SUPERCONDUCTING RF SYSTEM PLANS AT CLS

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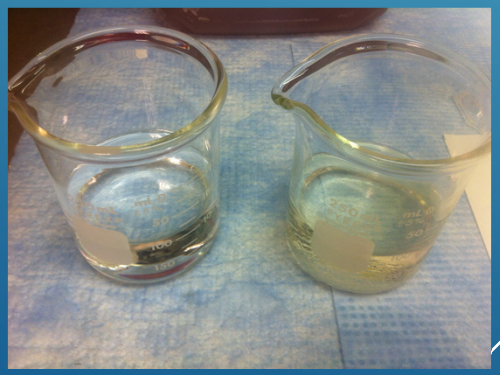

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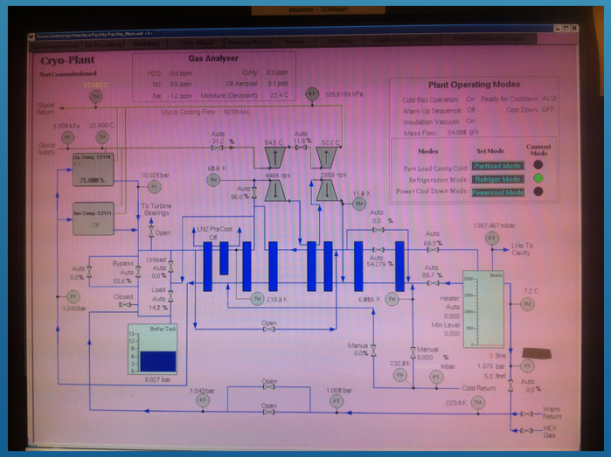
CRYOGENICS AT CLS - OUTLINE

- The Canadian Light Source
- The storage ring SRF system
  - The CESR-B cryomodule
- CESR-B history at CLS
- Past problems
- The "Cryo Upgrade"
- Superconducting vs. normal-conducting
- Another CESR-B for CLS
- The cold RF test



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THE CANADIAN LIGHT SOURCE

- CLS is a 3rd Generation Synchrotron
  - Canada's only synchrotron
  - Located in Saskatoon, Canada
    - Population 250,000
    - Western Canadian prairie
    - ~1200 km to Vancouver, ~2200 km to Toronto
- 13 active beamlines + 4 under construction
- CLS uses superconducting RF to replenish energy lost to synch radiation
  - Storage ring was commissioned with SRF

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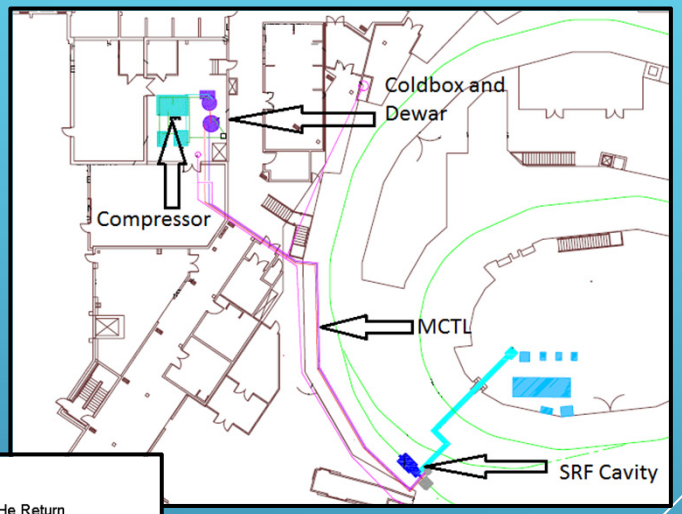
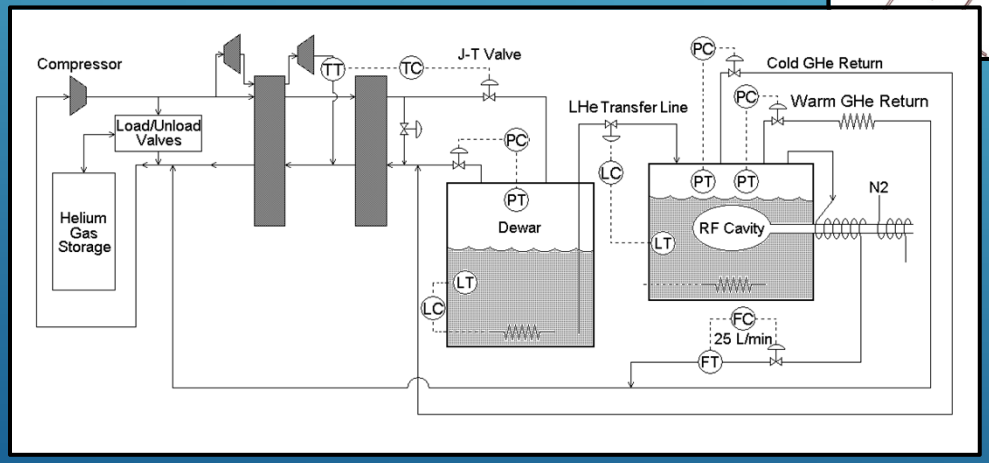
THE STORAGE RING SRF SYSTEM

