Tips on How To Poster

Fernanda Psihas

My own views + most common poster advice from people "in the know"

Why poster sessions?

Posters are exactly a format where the audience can learn about something in more depth than a plenary talk usually allows.

Experiments are complex and not all interesting things are shown in results talks! On posters we can show details about the experiment (or your project)

Good way to go to a conference if your point is not quite “talk-worthy”

Some conferences only have poster sessions (talks are by invitation).

You want to show a small study or geek out about a particular concept.

Good practice to talk to people about your project.

Before you begin:

How long will people spend on my poster?

$$TTC = \frac{\text{Number of posters}}{\text{Length of the poster session}}$$

Time To Care

$$TTC_{UsersMeeting} = 2.5\ min$$

$$TTC_{NEUTRINO2018} = 0.47\ min$$

OK, fine. You'll go use the restroom(3 min), get a snack/drink(5 min), run into your buddy (2 min) then look at the posters which look interesting (20 sec/poster).

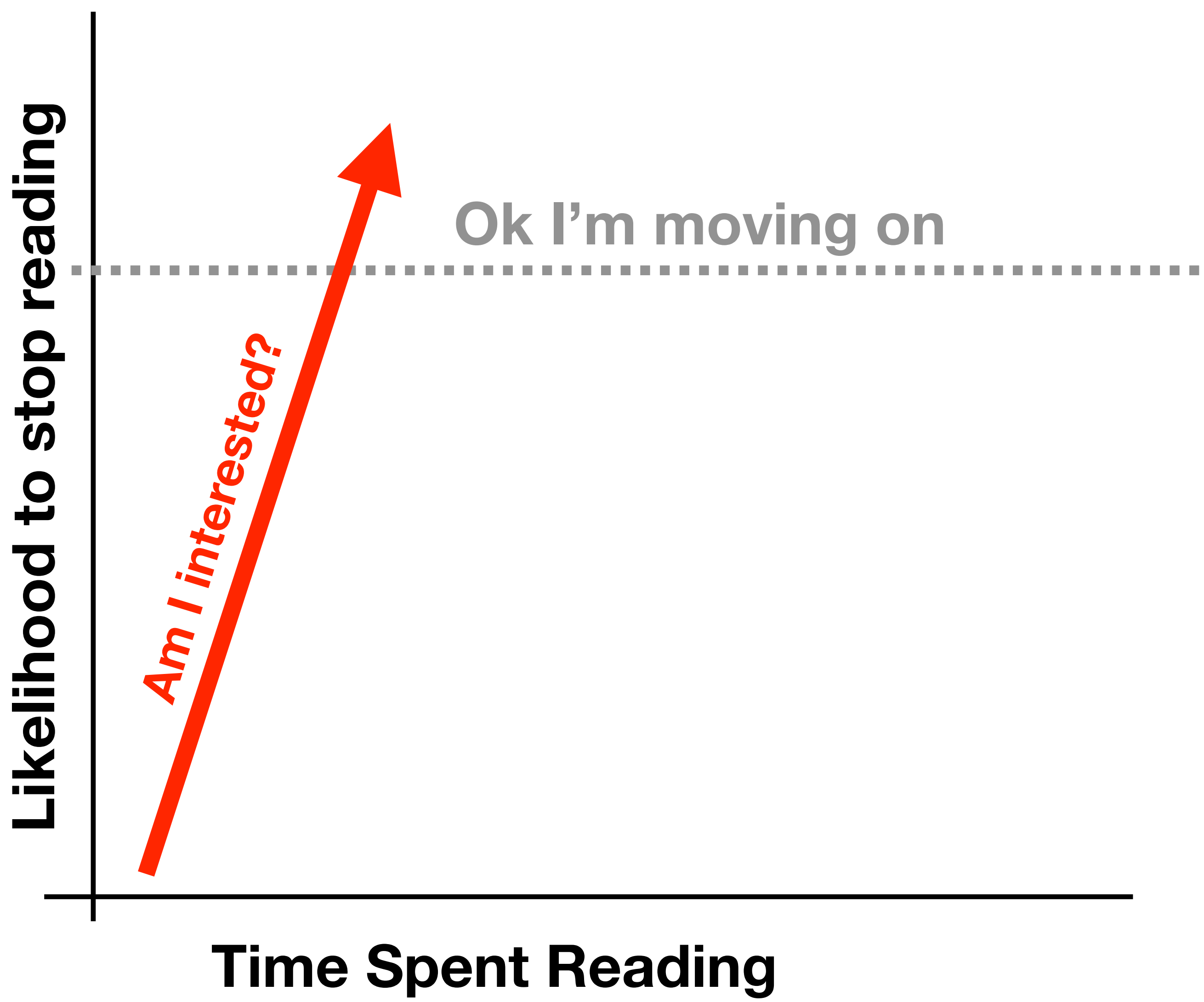
$$MTTC = \frac{\text{Number of interesting looking posters}}{\text{Remaining Length of the poster session}}$$

Modified TTC

$$MTTC_{UsersMeeting} = 4\ min$$

$$MTTC_{NEUTRINO2018} = 0.98\ min$$

Content



Title & Abstract:

Consider the conference selection process.

Deliver your message up front.

Poster author lists: Usually preseneter(s) + "For the NOvA Collaboration" but ask your advisor & convener first!

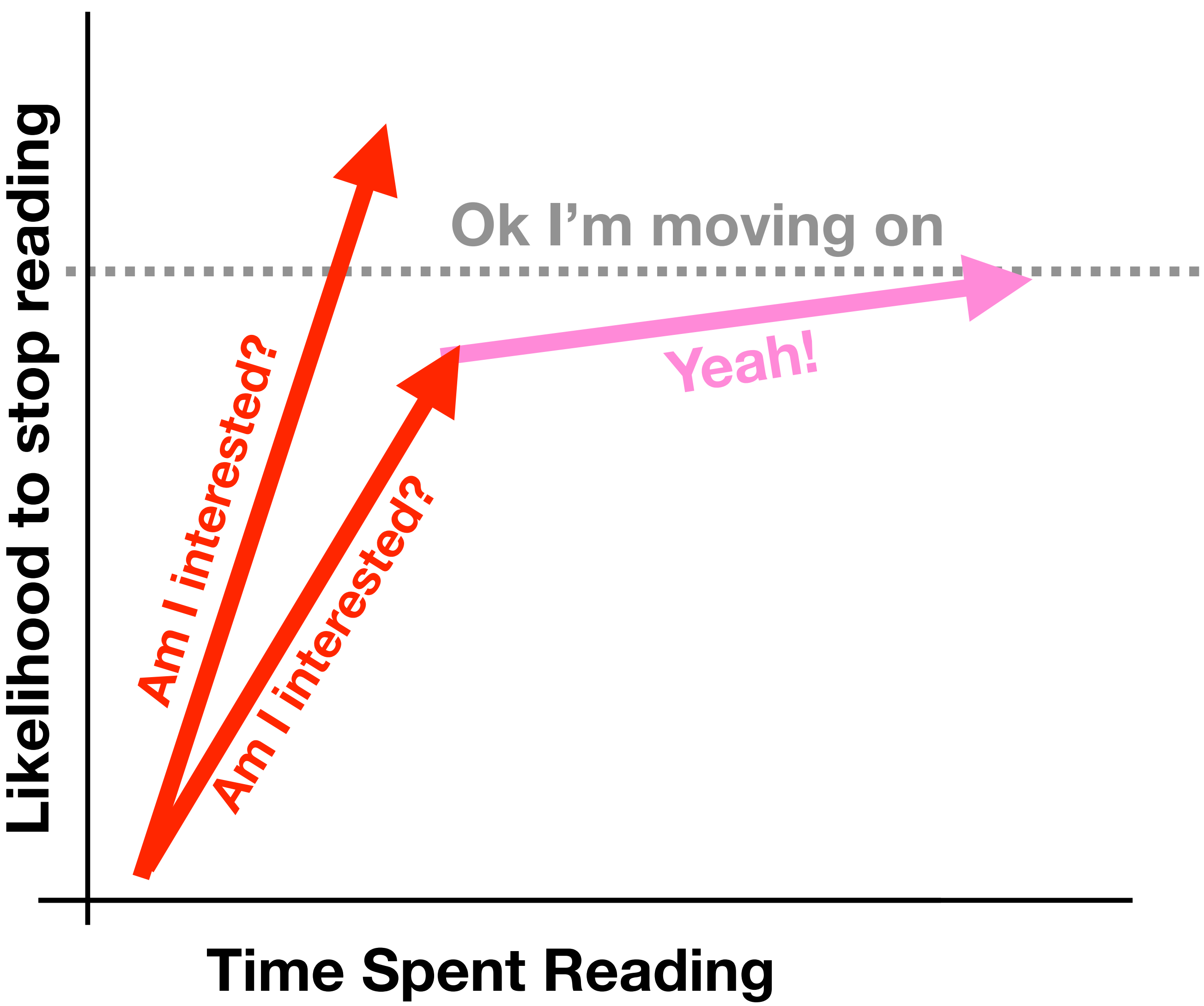
Content etc:

Plan before you write.

Think carefully about your message.

What other posters are at this session?

Content



I usually know if I am interested after ~20 sec of skimming

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What other posters are at this session?

What your poster should answer on it's own.

Where should I start reading?

Why do I care?

What is your point?

What order should I read in?

Your tools to deliver that message:

Editor: Invest in becoming familiar with your tool.

**I recommend Adobe Illustrator. Power point, keynote are also used commonly. Some people swear by beamer…

There is no best tool. Only tools you are more familiar with.

Figures, plots and word content.

Style choices.

Your own presentation.

Style and figures are your #1 tool to efficiently deliver your message

Tips for using those tools

Look at other posters, see what you like and what helps deliver the message.

Use appropriate text size. Consider printing parts of your poster and checking it out.

Alignment: Guides your eye and determines hierarchy.

Colors: Consider limiting color usage to serve a purpose.

Space: Use it hierarchically and efficiently.

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Style is not just about "pretty" it's about efficiency to communicate

Content tips and good practice

Don’t say too much

Making your sentences short & to the point.

Add context, point to other posters.

Try to factorize content into sections that people can focus on per their interest.

Don't cram too much in, but don’t shy away from technical details.

Assume no previous knowledge, but don’t explain every detail.

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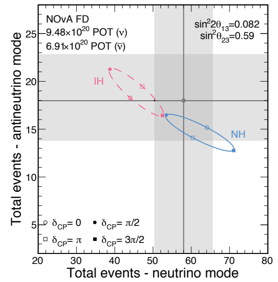
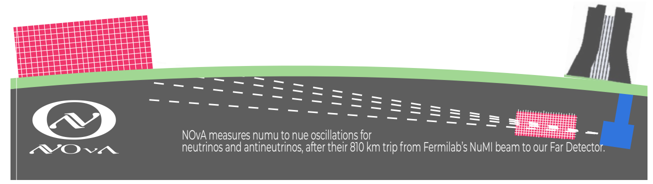
Don’t forget!

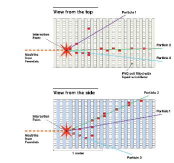
Thank yous!
Logos.
References.
QR codes/links

Neutrino Physics with Deep Learning on NOvA

NOvA's Measurement







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Oscillations measurements rely on flavor identification, event reconstruction, and energy reconstruction, for which we employ deep learning techniques.

The NOvA detector is a tracking calorimeter of extruded PVC filled with liquid scintilator. When a charged particle passes through the scintilator, it emits light which can be detected.

Event Classification

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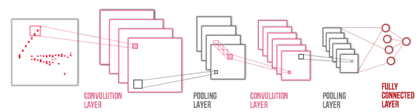

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Training labels from final state, not GENIE.

