SCRF Infrastructure for ILC

EGDE Meeting

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Disclaimer

- This relies on my memory from my Ph.D. thesis at CERN
  - More recent information from CERN needed
- This is my opinion
    - Some discussion with colleagues
- … this might be politically incorrect ….

Overall Framework

- GDE Discussions
  - Effort needed
    - To make ILC-gradients more reproducible
      - Any step in Europe should be integrated in the larger R&D framework
    - Step toward a integrated systems test
      - At least the size of one RF unit, which determines the number of cavities to at least 30
    - To improve further knowledge transfer to industry
      - Large contribution of the XFEL
      - But: the XFEL will not have the time to explore all the parameter space (see below)
- FP7 preparation
  - A preparation for a bid should start now to avoid some late night working hours…
- Start discussion here

Primary goal:
Production of ILC prototype modules (4th generation) in Europe

- Scope
  - Should include all parts
    - Cavities
    - Couplers
    - Magnet
    - BPM
    - Cryostat vessel
  - Should include a next generation cavity preparation facility
  - Improve processes
  - Avoid bottlenecks

Production Goals ctd.

- Implementation:
  - Location
  - Makes sense to site this at existing TTF infrastructure here at DESY.
    - Additional manpower would be a pre-requisite
  - Alternatives:
    - CERN
    - Available (needs check):
      - 2K cryogenic-infrastructure
      - Vertical Teststands
      - Module Teststands (How many?)
      - Single-cell preparation infrastructure?
      - Surface science department in-house
      - Manpower ?
    - Needed
      - Infrastructure for multi-cells with redundancy
      - RF Power
    - Others ?
- Qualified manpower is a critical issue on all levels (engineers, technicians)
- How ‘free’ could this expertise be in 2008+?
- How much additional manpower could be made available?

Sketch of possible programme:

ILC Cryomodule Design

- Goals
  - 4th generation module
    - Quadrupole in the center
    - Shorter cavity spacing
  - Module assembly capability
  - Module testing capabilities
  - Prototyping of cryostat vessel in European industry
- Implementation:
  - Finish design work as collaboration of INFN and DESY
    - ILC design finished in 2007?
    - Collaboration with other partners ?
  - Assembly of modules
    - Need a cleanroom for string
      - » Could use refurbished CERN cleanroom in SM18
      - » could be at TTF?
  - Test facility without beam
    - Could refurbish CERN infrastructure in SM18
    - Could be extension to XFEL module test hall, then use single module test stand for ILC
  - If Beam test is needed somewhere (e.g. HOM damping), could be just a probe beam.

High-quality cavity production and preparation including full-power test

- Cavity design
  - Goals:
    - Compact with shortened beam tubes
    - Cavity shape options
      - Standard
      - Low-Loss
        - » full HOM design available now
  - Implementation
    - ILC LL complete design available soon
      - Design done at SLAC, DESY and others
- Material options
  - Goals:
    - Large-grain or single-crystal
    - Standard material
  - Implementation
    - Built 30 ILC-cavities and test

High quality cavity production ctd.

- Cavity preparation
  - Goals
    - Improve preparation process
      - Improve EP (is a must…)
      - Etching needed (e.g. outside cleaning)
      - Improve Final cleaning
      - High pressure rinse (HPR)
        - » Online particle count integrated in drain water line
      - Dry-ice cleaning?
        - » Needs feasibility demonstration
      - Cleaning of parts
        - » Automation needed: screws used as example
      - Improved/novel methods of QA/QC
  - Implementation
    - Setup of new infrastructure
      - » DESY: Independent of TTF
      - » CERN: partial refurbishment might be an option
      - Modular setup
        - » Institutes get responsibility for part of the process (HPR design, EP design etc.)
      - Redundant setup
        - » 2 x EP,
        - » 2 x HPR,
        - » 2-3 120 °C bakeout stations
      - designated 800°C furnace
      - Sufficient pump stations, etc.

High quality cavity program ctd.

