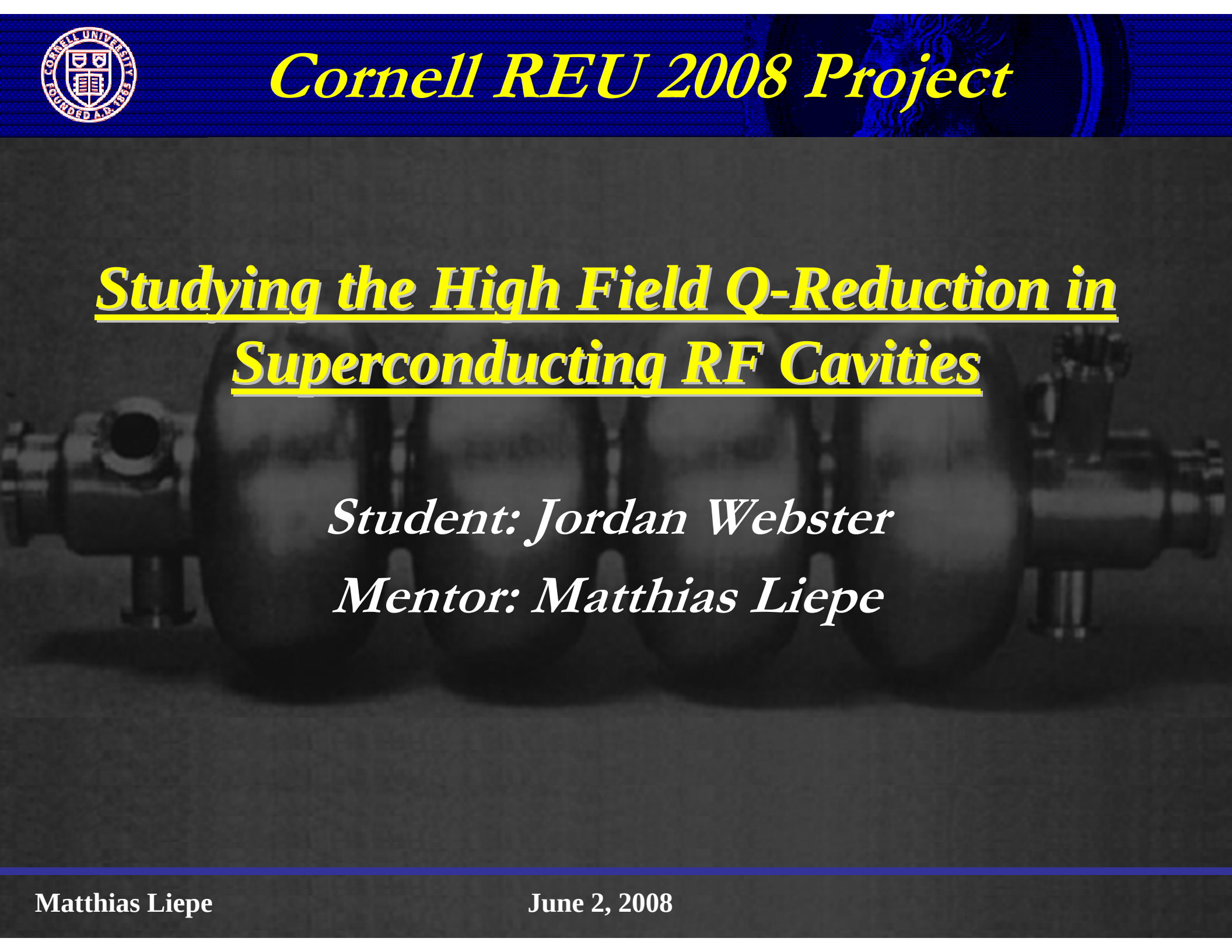


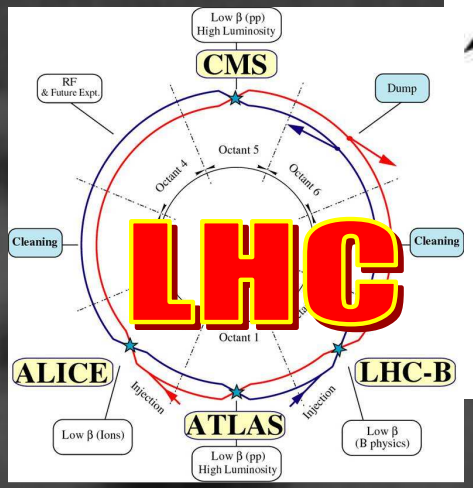
Cornell REU 2008 Project

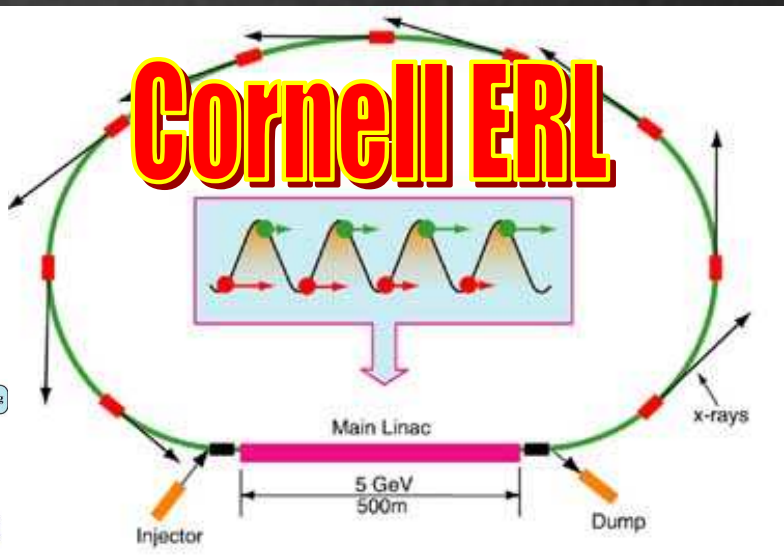
Studying the High Field Q-Reduction in Superconducting RF Cavities

