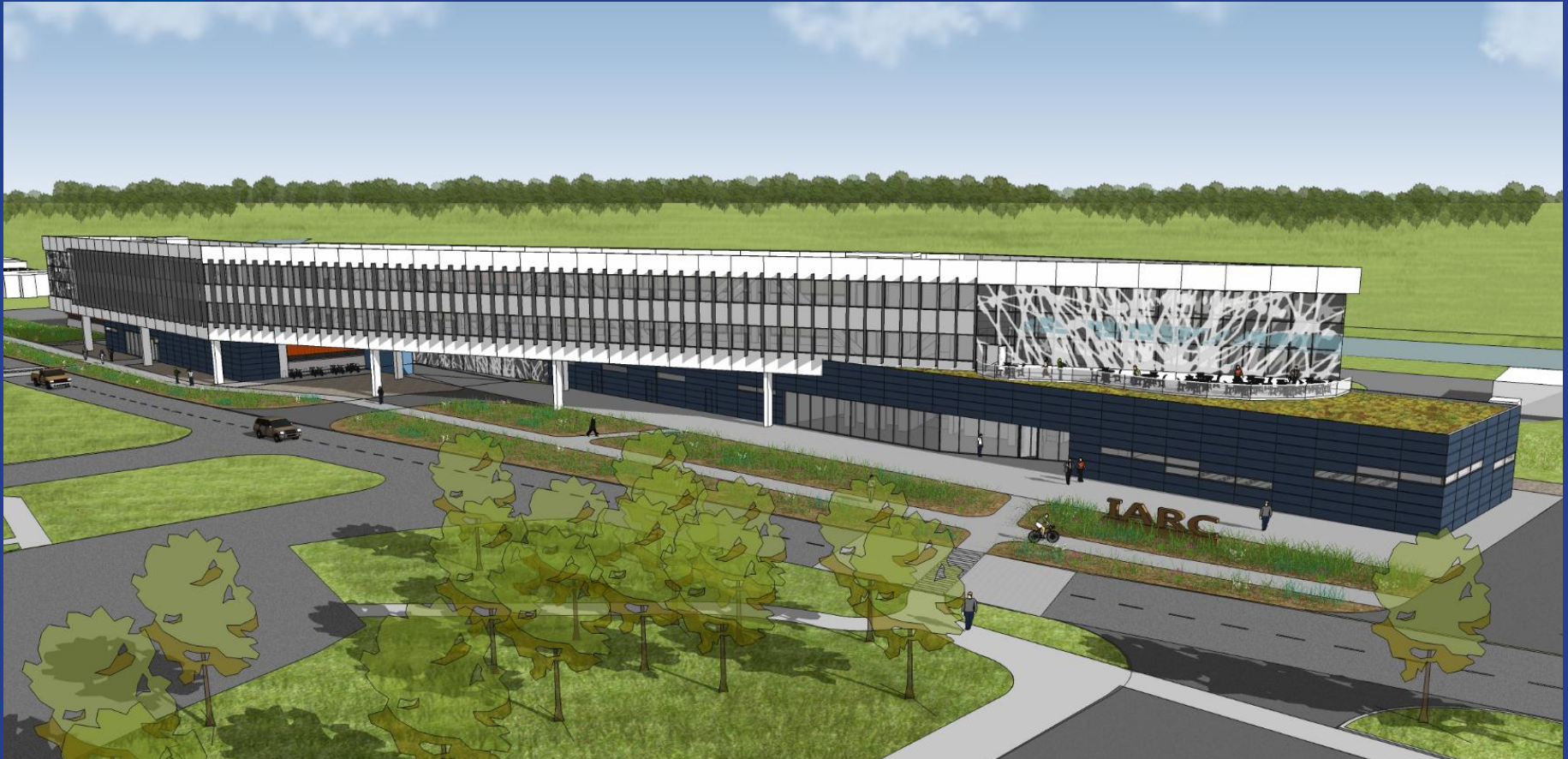


Illinois Accelerator Research Center (IARC)



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)
- *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.
- *2012 Senate Water and Energy bill language*
Requested an accelerator stewardship plan from the DOE office of High Energy Physics

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
- **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

- **Preservation of the Environment**
 - **Coal:** removal of NO_x and SO_x from flue gas (\$ 500 M/yr business?)
 - **Water:** treatment of drinking water to remove pesticides and pharmaceuticals
 - **Water:** sterilization of municipal waste into Nitrogen and Phosphorus rich fertilizers vs pollution
 - **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 ~ 2015-17)
- **New Sources of sustainable Energy**
 - Nuclear: Accelerator Driven systems that burn Thorium and other new fissile materials (Safer, cleaner, more abundant fuels)
- **Improved cancer treatment** (e.g. Carbon ions)
- **Medical isotopes** (Created locally at hospitals, without reactors, highly enriched uranium, and nuclear chemistry)
- **New industrial process applications** (many!)

