Argonne NATIONAL LABORATORY

... for a brighter future

E-906/Drell-Yan:

Probing the sea quark structure of the nucleon and nuclei, or

The 120 GeV follow-on to E-605/789/866

Paul E. Reimer

2 February 2009

Fermilab All Experimenters' Meeting

Who, What, When, Where and Why?

- Who are we?
- Why do we want to make these measurements?
- What will we measure?
- Where will we do the experiment?
- When will we do it?

U.S. Department of Energy

UChicago Argonne LLC

Office of Science
U.S. DEPARTMENT OF ENERGY

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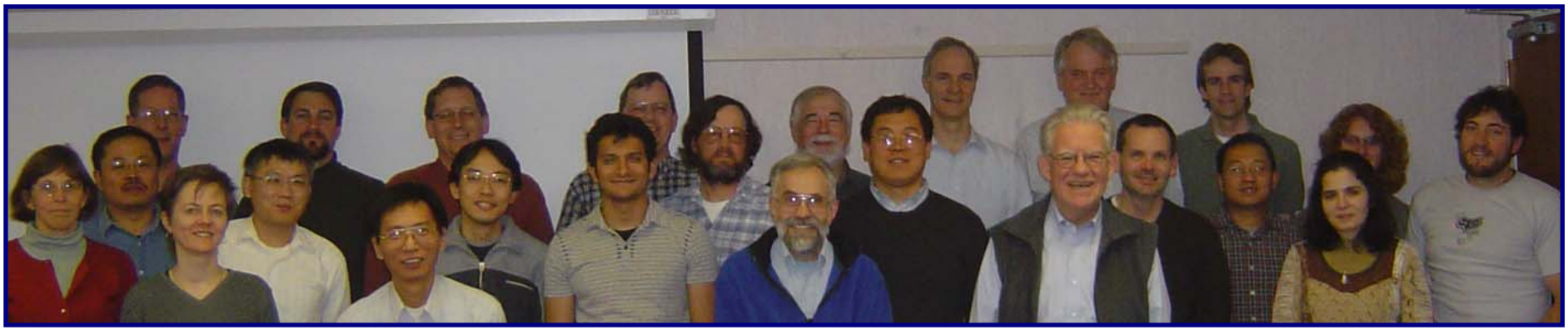
E906 Group Meeting, Jan 7th, 2009

We're smiling because Fermilab informed us we had Stage II approval just before Christmas

