PHENIX

PHENIX
Beam Use Proposal

W.A. Zajc
for the PHENIX Collaboration

(this talk available at http://www.phenix.bnl.gov/phenix/WWW/publish/zajc/sp/presentations/RBUP05/)

Collaboration Status

- University of São Paulo, São Paulo, Brazil
- Academia Sinica, Taipei 11529, China
- China Institute of Atomic Energy (CIAE), Beijing, P. R. China
- Peking University, Beijing, P. R. China
- Charles University, Faculty of Mathematics and Physics, Ke Karlovu 3, 121 Prague, Czech Republic
- Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering, Brehova 7, 11519 Prague, Czech Republic
- Institute of Physics, Academy of Sciences of the Czech Republic, Na Slovance 2, 182 21 Prague, Czech Republic
- Laboratoire de Physique Corpusculaire (LPC), Universite de Clermont-Ferrand, 63 170 Aubiere, Clermont-Ferrand, France
- Dapnia, CEA Saclay, Bat. 703, F-91191 Gif-sur-Yvette, France
- IPN-Orsay, Universite Paris Sud, CNRS-IN2P3, BP1, F-91406 Orsay, France
- Laboratoire Leprince-Ringuet, Ecole Polytechnique, CNRS-IN2P3, Route de Saclay, F-91128 Palaiseau, France
- SUBATECH, Ecòle des Mines at Nantes, F-44307 Nantes France
- University of Muenster, Muenster, Germany
- KFKI Research Institute for Particle and Nuclear Physics at the Hungarian Academy of Sciences (MTA KFKI RMKI), Budapest, Hungary
- Debrecen University, Debrecen, Hungary
- Eövös Loránd University (ELTE), Budapest, Hungary
- Banaras Hindu University, Banaras, India
- Bhabha Atomic Research Centre (BARC), Bombay, India
- Weizmann Institute, Rehovot, 76100, Israel
- Center for Nuclear Study (CNS-Tokyo), University of Tokyo, Tanashi, Tokyo 188, Japan
- Hiroshima University, Higashi-Hiroshima 739, Japan
- KEK - High Energy Accelerator Research Organization, 1-1 Oho, Tsuku Ibaraki 305-0801, Japan
- Kyoto University, Kyoto, Japan
- Nagasaki Institute of Applied Science, Nagasaki-shi, Nagasaki, Japan
- RIKEN, The Institute of Physical and Chemical Research, Wako, Saitama 351-0198, Japan
- RIKEN – BNL Research Center, Japan, located at BNL
- Physics Department, Rikkyo University, 3-34-1 Nishi-Ikebukuro, Toshima, Tokyo 171-8501, Japan
- Tokyo Institute of Technology, Oh-okayama, Meguro, Tokyo 152-8551, Japan
- University of Tsukuba, 1-1-1 Tennodai, Tsukuba-shi Ibaraki-ken 305-8577, Japan
- Waseda University, Tokyo, Japan
- Cyclotron Application Laboratory, KAERI, Seoul, South Korea
- Kangnung National University, Kangnung 210-702, South Korea
- Korea University, Seoul, 136-701, Korea
- Myong Ji University, Yongin City 449-728, Korea
- System Electronics Laboratory, Seoul National University, Seoul, South Korea
- Yonsei University, Seoul 120-749, Korea
- IHEP (Protvino), State Research Center of Russian Federation "Institute for High Energy Physics", Protvino 142281, Russia
- Joint Institute for Nuclear Research (JINR-Dubna), Dubna, Russia
- Kurchatov Institute, Moscow, Russia
- PNPI, Petersburg Nuclear Physics Institute, Gatchina, Leningrad region, 188300, Russia
- Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Vorob'evy Gory, Moscow 119992, Russia
- Saint-Petersburg State Polytechnical Univiversity, Politechnicheskayastr, 29, St. Petersburg, 195251, Russia

13 Countries; 62 Institutions; 550 Participants*

- Lund University, Lund, Sweden
- Abilene Christian University, Abilene, Texas, USA
- Brookhaven National Laboratory (BNL), Upton, NY 11973, USA
- University of California - Riverside (UCR), Riverside, CA 92521, USA
- University of Colorado, Boulder, CO, USA
- Columbia University, Nevis Laboratories, Irvington, NY 10533, USA
- Florida Institute of Technology, Melbourne, FL 32901, USA
- Florida State University (FSU), Tallahassee, FL 32306, USA
- Georgia State University (GSU), Atlanta, GA, 30303, USA
- University of Illinois Urbana-Champaign, Urbana-Champaign, IL, USA
- Iowa State University (ISU) and Ames Laboratory, Ames, IA 50011, USA
- Los Alamos National Laboratory (LANL), Los Alamos, NM 87545, USA
- Lawrence Livermore National Laboratory (LLNL), Livermore, CA 94550, USA
- University of New Mexico, Albuquerque, New Mexico, USA
- New Mexico State University, Las Cruces, New Mexico, USA
- Department of Chemistry, State University of New York at Stony Brook (USB), Stony Brook, NY 11794, USA
- Department of Physics and Astronomy, State University of New York at Stony Brook (USB), Stony Brook, NY 11794, USA
- Oak Ridge National Laboratory (ORNL), Oak Ridge, TN 37831, USA
- University of Tennessee (UT), Knoxville, TN 37996, USA
- Vanderbilt University, Nashville, TN 37235, USA

Beam Use Proposal

Requested input:

- Desired "beam run segments"
- Physics from same
- Nominal (restricted) 29(20) week scenarios
- Collaboration/experiment status

- **A note on nomenclature:**
  - "Run-1" ≡ Summer-2000 Au+Au run at 130 GeV
  - "Run-2" ≡ 2001/2002 Au+Au/p+p at 200 GeV
  - "Run-3" ≡ 2003 run d+Au/p+p at 200 GeV
  - "Run-4" ≡ 2004 run Au+Au/p+p at 200 (62) GeV
  - "Run-5" ≡ 2005 run Cu+Cu/p+p at 200 (62) GeV

Summary

- PHENIX has done great things in the past
- PHENIX is doing great things in the present
- Our request will insure that PHENIX does great things in the future

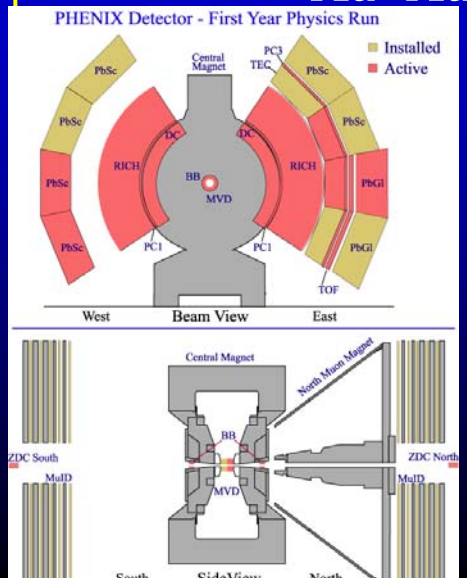
PHENIX

Past Accomplishments

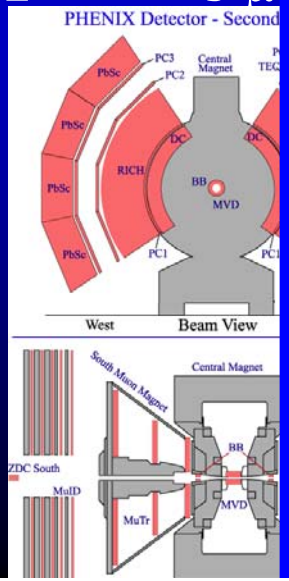
Run-1 to Run-4 Capsule History

Run	Year	Species	$s^{1/2}$ [GeV]	∫Ldt	N_{tot}	p-p Equivalent	Data Size
01	2000	Au+Au	130	1 μb^{-1}	10M	0.04 pb^{-1}	3 TB
02	2001/2002	Au+Au	200	24 μb^{-1}	170M	1.0 pb^{-1}	10 TB
		p+p	200	0.15 pb^{-1}	3.7G	0.15 pb^{-1}	20 TB
03	2002/2003	d+Au	200	2.74 nb^{-1}	5.5G	1.1 pb^{-1}	46 TB
		p+p	200	0.35 pb^{-1}	6.6G	0.35 pb^{-1}	35 TB
04	2003/2004	Au+Au	200	241 μ			
		Au+Au	62	9 μ			

Run-1



Run-2



PHENIX Successes (to date) based on ability to deliver physics at ~all scales:

barn : Multiplicity (Entropy)

millibarn: Flavor yields (temperature)

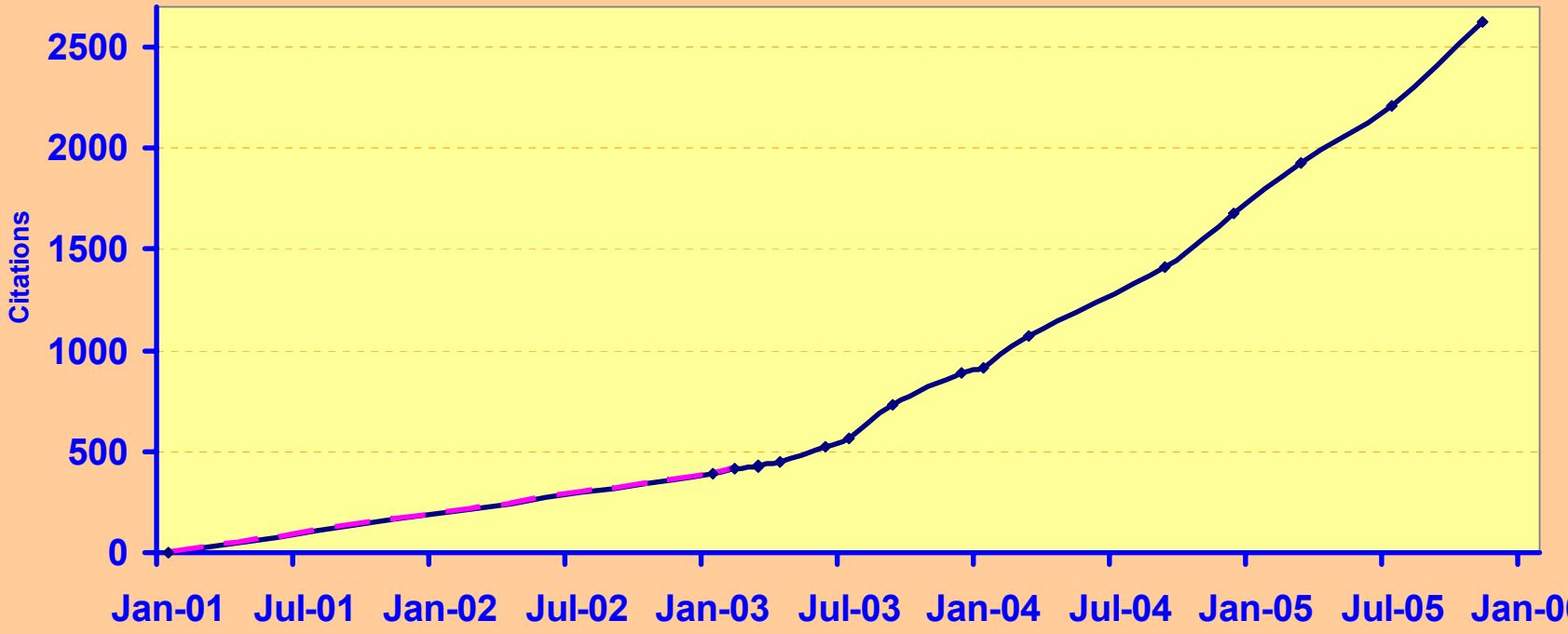
microbarn: Charm (transport)

nanobarn: Jets (density)

picobarn: J/Psi (deconfinement ?)

Publication Summary

Cumulative PHENIX Citations

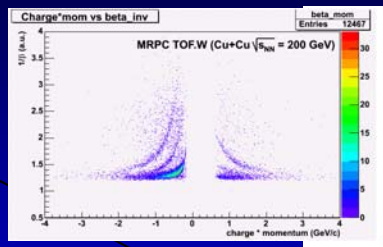


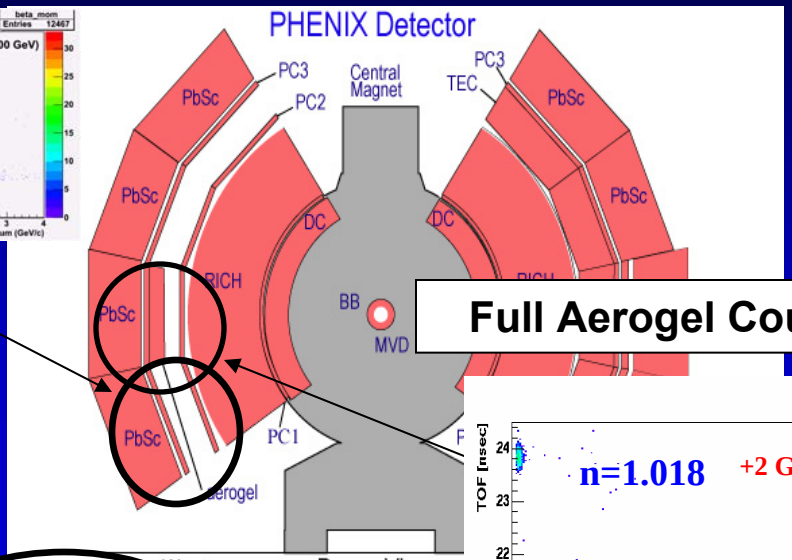
	1-Jan-01	1-Jan-03	20-Feb-03	10-Mar-03	20-Mar-03	12-Apr-03	6-Jun-03	4-Jul-03	26-Sep-03	4-Dec-03	1-Jan-04	26-Mar-04	4-Sep-04	5-Dec-04	19-Mar-05	1-Jul-05	1-Nov-05
Cite Data	0	390	413	426	428	449	524	567	733	887	912	1075	1409	1676	1927	2206	2624
Inferred	0	390	413														

- Total: 40 papers to date, 17 TopCites, 11 “Famous” papers
- 20 additional manuscripts in preparation

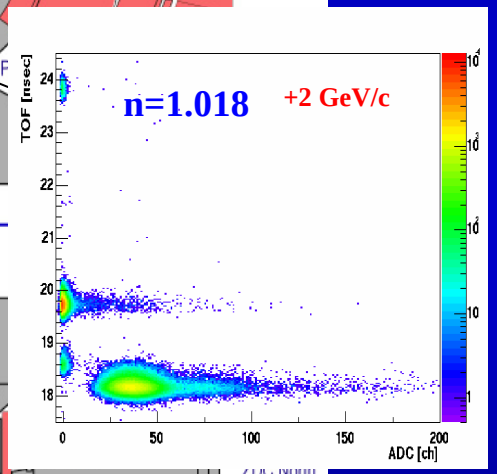
PHENIX Configuration in Run-5

TOF-West RPC prototype installed and tested in CuCu running.



