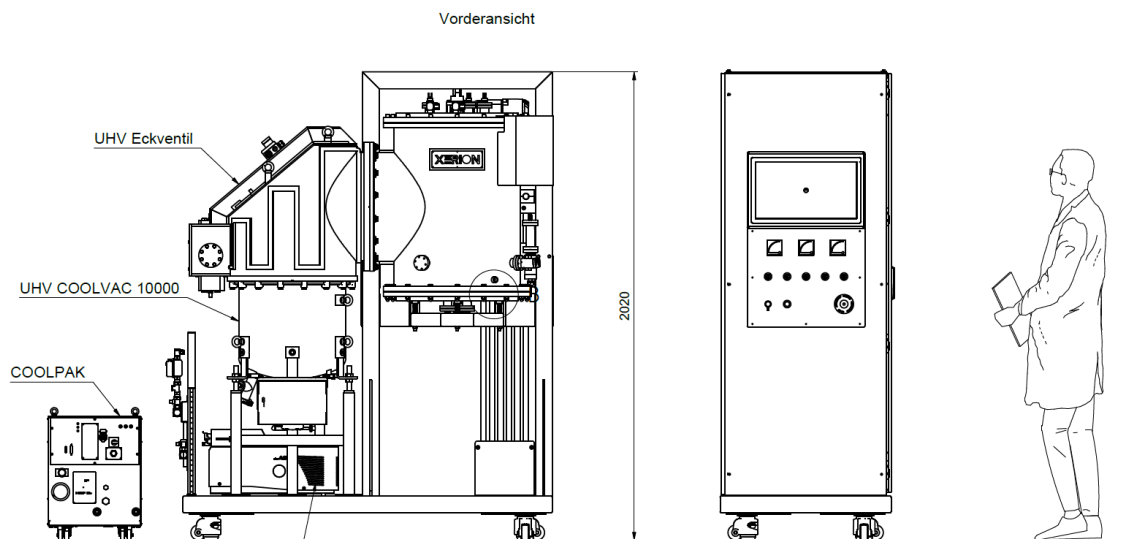
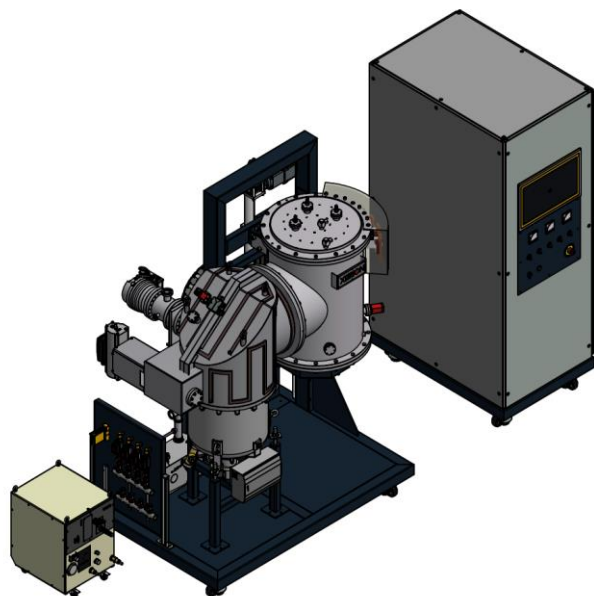
Curves are exemplary representations
Cavities limited by quench

Approach

1. WP A: Optimization of the current density distribution and minimization of losses
 - Treat samples & cavities and study them with state-of-the-art methods
 - Correlate structural & electrical properties
2. WP B: Surface and near-surface dynamics due to interstitial diffusion and lattice properties
 - In-situ studies of samples using XRR/XRD/XPS in-house
 - And at beam lines (ESRF/PETRA)
3. **WP C (QPR Development) & WP D (Numerical Studies on SRF) was cut**

New Single-Cell (U)HV Furnace

- $T_{\max} = 1100^{\circ}\text{C}$
- $p_{\min} \sim 1 \times 10^{-8}$ mbar at RT
- Oil-free vacuum system
- Complete Moly-Heat zone



Delivery: Nov. 2021

Milestones

Nr.	(Quartal/Jahr)	TP	Beschreibung des Meilensteins
1	IV/2021	A	Ofen-Kommissionierung abgeschlossen
2	IV/2021	C	Design Solenoid & Heizer fertig
3	I/2022	D	Abgeschlossener Vergleich bisheriger Algorithmen
4	II/2022	A	Erste NbTiN-beschichtete Antennen einbaubereit
5	III/2022	C	Abschluss Prototypentest Solenoid & Heizer
6	IV/2022	B	Halbzeit-Report Probenstudien
7	IV/2022	B	Auswertung Scanning-SQUID-Prototyp-Messungen
8	IV/2022	C	Abschluss Validierung des dynamischen Detuning-Modells
9	IV/2022	D	Implementierter Auswerte Algorithmus
10	I/2023	C	Abschluss Kommissionierung Solenoid & Heizer
11	III/2023	C	Ergebnis der Validierung der Korrekturen für die QPR Messungen
12	III/2023	D	Abschluss der Analyse der Unsicherheiten im Algorithmus
13	II/2024	A	Abschließende Veröffentlichung und Wissenstransfer
14	II/2024	B	Abschließende Veröffentlichung
15	II/2024	C	Dokumentation der Arbeit und Veröffentlichung der Ergebnisse (Open Access)
16	II/2024	D	Ergebnisse unter Anwendung des entwickelten Verfahrens bzgl. der SRF-Leistung nach Oberflächenbehandlungen. Dokumentation der Arbeit und Veröffentlichung der Ergebnisse (Open Access)

Approved Funding

1. Personal: 1 PhD + 1 Postdoc (54 PM)
 - **PhD for WP A was cut**
 - *PhD for WP B*: local structural and chemical properties of fine grain Nb (~grain resolution) with surface sensitive x-ray methods (XRR/XRD) – looking for applications
 - *Postdoc (Marc Wenskat)*: Responsible for furnace & QPR, project coordination & reporting
 - *“Bonus” PhD (Rezvan Ghanbari) for WP A*: rf studies of samples (PCTS/QPR/SHPM/MOKE) & cavities
2. Invest: 20k€ (sample-material / furnace auxiliaries)
Requested invest was 69k€
3. + Travel & Consumables

In total: 495 k€ (incl. Overhead) (912k€ incl. Overhead was applied for)

1. Coating of Antenna with NbTiN / NbN (U Mainz)
2. QPR Tests of Nb₃Sn coated Cu Samples (TU DA - MaWi)
3. Laserpolishing of Nb surface (BUW)
4. Optimized QPR Design including dynamical uncertainties (URO)

Kooperationsvertrag

- UHH will prepare a first draft
- Will send it to the local coordinators
- → please forward to your legal departments / project administrations

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Please provide your slides so I can upload them onto the Homepage