# CDF
# Detector and Collaboration prospects for Run III

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PAC meeting

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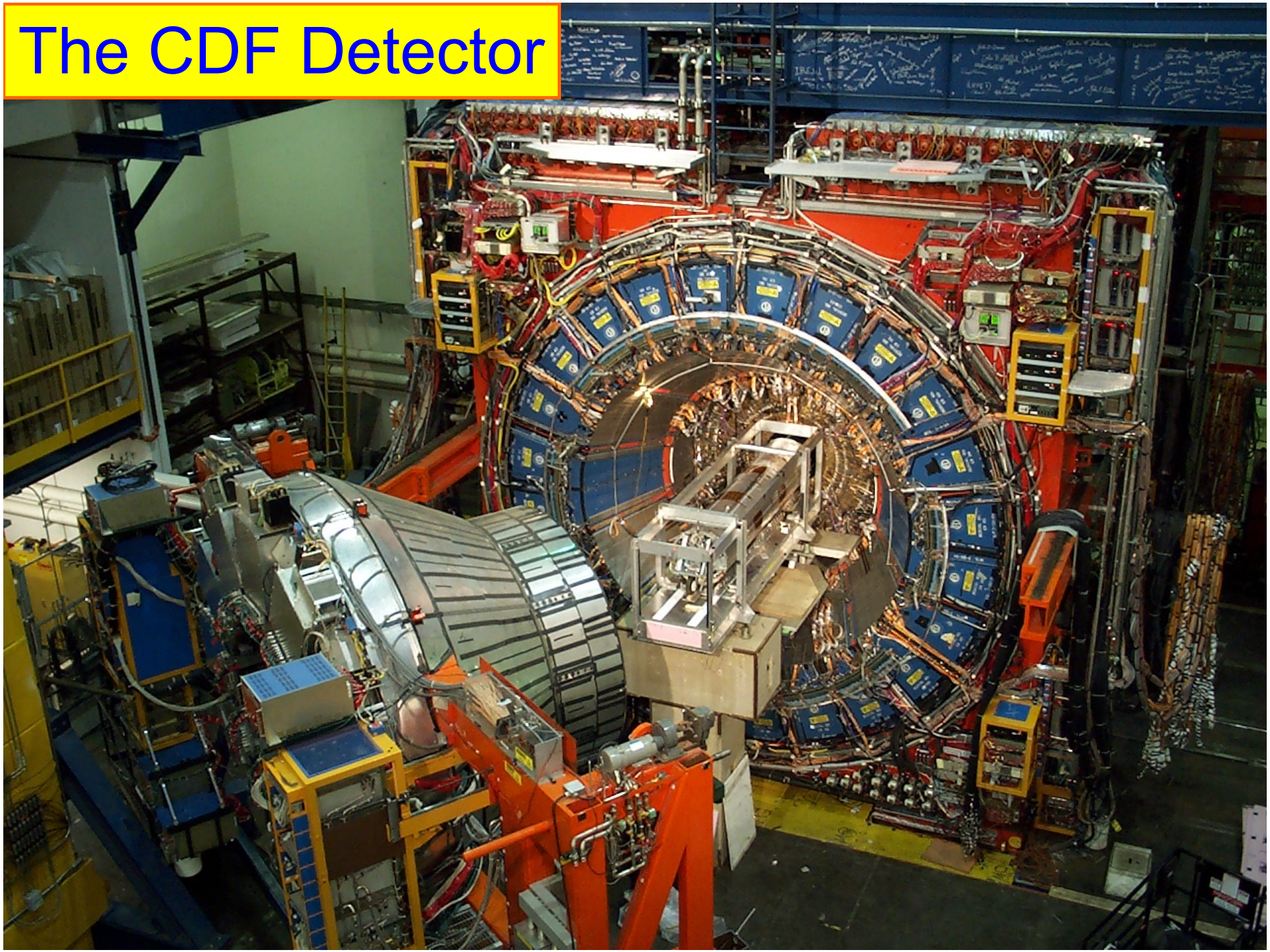
# The CDF Detector