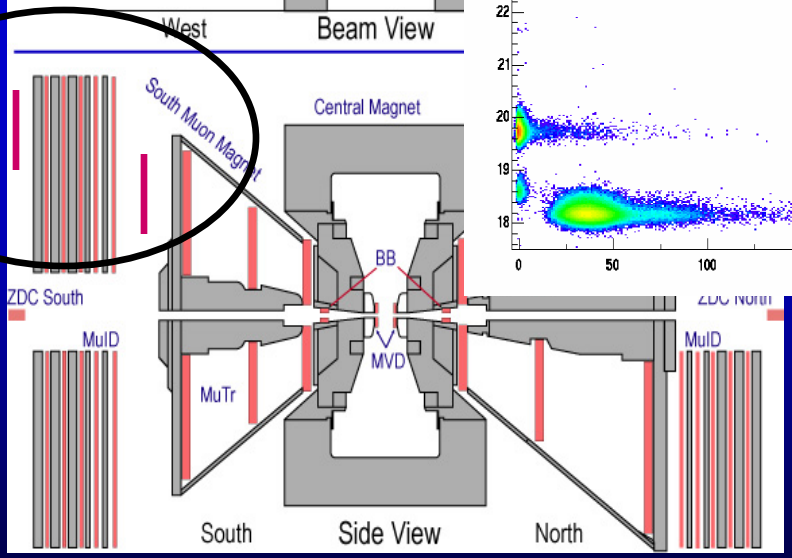


Full Aerogel Counter



Prototype RPC muon trigger chambers.

NSF $1.98M
Approved!



***ALSO*:**
New LVL1 Triggers (MuID and ERT)
Improved DAQ (>5kHz)
Multi-Event Buffering (95% live)
OnCal calibrations
LVL2 Filtering rare events

PHENIX

Run-1 to Run-5 Capsule History

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01	2000	Au+Au	130	1 μb^{-1}	10M	0.04 pb^{-1}	3 TB
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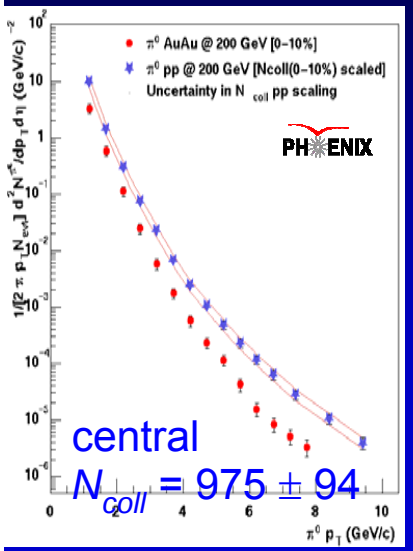
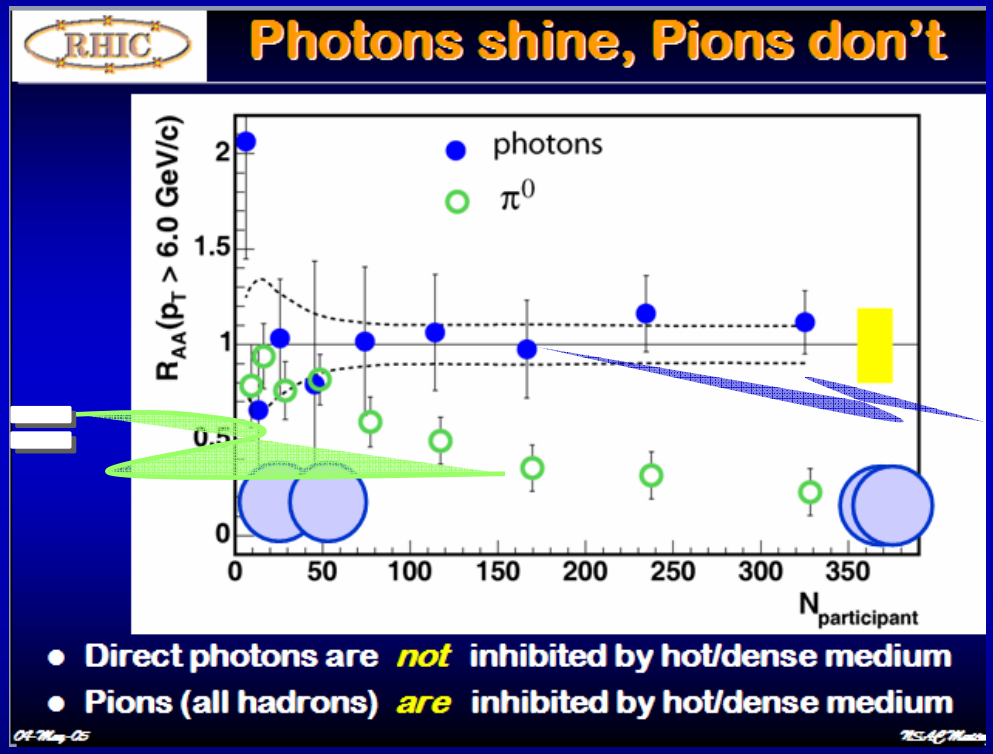
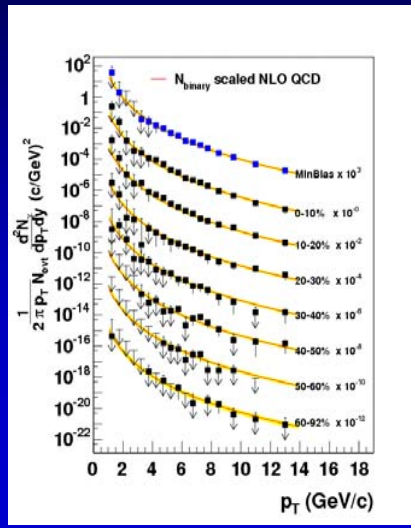
		p+p	200	0.35 pb^{-1}	6.6G	0.35 pb^{-1}	35 TB
04	2003/2004	Au+Au	200	241 μb^{-1}	1.5G	10.0 pb^{-1}	270 TB
		Au+Au	62	9 μb^{-1}	58M	0.36 pb^{-1}	10 TB
05	2004/2005	Cu+Cu	200	3 nb^{-1}	8.6G	11.9 pb^{-1}	173 TB
		Cu+Cu	62	0.19 nb^{-1}	0.4G	0.8 pb^{-1}	48 TB
		Cu+Cu	22.5	2.7 μb^{-1}	9M	0.01 pb^{-1}	1 TB
		p+p	200	3.8 pb^{-1}	85B	3.8 pb^{-1}	262 TB

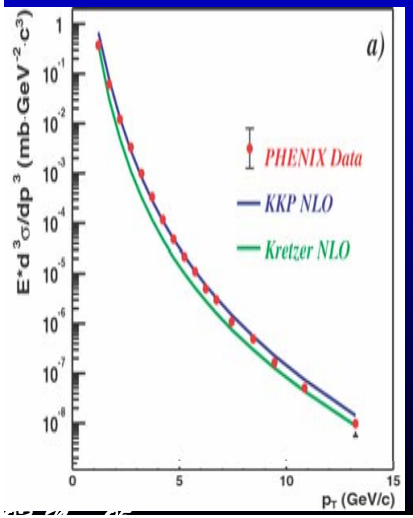
Scientific Precision



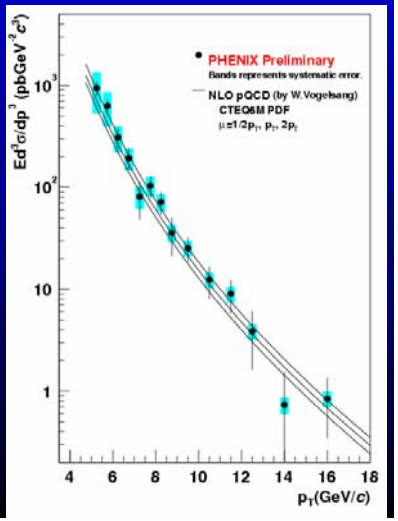
- This one figure encodes rigorous control of systematics



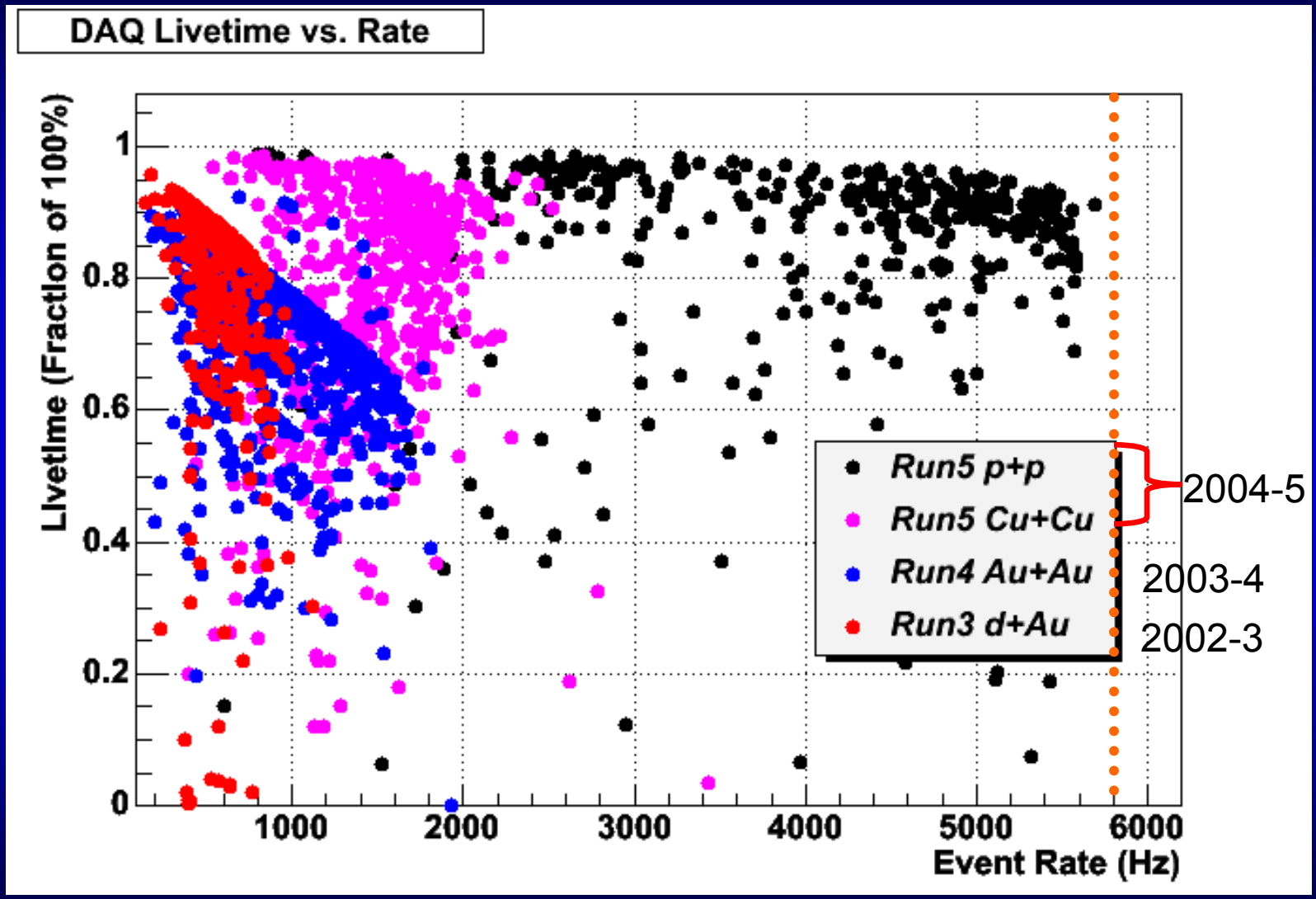




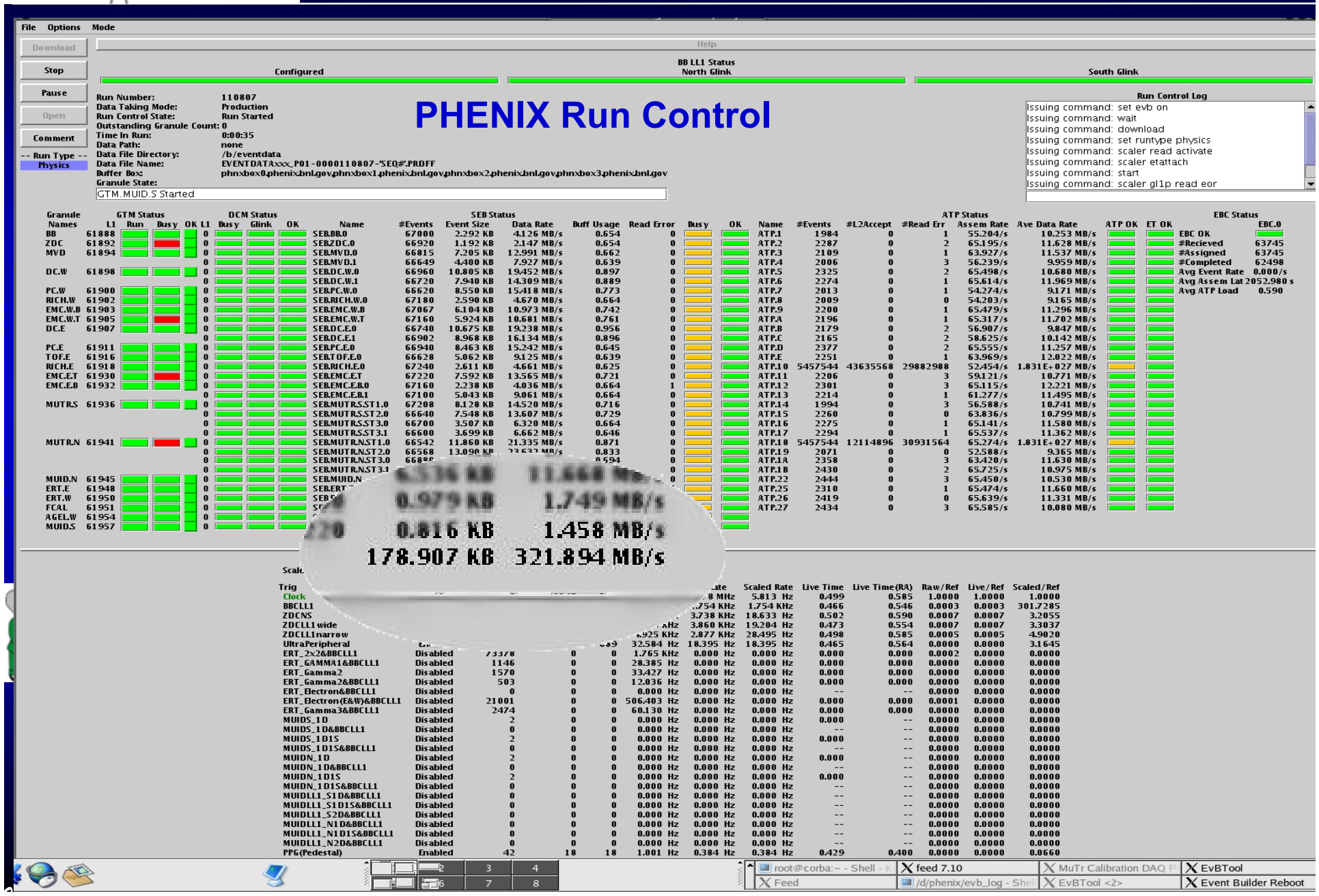
- in four different measurements over many orders of magnitude