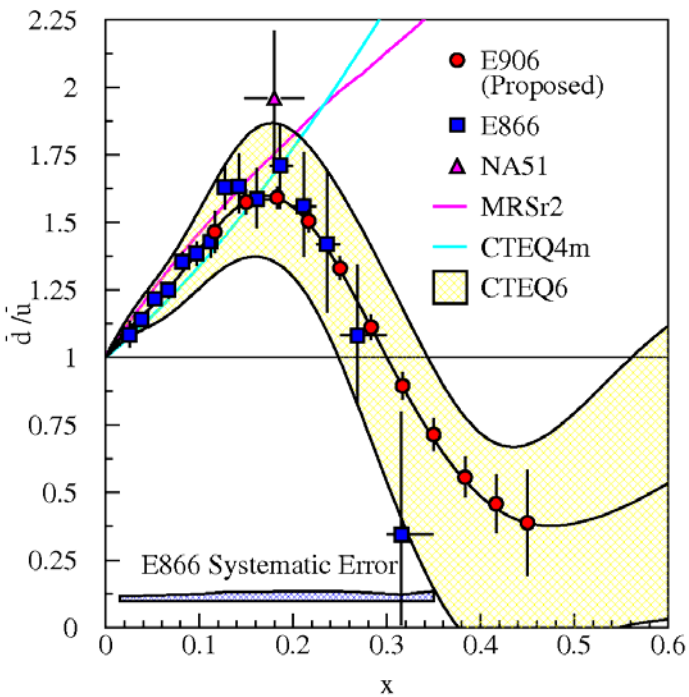


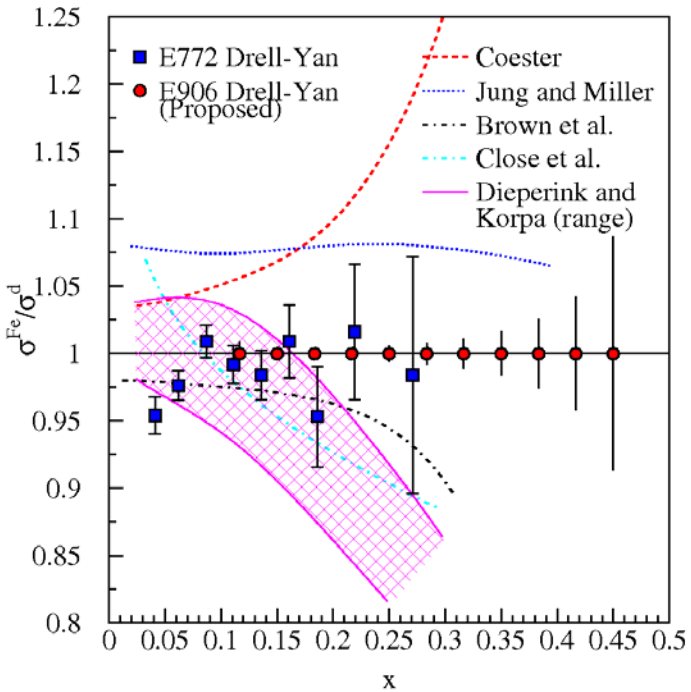
- Abilene Christian University
- Institute of Physics, Academia Sinica
- Argonne National Laboratory
- University of Colorado
- Fermi National Accelerator Laboratory
- University of Illinois
- Ling-Tung University
- Los Alamos National Laboratory
- University of Maryland
- Rutgers University
- Texas A & M University
- Thomas Jefferson National Accelerator Facility

Collaboration contains many of the E-866/NuSea groups and several new groups

Why do we want to do these measurements?

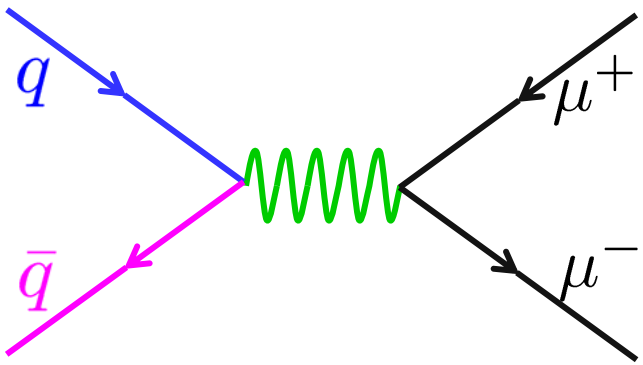
- Learn about the sea quark distributions in protons and in nuclei
- Drell-Yan σ ≈ 1/s Larger cross section at 120 GeV than at 800 GeV and less background.

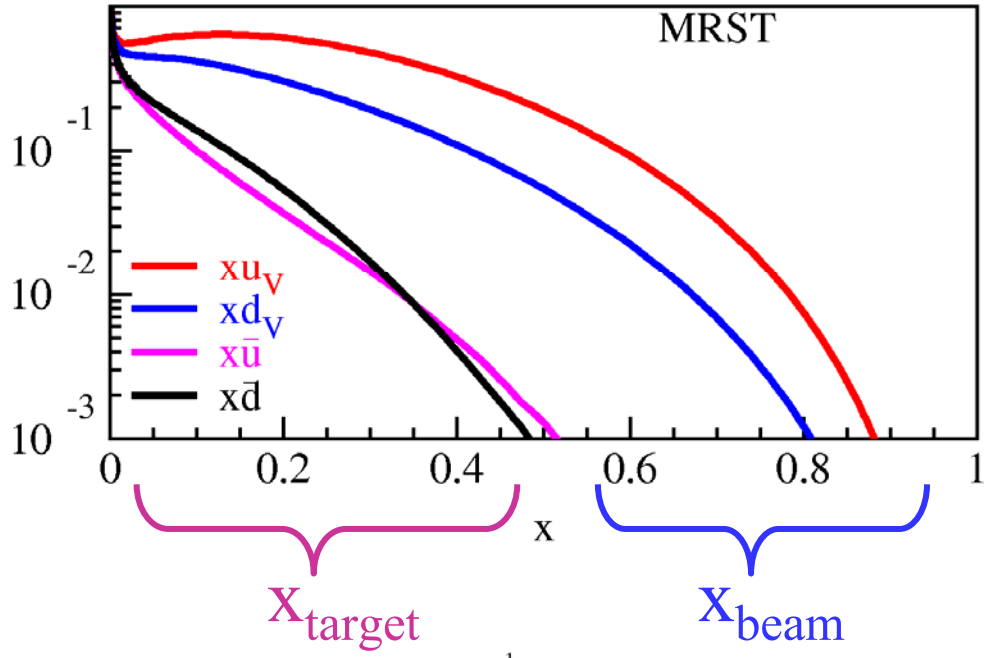




- D-bar/u-bar ratio in the proton—by what mechanism is the sea created
- EMC effect for sea quarks and nuclear binding

