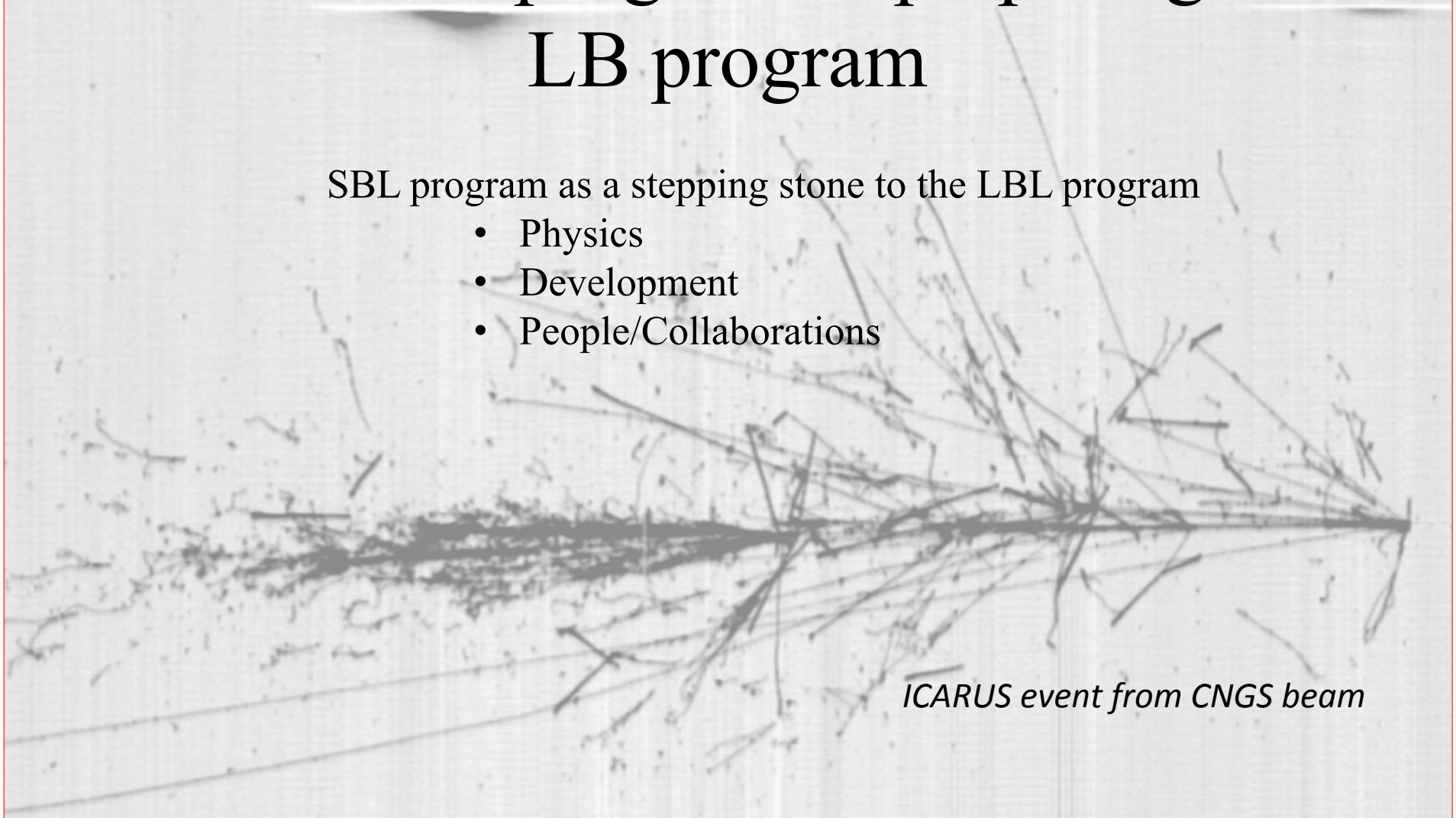
# Role of SB program in preparing for LB program

