

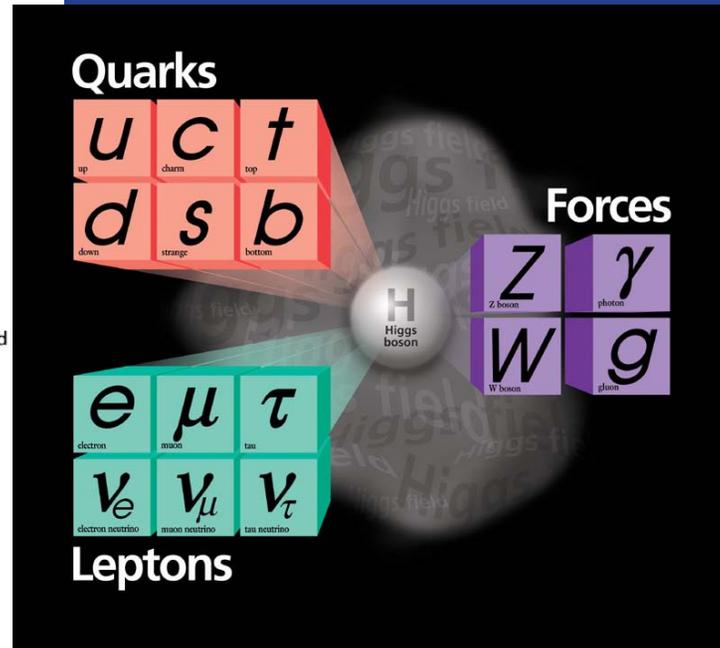
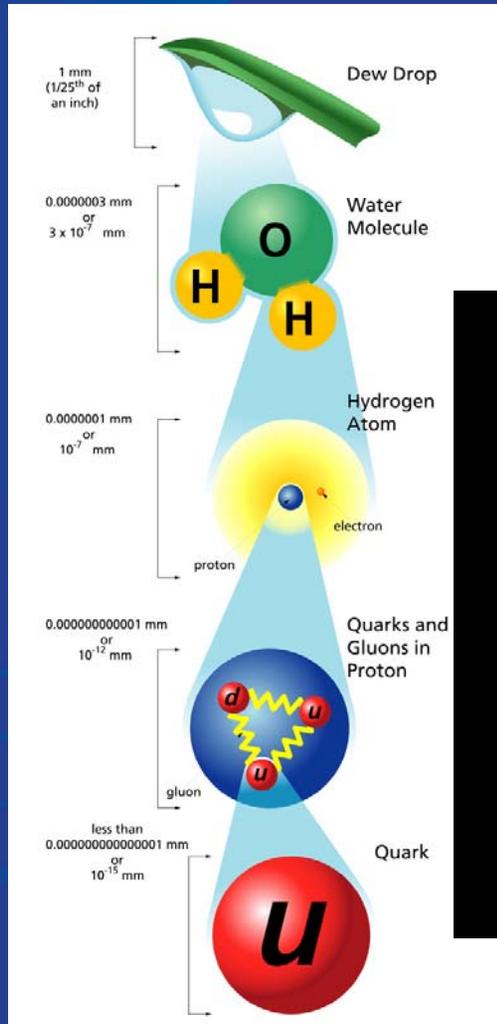
# Fermilab and the Intensity Frontier