Drell-Yan scattering: A laboratory for sea quarks

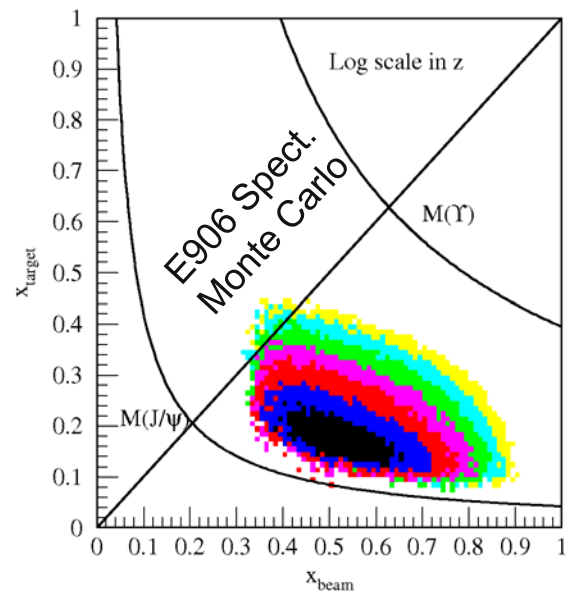




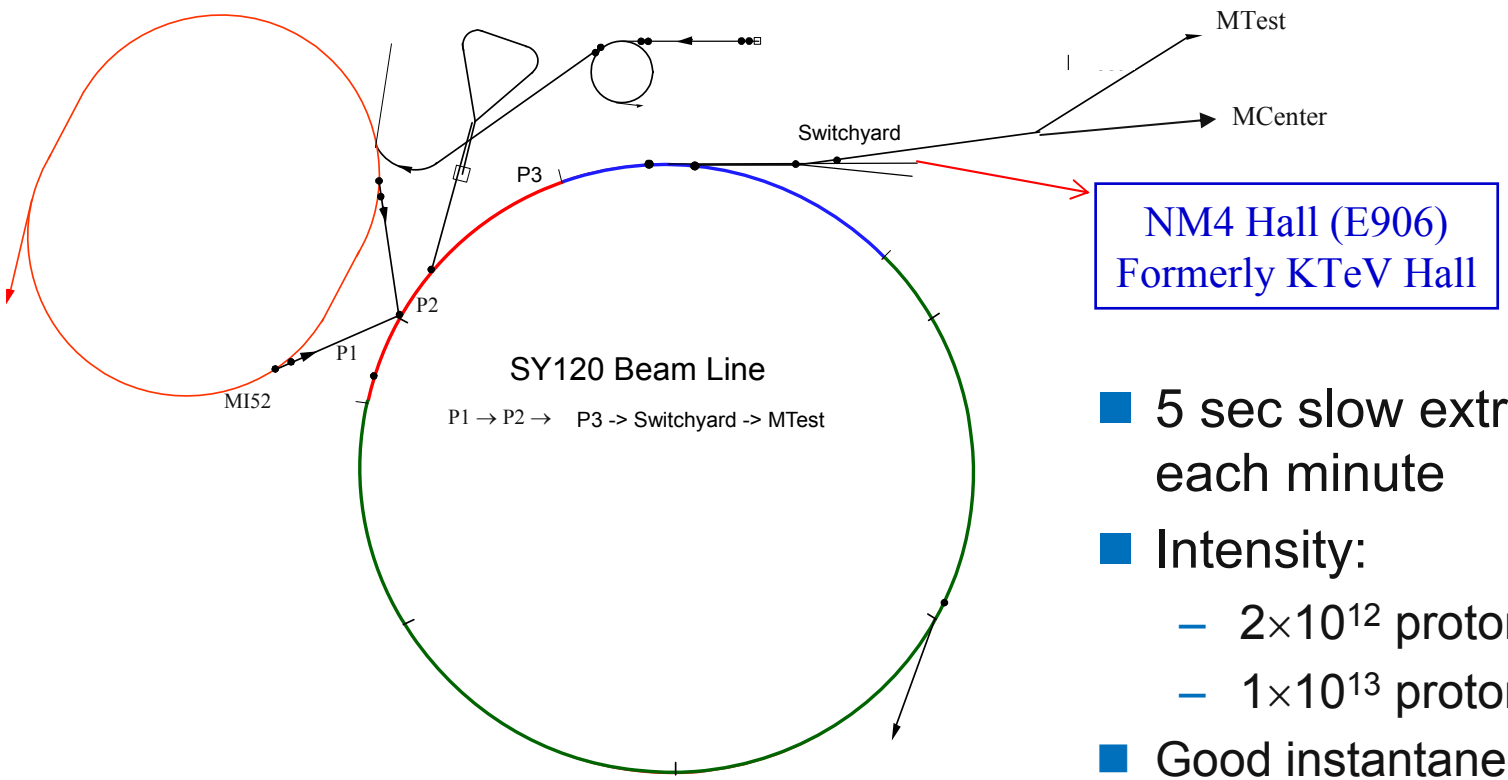
$$\frac{d^2\sigma}{dx_1 dx_2} = \frac{4\pi\alpha^2}{9x_1x_2}\frac{1}{s}\sum e^2\left[\bar{q}_t(x_t)q_b(x_b) + \cancel{q_t(x_t)\bar{q}_b(x_b)}\right]$$