PHENIX DAQ Performance

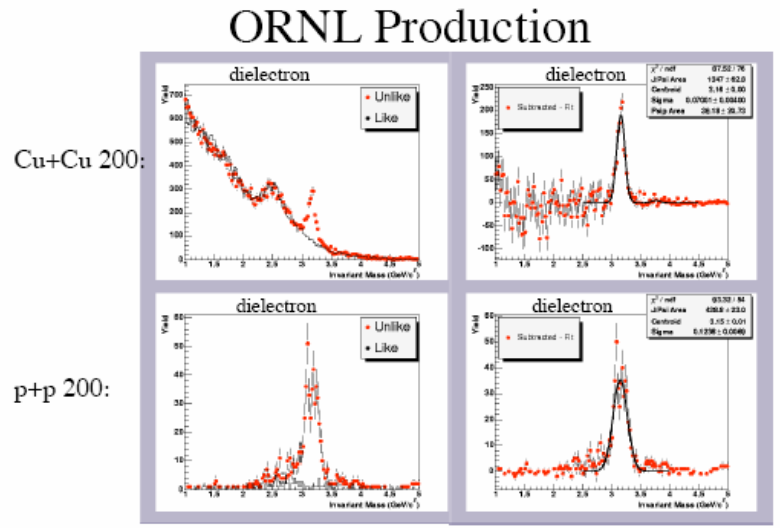


Comparable Data Archiving Rates

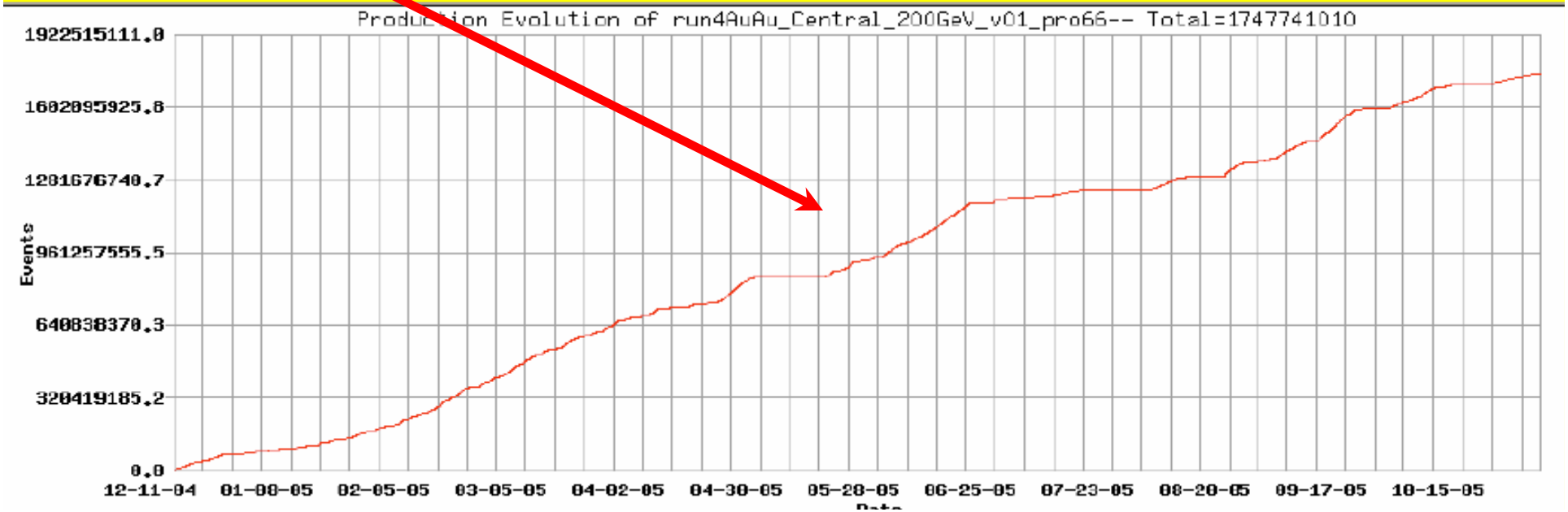


Keeping up with the DAQ

- **Major improvements in calibrations, monitoring and reconstruction**
  - **Quasi-real-time production of Level-2 triggers (ORNL)**
  - **Transfer, production of Run-5 p+p data set (CC-J in Japan)**
  - **Production of entire Run-4 Au+Au data set**



- Fully automated setup for catching new filtered prdff's, transfering files from 1008 to ORNL, running reconstruction at ORNL, transfering to RCF and producing analysis updates on the web



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Present Status

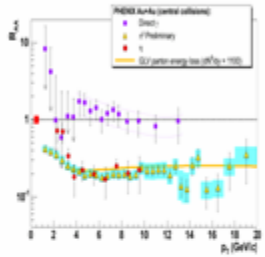
PHENIX At Quark Matter '05

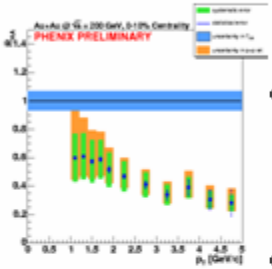
- **Eighteen parallel talks at QM05:**
  - PHENIX Measurement of Particle Yields at High pT with Respect to Reaction Plane in Au+Au collisions at sqrt(s) = 200 GeV, **David Winter**
  - High pT pi0, eta, identified charged hadron and inclusive charged hadron spectra from PHENIX, **Maya Shimomura**
  - Probing Cold and Hot, Dense Nuclear Media via High p_T Jets with Di-hadron and gamma-hadron Correlations with PHENIX, **Nathan Grau**
  - Flavor Dependence of jet-correlations in Au+Au collisions at sqrt(s_NN) =200GeV with the PHENIX Detector, **Wolf Holzmann**
  - Measurement of Direct Photons in sqrt(s_NN) = 200 GeV p+p, d+Au, and Au+Au Collisions with the PHENIX Experiment at RHIC, **Stefan Bathe**
  - Evidence for a long-range pion emission source in Au+Au Collisions at sqrt(s_NN)=200GeV in PHENIX, **Paul Chung**
  - Systematic study of identified particle production in PHENIX, **Masahiro Konno**
  - Anisotropic Flow in sqrt(s_NN) = 200 GeV Cu+Cu and Au+Au collisions at RHIC - PHENIX, **Hiroshi Masui**
  - Nuclear modifications and elliptic flow measurements for phi mesons at sqrt(s_NN) = 200 GeV dAu and AuAu collisions by PHENIX, **Dipali Pal**
  - Measurement of event-by-event fluctuations and order parameters in PHENIX, **Tomoaki Nakamura**
  - PHENIX results on J/ψ production in Au+Au and Cu+Cu collisions at sqrt(s_NN)=200 GeV, **Hugo Pereira**
  - Study of J/ψ Production in $p+p$ and $d+Au$ Collisions at sqrt(s_NN) = 200 GeV by the PHENIX Experiment, **Sasha Lebedev**
  - Heavy flavor production in p+p and d+Au collisions at sqrt(s_NN)=200 GeV, from single leptons over a wide kinematic range, **Youngil Kwon**
  - PHENIX results on Open Heavy flavor production in Au+Au collisions at sqrt(s_NN) = 200 GeV, **Sergei Butsyk**
  - Comparison of Phi properties as seen in dielectron and hadronic decay channels in Au+Au collisions by PHENIX at RHIC, **Sasha Kozlov**
  - First measurement of omega-meson production with the PHENIX Experiment at RHIC, **Viktor Riabov**
  - Measurement of low mass dielectron continuum in sqrt(s_NN)=200 GeV Au-Au collisions in the PHENIX Experiment at RHIC, **Alberica Toia**
  - Analysis of three-particle correlations in sqrt(s_NN) = 200 GeV Au+Au collisions at PHENIX, **Mate Csanad**

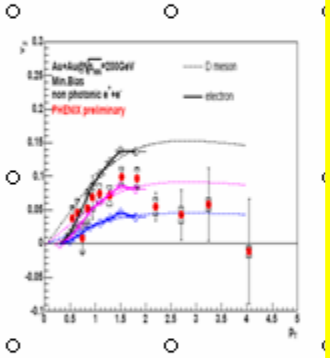
PHENIX "Focus Talk" at QM05

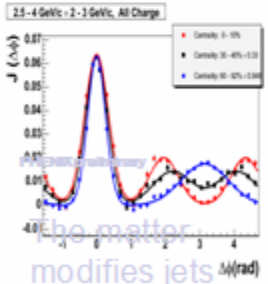
- As highlighted by Berndt Müller's summary talk:

An offer too good to refuse…

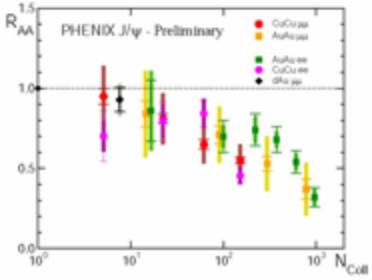


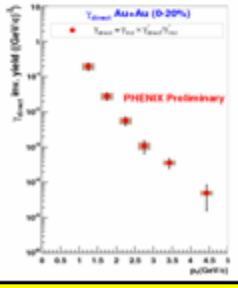






We look forward to working with the theory community to extract the properties of the matter





- not to mention…

$$\text{pQCD:}\quad D \approx \frac{6}{8\pi\alpha_s^2 T} \approx 6\frac{\eta}{sT} \xrightarrow[\text{Data}]{\text{PHENIX}} D = \frac{3\cdots 6}{2\pi T} \Leftrightarrow \frac{\eta}{s} = \frac{1\cdots 2}{4\pi}$$

First (Run-3) Results on A_{LL}

- First results on $A_{LL}(\pi^0)$:
- "Double Helicity Asymmetry in Inclusive Mid-Rapidity neutral pion Production for Polarized p+p Collisions at sqrt(s)=200 GeV"
  Preprint: hep-ex/0404027
  - Phys.Rev.Lett.93:202002, 2004
  - Compared to calculations by
    - B.Jäger *et al.*, PRD67, 054005 (2003)
    - M. Glück *et al.*, PRD63, 094005 (2001)
  - Consistent with GRSV-std (C.L. ~ 16-20%)

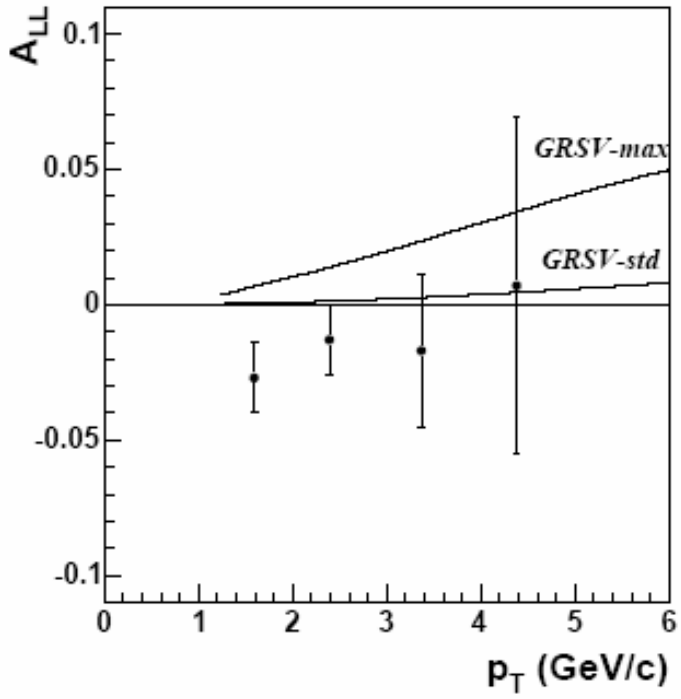
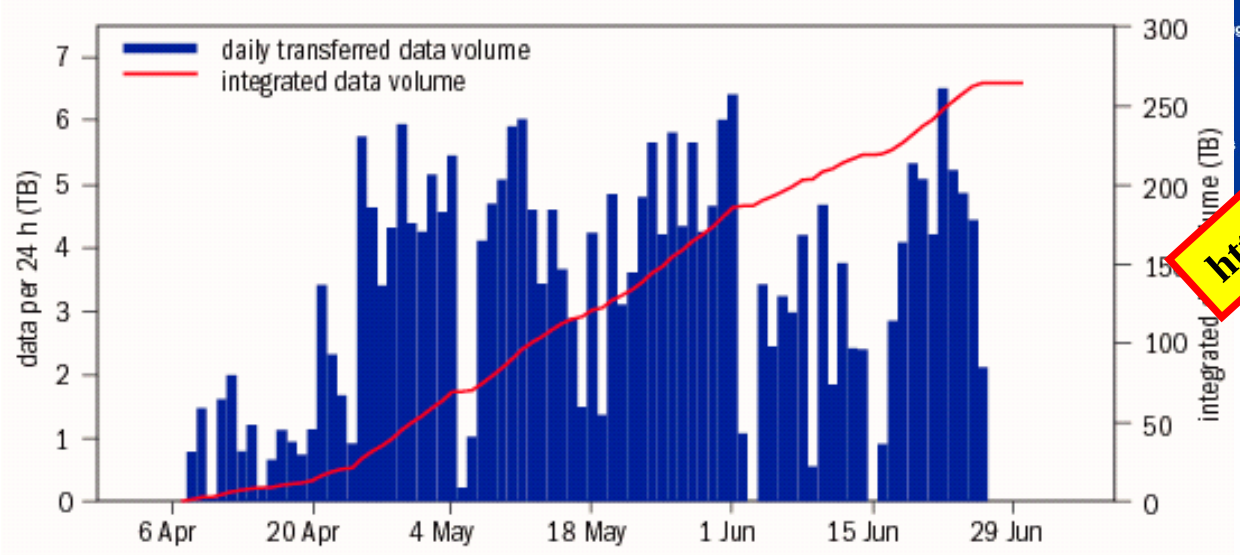


FIG. 3: The measured double spin asymmetry $A_{LL}^{\pi^0}$ versus mean p_T of π^0's in each bin. A scale uncertainty of ±65% is not included. Two theoretical calculations based on NLO pQCD are also shown for comparison with the data (see text for details).

Data Analysis at Wako

- Data transfer between RCF (BNL) and CC-J (RIKEN):
  - data sample: 270 TB
  - rate : 60MB/sec.
  - duration : ~11 weeks
- Cooperative effort between PHENIX RCF+CC-J computing personnel



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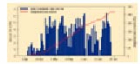
Computing News and Features

PHENIX experiment uses Grid to … 270 TB of data to Japan

During the polarized proton-proton run that … the Relativistic Heavy Ion Collider (RHIC) at Brookhaven … used by the PHENIX experiment to send recently … regional computing centre for the experiment in Japan … onal Laboratory, on Long Island, New York, is home to the … mputing Facility (RCF/ACF), which is the main computing … ents at RHIC and a Tier-1 computing centre for ATLAS … egional computing centre in Japan (CCJ) is at the RIKEN … its Wako campus close to Tokyo.

Going into the po… ton run, PHENIX faced the chall… would be busy reconstructi… gold-gold and copper-copper d… 04 and 2005. The enormous polariz… data set was transferred to Jap… the substantial computing … which is comparable to the PHENIX …CF.



Data transfer

…NIX data acquisition can sustain a peak data rate of up to 600 MB/s, …ns at a typical rate of 250 MB/s while beam is stored in RHIC. The data …e buffered at the experimental site before being transferred and archived in …e RCF tape library. A 35 TB disk-storage system (about 60 h at typical data rates) allowed PHENIX to archive and transfer data at a lower steady rate, taking advantage of various breaks in the flood of data. A transfer rate of 60 MB/s sustained steadily around the clock was able to keep up with the incoming data stream.

Initially, PHENIX had planned to transfer the polarized proton-proton data by physically transporting tape cartridges to CCJ. During the early part of the run, however, it was found that network transfer rates of 700-750 Mbits/s could be achieved. A dedicated network path was established from the PHENIX counting house to the BNL perimeter network, and the tape option became a fall-back solution. In the end, not a single tape was shipped.

The principal tool used for the transfer was GridFtp, which proved to be very stable. Brookhaven has a high-speed connection (OC48) to ESNET, which is connected to a transpacific line (10 Gbit/s) served by SINET in Japan. Apart from two half-day outages of ESNET, the transfers continued around the clock for the entire 11 week run.