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March 2<sup>nd</sup>, 2010

# Experiments at the Intensity Frontier attack deep questions in physics today...



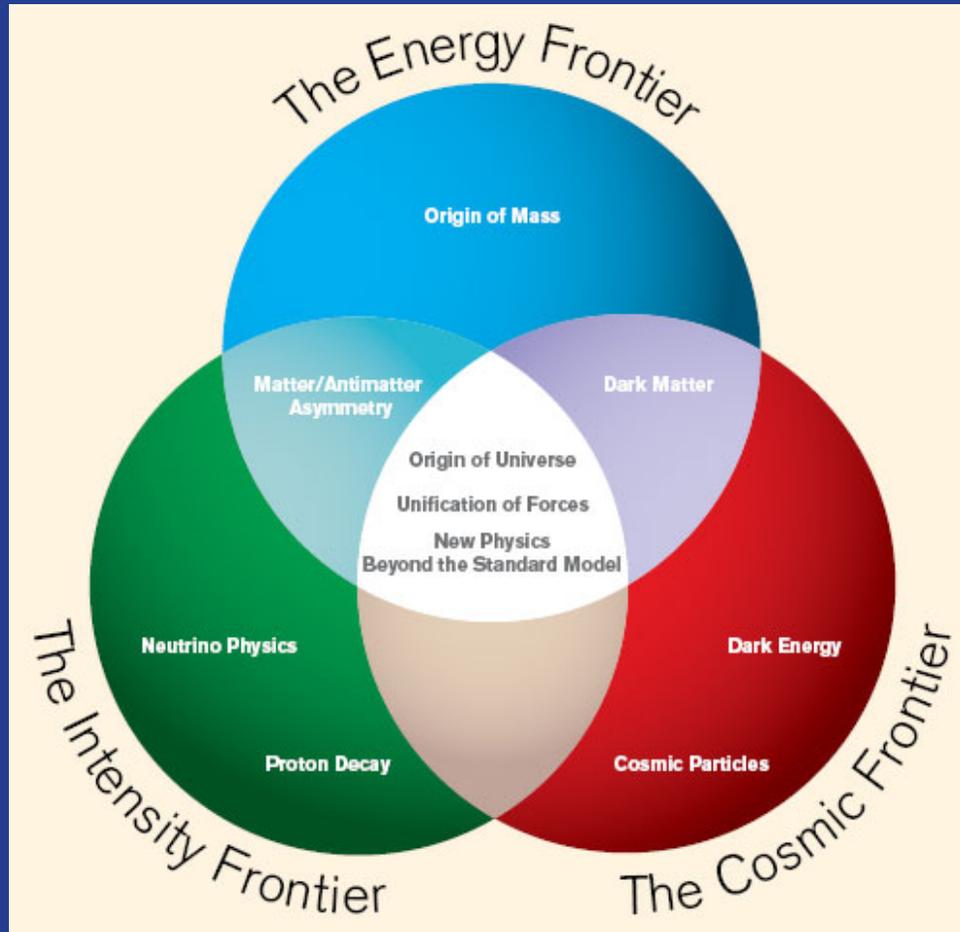
Why are there so many kinds of particles?

Why do particles have mass?

What happened to the antimatter?

Einstein's dream: Do all forces become one?

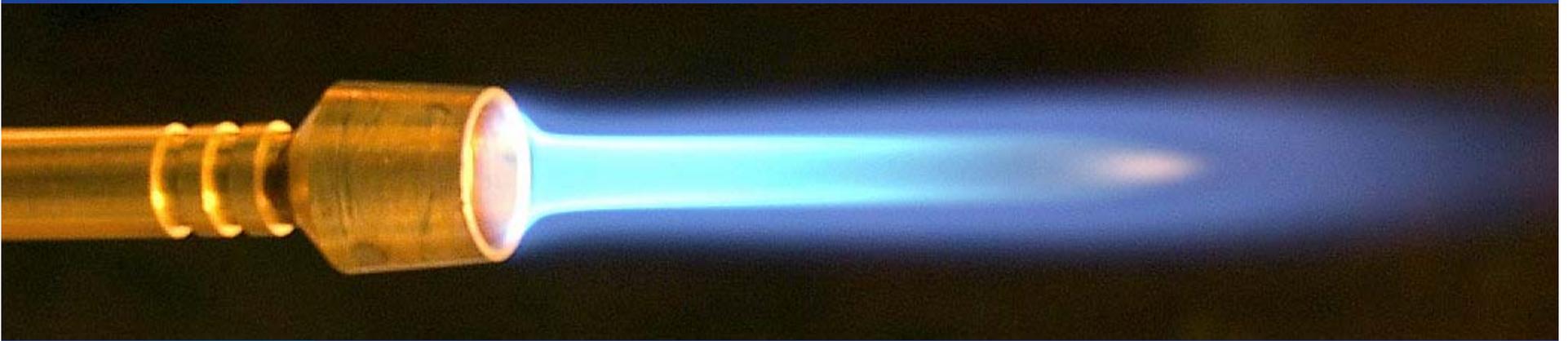
# How do we find the answers?



