Analysis--Why has it taken so long?

- DoE (and NSF for U. of Colorado) decided NOT to fund MIPP specific graduate students and postdocs . Net result- University participants had to use their existing grants to fund students, postdocs (MINOS, others).
- As a result, Colorado, IIT and Purdue could not participate.
- Livermore had to drop out (of MIPP and MINOS), because they lost stockpile stewardship program to LANL.
- Finally, DoE forced University of Virginia to leave MIPP and join D0!
- But we kept going. And we are near completion. MIPP data is now needed by all neutrino experiments, as well as mu2E, muon collider/neutrino factory, Rare Kaon decay experiments, as well as all experiments that require modelling of hadronic showers.

MIPP-II

- Plan to increase data taking rate from 20Hz to 3000 Hz, a factor of 150 by updating the electronics.
- Can acquire data at 5 million events/day.
- Add the plastic ball detector to measure neutrons and backward going pions, recoil protons that would otherwise miss the TPC.
- 6 beam species are essential to solve the hadronic shower simulation problem completely.
- Competitor-NA49(1 Hz) /NA61(70Hz) has 3 beam species p, $\pi^{\pm}$ and does particle id by dE/dx alone (relativistic rise). Does not have plastic ball like device which will measure slow neutrons from nuclei.

Hadronic Shower Simulation problem

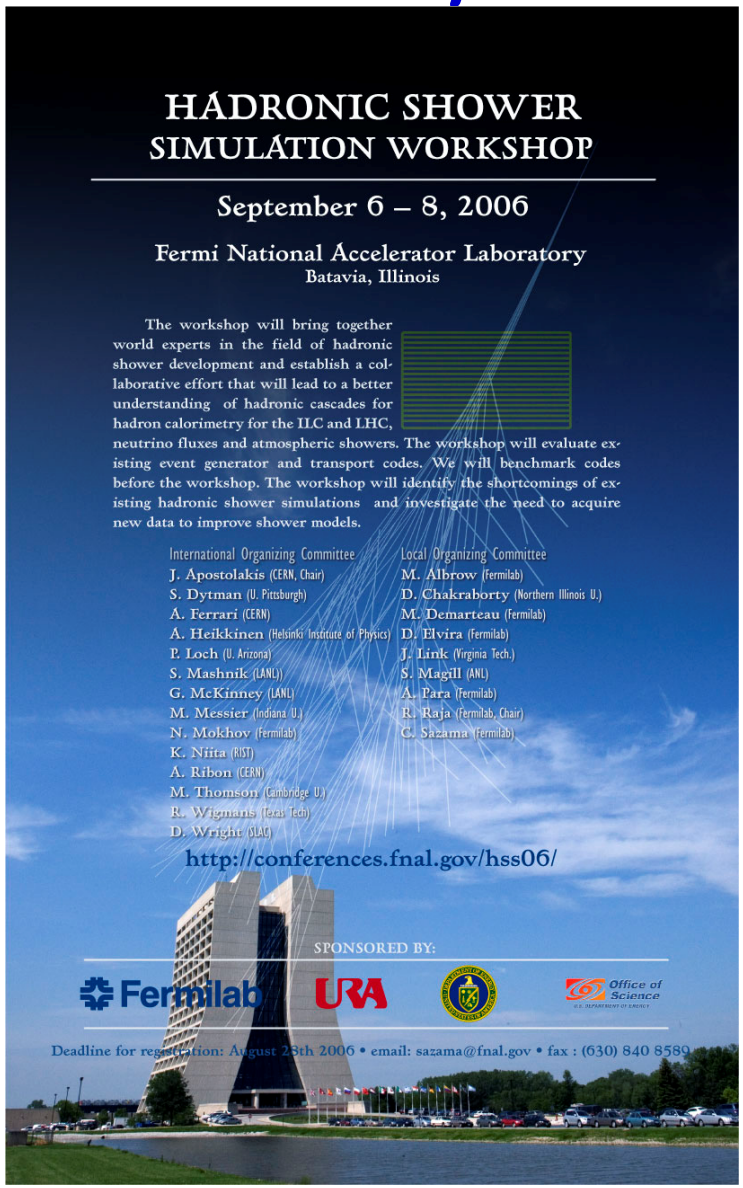
- All neutrino flux problems (NUMI, MiniBoone, K2K, T2K,Nova, Minerva) and all Calorimeter design problems and all Jet energy scale systematics (not including jet definition ambiguities here) can be reduced to one problem- the current state of hadronic shower simulators.
- MIPP-II data will significantly improve the precision of hadronic shower simulation. Will obtain particle production off 30 nuclei
- Will measure Nova target.
- Will measure liquid nitrogen target to pin down the atmospheric neutrino and muon ray spectra.

Hadron Shower Simulator problem

- Timely completion of MIPP upgrade progam can help systematics in all neutrino experiments as well as CMS/ATLAS, and ILC.
- **MIPP- II offers NOT only primary π/K production, but also the measurement of interactions needed to model the particle transport. Secondary/tertiary interactions off a variety of nuclear targets present in horn/baffle/beam-pipe/gas of π/p/K (1-100GeV).**
- Describe how showering is done in calorimeter simulations
- Why are correlations important?
- In order to have better simulator, we need to measure event by event data with excellent particle ID using 6 beam species (pi,K,P and antiparticles) off various nuclei at momenta ranging from 1 GeV/c to ~100 GeV/c. MIPP upgrade is well positioned to obtain this data.
- MIPP can help with the nuclear slow neutron problem.—plastic ball detector
- Current simulators use a lot of „Tuned theory". Propose using real library of events and interpolation.

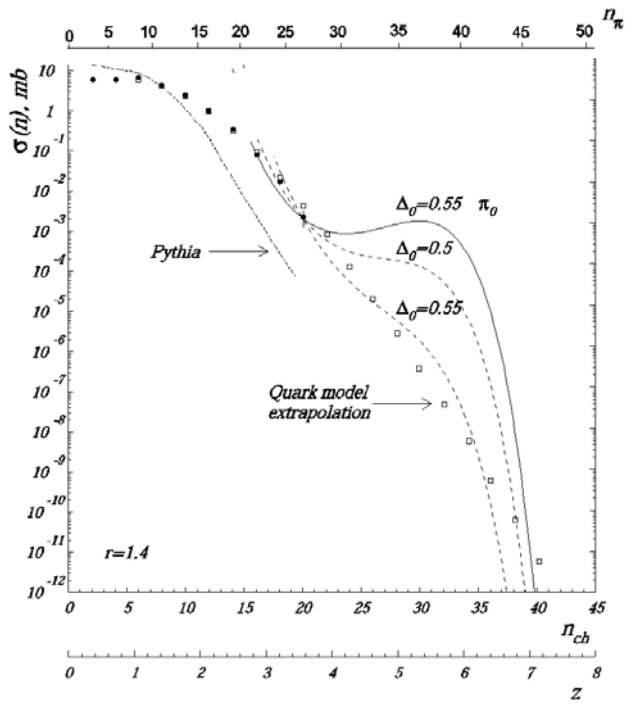
Hadronic Shower Simulation Workshop HSSW06

- Venue—Fermilab September 6-8, 2006
- Experts from GEANT4, FLUKA, MARS, MCNPX, and PHITS attended as well users from Neutrino, ILC, Atlas, CMS communities. Goal was to reduce systematics between various models and arrive at a suite of programs that can be relied on.
- Major conclusion—too many models-new particle production data on thin targets essential to improve models.
- Thick target data to verify new simulators



Other physics interests

High Multiplicity excess due to Bose- Einstein effects in pion emission?



GSI Darmstadt/ KVI are interested in measuring anti-proton cross sections for helping them design the PANDA detector better.

Nuclear physics- y scaling, propagation of strangeness through nuclei. Measure spallation products.

Measure particle production off targets such as mercury, tantalum for neutrino factory/muon collider
Make production measurements for mu2E and Rare K decay expts.
Scaling laws with 2 particle inclusives

Missing baryon Resonances

- If baryons have 3 quark degrees of freedom there ~ 20 missing resonances in the range 1-3 GeV. Sparse data. MIPP-II could increase available data by 100 fold.
- Partial wave analyses of pN scattering have yielded some of the most reliable information of masses, total widths and pN branching fractions. In order to determine couplings to other channels, it is necessary to study in reactions such as

$$\pi^- p \to \eta n; \pi^- p \to \pi^+ \pi^- n; \pi^- p \to K^0 \Lambda$$

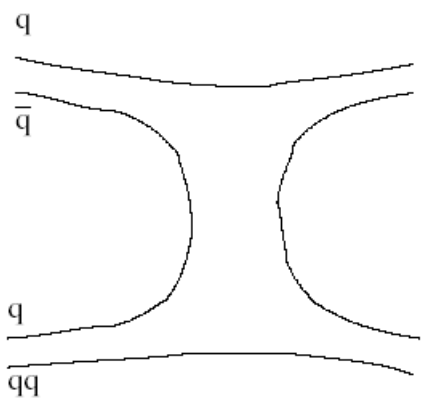
$$\gamma p \to \pi^0 p; \gamma p \to K^+ \Lambda; \gamma p \to \pi^+ \pi^- p$$

- All of the known baryon resonances can be described by quark-diquark states. Quark models predict a much richer spectrum. Where are the missing resonances? F.Wilczek, A. Selem
- "..this could form the quantitative foundation for an effective theory of hadrons based on flux tubes"– F.Wilczek
- Low Energy Pions (> 1 GeV/c), Charged Kaon beams (>3 GeV/c), TPC, Plastic ball + chambers required.
- Synergy with J-Lab

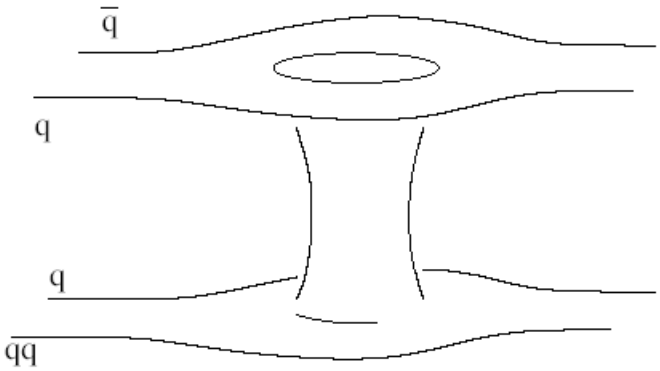
Describe a widely used model—Used to generate hadron nucleus interactions

There exists no workable theory of the strong interaction in the non-perturbative regime. No cross section (elastic, diffractive, central) can be calculated from first principles. People resort to models with tunable parameters and arbtraty assumptions. To illustrate– let us review briefly DPMJET (Dual Parton Jet) concepts similar to QGSJET. Used in Fluka as well as by itself similar to QGSJET in Geant4.