Approximately 270 TB of data (representing 6.8 billion polarized proton-proton collisions) were transferred to CCJ. After a few days of fine-tuning the transfer parameters, the transfers became part of the regular data-handling operation of the PHENIX shift crews, requiring experts to intervene only occasionally.

This seems to be the first time that a data transfer of such magnitude was sustained over many weeks in actual production, and was handled as part of routine operation by non-experts. The successful completion of this large-scale transfer project demonstrates both the maturity of today's Grid tools and the real feasibility of integrating remote resources into the data-handling and processing chain of large experiments.

http://www.cerncourier.com/main/article/45/7/15

- Allowed complete analysis of central arm Run-5 p+p data for presentation at PANIC meeting last month (next slide)

$A_{LL}(\pi^0)$ in Run-5

(Slide from last year's PAC presentation)

- **Assumptions:**
  - 11 physics weeks
  - 'Usual' geometric mean of minimum and maximum guidance
  - <P> = 45%
  - ➡ Integrated luminosity: 5.5 pb^{-1}
  - ➡ Figure of merit: ~100 x Run-3
- **Implications**
  - Current errors reduced by > factor of ten
  - p_T reach extended to ~ 7 GeV/c
  - ➡ Access to g+q, in addition to g+g, production mechanism

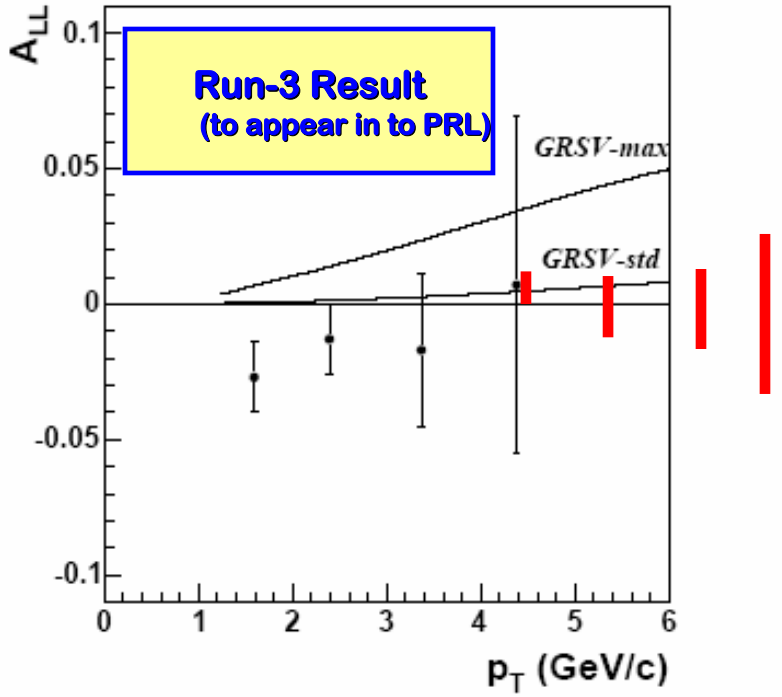


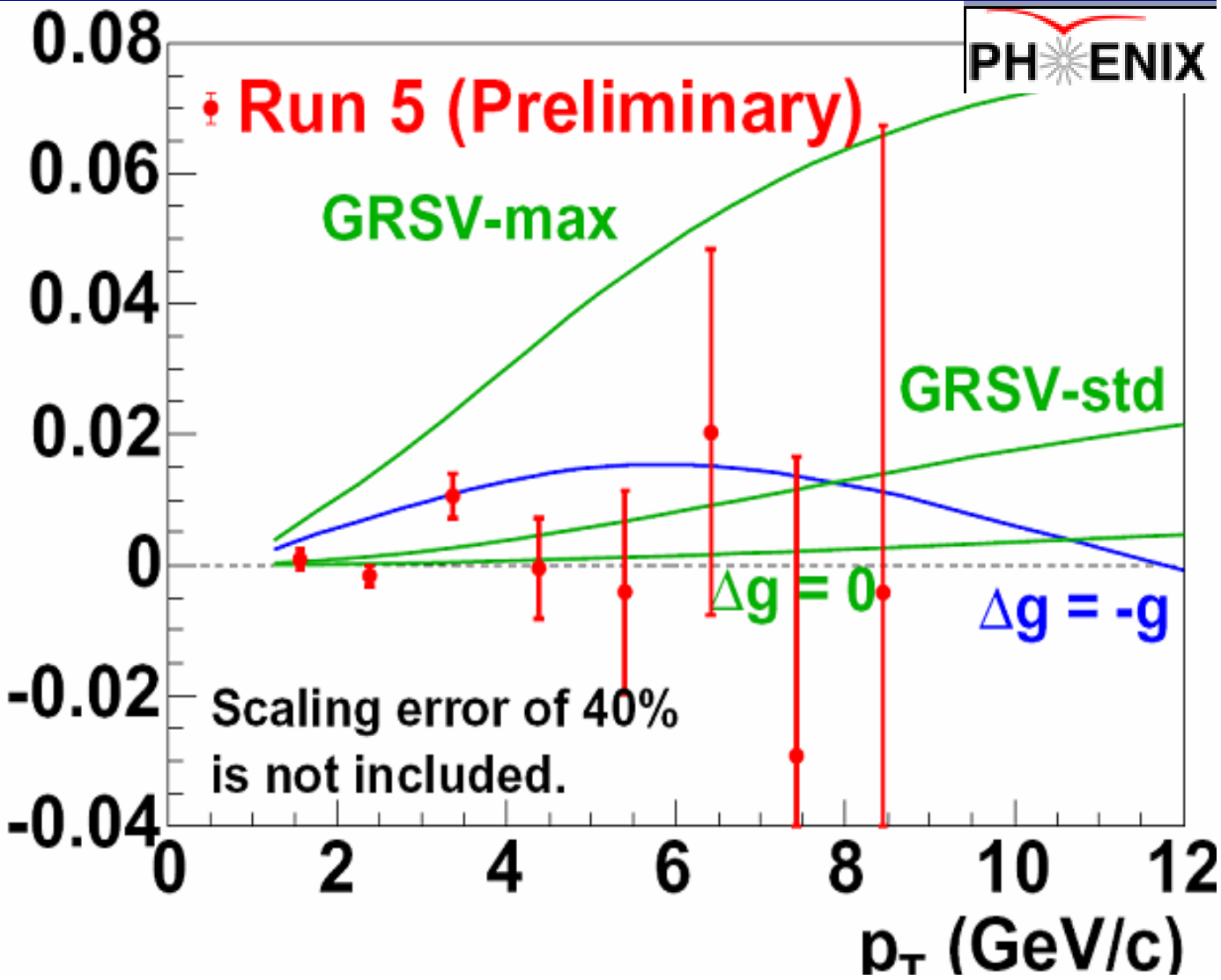
FIG. 3: The measured double spin asymmetry $A_{LL}^{\pi^0}$ versus mean p_T of π^0's in each bin. A scale uncertainty of ±65% is not included. Two theoretical calculations based on NLO pQCD are also shown for comparison with the data (see text for details).

$A_{LL}(\pi^0)$ in Run-5

- **Assumptions:**
  - 11 physics weeks
  - 'Usual' geom
    guidance

NOW MEASURED!

Theory model	C.L. (%)
GRSV-std	21.7-17.1
*GRSV-max ($\Delta g=g$)	0.0-0.0
*GRSV $\Delta g=0$	16.7-18.4
*GRSV $\Delta g=-g$	0.7-0.0

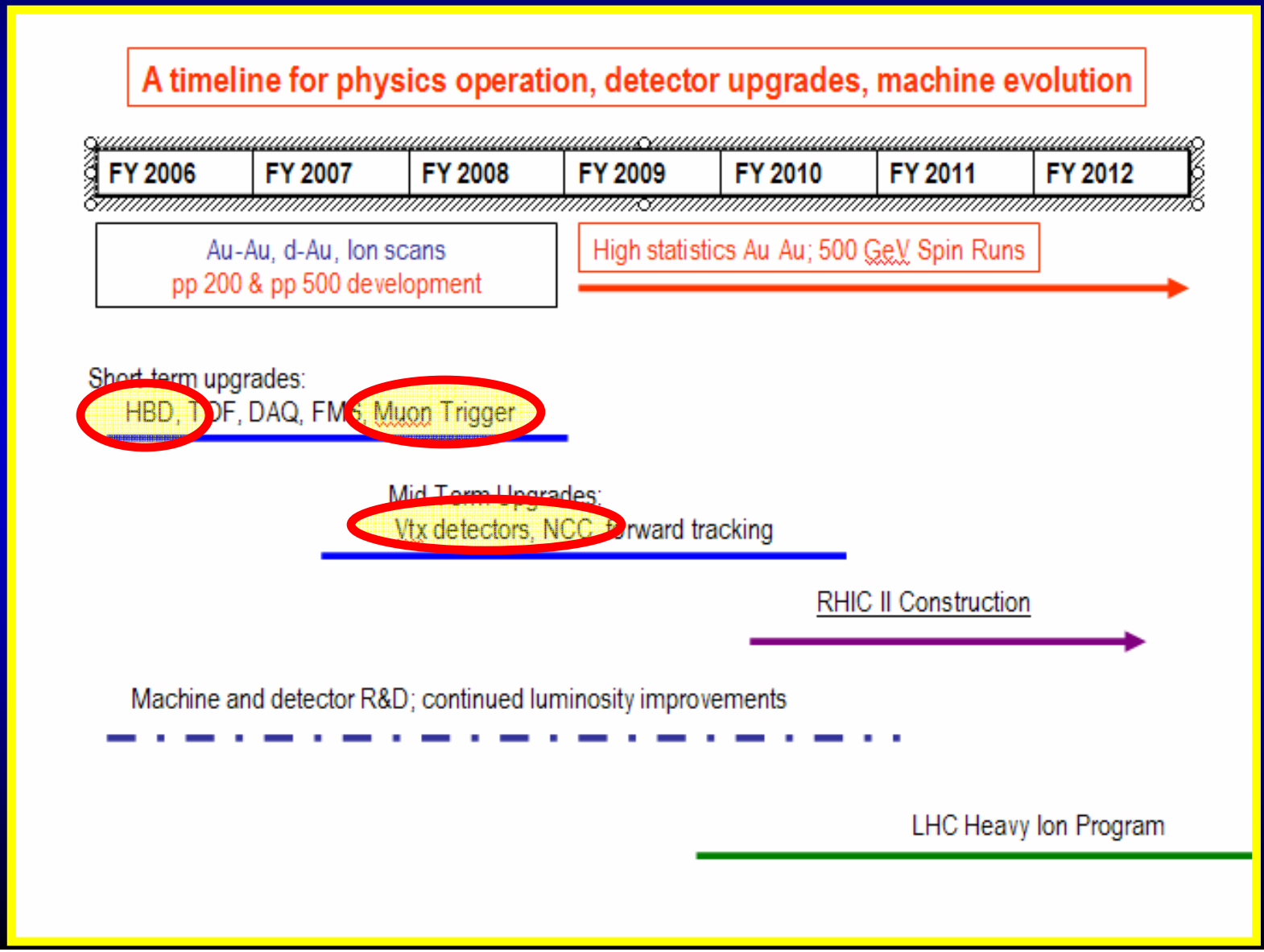


PHENIX

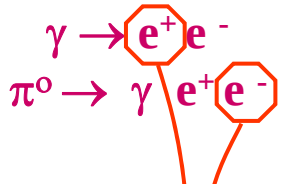
Future Goals

Upgrades

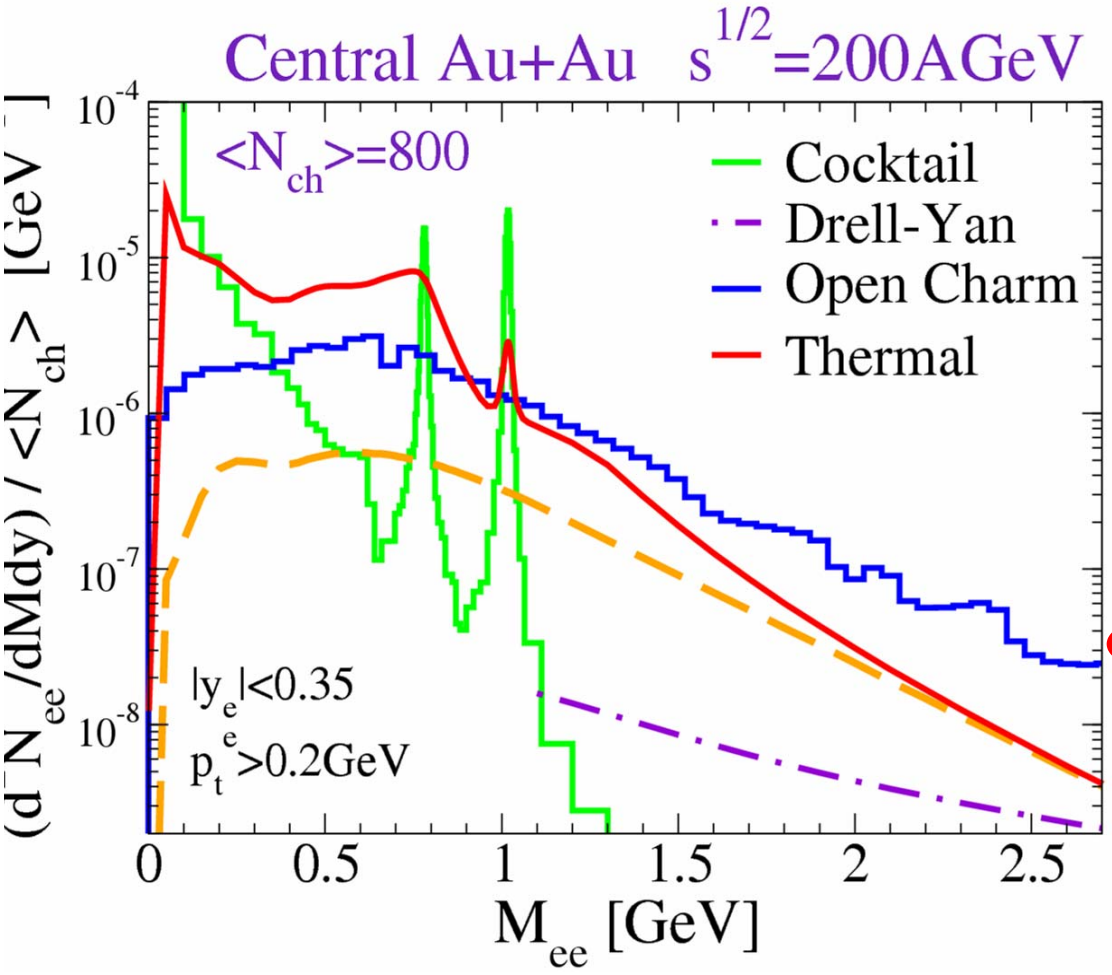
- As presented by T. Ludlam to PAC this morning:

