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# Americas Regional Team Activities

G. Dugan

ILC/GDE and Cornell University

**LINEAR COLLIDER FORUM OF AMERICA**
**SLAC MEETING MAY 1-2**

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# Outline

- GDE Mission
- Organization of the Americas Regional Team
  - MoU process; FY06 budgets
- FY06 ILC R&D program highlights
- Outlook for FY07 and beyond
- Conclusion

# The Global Design Effort
## Mission

- Produce a design for the ILC that includes a detailed design concept, performance assessments, reliable international costing, an industrialization plan, and a siting analysis, as well as detector concepts and scope.
- Coordinate worldwide prioritized proposal driven R & D efforts (to demonstrate and improve the performance, reduce the costs, attain the required reliability, etc.)

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# ILC Program Execution

In the Americas region, the ILC program (the RDR effort, and supporting ILC R&D), is executed by the Americas Regional Team, under the co-ordination of the GDE

## ILC-Americas Regional Team Leaders

**ANL**-Kwang-Je Kim

**BNL**-Mike Harrison

**Fermilab**-Bob Kephart, Shekar Mishra, Sergei Nagaitsev

**Cornell LEPP-** Hasan Padamsee, Mark Palmer

**Jefferson Lab** -Swapan Chattopadahay, Warren Funk

**LLNL** -Jeff Gronberg

**LBNL** -Mike Zisman, Christine Celata

**SLAC** -Tor Raubenheimer, Nan Phinney, Tom Himel

**TRIUMF** - Shane Koscielniak

**Universities-** Project Leaders

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# Organization of the ILC-Americas Program

- The work is broken down into a series of technically-based work packages.
- GDE and each DoE lab sign MoU's detailing the co-operative arrangement for the execution of work packages at each lab.
- Yearly scope of work is spelled out in Addenda to the MoU, which detail the work packages.
- For university R&D work, each university project is a work package.
- Labs report financial status at the work package level quarterly, and technical status semi-annually.
- About 100 work packages for FY06 are organized into a WBS.
- The list of work packages, and associated resources, as well as the MOU Addenda, are posted on the ILC-Americas web site:
  https://wiki.lepp.cornell.edu/ilc/bin/view/Public/Americas/WebHome

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# FY06 budgets: Breakdown by Machine Area

| MACHINE AREA | FTE | DOE FY06 M&S Direct | DOE FY06 Total Total | NSF FY06 |
|---|---|---|---|---|
| Program direction and administration | 9.50 | $766 | $3,006 | $326 |
| Management | 4.10 | $100 | $761 | $0 |
| Global systems | 4.47 | $519 | $1,158 | $0 |
| Electron sources | 3.35 | $100 | $658 | $0 |
| Positron sources | 10.32 | $159 | $1,988 | $0 |
| Damping rings | 9.63 | $509 | $2,135 | $0 |
| Bunch compressor | 1.30 | $0 | $214 | $0 |
| Main Linacs: Optics, beam dynamics, instrumentation | 5.74 | $75 | $988 | $0 |
| Main Linacs: RF systems | 16.84 | $1,451 | $4,410 | $0 |
| Main Linacs: Cavities and Cryomodules | 16.90 | $3,961 | $7,380 | $242 |
| Beam delivery system | 14.38 | $376 | $2,796 | $0 |
| Conventional facilities | 2.69 | $519 | $1,039 | $0 |
| Technical Systems | 0.00 | $590 | $870 | $0 |
| Reserve | | | $2,437 | |
| | **99.23** | **$9,126** | **$29,841** | **$568** |