Reggeon exchange. Can either be thought of as a sum of t channel exchanges or as a sum of s channel resonances– Hence Dual.

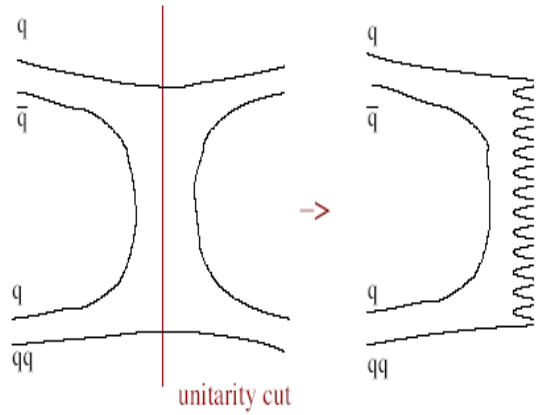


Pomeron exchange Does not depend on flavor of scattering particles.

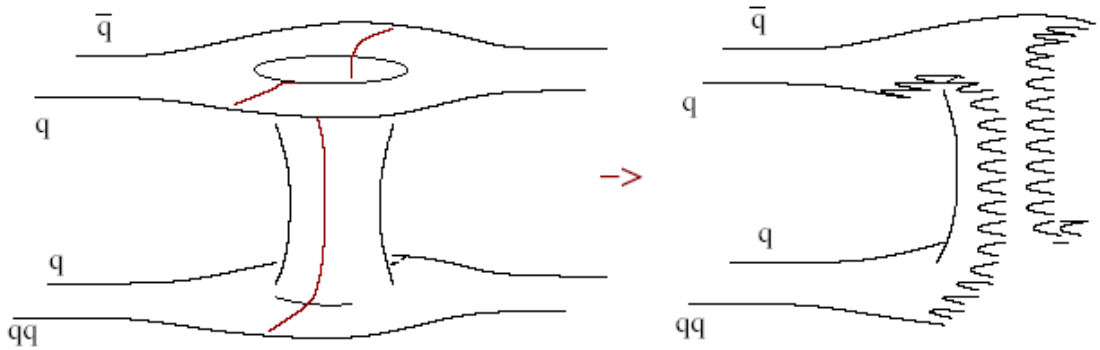


Dual Parton Model- Concepts-Optical theorem

Reggeon Exchange-Single string of hadrons

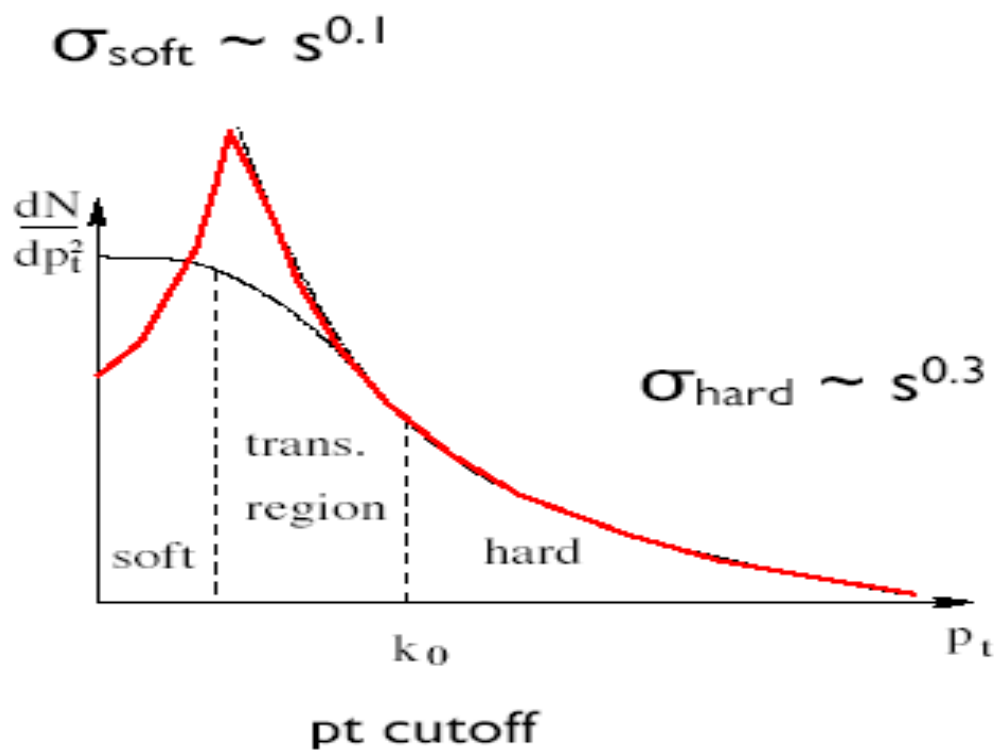


Pomeron Exchange-Two strings of hadrons



Conceptual problem- Matching soft and hard processes.

This is done by tuning the transition region carefully! And arbitrarily



HSSW06 programs and models used by them

Program	Event Generator Models	Nuclear Break up models
Fluka05	Isobar model (below few GeV) own version of DPM + hadronization	PEANUT (Includes GINC) Generalized InterNuclear Cascade
Geant4	QGS + Fritiof String model $> 20GeV$ Bertini Cascade Model $< 10GeV$ Binary Cascade model Low Energy Parametrized Models & High Energy Parametrized Models (GHEISHA origin)	Geant4 Pre-compound model Bertini evaporation model Chiral Invariant Phase Space model (CHIPS) $< 20MeV$ Nuclear break-up libraries
MARS15	Inclusive event generator CEM03, LAQGSM03 Quark-Gluon String model	Generalized intra-nuclear cascade evaporation and fission models
PHITS	Jet AA Microscopic Transport Model (JAM) $> 20MeV$ Jaeri Quantum Molecular Dynamics model JQMD	Neutrons done as in MCNP JQMD
MCNPX	Fluka79 or LAQGSM	Intra Nuclear Cascade models Bertini, ISABEL, CEM, INCL4..

HARP-CDP comparison of data to models 8.9 GeV/c protons and -8GeV/c pions on Beryllium

Table 2 Conclusions on Geant4 standard physics lists of hadronic interactions

Physics list	Proton beam		$\pi^{\pm}$ beam	
	Secondary protons	Secondary $\pi^{\pm}$	Secondary protons	Secondary $\pi^{\pm}$
LHEP	**acceptable** (shape)	**unacceptable** (diffr. patt.)	**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
LHEP_PRECO_HP			**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
QGSC	**poor** (shape)	**unacceptable** (diffr. patt.)	**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
QGS_BIC			**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
QGSP	**poor** (shape)	**unacceptable** (diffr. patt.)	**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
QGSP_BERT	**poor** (shape)	**poor** (shape)	**acceptable** (el. scatt. peak in π^{+} beam)	**poor** (shape)
QGSP_BIC	**poor** (shape)	**poor** (shape)	**poor** (el. scatt. peak in π^{+} beam)	**unacceptable** (diffr. patt.)
QBBC	**unacceptable** (el. scatt. peak)	**acceptable**	**unacceptable** (el. scatt. peak)	**good**
FTFC			**unacceptable** (el. scatt. peak)	**acceptable**
FTFP	**unacceptable** (el. scatt. peak)	**poor** (shape)	**unacceptable** (el. scatt. peak)	**acceptable**
FTFP_BERT	**unacceptable** (el. scatt. peak)	**acceptable**	**unacceptable** (el. scatt. peak)	**acceptable**

Models Fit to data where they have been tuned

- Tuning done in single inclusive variable –eg Feynman x or multiplicity.
- Errors in models multiply when applied to the calorimeter problem. Repeated showering causes systematics to be enlarged.
- In order to get longitudinal and transverse shapes correctly, one needs to not only single particle inclusive cross sections but also multiparticle correlations.
- To do this we need new data.
- To illustrate—Neutrino targets (many interaction lengths) and transverse size of target restricted.

Particle Correlations

- Inclusive approach was invented in the early 1970's (Feynman?) to compensate for the fact that new accelerators (NAL, Serpukhov) were producing hadronic interactions where only momenta and multiplicity of the final states could be reliably obtained (e.g. 30" bubble chamber). Particle ID previously was done (Berkeley, CERN) using Kinematic fitting. So inclusive cross sections became commonly used.

$$E\frac{d^3\sigma}{dp^3} = f(x_F, p_T^2)$$

- A lot of information is lost in doing this.
- The full multi-differential cross section (multiplicity n , suppressing particle id symbol) is be expressed as