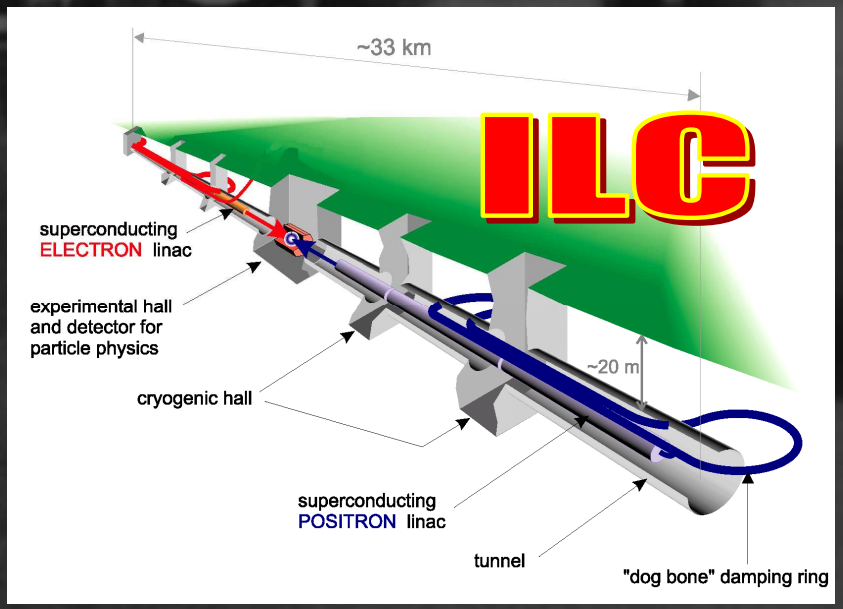
Student: Jordan Webster

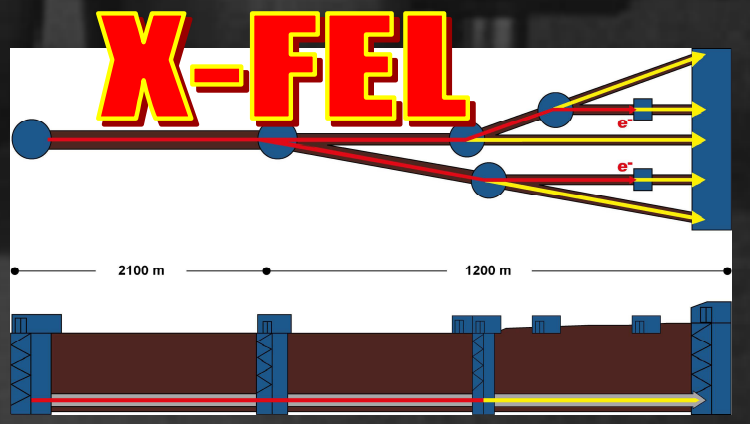
Mentor: Matthias Liepe

Superconducting RF around the World



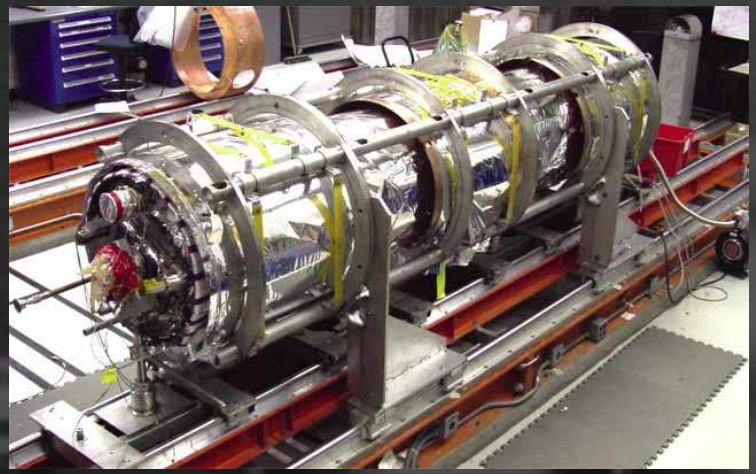






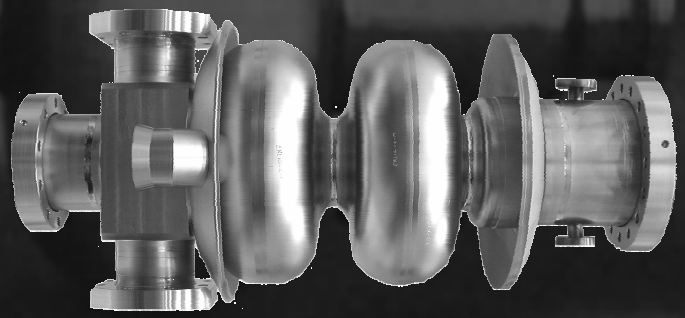
Superconducting RF around the World

SNS



LHC

Cornell ERL



