ILCTA plans and opportunities

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ILC Cryomodule

Cryomodules are complex

- 8 or 9 Cavities, ultra clean surfaces
- Operate in 2K superfluid He
- Quad Focusing magnets
- Couplers feed RF energy to cavities
- Tuners adjust cavity resonant frequency to match klystron
- 1200 parts !

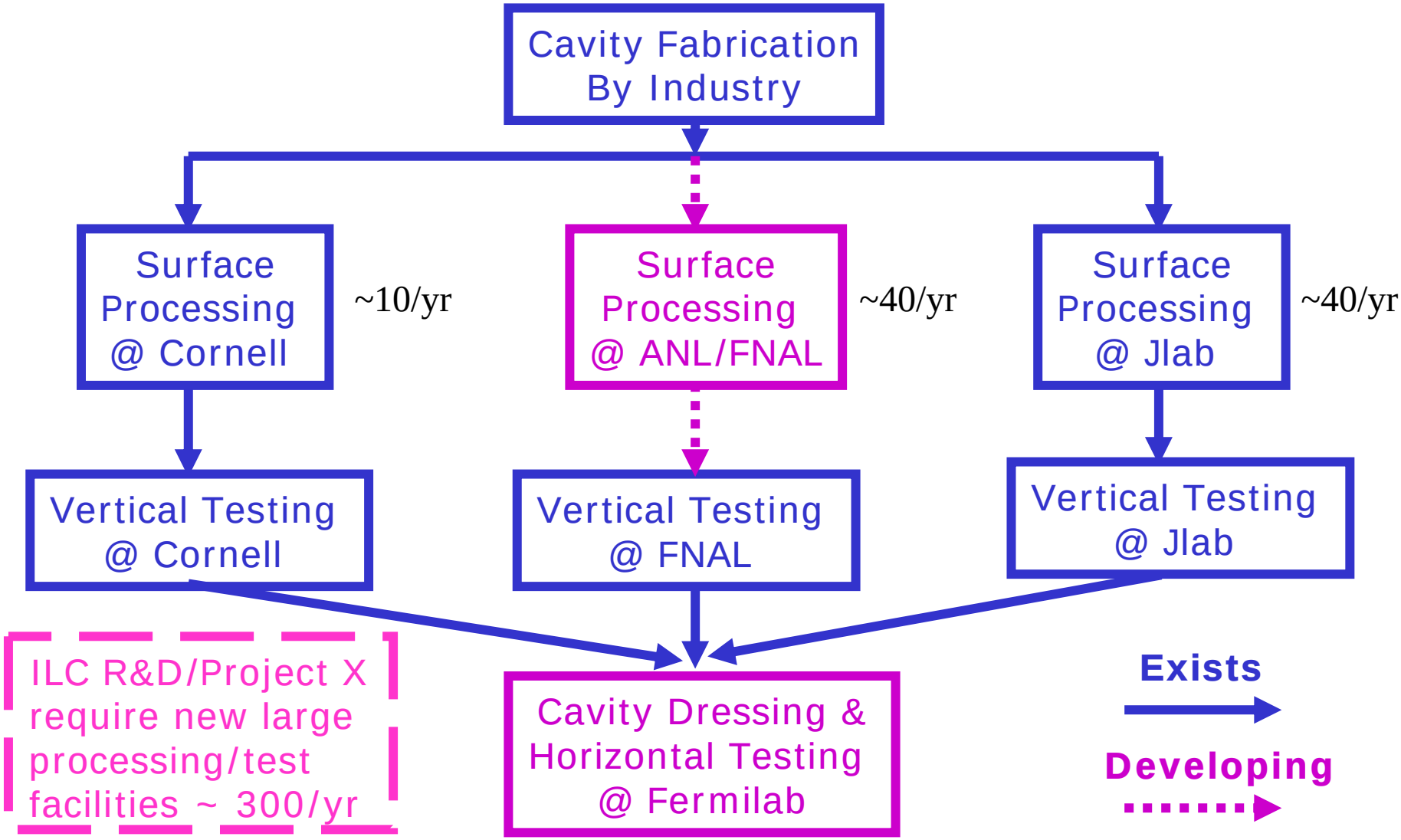
Cryomodules are expensive

- Single most expensive component of the ILC
  - About 2000 are needed for the ILC, 40 for Project X
- FNAL leads an international team working to improve the TESLA CM design for ILC (DESY, INFN, KEK, CERN, SLAC, India, etc
- ILC must industrialize cavities, components, & maybe assembly
- Developing the extensive infrastructure to build and test CM's