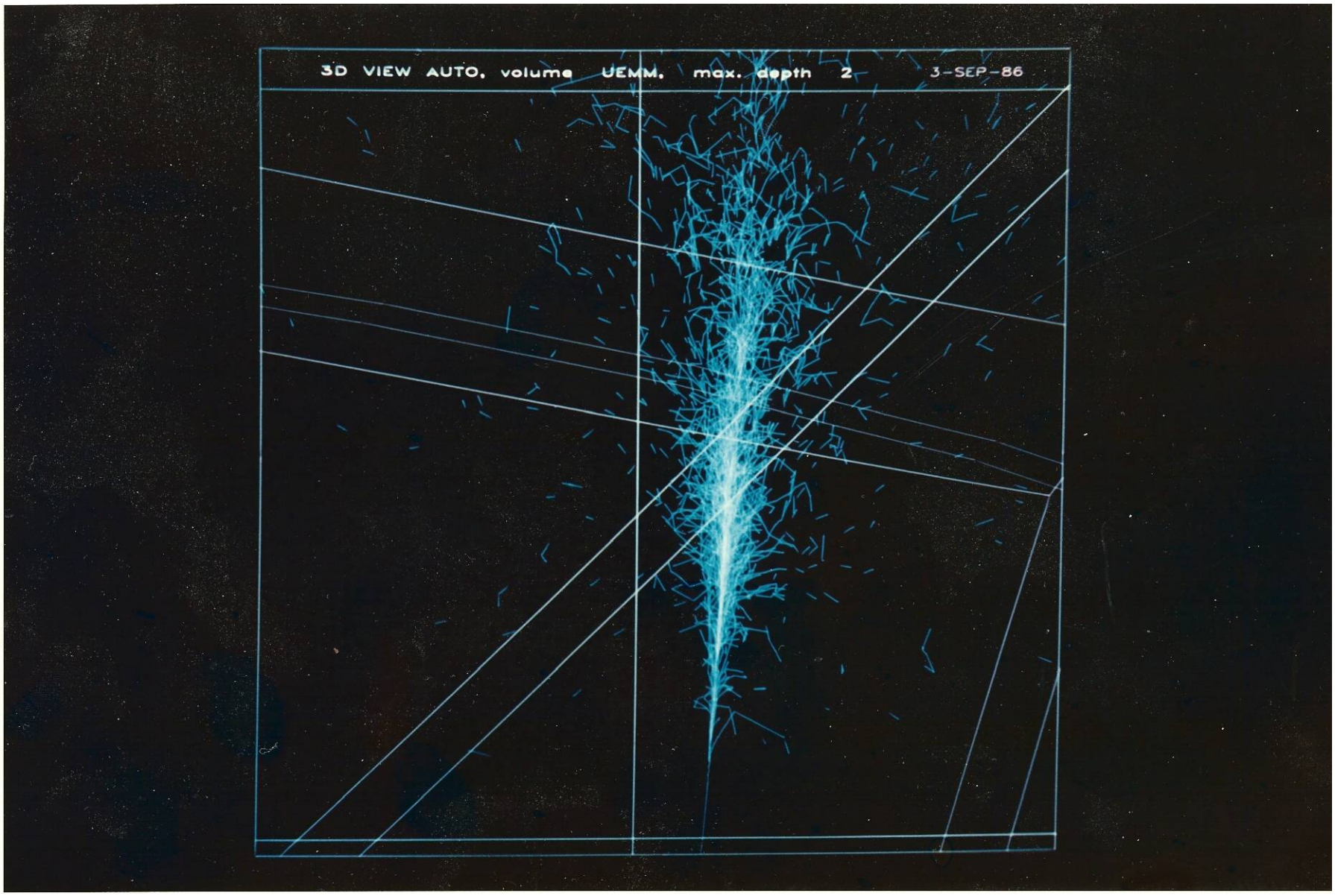
$$\sum_n E_1 E_2 \ldots E_n \frac{d^{3n}\sigma}{dp_1^3 dp_2^3 \ldots dp_n^3}$$

- Hadronic dynamics (Resonance correlations, Charge, baryon number, isospin conservation correlations, Bose Einstein Correlations)all play a part in determining where a second particle goes transversely with respect to the first one.

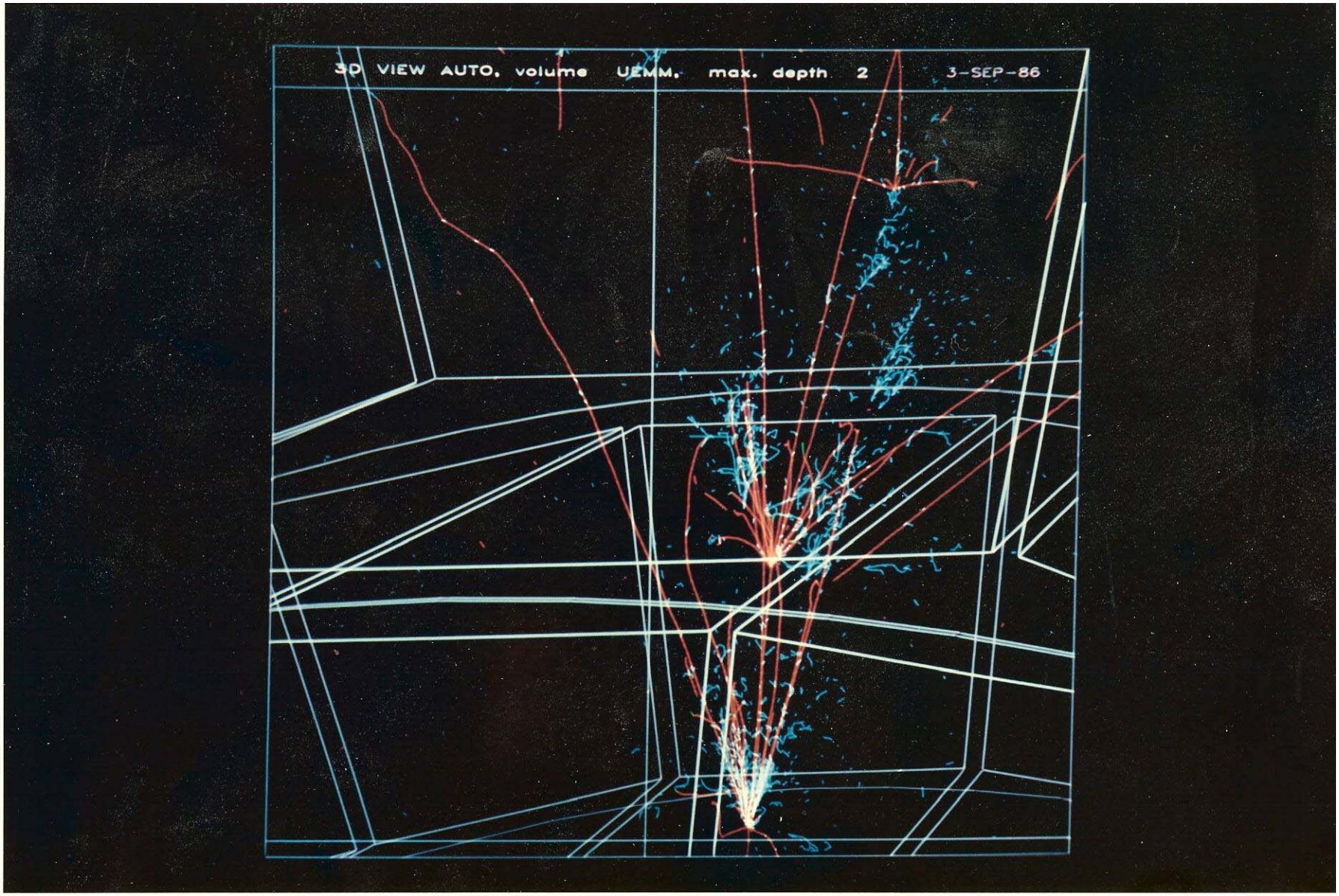
- Transverse shapes and their fluctuations depend on getting the correlations right.

- Some sparse data on 2 particle correlations. So we are entirely at the mercy of the model assumptions. Transverse shapes are critical in obtaining the correct neutrino spectrum off thick targets where the hadronic shower is bigger transversely than the target. You get the wrong spectrum and rate of neutrinos if the hadrons go outside the target transversely in a fashion that is different in the simulator than in nature.

EM Shower in D0 calorimeter

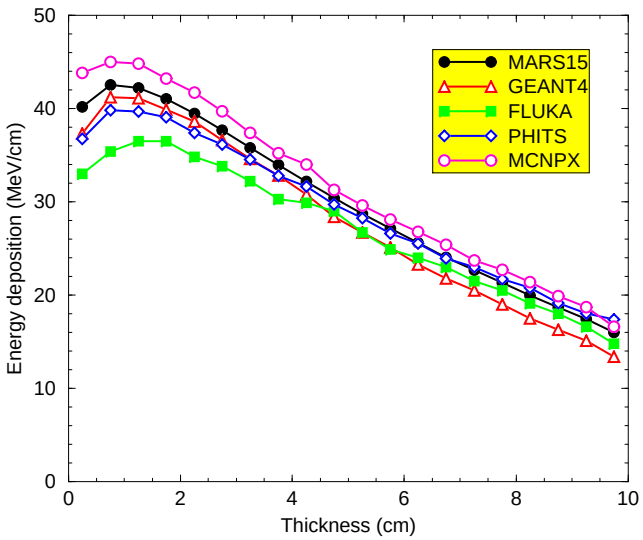


Hadronic Shower in D0 calorimeter

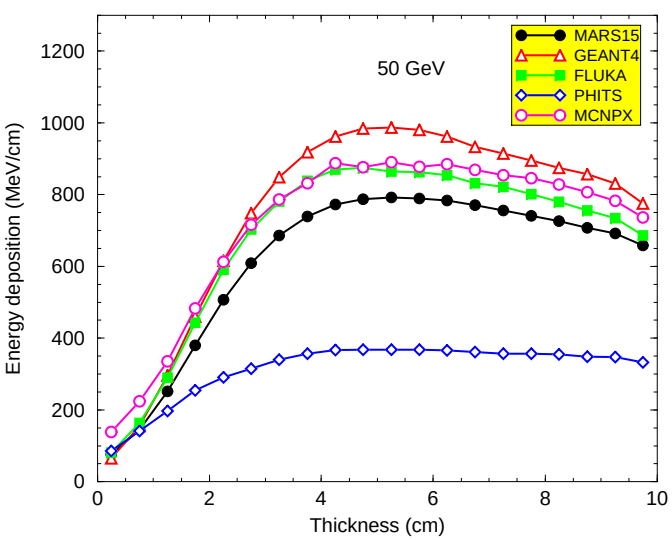


Benchmark example from HSSW06- (N.Mokhov,S.Striganov,D.Wright et al)

- Energy deposit profile as a function longitudinal depth in a tungsten rod of 1cm radius—Challenges to get longitudinal and transverse distributions correctly simultaneously.