Three frontiers of particle physics

## Tools of the Intensity Frontier: Producing lots and lots of particles

To find answers to their particle physics questions, scientists use high-intensity proton “blow-torch” accelerators to create vast number of particles



The more particles the accelerators produce, the better the chance to see something rare.

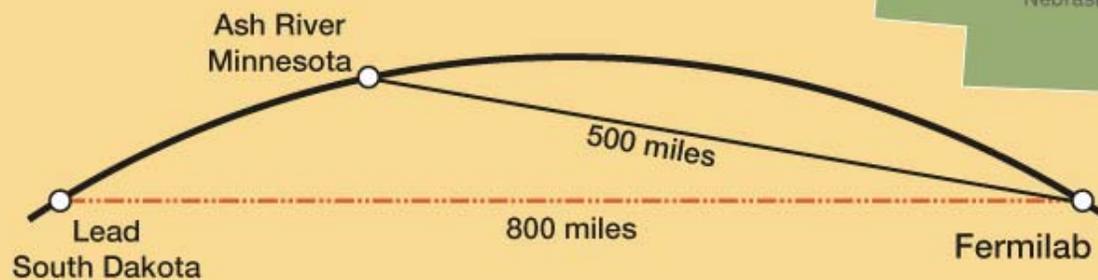
Fermilab aims to be the best laboratory in the world for the study of neutrino physics and the ultra-rare behavior of particles.



# Intensity Frontier: Shining neutrinos through 500 miles of rock to study their family behavior...

## Straight Through the Earth

<b>MINOS</b>	Soudan Mine, MN	2340 ft deep
<b>NOvA</b>	Ash River, MN	Surface level
<b>LBNE</b>	Homestake Mine, SD	4850 ft deep