SCRF Infrastructure

- Bare cavities
  - Fabrication facilities (Electron beam welder, QC, etc)
  - Surface treatment facilities BCP & Electro-polish facilities (EP)
  - Ultra clean H_2O & High Pressure Rinse systems
  - Vertical Test facilities (Cryogenics + low power RF)
- Cavity Dressing Facilities (cryostat, tuner, coupler)
  - Class 10/100 clean room
  - Horizontal Test System (cryogenics and pulsed RF power)
- Cryomodule Assembly Facilities
  - Large class 10/100 clean rooms, Large fixtures
- Cryo-module test facilities
  - Cryogenics, pulsed RF power, LLRF, controls, shielding, etc.
  - Beam tests ➔ electron source (RF unit test facilities)
- In 2005 FNAL/ANL began building this infrastructure

U.S. Cavity Processing & Test



FNAL/ANL SRF infrastructure for ILC cryomodules

- Cavity Surface Processing (ANL)
  - Joint electro-polish facility at ANL
- Vertical Test Stand: (FNAL)
  - Tests "bare" cavities
- Horizontal test stand (FNAL)
- Cryomodule Assembly areas (FNAL)
  - 1st ILC like cryomodule (being assembled)
  - 3.9 GHz cryomodule under assembly for DESY
- RF Unit Test Facility (FNAL)
  - ILC-like beam to test full RF units

ILC vs Project X SRF Goals

ILC

- Demonstrate the baseline ILC Main Linac technology
  - GDE S0: Cavity gradient of 35 MV/m; good yield
  - GDE S1: Cryomodules with average gradient > 31.5 MV/m
  - GDE S2: One or more ILC rf unit with ILC beam parameters
- Reduce cost
- Key issue is variability in cavity performance

FNAL/ANL

- Develop expertise in SRF technology
  - Train staff: Command of the technology for ILC
  - Collaborate with U.S. & International ILC partners
  - Transfer SRF technology to industry
- Build SRF Infrastructure to support these activities
- Construction of Project X supports these goals

