



Updates of Vertical Electro Polishing at Cornell

Fumio Furuta,

Georg H. Hoffstaetter

Cornell University

Laboratory for Elementary-Particle Physics

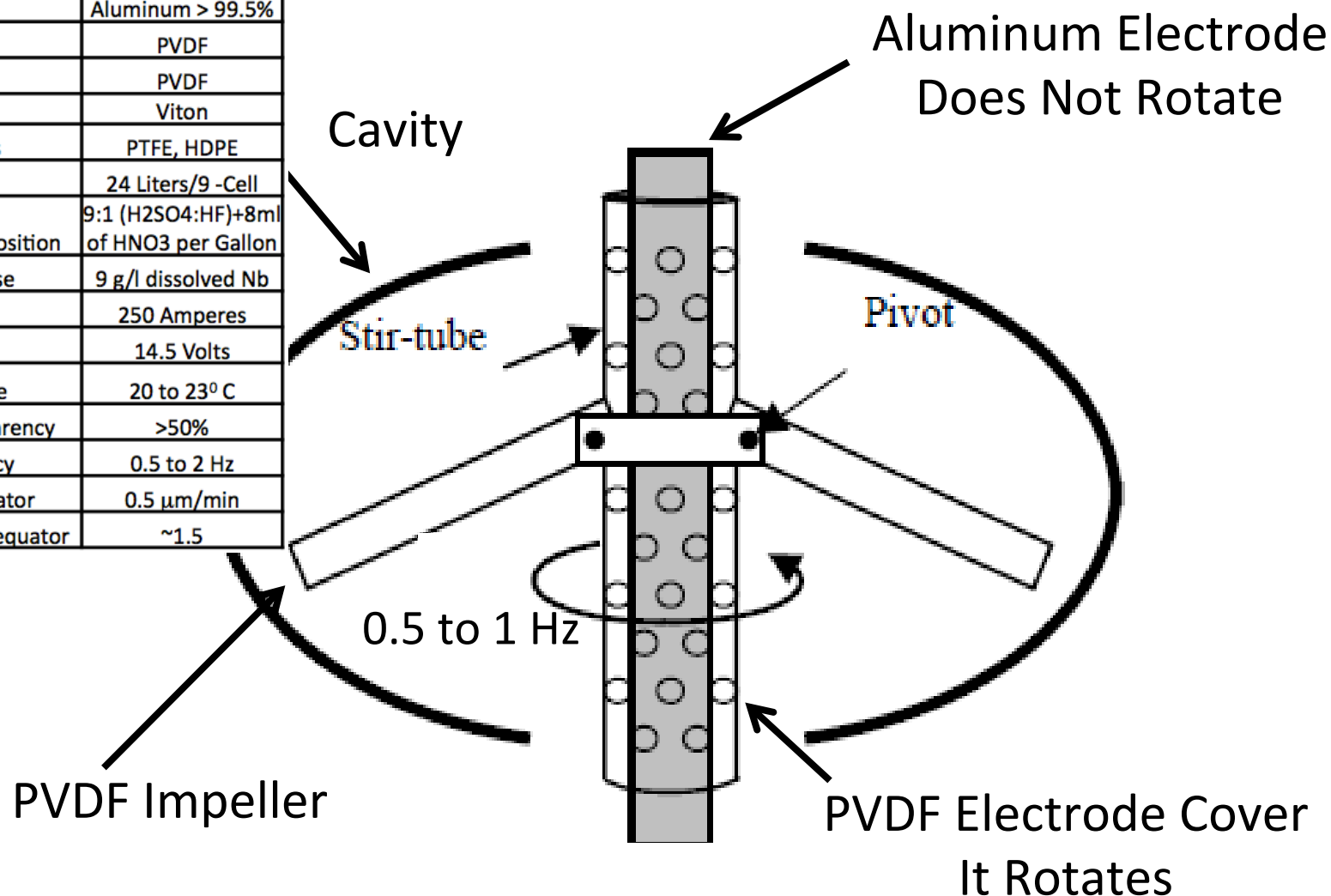
- Recent results of VEP'ed cavities.
- Analysis on VEP removal.
- Temperature oscillation asymmetry.





What is Vertical Electropolish?

