



U.S. DEPARTMENT OF
ENERGY

Office of
Science

All-hands meeting

Nigel Lockyer

February 6, 2014

Outline

- Fermilab ...the first 5 months at the lab...general observations
- Science today
- An emerging vision for the future
- Mingle in the budget
- Questionnaire
- Master plan

Observations and Comments

- “HEP community has not done the best of jobs bringing in united priorities.” (Secretary Moniz at URA Meeting)
- P5 process and report must deliver a unified message
- The HEP budget is contingent on the community, Fermilab, and FRA/URA placing priorities in a global context
- Partnerships of all kinds (labs, universities, international, industry) critical to our success
- Management team and lab must be on the same page
- Excellence in operations will be critical to our success
- DOE OHEP & FSO very supportive
- Science mission is not enough...must be relevant
 - Opportunities in IARC and “big data” to give added value

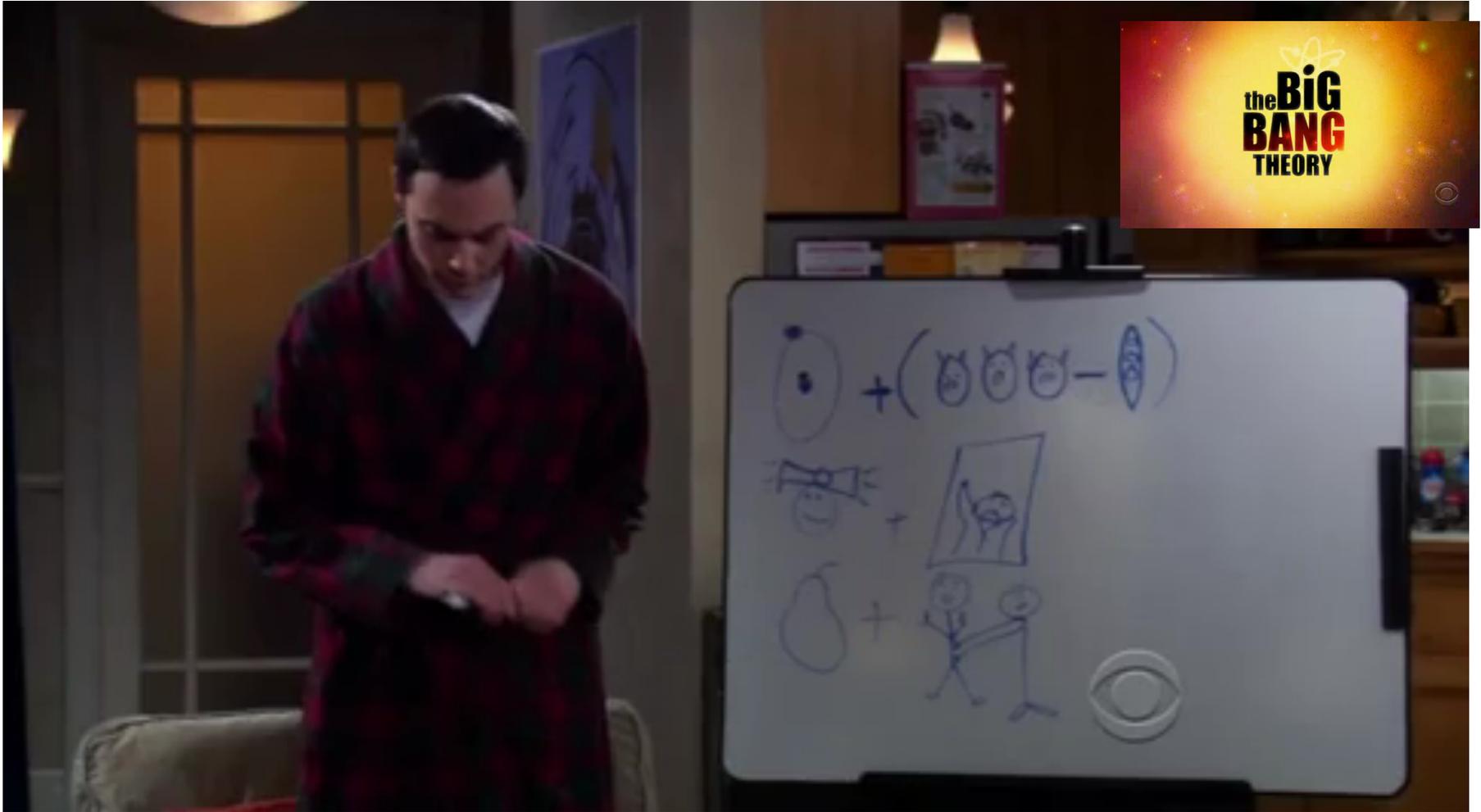
Emerging Scientific Vision

- Being shaped by our scientists and the community
- P5 process proceeding...two more virtual town meetings
- Plan rolls out in May after HEPAP “approves”
- Once P5 report approved, then hopefully community gets behind the report, DOE gets behind the report, and international colleagues recognize we are serious about being good partnersthis is a crucial new step we are taking...looking for unprecedented international investment in our program while investing significant funds abroad as well.
- This is a complicated picture to explain to DOE and Congress