- Major Components
  - Linde TCF-50 coldbox
  - Kaeser ESD351 compressor
  - 2000 L dewar
  - ~55 m MCTL to valve box above cryomodule
  - 157 m^3 buffer
  - Single SRF module in storage ring





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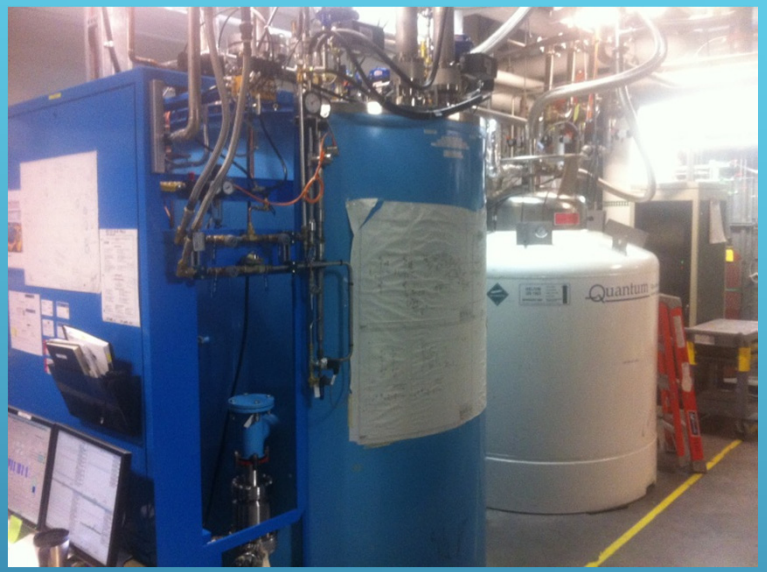
THE STORAGE RING SRF SYSTEM



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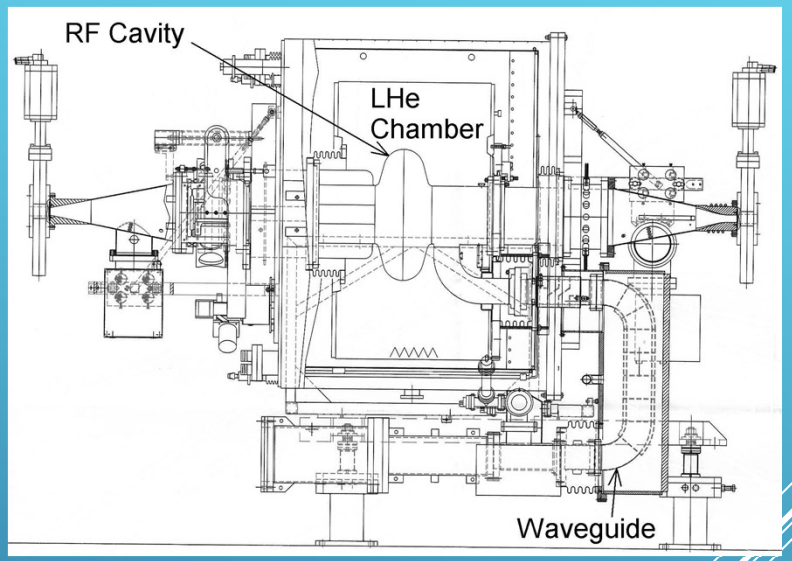
THE STORAGE RING SRF SYSTEM

- 500 MHz CESR-B elliptical SRF cavity
  - CLS has 2 units (one operating, one offline spare)
- Designed at Cornell in 1990s
- Constructed by Accel (now RI)
- V_{acc} = 2.05 MV
- 310 kW Thales TB 2161 klystron
- Other facilities operating the CESR-B
  - Cornell (CHESS)
  - TLS
  - Diamond
  - SSRF
  - PLS
  - NSLS-II
  - SIRIUS (planning in progress)