Parameters for VEP	
Cathode	Aluminum > 99.5%
Stir-Tube	PVDF
Paddles	PVDF
Seals	Viton
End Groups	PTFE, HDPE
Electrolyte	24 Liters/9 -Cell
Electrolyte Composition	9:1 (H ₂ SO ₄ :HF)+8ml of HNO ₃ per Gallon
Maximum Use	9 g/l dissolved Nb
Current	250 Amperes
Voltage	14.5 Volts
Temperature	20 to 23° C
Stir-Tube Transparency	>50%
Stir Frequency	0.5 to 2 Hz
EP Rate at Equator	0.5 μ m/min
Ratio EP Rate iris/equator	~1.5



H. Padamsee & A.C. Crawford, PAC07, WEPMS009

TTC meeting 6 Dec. 2011, Beijing

Cornell SRF group

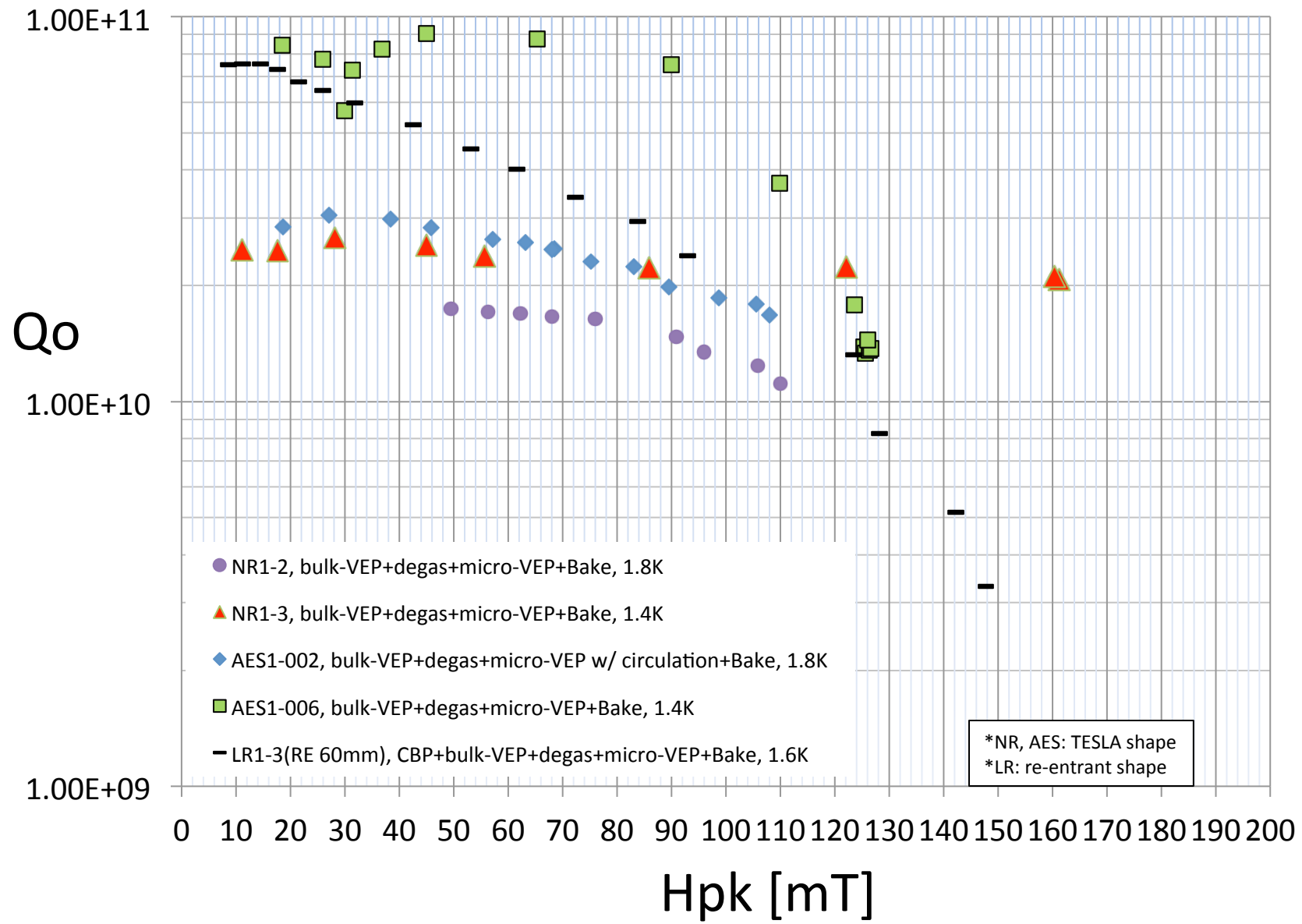


Why Vertical Electropolish?