SBL program as a stepping stone to the LBL program

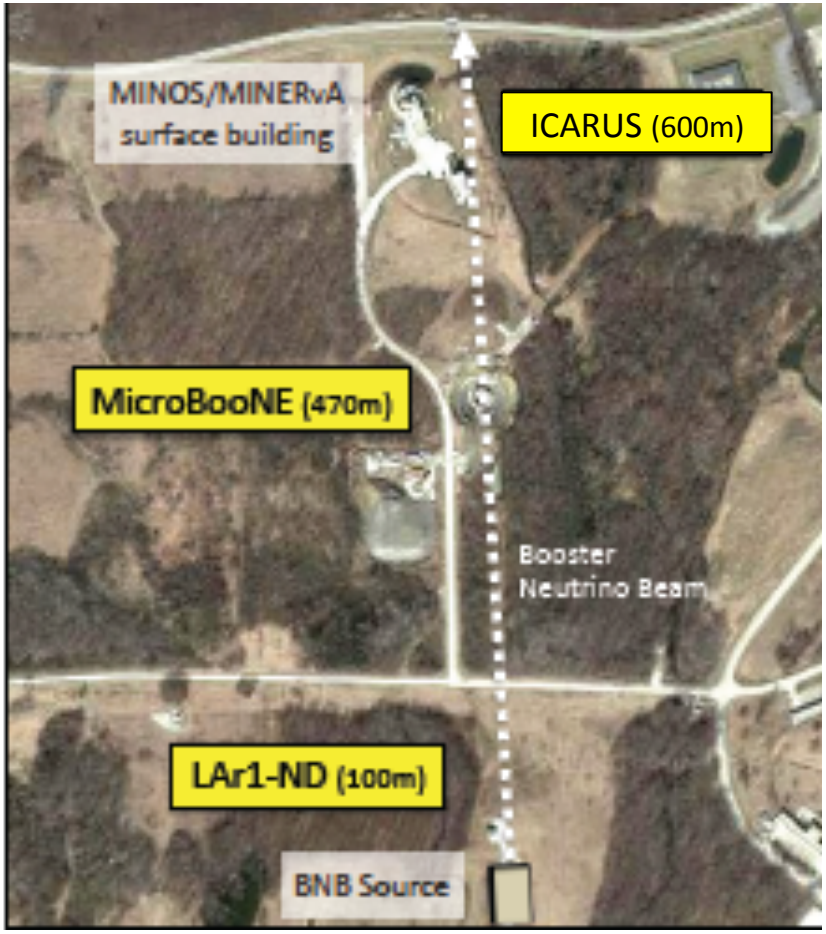
- Physics
- Development
- People/Collaborations



*ICARUS event from CNGS beam*

Bonnie Fleming and Carlo Rubbia

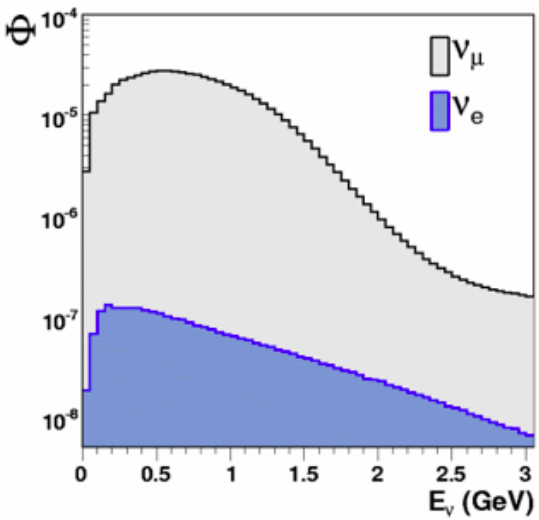
# Short Baseline BNB Physics




- LAr1-ND
  - 110m from the BNB target
  - ~150 ton LArTPC
  - CDR under development
- MicroBooNE
  - 470m from BNB target
  - ~170 ton LArTPC
  - Data taking in 2015
- ICARUS
  - 600m from BNB target
  - 600+ ton LArTPC
  - CDR under development

- Program of short baseline neutrino oscillation and neutrino scattering measurements
- Development program for LArTPC detectors