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# FY06 budgets: Breakdown by Laboratory

| Lab / Univ | FTE | DOE FY06 M&S Direct | DOE FY06 Total Total | NSF FY06 |
|---|---|---|---|---|
| SLAC | 56.18 | $2,683 | $12,300 | $0 |
| FNAL | 30.00 | $6,046 | $12,600 | $0 |
| ANL | 3.40 | $27 | $300 | $0 |
| Jlab | 1.00 | $136 | $400 | $0 |
| Jlab (FNAL MOU) | | $600 | $600 | $0 |
| LLNL | 2.25 | $180 | $1,000 | $0 |
| LLNL (SLAC MOU) | 0.42 | $50 | $200 | $0 |
| LBNL | 2.48 | $30 | $500 | $0 |
| BNL | 3.50 | $25 | $600 | $0 |
| Cornell (FNAL MOU) | | $165 | $165 | $0 |
| UNIV | 0.00 | $0 | $280 | $568 |
| DOE/GDE | | | $1,860 | $0 |
| **sum** | **99.23** | **$9,126** | **$29,841** | **$568** |

Most labs are also putting additional funds into ILC R&D. For example, Fermilab is devoting an additional ~$12 M to developing SCRF infrastructure.

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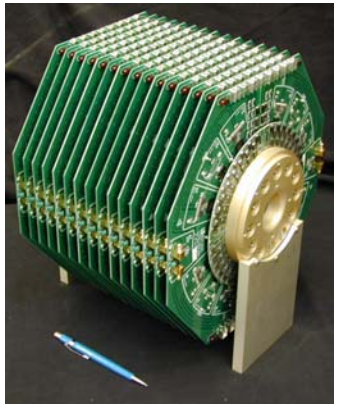
# ILC-Americas University FY05 R&D Program

- SCRF materials and surface preparation: Wisconsin ($64K), Northwestern($40K), Old Dominion ($58K)
- RF power sources: Yale ($60K), MIT($30K)
- Polarized electron source: Wisconsin ($35K)
- Polarized positron source: Tennessee ($40K), Princeton
- Damping rings: Illinois ($17K), Cornell ($75K, $46K) **[NSF]**
- Instrumentation, diagnostics: Berkeley ($35K), Cornell ($24K) **[NSF]**
- Mover systems: Colorado State ($49K) **[NSF]**
- Radiation hard electronics: UC Davis ($38K), Ohio State ($75K)
- Ground motion: Northwestern ($28K)
- Linac beam dynamics design-Cornell ($21K)
- High-gradient SCRF R&D- Cornell ($140K) **[NSF]**

# Global Systems

- System availability studies (SLAC)
- Design of high availability hardware (SLAC, LLNL)
  - Kickers, Power supplies, diagnostics, and control system

**Fast (redundant) kicker for DR**



- General control system design (ANL, Fermilab, SLAC)

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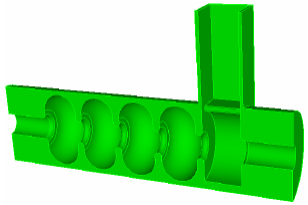
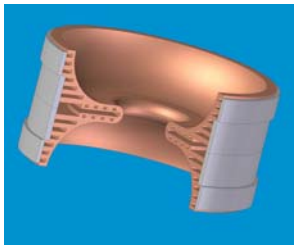
# Sources

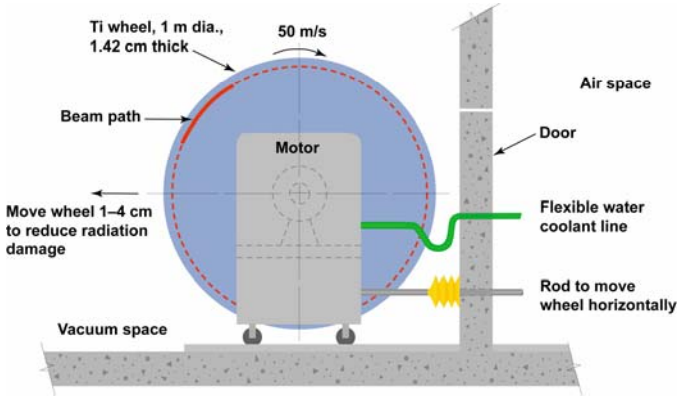
- Laser and cathode for polarized electron source (SLAC)
- NC structures: design and test (SLAC)





**Positron capture structures**

- Undulator design, E166 (SLAC, Cornell)
- Positron Source simulations (ANL)
  - A comprehensive start-to-end simulation of conventional, polarized, and keep-alive sources.
- Positron target design (LLNL)
  - Detailed engineering
  - Target simulations
    - Energy deposition
    - radiation damage, activation