# Intensity Frontier: “Long-baseline” neutrino experiments



Soudan, Minnesota

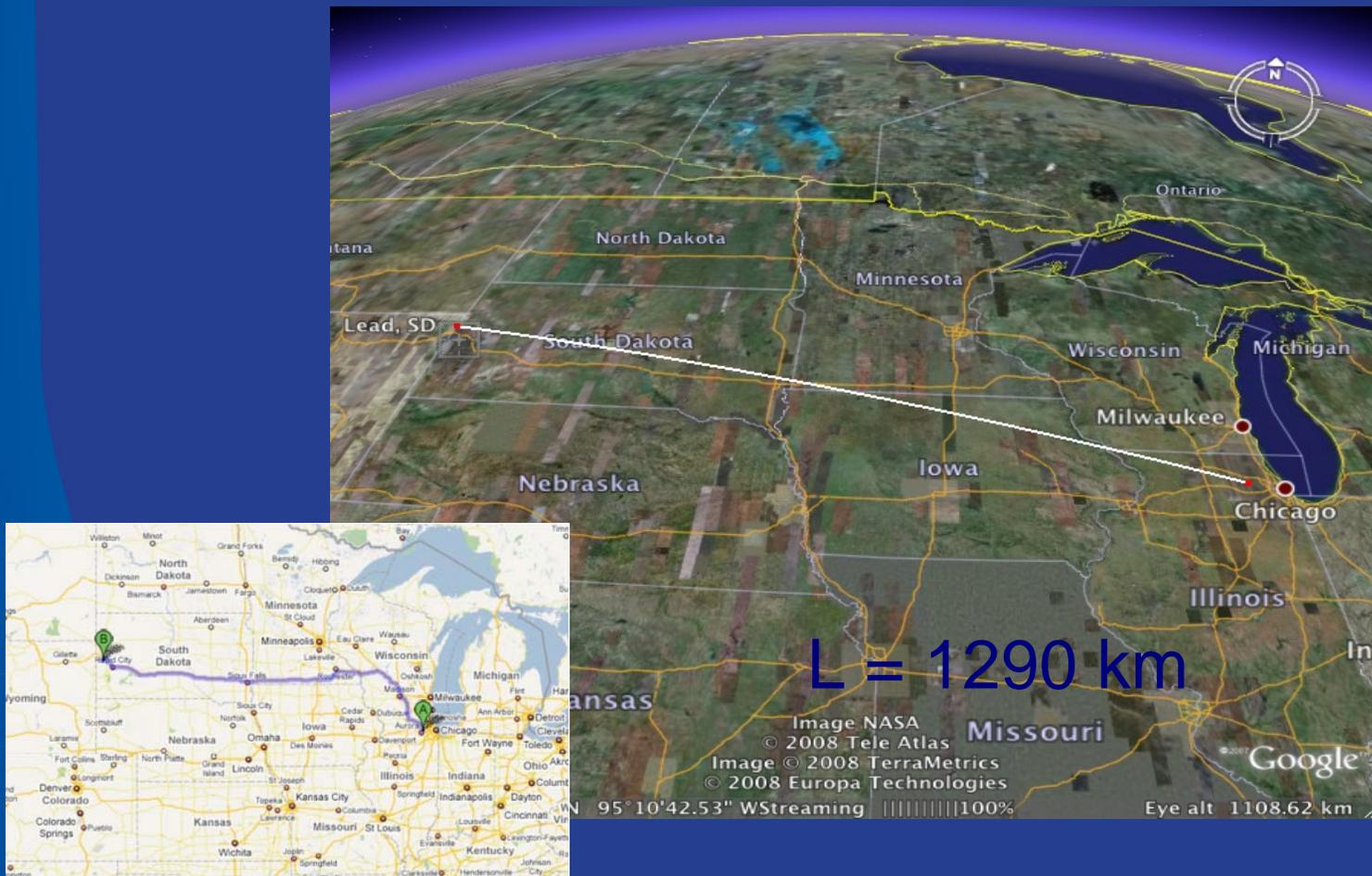


Ash River,  
Minn.



Recovery Act: \$55 million  
for new NOvA laboratory

# The Next Proposed Step: Neutrinos from Fermilab to South Dakota



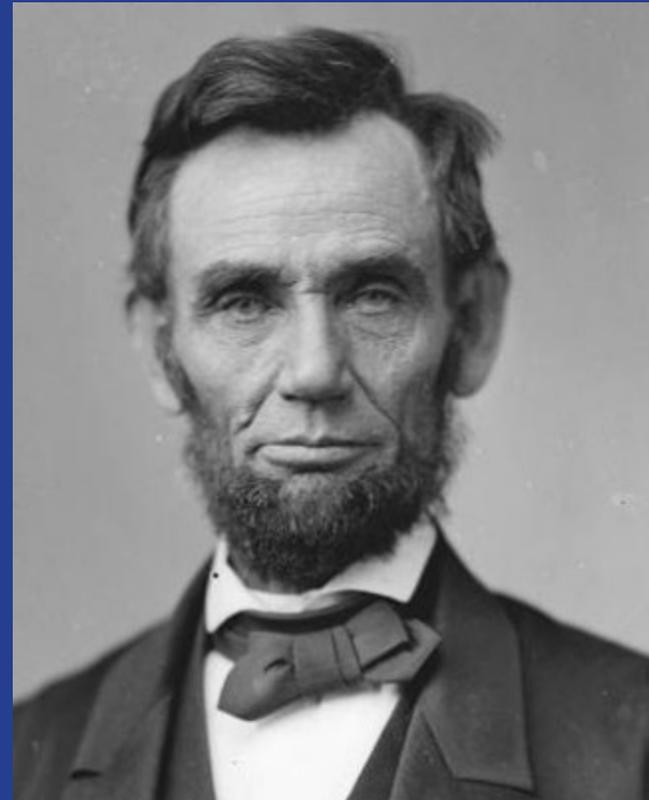
# Intensity Frontier: Why are scientists interested in rare events??



In fact, as a species we are fascinated by rare events....