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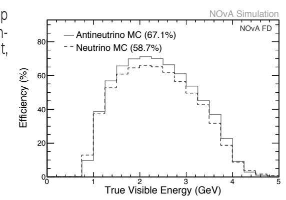

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Table showing improvements in efficiency obtained for antineutrino selection for antineutrino vs neutrino trained networks.

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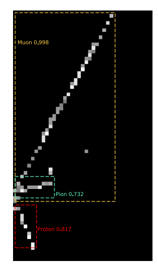
One network: particle ID, clustering, & reconstruction



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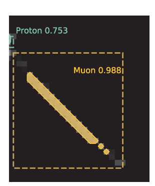

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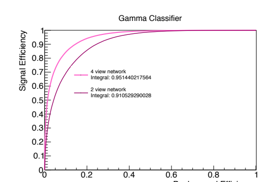

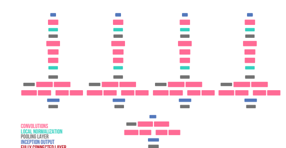

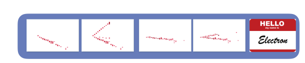

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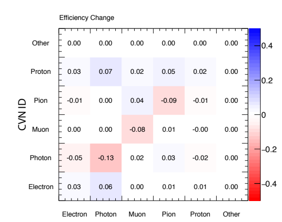

Classification matrix for NOvA's single particle classifier. The diagonal elements show the change in efficiency for each possible category when including the event in the training input.

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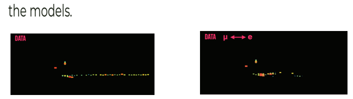

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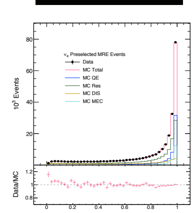

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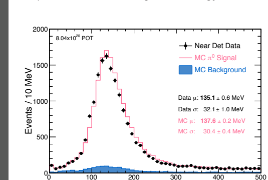

The reconstructed invariant mass of neutral pions in the NOvA near detector.

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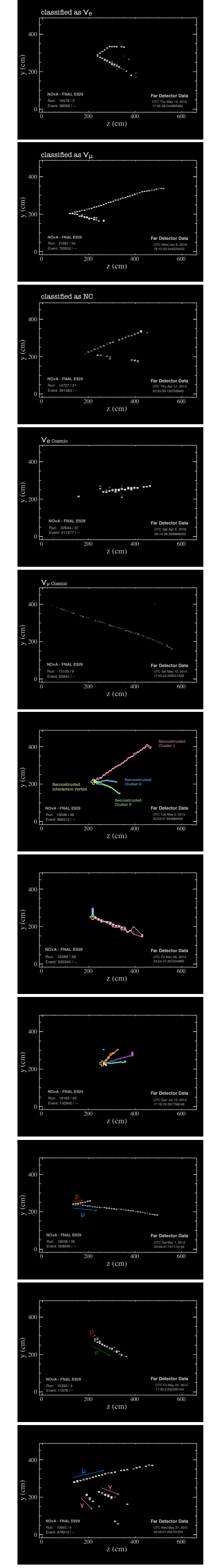

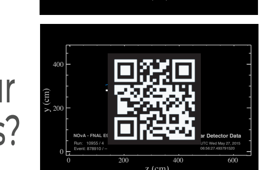

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Alignment

Use of color

Use of sizes

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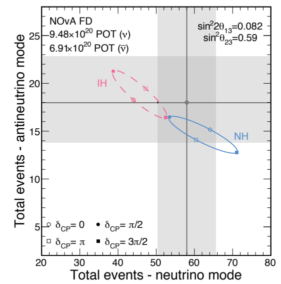

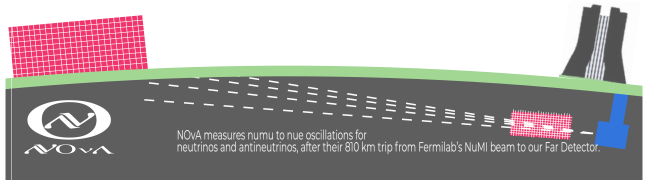

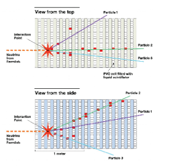

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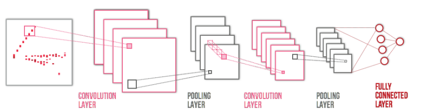

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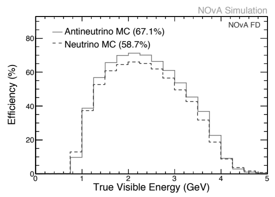

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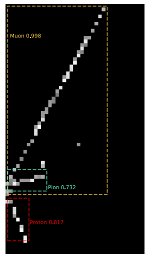

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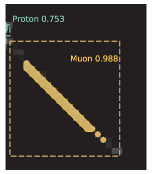

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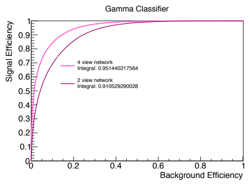

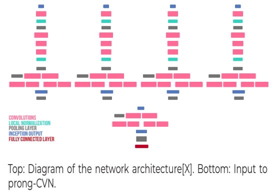

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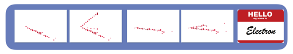

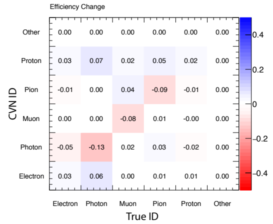

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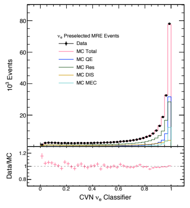

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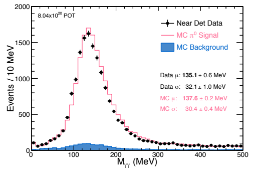

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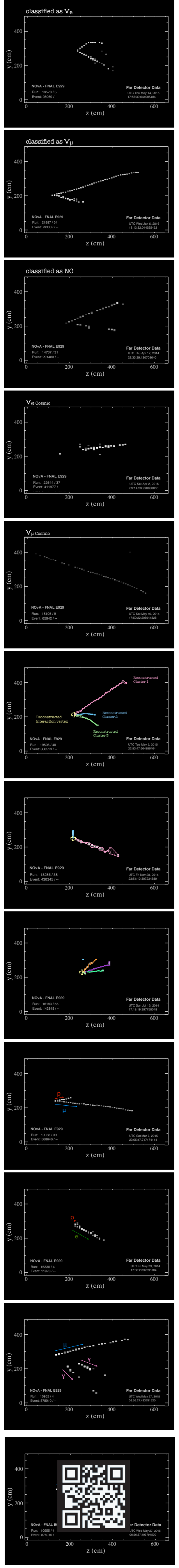


Too much info?

Too much text?

Observing Neutrinos from the Next Galactic Supernova with the NOvA Detectors

MOTIVATION

Supernova neutrinos carry reavling information
- nuclear conditions in the core
- shockwave propagation
- explosion mechanism
- oscillations & mass hierachy
- ν–ν interactions & collective effects

Core collapse supernovae
- occur 2–4 times per century
- can outshine galaxies
- releases 99% of its energy as neutrinos

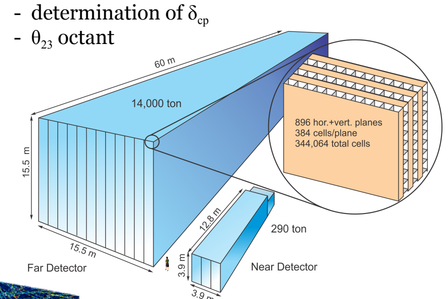
rarity ⊗ priceless data = incredible opportunity

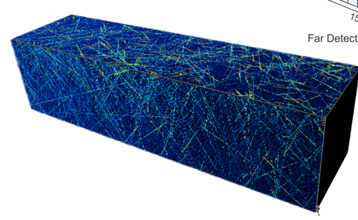
THE NOvA DETECTORS

The NOvA Near and Far detectors are located at Fermilab and Ash River, MN, separated by a distance of 810 km.

*NuMI **O**ff-axis ν_e Appearance*
- two segmented, functionaly-equivalent liquid scintillator ν detectors
- baseline: 810 km (1[st] $\nu_\mu \rightarrow \nu_e$ osc. maximum)
- energy: 2 GeV

Primary physics goals
- measurement of mass hierarchy
- determination of δ_{cp}
- θ_{23} octant

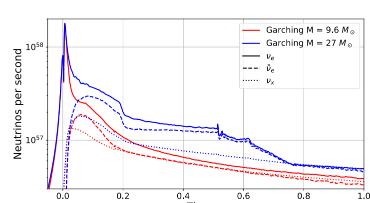


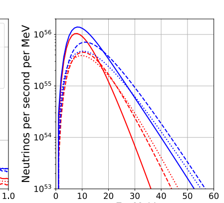


Above
The NOvA detectors: 300 ton near detector dwells 100 m underground. 14 kton far detector sits on the surface, with a modest barite overburden.

Left
5ms of cosmic activity in the far detector. Identifying small, low-energy clusters of hits in this background is a significant challenge to reconstructing supernova neutrinos.

SUPERNOVA NEUTRINOS





Simulated SN neutrino characteristics based on Garching[1] simulation for two progenitor masses.

Left
Time profiles for various neutrino flavors during the first second after core bounce.

Right
Energy distribution peaks around 10–20 MeV and most energies are less than 100 MeV.

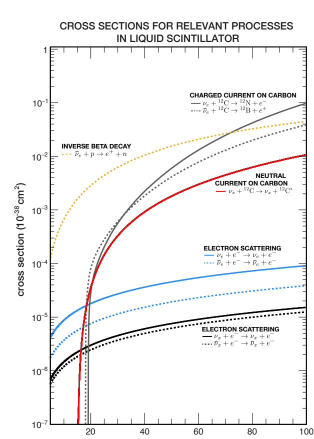
Signal characteristics
- energy: ~10–100 MeV
- timescale: 10s of seconds (burst within 1s)

Interaction channels

Channel	Events Far	Events Near
$\bar{\nu}_e + p \longrightarrow e^+ + n$	2,163	46
$\nu_x + e^- \longrightarrow \nu_x + e^-$	199	4
$\nu_e + {}^{12}C \longrightarrow e^- + {}^{12}N$	137	3
$\bar{\nu}_e + {}^{12}C \longrightarrow e^+ + {}^{12}B$	139	3
$\nu_x + {}^{12}C \longrightarrow \nu_x + {}^{12}C^*$	393	9
Total	*3,031*	*65*

Expected number of detected interactions in each NOvA detector based on the GVKM flux model[x] for a supernova 8.5 kpc away.

- inverse beta decay (IBD) is dominant
- positrons can deposit energy in several cells
- expect ~3,000–4,000 hits for 8.5 kpc SN

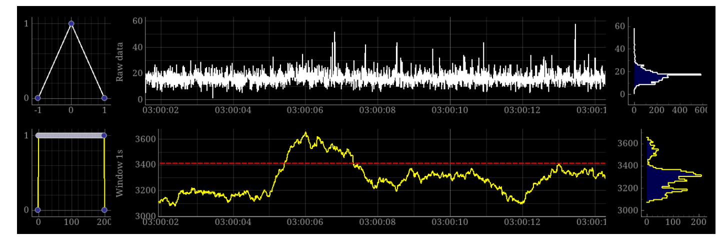


Cross sections for relevant processes in liquid scintillator.

TRIGGERING ON SUPERNOVAE *(Two types)*

External
NOvA subscribes to alerts from the SuperNova Early Warning System (SNEWS)[3]:
- a global network of neutrino detectors
- issues alerts when at least two detectors internally trigger within a 10-second coincidence window.

Internal
- in final stages of developement
- expected deployment in the fall
- relies on tagging IBD interaction candidates
- detects an increase above background during the SN signal.
- false alarm rate < 1/week to join SNEWS.