# Background: Overall Detector Status

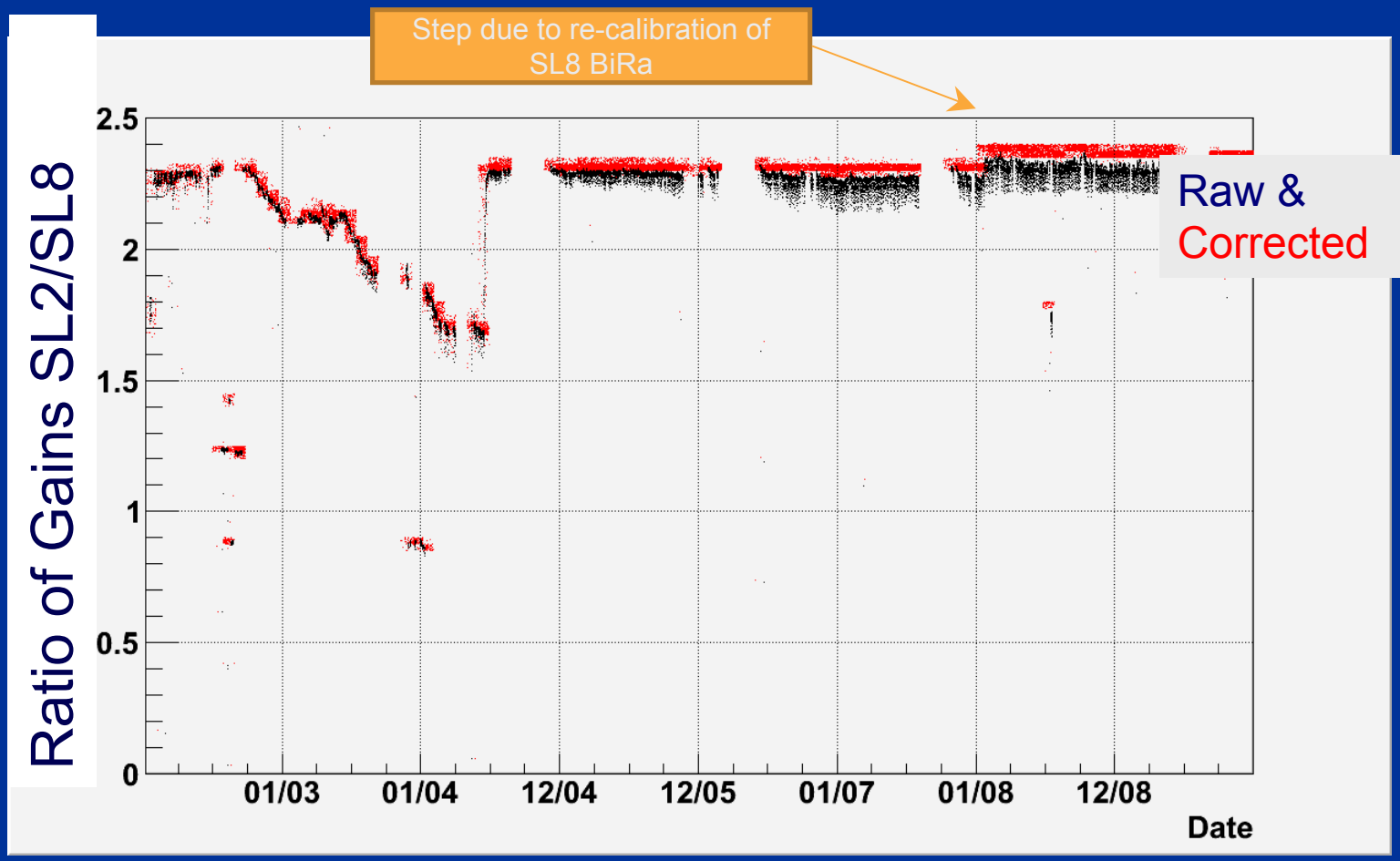
- Commissioned a detector vulnerability study in 2007 using outside “consultants”. (Reports available upon request)
  - Followed up on their recommendations
  - Thus we are in quite good shape overall WRT continued running
- Luminosity and loss monitors, Calorimeter, TOF, Muon systems running well
- Cryo, gas and cooling systems all stable with no issues
- Aging on-line computing that will need attention in a run extension