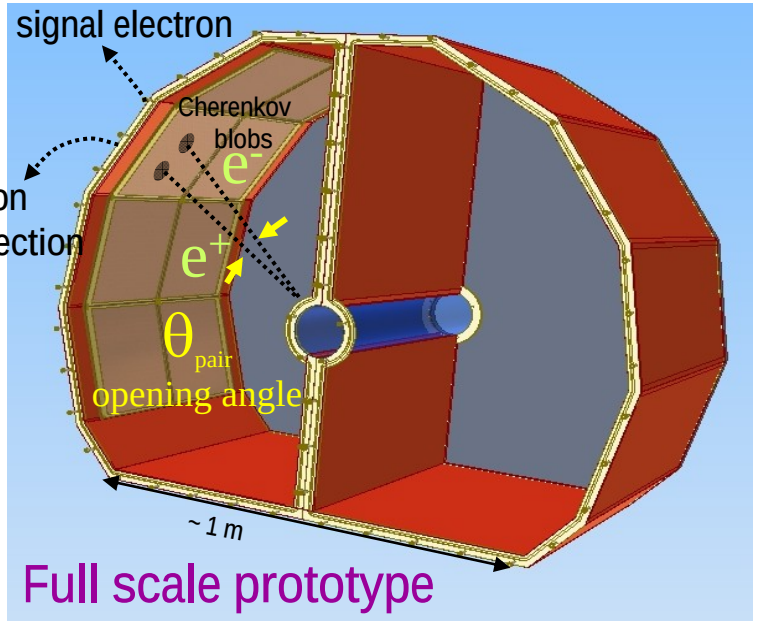


Hadron Blind Detector



"combinatorial pairs"





Low-Mass e^+e^- Pairs

A Hadron-Blind detector for PHENIX

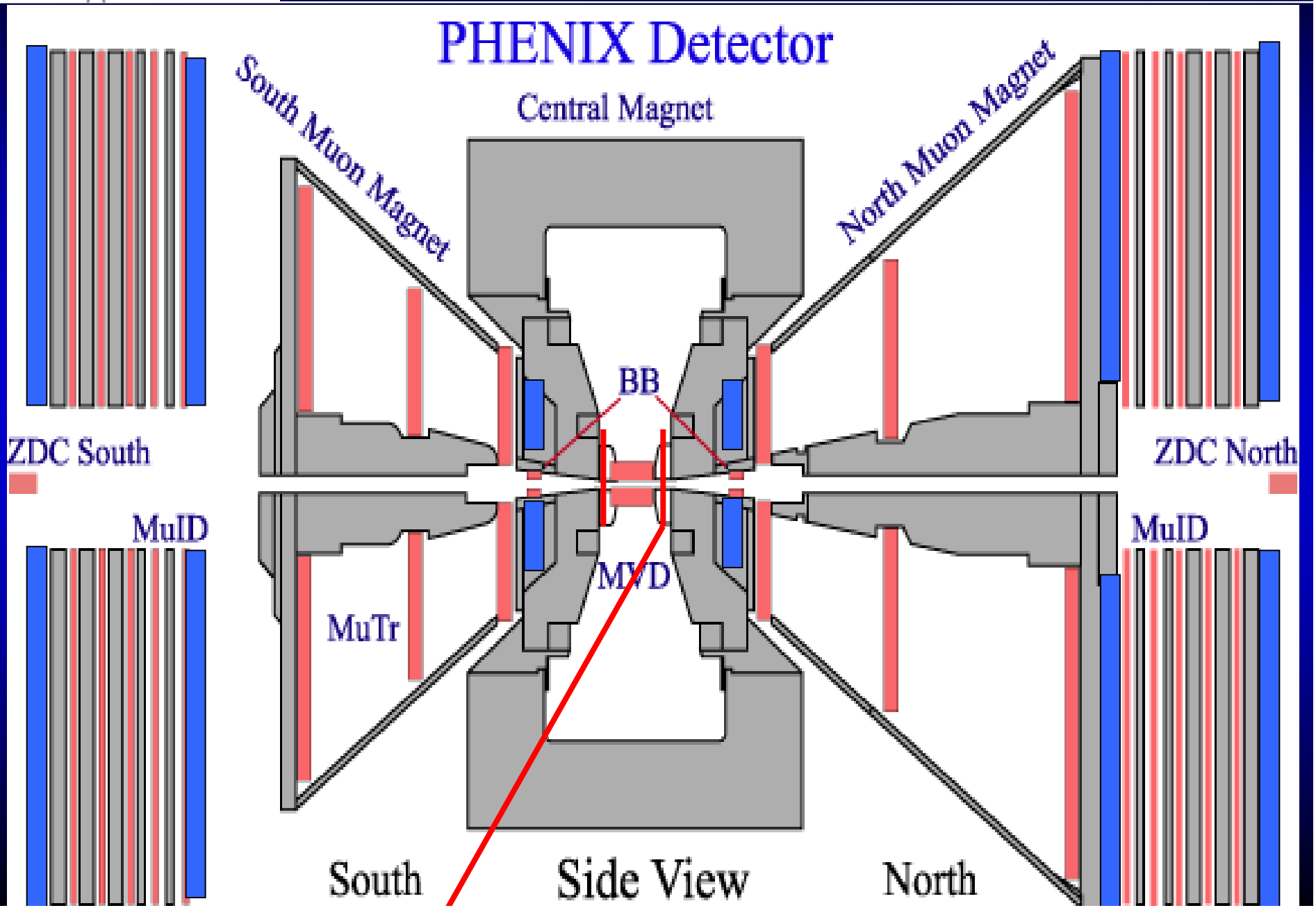
Engineering run FY 06

Operational FY 07

Supported in part by NSF

Muon Trigger

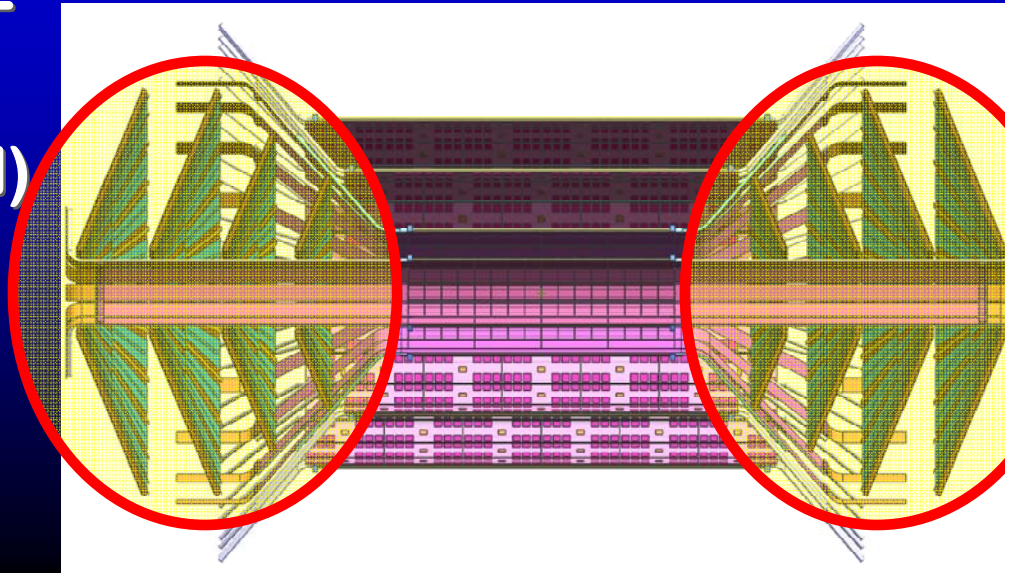
Funded ($1.98M) by NSF



Silicon Vertex Tracker

- PHENIX: Si-VTX collaboration
  - 72 collaborators from 14 institutions
  - BNL, Florida State Univ., Iowa State Univ., KEK, Kyoto Univ., LANL, Niigata Univ., ORNL, RIKEN, RIKEN BNL Reas. Center, Stony Brook Univ., Univ. New Mexico, LLR
- Proposal submitted to DOE
- Potential funding FY07
- ~$3M funds to date (RIKEN)

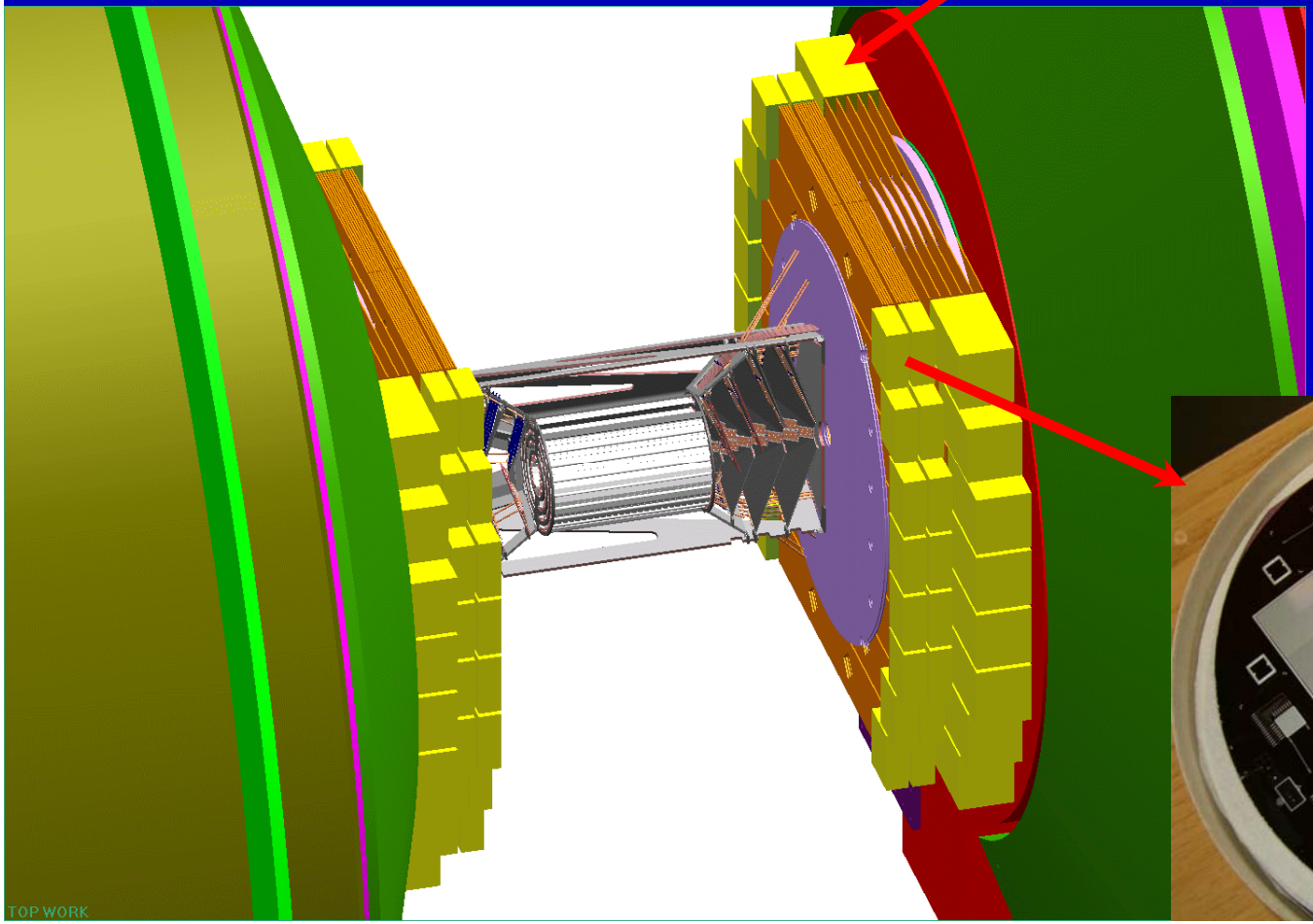
- PHENIX: F-VTX
  - Proposal in prepartion
  - LANL LDRD approval to construct ¼ of 2π prototype
  - Developing connection with FNAL Si-Det lab



Nose-Cone Calorimeter

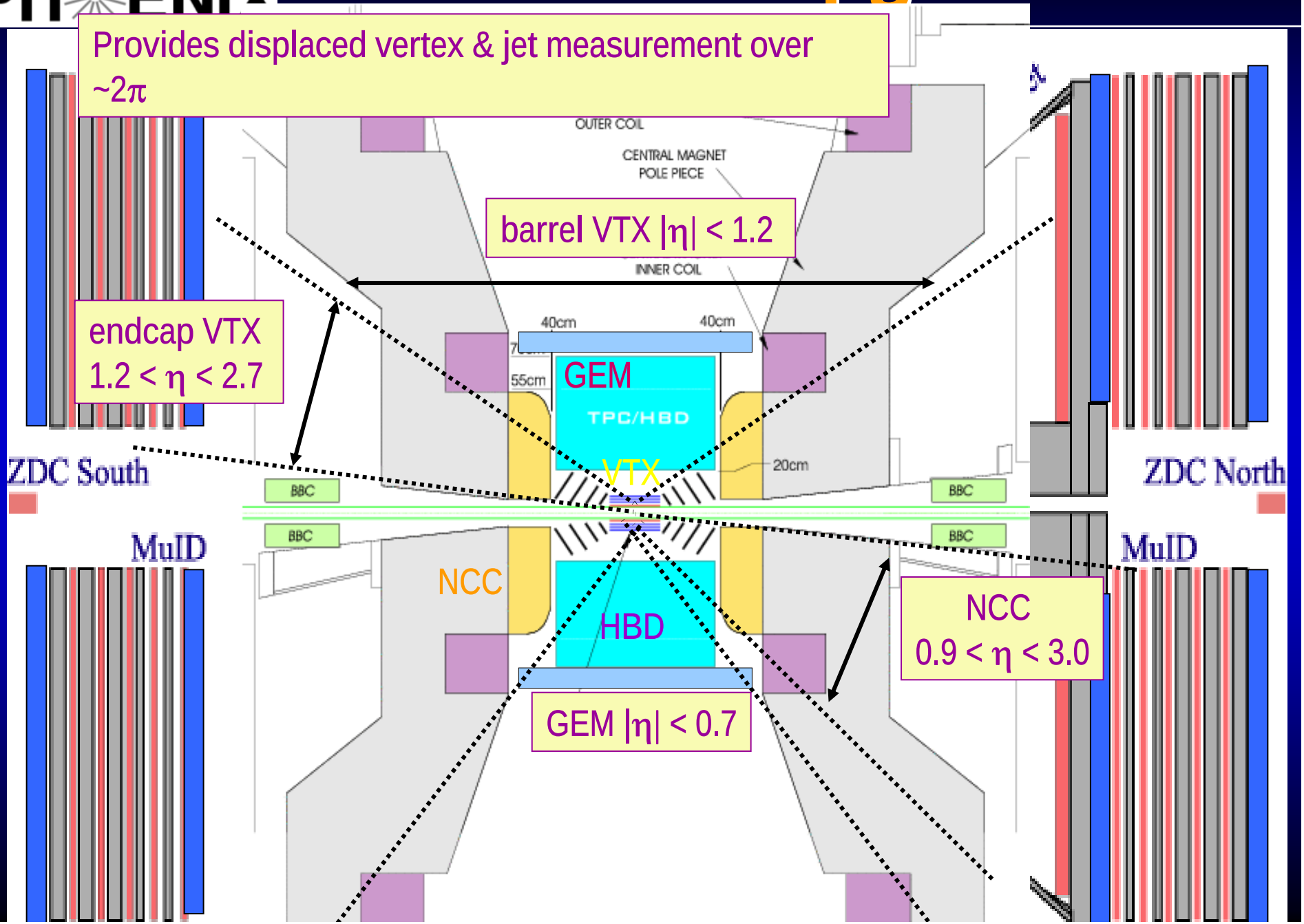
- Replace existing PHENIX "nose-cones" (hadronic absorbers for muon arms) with Si-W calorimeter
- Major increase in acceptance for photon+jet studies

- Prototype silicon wafer with
  - 3 different versions of "stri-pixel" detectors for the preshower and shower max layers

