

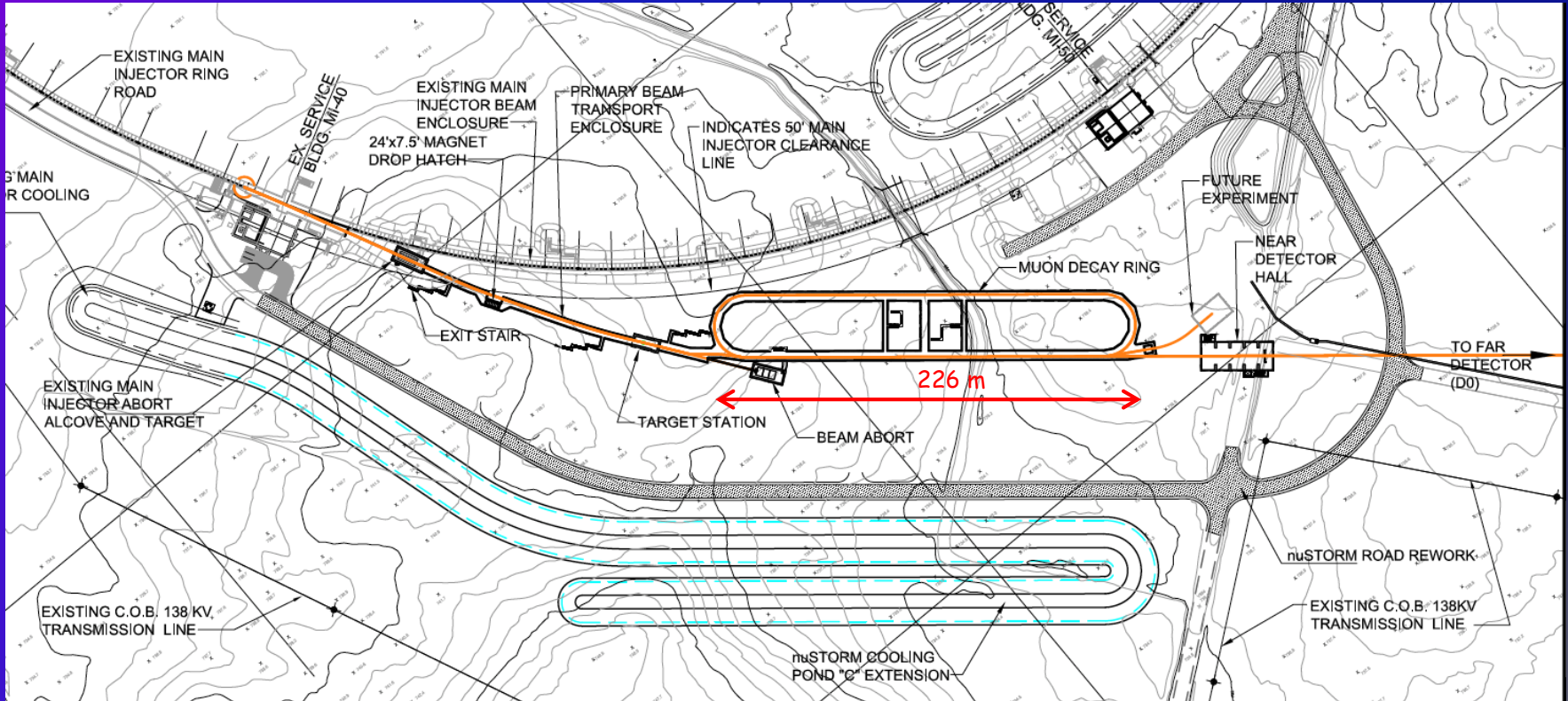
nuSTORM at FNAL: implementation

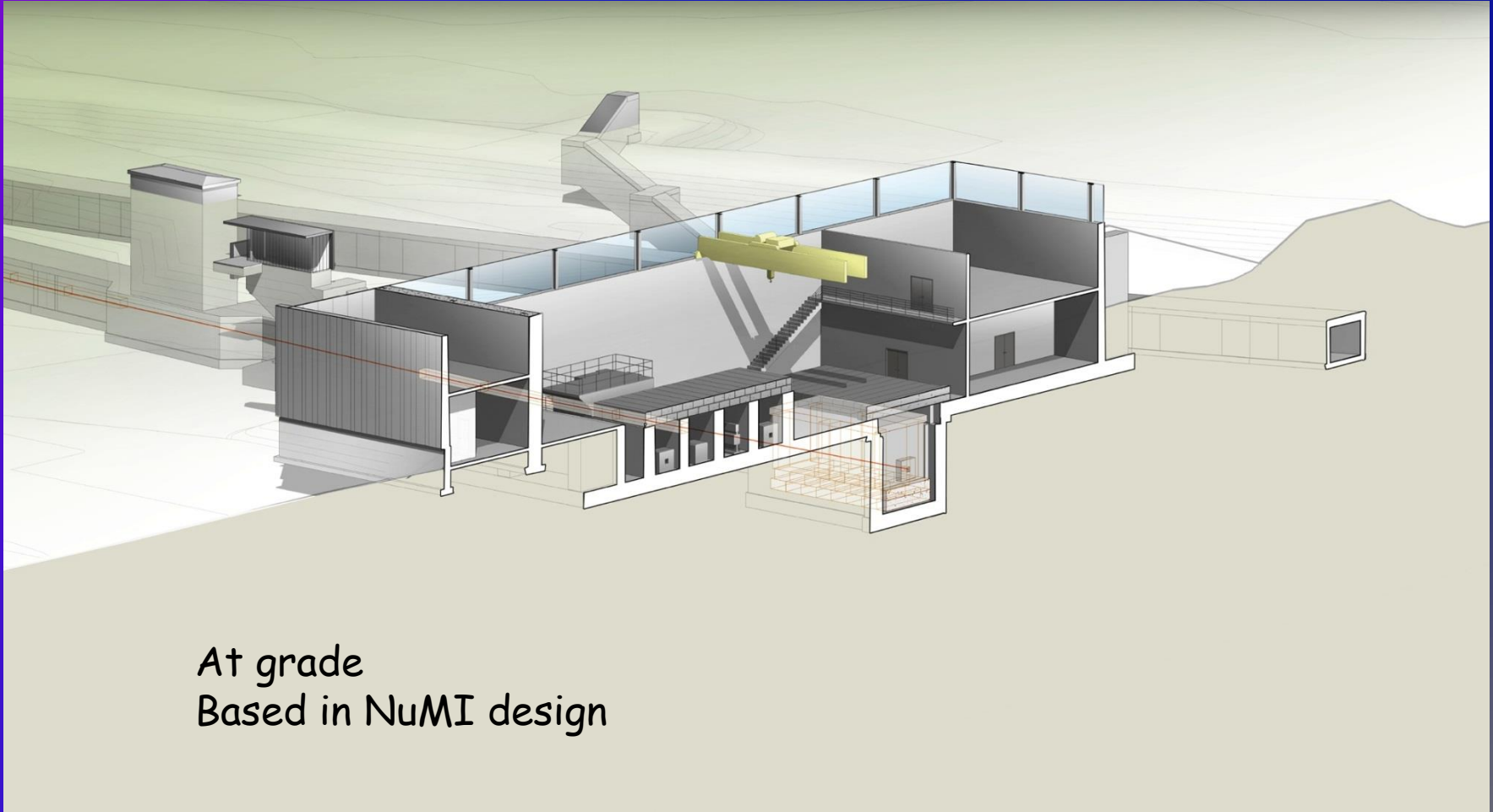
Plus some additional
thoughts



Funded siting study and delivered Project Definition Report

Site schematic



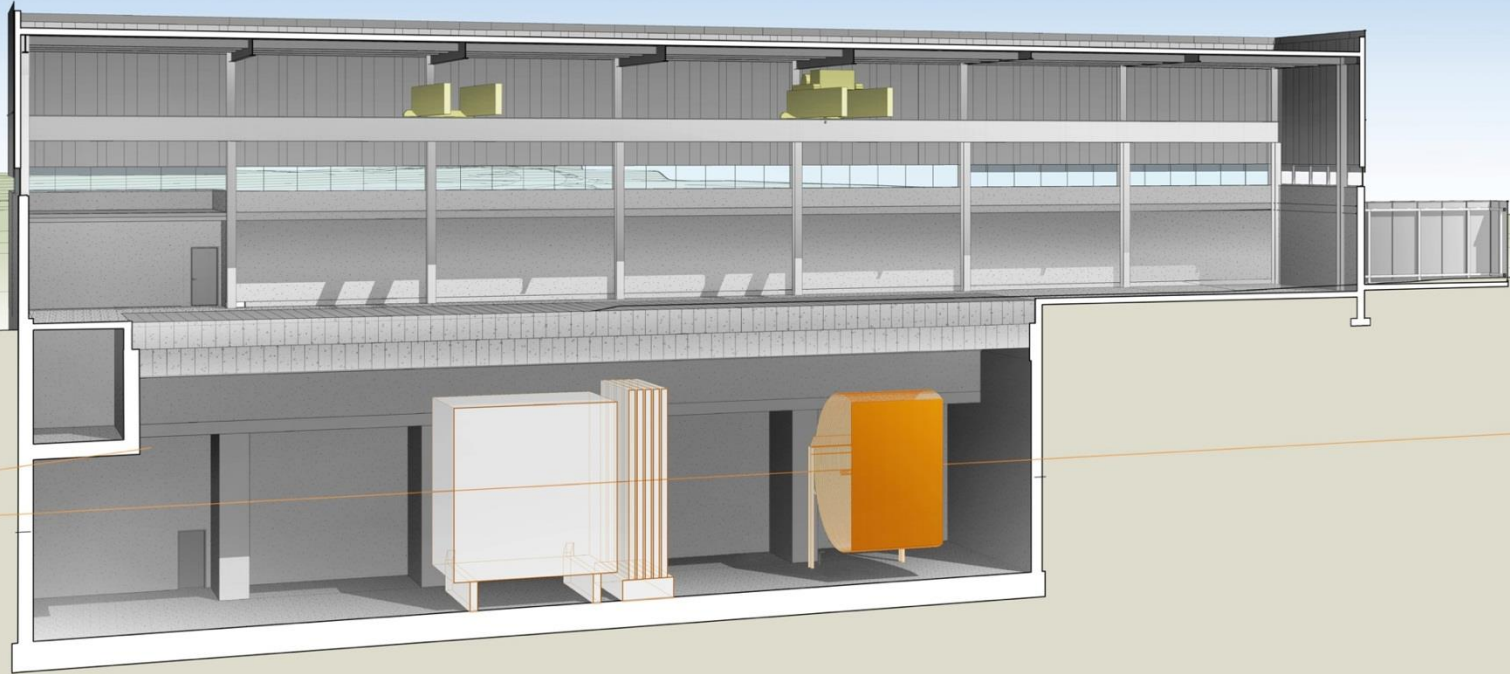


At grade
Based in NuMI design

Decay ring



Straightforward design
Sized to allow for multiple detectors



Far Detector Hall D0 Assembly Building



Costing

On the next slide all costs are given in US accounting methodology

1. All labor (fully burdened) included
 - Including Scientific
2. All M&S with over heads applied
3. All project management

Basis of Estimation

- Conventional facilities
 - Project Definition Report
 - Prepared by Fermilab Facilities Services Section (FESS)
- Cost estimates from AD for
 - Primary beam line
 - Target Station
- Cross-checks to LBNE
- Magnet Costs based on construction analysis for room temperature magnets and on Strauss & Green model for SC magnets (TD)
- With contingency

