



Cornell Laboratory for
Accelerator-based Sciences and Education (CLASSE)



Industrialization of Vertical Electropolish

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- What is Vertical Electropolish?
- Why do we care?
- Vertical Electropolish Industrialization
- Future Work

Collaborators:

Curtis Crawford

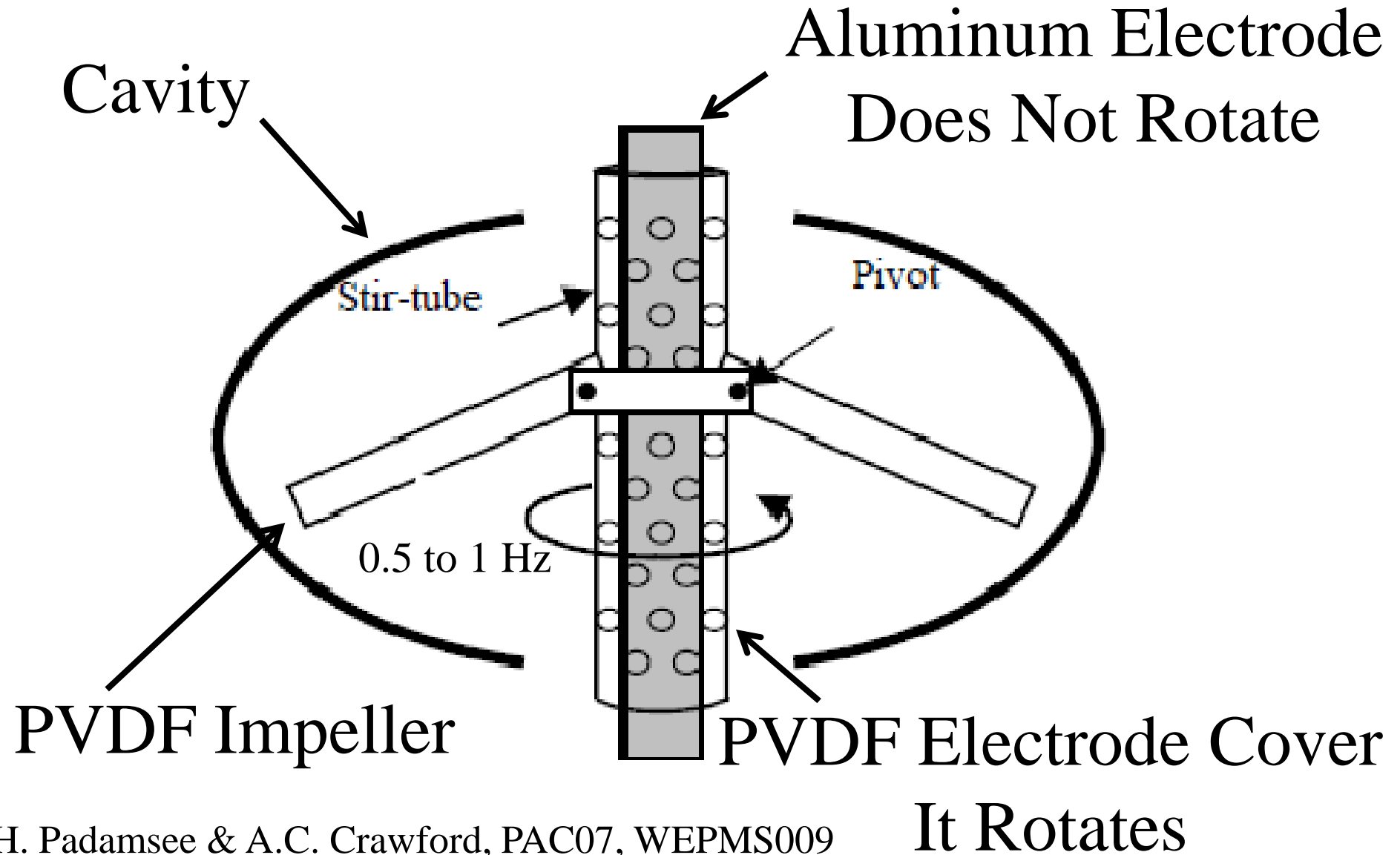
Holly Conklin

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Cornell SRF Group



What is Vertical Electropolish?



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

It Rotates

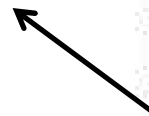


What is Vertical Electropolish?