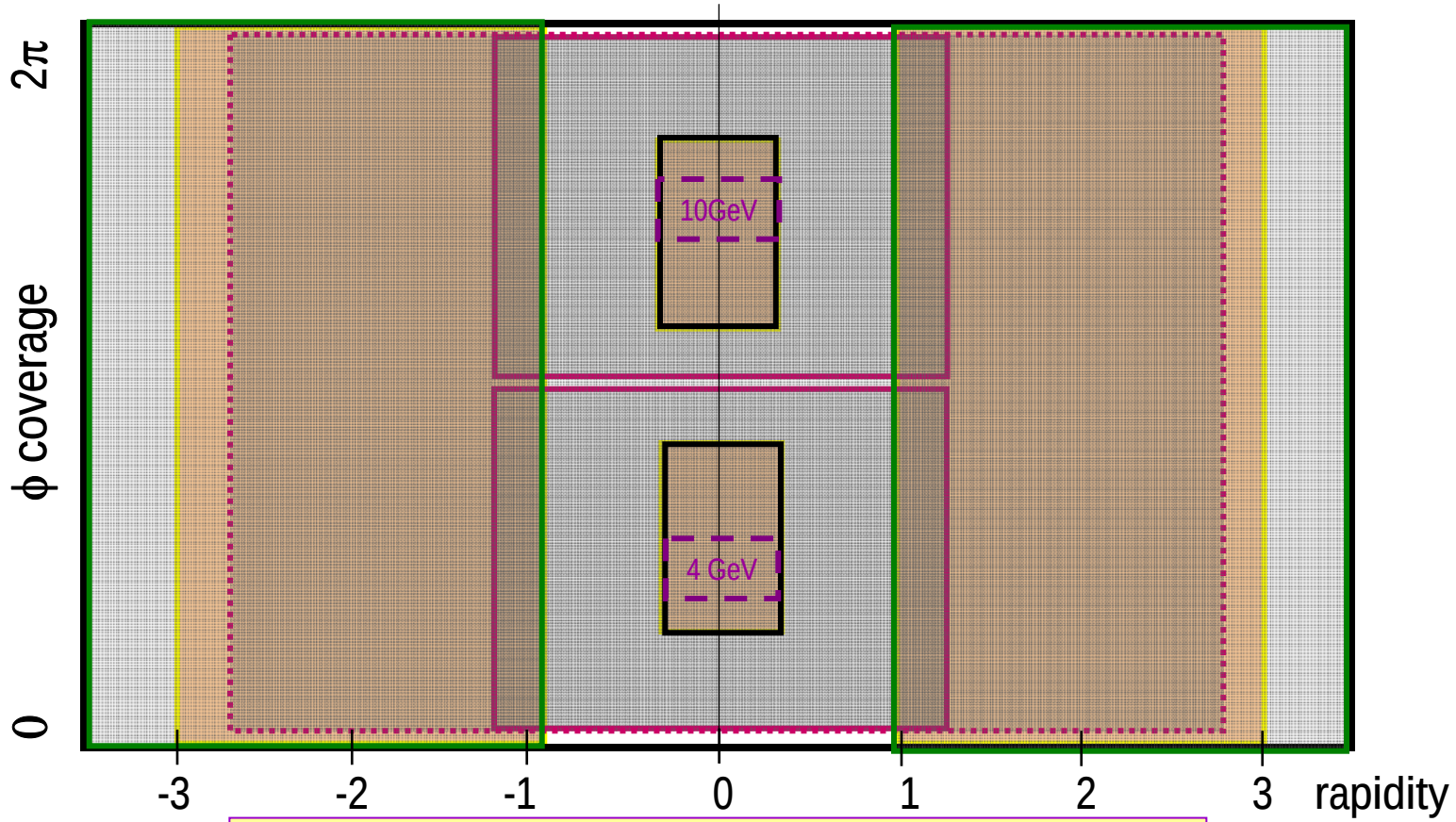


PHENIX Upgrades

Provides displaced vertex & jet measurement over ~2π



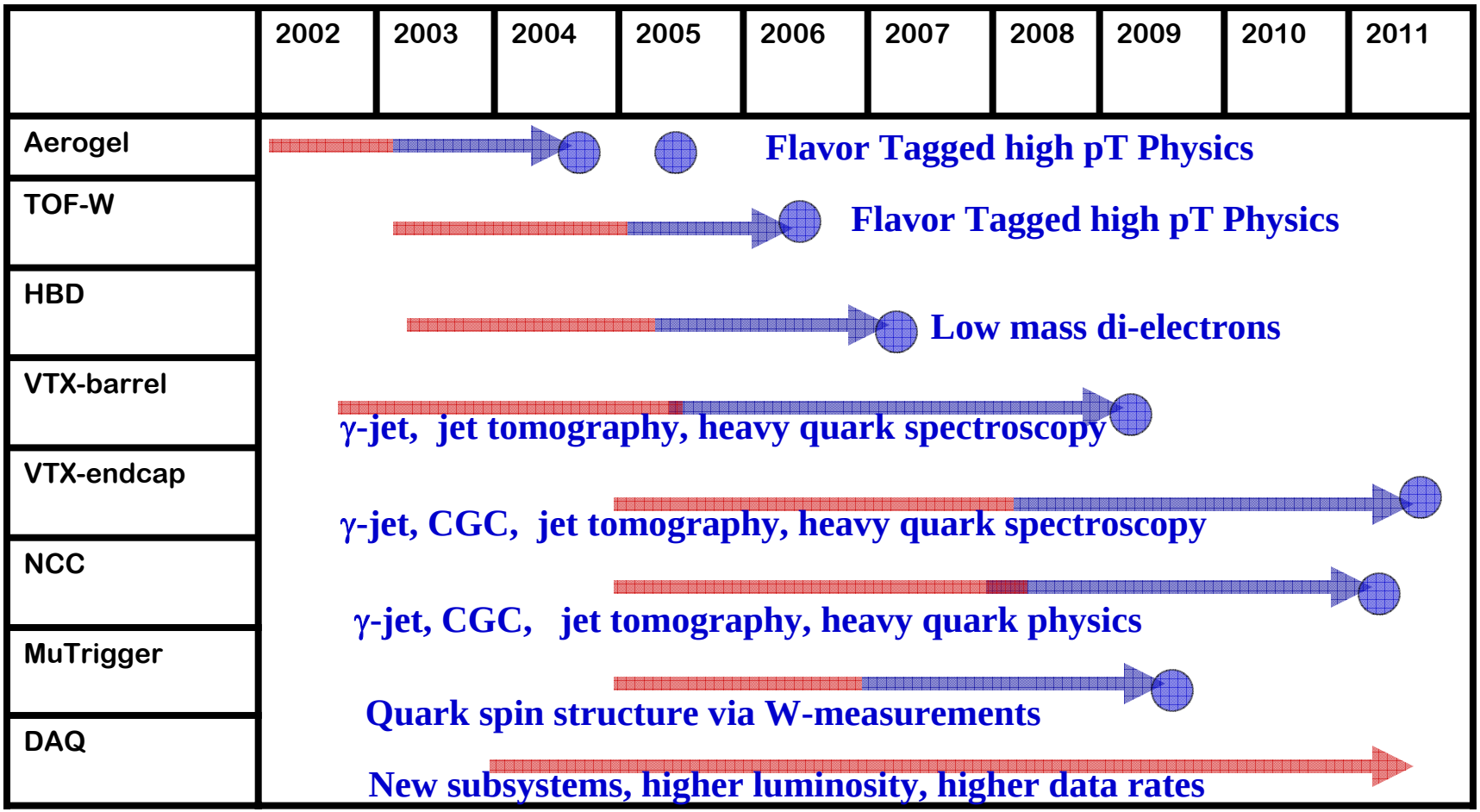
Prompt photons:	central EMCal	$\|y\| < 0.35$	forward NCC	$0.9 < y < 3.0$ $(-3.0 < y < -0.9)$
Jet (charged):	central TPC + VTX	$\|\eta\| < 1.2$	forward silicon	$1.2 < \eta < 2.7$ $(-2.7 < \eta < -1.2)$
Jet (energy):			forward NCC	$0.9 < \eta < 3.5$ $(-3.5 < \eta < -0.9)$



Large acceptance for γ-jet tomography:
expect measurements out to $E_{jet} > 20$ GeV
Large acceptance for flavor tagging
Limited acceptance for p – meson separation

PHENIX

Upgrade Physics



Notes on Methodology

- Similar to previous year's (calibrated, demonstrated) run planning
- Implements
  - (Revised) C-AD guidance, "linear growth model"
- Assumes
  - Overheads:
    - Cool-down: 2 weeks
    - Warm-up : 0.5 week
    - Set-up :
      - Initial set-up = 2 weeks
      - Second species = 1 week (2 for polarized protons)
    - Ramp-up:
      - Useful stable initial luminosity = 2 weeks (1 week for 2nd species)
      - Useful stable initial luminosity = 25% of final value
      - Linear ramp over 4 weeks to final luminosity value
  - PHENIX
    - 70% useful vertex fraction
    - 60% efficiency
    - Use geometric mean of C-AD minimal and maximal guidance (unpolarized)
    - Use 70% of C-AD maximum for polarized running (consistent with Spin Plan)
- Physics Weeks:
  - 1-mode: N Cryo Weeks – 2 –(2 +1) -- 0.5 = N Cryo Weeks – 5.5
  - 2-mode: N Cryo Weeks – 2 –(2 +1)-(2+1) – 0.5 = N Cryo Weeks – 8.5
- General PHENIX approach: When ever possible, develop equivalent parton+parton luminosity for all species studied

PHENIX

Strategy

- *Continued enrichment* of existing data sets that are statistically sparse in essential physics channels
  - ☞ accepting that this may in fact require accumulation of data over multi-year periods
  - ☞ *exploiting* the improvements in our DAQ (and RHIC) that make it profitable to re-visit "canonical" systems (Au+Au, d+Au)
- *Continued development* of luminosity and polarization to maximize efficient usage of scarce weeks
- *Completing surveys* by securing requisite baseline data in timely fashion, so that comparison data sets are obtained with essentially the same detector configuration.
- *Goal:* To maintain and enhance the *discovery program* essential to further progress in RHIC science

PHENIX

Request Summary

- Additional Au+Au running at $\sqrt{s_{NN}}$ = 200 GeV to significantly advance the statistical reach and physics precision of our existing Run-4 data set:
  - ☞ Run-6 + Run-8 = factor of 10 beyond Run-4
- Two comparison runs:
  - p+p collisions at 62.4 GeV to complete the investigation of the energy dependence of the high p_T suppression pattern observed at 200 GeV.
  - p+p collisions at 22.5 GeV to complete the Run-5 low energy studies in the Cu+Cu system, and to make valuable comparisons between RHIC and SPS measurements of the nuclear modification factor.
- A period of polarized proton running with transverse (radial) polarization, to perform a measurement of the gluon Sivers function.
- Continued development of polarized proton luminosity and polarization leading to a sensitive measurement of the gluon polarization of the proton via 200 (and 500) GeV p+p collisions.
- A d+Au run, again to take advantage of significant advances in luminosity and data acquisition throughput to refine our knowledge of this essential baseline system.

Run Request Summary Table

Table 2: The PHENIX Beam Use Proposal for Runs 6-10.

RUN	SPECIES	$\sqrt{s_{NN}}$ (GeV)	PHYSICS WEEKS	$\int \mathcal{L}dt$ (recorded)	p+p Equivalent
6	Au+Au	200	13	1 nb^{-1}	40 pb^{-1}
	p+p	200	4	7 pb^{-1}	7 pb^{-1}
	p+p	62.4	2	0.6 pb^{-1}	0.6 pb^{-1}
	p+p	22.5	0.5	4 nb^{-1}	4 nb^{-1}
	p+p	500	1	NA	NA
7	d+Au	200	10	28 nb^{-1}	11 pb^{-1}
	p+p	200	15	57 pb^{-1}	57 pb^{-1}
8	Au+Au	200	15	1.5 nb^{-1}	60 pb^{-1}
	p+p	200	10	52 pb^{-1}	52 pb^{-1}
9	TBD	200	10		
	p+p	200	5	22 pb^{-1}	22 pb^{-1}
	p+p	500	10		
10	U+U?	200	15		
	p+p	500	10		

Run-6 Request (29 weeks)

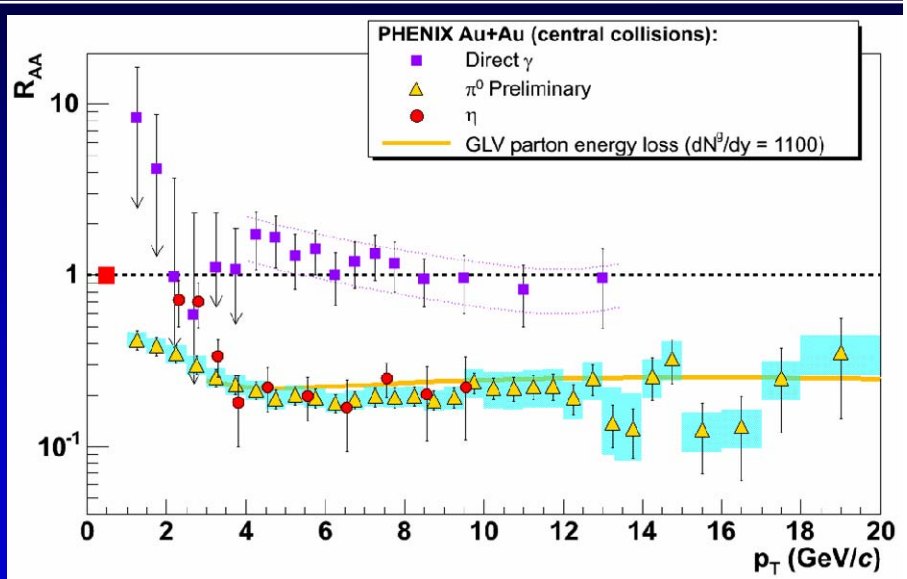
- 13 weeks of Au+Au at $\sqrt{s_{NN}}$ = 200 GeV
  - To significantly advance the statistical reach and physics precision of our existing Run-4 data set.
    - Run-4: 0.24 nb^{-1}
    - Run-6: 1.0 nb^{-1}
- 4 weeks of polarized p+p at $\sqrt{s}$ = 200 GeV
  - Transverse (radial) polarization
  - Measurement of the gluon Sivers function via A_N for di-hadron azimuthal correlations
- 2 weeks of p+p at $\sqrt{s}$ = 62 GeV
  - To complete the investigation of the energy dependence of the high p_T suppression pattern observed at 200 GeV.
- 0.5 weeks of p+p at $\sqrt{s}$ = 22 GeV
  - Baseline data needed to determine whether jet quenching is already present in A+A collisions at CERN SPS energies
- 1.0 weeks of p+p at $\sqrt{s}$ = 500 GeV
  - Machine development, potential measurement of trigger rates and backgrounds

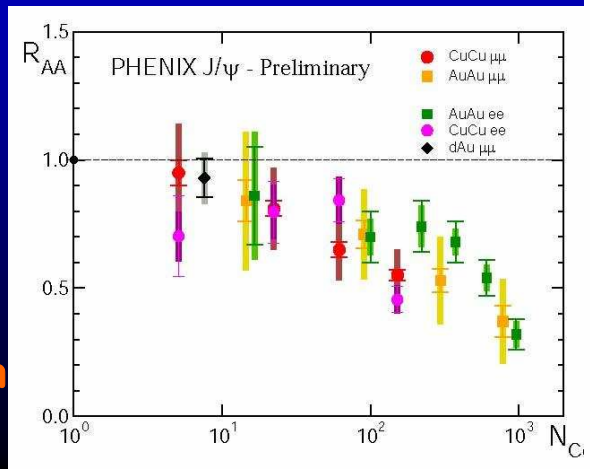
PHENIX "Run Coordinator" for Run-6:

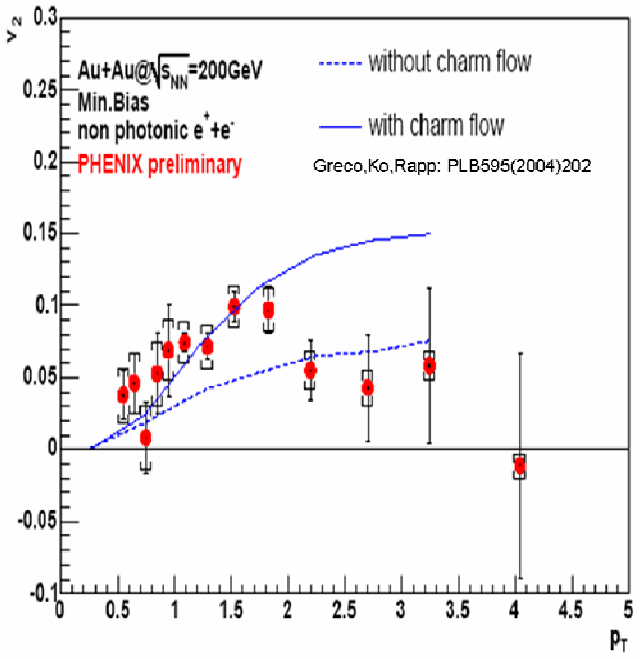
➡ **Prof. Abhay Deshpande (SUNY-SB)**

13 weeks of Au+Au at $\sqrt{s_{NN}}$ = 200 GeV

- **Motivation:**
  - **Extend *statistically limited* observations of**
    - **nuclear modification factors**
      - **To test universality(?) of partonic suppression**
    - **jet correlations**
      - **Identify mechanism responsible for away-side structure (Mach, Cerenkov, flow, …)**
    - **Heavy flavor flow, R_{AA}**
      - **Measure viscosity(!)**
      - **Investigate bottom contributions**
    - **Charmonium**
      - **Understand recombination**
      - **Measure flow**

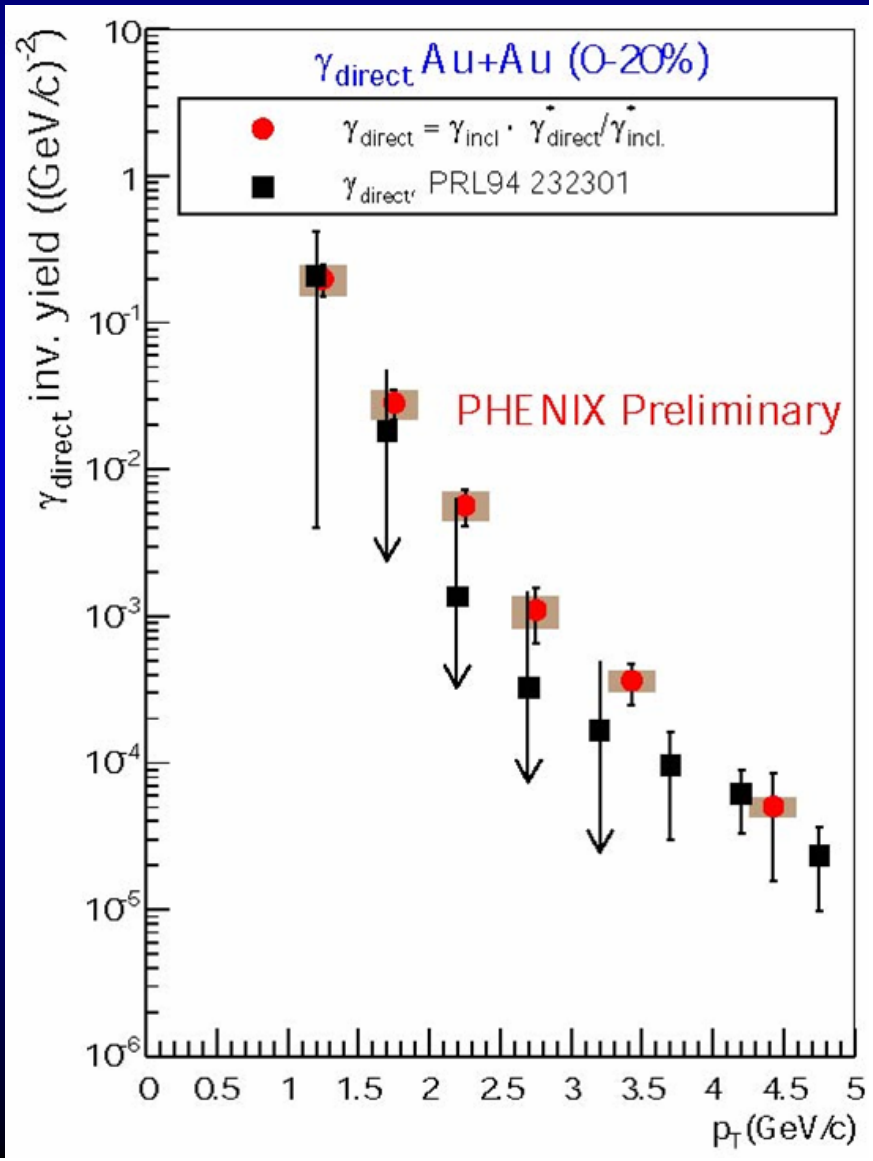






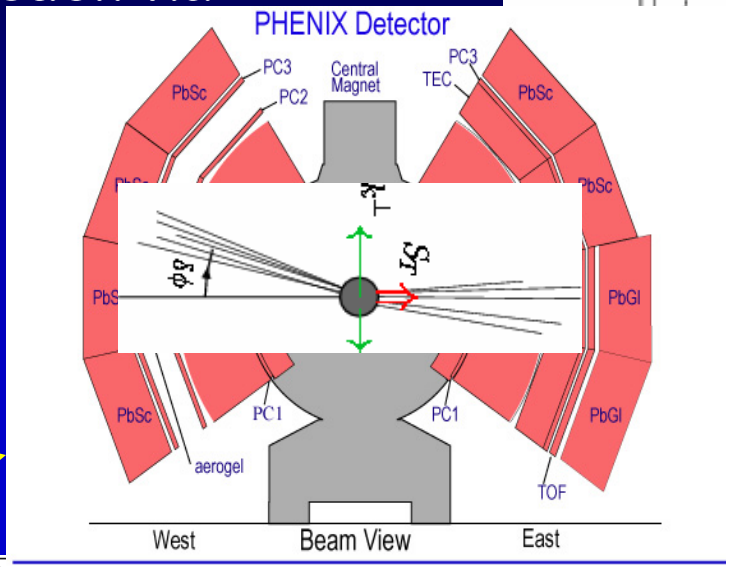
Specific to Run-6

- Confirm/extend measurement of (potentially) thermal photons before introduction of new detectors (HBD, Si-VTX) in central aperture
- May be best opportunity to examine the photon spectrum in this very difficult regime thought to be sensitive to thermally emitted photons from QGP
  - HBD: Will use +- field configuration
  - Si-VTX: increases conversion backgrounds

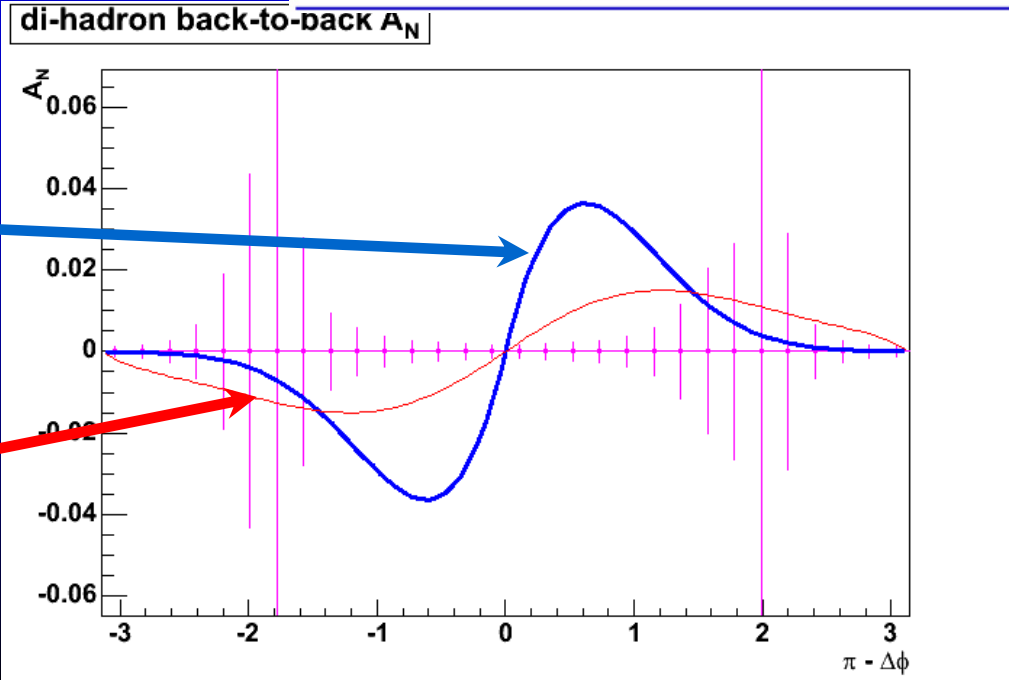


4 Weeks of Polarized p+p at $\sqrt{s}$ = 200 GeV

- Goal: measurement of the gluon Sivers function via A_N for di-hadron angular correlations
  - D. Boer and W. Vogelsang, Phy. Rev. D69, 094025, 2004; hep-ph/0312320
  - Sivers distribution is a transverse parton momentum distribution correlated with the nucleon's spin axis, which *could* arise from orbital angular momentum

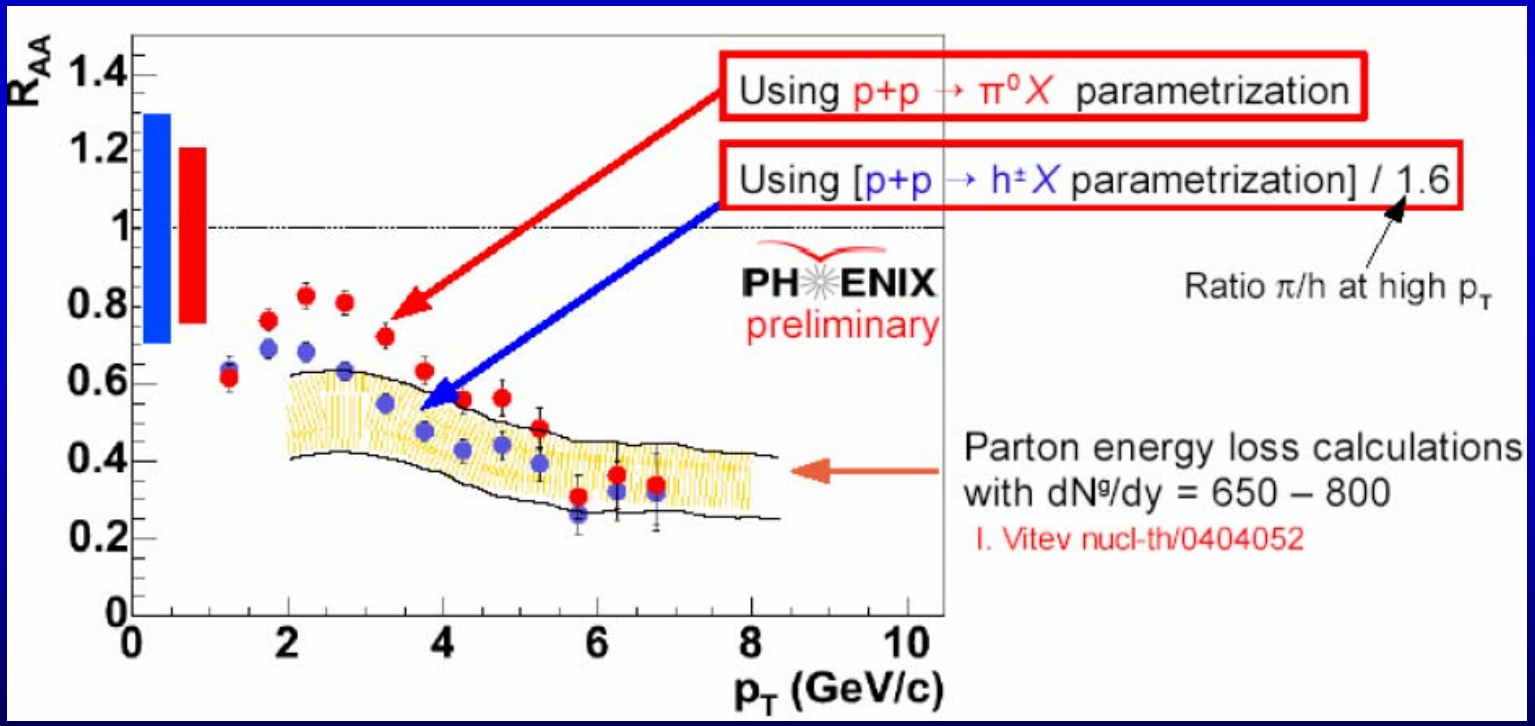


- Request: 4 weeks, 200 GeV, *radial* polarization
- Expectations: ~7 pb^{-1} , P=60%
  - Blue Curve: Fig.3 from Boer and Vogelsang
  - Red Curve: Blue curve after accounting for di-hadron smearing and realistic polarization
  - Error bars: Expected sensitivity with P=60% and 7 pb^{-1}



2 weeks of p+p at $\sqrt{s}$ = 62 GeV

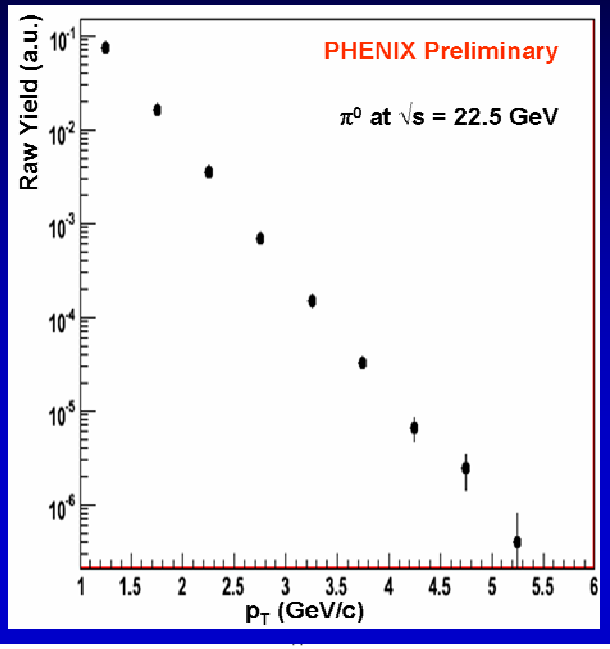
- Goal: To *complete* the investigation of the $\sqrt{s}$ dependence of the high p_T suppression pattern observed at 200 GeV.
- Problem:
  - No *in situ* measurement of p+p reference
  - Inadequate reference from world's data