Sub System	Cost M\$
Primary Beam Line	28.5
Target Station	37.9
Transport Line	16.5
Decay Ring	135.2
Near Hall	23.5 ¹
SuperBIND	27.1 ²
Site work	27
Other	2.5
Sub Total	298.2
Management	37.1 ³
Total	335.3

Total contingency - 45%

¹Near Hall sized for multiple experiments & ND for SBL oscillation physics

²1.3kT Far + .2kT Near & include DAB work

³Assumes LBNE estimates: Proj. Office (10%), L2 (9.4%), L3 (4%)

Association for the Advancement of Costing Engineering (AACE)

Developing the Cost Range

ESTIMATE CLASS	Primary Characteristic		Secondary Characteristic		EXPECTED ACCURACY RANGE Typical variation in low and high ranges. ^N
	DEGREE OF PROJECT DEFINITION Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method		
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%	
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%	
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%	
Class 2	30% to 70%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%	
Class 1	70% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%	

LBNE CD-1 Director's Review - 25-27 September 2012

Bob O'Sullivan

nuSTORM 2017

MISSION NEED?

"Who ordered it?"

Three Pillars of nuSTORM?



1. Delivers on the physics for the study of sterile ν
 - The allowed region has become very small (0?) and each new measurement has added new constraints
2. Can add significantly to our knowledge of ν interactions, particularly for ν_e
 - Too little too late?
3. Provides an accelerator technology test bed
 - Maybe, if that is the direction you want to go

