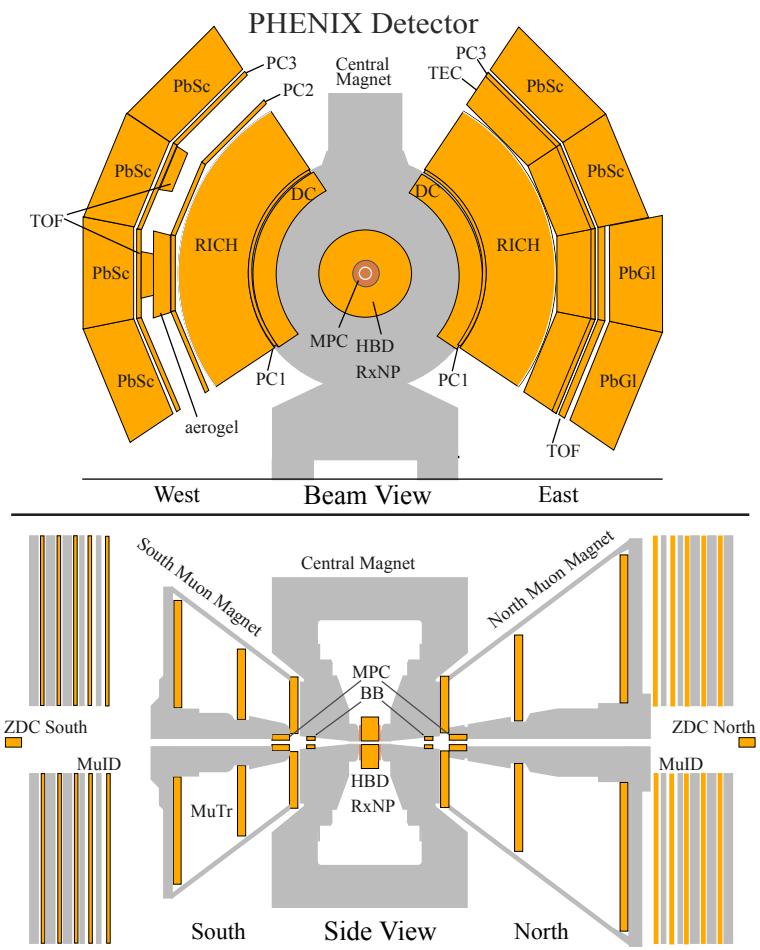
# BNL/PHENIX Group

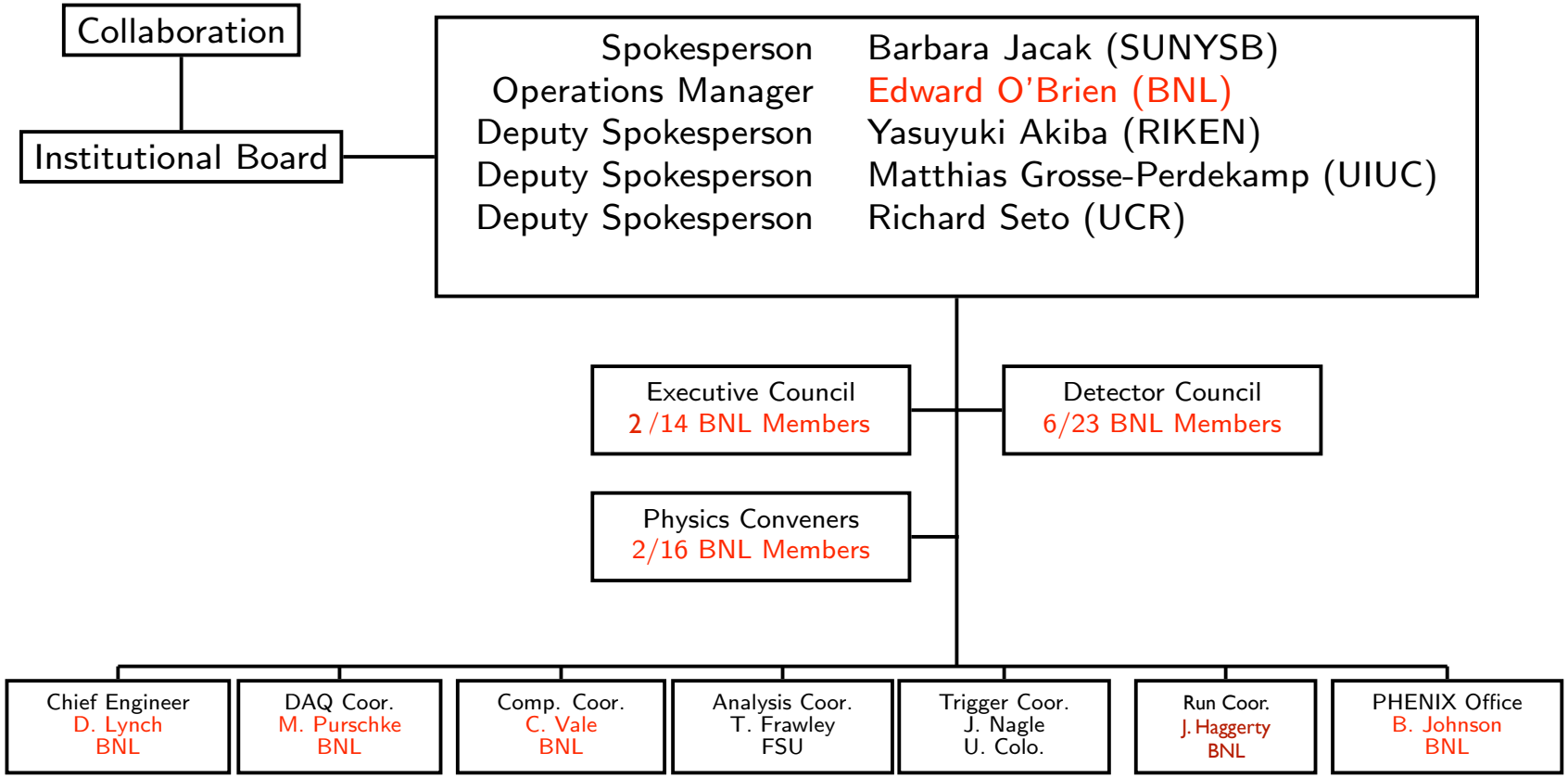
David Morrison

July 23, 2009

# BNL/PHENIX Group




- BNL/PHENIX Group ≠ PHENIX Collaboration
- main responsibility: detector operation
- 21 staff scientists
- no post-docs currently