- Vertical Electropolishing has the Following Benefits:
 - Eliminates rotary acid seals
 - Eliminates sliding electrical contact
 - Eliminates the cavity vertical/horizontal position control fixtures
 - Simplifies the acid plumbing/containment
 - The outside of the cavity is actively cooled, providing better temperature control of the polishing reaction.
 - Lower capital equipment cost.

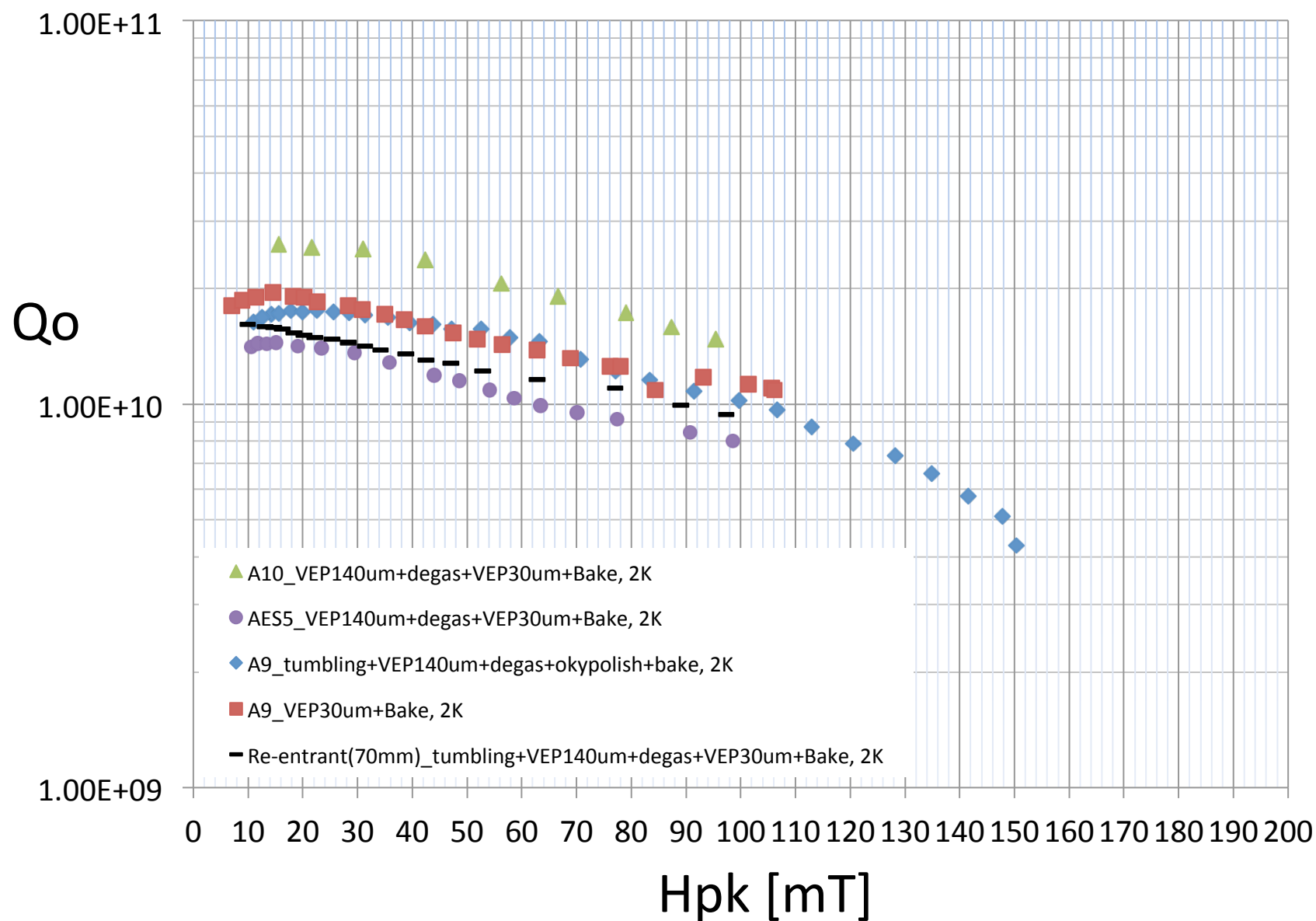


Recent results of single cell + VEP



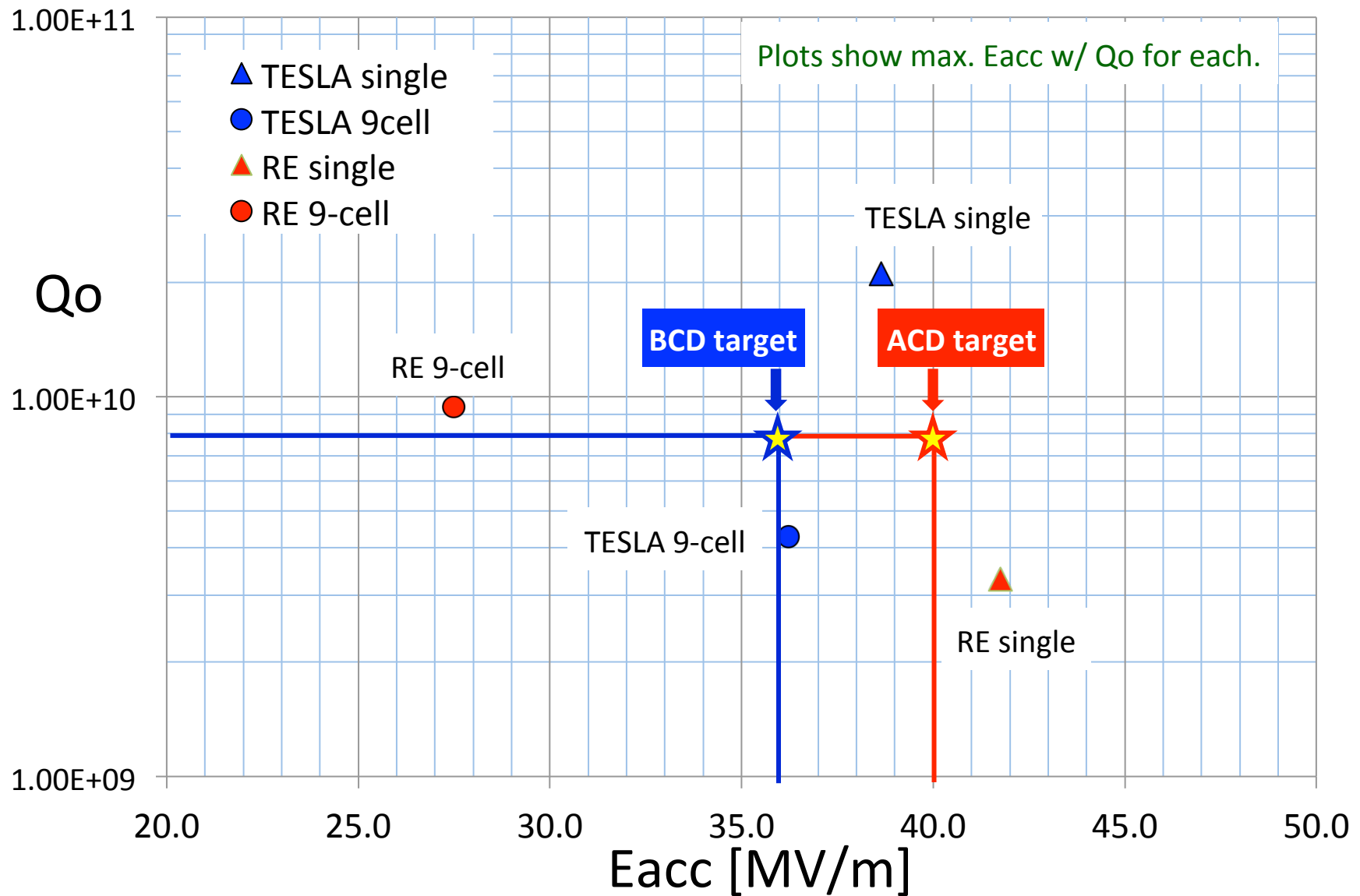