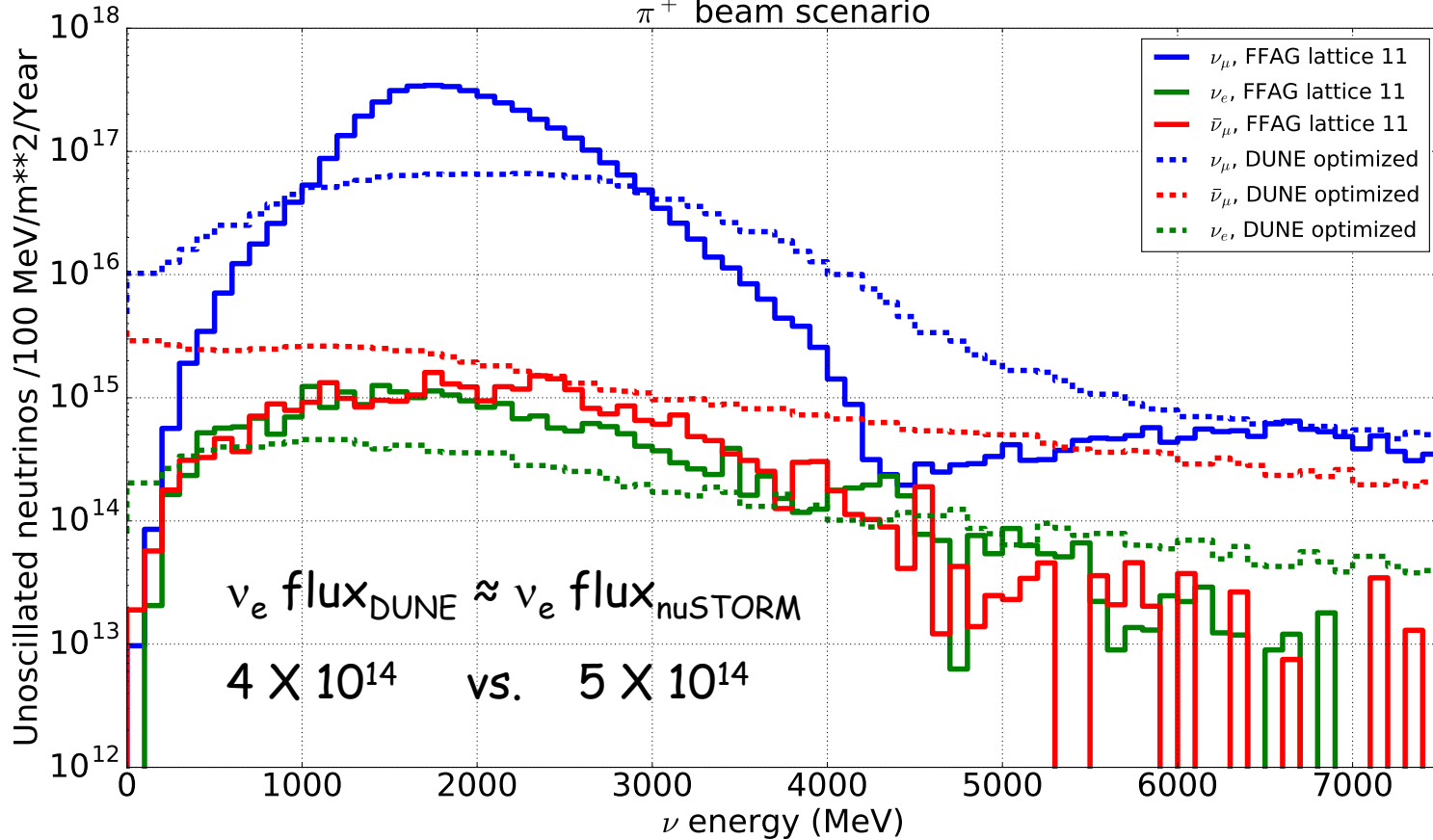
RE: ν interaction physics

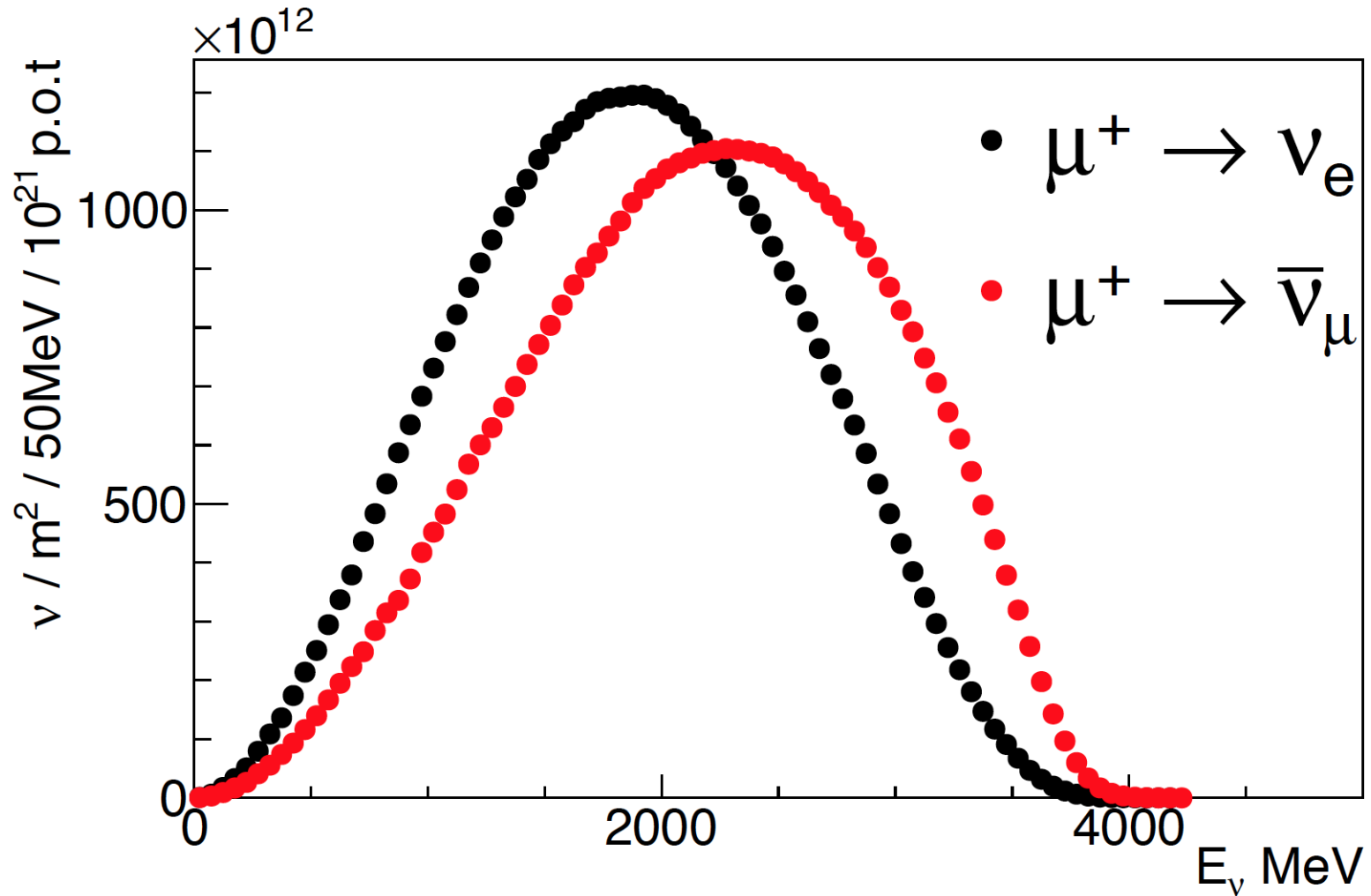
Near Detector Physics at DUNE

- Very powerful ND now being considered
 - Large 10 ATM TPC
 - .5-1T B field
 - Intrinsic Particle ID
 - Calorimetry inside the magnet
 - Muon system
 - Looking like a collider detector
- Will have great capability for ν interaction physics
- ν_e flux \approx to what is obtained at nuSTORM with ~ 200 kW

- Questions:
 - Are backgrounds manageable?