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 help fill these gaps by providing access to accelerator experts and laboratory infrastructure

IARC: The Opportunity for Fermilab

- 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 (e.g. Project X, NGLS) in the Office of Science and to partner with industry and labs (e.g. 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 could potentially be used in application beyond the field of high-energy physics.
 - And will have the IARC physical plant in FY15
- Industry can leverage these assets to create new accelerator based products and capabilities

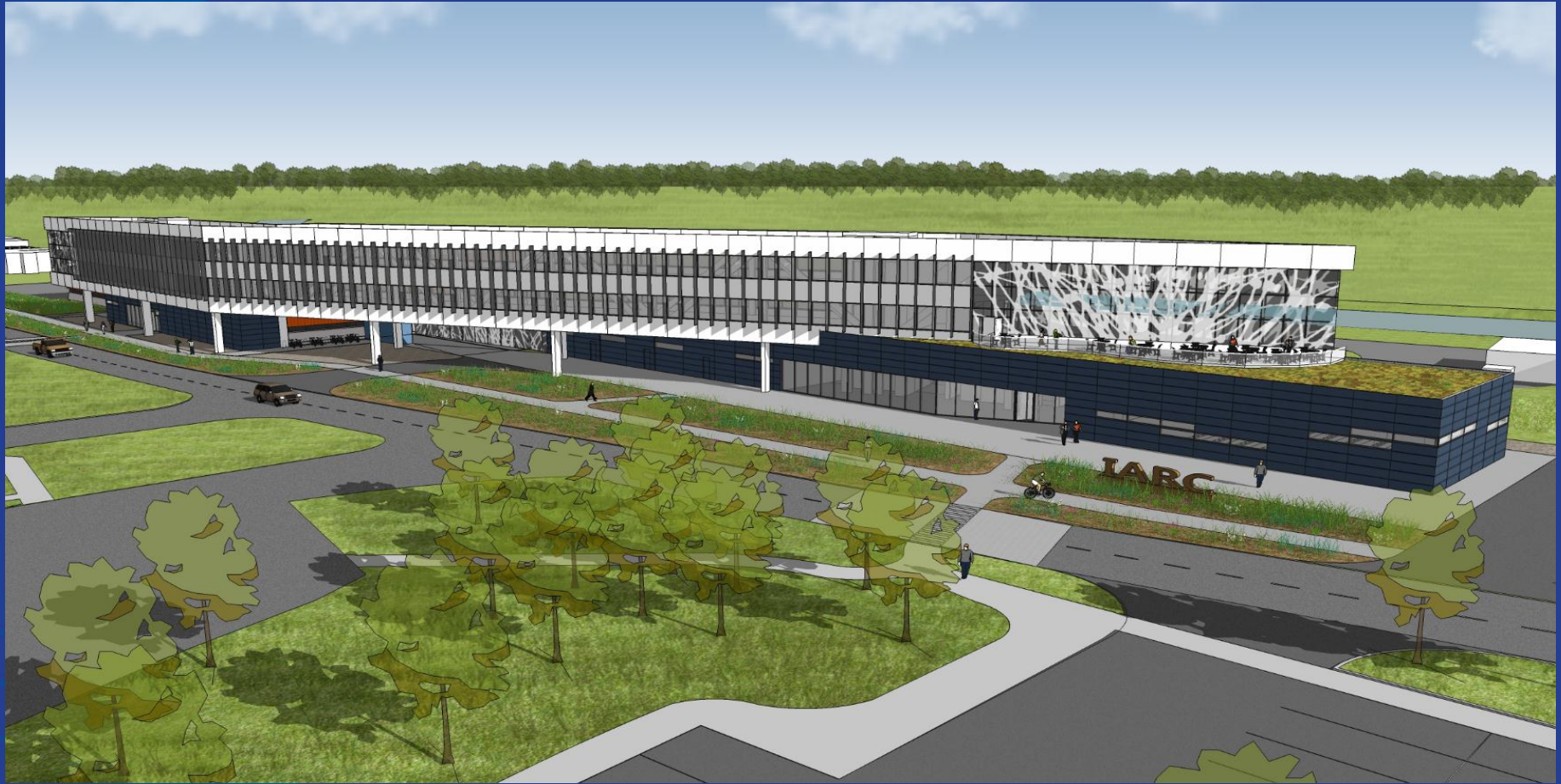
IARC: The Opportunity for Universities

- Universities can:
 - Use their engineering and accelerator scientific staff to partner with industry to develop accelerator ideas into new products or services
 - Leverage the IARC infrastructure and FNAL staff to enable your entrepreneurs
 - Use IARC to support their existing Accelerator Education programs or partner with Fermilab to create a larger national center for accelerator education