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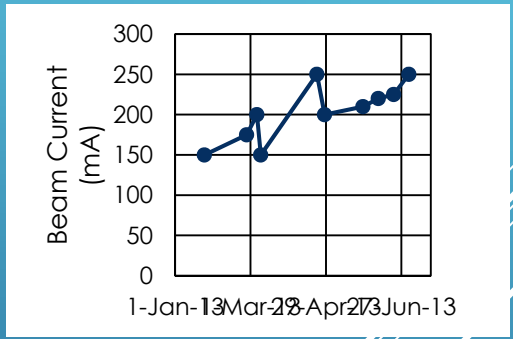
CESR-B HISTORY AT CLS

- Cavity 1 – delivered May 2003
  - Commissioned August 2003 in the storage ring
- Cavity 2 – delivered mid-2004
  - Cavity 1 removed from SR to commission Cavity 2
  - Small leak to insulation vac – reinstalled Cavity 1

- Cavity 1 leak to UHV – January 2013
  - Reinstalled Cavity 2
  - Cavity 1 to RI for repair – 27 months
  - Leaks at RF pickup flanges
  - Cavity 2 needed significant conditioning – 6 months



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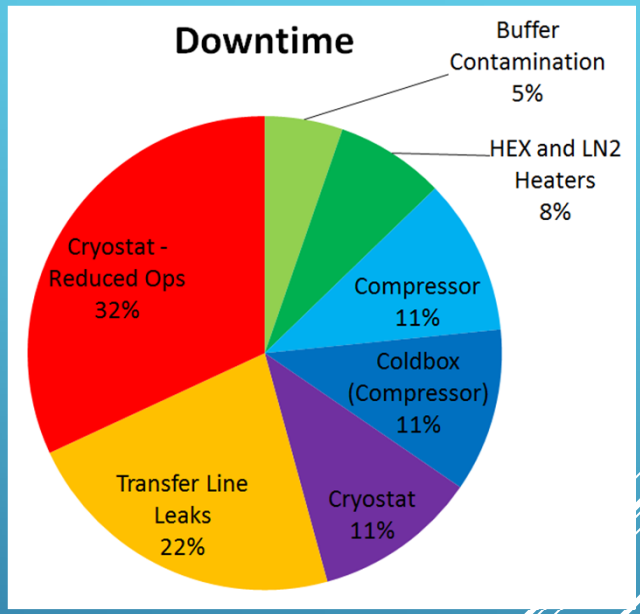
PAST PROBLEMS

- CLS is an "operating facility"
- Cryogenics at CLS is a "utility"
- SRF system has been generally reliable
- ~ 14 weeks of unplanned downtime
  - over a 13 year period
  - Continually striving for improvement



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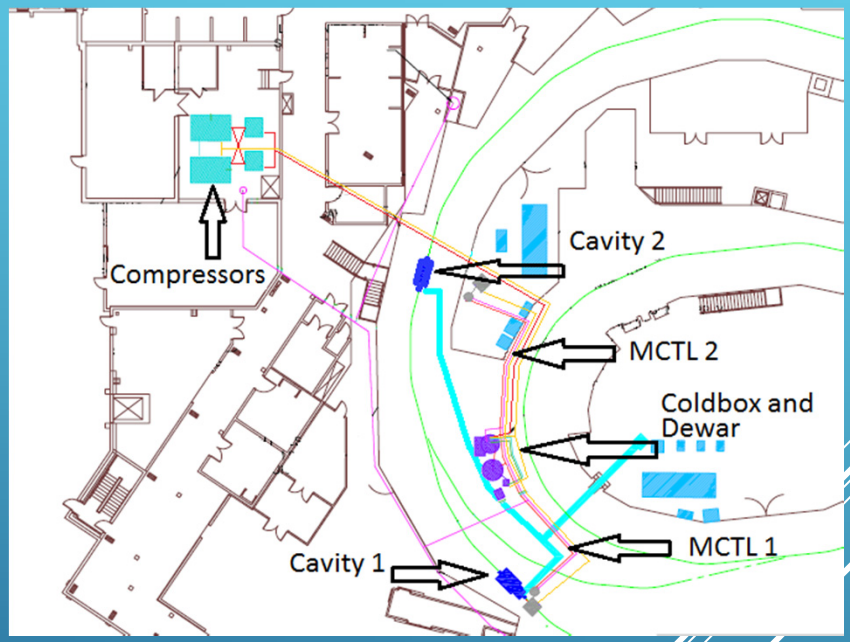
THE "CRYO UPGRADE"

