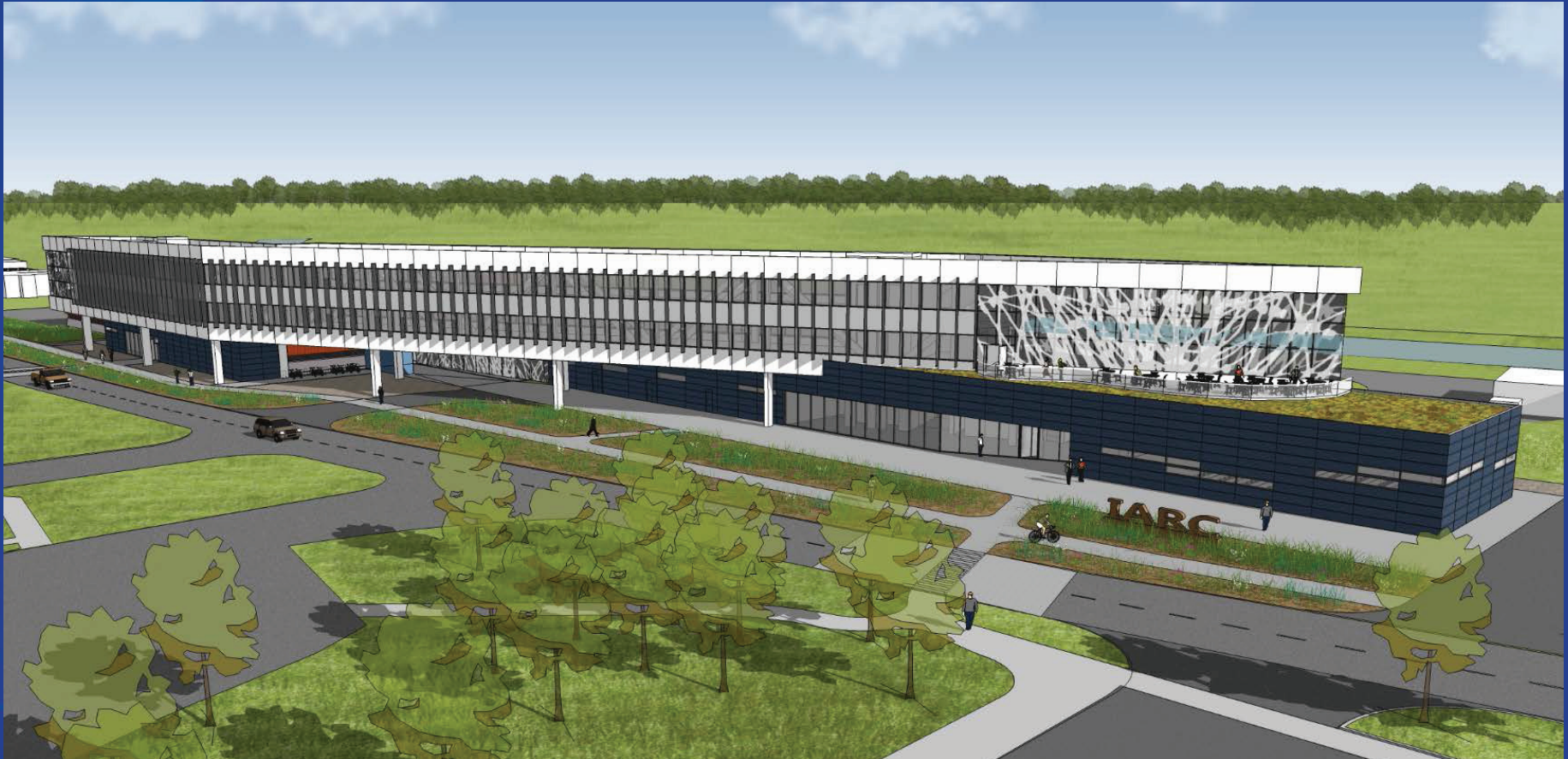


Illinois Accelerator Research Center (IARC)



A New U.S. Center for Accelerator Applications

Bob Kephart

IARC: What is it?

- A partnership between Department of Energy and the State of Illinois

To enable Fermilab to work more closely with industry and university partners on Accelerator Technology Development and Accelerator Education

To develop new accelerator technology based products and high tech industries in the U.S. (especially Illinois)

How did this partnership get created?