- Cavity testing capabilities
  - Goals :
    - Low-power and high-power individual cavity tests
  - Implementation
    - DESY: Extension of XFEL infrastructure or use TTF
    - CERN: Make SM18 1.3GHz compatible
      - Minor work cryostats
      - Improve pumps for 2K ?
      - RF system esp. for Pulsed operation
        - » obtain MBK from America

Cavity auxiliaries

- ***TTF-III coupler***
  - **Goals**
    - Lower cost
    - Even faster processing
  - **Implementation**
    - Continue work at LAL Orsay
    - Full synergy with XFEL
- ***Compact Tuner design***
  - **Goals**
    - Develop compact tuner
    - Including fast tuning (e.g Piezo)
  - **Implementation**
    - Blade tuner at INFN
    - Compact lateral tuner at Saclay ? – needs confirmation

ILC magnet design

- **Goals**
  - Full design to ILC specs
  - Follow discussions on ILC issues
- **Implementation**
  - Continue work with CIEMAT
  - Acquire magnets in America?

ILC BPM design

- **Goals**
  - More compact re-entrant
  - Eventually integrated (closely attached) to quadrupole
- **Implementation**
  - Basic layout XFEL-like ?
    - Resolution sufficient ?
    - Continue CEA work
    - Need compact design

CERN Infrastructure (My guesses…): Cleanrooms

- LEP Module Cleanroom in SM18
  - Horizontal flow
    - Pre-assy Class 10000
      - 15m x 4m
    - Class 10-100:
      - 15m x 4m
  - Mobile laminar flow available
    - Smaller area for parts cleaning
- Cleanroom 252
  - Class 100 or better
  - 10mx5m
  - Pre-clean:3mx5m
- Small cleanrooms
  - Coupler assy

CERN infrastructure: Cryo Infrastructure in SM18

- Cryo Power:
  - 6 kW at 4.5K, 32 g/s liquid He
  - 2 kW at 1.8K, 12 g/s liquid
    - Pumping could be modified up to 20 g/s
- Vertical testing
  - 4 positions
    - 2 installed (4.5m height, 1m diameter)
      - 2 in stock
    - 2 installed (2.5m height 1m diameter)
- Module testing
  - 2 bunker for modules
  - 2 klystrons (with 352 and 400 MHz respectively)

CERN Infrastructures: Chemistry

- Búilding 118
  - Prepare LHC vacuum chambers
  - Chemistry
    - LEP infrastructure for etch exists
  - Small cleanroom
    - Glovebox?
  - Pure water rinse
    - 6 bar in lam. Flow class 100
  - HPR
    - 100 (-200) bar
    - Portable?
    - Valves

Time scales:

- >2008
  - Time scale would have this infrastructure running parallel to XFEL cryomodule production, which could provide ‘mass production’ feedback for foreseen ILC programme.
  - some of the design work will be done until end 2007 by ILC worldwide
  - setting up of preparation infrastructure is most time-consuming
    - if parts of TTF infrastructure can be used the cavity preparation can be started earlier
    - at CERN the adaptation of the infrastructure needs to be cross-checked but should be rather straight-forward

Money Scales (Warning: My Guess!)

- potential amount 30 MEUR (greenfield site)
  - Collaborations will probably still require to support 50% of the activities.
  - Budget would be allocated for
    - New cryostat vessels
      - Up to 3 modules 6 MEUR
    - new cavities (>30)
    - auxiliaries
    - new infrastructure
      - RF 2 MEUR
      - Cryo
        - » Plant 5 MEUR
        - » Cryostats +low-power RF 5 MEUR
      - Cleanroom (min.2 HDs) 4 MEUR
        - » Assembly tooling 1 MEUR
      - Chemistry 3,5 MEUR
        - » EP (2 benches)
        - » Etching
      - Furnace min.800°C 1 MEUR
        - » Extras 5 MEUR
      - manpower (new people)

And Now For Discussion…

- I see two possibilities for such a facility
  - CERN refurbishment
  - DESY would need new construction and significant manpower
    - Cavity testing might start earlier by using existing facilities
- A participation by collaborating insitutes are hardware (e.g. EP system) or people
  - Any takers?