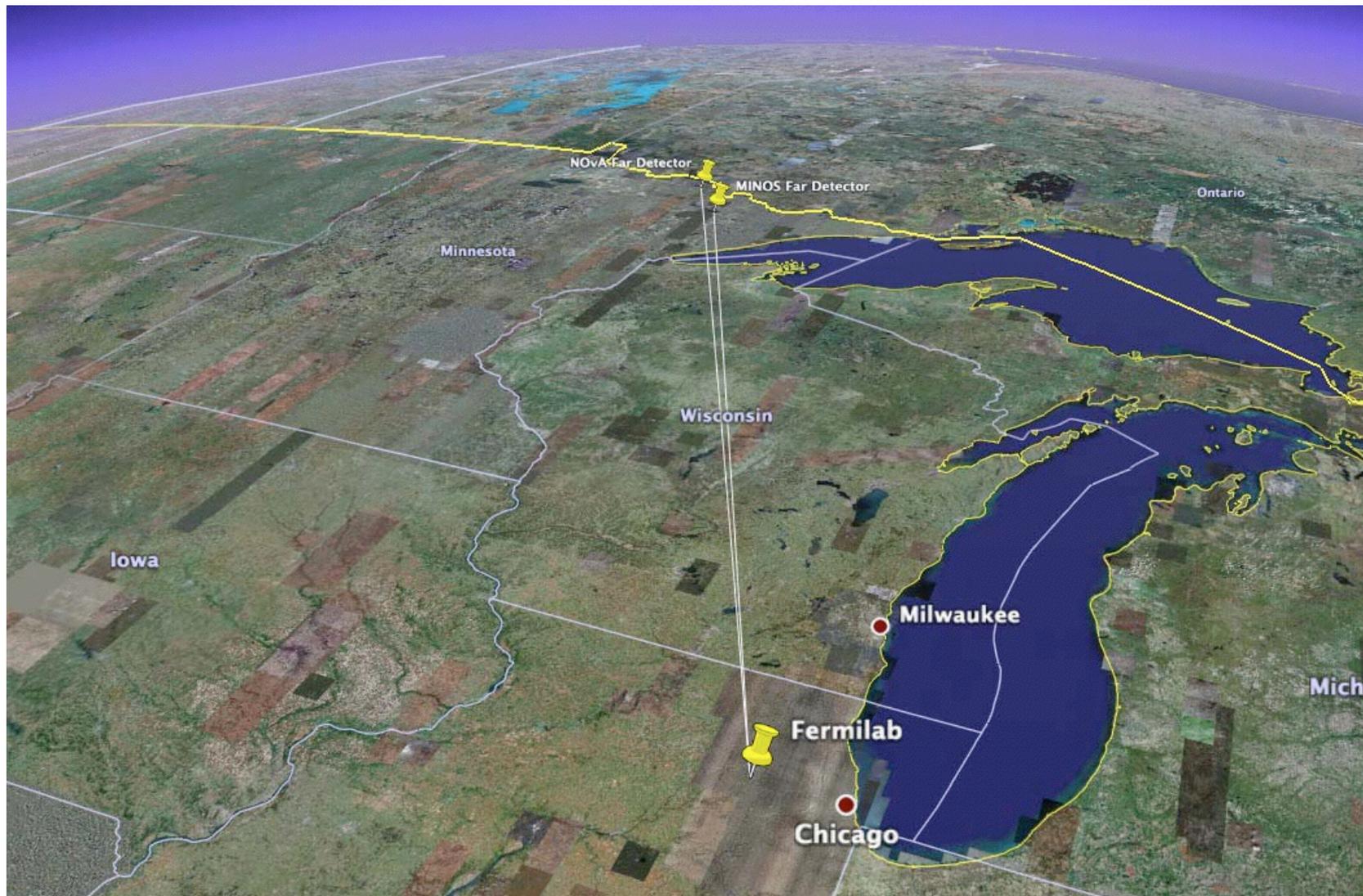
Science Program Today

- CDF and D0 continue for ~2 years.....important results
- Test Beam Facility running well & at “over capacity”
- Cosmic
 - Dark Energy Survey (telescope in Chile) taking beautiful data
 - Dark matter searches (exciting)
- Neutrinos
 - MINOS+, MINERvA taking data
 - MicroBooNE about to move & soon commence commissioning
 - NOvA just about to commence data taking...congratulations!
- CMS.....the Higgs!
 - Analysis continues with present data sets
 - Near term upgrades proceeding
 - Data taking begins again in 2015 at ~14 TeV

Sheldon & Higgs Boson Particle



NuMI to NOvA (NuMI Off-Axis Neutrino Appearance)





Science Program Today

- Accelerator technology research into high Q cavities
- High power target program
- Continue building out infrastructure in NML
 - Future location of ASTA (if successful)
- Continue building out infrastructure at CMTF
 - Future home of PXIE
- LARP National Program (requires P5 & funding)
 - Moving towards high field Nb₃Sn magnets for LHC Hi-LUMI
 - Involvement in crab cavities?
- MAP National Program
 - MICE
 - Targets, high field magnets, cavities, simulations

Operations Excellence.....is a must!

- Administration is the pillar that the laboratory sits upon