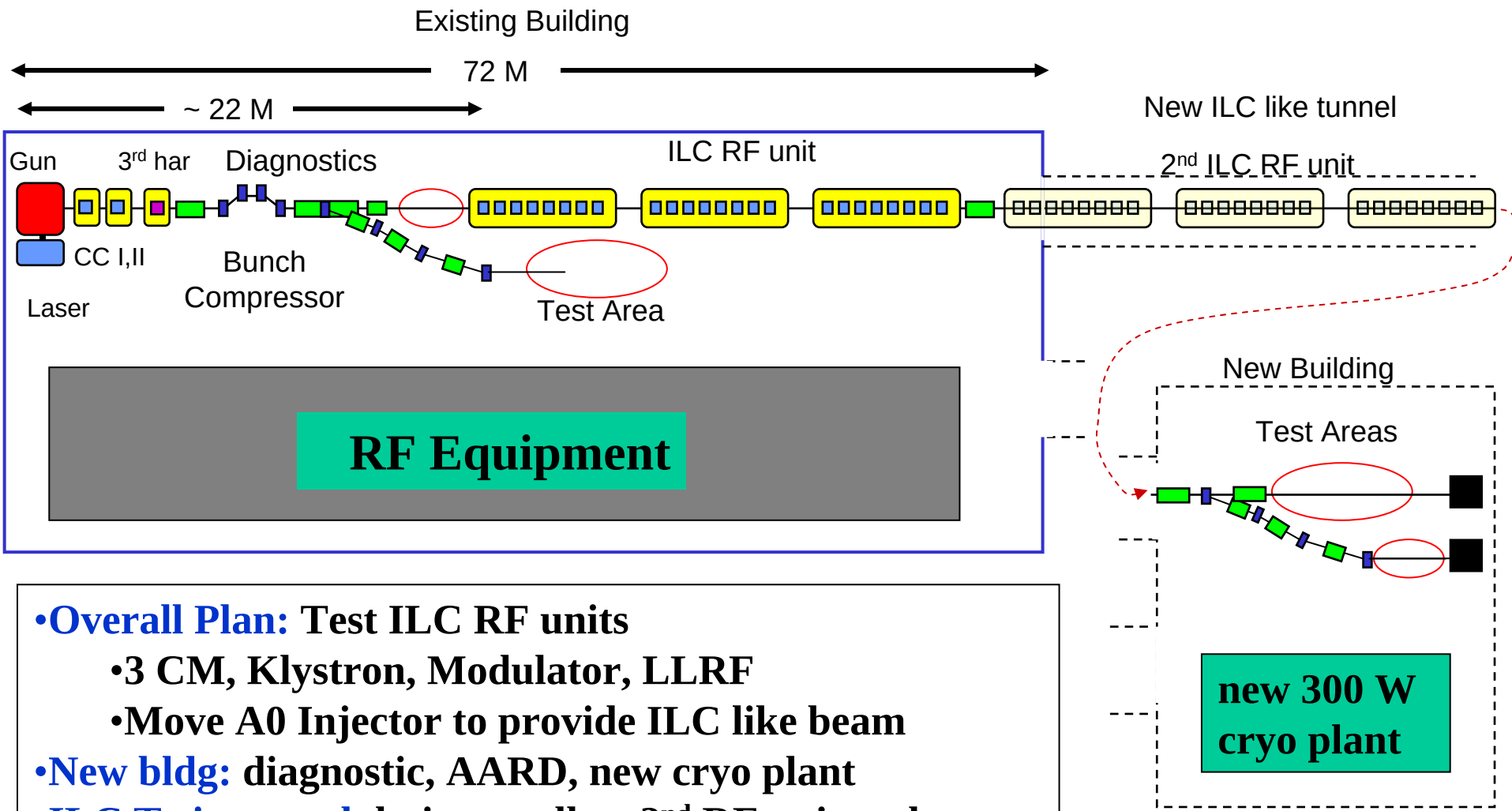
Scope of ILC/SRF R&D prgm

- Technically achievable ILC CM production schedule

	FY07	FY08	FY09	FY10	FY11	FY12
CM	1	1	2	4	8	12

- Goal is to improve process and demonstrate achievable gradient for ILC
- Scale needed for Project X: 12 CM/year