- Realized that Fermilab staff and infrastructure could be used to attack the problems of society
- **2007: Proposal to the state of Illinois and DOE**
- **2009: Accelerators for Americas Future** symposium hosted by the Department of Energy Report provided strong support. <http://www.acceleratorsamerica.org/>
- **Bottom line:**
Many future Accelerator applications exist that could be realized or commercialized in the future
 - New sources of sustainable energy (Accelerator Driven systems)
 - Preservation of the environment (flue gas and water treatment, etc.)
 - Medical applications (cancer treatment and isotopes)
 - New industrial process applications
- **2010: IARC Project funded by the State of Illinois**

Aligned with National Priorities

- *Presidential Memorandum on Accelerating Technology Transfer and Commercialization of Federal Research in Support of High Growth Businesses* (Oct. 28, 2011)
- *2012 Senate Water and Energy bill language*
Requested an accelerator stewardship plan from the DOE office of High Energy Physics
- *DOE Accelerator Stewardship Mission* -- DOE/OHEP has taken on the mantle of stewardship of accelerator science and technology within DOE-SC with a thrust related to applied technology. (Preparing for funding announcement)

Why do this? Growing use of Accelerators

- About 30,000 accelerators are in use in the world
Sales > \$ 2 B/yr and growing, touch \$ 500B/yr in products
- **Health and environment:** medical accelerators for cancer treatment, medical isotopes, electron microscopes, etc.
- **Digital electronics:** all computers, cell phones, televisions, etc. use accelerators to implant ions to make IC's
- **Industrial fabrication:** Electron beam welders used for auto fuel injectors, transmissions, to harden gears, & in aircraft construction
- **Industrial Processes:** Radial tires are cured and your car under hood wiring is made heat resistant with accelerators, the ink on food packaging can be “instantly” cured with an electron beam (25 feet per second!)
- **Sterilization:** medical supplies & instruments
- **Food industry:** shrink wrap on your turkey, preservation of army field rations & Omaha steaks, irradiation of seeds to induce new variants, sterilize bee hives (to prevent colony collapse disorder)

Many future uses of accelerators are envisioned

Some examples

- **Preservation of the Environment**

- **Coal:** removal of NO_x and SO_x from flue gas
- **Municipal waste:** sterilization transforms sludge into Nitrogen/Phosphorus rich solid fertilizers vs hazardous land fill.
- **Waste water:** accelerators can destroy pathogens, and pharmaceuticals in municipal waste water allowing its use liquid fertilizers vs algae blooms in rivers (volume → cost challenge)
- **Nuclear:** Destruction of long-lived nuclear waste via ADS
- **Oil and Gas:** Conversion of natural gas to liquid hydrocarbons (fracking → estimated \$ 500 M/yr of natural gas flamed at well heads in the U.S. by ~ 2017.... \$ 3.1 B/yr flamed worldwide!

- **Defense**

- FEL based ship board missile defense

Many future uses of accelerators are envisioned

- **New Sources of sustainable Energy**

- **Nuclear:** Accelerator Driven systems that burn Thorium and other new fissile materials (Safer, cleaner, more abundant)

- **Medicine**

- Improved cancer treatment (reduce cost of Proton/Carbon ion beams)
- Medical Isotopes like Moly 99 created locally at hospitals, without reactors, enriched uranium, or nuclear chemistry
- New Medical Isotopes that cannot be easily produced by reactors (e.g. Astatine)

- **New industrial process applications** (many!)

- Hard Rock tunneling with electron beams
- Heavy Ion Fusion
- Extension of the lifetime of highways

What is the Problem?

- New applications of accelerator technology seem to die for one of several reasons

Feasibility not proven: Inadequate resources: (financial, personnel, infrastructure) in industry, universities, or labs to demonstrate the basic feasibility of an idea

During transition from small scale technology demonstration to a commercial product (may require large investments & infrastructure)

Judged not economically viable reliability of technology, capital investment required, or operating costs are not demonstrated vs other approaches

Lack of acceptance of the new technology by potential customers (ignorance or prejudice) that is cured only by large scale demonstrations that lower perceived risk and demonstrate costs

- IARC is intended to lower the barriers for new accelerator applications by providing both a facility for testing accelerators and access to Fermilab's accelerator experts and infrastructure

IARC: Physical Plant

- The State of Illinois, Department of Commerce and Economic Opportunity (DCEO) provided a \$ 20 M grant for the construction of a new building
- DOE/OHEP committed to \$ 13 M direct contribution and a refurbished \$ 38 M heavy assembly building at Fermilab
- Together these will create a \$ 70 M complex to enable the IARC mission
- IARC = New state funded Office, Technical, and Education (OTE) building + refurbished CDF heavy assembly building (HAB) + infrastructure to enable the IARC program

IARC OTE Building (State funded)