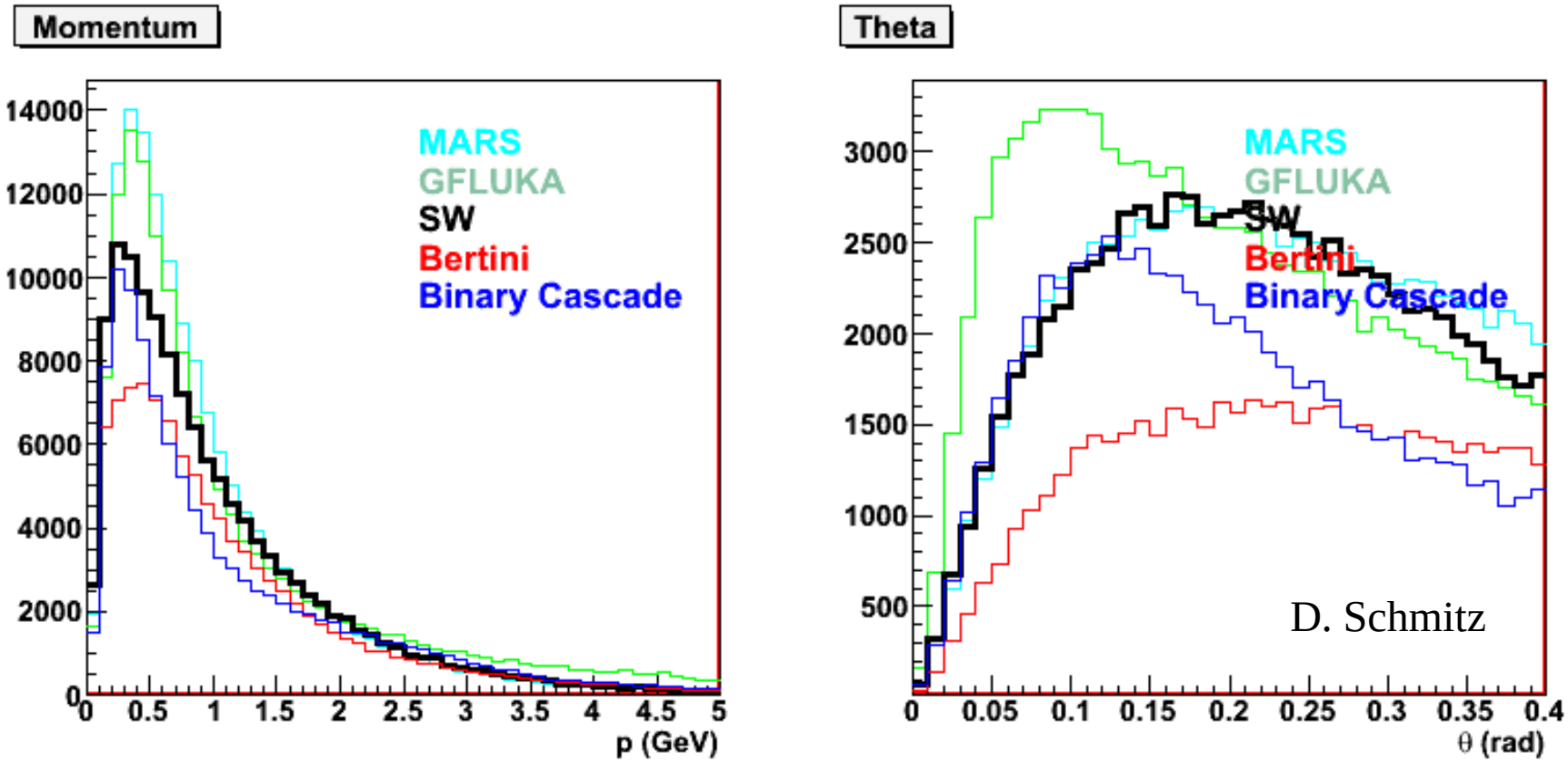


1 GeV/c protons



50 GeV/c protons

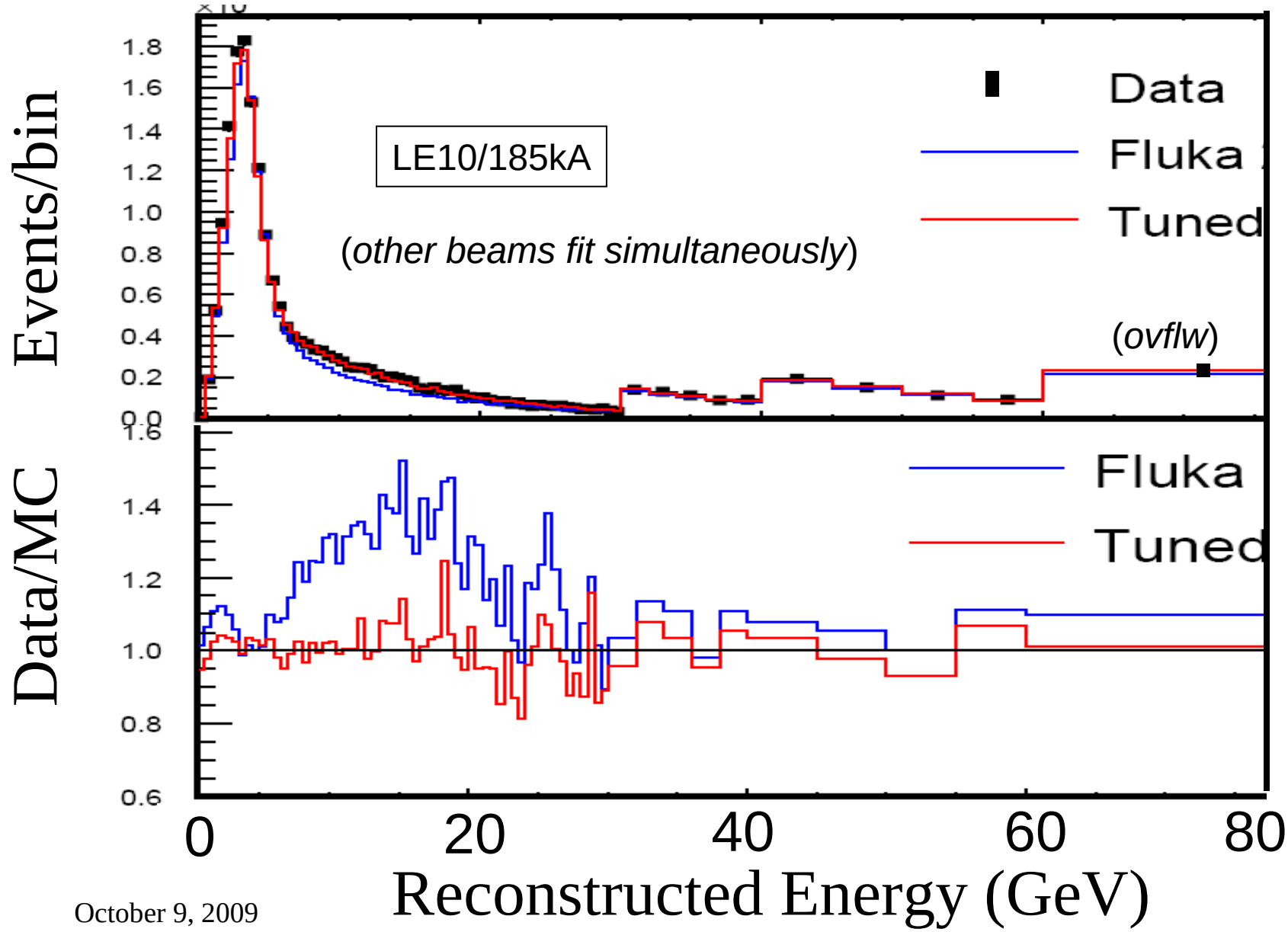
Miniboone-Sanford-Wang (SW) parametrizaion of E910 and HARP compared to other models



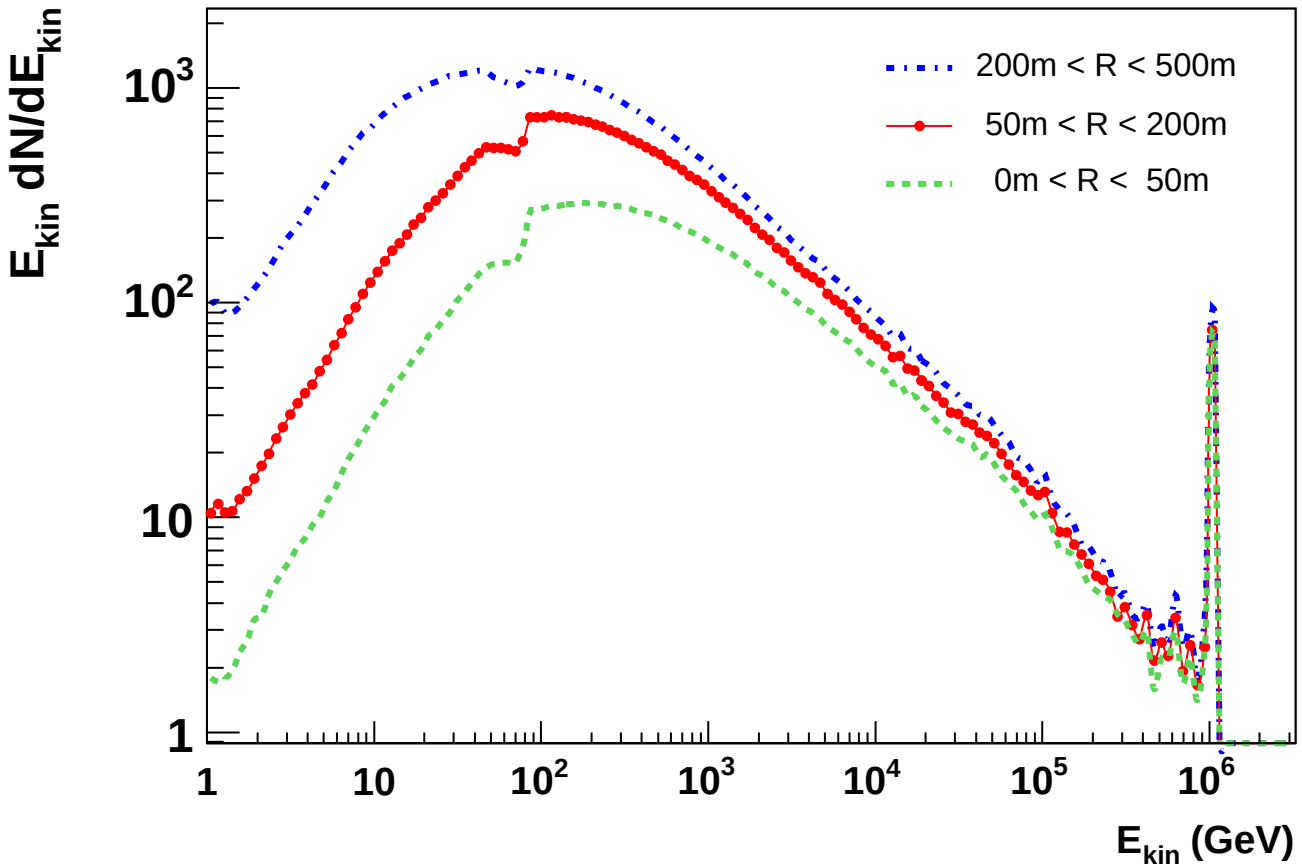
The differences are dramatic in the between models! But the E910 and HARP cross sections determine the correct model, which is very close to MARS.—Does this mean MARS is now the correct simulator to use?