IBD interaction candidate selection
1. Remove hits from other identified physics
2. Cluster hits in space and time
3. Require clusters to span both x- and y-views
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DETECTOR SIMULATION

- two simulations in use. One simulates the IBD particle distribution based off of the SNOwGLoBES[3] software. The other uses GENIE[4] to access all interaction channels (under development)
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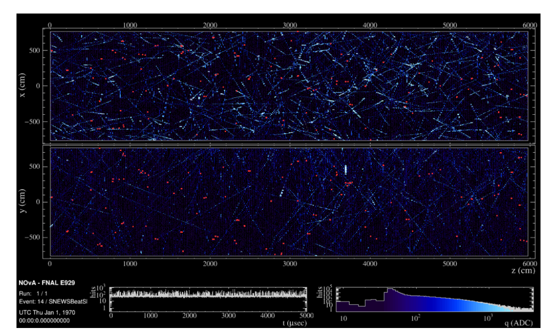


Event display of a simulated supernova over a period of 5ms.

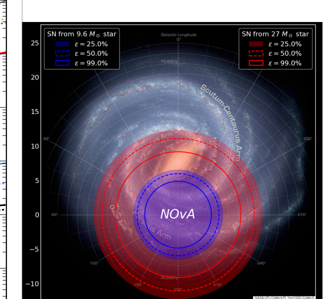
Only IBD positrons are present in the signal in this example (red dots indicate IBD production locations).

The blue hits are minimum-bias cosmic data which has been overlayed with the signal.

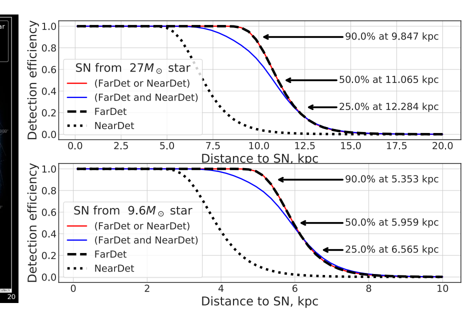
This represents 5ms of detector activity occurring 70ms after stellar core bounce.

SENSITIVITY AND OUTLOOK

- simulation is used to determine sensitivity to galactic SNe
- signal and background rate are assumed to be Poissonian.
- coincidence between both detectors can be used to reduce false alarm rate.



Sensitivity of NOvA's internal supernova trigger to galactic supernovae for two progenitor masses and various efficiency scenarios.



Detection efficiency vs distance to supernova under various detector coincidence conditions. Efficiency needs to be kept high enough to adhere to a false alarm rate of < 1/week for participation in SNEWS. Panes differ by progenitor mass. ***Top:*** 27 solar masses, ***bottom:*** 9.6 solar masses. Based on the Garching flux models[1].

REFERENCES

[1] Rampp, M., & Janka, H. T. (2000). Spherically Symmetric Simulation with Boltzmann Neutrino Transport of Core Collapse and Postbounce Evolution of a 15 $M_\odot$ Star. The Astrophysical Journal Letters, 539(1), L33.
[2] Gava, J., Kneller, J., Volpe, C., & McLaughlin, G. C. (2009). Dynamical collective calculation of supernova neutrino signals. Physical review letters, 103(7), 071101.
[3] http://webhome.phy.duke.edu/~schol/snowglobes/
[4] C.Andreopoulos, A.Bell, D.Bhattacharya, F.Cavanna, J.Dobson, S.Dytman, H.Gallagher, P.Guzowski, R.Hatcher, P.Kehayias, A.Meregaglia, D.Naples, G.Pearce, A.Rubbia, M.Whalley and T.Yang. The GENIE Neutrino Monte Carlo Generator Published in Nucl.Instrum.Meth.A614 (2010) 87-104

ACKNOWLEDGEMENTS

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- U.S. Department of Energy
- National Science Foundation
- Fermilab

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Observing Neutrinos from the Next Galactic Supernova with the NOvA Detectors

Use of color

Alignment

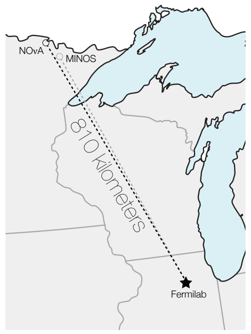
MOTIVATION

Supernova neutrinos carry reavling information
- nuclear conditions in the core
- shockwave propagation
- explosion mechanism
- oscillations & mass hierachy
- ν–ν interactions & collective effects

Core collapse supernovae
- occur 2–4 times per century
- can outshine galaxies
- releases 99% of its energy as neutrinos

rarity ⊗ priceless data = incredible opportunity

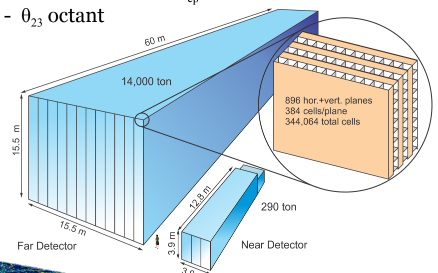
THE NOvA DETECTORS

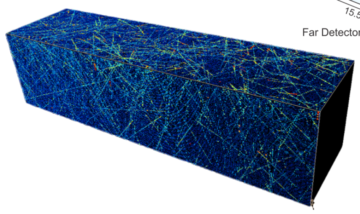


The NOvA Near and Far detectors are located at Fermilab and Ash River, MN, separated by a distance of 810 km.

NuMI Off-axis ν_e Appearance
- two segmented, functionally-equivalent liquid scintillator ν detectors
- baseline: 810 km (1st $\nu_\mu \to \nu_e$ osc. maximum)
- energy: 2 GeV

Primary physics goals
- measurement of mass hierarchy
- determination of δ_{cp}
- θ_{23} octant

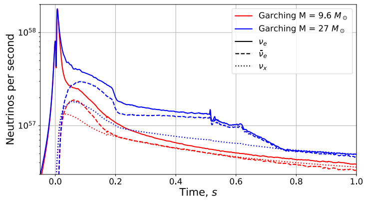


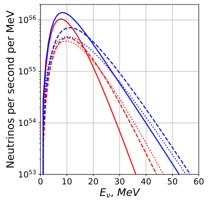


Above
The NOvA detectors: 300 ton near detector dwells 100 m underground. 14 kton far detector sits on the surface, with a modest barite overburden.

Left
5ms of cosmic activity in the far detector. Identifying small, low-energy clusters of hits in this background is a significant challenge to reconstructing supernova neutrinos.

SUPERNOVA NEUTRINOS





Simulated SN neutrino characteristics based on Garching[1] simulation for two progenitor masses.

Left
Time profiles for various neutrino flavors during the first second after core bounce.

Right
Energy distribution peaks around 10–20 MeV and most energies are less than 100 MeV.

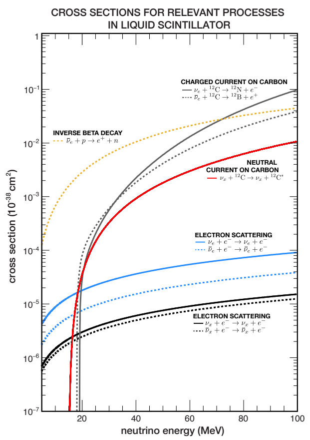
Signal characteristics
- energy: ~10–100 MeV
- timescale: 10s of seconds (burst within 1s)

Interaction channels

Channel	Events Far	Events Near
$\bar{\nu}_e + p \longrightarrow e^+ + n$	2,163	46
$\nu_x + e^- \longrightarrow \nu_x + e^-$	199	4
$\nu_e + {}^{12}C \longrightarrow e^- + {}^{12}N$	137	3
$\bar{\nu}_e + {}^{12}C \longrightarrow e^+ + {}^{12}B$	139	3
$\nu_x + {}^{12}C \longrightarrow \nu_x + {}^{12}C^*$	393	9
Total	*3,031*	*65*

Expected number of detected interactions in each NOvA detector based on the GVKM flux model[x] for a supernova 8.5 kpc away.

- inverse beta decay (IBD) is dominant
- positrons can deposit energy in several cells
- expect ~3,000–4,000 hits for 8.5 kpc SN

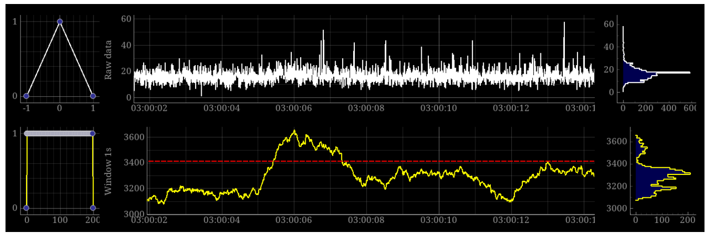


Cross sections for relevant processes in liquid scintillator.

TRIGGERING ON SUPERNOVAE *(Two types)*

External
NOvA subscribes to alerts from the SuperNova Early Warning System (SNEWS)[3]:
- a global network of neutrino detectors
- issues alerts when at least two detectors internally trigger within a 10-second coincidence window.

Internal
- in final stages of developement
- expected deployment in the fall
- relies on tagging IBD interaction candidates
- detects an increase above background during the SN signal.
- false alarm rate < 1/week to join SNEWS.



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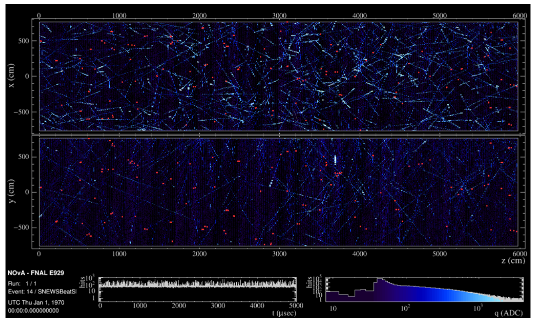

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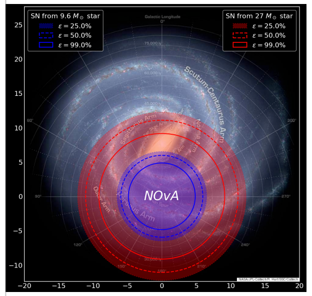

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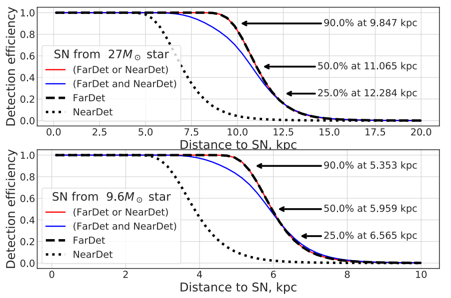

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Long Refs?

REFERENCES

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- U.S. Department of Energy
- National Science Foundation
- Fermilab

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Too much text?