- Add spare cavity to ring
  - 2nd compressor inline
  - 2nd ORS/GMP
  - Move coldbox and dewar
  - New MCTLs and valve boxes
  - CLS spare module installed in straight 2
  - LN2 phase separators & control



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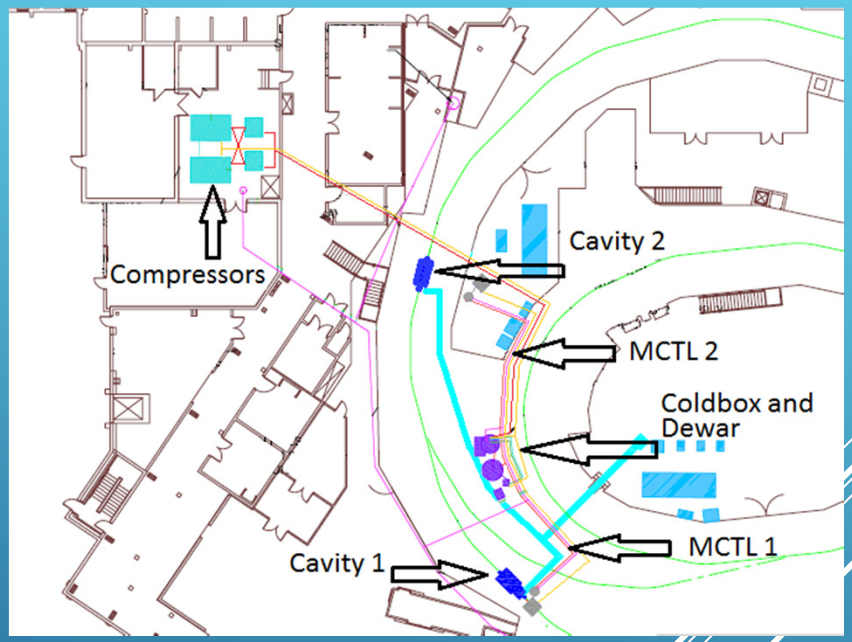
THE "CRYO UPGRADE"

- Advantages
  - Quick swap of compressors or ORS/GMP for maintenance or failure
  - Elevated dewar and coldbox
  - New shorter simpler MCTLs
  - CLS spare module installed in straight 2
  - LN2 phase separators & control



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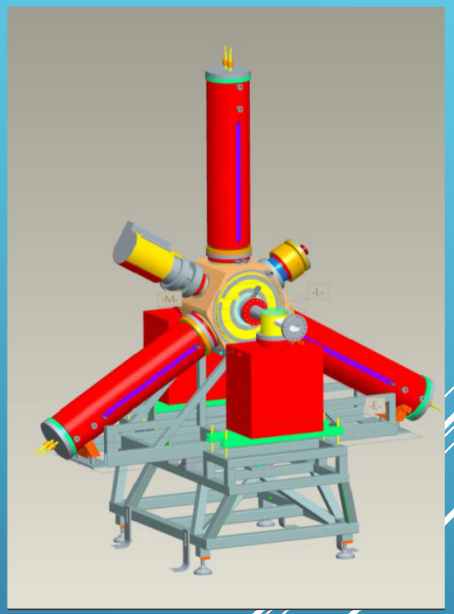
SUPERCONDUCTING VS. NORMAL-CONDUCTING

- Could we gain reliability by switching to a NC system
- Euro cavity (Alba, Bessy-II)
  - Better HOM damping than previous NC cavities
    - Still not as good as SC!
  - Easier to work on/repair
  - Lower voltage gradient – less arcing, multipactor etc.
- Decision: remain with SC
  - NC option very costly & time consuming
    - Cooling water upgrades, more RF transmitter power req'd
  - Longitudinal feedback required – complex system
  - The "devil you know" versus the "devil you don't"
- To reduce risk of failures SC would also require $$
- To become more self-reliant even more $$



Picture from: F. Perez et al. "New Developments for the RF System of the ALBA Storage Ring," *Proc. EPAC 2006*, Edinburgh, Scotland.