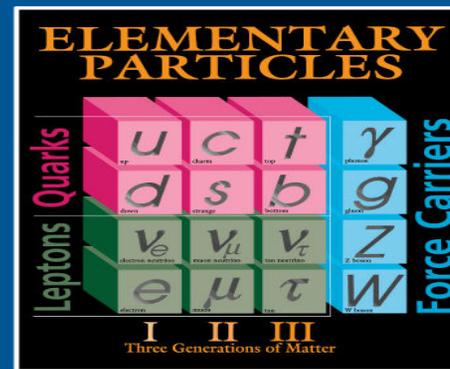
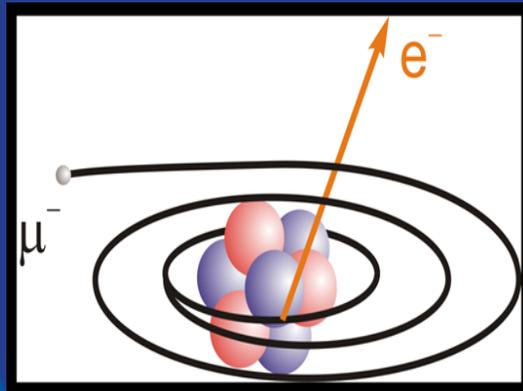


Rare events can change the course of history...



Fermilab is aiming to lead the frontier of ultra-rare event experiments in particle physics

Searching for family jumping in the charged cousins of neutrinos: muons  $\rightarrow$  electrons



Fermilab will study 1,000,000,000,000,000,000 muons searching for this...a number equal to the grains of sand on all the world's beaches!