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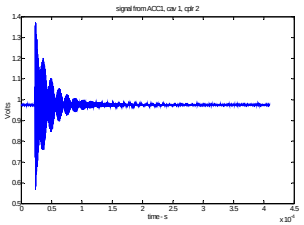
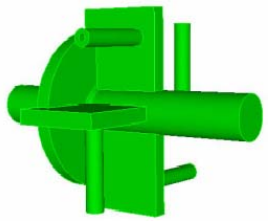
# Damping rings

- Damping ring component optimization (Cornell)
  - wigglers, fast kickers;
  - studies of the use of CESR as an ILC positron damping ring test facility (in 2008)
- Damping Ring Design and Optimization (ANL)
  - Lattice design and optimization
  - particle tracking for single-bunch instabilities with 3-D wakefields
  - studies of the fast ion instability in the APS ring
  - design of a hybrid wiggler
- SEY studies in PEP-II (SLAC)
- ATF damping ring experiments (SLAC, LBNL, Cornell)
- Damping ring studies (LBNL)
  - Lattice designs for damping rings and injection/extraction lines
  - characterization of some collective effects, including space-charge, IBS and microwave instability;
  - physics design of stripline kickers for single-bunch extraction at KEK-ATF

- RTML design (SLAC, Cornell)
- Main linac optics design (SLAC, Fermilab)
- Low emittance transport simulations and BBA design (SLAC, Fermilab, Cornell)
- Wakefield calculations (SLAC)
- Linac beamline Instrumentation (SLAC)



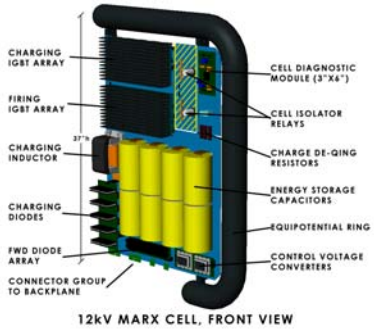
**TTF HOM Signal 800 monitors installed**



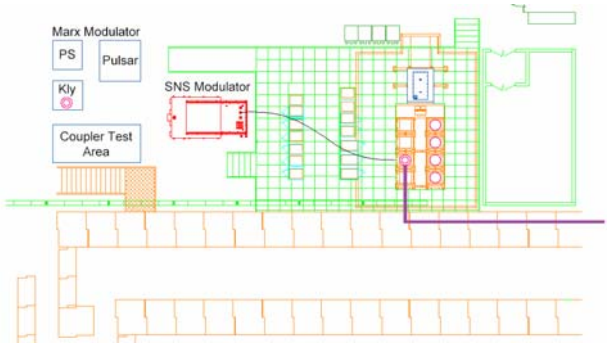
**RF BPM for linac**

# Main Linac RF sources

- Linac rf sources (SLAC, LLNL)
  Marx generator modulator




  - SLAC End Station B (RF Test Fac.)
    - Develop 5 MW station in FY06, and 10 MW station later
      - Test rf system components
      - Reuses extensive infrastructure




  - Coupler Test Stand (LLNL)
    - Evaluation and analysis of RF coupler designs
  - Linac SC quad and BPM (SLAC)
    - Studies of magnetic center stability with excitation

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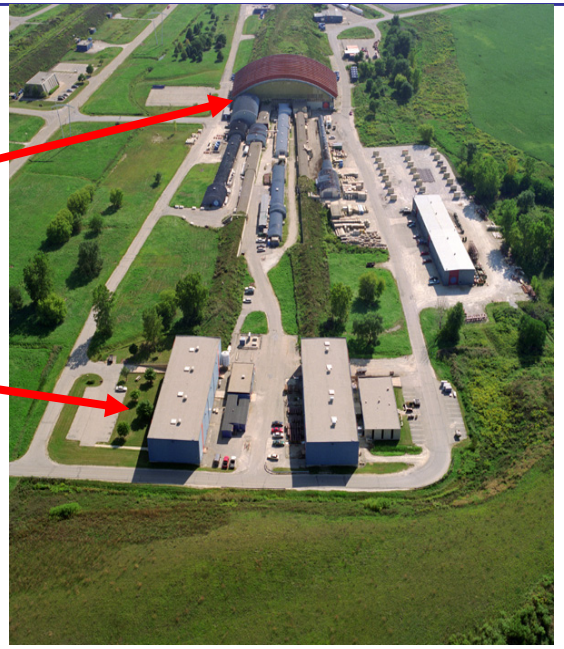
# ILC Cavities and test facilities