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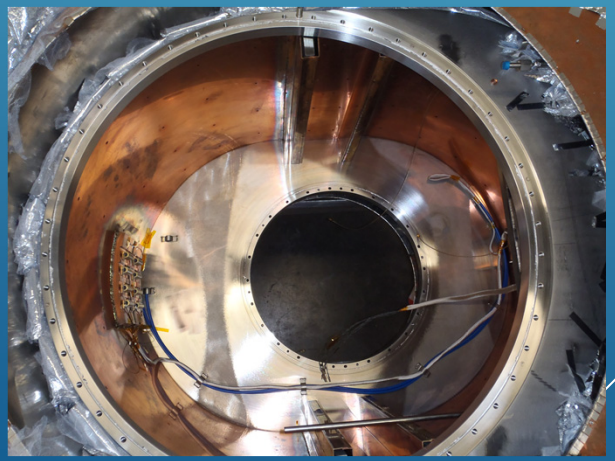
ANOTHER CESR-B FOR CLS

- Reduce risk due to double failure
  - Chance of double failure is statistically significant
    - Review of past failures indicates roughly 5-10% chance
    - Double failure upon installation with 27 month repair period = 27 months of downtime!
  - Risk of triple failure is considered acceptable
    - Roughly 0.25% to 1%



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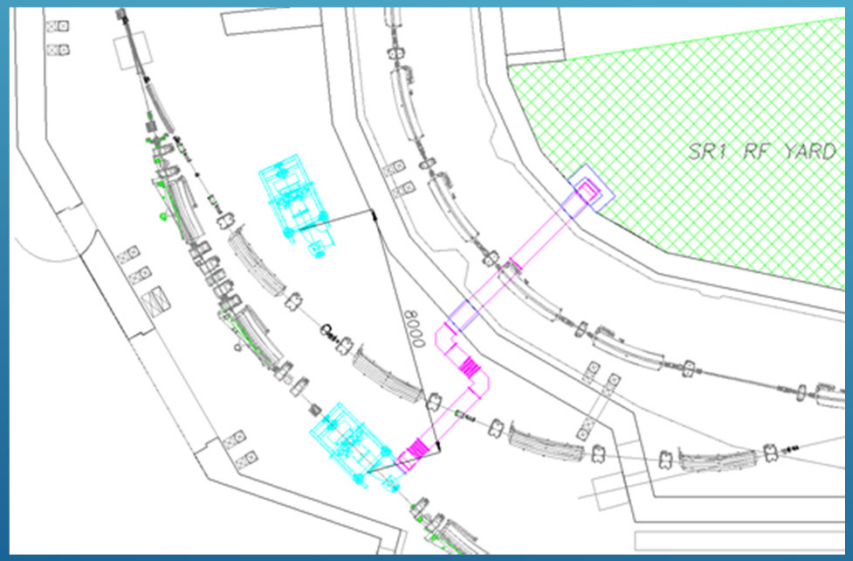
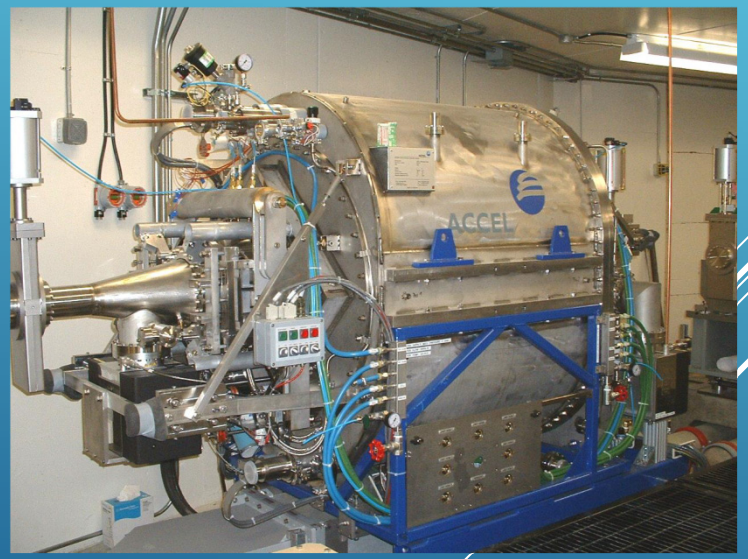
COLD RF TEST

- Connect spare cavity to cryo and instrumentation
  - Test RF and vacuum integrity when cold
  - Ensure it will function if required
  - Will occur during extended maintenance outage – Feb-Apr 2017





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QUESTIONS?