*Goal: CDR for program to present to the January PAC*

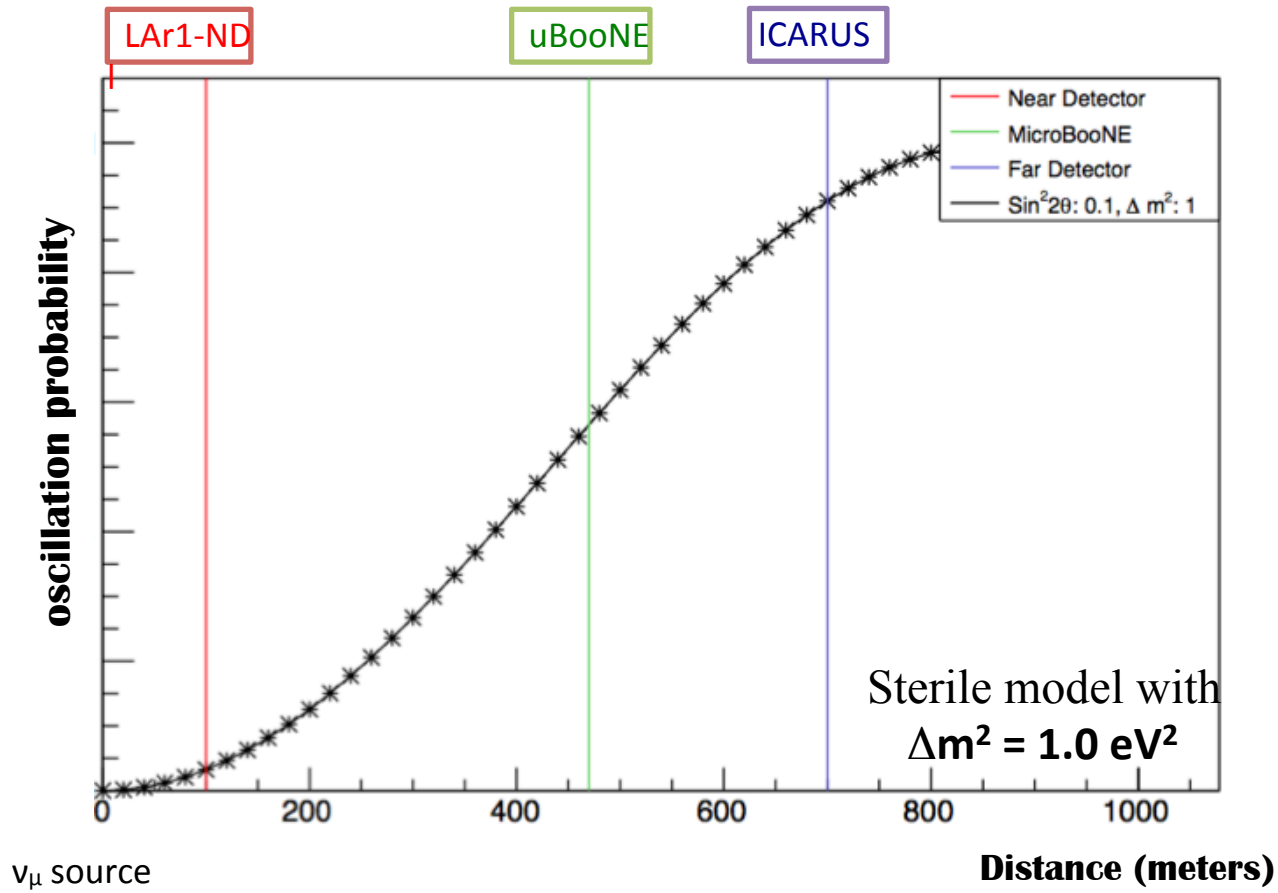



# Near/far comparison for $\nu_e$ appearance and $\nu_\mu$ disappearance
# High Statistics neutrino scattering meausrements (eg:1M events/year in LAr1-ND)

With MicroBooNE: determine the nature of the low energy excess

With LAr1-ND, MicroBooNE, and ICARUS Address the entire allowed region of LSND at 5σ

High statistics neutrino scattering measurements at low energy



# SBL as a stepping stone to LBL

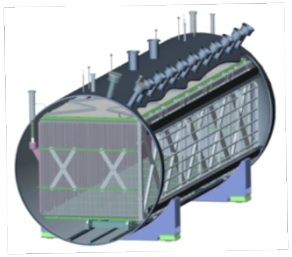
**Short Baseline**
***L/E ~1 km/GeV***
Hints of sterile neutrinos
New physics?
Neutrino interactions…

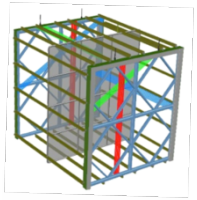
**Long Baseline**
***L/E > 1000km/GeV***
Measuring Mass Hierarchy and Looking for CP Violation