 - Thank you for what you do
- Accelerator operations key to science program
 - Thank you to the weekday, weekend & midnight warriors
- Performing well
 - Thank you to computer support
 - Thank you to all support services

Science Program Tomorrow (in 2014 budget)

- Muon g-2 now has a construction start and heading to CD-2
- Mu2e has a construction start & heading to CD-2
- Much work continues on muon campus projects
- LBNE received PED funds in budget

Infrastructure (in budget)

- PIP-I project critical to reaching 700 kW on target for NOvA
- \$35M power infrastructure upgrade (SLI proposal approved)
 - Essential investment in Fermilab's future
- More investment is being planned for and will take place

Preliminary Vision Neutrinos (requires P5 support & funding)

- Moving towards becoming the neutrino laboratory
- LBNE will hopefully become the flagship experiment for the next two decades
- PIP-II is first step in modernizing the accelerator complex
 - Aiming for CD0 in spring 2015
 - 800 MeV SRF linac injecting into Booster
- Developing thoughts on a short baseline neutrino program
 - Proposals received at last PAC
 - Referring to this program as SBNE

A golden opportunity.....

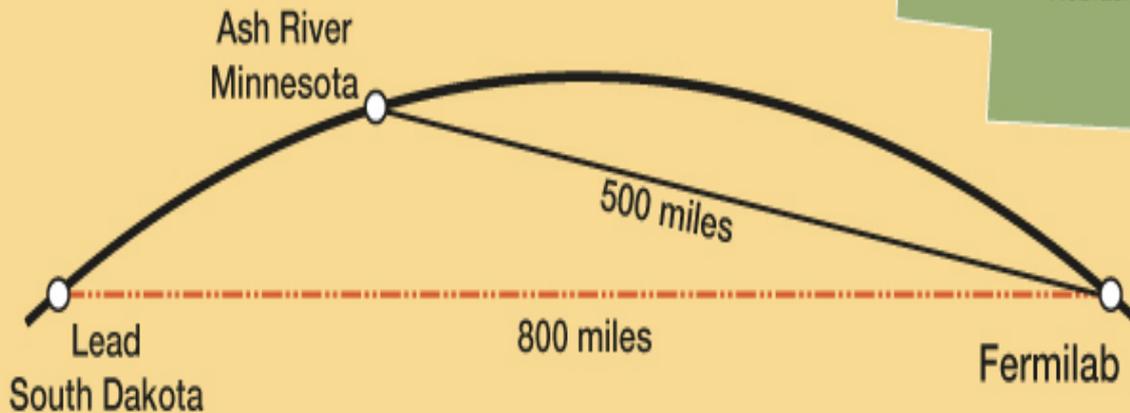
Returning to the scene
of the “crime”