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E. Zimmerman, University of Colorado 9/02 - 8/04
2003 USERS EXECUTIVE COMMITTEE ELECTION
K. Bloom, University of Nebraska 9/03 - 8/05
E. Gottschalk, Fermilab 9/03 - 8/05
M. Messier, Indiana University 9/03 - 8/05
S. Rolli, Tufts University 9/03 - 8/05
H. Tanaka, Princeton University 9/03 - 8/05
W. Trischuk, University of Toronto 9/03 - 8/05
2004 USERS EXECUTIVE COMMITTEE ELECTION
A. Alton, University of Michigan 9/04 - 8/06
M. Artuso, Syracuse University 9/04 - 8/05
I. Bertram, Lancaster University 9/04 - 8/06
D. Finley, Fermilab 9/04 - 8/06
H. Nguyen, Fermilab 9/04 - 8/06
R. Hughes, Ohio State University 9/04 - 8/06
2005 USERS EXECUTIVE COMMITTEE ELECTION
B. Casey, Brown University 9/05 - 8/07
M. Chertok, Univerity of California, Davis 9/05 - 8/07
H. T. Diehl, Fermilab 9/05 - 8/07
G. Gollin, University of Illinois 9/05 - 8/07
S. Kopp, University of Texas) 9/05 - 8/08
K. W. Merritt, Fermilab 9/05 - 8/07
B. Quinn, University of Mississippi 9/05 - 8/07
2006 USERS EXECUTIVE COMMITTEE ELECTION
E. Barberis, Northeastern University 9/06 - 8/08
G. Landsberg, Brown University 9/06 - 8/08
K. Pitts, University of Illinois 9/06 - 8/09
C. Polly, Indiana University 9/06 - 8/08
J. Slaughter, Fermilab 9/06 - 8/08
P. Wittich, Cornell University 9/06 - 8/08
2007 USERS EXECUTIVE COMMITTEE ELECTION
D. Hooper, Fermilab 9/07 - 8/09
M. Jones, Purdue University 9/07 - 8/09
A. Kotwal, Duke University 9/07 - 8/10
L. Sawyer, Louisiana Tech 9/07 - 8/09
M. Soderberg, Yale University 9/07 - 8/09
K. Tollefson, Michigan State University 9/07 - 8/09
2008 USERS EXECUTIVE COMMITTEE ELECTION
K. Gibson, University of Pittsburgh 9/08 - 8/10
M. Hildreth, Notre Dame 9/08 - 8/10
R. Moore, Fermilab 9/08 - 8/11
H. Ray, University of Florida 9/08 - 8/10
J. Urheim, Indiana University 9/08 - 8/10
T. Vahle, College of William and Mary 9/08 - 8/10
2009 USERS EXECUTIVE COMMITTEE ELECTION
T. Adams, Florida State University 9/09 - 8/12
M. Corcoran, Rice University 9/09 - 8/11
H. Gerberich, University of Illinois 9/09 - 8/11
M. Sanchez, Argonne & Iowa State University 9/09 - 8/11
D. Schmitz, Fermilab 9/09 - 8/11
W. Wester, Fermilab 9/09 - 8/11
2010 USERS EXECUTIVE COMMITTEE ELECTION
M. Cooke, Fermilab 9/10 - 8/12
H.R. Gustafson, University of Michigan 9/10 - 8/12
J. Lewis, Fermilab 9/10 - 8/12
M. Paulini, Carnegie Mellon University 9/10 - 8/12
B. Rebel, Fermilab 9/10 - 8/12
L. Whitehead, Brookhaven National Laboratory 9/10 -
8/12
2011 USERS EXECUTIVE COMMITTEE ELECTION
S. Jindariani, Fermilab 9/11 - 8/13
D. Kaplan, Illinois Institute of Technology (Chairperson
9/11-8/12) 9/11 - 8/13
R. Patterson, Caltech 9/11 - 8/13
G. Pawloski, University of Minnesota 9/11 - 8/13
N. Varelas, University of Illinois at Chicago (Chairperson
9/12-8/13) 9/11 - 8/14
B. Zwaska, Fermilab 9/11 - 8/13
2012 USERS EXECUTIVE COMMITTEE ELECTION
M.A. Cummings, Muons, Inc. 9/12 - 8/14
R.C. Group, University of Virginia and Fermilab 9/12 -
8/14
B. Quinn, University of Mississippi 9/12 - 8/14
B.L. Roberts, Boston University (Chairperson 9/13-8/14)
9/12 - 8/14
M. Rominsky, Fermilab 9/12 - 8/14
G. Snow, University of Nebraska 9/12 - 8/14
2013 USERS EXECUTIVE COMMITTEE ELECTION
S. Biedron, Colorado State University 9/13 - 8/15
T. Bose, Boston University 9/13 - 8/15
A. de Gouvea, Northwestern University 9/13 - 8/15
V. O'Dell, Fermilab 9/13 - 8/15
B. Lee, Fermilab 9/13 - 8/15
M. Soares-Santos, Fermilab 9/13 - 8/15
2014 USERS EXECUTIVE COMMITTEE ELECTION
F.G. Garcia, Fermilab 9/14 - 8/16
F. Happacher, INFN 9/14 - 8/16
W. Louis, LANL (Chairperson 9/14-8/16) 9/14 - 8/16
J. Orduna, Brown University 9/14 - 8/16
L. Spentzouris, IIT 9/14 - 8/16
T. Strauss, LHEP-UNIBE 9/14 - 8/16
2015 USERS EXECUTIVE COMMITTEE ELECTION
M. Betancourt, Fermilab 9/15 - 8/17
G. Karagiorgi, University of Manchester 9/15 - 8/17
E. Kearns, Boston University (Chairperson 9/16-8/17)
9/15 - 8/17
S. Lockwitz, Fermilab 9/15 - 8/17
E. Prebys, Fermilab 9/15 - 8/17
L. Suter, Argonne 9/15 - 8/17
2016 USERS EXECUTIVE COMMITTEE ELECTION
F. Chlebana, Fermilab 9/16 - 8/18
S. Gollapinni, University of Tennessee, Knoxville (Chair-
person 9/17-8/18) 9/16 - 8/18
C. McGivern, Iowa State University 9/16 - 8/18
T. Strauss, Fermilab 9/16 - 8/18
T. Walton, Fermilab 9/16 - 8/18
J. Zennamo, University of Chicago 9/16 - 8/18

"As elected representatives of Fermilab Users We provide a voice that is distinct from the experiments, laboratories or geographical regions."
Kevin Pitts, UEC 2008

"Keeping users informed of things relevant to our field and facilitate communications between the Laboratory and the users, and get feedback from the users."
Ashutosh Kotwal ,UEC 2009

WHAT DOES THE UEC DO?

We provide a **forum for discussion of scientific and administrative matters** relevant to the users organization and the user interests regarding functions of the Laboratory.

The UEC **provides input** on a variety of lab issues and **acts as an advocate** for the Users' community. We advise the relationship of Users to the Laboratory and provide input regarding the support they will have implementing their experimental programs.

UEC SUBCOMMITTEES

Government Relations Subcommittee: Organization of the annual trip to Washington, D.C. to promote science and (HEP). 2018 goal: Increase reach during the annual DC trip for stronger impact

Users Meeting Subcommittee: Organizes the annual Fermilab Users Meeting. 2018 goal: Inspire more active participation from users at the annual users meeting and introduce more user-centric topics.

Outreach and Education Subcommittee: Works towards broadening and enhancing the education and outreach efforts at the lab. 2018 goal: Provide resources/training for science communication and public engagement.

Quality of Life Subcommittee: Works on improving the quality of life for users at Fermilab. 2018 goal: Improve two-way communication with the user community to better serve users.

NEW EFFORT

Safe and Respectful Environments: Awareness about issues of work environment (inside and outside the lab). Advise on resources and campaigns to address concers from the community. This is a new effort! Talk to us about your concerns/sideas!

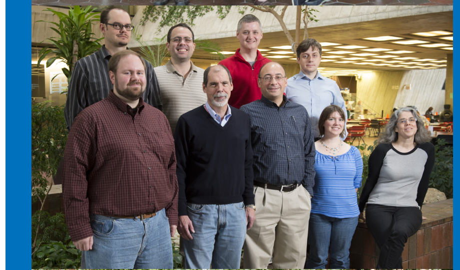
"The success of the UEC depends on participation from users of all ages, backgrounds and interests."
Ron Moore, UEC 2010

"Without a strong UEC, the Users Organization would lose effectiveness."
Nikos Varela, UEC 2013

Participate in the UEC

Consider running for a position next election!
Contact the UEC about your ideas/concerns