Joint ANL/FNAL BCP/EP Facility

Meson Detector Building (MDB)

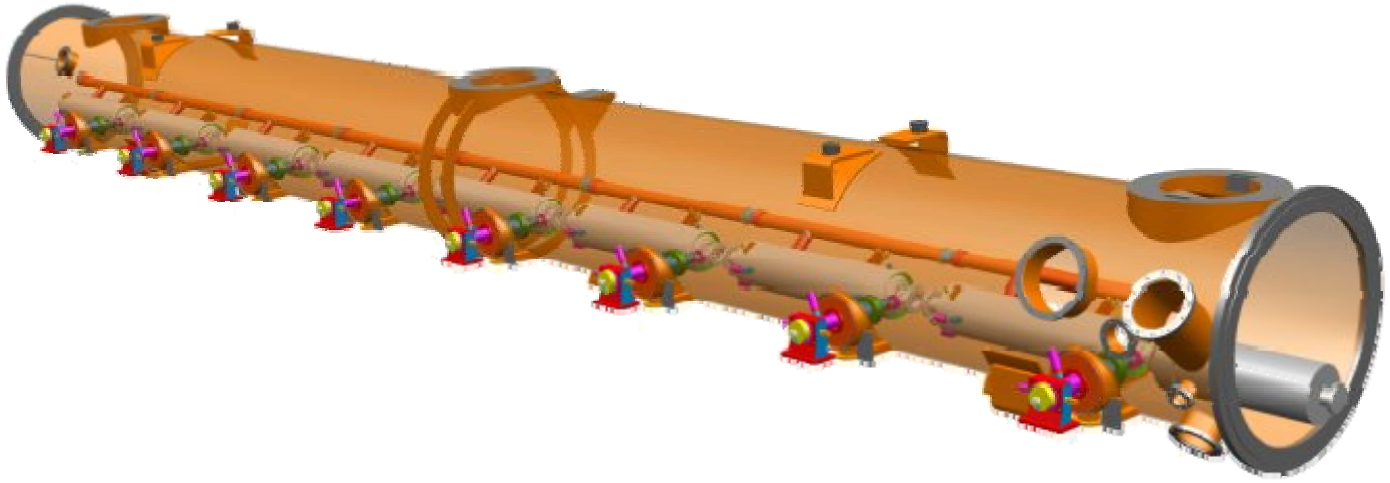
TD MP9 Cryomodule Assembly Facility (CAF)



- Industrial fabrication of cavities (12 cavities in FY06) (FNAL)
- BCP and vertical testing (FNAL, Cornell)
- EP process development and vertical testing (FNAL, Jlab).
- Joint BCP/EP facility being developed at ANL (late 06-07)
- Horizontal test facility @ FNAL (ILCTA-MDB) (complete Fall 06)
- Vertical test facility under development @ FNAL (ILCTA-IB1) (complete 07)

# Cryomodule Design

- In FY05 Fermilab started on converting drawings of the DESY/INFN design of the ILC cryomodule (Type-III+) to US standards for U.S. vendor fabrication and for cost reduction studies.
- IN FY06, as part of a co-ordinated global effort, design has started for an improved ILC cryomodule (Type-IV).