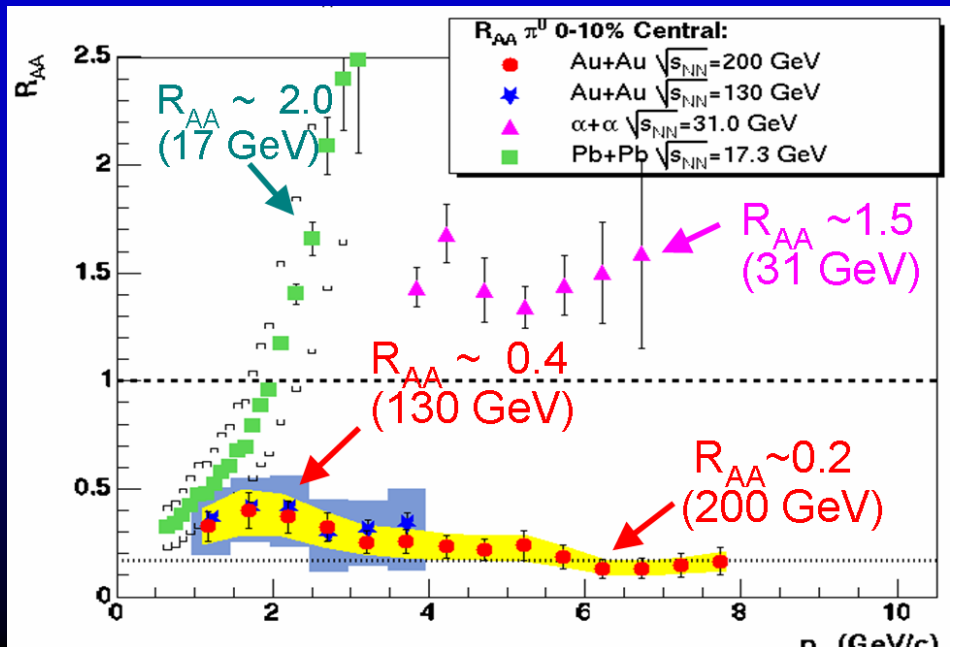


- Solution: Measure in PHENIX, 2 weeks ➡ 0.6 pb^{-1}
  (compare to Au+Au 0.36 pb^{-1} pp-equivalent)

0.5 weeks of p+p at √s = 22 GeV

- Goal: To *complete (fix!)* comparisons between the high p_T suppression pattern observed at the SPS and RHIC
- Problem:
  - No *in situ* measurement of p+p reference
  - Inadequate reference from world's data
- Solution: Measure in PHENIX, 0.5 weeks ➡ ?
  - Will evaluate rates in real time
  - Very likely to cover p_T range of SPS data





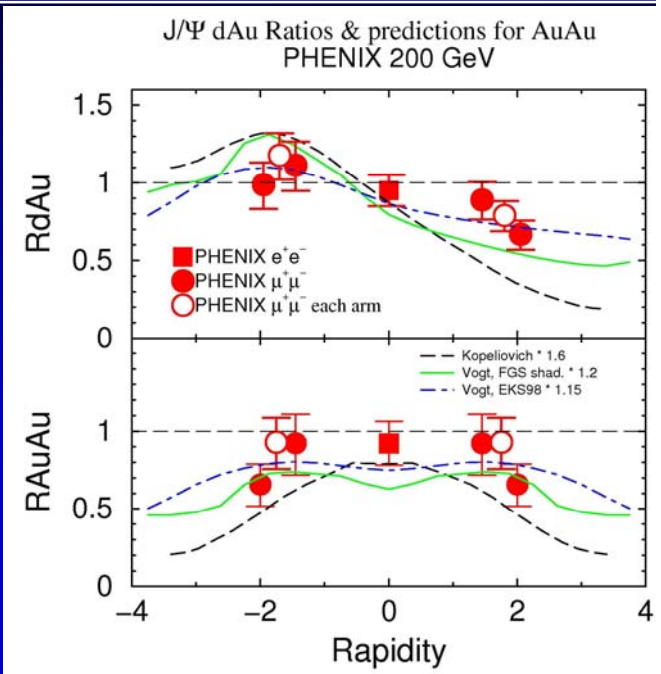
In the 20 Week Scenario…

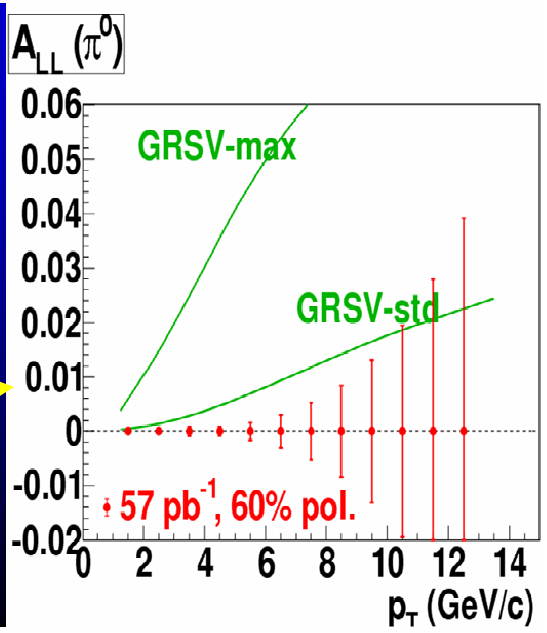
- Two "major modes" are not feasible in 20 cryo weeks
- Therefore- we *very reluctantly* forgo the Au+Au running
- Driven by
  - Need for further major developments in luminosity and polarization
  - Opportunity to perform a unique measurement
  - Need to complete existing analyses with required baseline measurements
- Thus (20 cryo weeks = 14.5 physics weeks)
  - 3.0 weeks of p+p at $\sqrt{s}$ = 62 GeV
  - 1.5 weeks of p+p at $\sqrt{s}$ = 22 GeV
  - 8.0 weeks of polarized p+p at $\sqrt{s}$ = 200 GeV
    - N weeks radial (transverse) polarization
    - 8-N weeks longitudinal polarization (N ~ 4, performance driven)
  - 2.0 weeks of p+p at $\sqrt{s}$ = 500 GeV

Run-7 Request (29 weeks)

- 10 weeks of d+Au at $\sqrt{s_{NN}}$ = 200 GeV
  - Given expected advances in integrated p+p luminosity, existing Run-3 d+Au data set becomes limiting factor in making precision statements about (small) nuclear modifications.
    - Run-3: 2.7 nb^{-1}
    - Run-7: 28 nb^{-1}
- 15 weeks of polarized p+p at $\sqrt{s}$ = 200 GeV
  - Longitudinal polarization
  - Factor of >10 improvement in integrated luminosity
    - Run-5: 3.8 pb^{-1}
    - Run-7: 57 pb^{-1}
  - Assumed polarization of 65%
    - ➡ factor of 40 improvement in sensitivity (figure of merit)

☞ *THERE IS NO PLAN FOR ANOTHER 20 WEEK SCENARIO*





PHENIX

Summary

- The PHENIX Collaboration
  - has a demonstrated record of using precision probes at RHIC to perform incisive measurements
  - has a demonstrated record of high performance triggering and data acquisition to take full advantage of RHIC's capabilities
  - has a demonstrated record of timely analysis of massive data sets
- The PHENIX Collaboration Beam Use Request
  - will advance this program via
    - significant extensions in experimental sensitivity in the key systems of interest (Au+Au, p+p, d+Au)
    - a suite of upgrades that will expand the kinematic reach and expand the physics capabilities of the present (very capable) apparatus.

Closing Remarks

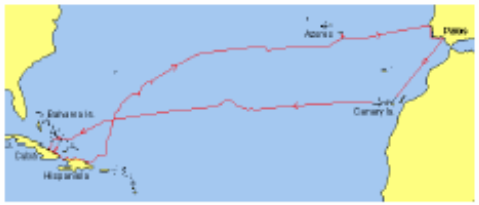
- Our Beam Use Request is motivated by the knowledge obtained during the initial discovery phase of RHIC
- We have found the New World
- We now wish to **fully** explore it

☞ ***Before*** others do!

RIKEN-BNL workshop, May 15 2004

Ed Shuryak: "One may have an absolutely correct theory and still make *accidental* discoveries…"

Columbus' Theory:
(1) world is not flat, $E_2 \Rightarrow S_3$
(2) if he goes west he should eventually come to India



But he discovered something else was on the way…

We set out at RHIC we find wQGP. But 1000 experimentalists found something else on the way… the sQGP !

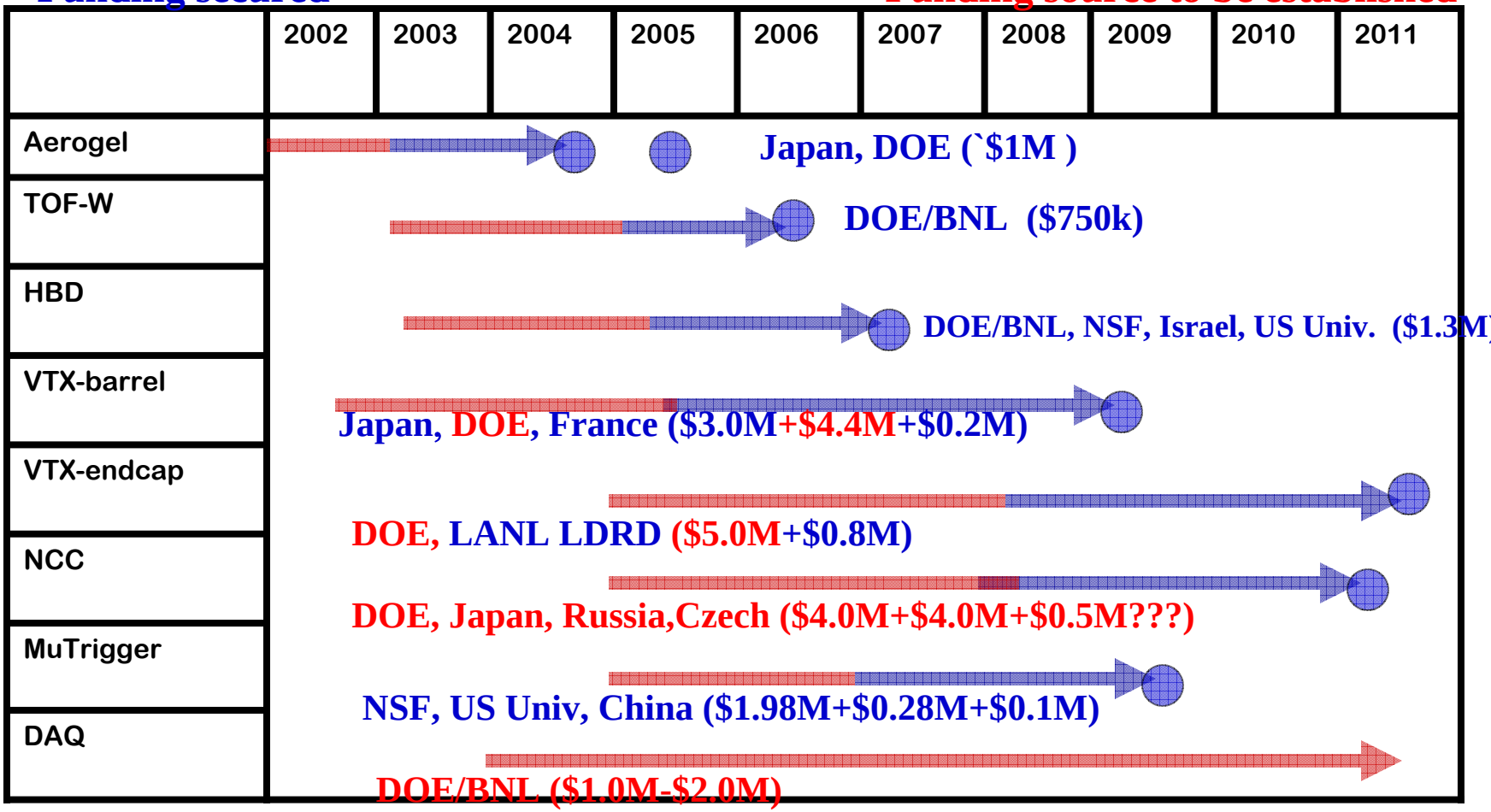
Gyulassy RBRC/BNL 12/16/04 8

PHENIX

Back-up

Funding Source

Funding secured | **Funding source to be established**



R&D Phase | Construction Phase | Ready for Data

World's Data at 62 GeV

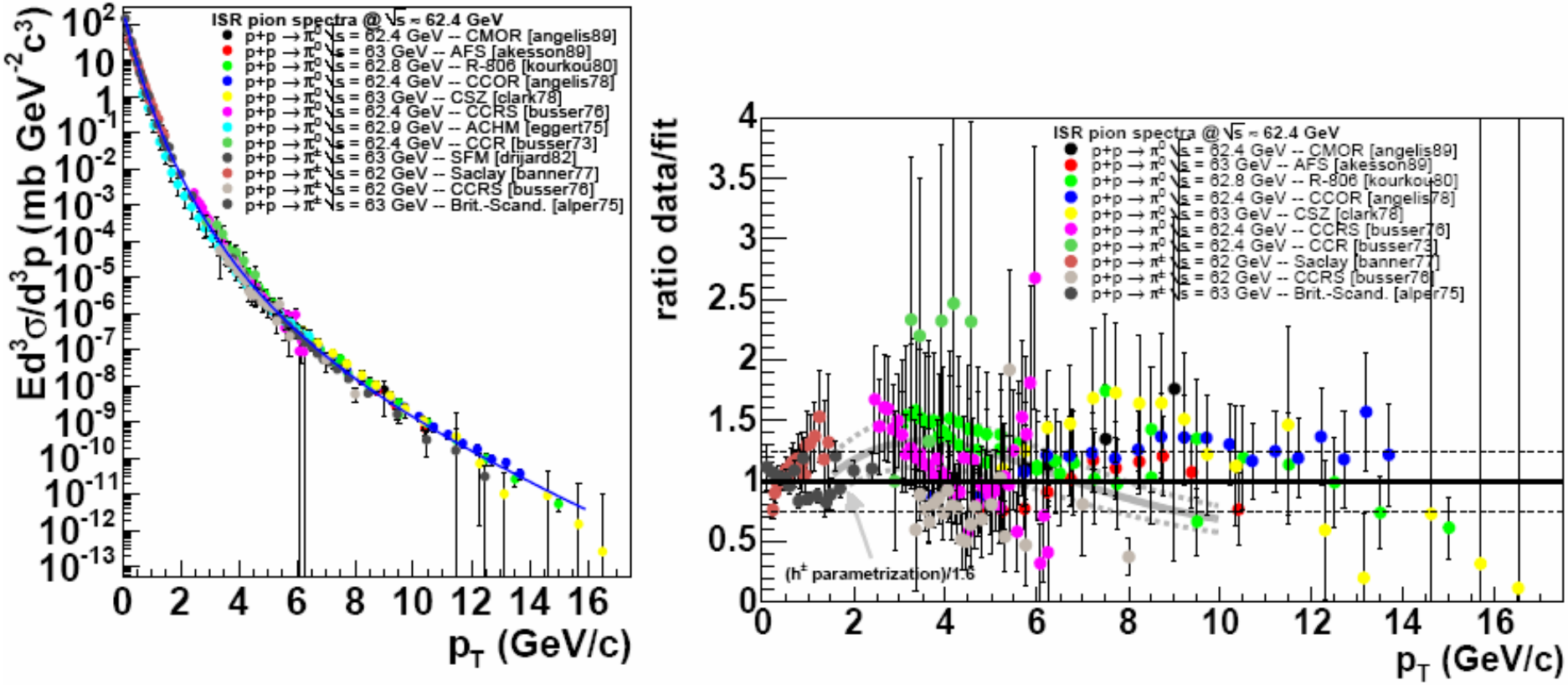


Figure 11: Left: World's data for $p + p \rightarrow \pi^0 + X$ at $\sqrt{s}$=62.4 GeV. Right: The ratio of the individual data sets to a global fit.