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 (145 offices); 3,700 SF Light Tech Space
- 3,900 SF New Lecture Hall (175 seats); 900 SF Meeting Rooms
- New 250 car parking lot

IARC OTE Building (State funded)



The image is an architectural rendering of a large building complex. On the left is a long, single-story building with a solid orange facade, labeled 'CDF Heavy Assembly bldg'. To its right is a taller, multi-story building with a modern design featuring large glass windows and white horizontal bands, labeled 'State funded Office Technical Engineering bldg'. The buildings are set against a clear blue sky and a green landscape. A paved area with some landscaping is in the foreground.

CDF
Heavy Assembly bldg

State funded Office
Technical Engineering bldg

IARC Construction Status



- State funded building June 3, 2013
- 78% costed. On track to complete expenditures well before DCEO grant ends in May 31, 2014

IARC Construction Status



- Currently installing siding, lobby, conf room, HVAC
- 1st occupants planned for Fall 2014

Heavy Assembly Building

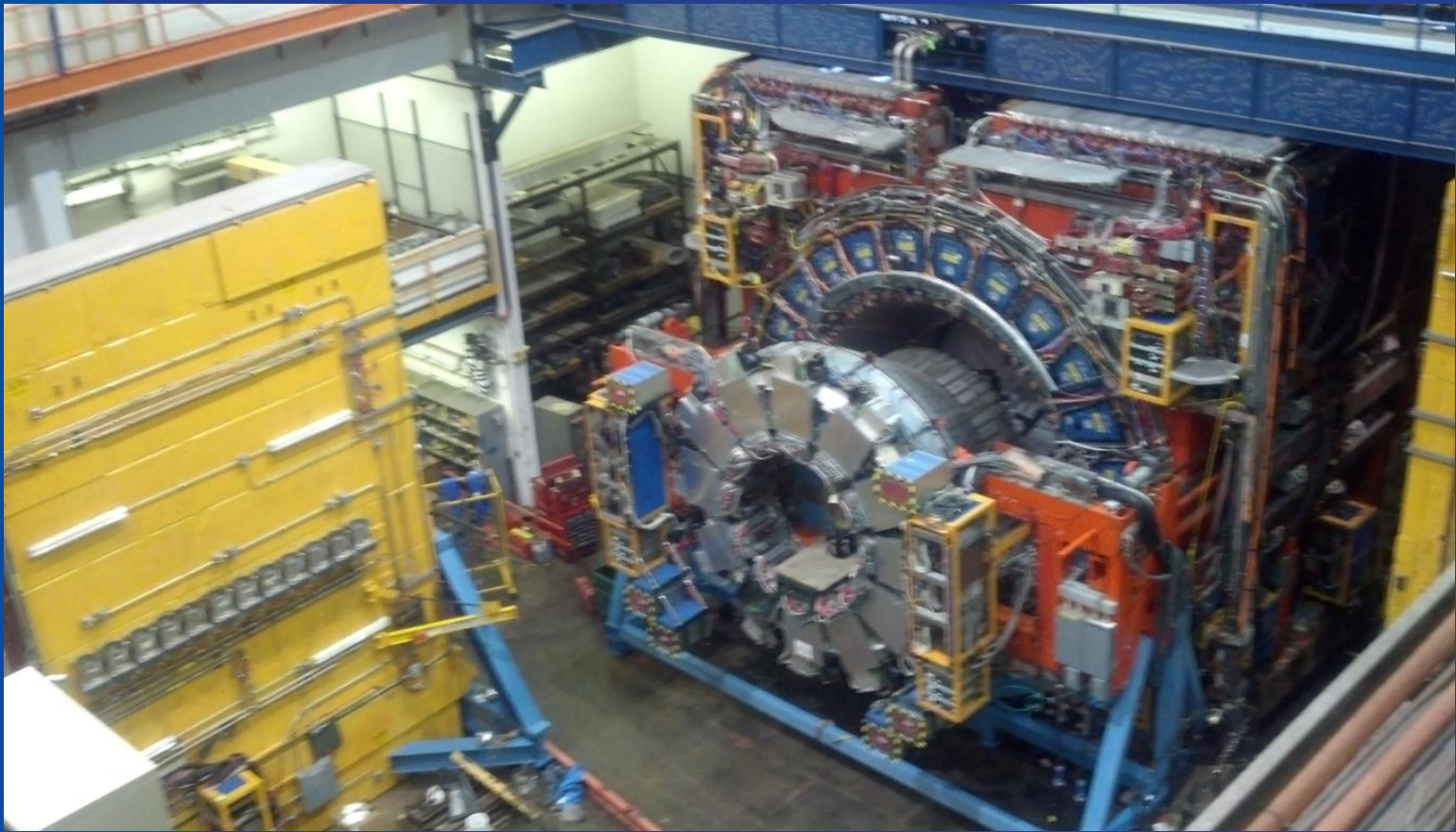


- Heavy assembly building used for the construction of the CDF experiment at the Tevatron
- 42,000 sq ft: 50 T crane; deep pit for radiation shielding of accelerators; 40 offices , extensive infrastructure; (next slide)
- More than a dozen industries have expressed interest, the deep pit area is particularly interesting to them
- Building cleanup and refurbishment in progress (FY14-15)