MINOS problem– (from S.Kopp)

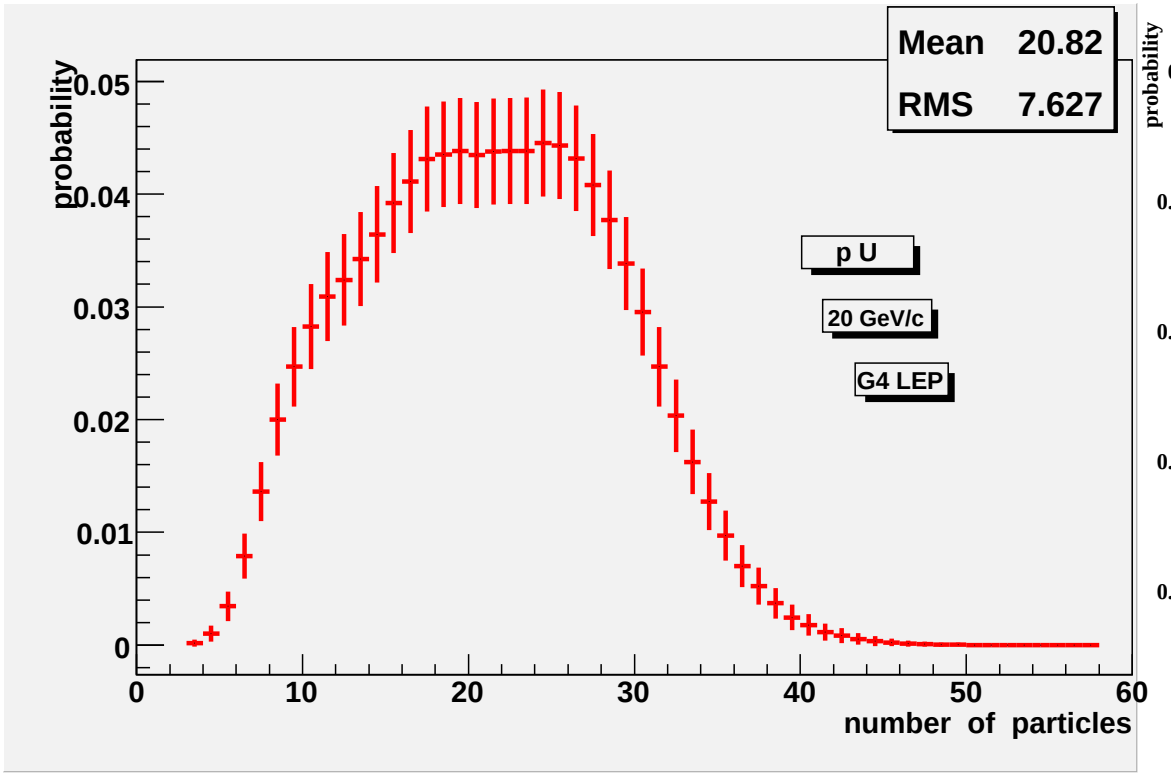
To get red points, MINOS assumed they know the νN cross section for E_ν<10 GeV. Somewhat circular argument. We need flux to measure νN cross section, instead we use an assumed cross section to determine flux. First principles flux measurement will get us out of this loop.

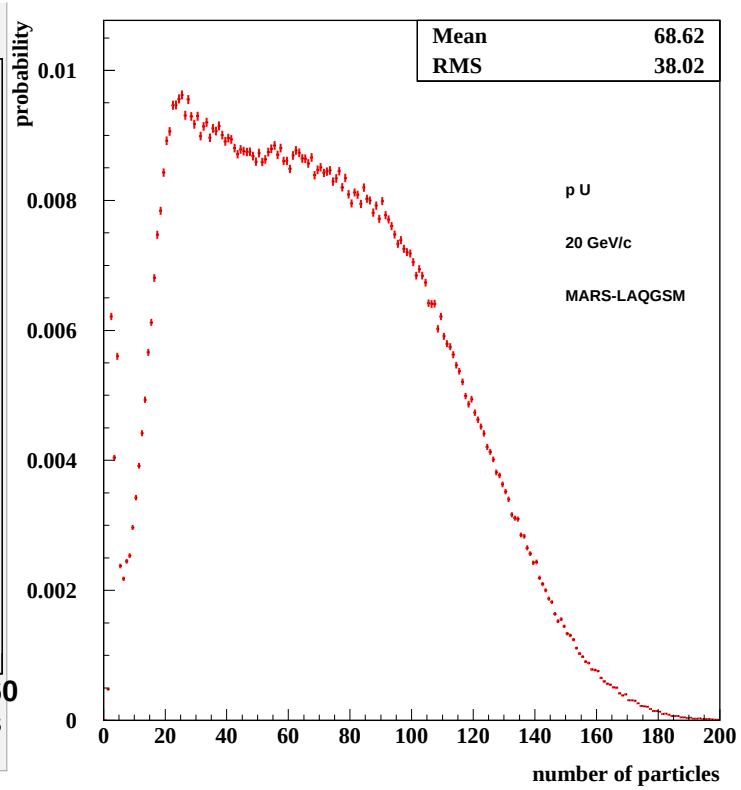


Meurer et al –Cosmic ray showers Discontinuity-Gheisha at low energies and QGSJET at higher energies-Simulation of air showers. This problem cannot be solved by measuring a nitrogen target at one or two energies.DUSEL will benefit.



Thin target data model comparisons





Summary of simulator problem

- Large variations in models predicting longitudinal energy deposition in thick targets.
- Models/data are off ~500% in 67-GeV p-Al (Thick target data) from Protvino.
- x_F-vs-p_T distribution of π/K production are 30 years old and are sparse.
- Thin target data (where avaliable) and models do not agree
- Particle correlations are important for transverse shapes (and thus also for neutrino spectra for thick targets whose transverse size is less than hadronic shower). Little correlation data available. So large model variations.

Summary of simulator problem

- Calorimeter test beam data cannot be used to tune simulation programs—said clearly by D.Wright (Geant4) at Hadronic Shower Simulation Workshop. To do this we need hadron nucleus data with particle id that MIPP can provide.
- Transverse profiles of hadronic showers are governed by particle correlations which result from dynamics. None of the models get the dynamics right. Some may agree better than others at some test beam settings but the same models will disagree at other energies.
- ILC needs to measure calorimeter transverse shapes but also to build simulators that get this right for PFA. This can only be done by random access libraries that contain events that contain the right correlations—until a workable theory emerges

Interest in MIPP Upgrade data

January 10, 2008

Dr. R. Raja
Fermilab

Re: Interest in data provided by the upgraded MIPP experiment at Fermilab

Dear Raja:

We would like to express our keen interest in utilizing the data provided by the upgraded MIPP experiment at Fermilab in improving the predictive power of hadronic shower simulation codes. The upgraded MIPP experiment will provide high quality data with final state particle identification on 30 nuclei using six beam species with momentum ranging from 1 to 90 GeV/c. The present codes use models that are tuned on single-particle inclusive data taken over many years and not always mutually consistent with each other. The MIPP upgrade data will eliminate a significant portion of the systematic uncertainties involved in hadronic shower simulations. Improved codes will benefit diverse fields within the HEP community, such as the fixed target neutrino and kaon programs, the atmospheric neutrino program, cosmic rays, calorimetry simulations in hadron collider experiments, as well as outside HEP such as studies to design radiation safe spacecraft environments. Improved codes will also help planning and calorimeter design studies for the International Linear Collider and a Muon Collider.

Sincerely,

John Apostolakis (CERN), Dennis Wright (SLAC), on behalf of the GEANT4 team

Nikolai Mokhov (Fermilab) on behalf of the MARS team

Koji Niita (RIST/JAEA) on behalf of the PHITS team

Laurie Waters (LANL) on behalf of the MCNPX team

MIPP Upgrade P-960-collaboration list

D.Isenhower,M.Sadler,R.Towell,S.Watson
Abilene Christian University
R.J.Peterson
University of Colorado, Boulder
W.Baker,B.Baldin,D.Carey, D.Christian,M.Demarteau,D.Jensen,C.Johnstone,H.Meyer, R.Raja,A.Ronzhin,N.Solomey,W.Wester,J-Y Wu
Fermi National Accelerator Laboratory
Bill Briscoe, Igor Strakovsky, Ron Workman
George Washington University, Washington D.C
H.Gutbrod,B.Kolb,K.Peters,
GSI, Darmstadt, Germany
G. Feldman,
Harvard University
Y.Torun,
Illinois Institute of Technology
M. Messier,J.Paley
Indiana University
U.Akgun,G.Aydin,F.Duru,E.Gülmez,Y.Gunaydin,Y.Onel, A.Penzo
University of Iowa
V.Avdeichicov,R.Leitner,J.Manjavidze,V.Nikitin,I.Rufanov,A.Sissakian,T.Topuria
Joint Institute for Nuclear Researah, Dubna, Russia
D.M.Manley,
Kent State University
H.Löhner, J.Messchendorp,
KVI, Groningen, Netherlands
H.R.Gustafson,M.Longo,T.Nigmanov, D.Rajaram
University of Michigan
S.P.Kruglov,I.V.Lopatin,N.G.Kozlenko,A.A.Kulbardis,D.V.Nowinsky, A.K.Radkov,V.V.Sumachev
Petersburg Nuclear Physics Institute, Gatchina, Russia
A.Bujak, L.Gutay,
Purdue University
D.Bergman, G.Thomson
Rutgers University
A.Godley,S.R.Mishra,C.Rosenfeld
University of South Carolina
C.Dukes,C.Materniak,K.Nelson,A.Norman
University of Virginia
P.Desiati, F.Halzen, T.Montaruli,
University of Wisconsin, Madison
P.Sokolsky, W.Springer
University of Utah

10 new institutions have joined. More in negotiations. Previous collaboration built MIPP up from ground level. Less to do this time round. More data.