tinyurl.com/Fermilab-UEC



The Users Executive Committee

1967 USERS EXECUTIVE COMMITTEE ELECTION
T. H. Fields, ANL 12/67 - 12/68
D. H. Frisch, MIT 12/67 - 12/68
W. F. Fry, Wisconsin 12/67 - 12/68
M. L. Good, SUNY 12/67 - 12/68
D. Keefe, LBL 12/67 - 8/70
A. D. Krisch, Univ. of Michigan 12/67 - 8/70
J. R. Sanford, BNL 12/67 - 8/70
M. Schwartz, Stanford 12/67 - 12/68
H. K. Ticho, UCLA (Chairman 12/69-12/70) 12/67 - 11/71
A. Wattenberg, Illinois 12/67 - 8/70
W. A. Wenzel, LBL 12/67 - 12/68
W. Willis, Yale 12/67 - 8/70
1969 USERS EXECUTIVE COMMITTEE ELECTION
D. B. Cline, Wisconsin 3/69 - 3/71
M. Derrick, ANL 3/69 - 3/71
A. Pevsner, Johns Hopkins 3/69 - 9/70
V. Telegdi, Chicago 3/69 - 3/71
D. H. White, Cornell 3/69 - 9/70
S. G. Wojcicki, Stanford 3/69 - 11/71
1970 USERS EXECUTIVE COMMITTEE ELECTION
C. Baltay, Columbia 8/70 - 5/72
E. C. Fowler, Purdue 8/70 - 5/72
G. Masek, UCSD 8/70 - 5/72
L. Pondrom, Wisconsin 8/70 - 5/72
D. Ritson, SLAC 8/70 - 5/72
H. Taft,Yale 8/70 - 5/72
R. Zdanis, Johns Hopkins 9/70 - 6/73
1971 USERS EXECUTIVE COMMITTEE ELECTION
D. Jovanovic, ANL 5/71 - 6/73
D. H. Miller, Northwestern 5/71 - 6/73
P. Piroue, Princeton 5/71 - 6/73
G. A. Smith, Michigan State 5/71 - 6/74
M. Tannenbaum, Harvard 5/71 - 6/73
1972 USERS EXECUTIVE COMMITTEE ELECTION
B. C. Barish, CIT 5/72 - 6/74
V. Kistiakowsky, MIT 5/72 - 6/74
T. F. Kycia, BNL 5/72 - 6/74
L. C. Teng, Fermilab 5/72 - 6/74
J. Vandervelde, U. of Michigan 5/72 - 6/74
W. D. Walker, Duke 5/72 - 6/75
1973 USERS EXECUTIVE COMMITTEE ELECTION
D. Drickey, UCLA (Chairman 6/74-12/74) 6/73 - 12/74
T. Ferbel, Rochester 6/73 - 6/75
M. Law, Harvard 6/73 - 6/75
W. Lee, Columbia 6/73 - 6/75
U. Nauenberg, Colorado 6/73 - 6/76
J. Rosen, Northwestern 6/73 - 6/75
1974 USERS EXECUTIVE COMMITTEE ELECTION
D. Caldwell, UCSB 6/74 - 6/76
L. Hand, Cornell 6/74 - 6/77
G. Kalbfleisch, BNL 6/74 - 6/76
R. Lander, UCD 6/74 - 6/76
J. Peoples, Fermilab (Resigned 7/75) 6/74 - 7/75
M. L. Stevenson, LBL 6/74 - 6/76
1975 USERS EXECUTIVE COMMITTEE ELECTION
W. Busza, MIT 6/75 - 6/77
H. J. Lubatti, Washington 6/75 - 6/77
J. Pine, CIT 6/75 - 6/77
D. D. Reeder, Wisconsin 6/75 - 6/78
L. Stutte, CIT 6/75 - 6/77
M. Widgoff, Brown 6/75 - 6/77
P. Koehler, Fermilab 7/75 - 6/76
1976 USERS EXECUTIVE COMMITTEE ELECTION
N. W. Reay, Ohio State 6/76 - 6/78
R. Rubinstein, Fermilab 6/76 - 6/78
P. F. Slattery, Rochester 6/76 - 6/78
A. J. Slaughter, Yale 6/76 - 6/78
R. K. Yamamoto, MIT 6/76 - 6/78
L. B. Leipuner, BNL 6/76 - 6/79
1977 USERS EXECUTIVE COMMITTEE ELECTION
S. C. Loken, LBL 6/77 - 6/79
M. J. Longo, Michigan 6/77 - 6/79
T. A. O'Halloran, Illinois 6/77 - 6/79
J. D. Prentice, Toronto 6/77 - 6/79
F. Sciulli, CIT 6/77 - 6/79
M. J. Shochet, Chicago 6/77 - 6/79
1978 USERS EXECUTIVE COMMITTEE ELECTION
R. Diebold, ANL 6/78 - 6/80
A. Erwin, Wisconsin 6/78 - 6/80
A. L. Read, Fermilab 6/78 - 6/80
J. Rutherfoord, Washington 6/78 - 6/81
P. Surko, Princeton 6/78 - 6/80
S. Wojcicki, Stanford 6/78 - 6/80
1979 USERS EXECUTIVE COMMITTEE ELECTION
C. Ankenbrandt, Fermilab 6/79 - 6/81
G. Brandenburg, Harvard 6/79 - 6/81
T. Devlin, Rutgers 6/79 - 6/81
H. Frisch, U. of Chicago 6/79 - 6/81
K. Goulianos, Rockefeller 6/79 - 6/81
1980 USERS EXECUTIVE COMMITTEE ELECTION
L. Jones, U. of Michigan 6/79 - 6/82
H. R. Gustafson, U. of Michigan 6/80 - 6/83
S. Hagopian, Florida State 6/80 - 6/82
V. Peterson, Hawaii 6/80 - 6/82
T. Romanowski, Ohio State 6/80 - 6/82
M. Schwartz, Stanford 6/80 - 6/82
F. Turkot, Fermilab 6/80 - 6/82
1981 USERS EXECUTIVE COMMITTEE ELECTION
M. Abolins, Michigan State 6/81 - 6/84
J. Appel, Fermilab 6/81 - 6/83
J. Rosen, Northwestern 6/81 - 6/83
M. Shaevitz, Columbia 6/81 - 6/83
J. Walker, Fermilab 6/81 - 6/83
G. Yodh, Maryland 6/81 - 6/83
1982 USERS EXECUTIVE COMMITTEE ELECTION
W. Carithers, LBL 6/82 - 6/84
L. Holloway, Illinois 6/82 - 6/84
J. Lannutti, Florida State 6/82 - 6/84
S. Loken, LBL (Chairman 8/83-6/84) 6/82 - 6/85
E. Malamud, Fermilab 6/82 - 6/84
F. Taylor, MIT 6/82 - 6/84
1983 USERS EXECUTIVE COMMITTEE ELECTION
C. Bromberg, Michigan State 6/83 - 6/85
R. L. Dixon, Fermilab 6/83 - 6/85
A. R. Dzierba, Indiana 6/83 - 6/85
R. L. McCarthy, SUNY, Stony Brook 6/83 - 6/86
C. Wilkinson, Wisconsin 6/83 - 6/85
K. Young, Washington 6/83 - 6/85
1984 USERS EXECUTIVE COMMITTEE ELECTION
C. N. Brown, Fermilab 6/84 - 6/86
P. D. Grannis, SUNY, Stony Brook 6/84 - 6/86
K. Heller, U. of Minnesota 6/84 - 6/86
D. Levinthal, Florida State 6/84 - 6/86
F. Merritt, U. of Chicago 6/84 - 6/86
1985 USERS EXECUTIVE COMMITTEE ELECTION
N. W. Reay, Ohio State 6/84 - 6/87
D. Buchholz, Northwestern 6/85 - 6/87
T. H. Burnett, U. of Washington 6/85 - 6/87
D. Green, Fermilab 6/85 - 6/87
A. Scribano, INFN, Pisa 6/85 - 6/87
M. Shapiro, Harvard 6/85 - 6/87
J. Wiss, U. of Illinois 6/85 - 6/87
1986 USERS EXECUTIVE COMMITTEE ELECTION
R. Cester, U. of Torino 6/86 - 6/88
T. Ferbel, Rochester 6/86 - 6/88
M. Franklin, Illinois 6/86 - 6/88
H. Montgomery, Fermilab 6/86 - 6/88
A. J. Slaughter, Yale 6/86 - 6/89
B. Winstein, Chicago 6/86 - 6/88
1987 USERS EXECUTIVE COMMITTEE ELECTION
M. Corcoran, Rice University 6/87 - 6/89
E. Engels, Jr., U. of Pittsburgh 6/87 - 6/89
S. Errede, U. of Illinois 6/87 - 6/90
A. Garfinkel, Purdue 6/87 - 6/89
S. Holmes, Fermilab 6/87 - 6/89
J. Siegrist, LBL 6/87 - 6/89
1988 USERS EXECUTIVE COMMITTEE ELECTION
R. Brock, Michigan State Univ. 6/88 - 6/91
J. Christenson, Fermilab 6/88 - 6/90
G. Gollin, Princeton 6/88 - 6/90
M. Kreisler, U. of Massachusetts 6/88 - 6/90
H. Lubatti, U. of Washington 6/88 - 6/90
R. Rameika, Fermilab 6/88 - 6/90
1989 USERS EXECUTIVE COMMITTEE ELECTION
J. N. Butler, Fermilab 6/89 - 6/91
K. Kondo, U. of Tsukuba 6/89 - 6/91
K. B. Luk, U. of California, Berkeley 6/89 - 6/91
J. Russ, Carnegie-Mellon 6/89 - 6/93
M. Sheaff, U. of Wisconsin 6/89 - 6/91
A. Zieminski, Indiana 6/89 - 6/91
1990 USERS EXECUTIVE COMMITTEE ELECTION
D. Christian, Fermilab 9/90 - 6/92
J. Conrad, Harvard 9/90 - 6/92
R. Ruchti, U. of Notre Dame 9/90 - 6/92
J. Rutherfoord, U. of Arizona 9/90 - 6/93
P. Shepard, U. of Pittsburgh 9/90 - 6/92
A. Tollestrup, Fermilab 9/90 - 6/92
1991 USERS EXECUTIVE COMMITTEE ELECTION
D. Cutts, Brown Univ. 10/91 - 6/94
G. Ginther, U. of Rochester 10/91 - 6/93
S. Kuhlman, ANL 10/91 - 6/93
M. Purohit, Princeton 10/91 - 6/93
W. J. Spalding, Fermilab 10/91 - 6/93
P. M. Tuts, Columbia 10/91 - 6/93
1992 USERS EXECUTIVE COMMITTEE ELECTION
B. A. Barnett, John Hopkins 8/92 - 6/94
M. Campbell, U. of Michigan 8/92 - 6/94
J. Cumalat, U. of Colorado 8/92 - 6/94
H. E. Fisk, Fermilab 8/92 - 6/94
C. James, Fermilab 8/92 - 6/94
S. Seidel, U. of New Mexico 8/92 - 6/94

