

ILC ACCELERATOR AND DETECTOR TECHNOLOGY IN INDUSTRY

SUPERCONDUCTING PARTICLE ACCELERATOR FORUM OF AMERICA

KENNETH O. OLSEN

June 12, 2013



Presentation Outline

- Overview of the accelerator industry
- US Industrial forum for superconducting accelerator technology
- Americas region accelerator and detector collaborations
- Industry perspective and issues on the potential ILC market
- Future SC accelerator markets

Accelerator Industry Segments

“Low Energy” Commercial applications:

- Ion and e-beam accelerators for industrial processes
- Medical, security and defense

Advanced “High Power” Accelerators

- Discovery science and R&D facilities
- RF technology machines, some SC

Commercial Applications

- Technology evolved from laboratories to industry over several decades
- Mature and growing market and applications (30000-40000 in use world-wide)
- Relative low energy (75 KeV- 20MeV)
- Examples: ion implantation, food irradiation, sterilization, e-beam welding, environmental waste treatment

Medical and Defense

- Disease treatment
- Radionuclide production
- Wide energy range 1- 250 MeV, SC cyclotron applications deployed
- Weapon systems, i.e. missile countermeasures

Advanced “High Power” Accelerators

- High tech components and systems: SC cavities, magnets, klystrons, power couplers
- Government market
- Major projects spaced years apart
- Higher technology risks
- Component performance improvement thru joint lab/industry collaborations

Two Facets of the Accelerator Industry

“Low” Energy (Commercial Customers)

- Evolutionary market
- 10% annual growth
- >10,000 in 1992; >30,000 now
- >6,000 in medical applications
- Multiple suppliers for major market segments

A few
companies
are in both
facets

“High” Energy (Government Customers)

- Each facility different design
- Gov’t, university and industry users
- SC technology showing dominance
- ILC technologies mainly here
- No near term significant commercial market

US Industrial Forum

- Linear Collider Forum of America formed in 2005: not-for-profit 501 (c) 6 forum to support industrial participation within Americas region during ILC R&D.
- Modified mission to Superconducting Particle Accelerator Forum of America (SPAFOA) in 2008 to support all SC accelerator technology projects in the US.
- Currently 25 members covering SC cavities, cryogenic plants and components, high performance magnets, pressure vessels, klystrons, instrumentation, A&E and CM.
- Members located in 14 states and DC
- Represent industry as a group focused on SC accelerator market
- Totally financed by membership dues, no Federal funding.