- 48,000 gross square footage
- 23,000 SF of Office Space (140 offices)
- 3,700 SF Light Tech Space
- 175 seat Lecture Hall, 900 SF Meeting Rooms
- Designed for IP protection (e.g. zoned key card access, IT network isolation, lockable offices, etc)

IARC OTE Building (State funded)



- New state funded building is being constructed as an addition to an existing large Heavy Assembly Building formerly used to construct one of the large Tevatron Experiments (CDF)

Status of State funded IARC OTE Building



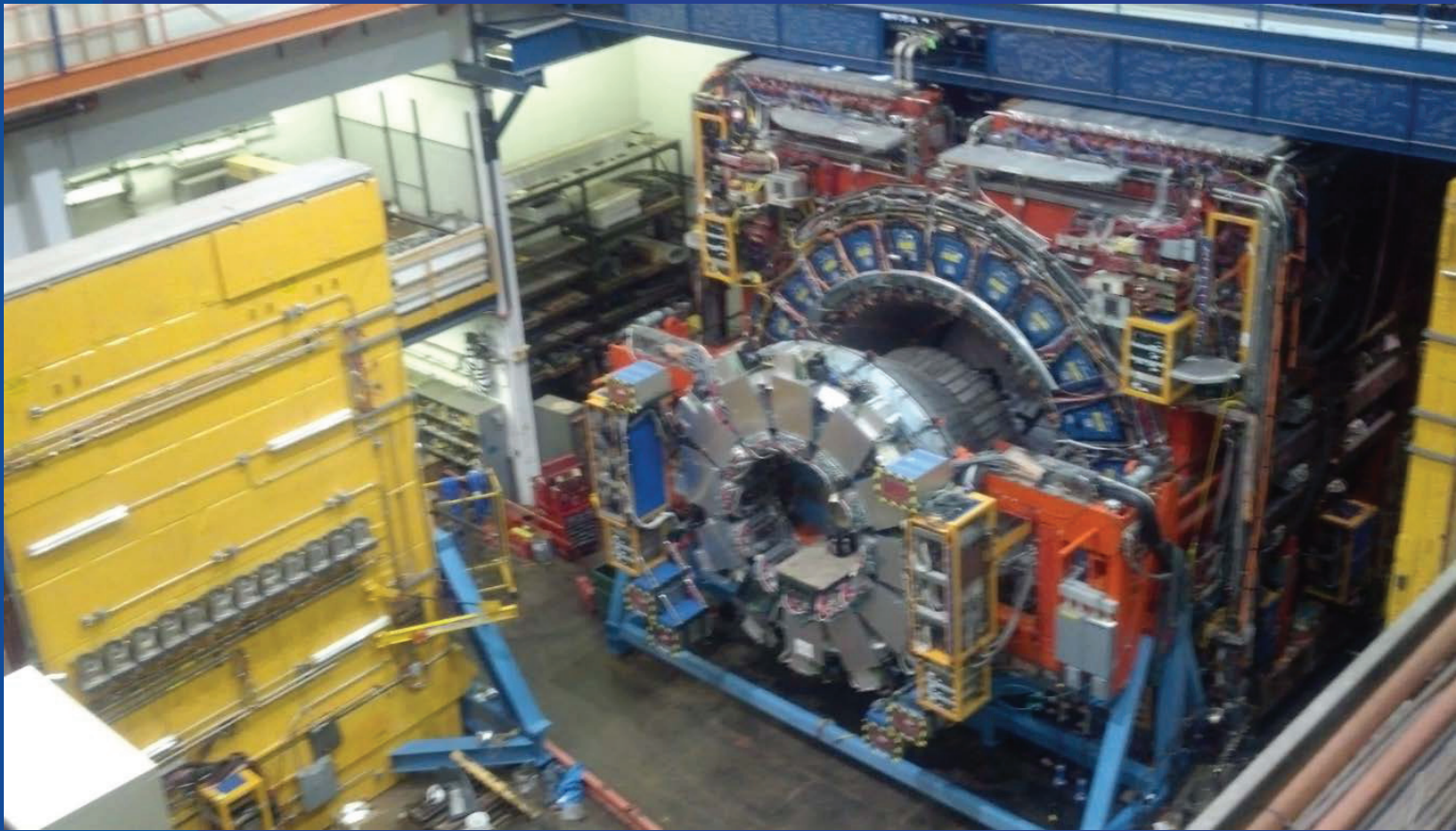
- State funded building shell is 93% complete
- DOE funded Interior partitions, furniture, IT networks start Oct 1, 2014
- First Occupants ~ Sept 2014
- Mix of lab accelerator staff and Industry
- Dedication Event ~ Oct-Nov 2014 ... 1st Industry workshop !