# More intense beams: Project X proposal

9&10  
November  
2009

Project X  
Physics  
Workshop

Fermilab  
Batavia, Illinois  
USA

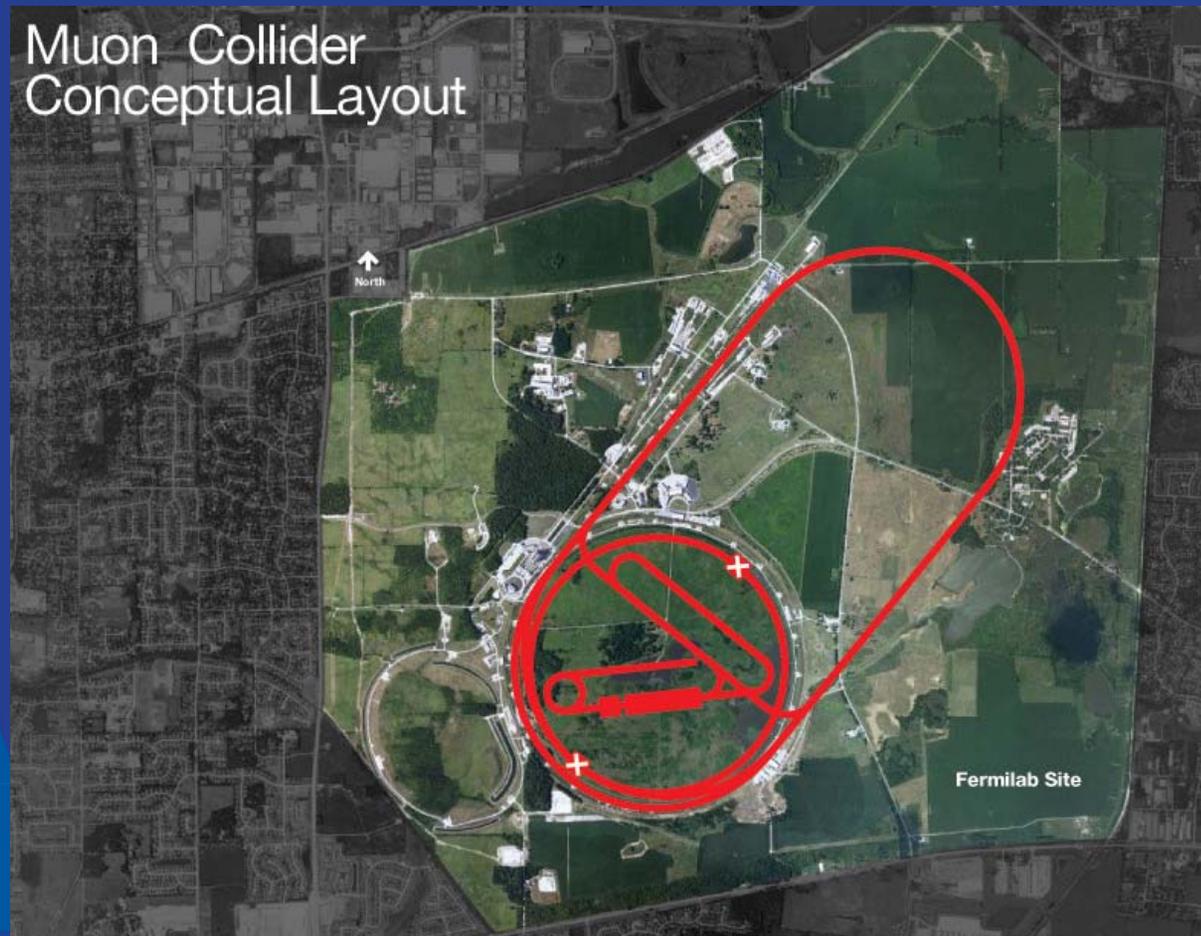


Project X :

a unique and flexible facility  
with intense beams for many  
Intensity Frontier experiments.



Project-X is also a technology step back towards the Energy Frontier...



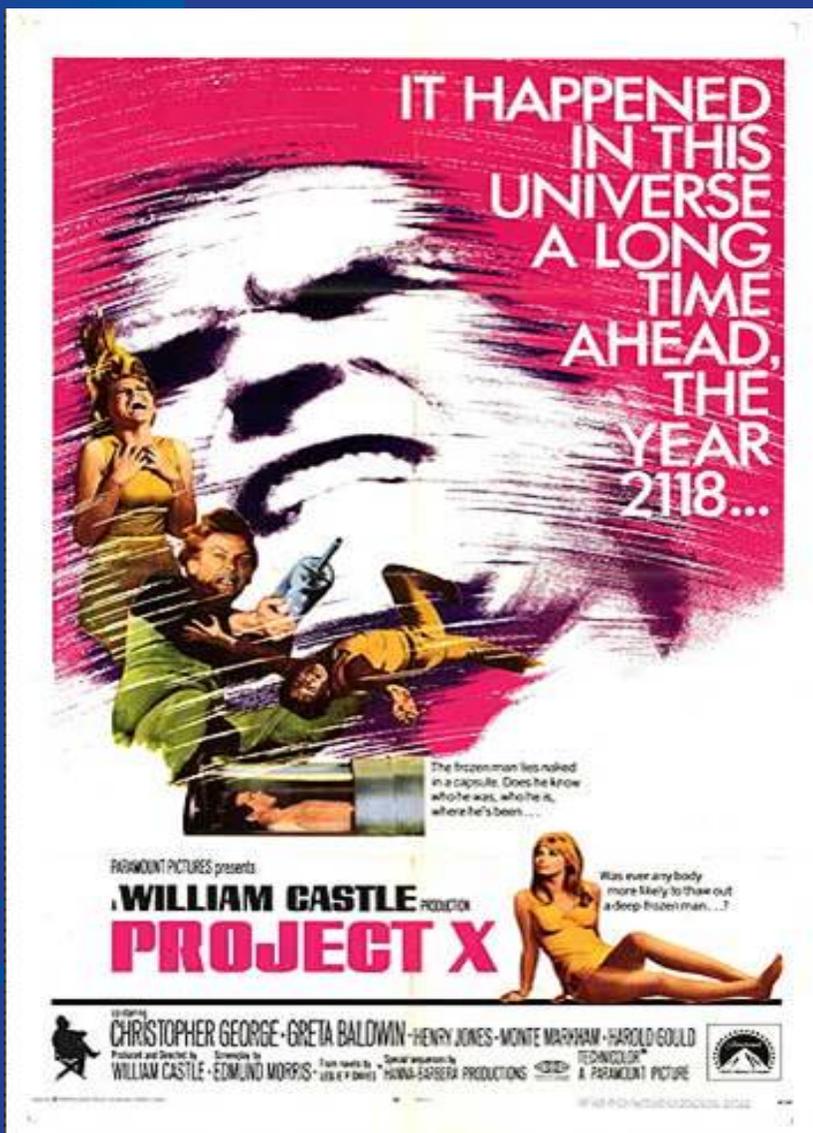
# What's next at the Intensity Frontier?