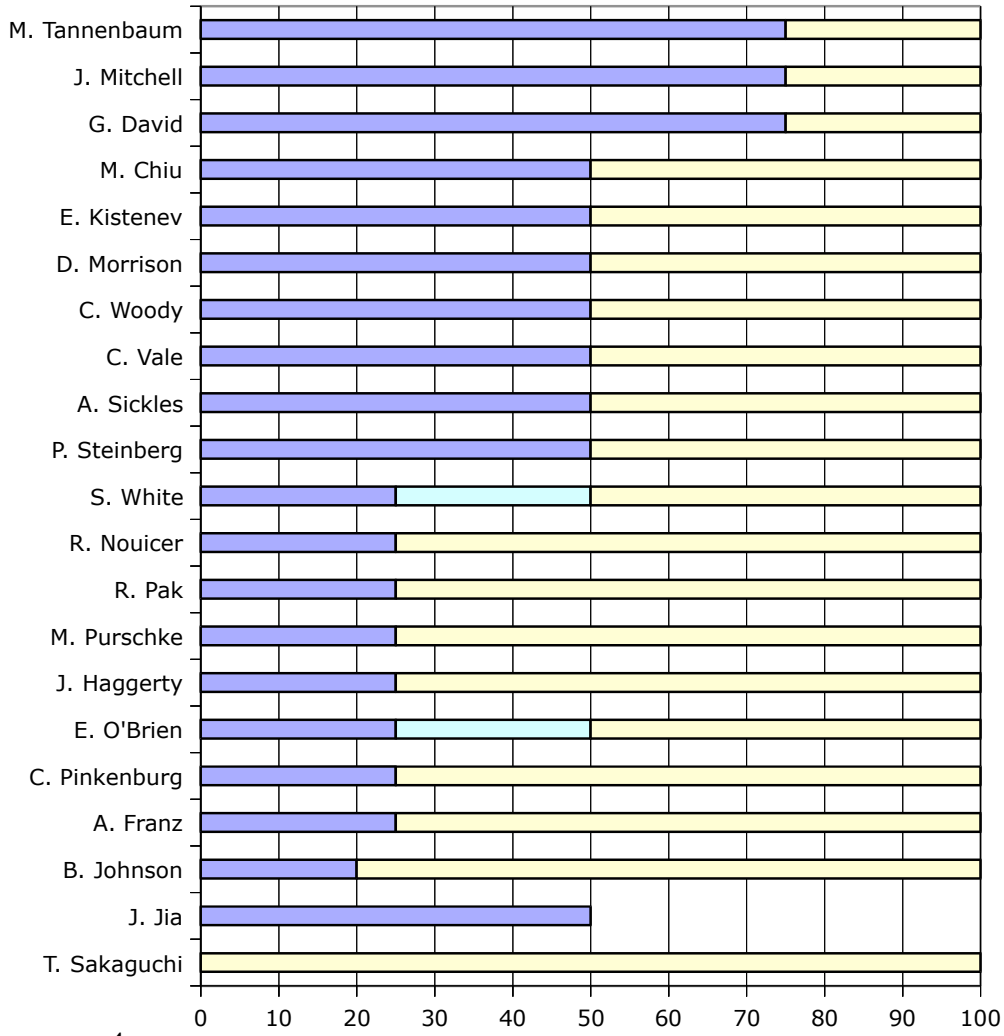



Names in red are BNL/PHENIX Group Members.

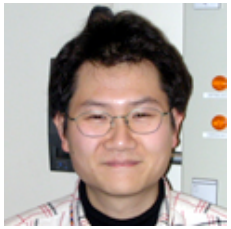
P. Steinberg Co-convener ATLAS Heavy Ions

# Funding and FTEs

- Funding divided research:ops :: 40:60
- Research fraction is contingency of first resort
- Split for individual physicists varies

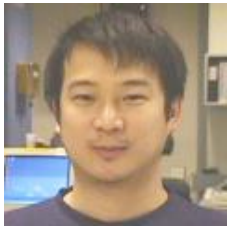


# Junior Staff



# Takao Sakaguchi

- Ph. D., Waseda Univ. (1998)
- Hard Scattering/Photon WG Convener
- $\pi^0$'s and direct photons
- Task force on low energy running
- Invited talk at Tamura Symposium (2008)



# Mickey Chiu

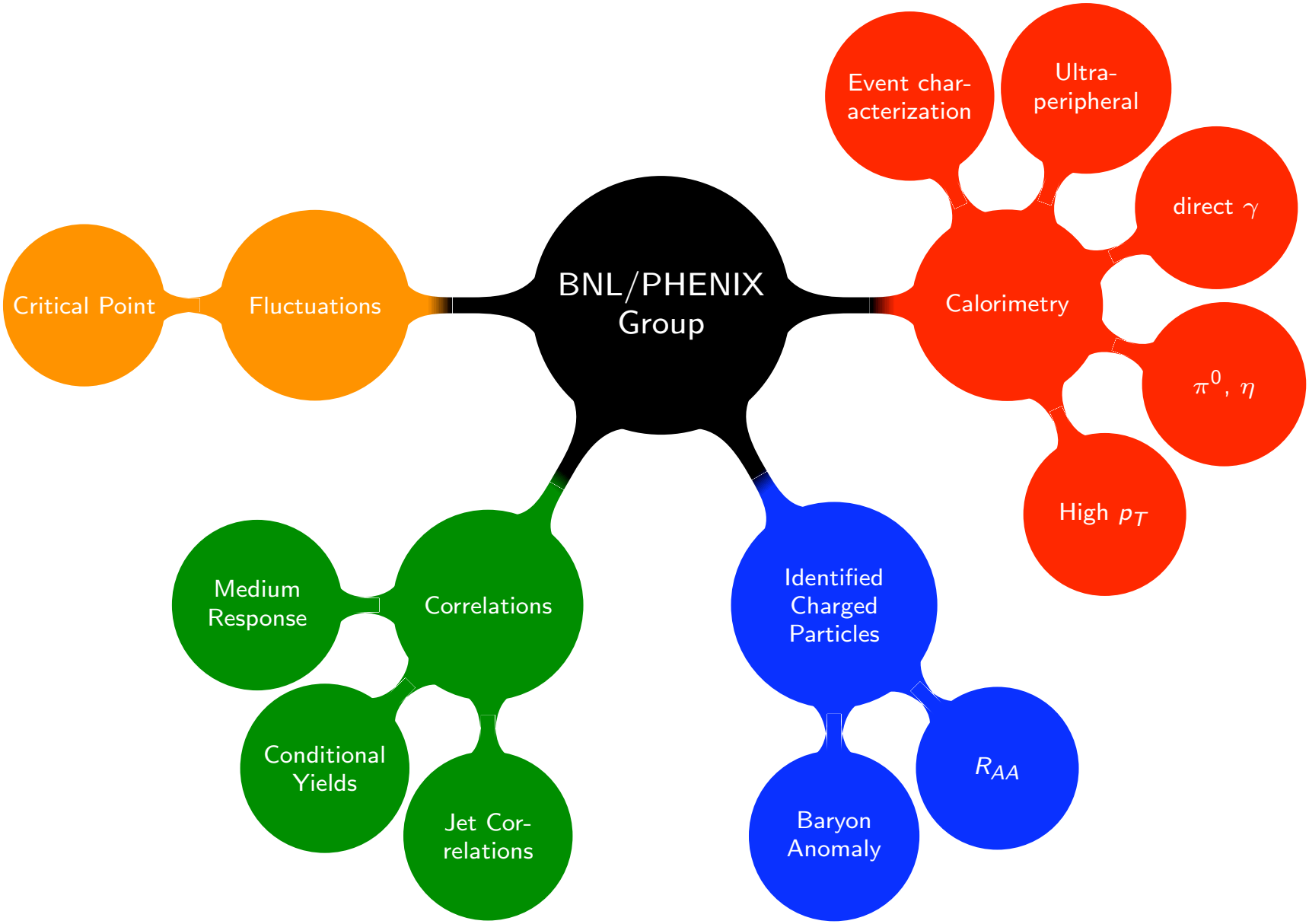
- Ph. D. , Columbia U. (2004)
- 2007 PECASE
- Muon piston calorimeter ($\pi^0$ $A_N$, $I_{dA}$)
- Organizing W working group