 - Rock neutrino interactions
 - Mixed beam
 - Detectors measure Flux \times σ
 - How well will Flux be known?

Neutrino flux at the super near detector (50 m)
 π^+ beam scenario

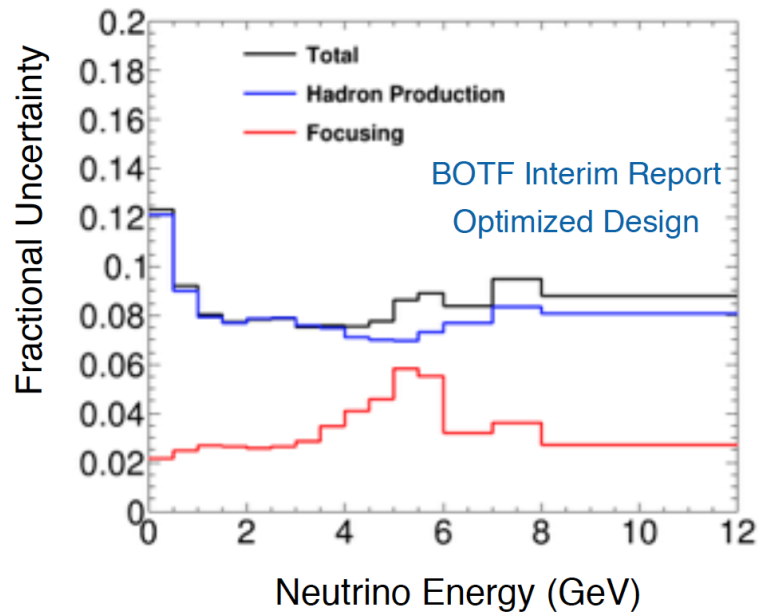




- So, the flux is same
- How well is it known (DUNE vs. nuSTORM)?
 - We have always said 5-8% for conventional beam vs. 1% or less for nuSTORM
 - DUNE now says ~ 8% at peak

DUNE flux uncertainties

- Our current estimates of neutrino flux uncertainties:



About 8% in the focusing peak

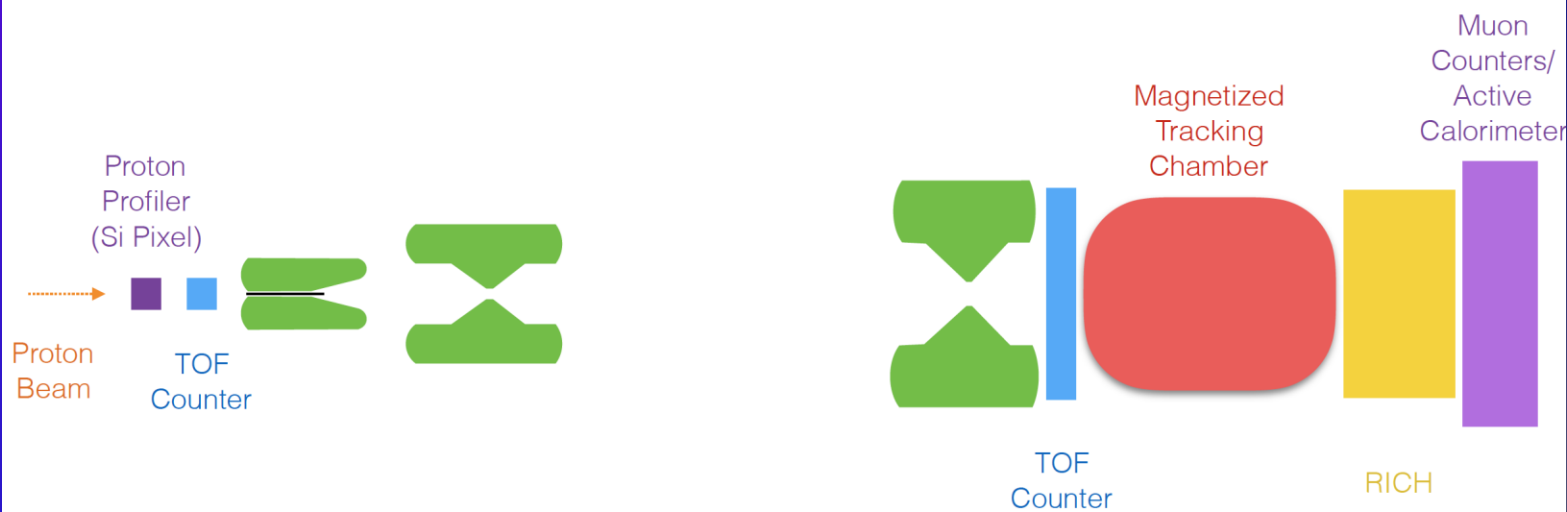
Laura Fields plenary talk
at CERN DUNE CM in Jan

Can they do Better?

The Concept

- Another possible configuration:

Laura Fields plenary talk
at CERN DUNE CM in Jan



Get flux uncertainties down to ~ few percent?

- ν interaction physics reach
 - Not more flux - better flux/beam
- But the bar is now likely raised
 - 1% is not compelling if DUNE eventually gets to a few %
 - Is 0.1% possible?
- During the nuPIL discussions with DUNE, there was skepticism that 1% flux determination was obtainable
 - Not demonstrated
- Key requirement in establishing mission need for nuSTORM
 - Detailed and exhaustive MC showing flux uncertainty

- First step in path to a future muon facility ($\mu^+\mu^-$)?
 - Very Hard Sell (in my opinion)
 - Certainly in the US at this time
- Steriles
 - Dead parrot, for now. Could change rapidly, if something positive comes out of Fermilab SBN program

Conclusion

- The most important (only?) near-term goal/requirement for nuSTORM is to establish "Mission Need" within the greater neutrino community.
 - Robust & convincing demonstration of flux precision.
- Technically it is on very sound footing.
- Costs are understood at a level more precise than usually found for a project without having mission need clearly established.
- Finally - we will continue to fight the argument that the LBL experiments will do "Good Enough"