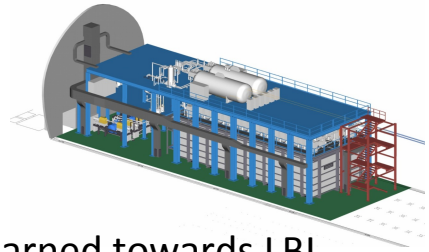
$\nu_\mu \rightarrow \nu_e$ appearance experiments
$E_\nu$ 1-10 GeV
Precision detectors: Liquid Argon TPCs

# LArTPC Development towards LBL

Conventional ICARUS style detectors, building on experience from ICARUS towards new developments for LBL







- MicroBooNE:
  - Builds on ICARUS T600 design
  - Cold front end electronics
  - Purity in un-evacuated, instrumented vessel
- LAr1-ND
  - Membrane cryostat
  - Cold front end + multiplexing
  - APA-like design for TPC, light collection system development
- ICARUS
  - Re-furbished detector
  - Cryo system for ICARUS and LAr1-ND from CERN with lessons learned towards LBL

All three: Test new ideas and gain experience for building larger LArTPCs, develop/refine reconstruction tools, produce timely physics results

(Other test beam efforts underway as well: 35 ton, LArIAT, CAPTAIN, new ideas….)

# MicroBooNE Collaboration + Project Team

*Brookhaven:* M. Bishai, H. Chen, K. Chen, S. Duffin, J. Farrell, B. Kirby, F. Lanni, Y. Li, D. Lissauer, G. Mahler, D. Makowiecki, J. Mead, M. Mooney, X. Qian, V. Radeka, S. Rescia, A. Ruga, J. Sondericker, C. Thorn, B. Yu, C. Zhang

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*Fermilab*: R. Acciarri, L. Bagby, B. Baller, D. Bogert, B. Carls, H. Greenlee, C. James, E. James, H. Jostlein, M. Kirby, S. Lockwitz, B. Lundberg, A. Marchionni, S. Pordes, J. Raaf, G. Rameika+, B. Rebel, A. Schukraft, S. Wolbers, T. Yang, G.P. Zeller*

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*Otterbein University*: N. Tagg

*University of Oxford*: G. Barr, M. Bass, R. Guenette

*University of Pittsburgh*: S. Dytman, D. Naples, V. Paolone

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*Saint Mary's University of Minnesota*: P. Nienaber

*SLAC*: M. Convery, B. Eberly, M. Graham, D. Muller, L. Rochester, Y-T. Tsai, T. Usher

*Syracuse University*: J. Asaadi, J. Esquivel, M. Soderberg

*University of Texas at Austin:* S. Cao, J. Huang, K. Lang

*University of Bern, Switzerland:* A. Ereditato, D. Goeldi, I. Kreslo, M. Luethi, C. Rudolf von Rohr, T. Strauss, M. Weber

*INFN, Italy:* F. Cavanna, O. Palamara *(currently at Yale)*

*Virginia Tech:* M. Jen, L. Kalousis, C. Mariani. R. Pelkey

*Yale University*: C. Adams, E. Church, B. Fleming*, E. Gramellini, A. Hackenburg, B. Russell, A. Szelc

total team (collaboration + project):

3 countries: US, INFN, Switz.

24 institutions

137 collaborators

(includes project team)

32 postdocs

24 grad students

* spokespeople,

\+ project manager

# The LAr1-ND Collaboration

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**University of Oxford:** R. Guenette
**University of Pennsylvania:** J. Klein
**University of Sheffield:** T. Gamble, J. Klinger, V..A. Kudryavtsev, N. McConkey, S. Pal, J. Perkin, M. Richardson, N. Spooner, M. Thiesse, L. Thompson
**Virginia Tech:** C.M. Jen, L.M. Kalousis, C. Mariani
**Yale University:** C. Adams, F. Cavanna, E. Church, B. Fleming, A. Hackenburg, A.M. Szelc

including scientific and technical personnel
*spokespeople

82 Collaborators from 20 institutions
12 US, 6 UK, 1 Swiss, CERN

# The ICARUS Collaboration

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11 INFN, 4 Poland, 2 US, 1 Russia, CERN

# Summary

- SBL experiments brings early physics and development en route to LBL program
  - Development test-beds for technology
  - Physics measurements and reconstruction development
  - Coordination of analysis efforts (near/far comparison)
  - Fostering collaboration on physics and technology

*Program: model for International collaborations working together to fund, build, and analyze data*