TTC High Q_0 Working Group

C. Reece

- Informal discussions in 2012-13 noted new opportunities in improved cavity Q_0 over common expectations.
- How to obtain efficient rapid development through common efforts?
- G. Hoffstaetter requested a TTC-based topical working group.
- TTC CB accepted proposal at SRF2013 meeting
- C. Reece asked to host/facilitate the Working Group

- An activity crunch to compose LCLS-II CDR preoccupied a number of us Oct – Dec.

- First web-based virtual meeting was held January 9
  - Indico site: http://www.jlab.org/indico/event/TTC_High_Q_WG
- Second virtual meeting was held February 12
  - Indico site: http://www.jlab.org/indico/event/TTC_High_Q_WG_2

- Although most of the presentations were from US participants, there was broad and growing participation from all regions and good stimulating discussion.
- In several cases this has contributed to good progress reported at this meeting.

TTC High Q working group

From 1st meeting

- Informal working group from TTC-member institutions pursuing routes to minimized rf surface resistance in SRF applications.
  - Response to request from Cornell University to TTC Collaboration Board
  - Proposal by Reece to facilitate the WG accepted by CB

- **Periodic web-based meetings** (4-6 weeks)   {Suggest 13 Feb for next mtg.}
  - Information exchange
  - Solicitation of technical feedback
  - Learning from each other
  - Not project-specific

- **Prepared short presentations**
  - Posted on closed Indico site: http://www.jlab.org/indico/event/TTC_High_Q_WG
  - For informational and learning purposes
  - Not for technical reference
  - All material considered "preliminary"

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- Although most of the presentations were from US participants, there was broad and growing participation from all regions and good stimulating discussion.
- In several cases this has contributed to good progress reported at this meeting.
- Next meeting anticipated for week of May 12.
  - Participation is encouraged – contact C. Reece to get on the mailing list