1993 USERS EXECUTIVE COMMITTEE ELECTION
A. Boehnlein, Texas A&M 9/93 - 8/95
N. Hadley, U. of Maryland 9/93 - 8/95
T. Murphy, Fermilab 9/93 - 8/95
H. Schellman, Northwestern 9/93 - 8/95
P. Sinervo, U. of Toronto 9/93 - 8/95
P. Yager, U. of California-Davis 9/93 - 8/95
1994 USERS EXECUTIVE COMMITTEE ELECTION
D. Bortoletto, Purdue University 9/94 - 8/96
J. Conrad, Columbia University 9/94 - 8/96
A. Goshaw, Duke University 9/94 - 8/96
J. Huston, Michigan State University 9/94 - 8/96
G. Jackson, Fermilab 9/94 - 8/96
T. Joffe-Minor, Northwestern University 1/96 - 8/96
S. Wimpenny, U. of California-Riverside 9/94 - 1/96
1995 USERS EXECUTIVE COMMITTEE ELECTION
M. Goodman, Argonne National Laboratory 9/95 - 8/97
J. Hauser, U. of California, Los Angeles 9/95 - 8/97
P. McBride, Fermilab 9/95 - 8/97
R. Partridge, Brown University 9/95 - 8/97
J. Whitmore, Fermilab 9/95 - 8/97
J. Yoh, Fermilab 9/95 - 8/97
1996 USERS EXECUTIVE COMMITTEE ELECTION
M.A. Cummings, Northern Illinois University 9/96 - 8/98
D. Gerdes, Johns Hopkins University 9/96 - 8/98
R. Gustafson, University of Michigan 9/96 - 8/98
T. Joffe-Minor, Northwestern University 9/96 - 8/98
Y.K. Kim, U. of California, Berkeley 9/96 - 8/98
N. Makins, U. of Illinois, Urbana-Champaign 9/96 - 8/98
1997 USERS EXECUTIVE COMMITTEE ELECTION
K. Byrum, Argonne National Laboratory 9/97 - 8/99
L. Coney, University of Notre Dame 9/97 - 8/99
G. William Foster, Fermilab 9/97 - 8/99
G. Garvey, Los Alamos National Laboratory 9/97 - 8/99
G. Snow, University of Nebraska 9/97 - 8/99
D. Wood, Northeastern University 9/97 - 8/99
1998 USERS EXECUTIVE COMMITTEE ELECTION
D. Amidei, University of Michigan 9/98 - 8/00
R. Brock, Michigan State University 9/98 - 8/00
S. Eno, University of Maryland 9/98 - 8/00
D. Errede, University of Illinois 9/98 - 8/00
K. Heller, University of Minnesota 9/98 - 8/00
R. Ruchti, University of Notre Dame
9/98 - 8/00
1999 USERS EXECUTIVE COMMITTEE ELECTION
P. Garbincius, Fermilab 9/99 - 8/01
L. Nodulman, Argonne 9/99 - 8/01
V. Papadimitriou, Texas Tech. University 9/99 - 8/01
J. Thomas, University College, London, 9/99 - 8/00
H. White, Fermilab 9/99 - 8/01
P. Yager, University of California, Davis 9/99 - 8/01
2000 USERS EXECUTIVE COMMITTEE ELECTION
R. Erbacher, Fermilab 9/00 - 8/02
S. Koutsoliotas, Bucknell University 9/00 - 8/02
J. Musser, Indiana University 9/00 - 8/02
R. Rusack, University of Minnesota 9/00 - 8/02
R. St. Denis, Glasgow University 9/00 - 8/02
B. Tannenbaum, University of California, Los Angeles
9/00 - 8/02
G. Watts, University of Washington 9/00 - 8/02
2001 USERS EXECUTIVE COMMITTEE ELECTION
J. Conway, Rutgers 9/01 - 8/03
J. Huston, Michigan State University 9/01 - 8/03
R. Plunkett, Fermilab 9/01 - 8/03
S. Towers, SUNY Stony Brook 9/01 - 8/03
W. Taylor, SUNY Stony Brook 9/01 - 8/03
C. White, Illinois Institute of Tech. 9/01 - 8/03
2002 USERS EXECUTIVE COMMITTEE ELECTION
F.G. Garcia, Fermilab 9/02 - 8/04
L. Groer, Columbia 9/02 - 8/04
S. Hagopian, Florida State University (Chairperson
9/03-8/04) 9/02 - 8/04
P. Sheldon, Vanderbilt 9/02 - 8/04
R. Tschirhart, Fermilab 9/02 - 8/04
E. Zimmerman, University of Colorado 9/02 - 8/04
2003 USERS EXECUTIVE COMMITTEE ELECTION
K. Bloom, University of Nebraska 9/03 - 8/05
E. Gottschalk, Fermilab 9/03 - 8/05
M. Messier, Indiana University 9/03 - 8/05
S. Rolli, Tufts University 9/03 - 8/05
H. Tanaka, Princeton University 9/03 - 8/05
W. Trischuk, University of Toronto 9/03 - 8/05
2004 USERS EXECUTIVE COMMITTEE ELECTION
A. Alton, University of Michigan 9/04 - 8/06
M. Artuso, Syracuse University 9/04 - 8/05
I. Bertram, Lancaster University 9/04 - 8/06
D. Finley, Fermilab 9/04 - 8/06
H. Nguyen, Fermilab 9/04 - 8/06
R. Hughes, Ohio State University 9/04 - 8/06
2005 USERS EXECUTIVE COMMITTEE ELECTION
B. Casey, Brown University 9/05 - 8/07
M. Chertok, Univerity of California, Davis 9/05 - 8/07
H. T. Diehl, Fermilab 9/05 - 8/07
G. Gollin, University of Illinois 9/05 - 8/07
S. Kopp, University of Texas) 9/05 - 8/08
K. W. Merritt, Fermilab 9/05 - 8/07
B. Quinn, University of Mississippi 9/05 - 8/07
2006 USERS EXECUTIVE COMMITTEE ELECTION
E. Barberis, Northeastern University 9/06 - 8/08
G. Landsberg, Brown University 9/06 - 8/08
K. Pitts, University of Illinois 9/06 - 8/09
C. Polly, Indiana University 9/06 - 8/08
J. Slaughter, Fermilab 9/06 - 8/08
P. Wittich, Cornell University 9/06 - 8/08
2007 USERS EXECUTIVE COMMITTEE ELECTION
D. Hooper, Fermilab 9/07 - 8/09
M. Jones, Purdue University 9/07 - 8/09
A. Kotwal, Duke University 9/07 - 8/10
L. Sawyer, Louisiana Tech 9/07 - 8/09
M. Soderberg, Yale University 9/07 - 8/09
K. Tollefson, Michigan State University 9/07 - 8/09
2008 USERS EXECUTIVE COMMITTEE ELECTION
K. Gibson, University of Pittsburgh 9/08 - 8/10
M. Hildreth, Notre Dame 9/08 - 8/10
R. Moore, Fermilab 9/08 - 8/11
H. Ray, University of Florida 9/08 - 8/10
J. Urheim, Indiana University 9/08 - 8/10
T. Vahle, College of William and Mary 9/08 - 8/10
2009 USERS EXECUTIVE COMMITTEE ELECTION
T. Adams, Florida State University 9/09 - 8/12
M. Corcoran, Rice University 9/09 - 8/11
H. Gerberich, University of Illinois 9/09 - 8/11
M. Sanchez, Argonne & Iowa State University 9/09 - 8/11
D. Schmitz, Fermilab 9/09 - 8/11
W. Wester, Fermilab 9/09 - 8/11
2010 USERS EXECUTIVE COMMITTEE ELECTION
M. Cooke, Fermilab 9/10 - 8/12
H.R. Gustafson, University of Michigan 9/10 - 8/12
J. Lewis, Fermilab 9/10 - 8/12
M. Paulini, Carnegie Mellon University 9/10 - 8/12
B. Rebel, Fermilab 9/10 - 8/12
L. Whitehead, Brookhaven National Laboratory 9/10 -
8/12
2011 USERS EXECUTIVE COMMITTEE ELECTION
S. Jindariani, Fermilab 9/11 - 8/13
D. Kaplan, Illinois Institute of Technology (Chairperson
9/11-8/12) 9/11 - 8/13
R. Patterson, Caltech 9/11 - 8/13
G. Pawloski, University of Minnesota 9/11 - 8/13
N. Varelas, University of Illinois at Chicago (Chairperson
9/12-8/13) 9/11 - 8/14
B. Zwaska, Fermilab 9/11 - 8/13
2012 USERS EXECUTIVE COMMITTEE ELECTION
M.A. Cummings, Muons, Inc. 9/12 - 8/14
R.C. Group, University of Virginia and Fermilab 9/12 -
8/14
B. Quinn, University of Mississippi 9/12 - 8/14
B.L. Roberts, Boston University (Chairperson 9/13-8/14)
9/12 - 8/14
M. Rominsky, Fermilab 9/12 - 8/14
G. Snow, University of Nebraska 9/12 - 8/14
2013 USERS EXECUTIVE COMMITTEE ELECTION
S. Biedron, Colorado State University 9/13 - 8/15
T. Bose, Boston University 9/13 - 8/15
A. de Gouvea, Northwestern University 9/13 - 8/15
V. O'Dell, Fermilab 9/13 - 8/15
B. Lee, Fermilab 9/13 - 8/15
M. Soares-Santos, Fermilab 9/13 - 8/15
2014 USERS EXECUTIVE COMMITTEE ELECTION
F.G. Garcia, Fermilab 9/14 - 8/16
F. Happacher, INFN 9/14 - 8/16
W. Louis, LANL (Chairperson 9/14-8/16) 9/14 - 8/16
J. Orduna, Brown University 9/14 - 8/16
L. Spentzouris, IIT 9/14 - 8/16
T. Strauss, LHEP-UNIBE 9/14 - 8/16
2015 USERS EXECUTIVE COMMITTEE ELECTION
M. Betancourt, Fermilab 9/15 - 8/17
G. Karagiorgi, University of Manchester 9/15 - 8/17
E. Kearns, Boston University (Chairperson 9/16-8/17)
9/15 - 8/17
S. Lockwitz, Fermilab 9/15 - 8/17
E. Prebys, Fermilab 9/15 - 8/17
L. Suter, Argonne 9/15 - 8/17
2016 USERS EXECUTIVE COMMITTEE ELECTION
F. Chlebana, Fermilab 9/16 - 8/18
S. Gollapinni, University of Tennessee, Knoxville (Chair-
person 9/17-8/18) 9/16 - 8/18
C. McGivern, Iowa State University 9/16 - 8/18
T. Strauss, Fermilab 9/16 - 8/18
T. Walton, Fermilab 9/16 - 8/18
J. Zennamo, University of Chicago 9/16 - 8/18

"As elected representatives of Fermilab Users We provide a voice that is distinct from the experiments, laboratories or geographical regions."
Kevin Pitts, UEC 2008

"Keeping users informed of things relevant to our field and facilitate communications between the Laboratory and the users, and get feedback from the users."
Ashutosh Kotwal ,UEC 2009

WHAT DOES THE UEC DO?

We provide a **forum for discussion of scientific and administrative matters** relevant to the users organization and the user interests regarding functions of the Laboratory.

The UEC **provides input** on a variety of lab issues and **acts as an advocate** for the Users' community. We advise the relationship of Users to the Laboratory and provide input regarding the support they will have implementing their experimental programs.

UEC SUBCOMMITTEES

Government Relations Subcommittee: Organization of the annual trip to Washington, D.C. to promote science and (HEP). 2018 goal: Increase reach during the annual DC trip for stronger impact

Users Meeting Subcommittee: Organizes the annual Fermilab Users Meeting. 2018 goal: Inspire more active participation from users at the annual users meeting and introduce more user-centric topics.

Outreach and Education Subcommittee: Works towards broadening and enhancing the education and outreach efforts at the lab. 2018 goal: Provide resources/training for science communication and public engagement.

Quality of Life Subcommittee: Works on improving the quality of life for users at Fermilab. 2018 goal: Improve two-way communication with the user community to better serve users.

NEW EFFORT

Safe and Respectful Environments: Awareness about issues of work environment (inside and outside the lab). Advise on resources and campaigns to address concers from the community. This is a new effort! Talk to us about your concerns/sideas!

"The success of the UEC depends on participation from users of all ages, backgrounds and interests."
Ron Moore, UEC 2010

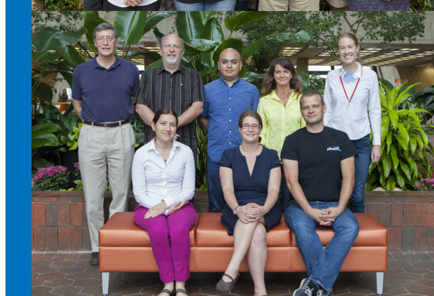
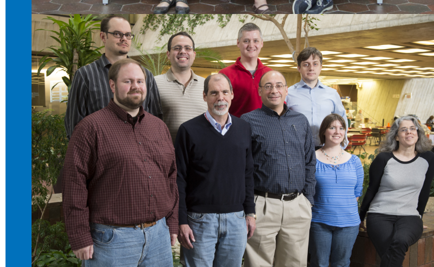
"Without a strong UEC, the Users Organization would lose effectiveness."
Nikos Varela, UEC 2013

Participate in the UEC

Consider running for a position next election!
Contact the UEC about your ideas/concerns

tinyurl.com/Fermilab-UEC




QR code?

Lots of tiny text

Status of the NOvA Experiment

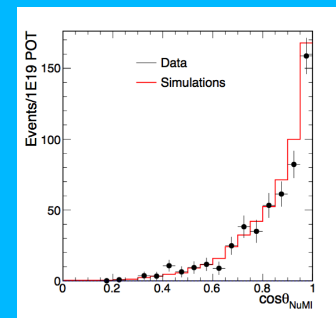
NOvA NDOS Run

The NOvA NDOS (**N**ear **D**etector **O**n the **S**urface) data run collected ~5000 neutrino interactions from the NuMI beam.

The NOvA NDOS is used as a prototype to test the detector technology and assembly procedures.

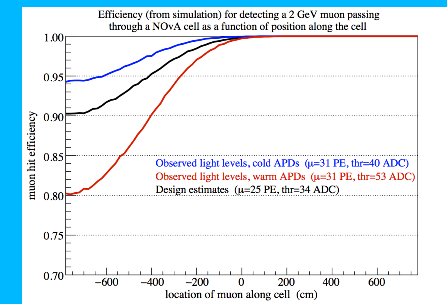
The NDOS is also used to investigate the expected cosmic ray background in the NOvA detector and to develop calibration techniques for the NOvA detectors.

NuMI Beam Data



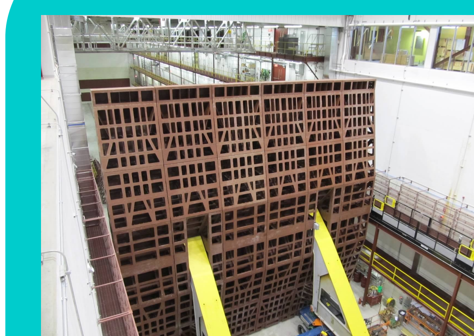
Comparison between NOvA NDOS cosmic subtracted data and MC. A selection has been applied to both the data and the MC to enhance beam neutrinos and reject the cosmic ray interactions. This plot shows good agreement between data in time with the NuMI (**N**eutrinos at the **M**ain **I**njector) beam and the NuMI beam MC.

Calibration Test Bed



Simulated efficiencies for detecting muon hits in the NOvA FD, shown as a function of position along the cell with more positive positions being closer to the cell readout. The black curve shows the NOvA technical design report's expectation. The colored curves give the performance assuming observed noise rates in the NDOS and observed full-length module light levels obtained with the "vertical slice" test setup. The warm and cold curves differ only in their hit trigger threshold, as warm APDs require a higher threshold to maintain a tolerable noise rate.

NOvA Block Pivoter



Once a block has been finished, the block pivoter (shown above) is used to move the block into place within the detector building, then pivots 90° to set the block upright.

Work on the first block of the NOvA far detector. Each plane is composed of 12, 32 cell modules. The modules of adjacent planes are laid out at 90° relative to the previous plane, giving both an X and a Y view. This picture shows the vacuum lifter used to put the modules in place within a plane.

Building the First NOvA Block

Far Detector Construction Underway

Construction of the NOvA far detector has begun in Ash River MN.

The NOvA far detector consists of 960 (15.6 m square) planes. 32 planes make 1 block, while 5 blocks make 1 super block.