Indo-U.S neutrino collaboration

- Result of the visit by Pier Oddone to India earlier this year. Came back and agreed to support 6 Indian students on MIPP and MIPP Upgrade.
- MoU about to be signed
- The following Indian Universities are currently participating. Universities of Panjab, Delhi, Banaras. Universities of Hyderabad and Cochin have agreed to start new HEP groups and are also signatories.
-

The MIPP Upgrade Proposal in a nutshell

- MIPP one can take data at ~30Hz. The limitation is the TPC electronics which are 1990's vintage. We plan to speed this rate up to 3000Hz using ALTRO/PASA chips developed for the ALICE collaboration.
- Beam delivery rate– We assume the delivery of a single 4 second spill every two minutes from the Main Injector. We assume a 42% downtime of the Main Injector for beam manipulation etc. This is conservative. Using these figures, we can acquire 5 million events per day.
- Jolly Green Giant Coil Replacement- Towards the end of our run, the bottom two coils of the JGG burned out. We have decided to replace both the top and bottom coils with newly designed aluminum coils that have better field characteristics for the TPC drift. The coil order has been placed ($200K).
- Beamline upgrade- The MIPP secondary beamline ran satisfactorily from 5 5GeV/c-85GeV/c. We plan to run it from ~1 GeV/c to 85 GeV/c. The low momentum running will be performed using low current power supplies that regulate better. Hall probes in magnets will eliminate hysteresis effects.
- TPC Readout Upgrade-We have ordered 1100 ALTRO/PASA chips from CERN ($80K). The order had to go in with a bigger STAR collaboration order to reduce overhead. We expect delivery in the new year of tested chipsets.

The Proposal in a nutshell

- MIPP- Recoil detector- GSI- Darmstadt / KVI Groningen have joined us. They will bring the plastic ball detector (a hemisphere of it) which will serve to identify recoil (wide angle) neutrons, protons and gammas from our targets. + Recoil cluster counting chamber ?
- Triggering system- We propose to replace the MIPP interaction trigger (scintillator/wire chamber) with 3 planes of silicon pixels based on the B-TeV design. Will enable us to trigger more efficiently on low multiplicity events.
- Drift Chamber/ PWC electronics- These electronics (E690/RMH) worked well for the first run. They are old (1990's). RMH will not do 3kHz. We will replace both systems with a new design that utilizes some of the infrastructure we developed for the RICH readout.
- ToF/CKOV readout-Plan to build new readout based on TripT chip (Used by Minerva) and a high resolution TDC chip. Will use the VME readout cards in common with RICH, TPC
- RICH detector and the Beam Cerenkovs will work as is.
- Calorimeter Readout- Switch to FERA ADC's (PREP).
- DAQ software upgrade- Front end DAQ software needs to be developed. The MIPP DAQ control software+ Data base can be kept as is.
- Plan is to store one spill's worth of data on each detector and read out the whole lot at end of spill.

Can we reduce our dependence on models?

- Answer- Yes- With the MIPP Upgrade experiment, one can acquire 5 million events per day on various nuclei with six beam species ($\pi^{\pm}$,$K^{\pm}$,$p^{\pm}$) with beam momenta ranging from 1 GeV/c-90 GeV/c. Full acceptance over phase space, including info on nuclear fragmentation
- This permits one to consider random access event libraries that can be used to generate the interactions in the shower.

Random Access Data Libraries

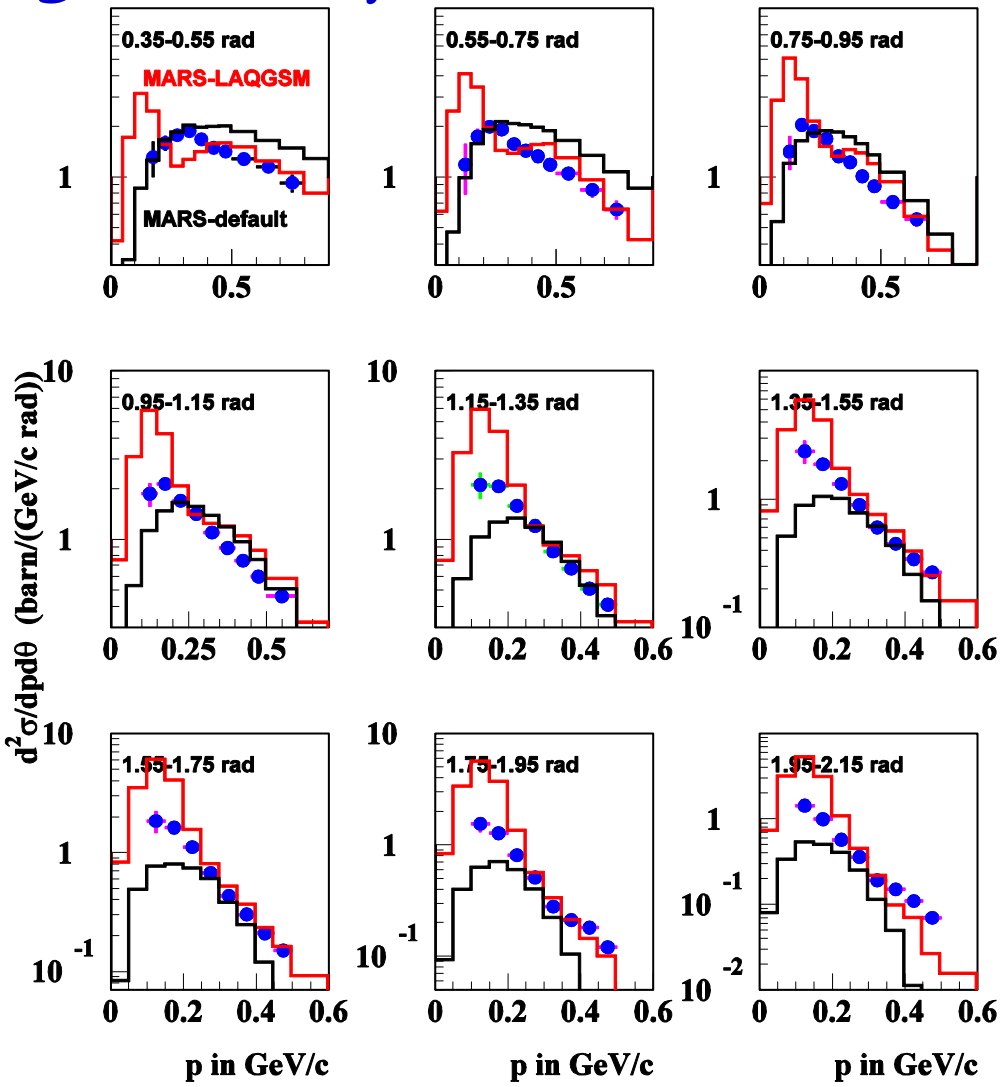
- Typical storage needed (36 GB + Overhead <0.5Terabyte)

Nuclei	beam species	momentum bins	events/bin	tracks/event	words/track
30	6	10	100000	10	5

Number of events	1.80E+08	Number of days	36
Total number of words	9.00E+09	to take data	
Bytes	3.60E+10		

- Mean multiplicities and total and elastic cross section curves are parametrized as a function of s.
- Event generation is done by looking up event in library that matches closest the center of mass energy for the beam & target of interest and scaling to the beam energy actually needed.
- Neutral particle Algorithm

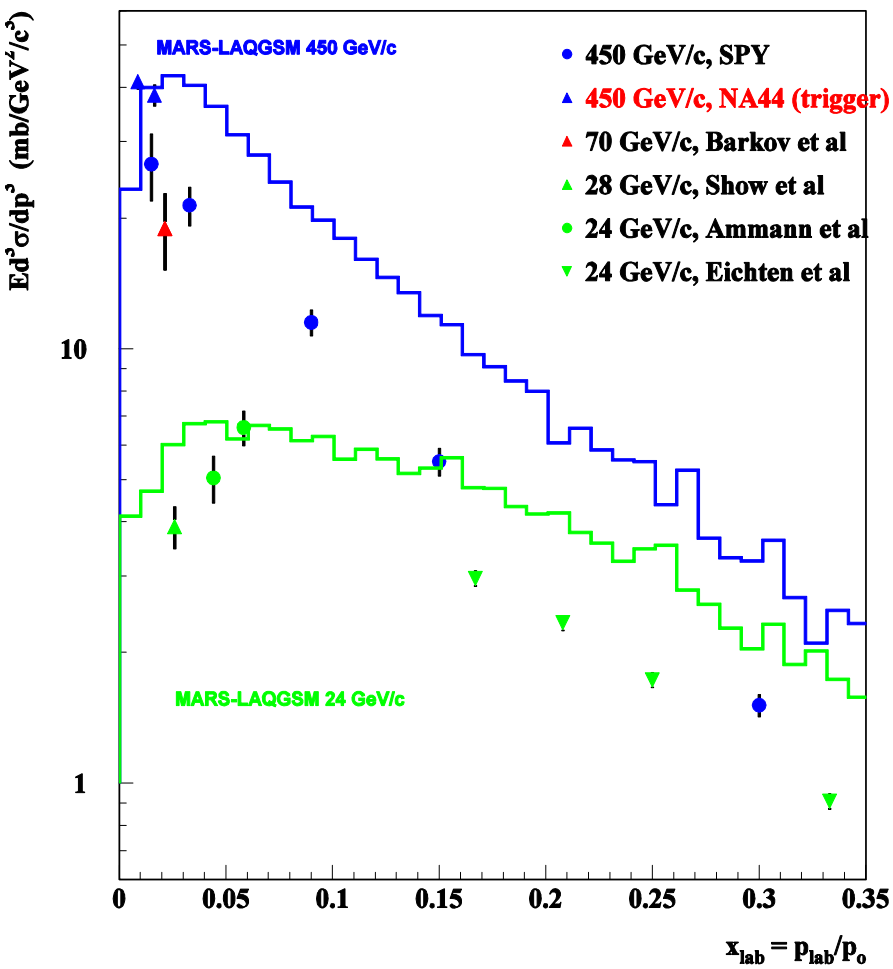
μ2e needs. Pion production off tantalum using 8 GeV protons—from S., Striganov