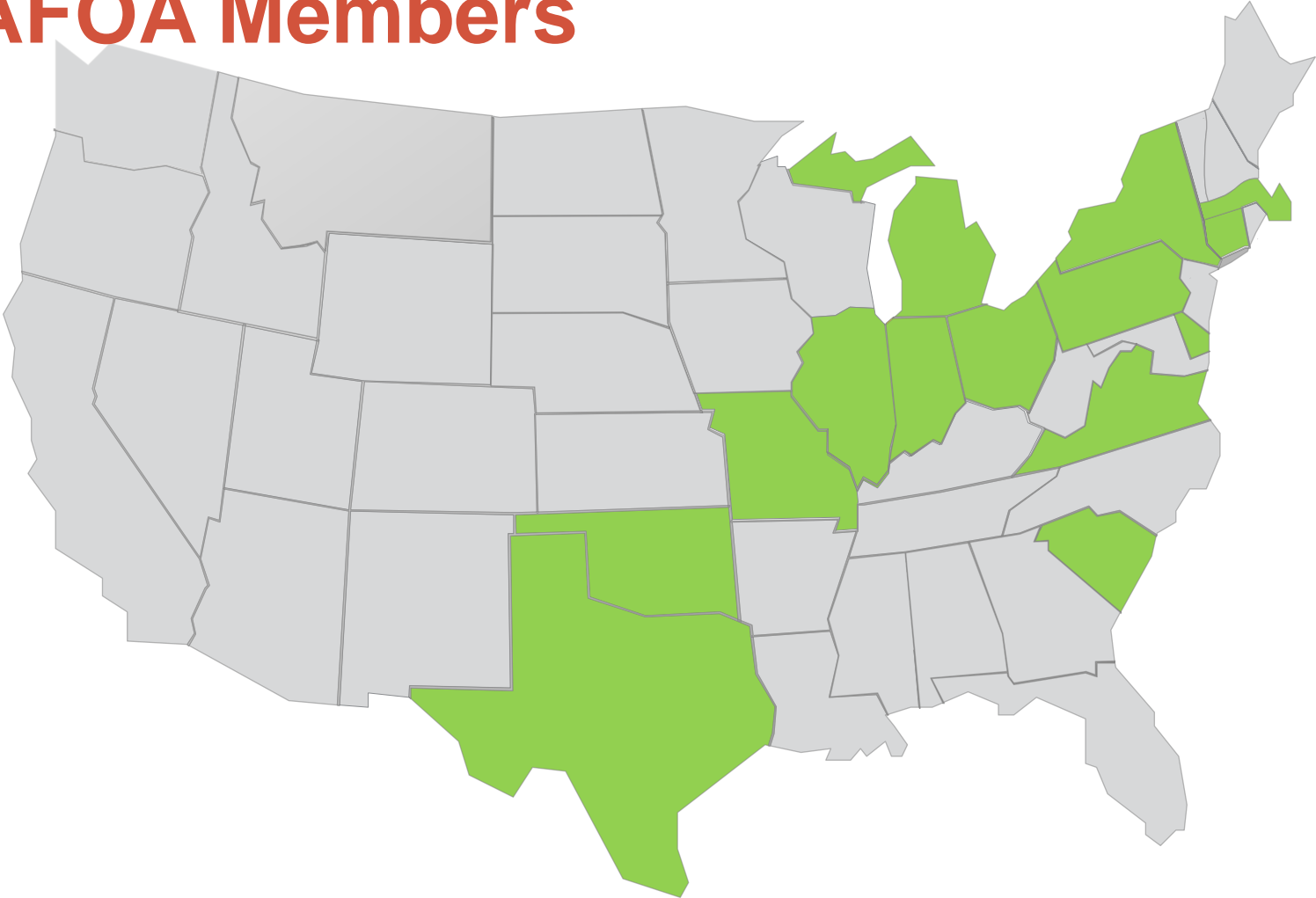
SPAFOA Mission

Enhance US industry's communications between US industry and DOE, labs, and universities. Promote understanding of each others issues

- Monthly Newsletter
- Three meetings/ year at National Labs. or research universities
- White papers on industrial issues
- Annual Capitol Hill briefing for members and staff
- Maintain www.spafoa.org



SPAFOA Members



ILC-Industry Collaborations

- SC Niobium cavities
- Klystrons
- Power Couplers
- High power magnets
- Cryogenic components
- Detector technologies
- A&E Studies (Siting)
- Cost studies on cavity manufacturing

ILC Cavity R&D

- ILC sponsored industry/lab collaborations since 2006
- 40+ prototype cavities produced by US companies
- Four potential suppliers in the Americas (in SPAFOA)
- 10 cavities certified at or above 35Mv/M



US Manufactured ILC Cavities



US Manufactured ILC Cavities

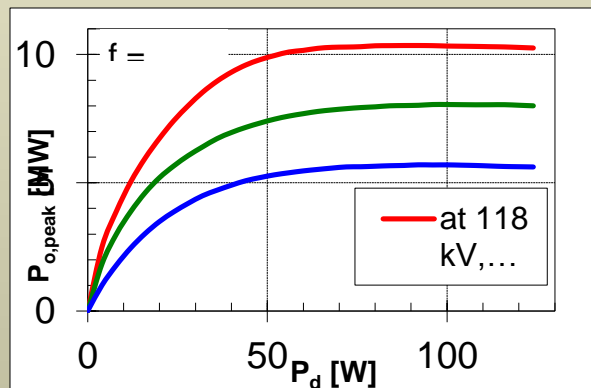
- 1.3 GHz 9-cell dumb-bell stacks in cleanroom before final welds



Klystrons

- Two klystron manufacturers in forum
- US industry working on plug and play concept with SLAC
- Klystrons require periodic replacements, production will continue on a limited basis throughout ILC operation