# Recent Tevatron Tracker Review

- Held on 6/7/2010 – organized jointly with PPD Head Mike Lindgren and Tevatron Spokes.
- Dan Green chaired committee – other members include Steve Worm(Rutherford Lab), Rainer Wallny (UCLA) , Marcel Demarteau (FNAL), Alan Bross (FNAL)
- Each Collaboration Gave 3 talks
  - Overview of the Experiment
  - Status of Silicon Detector
  - Status of outer tracker
- Review was on *hardware performance* only

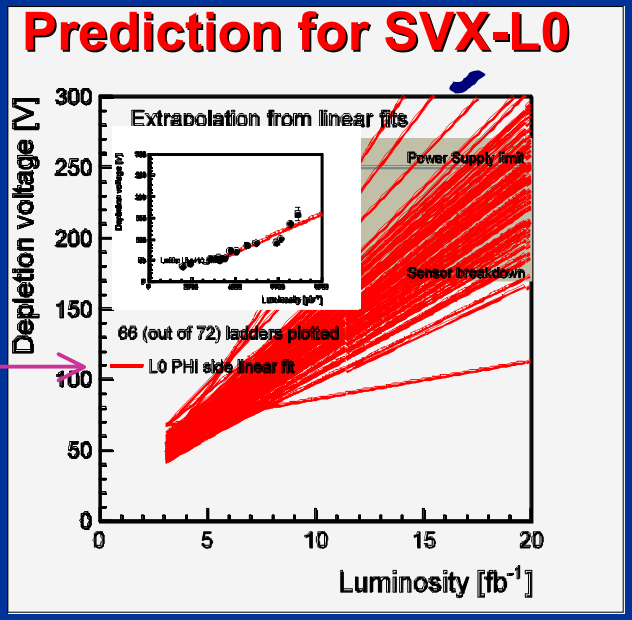
# Wire aging in COT (main drift chamber)

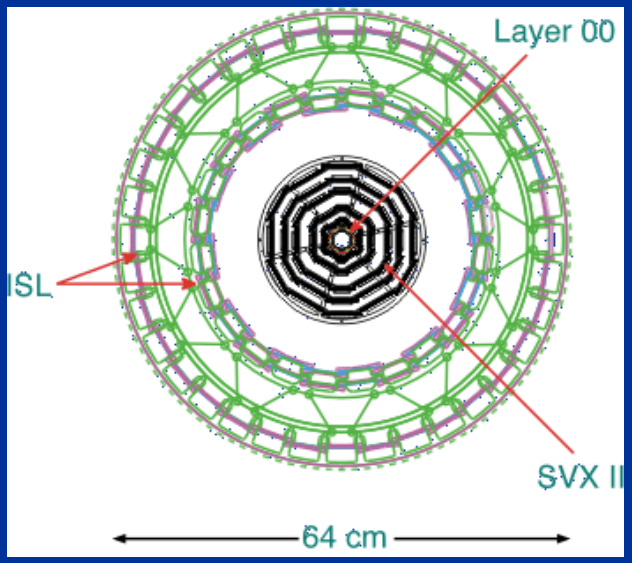
- Since the recovery after adding $O_2$, the gain is steady.
- Example of the many things that are running well



# Most significant detector concerns

we are here




1. Accumulated radiation damage to Layer-0 of the SVX may prevent us to fully deplete silicon.
   - Loss in efficiency - Loss in b-tag - Lost Higgs efficiency
   - ACTION: EVALUATED IMPACT ON HIGGS SENSITIVITY

2. Radiation Damage to digital optical transmitters (DOIM) may prevent reading out some parts of the detector
   - ACTION: STUDIED IN MORE DETAIL AND PLANNED A FIX