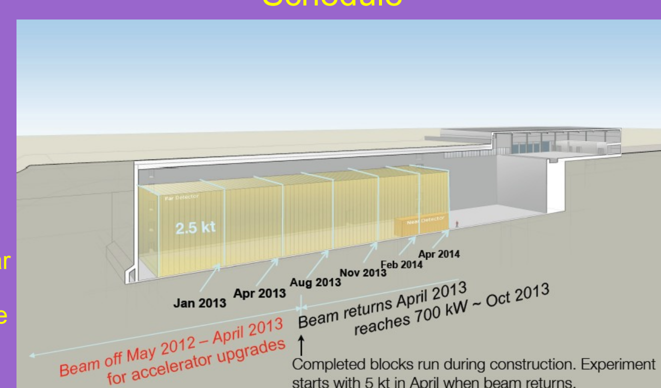
The final detector mass will be ~15k tons. With ~80% active detector material.

Schedule and Outlook

In May of this year the FNAL accelerator complex shut down for upgrades to the NuMI beam line along with regular maintenance to the facilities.

Construction has begun on the far detector. The first super block is scheduled to be completed by the end of the year. With additional super blocks being completed on a schedule that accelerates as the technicians gain experience with the detector assembly.

Schedule



The NuMI beam is schedule to return in April 2013. By then 2 Super blocks should be in place with a total detector mass of 5k tons. Construction will continue while the beam ramps up to 700kW in October 2013.

Outlook

NOvA will began taking data with a partially completed detector in spring of 2013. Data taking will continue as the detector is complete in spring of 2014.

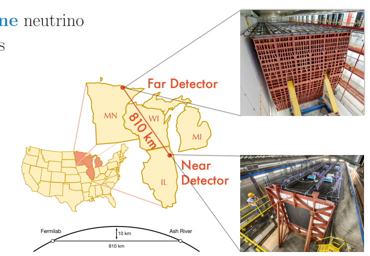
NOvA expects to collect approximately 14 electron neutrino interactions in by 2014 with approximately 7 background interactions by Neutrino 2014. For more information on NOvA physics see Raphaël Schroeter's poster (#99-3)

NOvA joint $\nu_e + \nu_\mu$ oscillation results in neutrino and antineutrino modes

The NOvA experiment

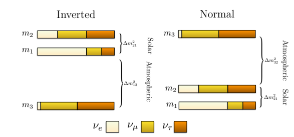
The NOvA experiment is a **long baseline** neutrino oscillation experiment utilizing the world's most powerful ν_μ beam—the NuMI beam at **Fermilab.**

- Two functionally identical detectors (**Far** and **Near**)
- Fine-grained, low-Z liquid scintillator calorimeters
- **14 mrad** off the NuMI beam axis



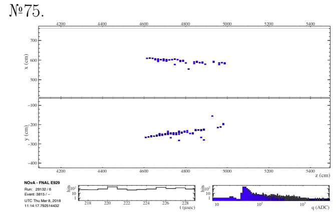
Physics motivations for studying ν_e appearance and ν_μ disappearance:

- Determine Neutrino **Mass Hierarchy**
- Probe δ_{CP} violating phase
- Resolve the octant of θ_{23} mixing angle

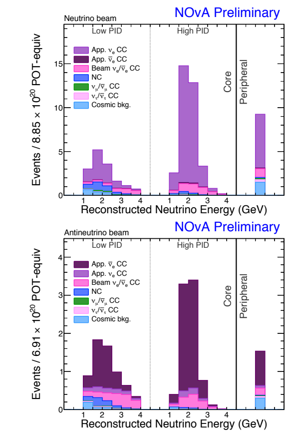


Event predictions

Our ν_e event selection includes cosmic rejection, data quality and pre-selection cuts, along with particle identification via a Convolutional Visual Network (**CVN**) (see the poster №79 for details). For details of the ν_μ event selection see the poster №75.

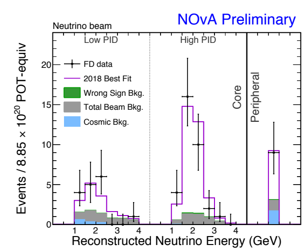


- Use **data-driven techniques** to predict the FD Monte-Carlo spectrum based on a fit to the ND data (see the poster №80 for details).

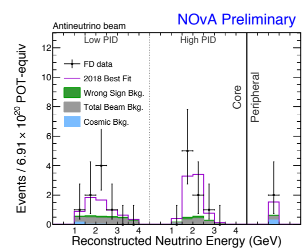


Results in the 2018 NOvA joint $\nu_e + \nu_\mu$ analysis in neutrino and antineutrino modes

With 8.85×10^{20} POT in neutrino beam and 6.91×10^{20} POT in antineutrino beam NOvA obtained the following results:



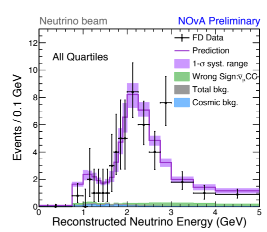
Observed 58 ν_e CC events					
Expected 30 ($\pi/2$ IH) - 75 ($3\pi/2$ NH) events					
Total background 15.1 events					
$\bar{\nu}_e$ CC	beam ν_e	ν_μ CC	ν_τ CC	NC	cosmic
0.66	6.85	0.63	0.37	3.21	3.33

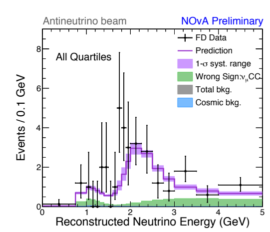


Observed 18 $\bar{\nu}_e$ CC events					
Expected 10 ($3\pi/2$ NH) - 22 ($\pi/2$ IH) events					
Total background 5.3 events					
ν_e CC	beam ν_e	ν_μ CC	ν_τ CC	NC	cosmic
1.13	2.57	0.07	0.15	0.67	0.71

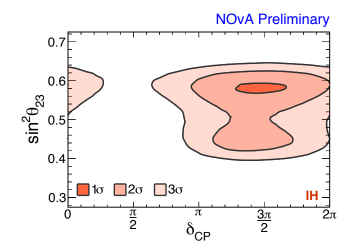
Observed 113 ν_μ CC events			
Total background 11.0 events			
$\bar{\nu}_\mu$ CC	NC	other beam bkg	cosmic
7.24	1.19	0.51	2.07

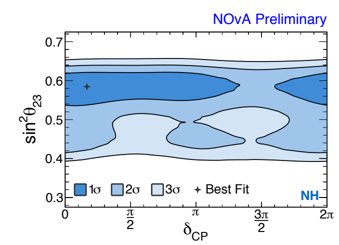
Observed 65 $\bar{\nu}_\mu$ CC events			
Total background 13.7 events			
ν_μ CC	NC	other beam bkg	cosmic
12.58	0.39	0.23	0.46





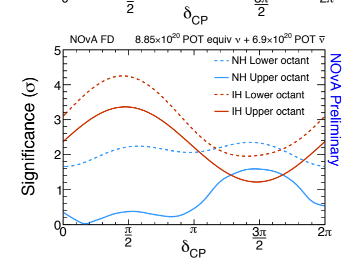
For the ν_μ disappearance analysis details see the poster №66.



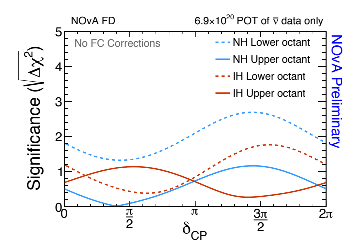


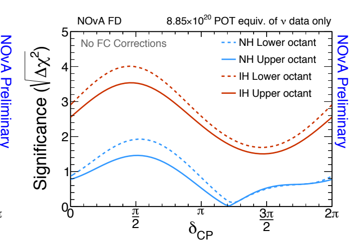
The joint $\nu_e + \nu_\mu$ **fit** in both neutrino and antineutrino modes with systematic uncertainties (see the posters №81 (ν_e) and №88 (ν_μ)) produced the next results:

- **Best fit**:
  NH, $\delta_{CP} = 0.17\pi$,
  $\sin^2\theta_{23} = 0.58 \pm 0.03$ (UO),
  $\Delta m^2_{32} = 2.51^{+0.12}_{-0.08} \times 10^{-3}$ eV^2
- Reject the area IH, $\delta_{CP} = \pi/2$ at $>3\sigma$, reject IH, all values of δ_{CP} at 1.8σ.



We performed the joint fit $\nu_e + \nu_\mu$ separately in neutrino and antineutrino modes as well:

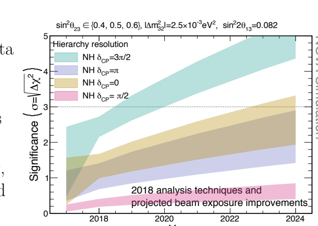


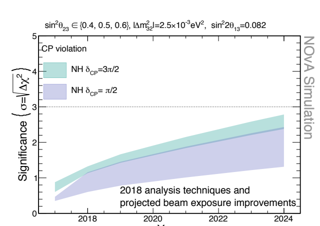


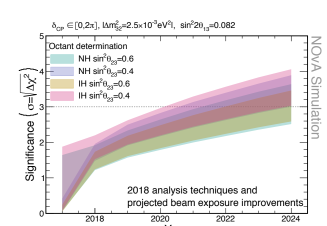
- Our antineutrino data prefer the $\delta_{CP} = 0.4\pi$, NH and IH are close.
- Our neutrino only joint fit results remain unchanged in comparison with 2017's.

Future sensitivities

- For **future prospects** we assume:
  - 50% neutrino beam and 50% antineutrino beam data per year.
  - 2018 analysis techniques, projected beam intensity improvements and reduced systematic uncertainties from NOvA's test beam (see the poster №58).
- **By 2020** expect 3σ sensitivity to **mass hierarchy**, for all allowed values of θ_{23}, if hierarchy is normal and $\delta_{CP} = 3\pi/2$.
- **By 2022** expect 2σ sensitivity to δ_{CP} determination if hierarchy is normal and $\delta_{CP} = 3\pi/2$.
- **By 2024** expect 3σ sensitivity (depends on hierarchy) to **octant** determination for $\sin^2\theta_{23}$ near 0.4 or 0.6







http://novaexperiment.fnal.gov
Fermilab

Detection of Galactic Supernova Neutrinos at the NOνA Experiment

Motivation

Supernova physics:

- Neutrino emission plays crucial role in the supernova explosion mechanism.
- Neutrinos produced in the early phases of the collapse carry information from the core.
- Existing models predict various neutrino luminosities & spectra.

Neutrino properties:

- Observable ν flux is affected by many aspects of neutrino physics: neutrino mixing parameters, mass hierarchy, sterile neutrinos and other.
- Enormous neutrino densities during the explosion make neutrino self-interactions important.

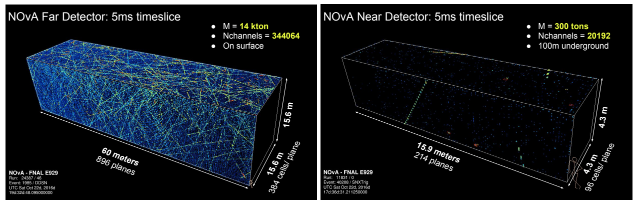
Challenging:

- Huge detectors are needed. Collaboration with other experiments → global network
- Previously registered only once: **SN1987a**
- Galactic supernovae are quite rare: $\sim 1-3$ per century

We need to be ready

NOνA : NuMI Off-axis ν_e Appearance

Primary goal: precise measurement of neutrino oscillations parameters, studying $\nu_\mu \to \nu_e$ and $\bar{\nu}_\mu \to \bar{\nu}_e$ oscillations in **2 GeV** neutrino beam.



NOvA features two segmented liquid scintillator detectors of similar structure.
The NOvA detectors can be used to register the neutrino signal from the next galactic supernova, measuring the neutrino flux and providing the trigger signal to other neutrino experiments. The detailed description of the NOvA detectors can be found in [1].