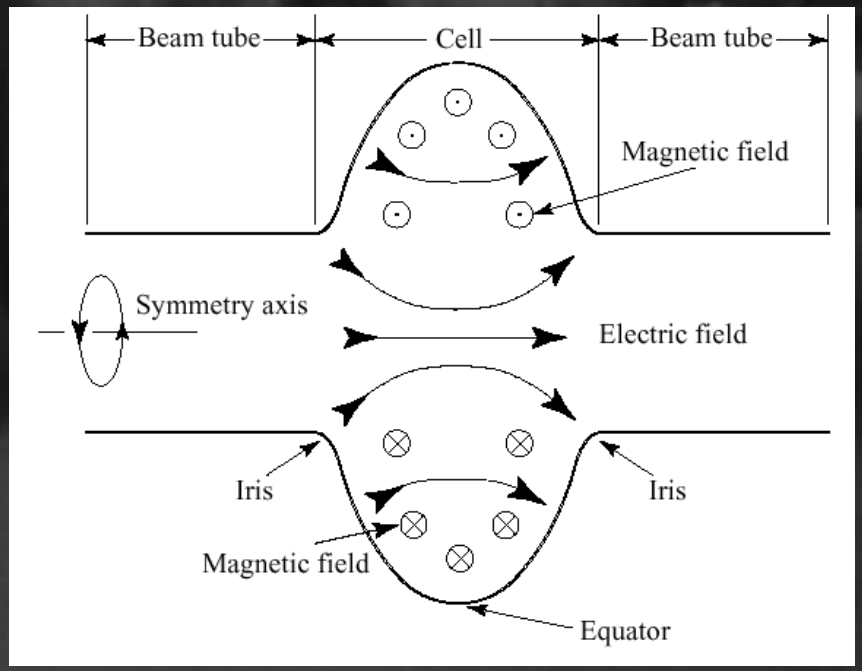
ILC

X-FEL

CEBAF

Superconducting RF Cavities I

- Use EM fields (rf-fields) in cavities for acceleration.
- Conducting walls “trap” fields in cavity which resonate at well defined frequencies (modes)
- Lowest mode has a longitudinal electric field and circular magnetic field → use this for acceleration