# An extreme scenario: L0 becomes unusable

- We need to evaluate how well we can perform b-tagging with a deteriorated L0

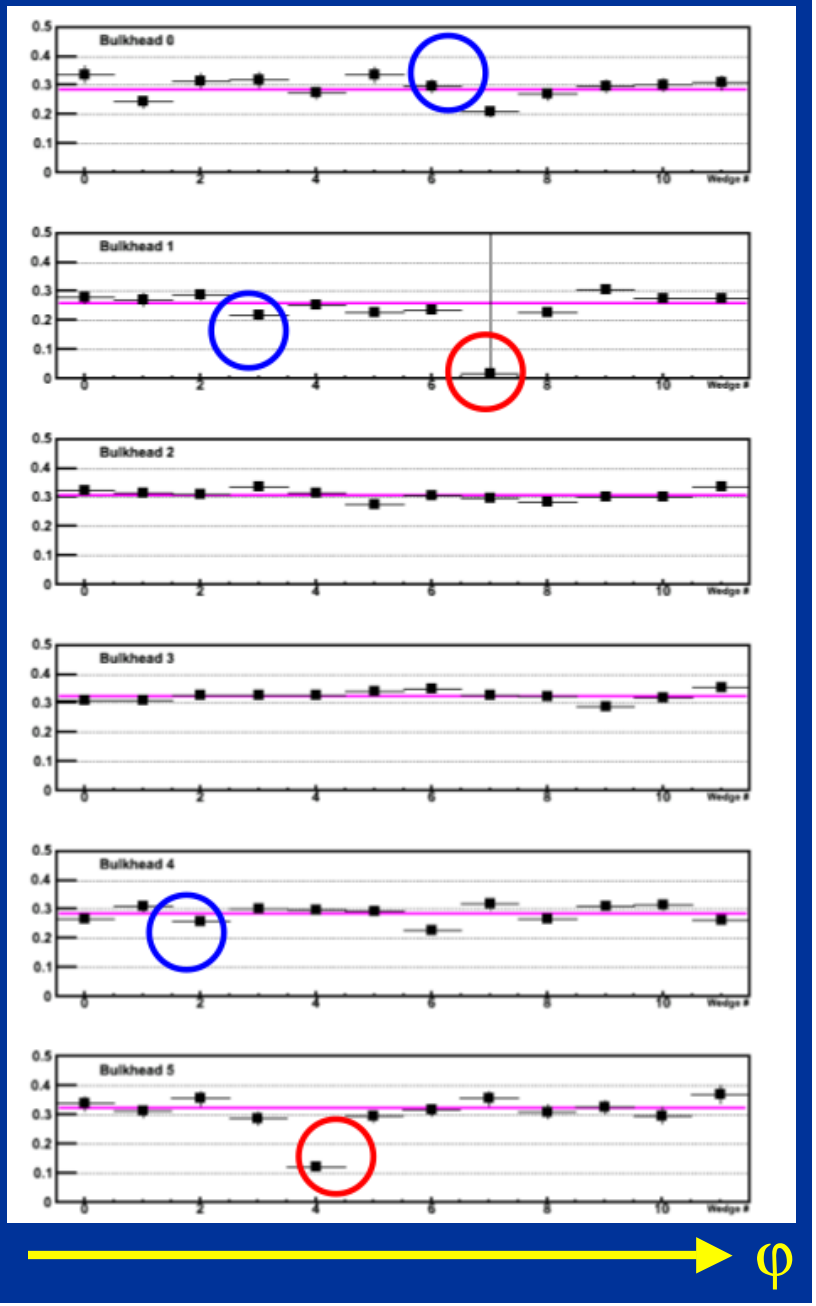
-We do this on REAL DATA, using a b-enriched jet sample tagged by a lepton

- We currently have 3 damaged SVX wedges where L0 is dead since long.