Detector acceptance chooses x_{target} and x_{beam}.

- Fixed target $\Rightarrow$ high $x_F = x_{beam} - x_{target}$
- Valence Beam quarks at high-x.
- Sea Target quarks at low/intermediate-x.



Extracted 120 GeV proton beam line to NM4, E-906 Drell-Yan



- 5 sec slow extraction spill each minute
- Intensity:
  - 2×10^{12} protons/sec
  - 1×10^{13} protons/spill
- Good instantaneous duty factor

•SY120 - 3 km beam line from MI52 to Meson

• new - 2.5 km from MI52 to KTeV Hall

Extracted 120 GeV proton beam line to KTeV Hall, E906

Reenergize the 800 GeV MuBeam components to run at 120 GeV
Enclosures in RED must be modified to transmit 120 GeV protons

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Encl-B - reinstall 2 MSEPs (FY09??)

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Encl-C - reinstall 2 MV100 EPBs, add a 3Q120 doublet (FY09??)

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Encl-G1

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Encl-G2 - replace MUBEND with 6 EPBs, move 3Q120 doublet

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Encl-NM1

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Encl-NM2 - remove and clear KTeV target channel and absorbers

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Encl-NM3 - remove sweeper magnet

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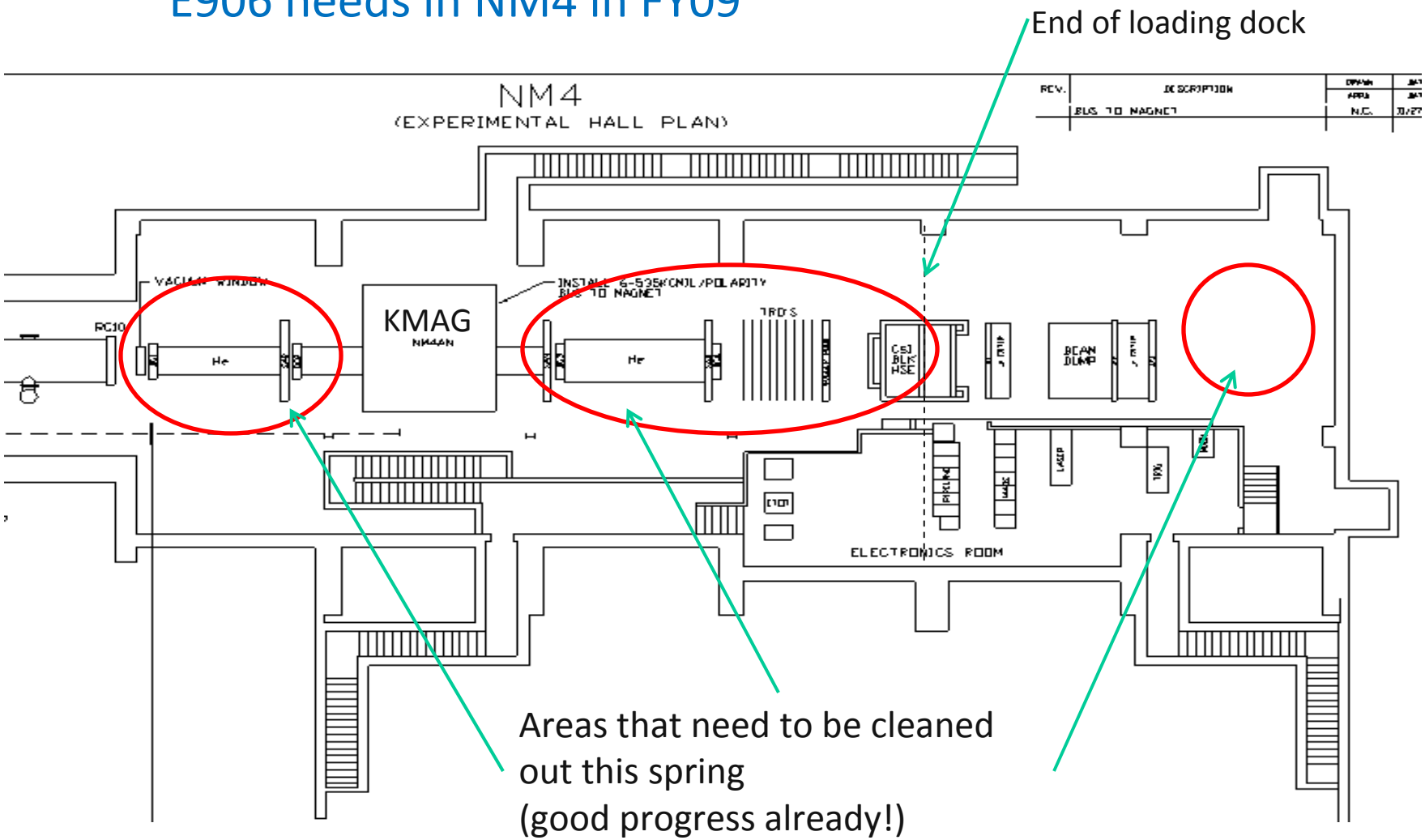
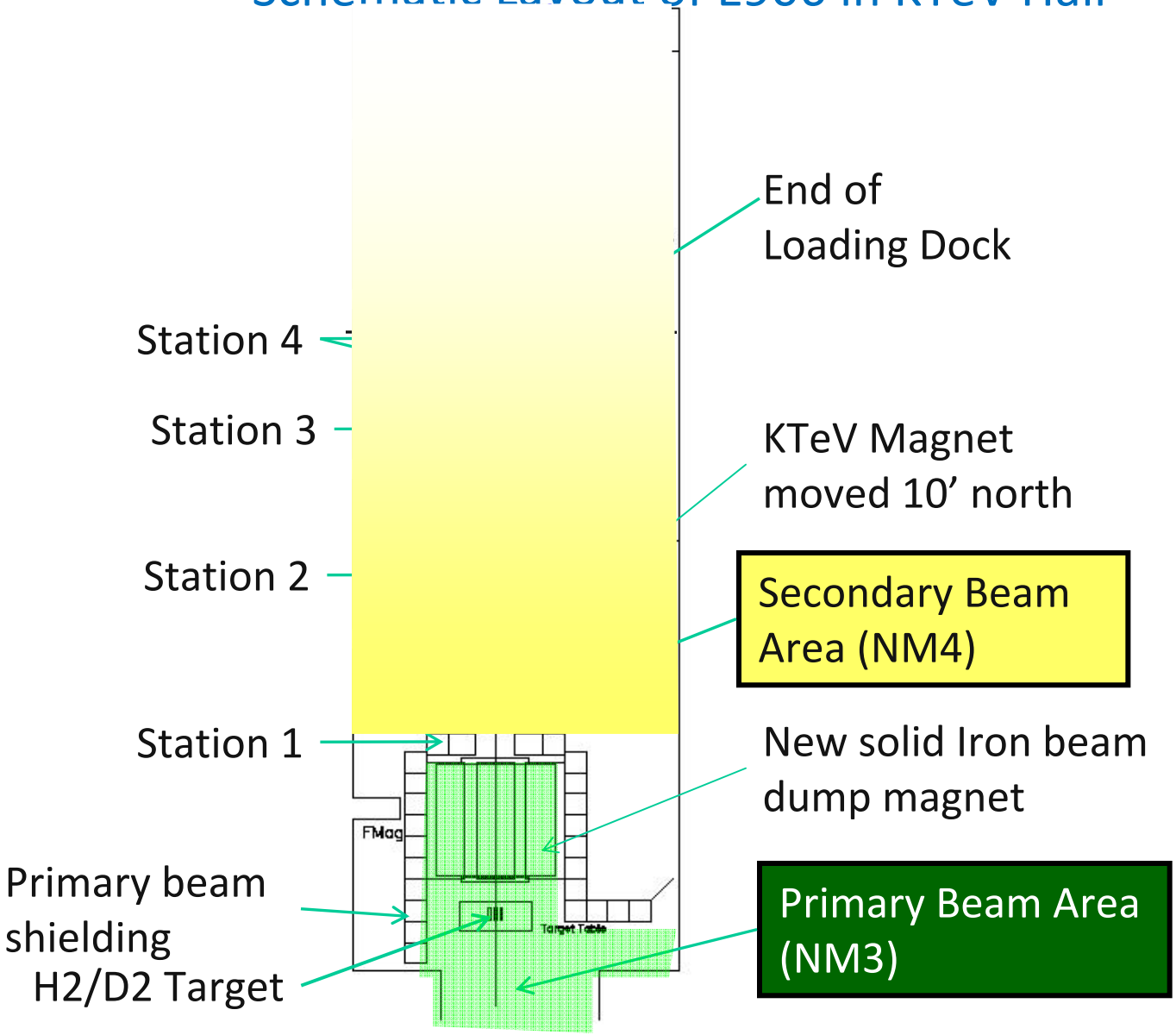
Encl-NM4/KTeV Hall – install SWIC, E906 cryotarget and experiment