Heavy Assembly Building



- Used for the construction of the CDF experiment (42,000 sq ft)
- 50 T crane; 10 T crane
- Deep pit ideal for radiation shielding of high power accelerators;
- 1.5 MW of installed electrical Power (upgradeable)
- 2.0 MW of industrial, Low conductivity, and chilled water systems
- 600 W @ 4 K cryogenic refrigerator (upgradeable)
- Light tech space, machine shop, 40 offices, high speed IT network
- Building cleanup and refurbishment in progress

But first, we must remove 2500 T of equipment!



- D&D in progress so that HAB pit can be ready for IARC
- Expect to complete this work by the end of 2014

Refurbishment of the HAB

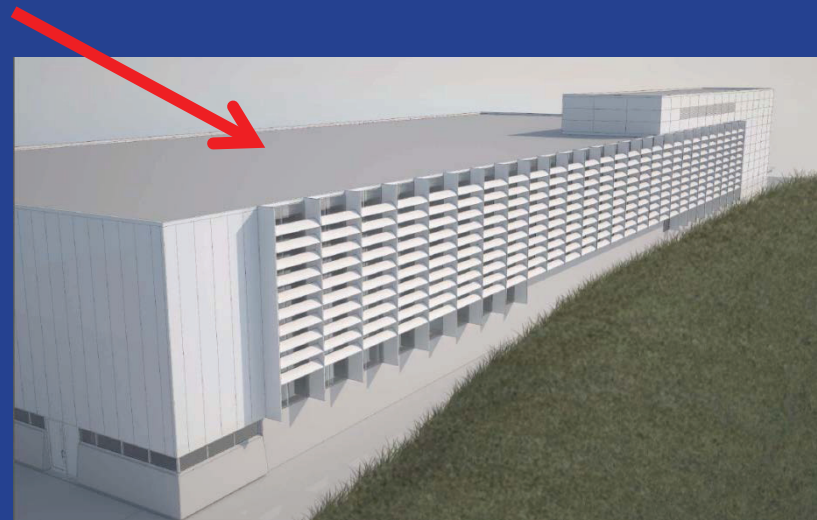
A great building but its 28 yrs old

Phase I: fully funded by DOE

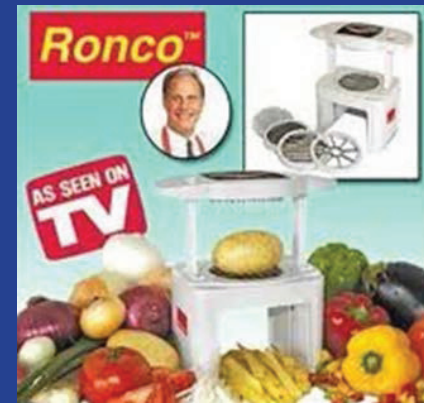
- Restore life safety systems: fire protection, exits etc
- Code compliant for new use: ADA, energy use, OSHA, etc.
- Restore/refurbish crucial infrastructure: crane radio controls, electrical switchgear for pumps, piping for LCW to pit, 25 yr old HVAC system and controls.

Phase II: (50% funded in FY13, balance in FY15)

- Refurbish office and tech space
- 40 more offices
- Additional technical space
- Design: A&E firm engaged



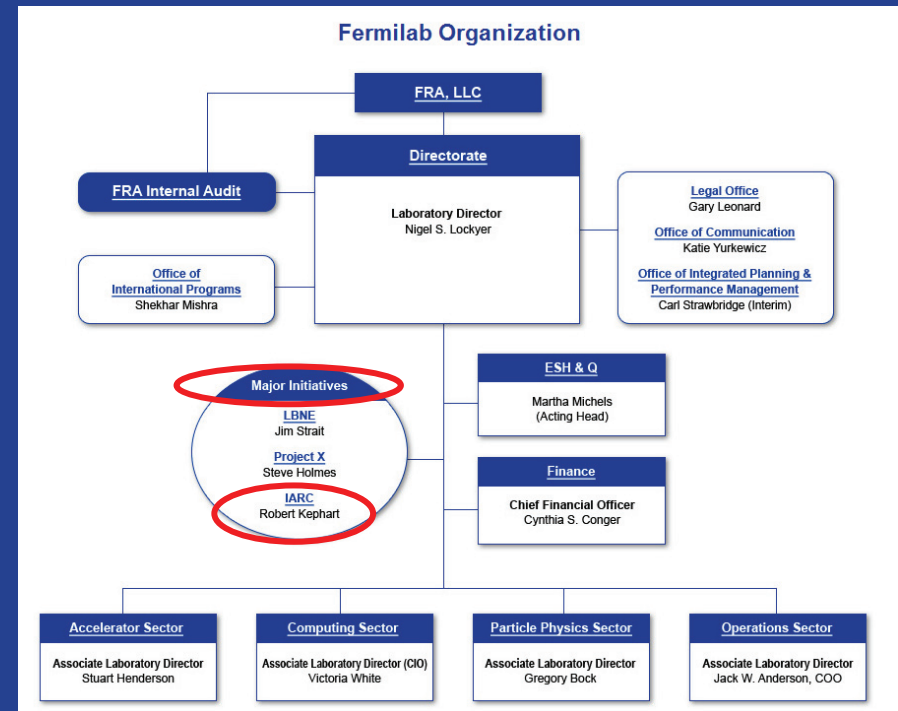
But... wait... there's more.....