Recent results of 9-cell + VEP



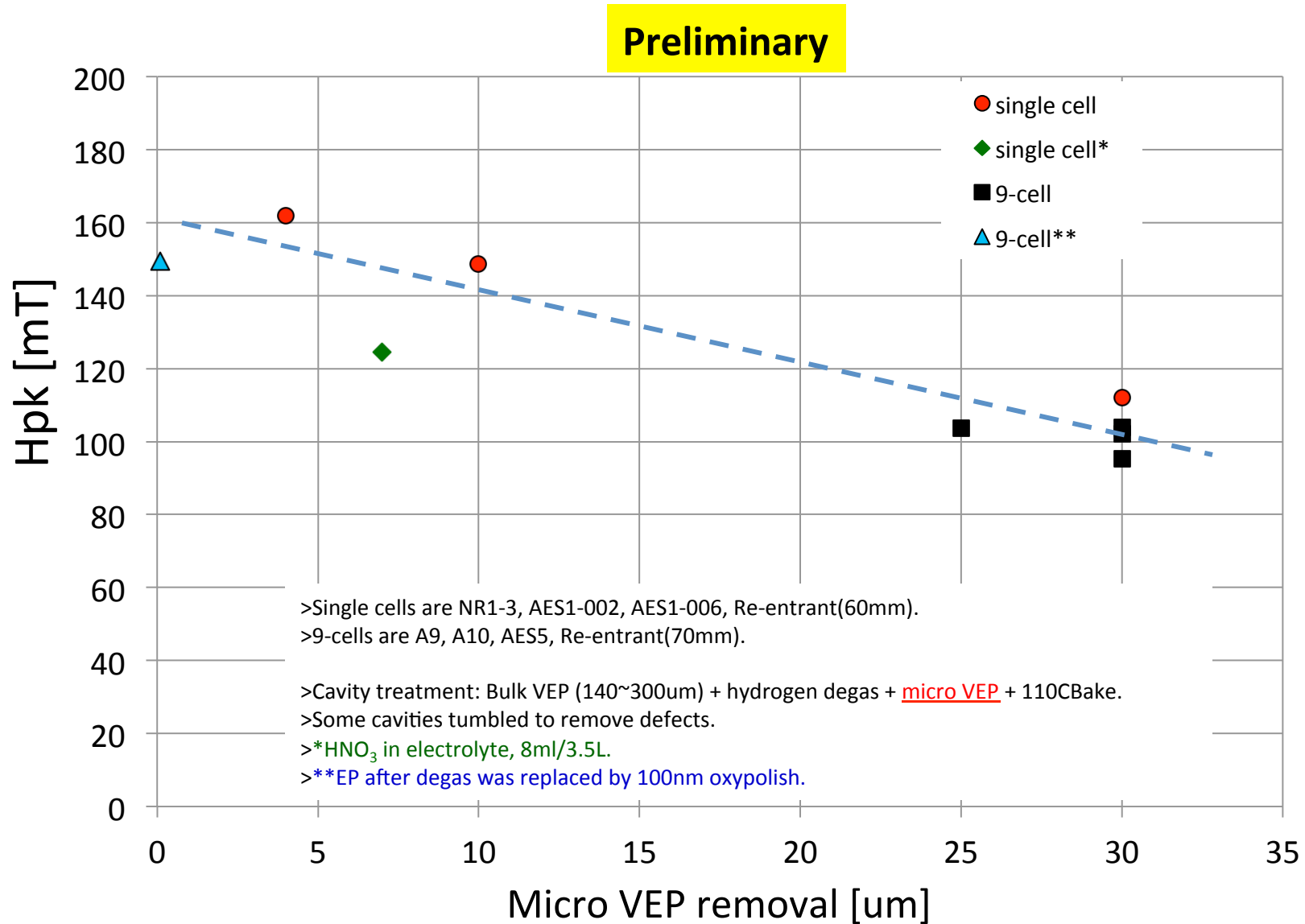


Achievements of VEP for ILC requirements



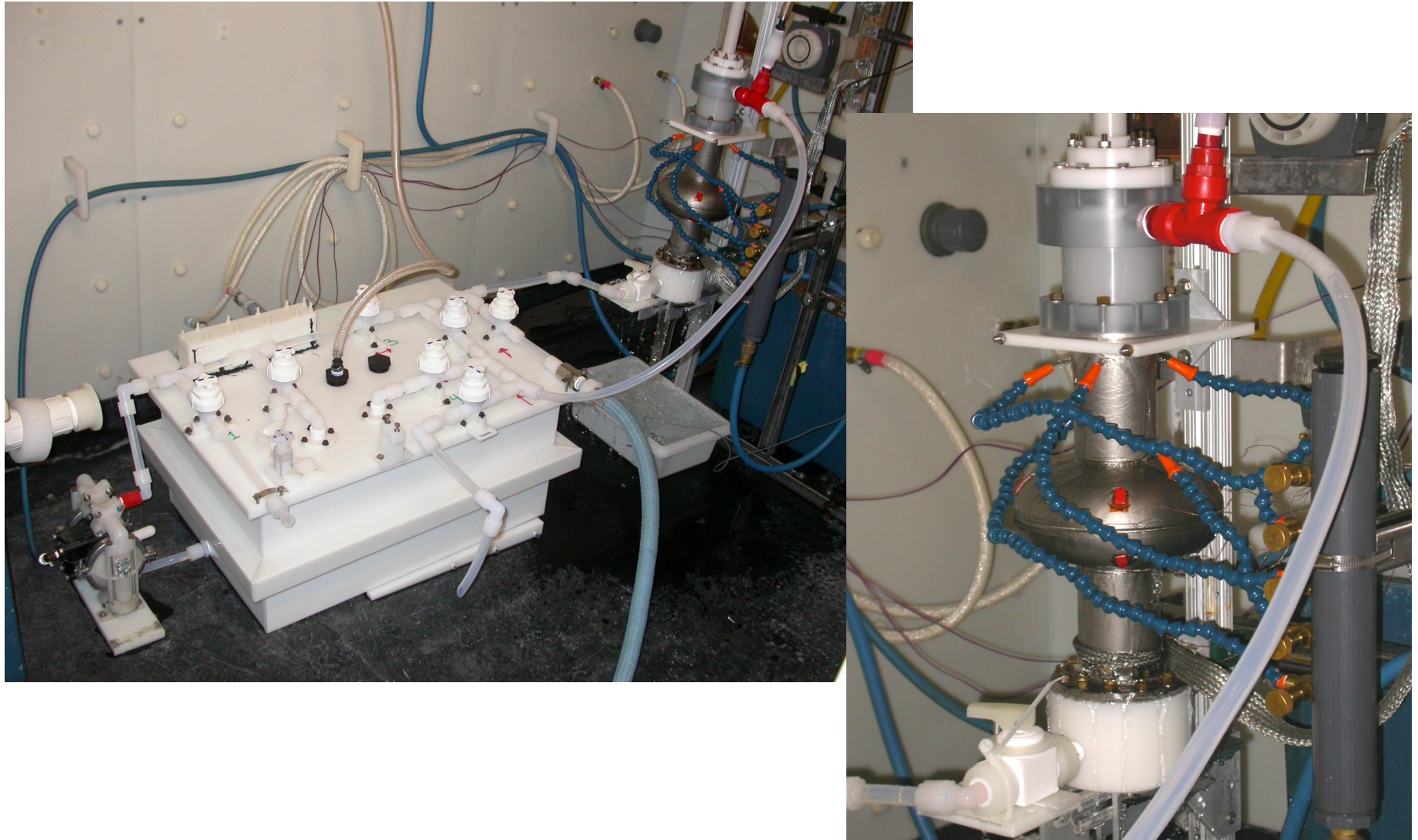


Analysis on VEP removal





VEP system with Recirculation

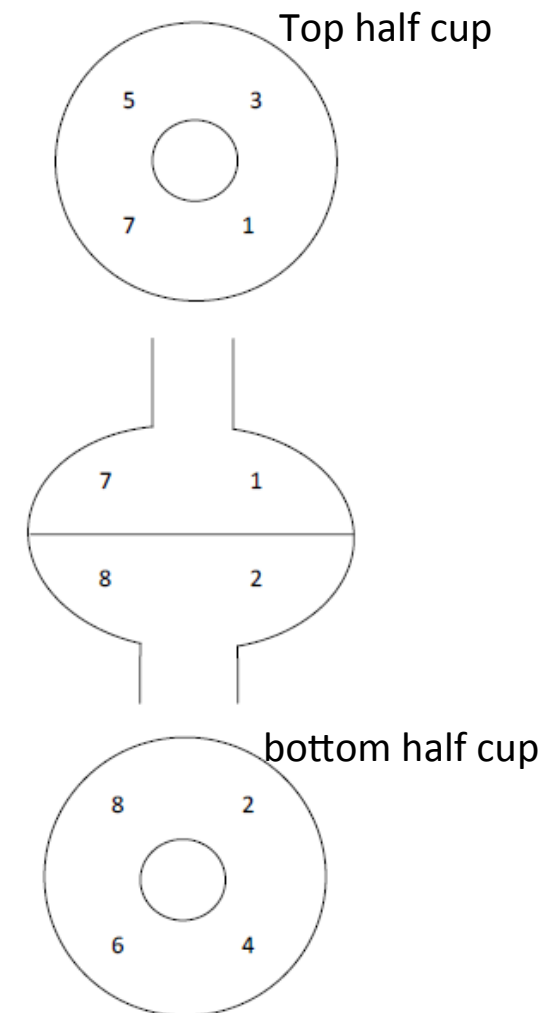
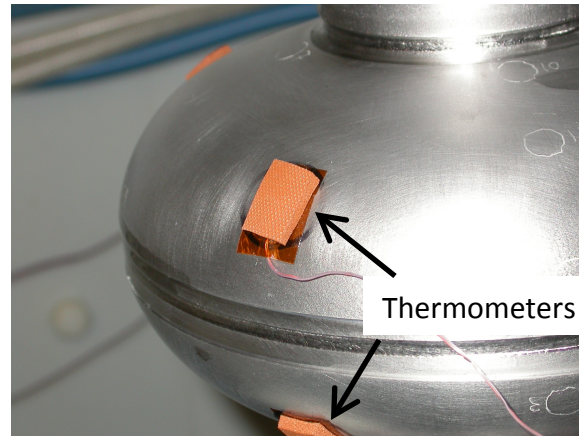


VEP 2.1: Recirculation



Temp. monitoring setup

- Resolution of thermocouples: 0.02°C
- Agitation: 0.85Hz
- Acid Recirculation(1Hz)
- Location of thermocouples ->
- 60 second window
- Sample rate of
 - TC: 1.5 Hz
 - Current: 5 Hz