Table 1. Parameters for EP

Cathode	Aluminum >99.5%
Stir-Tube	PVDF
Paddles	PVDF
Seals	Viton
End Groups	PTFE, HDPE
Electrolyte	24 Liters
Maximum Use	9 g/L dissolved Nb
Current	400 Amperes
Voltage	14.5 Volts
Temperature	36 to 40 degrees C
Stir -Tube Transparency	>50%
Stir Frequency	2 Hz
EP rate at Equator	0.5 micrometer/min
EP rate iris/equator	<1.5

20-25⁰C



~0.25 μm/min



→ 0.5 to 1 Hz



Electrolyte formula by Volume

H₂SO₄(96%) / HF(48%) = 10/1 + additional 2.5cc HNO₃
(70%) per liter

H. Padamsee et al, PAC07, Pg. 2343 WEPMS009

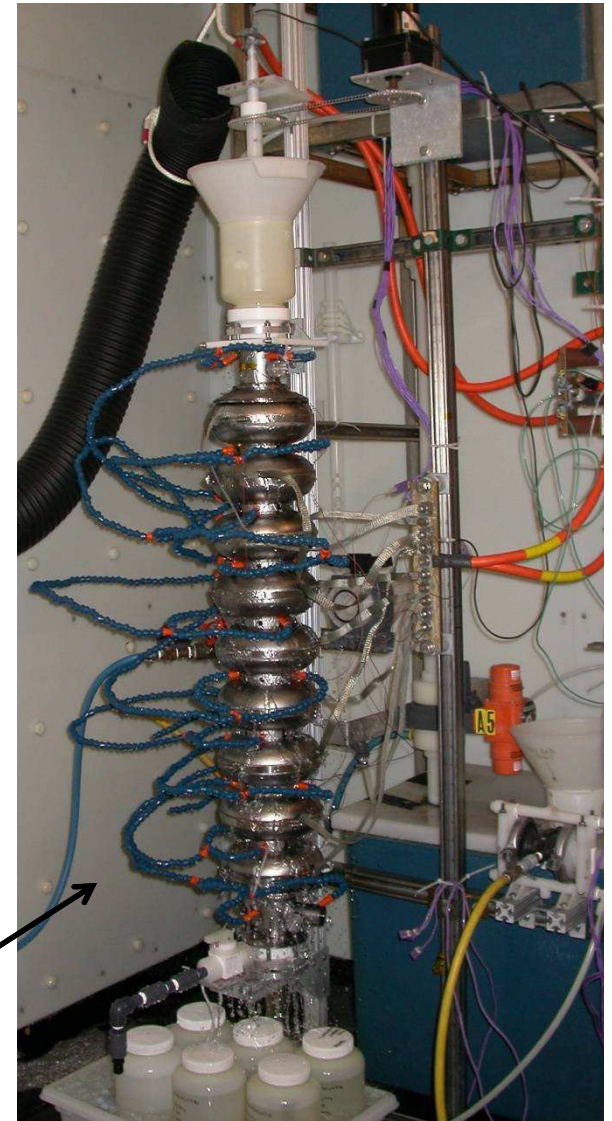


What is vertical Electropolish?

Horizontal Electropolish FNAL/ANL Joint Processing Center



Vertical Electropolish





Why do we care about Vertical Electropolish

- Vertical Electropolishing has the Following Benefits:
 - Eliminates rotary acid seals
 - Eliminates sliding electrical contact
 - Eliminates the cavity vertical/horizontal position control fixturing
 - Simplifies the acid plumbing/containment
 - The outside of the cavity is actively cooled, providing better temperature control of the polishing reaction.
- Vertical electropolishing's disadvantages are on the next slides.