- IARC is intended to be more than just this facility
- Key to the IARC concept is that it will serve as a portal for industry to gain access to the larger Fermilab accelerator staff and extensive technical infrastructure
- IARC will also house FNAL's new Office of Partnerships and Technical Transfer (OPTT) whose mission includes expediting and coordinating DOE agreements like WFO, CRADA, SBIR/STTR support letters, etc.

Fermilab as a Partner

- We operate the largest accelerator complex in the North America
- \$ 370M annual DOE/HEP budget
- 2400 users and visiting scientists
- 1700 full-time employees
- 6800 acre site



- World-class accelerator technology development program with strengths in SRF and SC Magnets
- 700 are accelerator scientists, engineers, technical staff
- As a Lab “Major Initiative” the IARC Director reports to the Laboratory Director

Fermilab Core Capabilities available via IARC

Core Capabilities	Areas of Expertise
Accelerator Science	Beam Dynamics, theory, simulation
Accelerator Operations	Commissioning and operation of complex accelerators
Accelerator Technology	Superconducting RF, conventional and SC Magnets, Cryomodules, RF systems, high power targets
Accelerator Engineering	Design, integration, cost estimates, electrical and cooling systems, cryogenic engineering
Particle Detectors	Advanced detector development, custom ASIC's, Beam test facilities
Controls and DAQ	Control, interlock & DAQ systems, controls modeling,
Computing	Management of large data sets, High speed parallel (GRID) computing Data storage, High speed networks

Approach: Creating a Successful IARC Program

- Listen to Industry meetings with heads of accelerator businesses who will be our customers, SPAFOA meeting, meetings like this, future workshops
- Use Business Experts
Hired accelerator industry consultant (Bob Hamm)
Advice from Chicago Booth business school
- Learn from Others
NREL facility (ESIF) is very similar lab-industry center at a DOE lab intended for the development of the renewable energy industry
- Strong support from the FNAL Director & DOE (FSO) Opens doors to those in DOE who want to advance the role of the DOE laboratories in contributing to the economy and U.S. industrial competitiveness
- Work with OHEP: Submitted an “IARC Business Plan” (under review)

IARC: The Opportunity for Fermilab & DOE

- Opportunity to put substance behind the claim that HEP is the developer/steward of accelerator technology within the Office of Science
- Opportunity to function as a center for accelerator based projects in the Office of Science and to partner with industry and labs (e.g. nearby ANL) on new accelerator applications
- Opportunity for Fermilab to become a National center for accelerator education
- Opportunity to establish additional funding sources outside HEP or with industry to develop intellectual property (patents, royalties)
- Opportunity to develop technologies that benefit society bringing recognition to the DOE SC laboratories and to Fermilab

IARC: The Opportunity for Industry

- Fermilab has:
 - a world-leading accelerator engineering and scientific staff that have the potential to make an impact beyond the field of high-energy physics. (with addition resources at nearby ANL)
 - core capabilities and infrastructure that are unique, and that can be used for applications beyond the field of high-energy physics.
 - the IARC physical plant in Jan 2015
 - Strong State support (DCEO) with incentives to encourage high tech businesses to locate in Illinois
- Industry can leverage these assets to create new accelerator based products and capabilities

IARC Summary

- Exciting new opportunity for FNAL, DOE, & industry
- Steady Progress on the IARC physical plant
- Working with DOE to converge on funding & “rules”
- Starting with WFO and CRADA’s and operating funds.
- Proposal driven Acc Stewardship funds in FY14
- Interesting challenges as we try to invent successful approach to the IARC program within the DOE systems...but strong support from DOE mgmt and Congress
- Even without a “formal” IARC program announcement there is lots of interest from Industry. To learn more or submit an EOI...
Check out the Web site IARC.fnal.gov