# Carla Vale

- Ph. D., MIT (2004)
- PHENIX Computing Coordinator
- Plenary talk Hard Probes ’08
- Plenary talk QM’09

# Anne Sickles

- New staff position made possible by Dept.
- Ph. D., SUNY Stony Brook (2005)
- Hard scattering/Photon WG Convener
- Plenary talk QM'09
- A. Sickles, S. Brodsky, *Phys. Lett. B668 111-115 (2008)* (baryon anomaly)

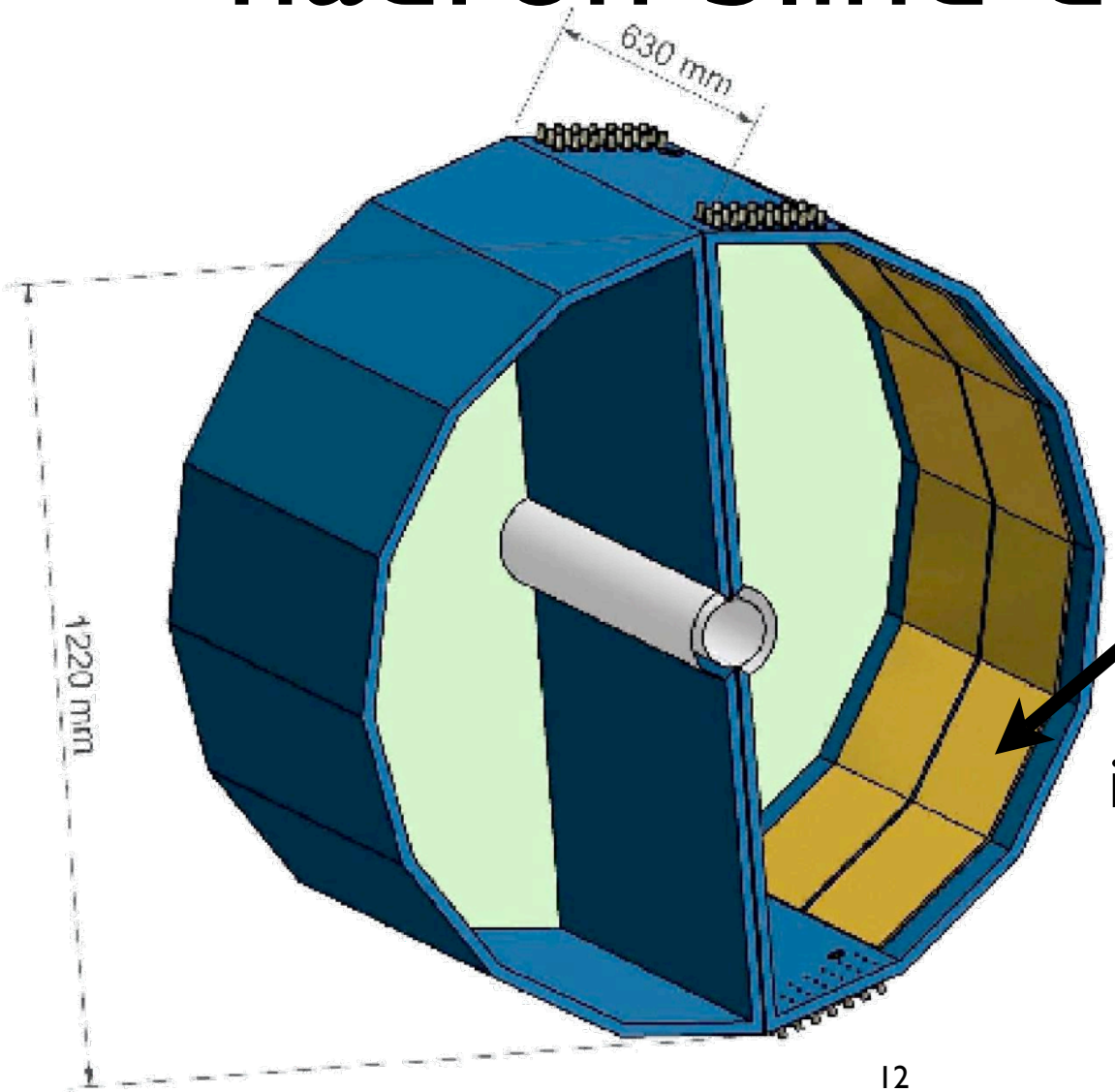

BNL/PHENIX Group
Critical Point
Fluctuations
Event characterization
Ultra-peripheral
direct $\gamma$
Calorimetry
$\pi^0$, $\eta$
High $p_T$
Medium Response
Correlations
Conditional Yields
Jet Correlations
Identified Charged Particles
$R_{AA}$
Baryon Anomaly

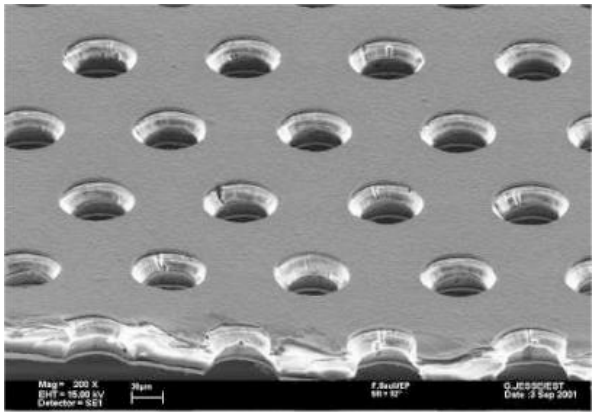
# four year research plan

- hadron-blind detector
- muon piston calorimeter
- W physics
- $J/\Psi$ and $e^+e^-$ in d+Au
- forward/central $\pi^0$ correlations
- $R_{AA}$ of $\pi^0$, $\eta$, $\omega$
- low-energy running
- forward calorimetry