# Cryomodule string test: ILCTA-NML at Fermilab



Building a dedicated ILC cryomodule string test facility in the New Muon Lab

- Building is cleaned out except for removal of CCM ( in progress)
- Started to install cryogenic system-complete in FY07
- Move FNPL Photo-injector to provide electron beam (FY07)
- Upgraded FNPL will provide beam tests of ILC cryomodules (FY08 and 09)

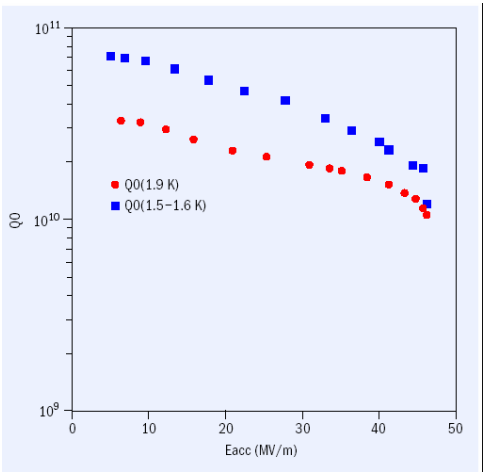
# High gradient cavity R&D

## Jlab: Fabricate, process and test cavities from large-grain/single-crystal material)

- Objectives (not a complete list):
  - Several single cell and at least one multi-cell cavity made from large grain/single crystal niobium and BCP processed.
  - Test cavity for superconducting rf joint investigations;
  - Two cavities suitable to be combined into a superstructure

## Cornell: ILC high-gradient SCRF cavities

- Re-entrant Cavity Shape:
  - 47 MV/m at Cornell…Later 52 MV/m at KEK
  - 9-cell re-entrant cavity ordered from AES



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# Beam Delivery System

- Beam delivery system design (SLAC)
- ATF-2 (SLAC)
  - Construction of magnets, PS, and instrumentation
- ESA MDI Test Facility (SLAC)
- NanoBPM for ATF2 (LLNL)
- ILC Final Focus Magnet Development (BNL)
  - Continue to support the baseline design efforts, and the development of the Conceptual Design/Cost Estimate for the Beam Delivery System
  - Fabricate and test a short proof of principle shielded final-focus-like quadrupole coil
  - Fabricate and test a short proof of principle sextupole/octupole corrector-like coil

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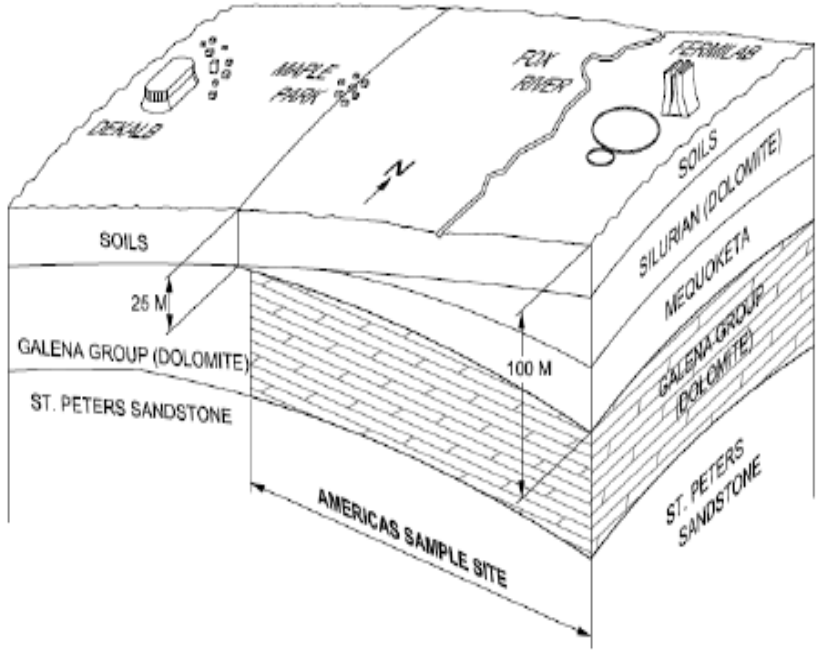
# ILC Civil Design for the RDR

- Design to “sample sites” from each region
  - Americas – near Fermilab
  - Japan
  - Europe – CERN & DESY
- Americas Site - in Illinois– location may vary from the Fermilab site west to near DeKalb
- Design efforts ongoing at Fermilab and SLAC