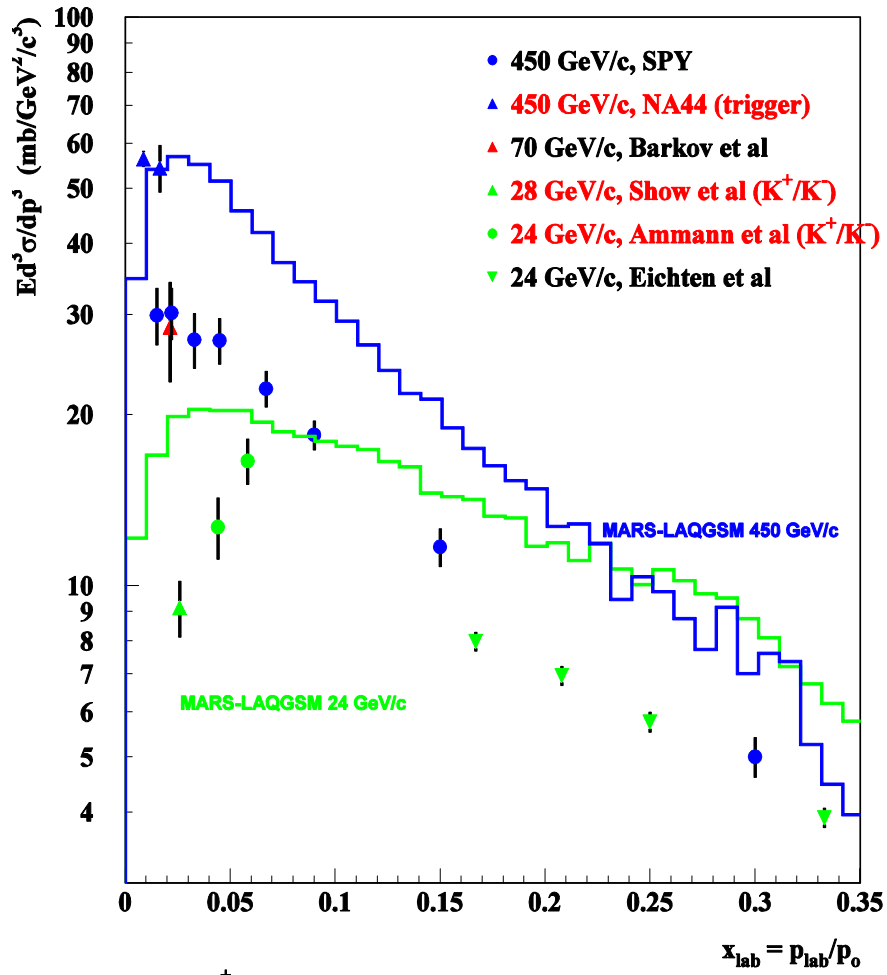
π^- production in proton tantalum interaction at 8 GeV/c

MARS-LAQGSM generator and experimental data Rare K Decay needs- From S. Striganov

We need data near kaon momenta of 500 MeV/c at 120 GeV/c (0.00417)
710 MeV/c at 24 GeV/c (0.03)



K^- production in proton beryllium interaction



K^+ production in proton beryllium interaction

Run Plan

Phase 1 Run Plan			
Target	Number of Events (Millions)	Running Time (Days)	Physics Need Group
NuMI Low Energy target	10	2	MINOS MINERVA
NuMI Medium Energy Target	10	2	MINERVA NOVA
Liquid Hydrogen	20	4	QCD PANDA DUBNA
Liquid Nitrogen	10	2	ICE CUBE
12 Nuclei			Nuclear Physics
D2 Be C Al Si Hg Fe Ni Cu Zn W Pb	60	12	Hadronic Showers
Total Events	110	22	
Raw Storage	11 TBytes		
Processed Storage	55 TBytes		

Phase 2 Run Plan			
Target	Number of Events (Millions)	Running Time (Days)	Physics Need Group
18 Nuclei			
Li B O2 Mg P S Ar K Ca			Nuclear Physics
Ni Nb Ag Sn Pt Au Pb Bi U	90	18	Hadronic Showers
10 Nuclei B-list			Nuclear Physics
Na Ti V Cr Mn Mo I Cd Cs Ba	50	10	Hadronic Showers
Total Events	140	28	
Raw Storage	14 TBytes		
Processed Storage	70 TBytes		

Phase 3 – Tagged Neutral beams for ILC 5 million events/day LH2 target

Missing baryon resonance search may request additional running depending on what is found.

Why np cross sections cannot be deduced from pp cross sections below 20 GeV—Why tagged neutral beams are necessary

- Isospin (Charge Symmetry to be exact) states that pp differential and total cross sections are equal to nn differential and total cross sections (ignoring electromagnetic interactions). For example

$$pp \rightarrow n\pi^{+} p$$

$$nn \rightarrow p\pi^{-} n$$

  are conjugates of each other by isospin reflection. Knowing the pp reaction, one can obtain the nn reaction.

- It is however not the case for np reactions. They cannot be deduced from pp reactions till we get to over 20 GeV incident momentum when pomeron exchange(limiting fragmentaition) dominates.

Argument in R. Raja Ph.D Thesis (1975)

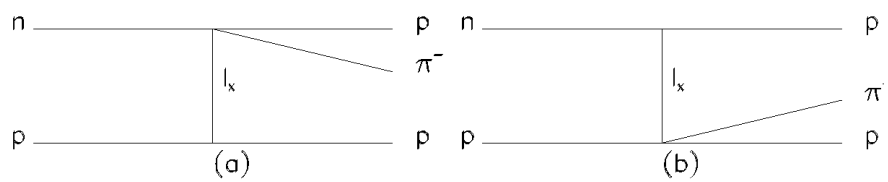
- Characterize amplitudes for reactions by $M^{I_x}{}_{I}$ where I_x is the isospin of the exchanged object and I the isospin of the Np combination.
- You can express all reaction cross sections in terms of 3 amplitudes which are fitted as a function of momentum Kp^{-n} yields

$$pp \rightarrow pp\pi^0$$

$$pp \rightarrow pn\pi^+$$

$$pn \rightarrow pp\pi^-$$

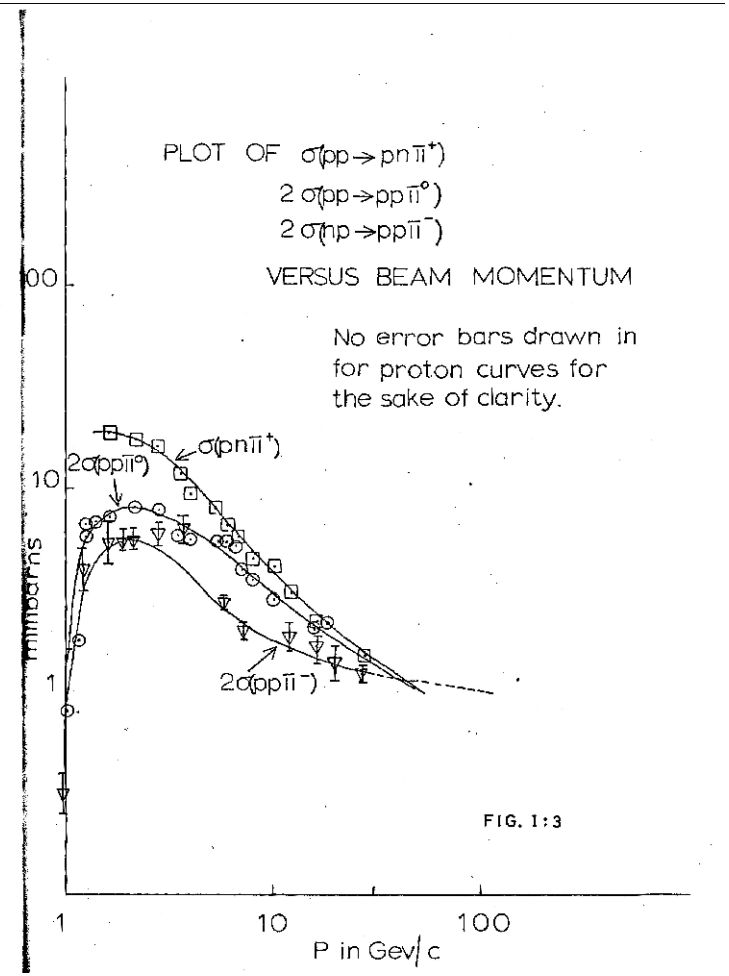
Cross section due to amplitude	n
$M^0{}_{1/2}$	-0.33
$M^1{}_{1/2}$	-1.37
$M^1{}_{3/2}$	-1.84



Pomeron Exchange dominance

- When Pomeron exchange ($M^0_{1/2}$) amplitude dominates, one can show

$$\sigma(pp \to pp\pi^0) = \sigma(np \to pp\pi^-) = \frac{1}{2}\sigma(pp \to pn\pi^+)$$



- Thus below 20 GeV, np cannot be deduced from pp.

np is poorly known.

If the target nucleus is not isoscalar, a proton will see different pn interactions than a neutron hitting the target.