from 2008 DOE quadrennial review of nuclear physics research programs, May 2008

# hadron blind detector



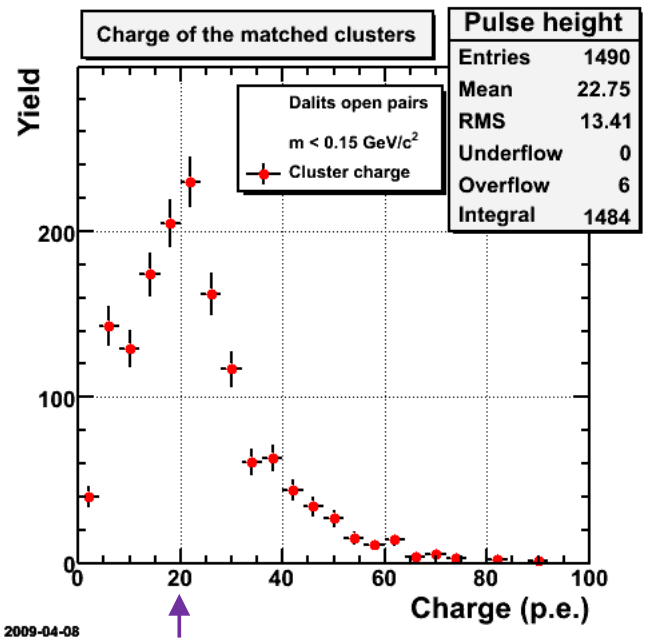



GEM

insensitive to hadrons
+
rejects Dalitz decays

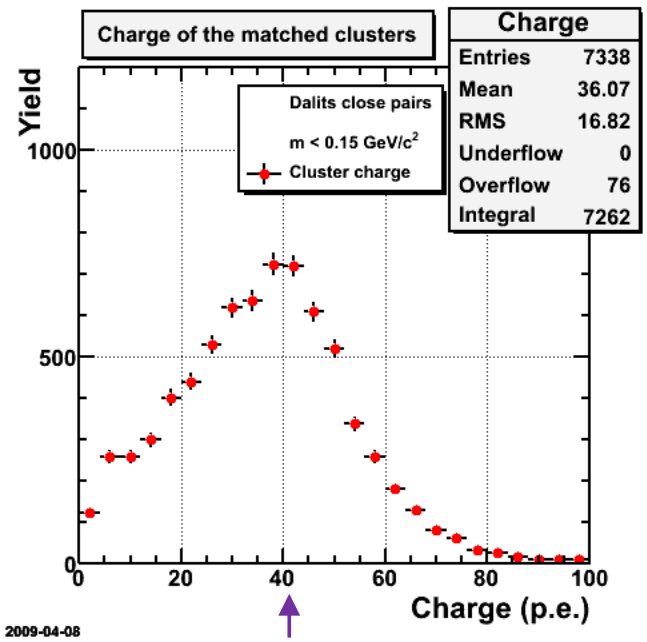
# hadron blind detector

Single electrons