-Plot at right: b-tag efficiency as a function of the SVX wedge the jet is hitting.
(Separate evaluation of b-tag errors shows no statistically significant effect)

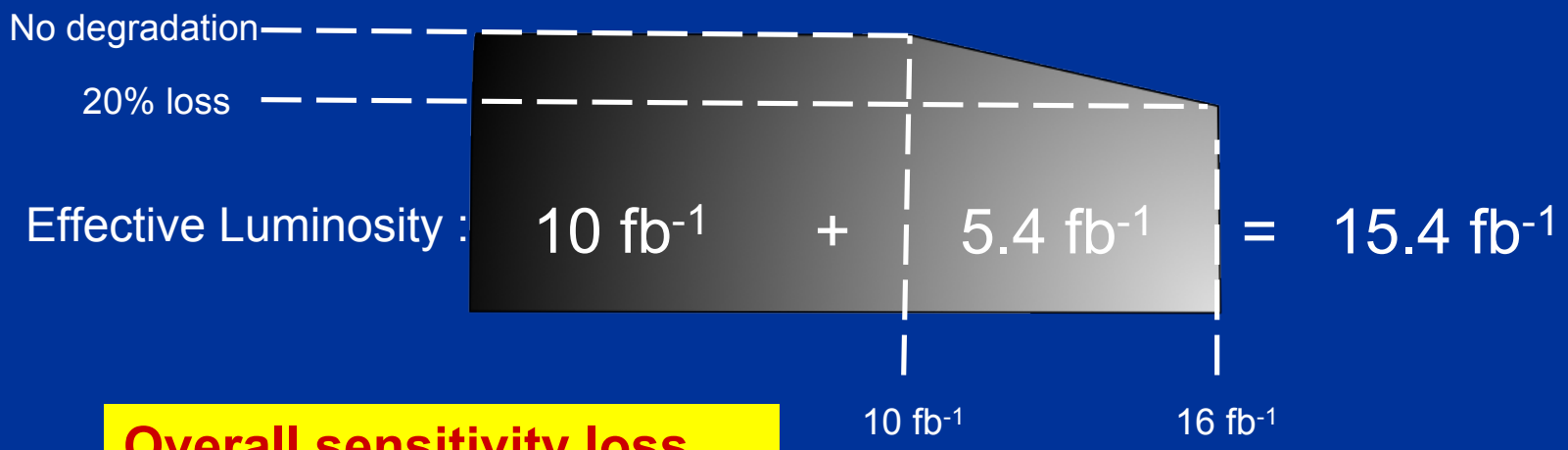
-Red circles: completely dead wedges.
-Blue circles: Layer-0 dead
- Line is fit to efficiencies for wedges by bulkhead, excluding damaged wedges.

-Even *loss* of L0 barely noticeable - we estimate it as a 10% effect.



# Effects on CDF Higgs sensitivity

- No degradation in first 10 $fb^{-1}$ of acquired data
  - Slow degradation in single b-jet tagging efficiency toward 10%
    - Implies 20% loss for pairs of tagged jets