RF Unit Test Facility

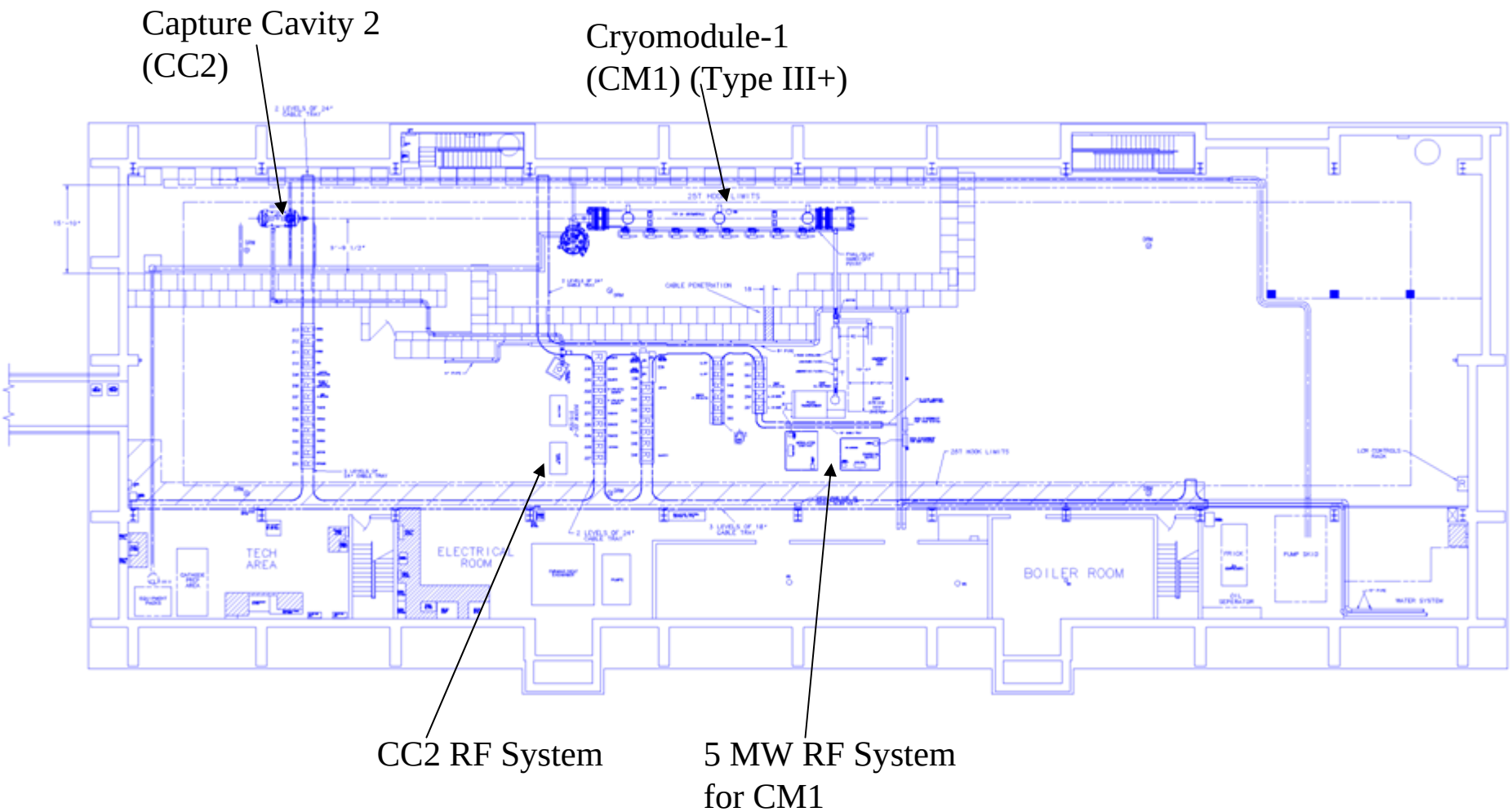


- **Overall Plan:** Test ILC RF units
  - 3 CM, Klystron, Modulator, LLRF
  - Move A0 Injector to provide ILC like beam
- **New bldg:** diagnostic, AARD, new cryo plant
- **ILC Twin tunnel** design to allow 2nd RF unit and to study tunnel layout and maintenance issues

Cryomodule testing with beam

- Overall Plan
  - Build an ILC RF Unit Test Facility at New Muon Lab Building (NML)
    - One ILC RF Unit (3 Cryomodules)
    - 10-MW RF System
    - ILC-like Beam (3.2 nC/bunch @3 MHz, Up to 3000 bunches @ 5Hz, 300-μm rms bunch length)
- Phase-1 (FY07 - FY08)
  - Prepare Facility for Testing of First Cryomodule (CM1) without Beam
    - Infrastructure; RF Power; Cryogenics (Refrigerator #1)
- Phase-2 & 3 (FY08 - FY11)
  - Install Gun, Injector, CM2 and CM3, Test with Beam
    - New RF Gun
    - Move A0 Photo-Injector to NML and Install Test Beamlines
    - Extend Building to fit Third Cryomodule
    - Cryogenics (Refrigerator #2 and New Cryoplant-300W)
    - Upgrade RF System to 10 MW

Phase-1 Layout



Summary

- FNAL/ANL are developing infrastructure and expertise, which will be useful for FRIB, ALS upgrade, ILC and ProjectX
- Opportunities for collaboration in the area of ILC/SCRF R&D
- The question is how to organize these collaborations