Simulation of supernova neutrino interactions

A dedicated simulation package **GenieSNova** was developed to simulate interactions of supernova neutrinos inside the NOvA detectors in a correct timing order, producing particles that can then be used in the full existing NOvA detector simulation chain.

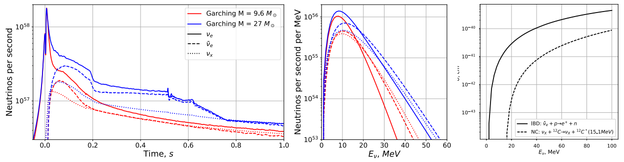


Figure 1: We use SN neutrino flux models for progenitor star masses $9.6 M_\odot$ and $27 M_\odot$ described in [2].

Selection of interaction candidates in NOvA Far detector

The main signal signatures in the detector are a positron from IBD process with energies up to tens of MeV, and a 15.1 MeV photon from ^{12}C* de-excitation. These particles produce small showers, which light up **1-4** scintillator cells, producing clusters of hits.

In order to detect such candidates, we have to:

1. Reject the signals associated with: muon tracks, Michel electrons, high energy showers and noisy electronic channels.
2. Find clusters of signals, close in time and space.
3. Request signals in both **X** and **Y** planes: reduce the background from electronic noise.
4. Apply fiducial volume cut: reject background from outside
5. Select clusters in the amplitude range.

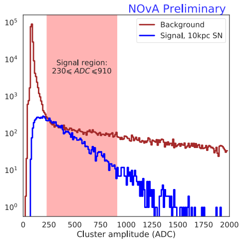


Figure 2: ADC range for IBD candidates selection was defined to maximize $\frac{s}{\sqrt{b}}$ for SN at **5 kpc** distance.

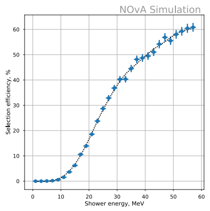


Figure 3: Using simulated sample of positrons, we determine the efficiency of the IBD candidate reconstruction

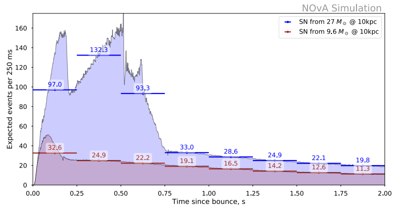


Figure 4: Number of signal IBD interactions after candidate selection procedures. We use 250ms time bins to define the signal shape. The $27M_\odot$ signal shows a specific structure during first 750ms after bounce. Both models share a general feature: exponential tail in the cooling phase.

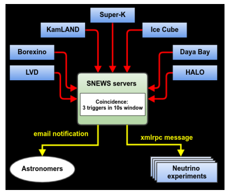
Supernova triggering system

External trigger signal: SNEWS

Super**N**ova **E**arly **W**arning **S**ystem[3] is a service that:

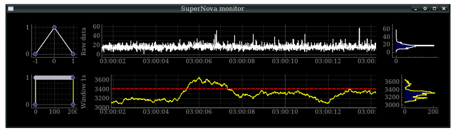
- Collects supernova triggers from 7 neutrino experiments.
- Provides notifications to other experiments and astronomers.

NOvA is currently triggered externally by a SNEWS coincidence, so we can record data from a galactic supernova for further analysis.



Internal NOvA trigger

We can detect supernova explosion, observing a short-time ($\tau \sim 1-10$s) increase in low-energy neutrino interactions rate.



Supernova trigger system uses existing NOvA triggering infrastructure:

- More than **1000** processes on about **160** nodes
- Analyze the data from detectors in **5ms** time slices in parallel
- Reconstruct neutrino candidates and count the interaction rate per slice
- Background level and variance is measured dynamically, accumulating data every 1 minute, so we can mitigate the slow changes in background.

Using signal shape information

To use the expected signal shape information, we can calculate the **likelihood** that the data follows expected shape in time.
We detect $n_i = s_i + b_i$ interaction candidates per i-th time bin. Then, assuming the Poisson distributions for events in time bin:

$$s_i \sim Poisson(\lambda = S_i) \quad b_i \sim Poisson(\lambda = B)$$

we can define the log likelihood ratio function:

$$LLR(\vec{n}) = \sum_i n_i \cdot \log(1 + S_i/B) - \sum_i S_i$$

Triggering signal is sent when this LLR value exceeds given threshold.

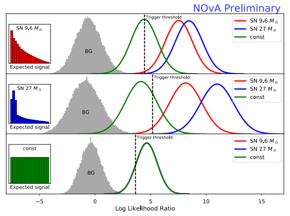
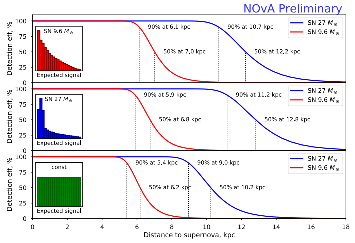


Figure 5: Signals with the same total number of events but different shapes, produce different distributions of LLR. This makes our trigger more sensitive to particular signal shapes.

Sensitivity to galactic supernovae

- SNEWS requires false triggering rate below **1/week**
- False trigger rate and LLR distribution for background define the triggering thresholds.
- Efficiency of supernova detection: probability for a SN signal to exceed the threshold.



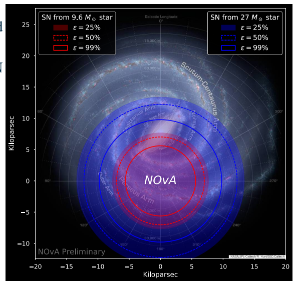


Figure 6: Probability of supernova detection in NOvA for the model with $27M_\odot$ and $9.6M_\odot$ progenitor star mass, using the expected shape of $9.6M_\odot$ signal.

Summary and current status

- The supernova triggering system is working on NOvA detectors since November 2017, with a false positive rate < 1/week. We plan to start sending trigger signals to SNEWS.
- Using the time profile of expected signal and the background distribution, the trigger can be sensitive to the supernovae in the galactic center (7 kpc).
- The next upgrade of the system is planned for summer 2018. With improved reconstruction algorithms and monitoring system, we expect to increase the stability and efficiency of the trigger.
- The GENIE-based simulation package for supernova neutrinos' interaction is being developed. We plan to include more interaction channels and supernova models.
- An understanding of NOvA's physics sensitivity and an offline analysis of the supernova neutrino signal is currently being developed.

[1] P. Adamson et al. (NOvA Collaboration), Phys. Rev. **D93** 051104 (2016)
[2] A. Mirizzi et al., Rivista del Nuovo Cimento Vol. **39**, N. 1-2 (2016)[arXiv:1508.00785]
[3] P. Antonioli et al, New Journal of Physics **6** (2004) 114

Physical poster tips

Make sure your poster is the right size! (Ask the conference webpage and make your document the appropriate size).

Use high quality images. No screenshots!

Print your poster in advance (but keep a digital copy on you just in case)

Buy a poster tube and roll the poster such that it curves into the board when unrolled, not away from it.

Protect the edges!

Expect that the conference will give you tools to put it up

…. but bring your own anyway.

Poster Competitions

These are (in most cases) a combination of things, but mostly rely on the interaction of the judges with the presenter!

Be at your poster!

Allow people time to read if they need it.

Practice your delivery beforehand.

Things poster judges have said

I try to judge mostly on the poster as that it matches the title, making sure the student understands and can explain whats on it.

I personally have never actually read what was written on a poster [in place of talking to the presenter].

Death was if I asked about something on the poster and the answer was “Umm I didn’t make that so I’m not sure…”

Tips from the room @ the tutorials

Have an elevator pitch.

Have two speeches prepared (different lengths).

When you look at good posters think “What is it that I liked?”

Iterate! Every poster will be better!

More Tips

Read this guy:

The Visual Display of Quantitative Information by Edward Tufte

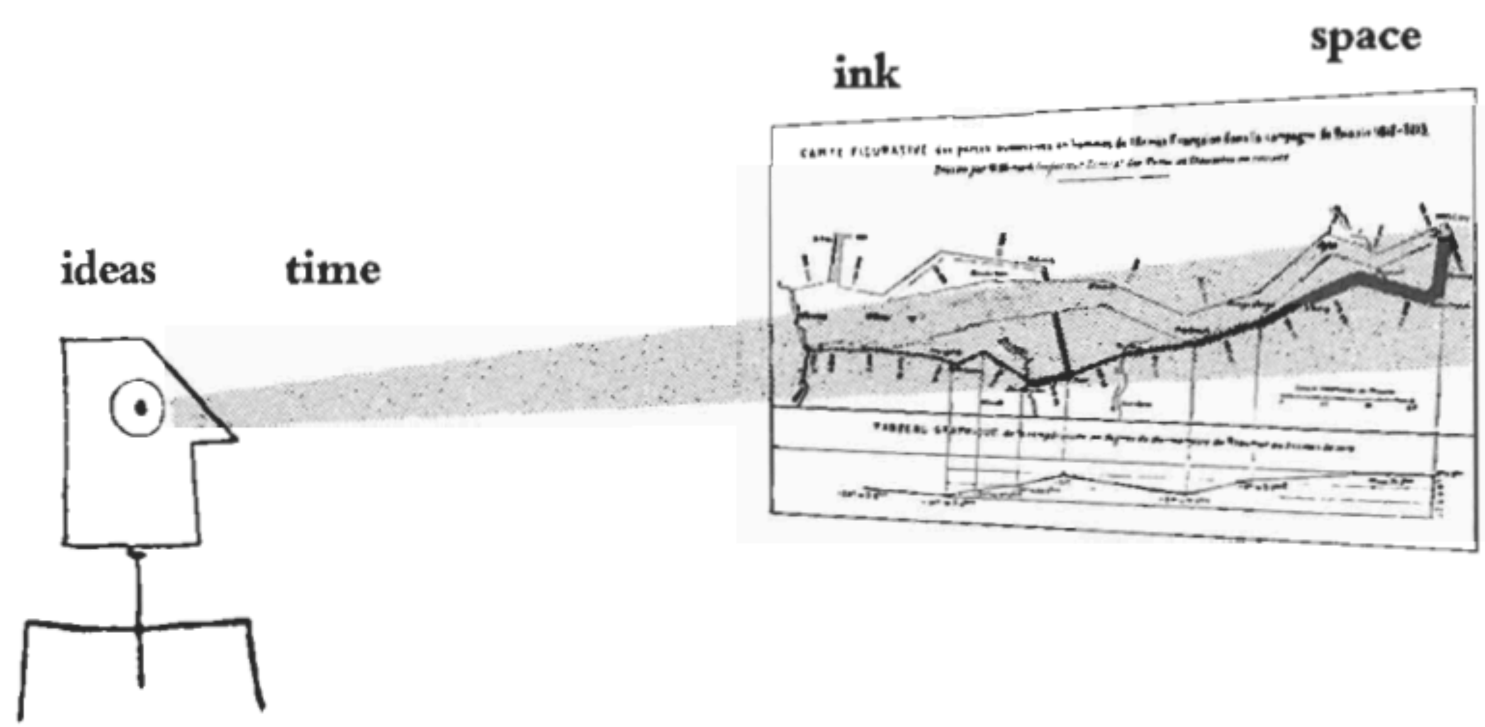
https://smile.amazon.com/gp/product/0961392142/ref=ox_sc_act_title_1?smid=ATVPDKIKX0DER&psc=1

Principles of Graphical Excellence

Graphical excellence is the well-designed presentation of interesting data—a matter of *substance*, of *statistics*, and of *design*.

Graphical excellence consists of complex ideas communicated with clarity, precision, and efficiency.

Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.



Graphical excellence is nearly always multivariate.

And graphical excellence requires telling the truth about the data.