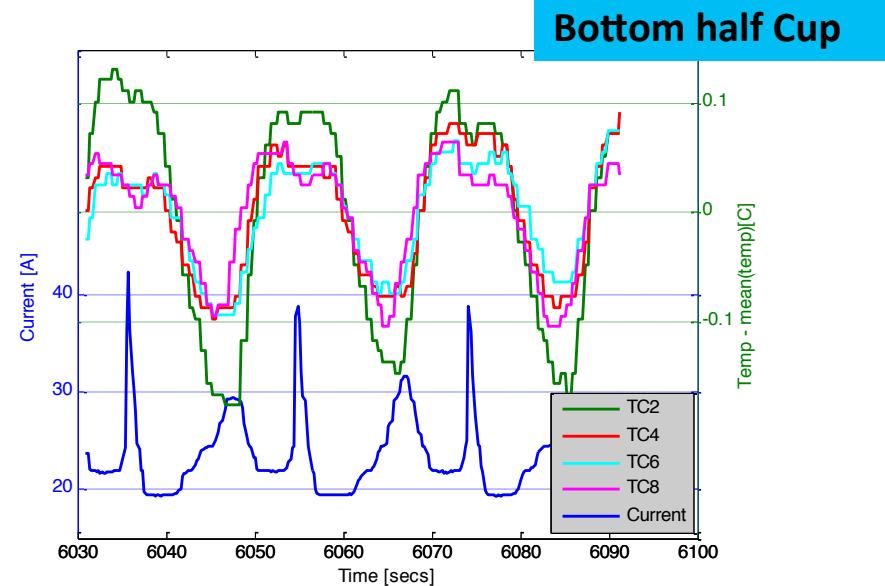
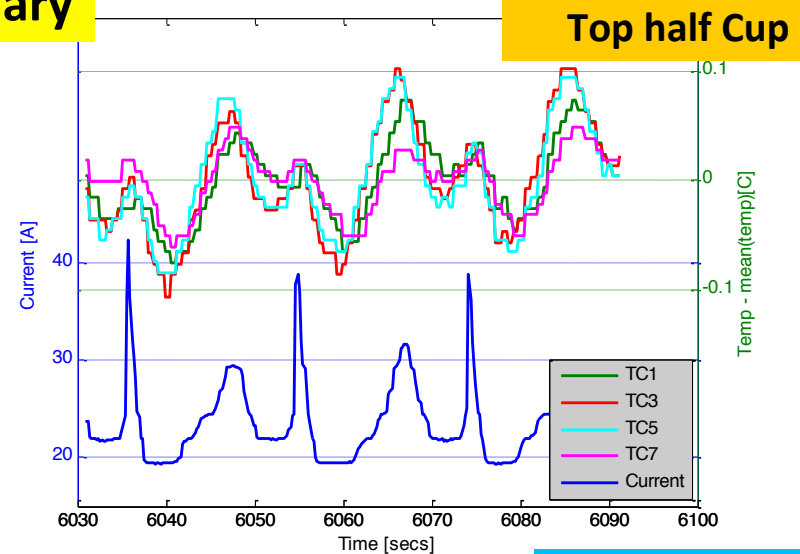
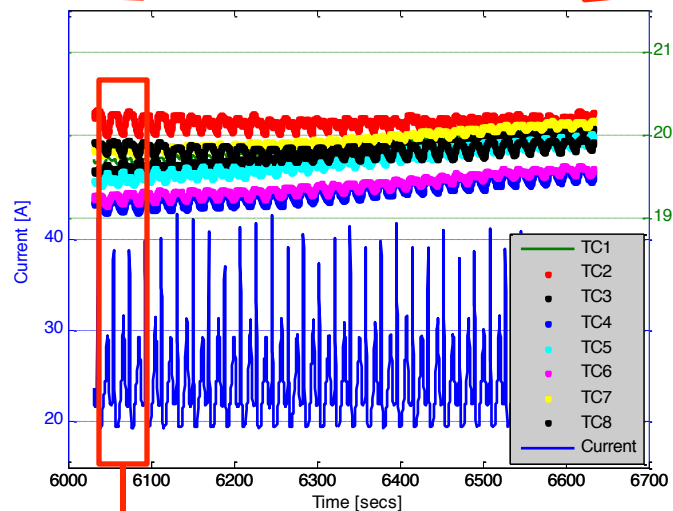
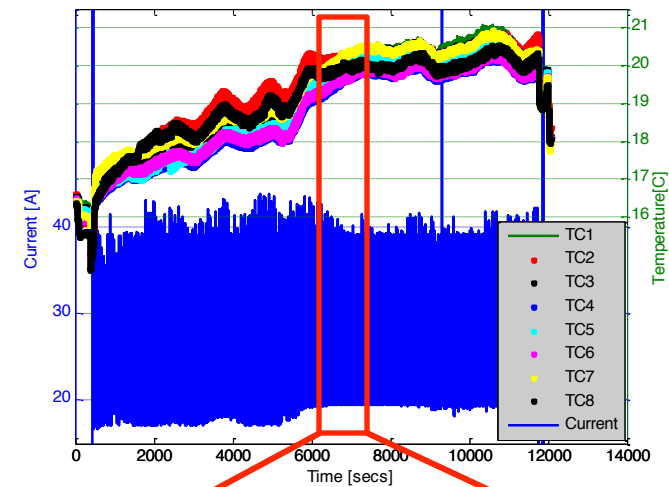




Temperature Oscillations Asymmetry

VEP of AES2-1 w/ acid circulation

Preliminary





Interpretation

- Frequency of top $\approx 2 * \text{frequency of bottom}$
- No obvious correlation between temperature & electrolyte motion
- Upper cup
 - T increase correlated for Type 1 & Type 2 current spike
- Lower Cup
 - T increase correlated with Type 2 current spike
 - T *decrease* correlated for Type 1 current spike
- Meter stick for VEP development
 - Top and bottom oscillations must be identical
- Further analysis on temperature/current correlation



Summary

Recent results.

- >TESLA single cell achieved 39MV/m with Q_0 of $2.1e10$ by VEP.
 - >Feasibility of VEP + oxypolish was demonstrated with TESLA 9-cell.
36MV/m was achieved so far.
 - >preliminary results show VEP removal dependence on gradient.
 - >Temperature oscillation asymmetry was found during single cell VEP.
- We will check reproducibility of these processes.
These may have hint to high gradient Q-slope issue of VEP.

Ongoing R&Ds for VEP establishment.

- 1) Demonstration of high gradient w/ high Q_0 .
step1. TESLA shape(okay) -> Re-entrant shape.
step2. single cell -> 9-cell.
- 2) Demonstration of reproducibility and high yield.
- 3) Optimization of parameters.
voltage, current, temp, removal, agitation, etc.
- 4) Understanding of VEP process.
Temp. oscillation asymmetry, circulation, etc.