ILC EDR Kick-off Meeting

DESY, 19-21 September 2007

ILC and XFEL Cryomodules

Preliminary thoughts for convergence

Carlo Pagani
University of Milano
INFN Milano-LASA & GDE

Present XFEL/ILC Differences
Cryomodules: the Linac Building Blocks

- Cavity distance and Quadrupole length:
  - Just "2 parameters" in the 3 D model
- Quadrupole position:
  - In the XFEL is maintained because of the required effort.
- Number of cavities per module:
  - XFEL maintains 8, ILC has 9+8+9 in one cryounit
  - ILC numbers could be reviewed if beneficial ?
- Cavity ancillaries:
  - Couplers: same baseline
  - Tuner: 2 alternatives on baseline. It could easily converge
  - Magnetic shield: tuner dependent
- Module ancillaries:
  - vacuum, beam pipe HOM, BPM, diagnostics: they could converge easily at least in term of interfaces.

General Remarks

- The present XFEL cryomodule is very close to the present ILC baseline design. Both are derived by the TTF Type III.
- A part from few parametric details (cavity distance and quadrupole length), the 2 modules could be set almost identical, or at lest compatible (consistent interfaces)
- A possible joint effort to reinforce convergence, if agreed upon by the two Project Managements, would have a number of unequivocal benefits, mainly for the ILC, but for the XFEL too:
  - **Maintain a strong links between the two projects**
  - **Have XFEL as a large size ILC prototype**
  - **ILC cost saving by sharing the XFEL invaluable experience on**
    - industrialization and consequent cost saving
    - managing QA and QC with industry
    - effective cavity gradient and yield
    - reliability issues of major components
    - ……

Convergence Effort: Cryomodule -1

- Use a unique 3D reference design, as the parametric one being developed at Fermilab for Type IV, in a collaborative effort that include: DESY, INFN and KEK:
  1. **Cavity spacing can be a parameter**
     - TTF type cavity on both baselines from iris to iris
     - End group lengths according to the project, with coupler port fixed
     - Same cavity bellow interface
  2. **Quadrupole package length can be a parameter**
     - Quadrupole-BPM packages will be different in term of length and weight, but can be identical in term of major interfaces
  3. **Interfaces between components can to be the same:**
     - the same interfaces between cavity and cold mass
     - the same interfaces between quadrupole package and cold mass
     - equal coupler ports and cavity flanges (bolts and seal position)
     - The same relative position of pipe axis and pipe diameters
     - Post position moves, according to parameters in points 1 & 2
     - Vacuum Vessel flange position from the parameters in points 1 & 2

Convergence Effort: Cryomodule - 2

4. **Minor modified details can be re-equalized on the baselines**
   - TTF experience is excellent in term of cost and performances
   - Each detail modification should be documented and proved
   - If its effect turns out being justified in term of performances and cost, the detail modification should be included in the baseline.
   - Unjustified, unproved or just marginal detail modification should be avoided to maintain the value of a common design and experience
5. **Most of the linked documentation can be almost identical**
   - Material properties, production critical steps, etc.
   - QC and QA specification and required production documentation
   - Pressure vessel qualification (ASME should be good for all)
   - Vibration analysis (scaled as point 1)) and transportation issues

Major consequences for the two projects

- **XFEL should move the quadrupole in the center**
- **ILC should renounce to the 9 + 8 + 9 scheme**

Convergence on Cavity Ancillaries

- **Power coupler**: Baseline designs are convergent
- **Tuner** and Tuner dependent ancillaries: **Helium Vessel** and **Magnetic Shield:** Two are the possible scenarios:
  - **Standard Saclay-Tuner selected for XFEL**
    - System compatibility at the cavity interconnection and cold mass interface: cavity flanges, sliding pads, invar rod connection, etc.
  - **Blade Tuner is chosen for the XFEL**
    - Identical baseline cavity packages (apart beam tube length)

XFEL Tuner decision is expected in the next few months

- **Standard tuner with piezo installed in module # 6**
  - Successfully operated up to 35 with 2 subsequent pulses
  - Still some problem on assembly reproducibility (pizo pre-load)
- **Blade tuner with piezo (with SS) tested last week on Chechia**
  - Impressively good preliminary results at 23 MV/m with an adapted helium tank: 1 pulse, 1 piezo (40mm), 65 V (200 V available)
  - Some details to be set on the final version

Both close to final, **Cost considerations will be dominant**

Benefits for the ILC and the XFEL

Supposing for a moment that we were living in a ideal world and that the same convergent design were adopted both for the XFEL construction, and for the ILC baseline. I could expect:

A few positive consequences for the ILC:

- All the huge XFEL experience would be quotable for ILC
- Results from the ongoing R&D dedicated to performance improvement and cost cutting would have a well defined reference for comparison.
- Motivations for changes would be forced to be more justified.
- The best ideas and results would easily win

A few positive consequence for the XFEL

- Maintain the global SRF expert community behind the project
- Sustain a global interest behind the XFEL Technology success to consistently increase the success probability.