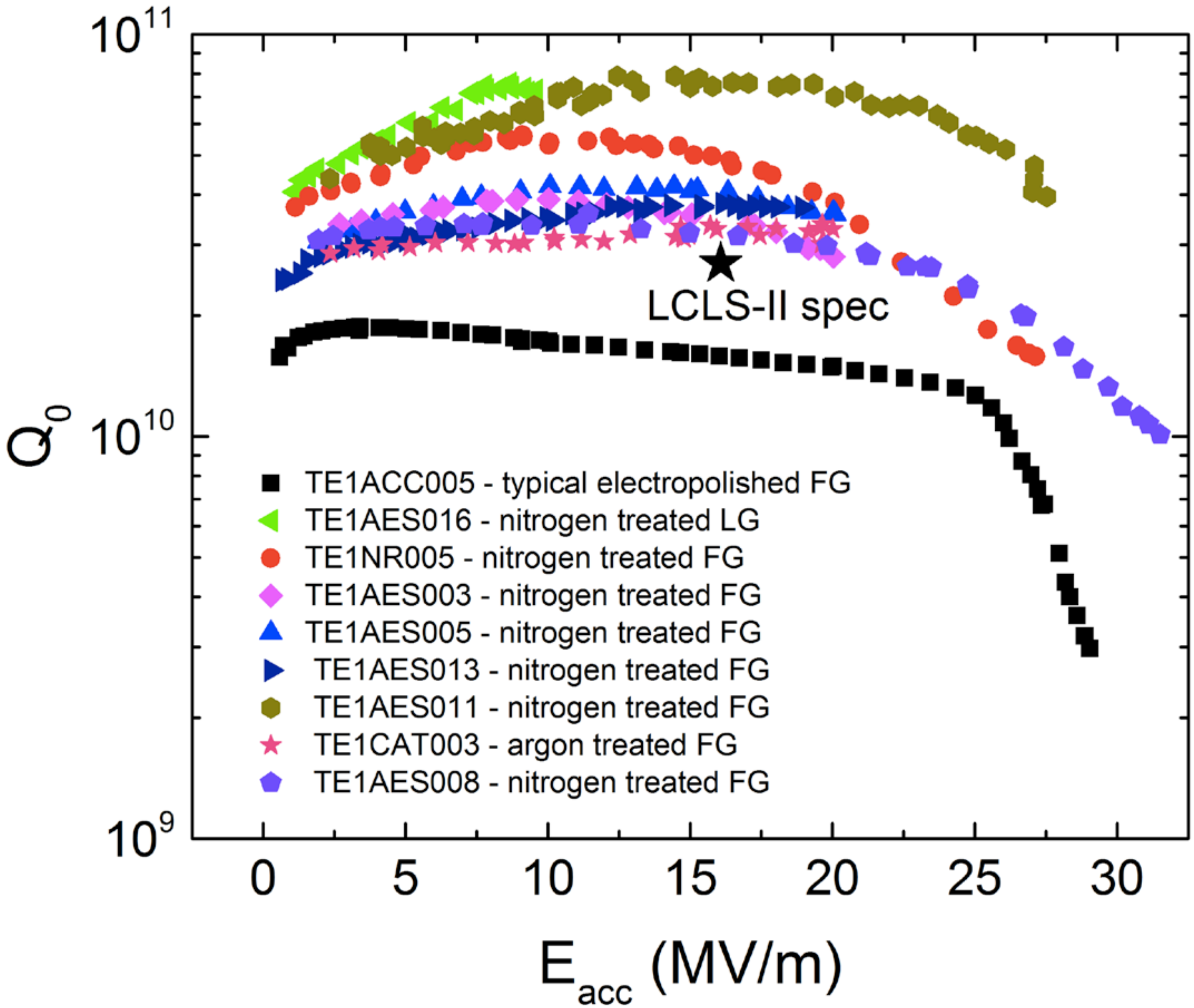
- A variety of topics are being discussed
  - *Q* variability with cooldown conditions
    - Pressure to better quantify external magnetic fields and amount of flux trapped
    - Pressure to scrutinize temperature profile and change rate through T_c
  - Analysis of *Q* dependence with rf Bpk as a function of various treatments
    - 120C bake
    - EP
    - BCP
    - HF-rinse
    - HT-N = 800C + N doping
    - Mini-EP
    - 1400C clean bake without subsequent chemistry

Common denominator of all measurements (HZB, Cornell, Fermilab, JLAB, CERN, …)