20 pe

Double electrons



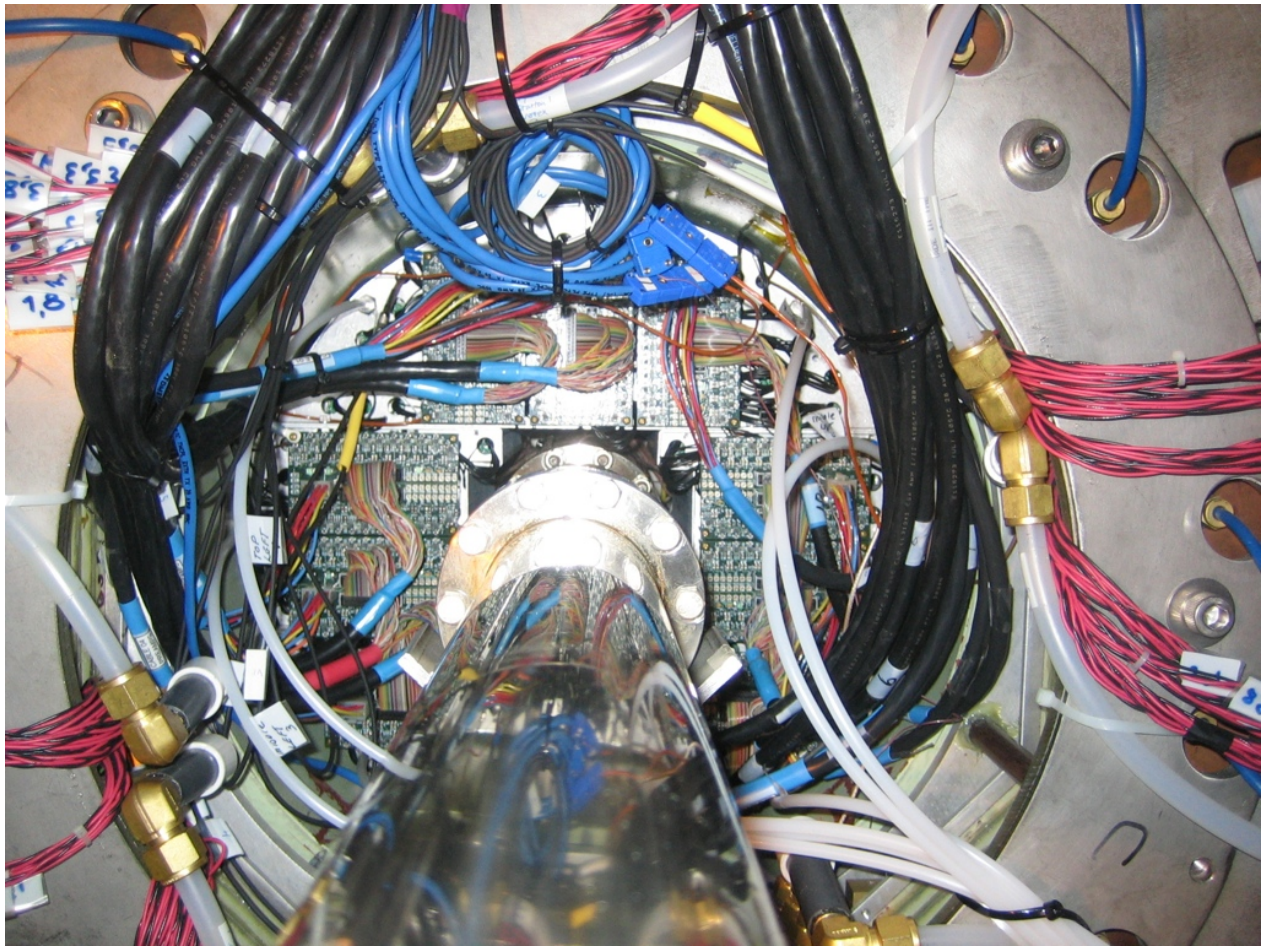

40 pe

run-9 p+p commissioning

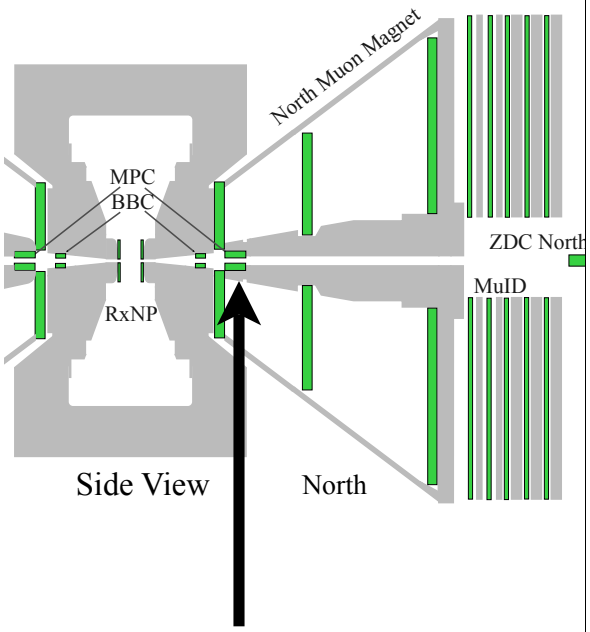
run-10 Au+Au physics

C. Woody
A. Sickles
T. Sakaguchi

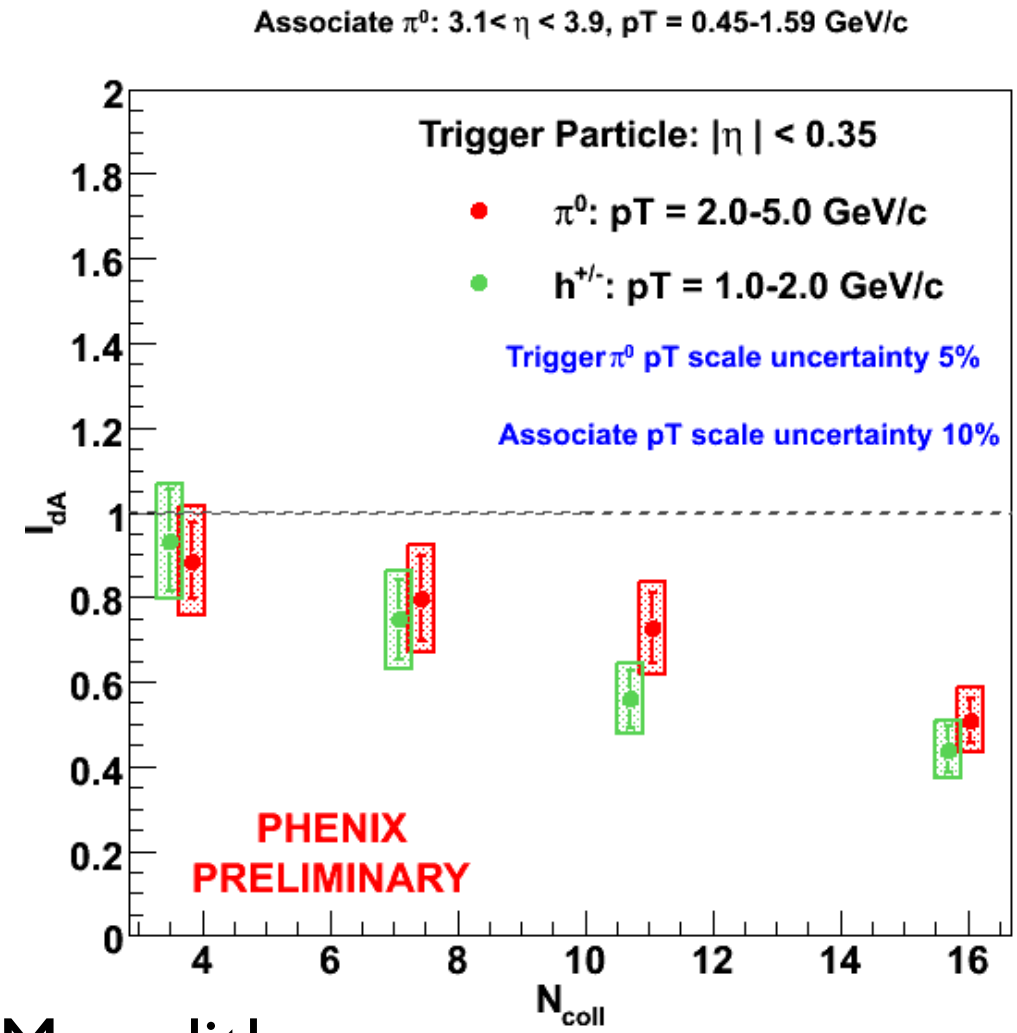
# muon piston calorimeter (MPC)



