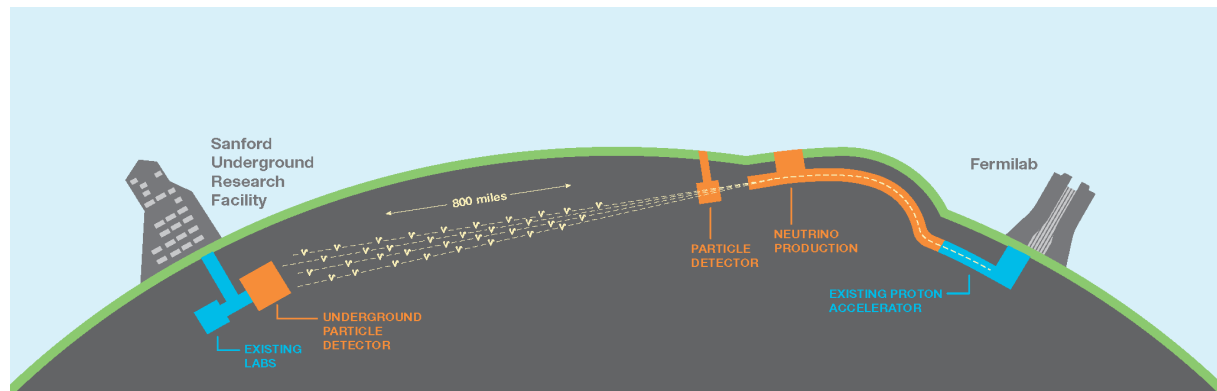Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Pressurized Gas Hadron Monitor Design for Intense Neutrino Beam Facilities

Holly Dinkel, University of Missouri-Columbia
Advisor: Dr. Katsuya Yonehara
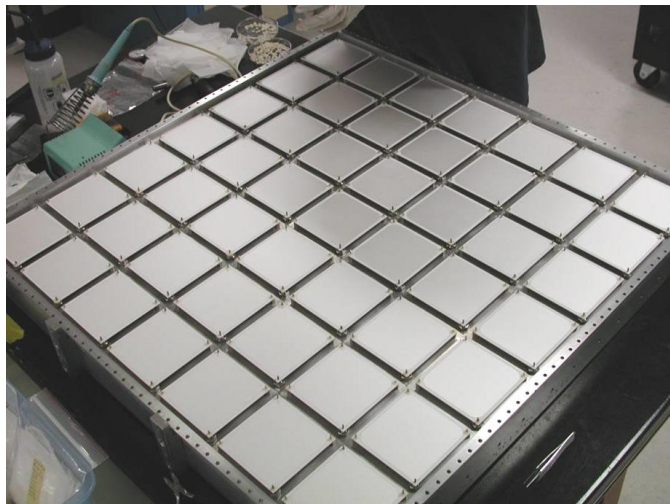Lee Teng Program Meeting
24 July 2015

Neutrinos at the Main Injector (NuMI) Hadron Monitor

NuMI:
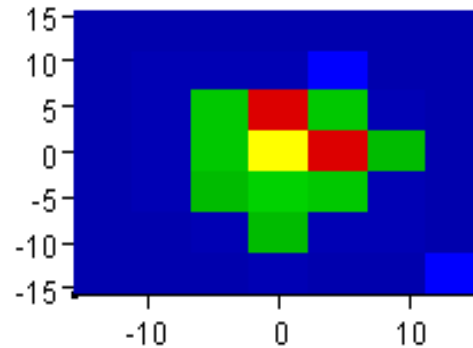- 7x7 array of ionization chambers
- Beam intensities up to 700 kW