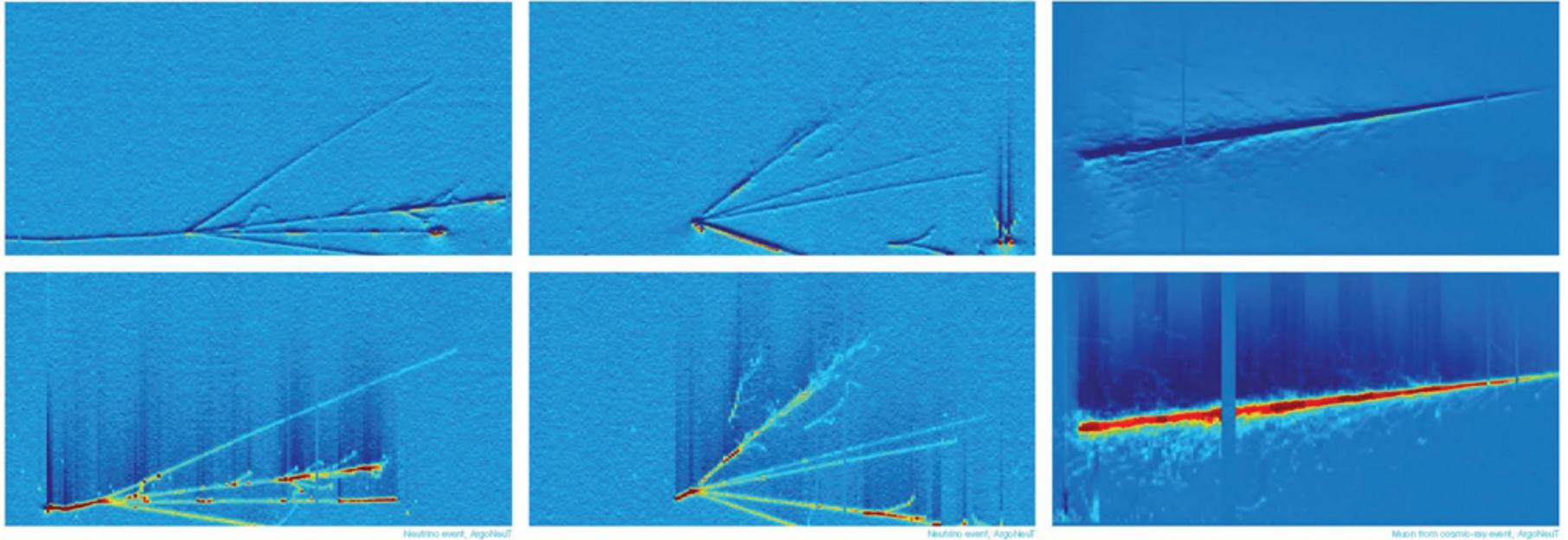
Straight Through the Earth

| | | |
|-------|--------------------|---------------|
| MINOS | Soudan Mine, MN | 2340 ft deep |
| NOvA | Ash River, MN | Surface level |
| LBNE | Homestake Mine, SD | 4850 ft deep |

**35ktons liquid argon
deep underground**



A new technology for detecting neutrinos : Liquid argon ($87^{\circ}\text{K} = -303^{\circ}\text{F}$)



Neutrino event, ArgoNeUT

Neutrino event, ArgoNeUT

Muon from cosmic-ray event, ArgoNeUT

Particle Signatures

Fermilab 2009



Images from a small prototype chamber in the NuMI beam



Long-Baseline Neutrino Experiment (LBNE)

- Observe and quantify the rate at which muon neutrinos \rightarrow electron neutrinos
- Determine neutrino mass hierarchy
- CP Violation: Neutrino-anti-neutrino beams provide important clues to understanding the overall asymmetry of matter versus anti-matter in our universe
- **Neutrino astronomy**..... Detect thousands supernova neutrinos
- **Search for proton decay**.....proton lifetime