M. Chiu

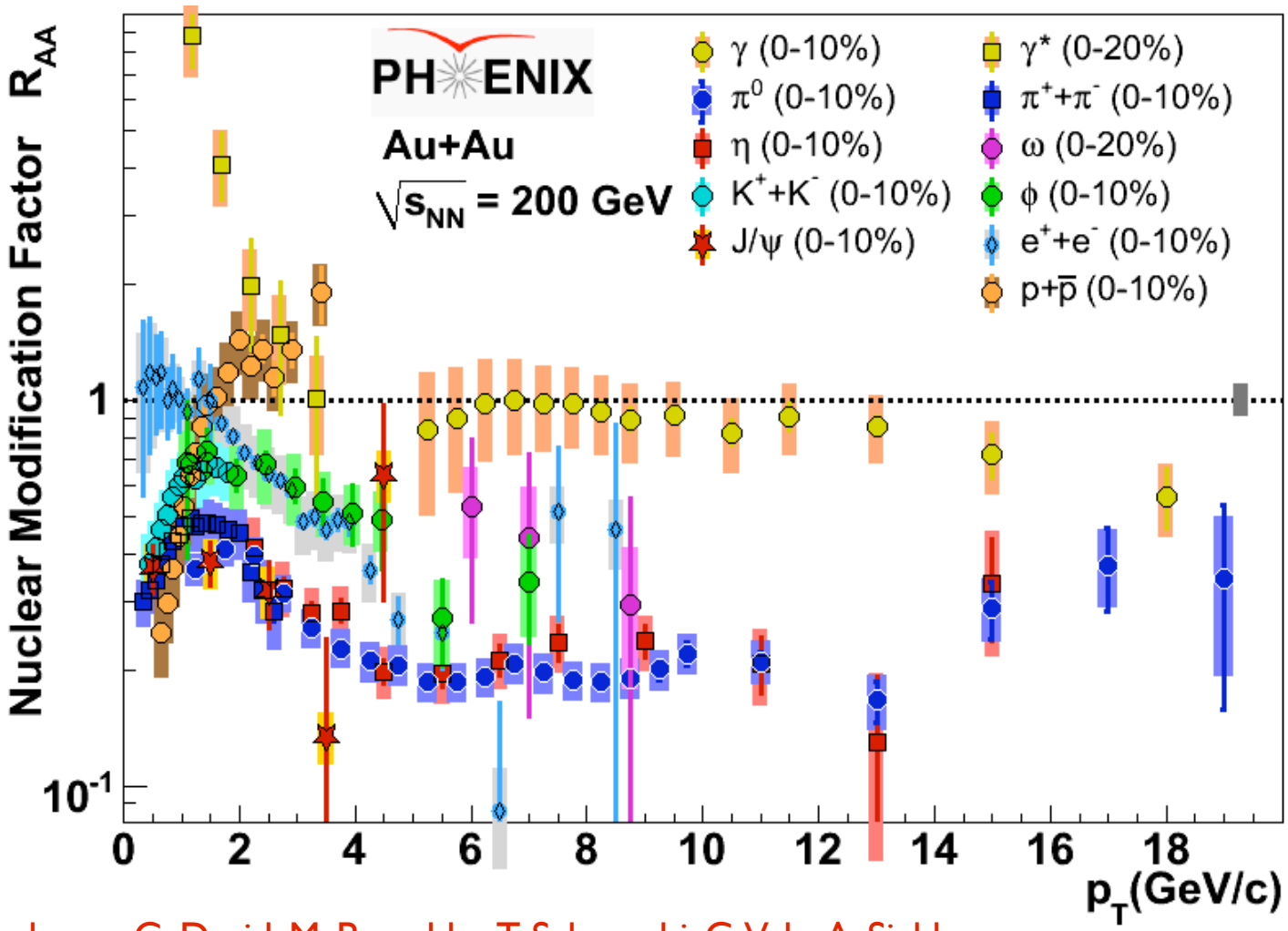


# muon piston calorimeter



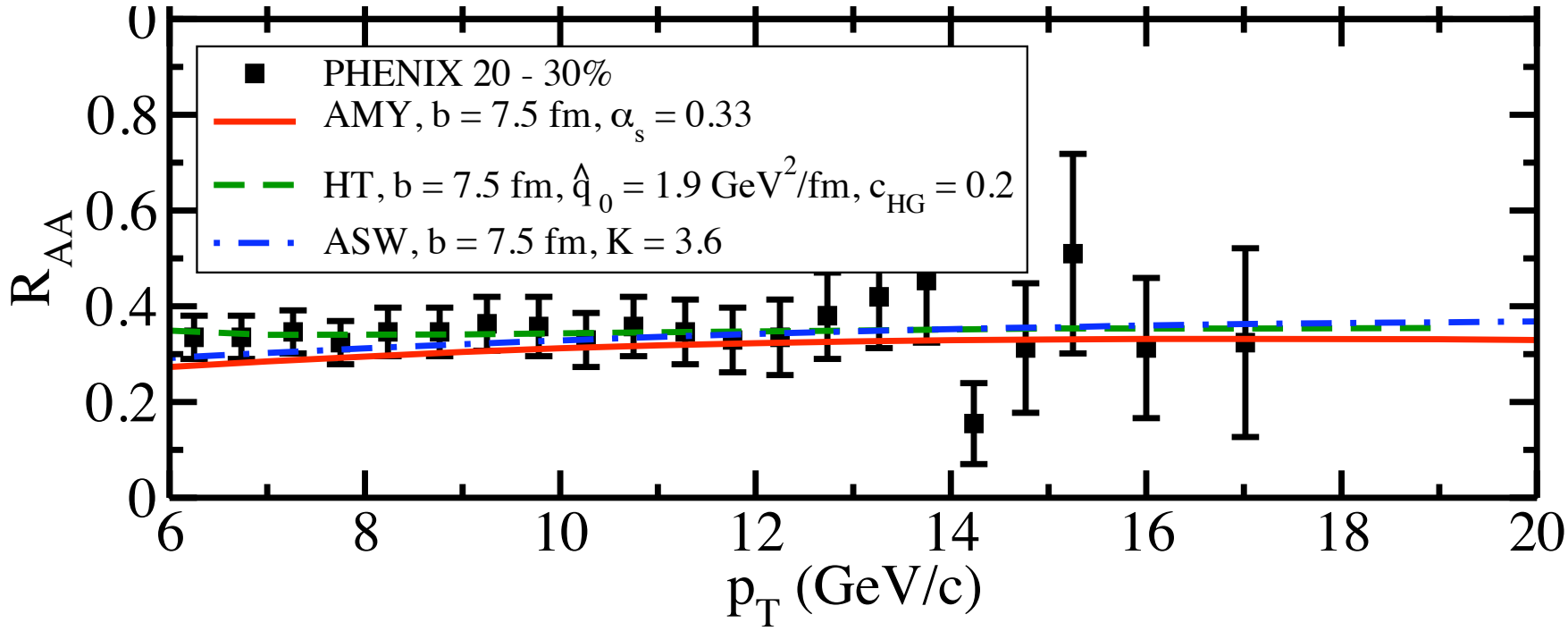

M. Chiu, B. Meredith

# nuclear modification $R_{AA}$




M. Tannenbaum, G. David, M. Purschke, T. Sakaguchi, C. Vale, A. Sickles

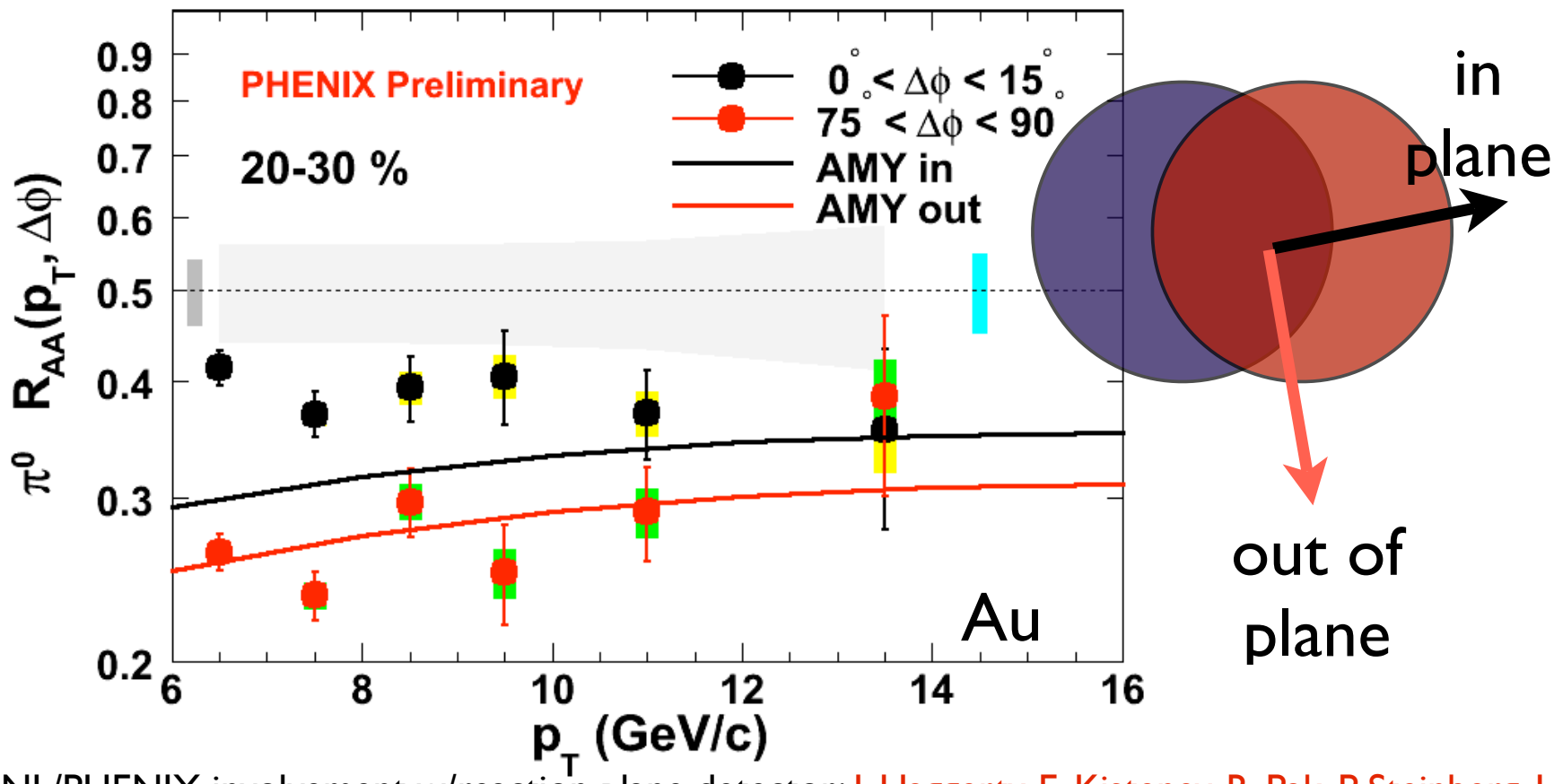
# all reaction planes




Bass *et al*, Phys.Rev.C79:024901,2009