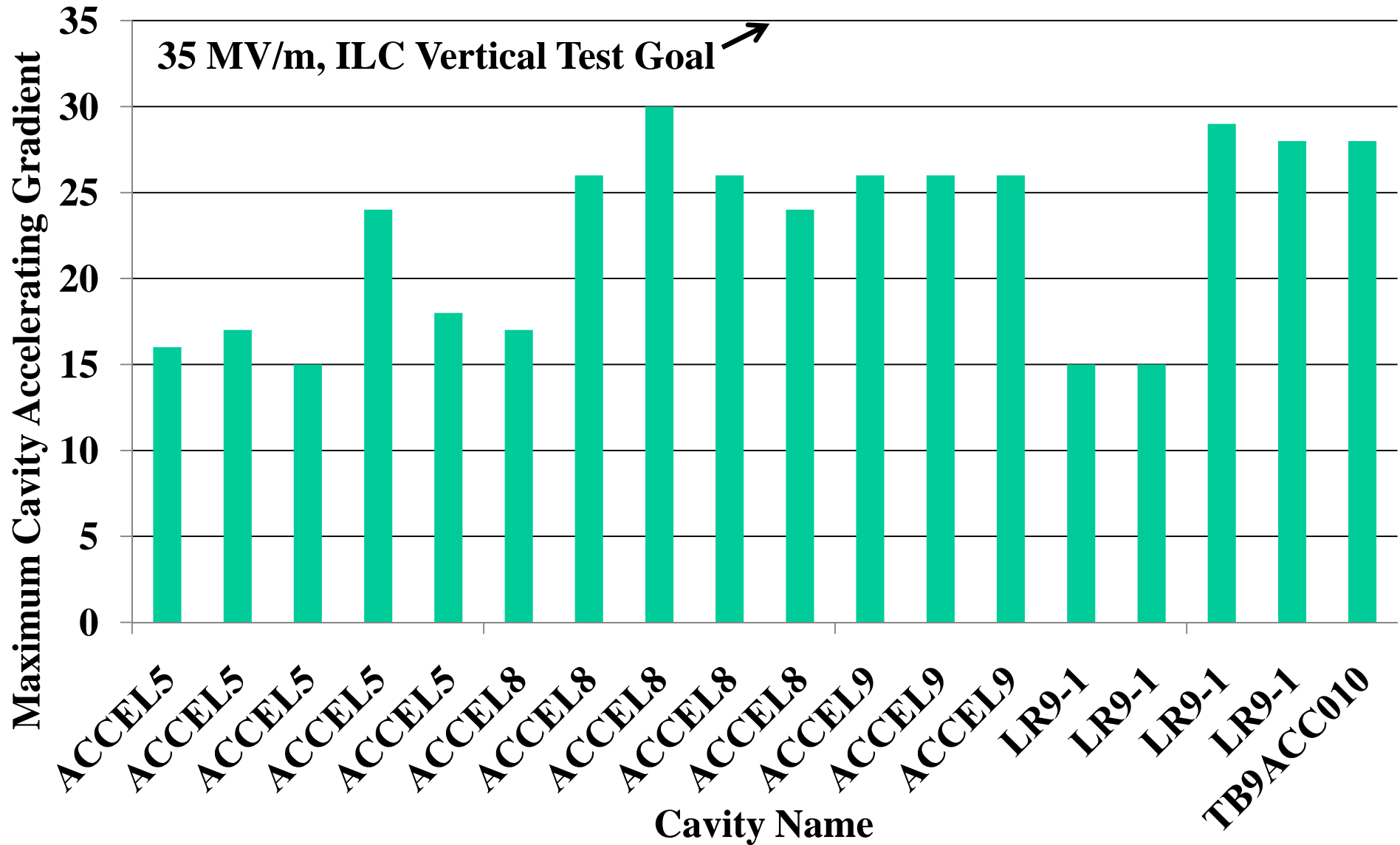


Why do we care about Vertical Electropolish

- Vertical electropolish has never produced a 9-cell cavity with an accelerating gradient greater than 30 MV/m.
- Individual cells have performed well but not every cell at the same time which is what you want in an accelerator.
- Vertical electropolish is not demonstrated at the same level of performance as the KEK horizontal electropolish performed all across the world.



Vertical Electropolish Results





Why do we care about Vertical Electropolish

- Vertical Electropolishing has the following difficulties
 - Accelerated material removal from downward facing surfaces.
 - Can remove material up to 2x faster
 - Depends upon the agitation speed and flow rate
 - Spinning impellers may rub on cavity surface. This is very very bad!
 - Cavity is rotated 180° every $\sim 100 \mu\text{m}$ during heavy polishes.
- Things that may or may not matter
 - Small acid volume, just fill the cavity.
 - Impeller hinges rub as you insert/remove the aluminum electrode



Industrialization of Vertical Electropolishing

- Nothing has happened yet
- What should we do to zeroth order:
 - Have someone visit Cornell/JLAB and learn how to vertically electropolish cavities
 - Send them back to their employer with the design and knowledge and have them build a vertical electropolish setup themselves.
 - Vertically electropolish a cavity and send it to a lab to test
 - If that all goes well, great.