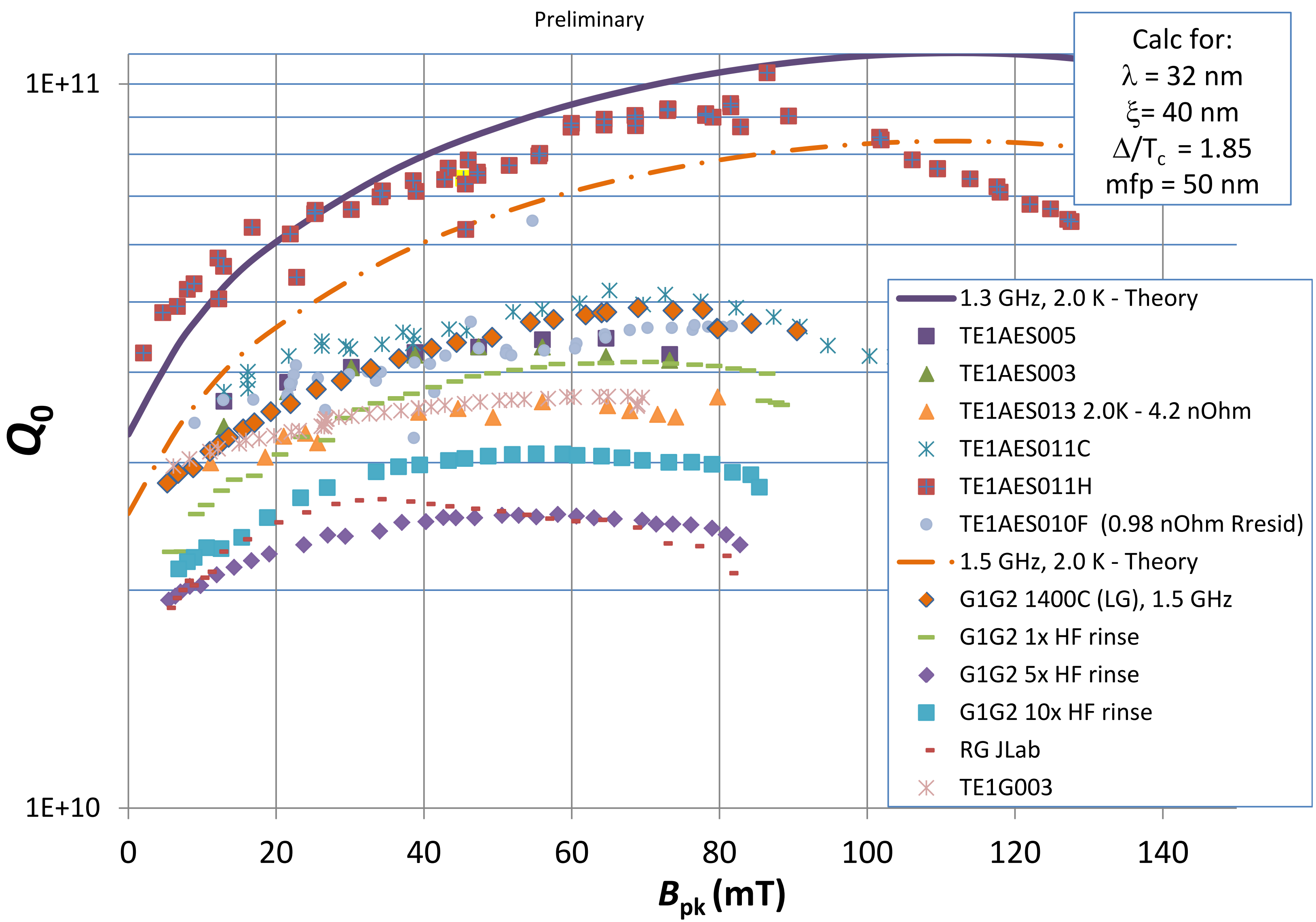
- **Cooling dynamics** influences obtained Q_0.
  - Cycling can lead to **increase** or **decrease** of Q_0.
- Effect is **reversible** by transition through T_c and choice of adequate cool-down conditions.
- Effect comes with a change in **trapped flux**.

- Work on further development of nitrogen doping
- In particular, we have focused on developing a robust recipe for meeting the LCLS-II requirement of Q > 2.7e10 at 2K
- Change duration of nitrogen bake for modifying thickness of doping layer
- Make the processing insensitive to tolerances in EP post gas bake
- Gradient wall has been overcome in several cavities – reached above 30 MV/m
- Successfully implemented on nine cell Q >2.7e10@2K

Example of doped cavities



Pursuit of High Q_0 via HT-N



Jefferson Lab

Toward Higher Q's

New data present **fresh challenges for the parameterization and interpretation** of the field dependence of the SRF surface resistance, R_s. ($Q_0 = G / R_{s\ avg}$)

R

$$R_s = R_{bcs}(T,B) + \underbrace{R_{flux} + R_{norm} + R_{pe}(T,B)}_{R_{residual}} + R_{eff\text{-topo}}(B) + R(E)_{eff\text{-FE}} + \ldots$$

BCS	ambient flux pinned	normal metal	proximity effect	roughness field enhancement	field emission

We are now learning more about all of these and must untangle them in the real world to minimize overall losses.