**Overall sensitivity loss**

**at $m_H$ = 115 GeV : 2%**

**at $m_H$ = 135 GeV : < 1%**

**at $m_H$ = 160 GeV : ~0%**

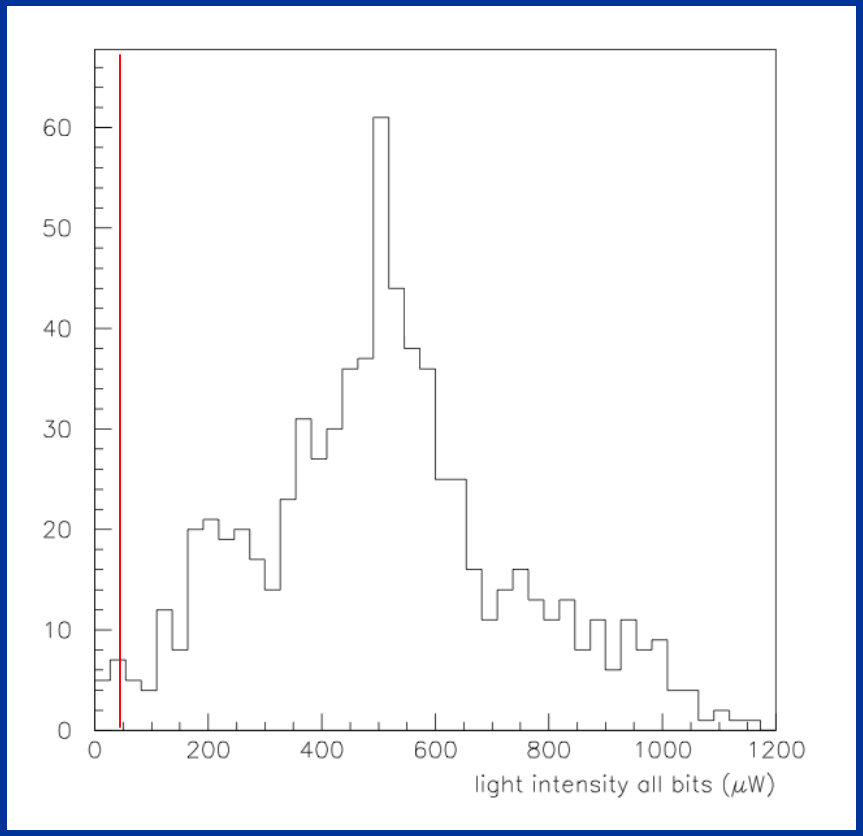
# Issue #2: Decline of Digital Optical transmitters

•They carry silicon detector digitized data to the readout system.

•We recently measured the light output of 1/4 of the channels in the SVX detector.

•Distribution of light output for all measured bits shows most are currently well above the threshold (red line), but we found a 25% decline over 7 $fb^{-1}$

-A few may be in danger of falling below threshold, preventing data readout for the corresponding portion of the SVX



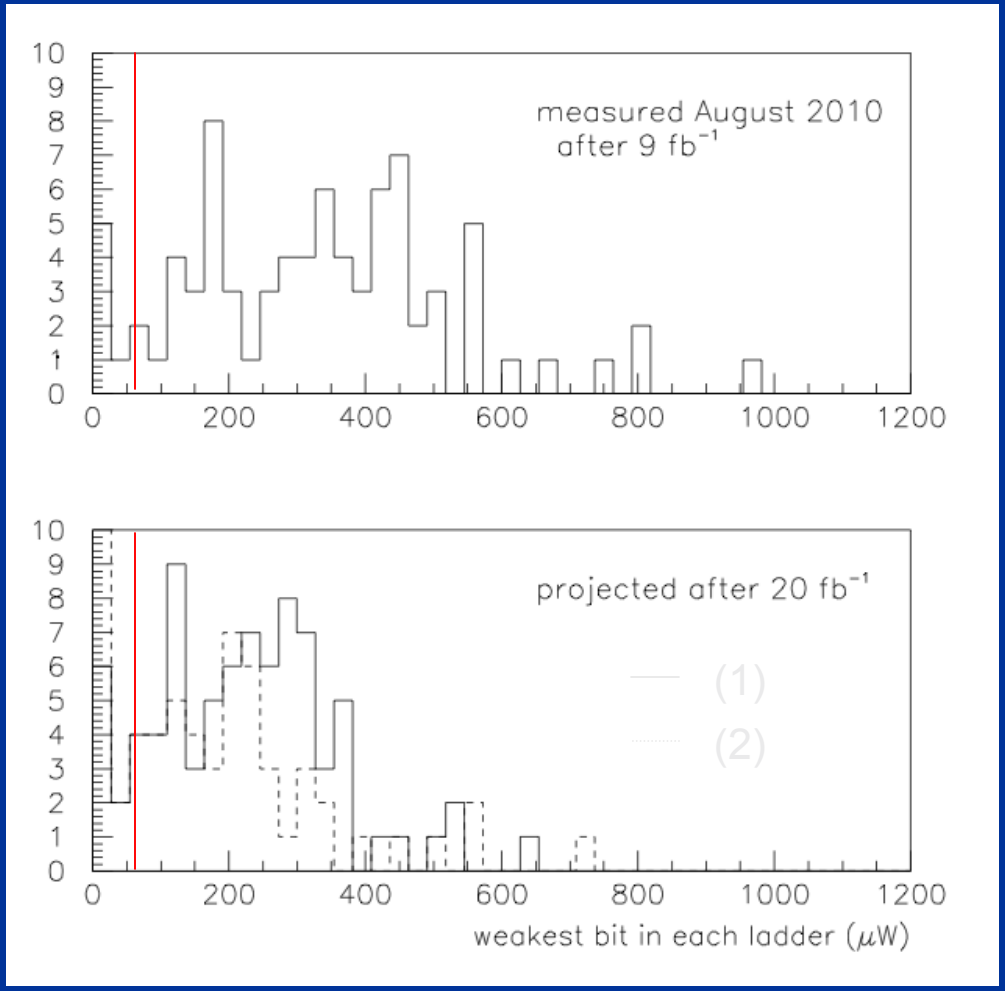
# Issue #2: Decline of Digital Optical transmitters