HAB infrastructure

- 43 foot deep pit with 50 T overhead crane, reconfigurable enclosures with concrete blocks
- 1.5 MW of installed electrical Power (upgradeable)
- 2.0 MW of industrial cooling water
- Low conductivity and chilled water systems
- 600 W @ 4 K cryogenic refrigerator
- High speed IT network
- Light and Heavy assembly space, 40 offices
- Permits, shielding assessment & safety review processes, in place for operation of accelerators.

Challenge... removing >2500 T of experiment!



- D&D in progress so that HAB pit can be ready for IARC
- Detector/Collision Hall D&D for possible role in ORKA

Approach: Creating a successful IARC Program

- Listen to Industry (SPAFOA meetings, meetings with heads of accelerator businesses who will be our customers, workshops planned)
- Use Industry Experts
Hired consultant: Bob Hamm, former head Varian Medical R&D and owned his own accelerator company for two decades, CEO of a new accelerator company
- Use Business Experts
Advice from Chicago Booth business school on the IARC business plan
- Learn from Others
NREL facility (ESIF) is very similar lab-industry center for development of renewable energy, NREL visit was very productive. (culture changes for the lab...eg NDA's)
- Work with Director & DOE (FSO) Plan for evolution of IARC as a facility. e.g. Should IARC become a DOE “user facility” ? (orange in a barrel of apples?)
- Work with OHEP: IARC Program Prospectus = “Vision and Plan” document sent to OHEP. Discussion on approach has started. Start with CRADA's & WFO and accelerator operations funding; evolve towards funding from “Accelerator Stewardship funds and perhaps as a DOE users facility. This is all NEW!

IARC Timeline

- FY13-14: Agree with OHEP on the IARC vision, submit a draft business plan, and funding model
- FY13-15: Complete the IARC physical plant including the state funded OTE building and refurbished CDF Heavy Assembly building → open for business! First workshops with industry in FY14
- FY14-16: Begin working with industry using existing mechanisms: Work for Others, Cooperative Research and Development Agreements, SBIR program
- FY15-17: Evolve towards a program with base funding e.g. via the Accelerator Stewardship Program, DOE sponsored announcement of funding opportunity, etc.

Who is interested in using IARC ?

- Even in the absence of an official announcements, many partners have contacted me about working at IARC (**yellow = IARC EOI, SBIR, funding**)

ANL.....education, SBIR, joint work with industry
AES.....SBIR's, Water Treatment with accelerators
Euclid.....SBIR phase II's several ,including PX SRF cavities
LLNL.....test accelerators funded by DTRA and/or DARPA
Muons Inc.....SBIR/STTR's, Muon Collider R&D, ADS R&D
National Instr.....accelerator instrumentation and controls
Niowave.....SBIR phase II for medical isotope machine, LHC crab CM
NIU:Source Development, SBIR/STTR, new RF sources, education
Omega-P.....SBIR Phase II: MB klystron for Project X
PAVAC.....Flue gas test accelerator, Several SRF based SBIR ideas
Radiabeam.....SBIR, access to accelerator experts, project fabrication
Harvard Medical....Moly 99 and med isotopes
Tandell systems....accelerator reliability, integration, and simulation
UC Irvine..... Water treatment with accelerators
Walter Reed, UTSW, Mayo, etc ..Carbon ion medical accelerator
Varian Medical.....test cell for medical machines, water treatment ?

- **Recurrent theme:** funding, clear program rules, IP protection, predictable schedule and processes, access to deep pit & infra to test accelerators!

Summary

- IARC = an exciting new opportunity for FNAL, OHEP, & Universities
- Steady Progress on the IARC physical plant.
- Plan to start the IARC program via WFO and CRADA's and operating funds.
- Anticipate proposal driven Accelerator Stewardship funds in FY15
- Working on the business model
- Significant challenges as we try to invent an approach to an IARC program that can succeed.
- Even without a “formal” IARC program announcement there is lots of interest from Industry. (NREL Advice: Don't advertise too soon!)

See Web site IARC.fnal.gov