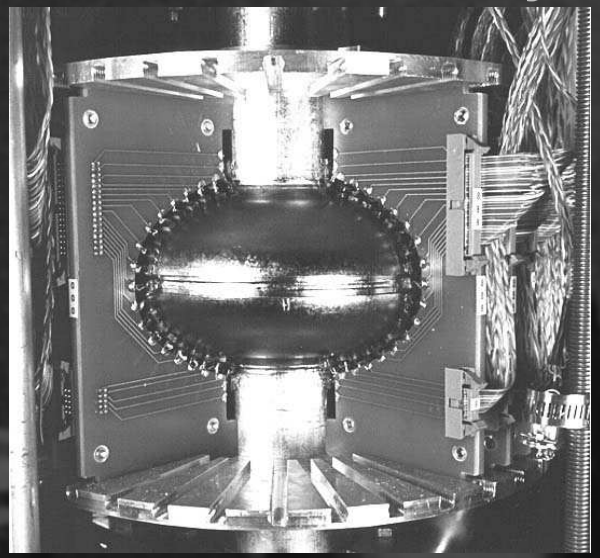
Superconducting RF Cavities II

- **Material: Niobium; superconducting below 9.2 K!**
- **Operate cavities at 2 to 4 K**
- **Very small wall losses:**
  - **Quality factor of this oscillator: $Q > 10^{10}$!**
  - **⇨ V=20MV ⇨ P_{SRF}=15W**
  - **⇨ Normal-conducting: $Q_0 \approx 10^4$ ⇨ P_{nc}=15MW**
- **Goal: Achieve accelerating electric fields of 20 to 50 MV/m**
- **Trick is to get such high fields and low wall losses!**

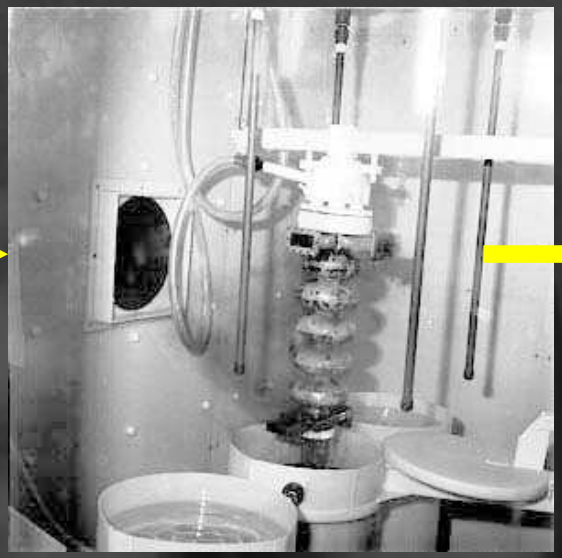
$$Q_0 = \frac{f}{bandwidth} \propto \frac{1}{R_S}$$

Jordan's Work this Summer…

Take a SRF Cavity

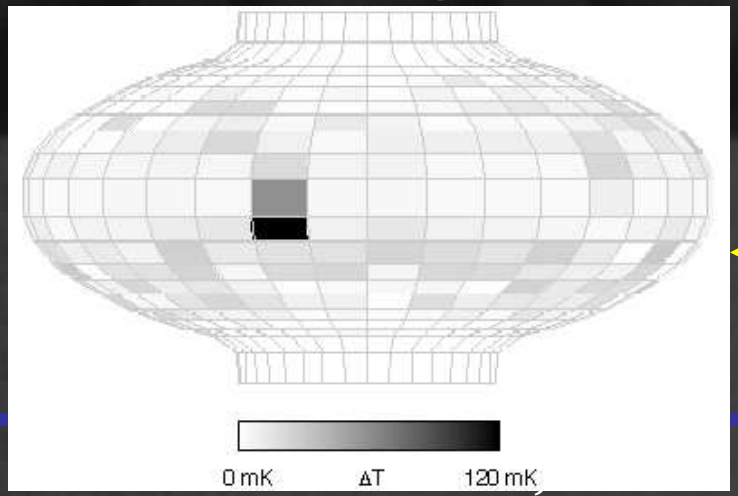


Prepare the Niobium surface (etch, clean, bake…)



Cool down and test the performance of the cavity

Analyze results



Jordan's Work Plan for this Summer

- High-pressure-rinse cavity
- Mount cavity on test stand
- Cool down cavity. Test cavity performance (test #1).
- Remove oxide layer on cavity inner surface (HF rinse)
- Cool down cavity. Test cavity performance (test #2).
- Bake cavity under vacuum at 400 C
- Cool down cavity. Test cavity performance (test #3).
- Expose cavity to 150 Torr sec of Nitrogen gas
- Cool down cavity. Test cavity performance (test #4).
- Expose cavity to 10^7 Torr sec of Nitrogen gas
- Cool down cavity. Test cavity performance (test #5).
- Bake cavity under vacuum at 400 C
- Cool down cavity. Test cavity performance (test #6).
- Expose cavity to 150 Torr sec of Oxygen gas
- Cool down cavity. Test cavity performance (test #7).
- Expose cavity to 10^7 Torr sec of Oxygen gas
- Cool down cavity. Test cavity performance (test #8).