- The top plot shows the worst of all measured bits in all ladders

- Assuming <u>linear rate of decrease:</u>

  Only 1 of the 75 measured good ladders will be lost after 20 $fb^{-1}$

- However, we cannot be completely sure of this model, so there is a risk.




What if the worst scenario hits and we start losing several ladders towards the end of 2014 ?

# Remedy

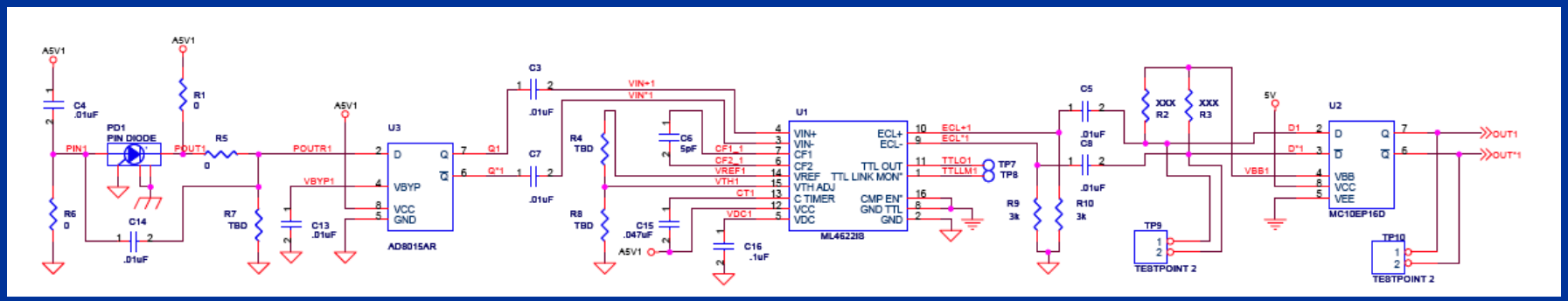
- We don't want to take any chances and have prepared a backup solution

- A new light-amplified board ("Bit Booster Board") with more sensitive light receivers (down to ~15 μW).

- The BBB will sit in the empty slots of current FTM crates, receive light from the TX's, treat each bit separately for amplification or attenuation, and re-emit light at levels appropriate to our current RX's.

- The design is finalized, and components have been ordered for a prototype, expected in about 1-2 months.

- With this board we are confident on no loss of ladders until well over 20fb$^{-1}$ (we actually expect to *recover* a few weak ones, gaining back some efficiency)