US Manufactured Klystron



Multibeam Klystron

1.3 GHz

10 MW Peak

65% Efficiency

2 Units Built for

DESY for the XFEL

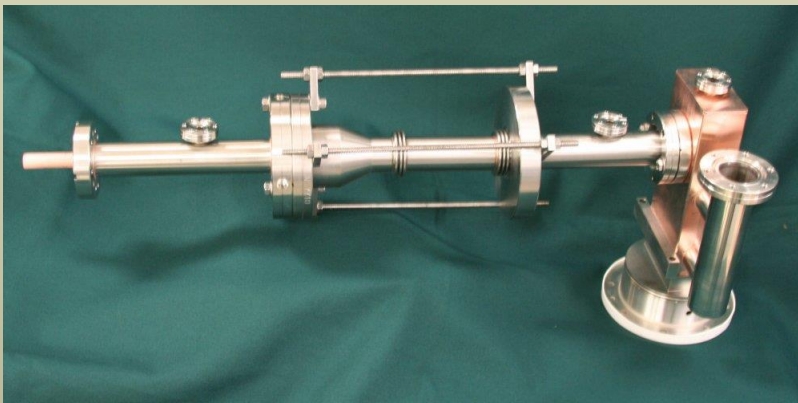
1 Unit Built for Fermi

Lab for ILC R&D

Power Couplers for the ILC



- US industry has produced over 200 power couplers in the last ten years.
- Industry provided 31 power couplers for ILC R&D.
- Industry also worked with SLAC and Fermi Lab on electroplating R&D.

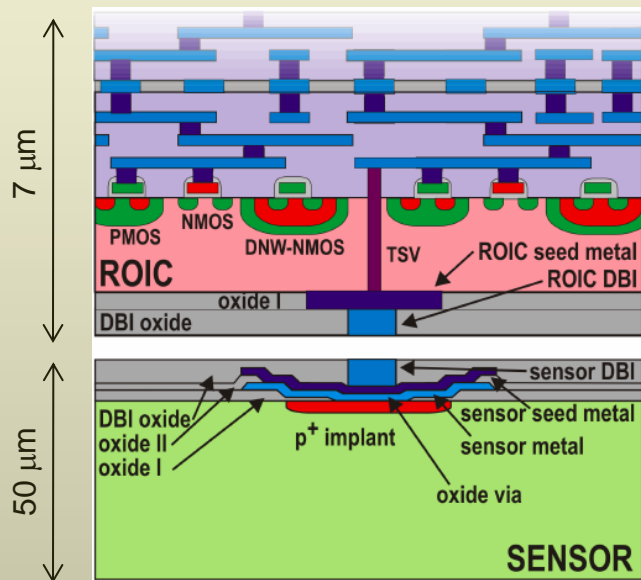


ILC Detector Collaborations

- True international collaborations on multiple technologies
 - 3D Silicon (SOI processes)
 - Imaging calorimetry
 - Vertex detector technologies

3D Integrated Planar Silicon Technology

- Vertically Integrated 3D Silicon sensor technology in HEP initiated by ILC R&D: Multiple thin Silicon layers, implementing analog and digital signal processing, stacked and bonded on top of sensor layer



- Process developed for fundamental science community as collaborative effort between Fermilab, Ziptronix and Tezzaron

ILC Detector Development and Industry

Still Growing ...



The 3D IC Company

3D INTERCONNECT



3D IC



MPW SERVICE



X-RAY DETECTORS

.....

MEDICAL TREATMENT

MEDICAL DIAGNOSIS

ENVIRONMENT



ILC Detector Development



Industrial Perspective

- Industry has proven its ability to produce prototypes of all critical ILC hardware in a commercial setting
- Next step is to industrialize its production (schedules, quantities/region, procurement vehicles)
- Industry views the US participation in the ILC as a project, not a sustainable business, i.e. tooling costs incl. in pricing for most hardware

Issues

- US Government must consider its contribution to the ILC project as hardware manufactured and assembled domestically
- All procurements should be made using “best value” selection criteria; except for commercial off the shelf (COTS) items
- ILC next phase should involve industry in cost effective machine operational factors such as component reliability, maintainability, spare part inventory, logistic support, etc.
- DOE accelerator stewardship program should be integrated into future ILC activities

Potential SC Accelerator Markets

- SC accelerators offer the advantage of very high output in an energy efficiency manner
- Future applications beyond discovery science include accelerator transmutation of waste, advanced defense systems, radionuclide production, ... (all high energy applications)
- Accelerator technology one of many R&D tasks
- Applications require significant Government involvement i.e. funding, regulatory compliance

Conclusion

- US SC accelerator industry has been collaborating with the ILC program since 2006
- Industry has proven its ability to produce critical SC accelerator components to meet the GDE specifications
- US industry strongly supports the ILC project and welcomes open global discussions on production quantities, schedule optimization, and ILC machine operation criteria

Questions?