LBNF:
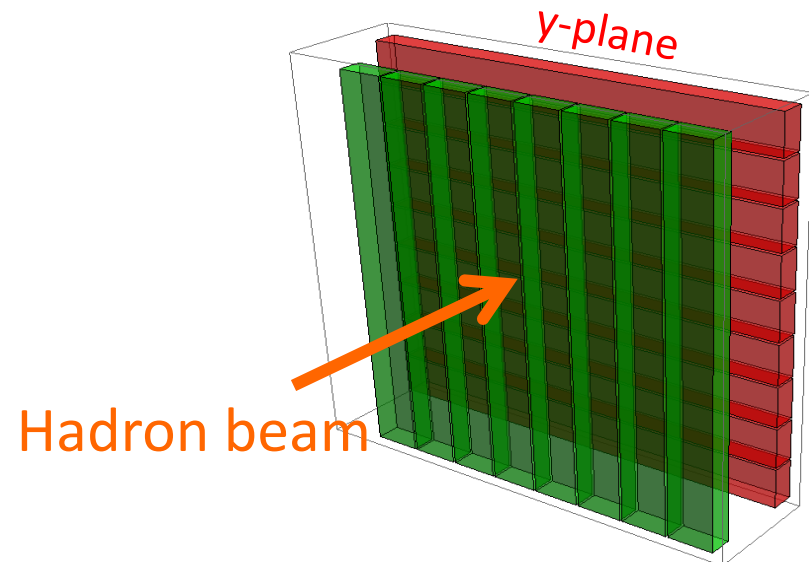- 1x1 m^2 gas-filled resonator
- Beam intensities up to 4 MW

NuMI Hadron Monitor 2-D Display (log Z)

XMean :	0.27173
XRms :	4.7484
YMean :	0.076763
YRms :	4.6779
SumOfWeights :	102379

y-plane

Hadron beam

Position vs. Electric Field in a Seven-Section RF Cavity
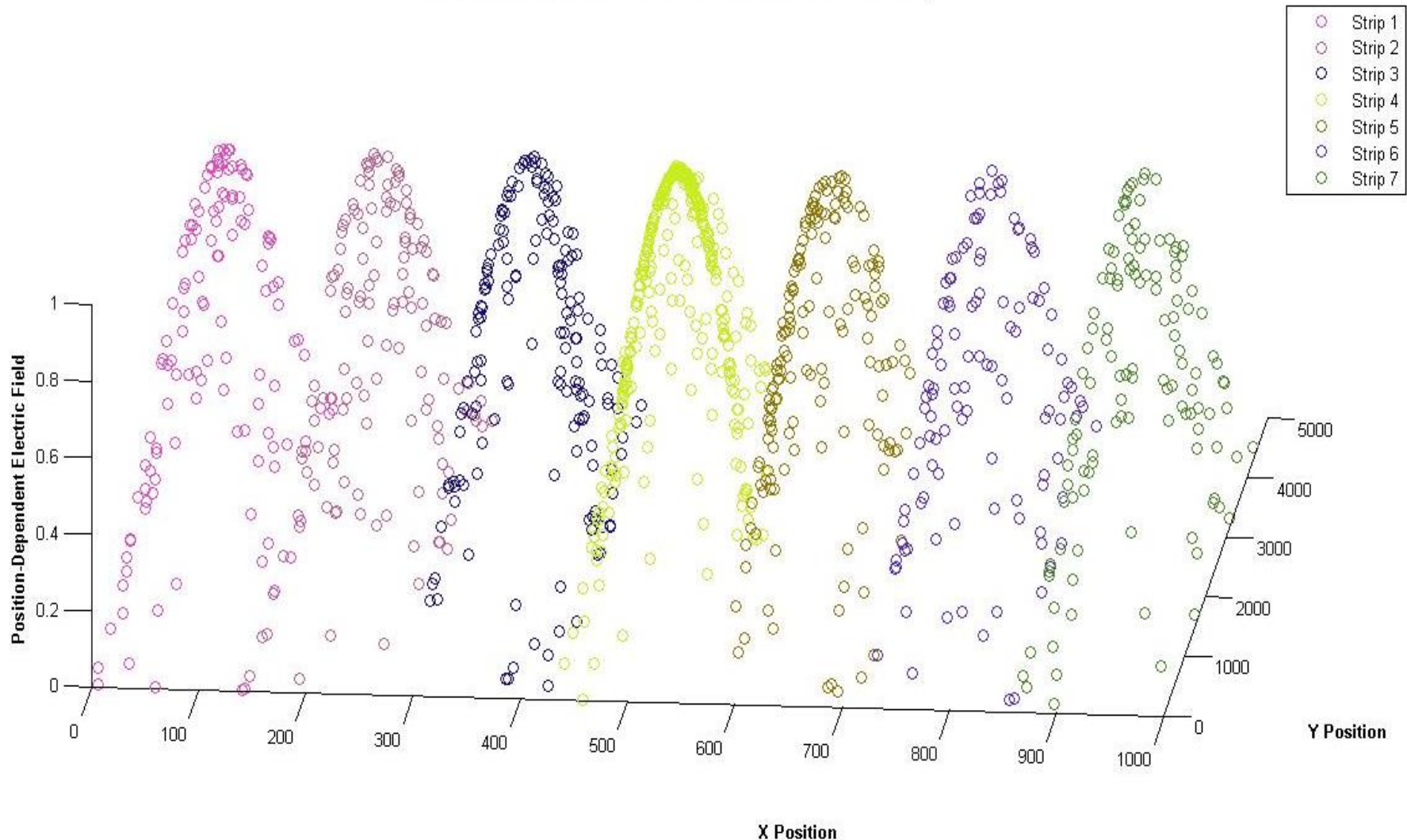
Accomplishments