# The CDF Collaboration

**North America**

- 30 institutions

**Europe**

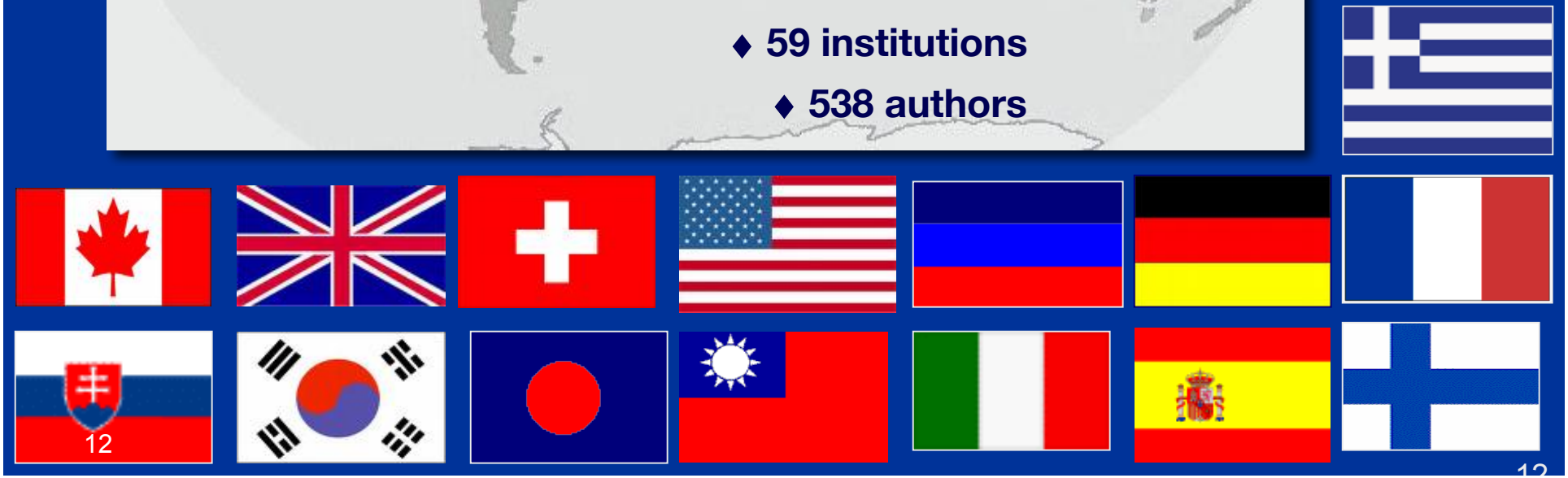
- 21 institutions

**Asia**

- 8 institutions

**The CDF Collaboration**

- 15 Countries
- 59 institutions
- 538 authors



# STRENGTH OF THE COLLABORATION

- Before June PAC meeting we performed a quick survey of the collaboration by email. Out of 59 institutions, 50 were interested in an extended run.

- In response to PAC request for a more accurate assessment we have taken a full survey, talking to every institution directly and discussing their projected involvement.

- We asked them to assume the following scenario:
  1. Tevatron run is extended for 3 years beyond 2011
  2. Their funding remains constant at 2010 level.

# CDF COLLABORATION projections

2009 Survey/ Current Survey /Actual

"RUN III"

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|
| Tot FTE | 292 | 249/278 | 191 | 141/184 | 179 | 176 |
| U.S. | 46% | 48%/51% | 50% | 46% | 46% | 46% |
| postdocs | 71 | 65/72 | 47 | 29/48 | 46 | 45 |
| students | 100 | 77/91 | 51 | 33/60 | 57 | 55 |
| fac. level | 121 | 107/115 | 93 | 79/76 | 76 | 76 |

- Actual 2010 numbers turn out larger than projected in 2009, staying at 2009 level. This has always been the case in past surveys.

**Notes:**

- #'s are in FTE
- faculty level = teaching and non-teaching faculty + lab scientists

# Effort Required to Operate CDF Today

| | Today |
|---|---|
| Operations | 40 FTE |
| Offline | 15 FTE |
| Management | 10 FTE |
| Algorithms | 10 FTE |
| Total Effort | 75 FTE |

- 40% less than a few years ago. Might still shrink a bit.
- This is the effort required to do everything in CDF operations except physics analysis
- This leaves 110 FTE for physics
- This is enough for Higgs analysis (30 FTE) and much more.

# SUMMARY

- CDF Detector degradation effects are very modest and their impact has now been explicitly incorporated in projections (see next talk).

- The CDF collaboration has enough strength to carry out the ambitious Run-3 program successfully.