More Preliminary Vision (P5 & funding dependent)

- CMS will continue to be a major emphasis of the laboratory
- LHC will run into 2030s
- Fermilab will be involved in ambitious detector upgrades
- Fermilab will be involved in LHC accelerator upgrade (LARP)

- LSST involvement (more funding needed for 2020 start)
- DESI involvement (P5 & funding needed)
- SPT Gen-4 CMB involvement developing
 - Labs & universities coming together on bold project

- ILC (MNEXT Minister met with Secretary Moniz)
 - 3 years of international negotiations

Far Future Science Vision.....not there yet

- LBNE and SBNE a stretch for Fermilab & global program
 - It is a two decade long effort
- We should be prepared to respond to a dark matter discovery
- We should be prepared to respond to an LHC discovery

- Longer term vision will be influenced by these discoveries or even non discoveries
- In presenting funding environment, little room for growth
- Two fledgling international planning efforts beginning,
 - 100 km 100 TeV: one in Europe (FCC) (2030s to begin)
 - Smaller but similar in China
 - Both require high field magnet technology....thus Fermilab

Accelerators Drive Innovation & Commercialization & Jobs



Office, Technical and Education Building (OTE)

- ❑ 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
- ❑ 250 car parking lot



Heavy Assembly Building (HAB)

- ❑ 36,000 sq ft
- ❑ 50 T crane
- ❑ deep pit for radiation shielding of accelerators
- ❑ 40 more offices, tech space, machine shop, extensive infrastructure

Partnerships

- Great discoveries in science come from teams of scientists from across the country working together more so than ever
- The National Laboratory system is working more closely together on projects than ever before
- Universities and National Labs are natural partners
- The URA is a great example of successful partners
- International partnerships and investment are needed to maintain US leadership in particle physics

- The flagship projects in particle physics, for example LBNE and the neutrino program at Fermilab, must be done as an international project....the times have changed! We cannot do it without our friends.

Conclusion

- Neutrino physics & accelerators are the new branding
- A vibrant Fermilab attracts global students & scientists
- URA universities win access to best students in world
- This next wave of students powers the innovation agenda
- Position US for a frontier neutrino machine at Fermilab
- Strong partnerships in science & accelerator technology
- Accelerator technology drives new economic growth
- Strength of FRA consortium enables Fermilab success

Online feedback form

- Launched in September
- Received 173 comments, suggestions and questions
- Almost half have been completed or are in progress. A few examples are:
 - Extended gate hours
 - Improved director's coffee breaks refreshments (thanks for feedback...I now understand your priorities)
 - Road repairs
 - Eliminated safety signage at entrances & the Porcelain Press
 - Formalizing lab-wide telecommuting, flex-time and alternative work schedule policies
- Additional suggestions are under consideration

Online feedback form

- Received many comments about how to:
 - Steer the scientific direction of the lab
 - Restructure the organization
 - Better capitalize on the vast amount of knowledge that resides with our employees and users
- The feedback form will be closed for now
- Will open up periodically to solicit your input on specific topics
- Your input is always appreciated
 - Feel free to stop by my office or email me

Wilson Hall improvements

- Received feedback from you about new cafeteria furniture
- Fits with the vision for Wilson Hall atrium
 - Should convey impression of vibrant, investment-worthy lab
 - Should be a welcoming place for employees, users and visitors to gather and exchange ideas
- Planned atrium renovations
 - New furniture has been ordered and will arrive this spring
 - “fancy design” cafeteria tables will remain
 - Receptionist position being reinstated
 - Relocation of director, deputy director, COO and CFO offices to a more accessible and hopefully less isolated location

Gary Van Zandbergen and the Master Plan

- The Fermilab Master Plan is a planning document that will guide the evolution of our site for the next 20 years.
- As you all know, Wilson had a very strong vision for the Fermilab site from the beginning that shaped everything – the buildings, roads, natural areas.
- Over time, however, we have lacked a clear strategy for the site's continuing evolution.
- We all want a site that respects our history while adapting to the needs of current and future science and technology, and this plan will help us get there.
- Having a master plan – which most major organizations, universities and labs already have – will also help us seek outside partnerships and support for new initiatives such as the ones Gary will describe.

Patrick Kane





- Thank you for making the first five months busy & pleasant
- Good luck to USA at Olympics