factor of 5 difference in extracted transport coefficients

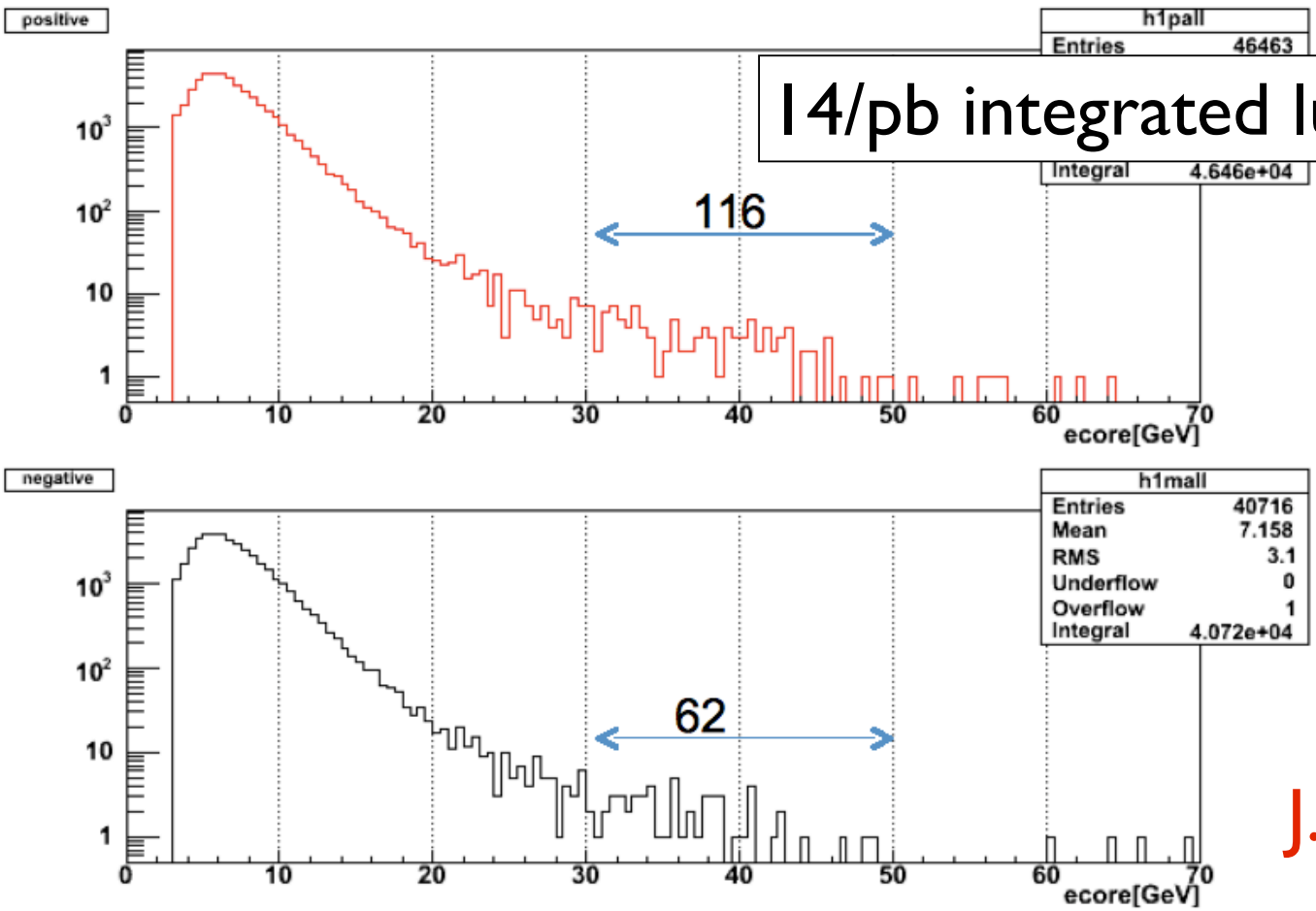
# with reaction plane




BNL/PHENIX involvement w/reaction plane detector: J. Haggerty, E. Kistenev, R. Pak, P. Steinberg, J. Jia

Related publication: High-pT $\pi^0$ Production with Respect to the Reaction Plane in Au + Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV, arXiv:0903.4886, G. David, C. Vale