E906 needs in NM4 in FY09

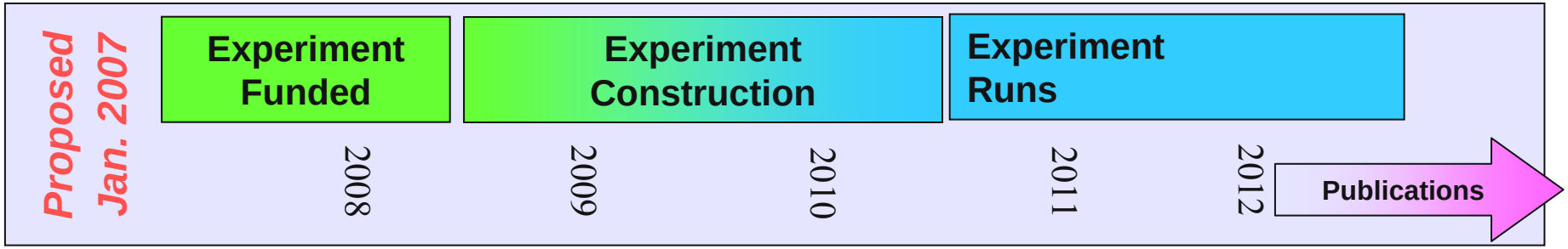


Schematic Layout of E906 in KTeV Hall



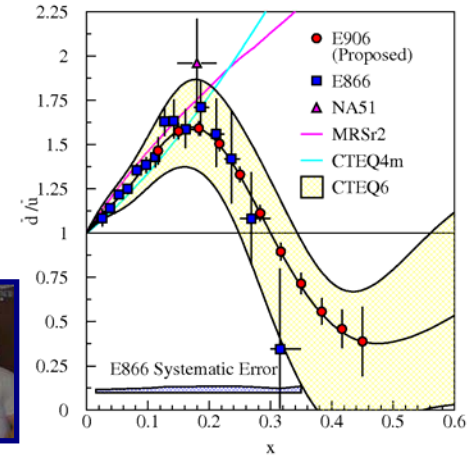
E906/Drell-Yan timeline

- Following PAC recommendation, Fermilab director approved the experiment in 2001, but experiment was not scheduled due to concerns about "proton economics"
- M&S funded by DOE/Office of Nuclear Physics (already received $538k in FY07 & 08--$292k being transferred to Fermilab this month)
- Fermilab PAC reaffirms earlier decision in Fall 2006
- Scheduled to run in 2010 for 2 years of data collection
  - Chamber testing (Station 2, Rutgers) Spring 2009
  - MWPC fabrication (Station 1, Colorado) Fall 2009
  - Prop. Tube mounting (Station 4, Los Alamos) Summer/Fall 2009
  - Hodoscope fabrication & mounting (All Stations, Abilene Christian & Illinois) Summer 2009
  - Magnet assembly (Fermilab) Spring 2010
  - Target installation (Michigan) Spring 2010



Summary

- Strong physics program studying sea quark distribution



- Experienced Collaboration

- A lot of work to be completed on
  - Beam line
  - NM4 cleanout and spectrometer assembly

All before June 2010