- Finish construction of NOvA in Minnesota and on Fermilab site
- Advance plans for Long-Baseline Neutrino Experiment from Fermilab to Lead, South Dakota and the muon  $\rightarrow$  electron conversion experiment.
- Advance plans for Project X



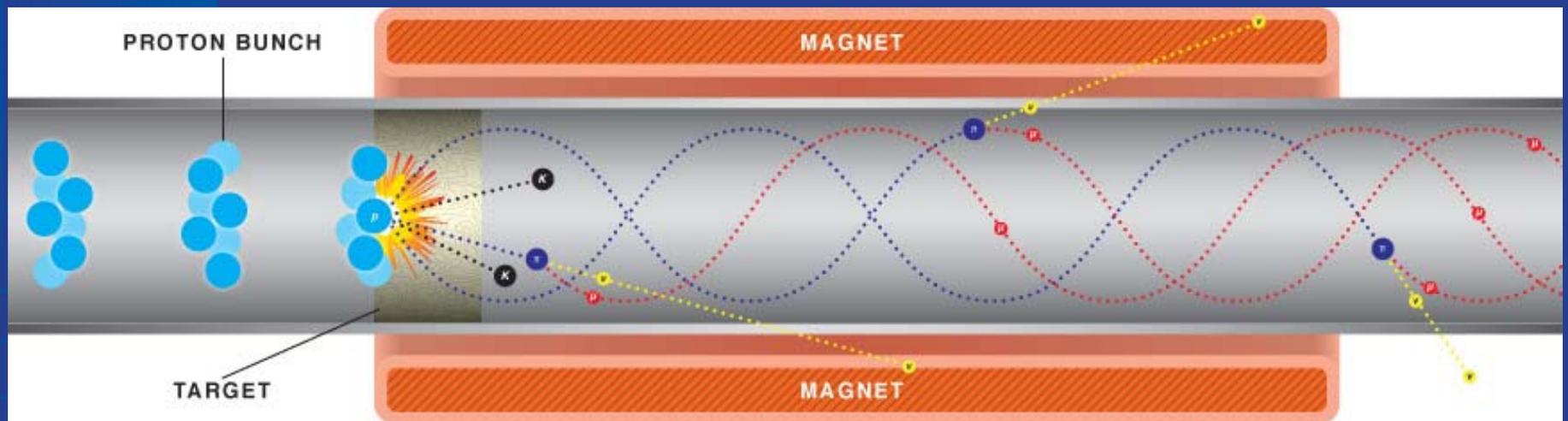
# Spare Slides

# Project-X, What it's not...



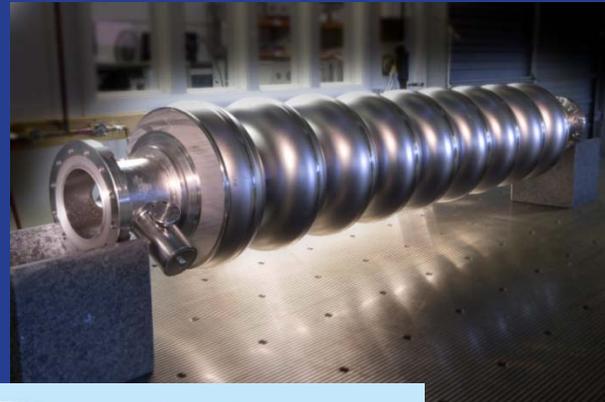
# Muon experiments at the Intensity Frontier

## Making a muon beam



Muon = heavy cousin of electron

# Project X: first steps



SRF: Creates synergies between R&D at the Energy and the Intensity Frontier



Recovery Act: \$52 million for SRF test accelerator