Tagged neutron K-long and π^0 beams in MIPP

- MIPP Spectrometer permits a high statistics neutron and K-long beams generated on the LH2 target that can be tagged by constrained fitting. The neutral momenta can be known to better than 2% event by event by the 3-C fit. The energy of the neutron (K-long) can be varied by changing the incoming proton(K^+) momentum. The reactions involved are

$$pp \rightarrow pn\pi^+$$

$$K^{\pm}p \rightarrow pK_L^0\pi^{\pm}$$

$$\bar{p}p \rightarrow \bar{n}\pi^- p$$

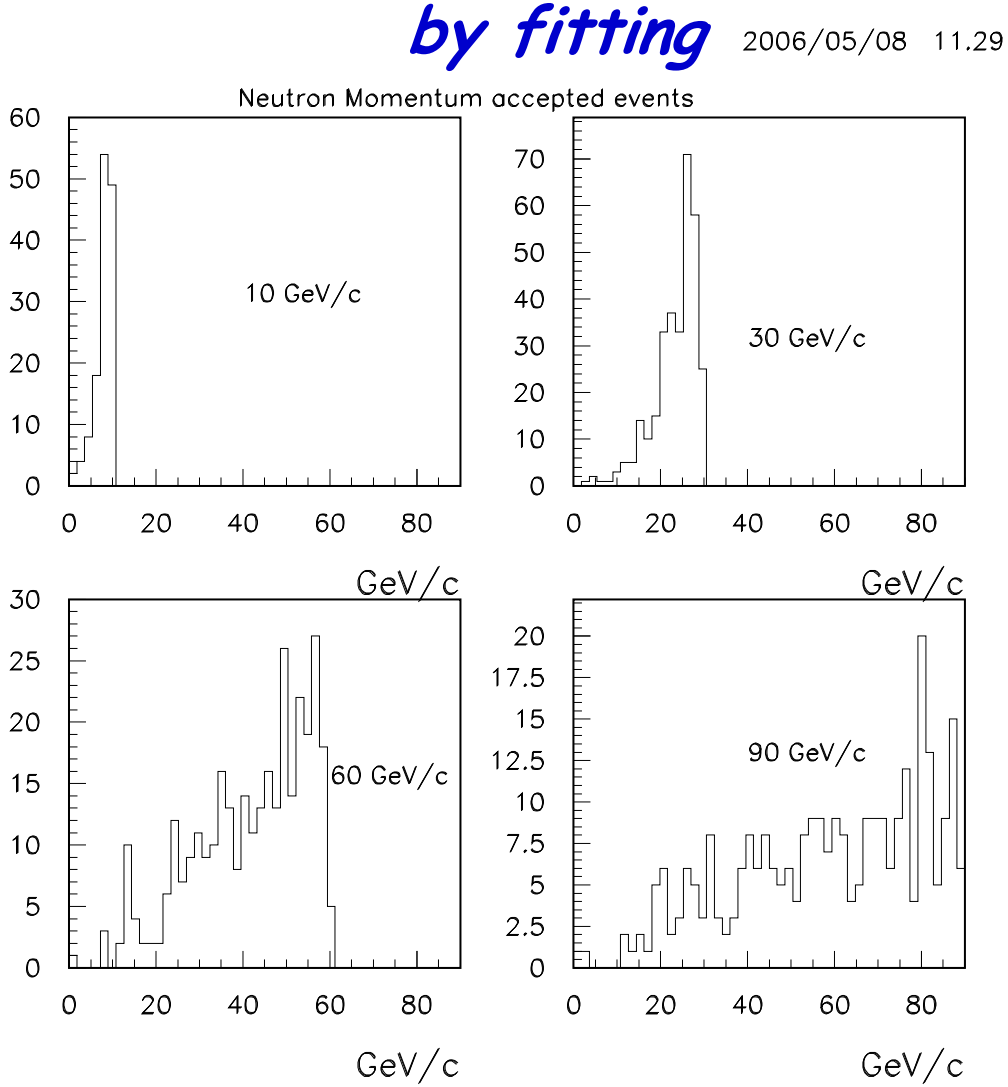
$$\pi^{\pm}p \rightarrow \pi^{\pm}\pi^0 p$$

See R.Raja-MIPP Note 130

hep-ex/0701043

~50K tagged neutrons per day

Neutron spectra for various beam momenta. Each individual momentum known to 2% or better by fitting

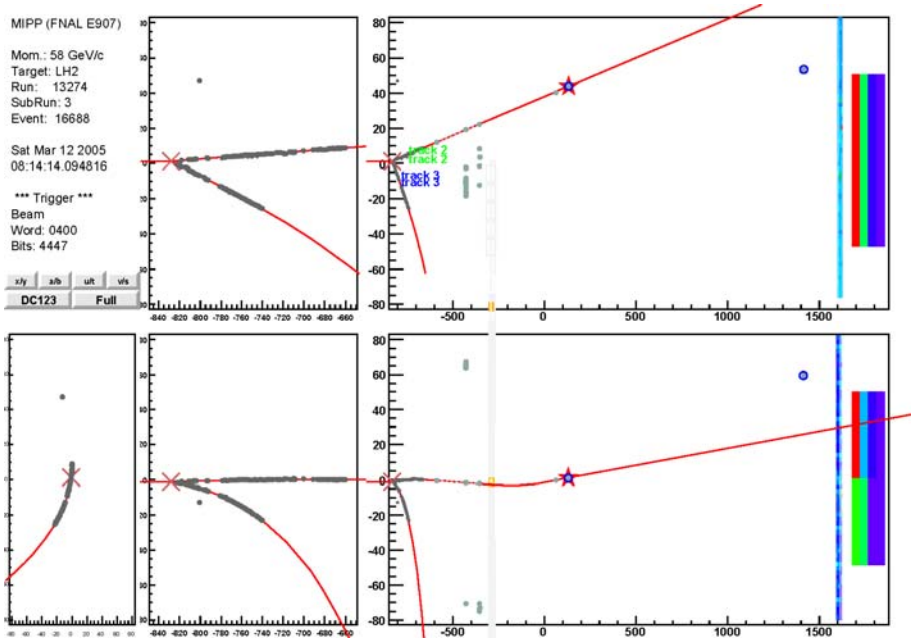


Expected tagged neutral beam rates

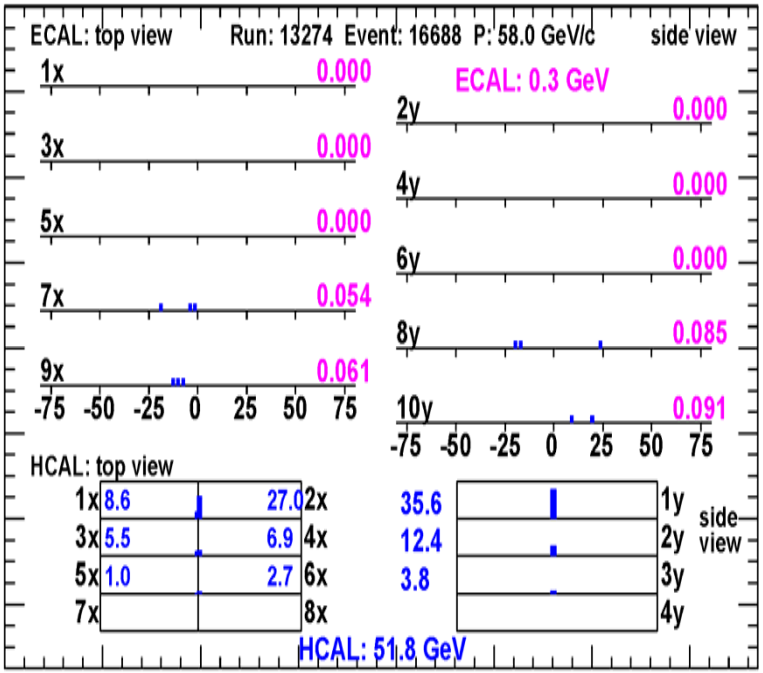
Beam Momentum GeV/c	Proton Beam n/day	K+ beam K-Long/day	K- beam K-Long/day	Antiproton beam anti-n/day
10	20532	4400	4425	6650
20	52581	9000	9400	11450
30	66511	12375	14175	13500
60	47069	15750	14125	13550
90	37600			

Expect a neutron background of 30 times the tagged rate from events with missing pizeros. MIPP will record 12,000 events in 4 seconds. Of which a large number will have multiple charged tracks hitting the calorimeter with particle id which can be used to study jet systematics.

An example of Tagged neutrons in MIPP-I. 58GeV/c proton beam in liquid hydrogen



Tracking. Both tracks positive. Consistent with p(0.1 GeV/c), π^+ (3.5GeV/c)



Calorimeter Display. EM Cal=0.3GeV, HCal=51.8GeV. Total=52.4GeV

- If you now do a 3C fit for the event, one gets a much more accurate value for the neutron energy (better than 2% error in beam momentum resolution). Tagged neutral beams are possible with **MIPP Upgrade DAQ rates.**

MIPP Experiment is the tagged neutron source

- The scenario where MIPP Experiment is done and then gets turned over to test beam users so that they can perform tagged nuetron measurements makes NO Sense. MIPP is a complicated system (apparatus, calibration, analysis).

- People interested in tagged neutrons should join MIPP in much the same way as embers of the neutrino community did.

Conclusions

- The MIPP Upgrade Collaboration has proposed a cost effective way to upgrade the experiment to speed up the DAQ by a factor of 100.
- We propose to add a recoil detector+chamber that will enhance the physics reach of the experiment.
- We propose to measure the NUMI LE/ ME targets.
- As well as 30 nuclei to benefit hadron shower simulators and the cosmic ray community.
- Tagged neutral beams possible for PFA studies(?)
- We propose to increase the momentum range of the beams (down to 1 GeV/c) that will benefit the hadron shower simulators and permit the search for missing baryon resonances.
- We welcome Collaborators

Why cutting the MIPP beam pipe is disruptive

- Once the ARRA funds get released, we plan to rewind the TPC (~2 months)and install JGG coils (~ 1month).
- We plan to run beam to the TPC, with beam chambers and triggers and old electronics, to check if the rewind worked. We want to measure the ionization and the interaction triggers to work out the ExB calibrations. During this time, we do not want the upstream cerenkov severed. We want to bring it up and use it for particle ID.
- We need access to beam chamber 1, the trigger counter TDC and the beam SWICS which are at the beginning of the hall.
- The proposed proposal by M-Test will interfere with MIPP commissioning. We will want to install chambers. We will want to start testing new electronics. Sooner or later the cross coupling between the tasks will become counter - productive to both parties.
- All MIPP experimenters are unanimous in their view of this.

Why cutting the MIPP beam pipe is disruptive

- Two questions:
  (a) If the proposed M-test ID is for a short term, then why not run test beam a little longer? How over-subscribed is it?

  (b) If the plan is for a longer term, why not spend the extra money and open up a new area (say) M-West as an additional area?

- MIPP Upgrade data is fundamentally needed for the whole of the DUSEL program. This is the feedback I received after my talk at the LBNE collaboration meeting (6.Oct.09). DUSELis one of the flagship programs of Fermilab.

  The realization that MIPP data, both in thick as well as thin targets, is essential to the success of the ν_e-appearance experiments is growing in the community.

  It should not be compromised by this intrusion which will make it harder to attract funding, collaborators, and get the job done.