**Americas Sample Plan / Section**



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# Potential TRIUMF Accelerator R&D Resources for ILC

The specific nature of Canadian involvement is under development. Some potential collaboration areas have been identified, along with relevant LHC experience:

- Kicker magnets, associated pulse-forming networks, and fast switches
- Precision room temperature magnet systems
- Beam instrumentation and readout systems
- Beam dynamics & lattice calculations for damping rings.
- Remote handling design/consulting of positron source target stations
- Peripheral aspects of SCRF., such as cryogenic coolant distribution system, design/consulting, small quantity e-beam welding of niobium
- Vibration control systems, alignment of components for the final focus system, and abort system kickers

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# FY07 outlook

- PB ~doubles ILC program budget to $60M (This includes  ILC detector R&D at labs and universities)
- However, the requested (“technically limited”) program (~$100 M) exceeds the available funding. A process of prioritization will be required.
- This process should look to GDE for guidance on priorities. Advice will be sought from GDE R&D Board for general ILC R&D efforts, and from the Linear Collider Steering Group for the Americas (LCSGA) for technical R&D in support of the US regional interest .
- First steps: document FY07 lab program requests (ongoing); Regional team meeting to discuss FY07 requests and future plans (May 3-4, SLAC)

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# FY07 ILC program request

- TDR engineering efforts
- Cavity and cryomodule work
- RF system development
- Sources, Damping rings, beam delivery
- Global systems
- Technical R&D in support of the US regional interest (“bid-to-host”: proposal to be developed by Osaki panel, formed under the auspices of the LCSGA)

# Cavities, cryomodules and related test infrastructure

- Fabricate (in industry) and process (at labs) 12 more ILC high-gradient cavities; continue R&D on large-grain and high-gradient cavities.
- Continue R&D on EP processing, field emission/dark current issues, thin film systems; develop EP facility at ANL.
- Horizontally test 10 cavities at Fermilab.
- Build first US-built cryomodule and receive parts for 2nd cryomodule (to be built in FY08).
- Complete design of Type IV (ILC-style) cryomodule.
- Complete vertical test facility, and second horizontal test facility, at Fermilab (IB1).
- Install cryogenic systems support for cryomodule tests in Fermilab's ILCTA-NML.
- Upgrade and move Fermilab photoinjector to ILCTA-NML.
- Purchase 10 MW klystron and another bouncer modulator for ILCTA-NML at Fermilab

# Main Linac RF systems

- Continue development of Marx modulator, and evaluation of DTI and SNS modulators: downselect modulator choice by end of FY07.
- Purchase two 10 MW klystrons from CPI and Toshiba. Contract with CPI to develop a high-efficiency 5 MW klystron. Fabricate two sheet-beam klystron prototypes, following SLAC design (split funding in FY07 and FY08). Goal is klystron choice by end of FY08.
- Investigate cost reduction options for RF distribution system and couplers.
- Continue development of LLRF systems

# Technical R&D in support of the US regional interest

*These "placeholders" to be reviewed by Osaki panel charged with developing a plan for technical R&D in support of the US regional interest*

## *Civil design*

- Begin design studies to fully develop an expression of interest for an Americas site for the ILC

## *Industrialization*

- Initiate procurements for the fabrication of the first of three complete RF units (cavities, cryomodules, RF system components) by industrial firms in the Americas. Cavity processing and cryomodule assembly would use existing lab infrastructure.

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# Conclusions

- In the Americas region, the Americas Regional Team is playing a major role in the development of the ILC RDR and cost estimate.
- A vigorous R&D program, in support of the GDE goals, is underway in FY06 at national labs and universities throughout the Americas region.
- Next year, as the project enters the TDR phase, a significant increase in resources will allow development of the TDR, expansion of the R&D program, and the start of technical R&D in support of the US regional interest.
- The requested resources for an FY07 technically limited program exceed those expected to be available. A process of prioritization is just getting started.
- Challenges remain in completion of the RDR and cost estimate this year, in cavity processing and klystron R&D, and in effective co-ordination of the regional R&D programs.