Bethe-Bloch Equation:

$$-\langle\frac{dE}{dx}\rangle = \frac{Kz^2\left(\frac{Z}{A}\right)}{\beta^2}\left(\frac{1}{2}ln\frac{2m_ec^2\beta^2\gamma^2T_{max}(\beta,\gamma)}{I^2} - \beta^2 - \frac{\delta(\beta\gamma)}{2}\right)$$

Estimation of plasma quantity:

$$n_e = N_b \times h\sum_k w_k\left(\frac{\rho_m\langle\frac{dE}{dx}\rangle}{W_i}\right)_k$$

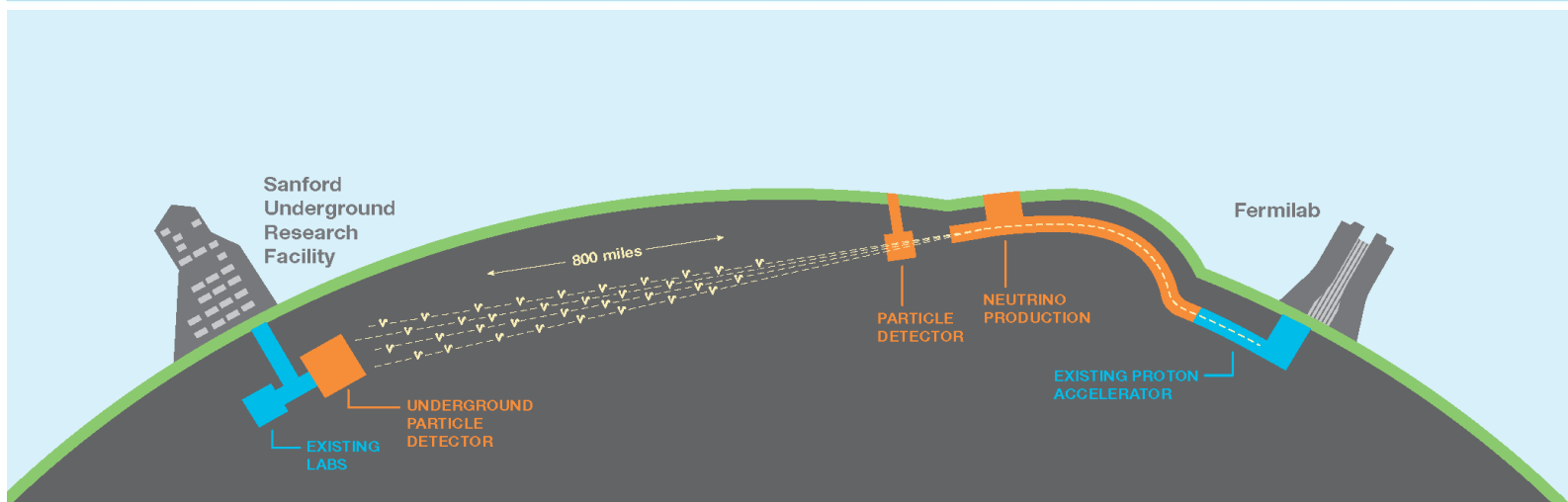Energy loss within the cavity:

$$U = \int n_e dw$$

Remaining Work

Inclusion of time structure
Evaluation of recombination rate

$$e^- + N_2^+ \rightarrow N_2^* \rightarrow N_2$$

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