# 500 GeV p+p

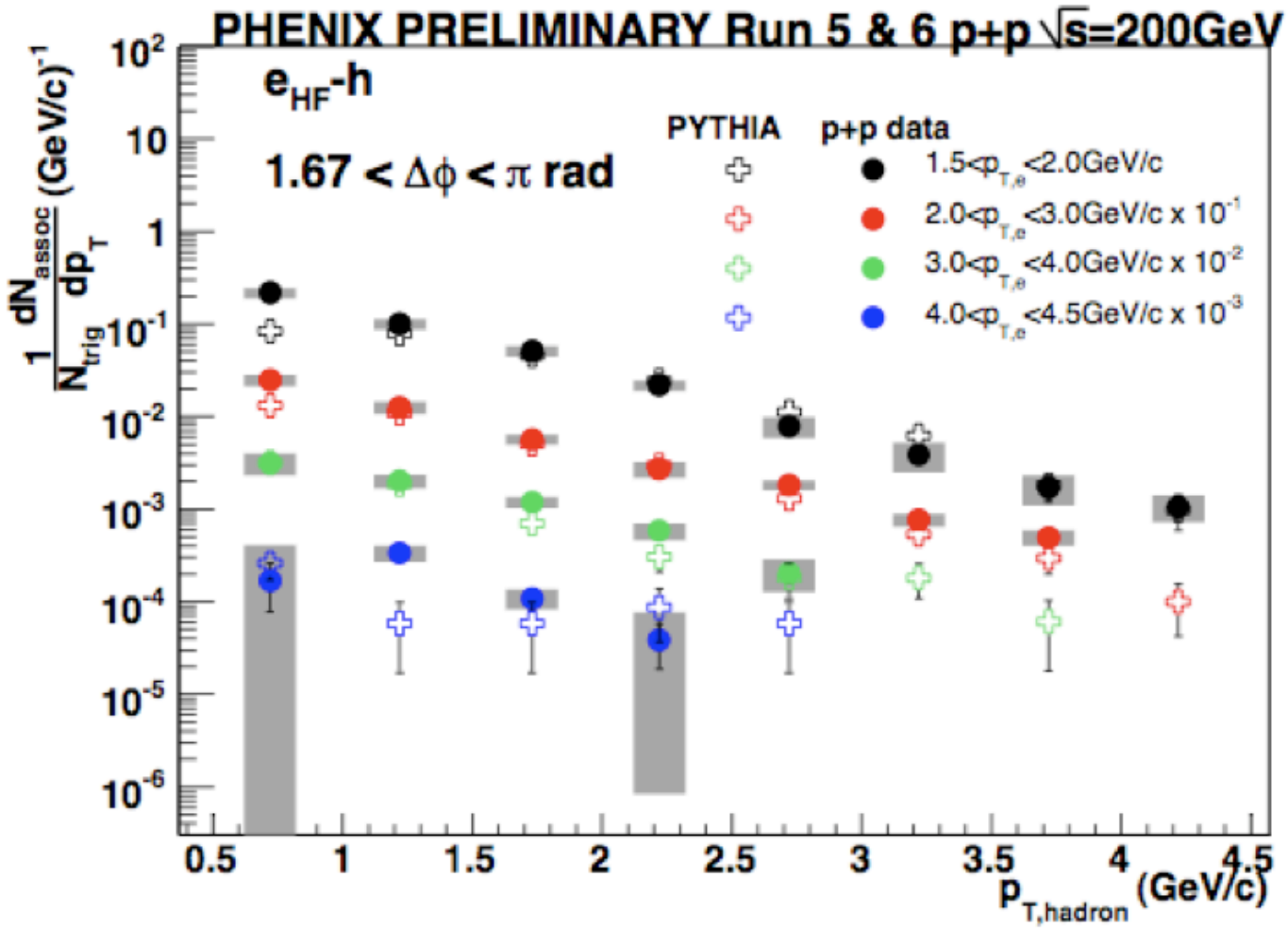



14/pb integrated luminosity

M. Chiu
J. Haggerty

evidence for $W^{\pm}$ near Jacobian peak at $M_W/2$

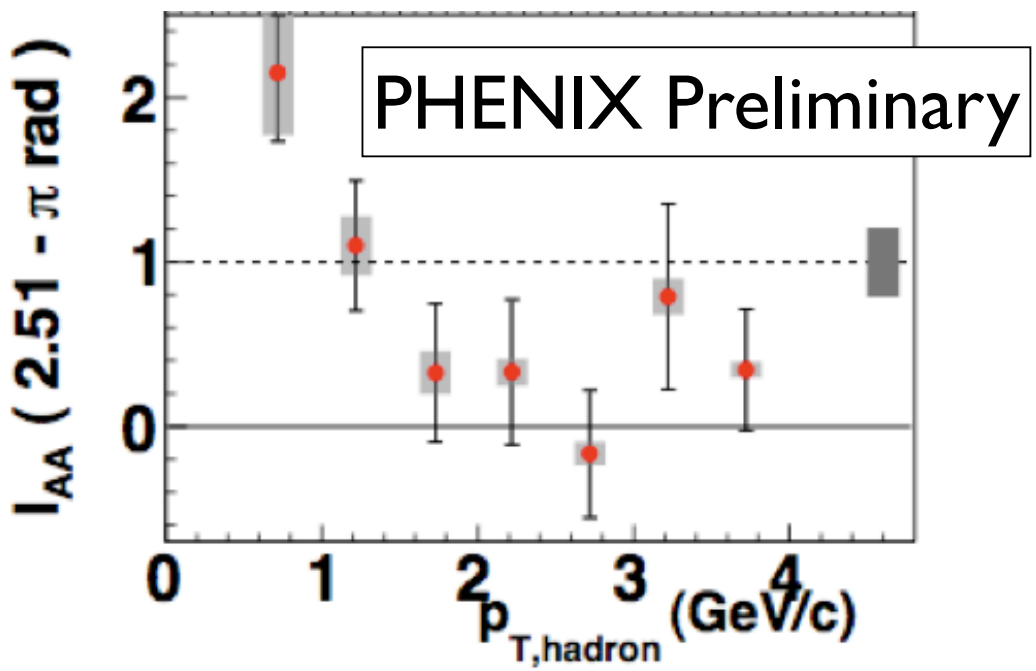
# e-hadron correlation




A. Sickles

# e-hadron correlation

"$R_{AA}$" for away side jets




proxy for c–$c_{bar}$ (b–$b_{bar}$) jets

$\sigma_{b,c}$ depend on $\sqrt{s}$
500 GeV p+p informs
e→b,c decomposition

A. Sickles

# low-energy running

Report of the Low Energy Task Force:
Strategic Approach to the RHIC low energy scan
with the PHENIX Detector

R. Averbeck[10], T. Csörgő[6], G. David[1], S. Esumi[11],
W. Holzmann[3], K. Homma[4], R. Lacey[8], J.T. Mitchell[1], R. Nouicer[1], R. Petti[9],
T. Sakaguchi[2,12], R.A. Soltz[5], P.W. Stankus[7]

[1] *Brookhaven National Laboratory, Upton, NY 11973-5000, U.S.*

[2] *Center for Nuclear Study, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-0033, Japan*

[3] *Columbia University, New York, NY 10027 and Nevis Laboratories, Irvington, NY 10533, U.S.*

[4] *Hiroshima University, Kagamiyama, Higashi-Hiroshima 739-8526, Japan*

[5] *Lawrence Livermore National Laboratory, Livermore, CA 94550, U.S.*

[6] *MTA KFKI RMKI, H-1525 Budapest 114, POBox 49, Budapest, Hungary*

[7] *Oak Ridge National Laboratory, Oak Ridge, TN 37831, U.S.*

[8] *Chemistry Department, Stony Brook University, Stony Brook, SUNY, NY 11794-3400, U.S.*

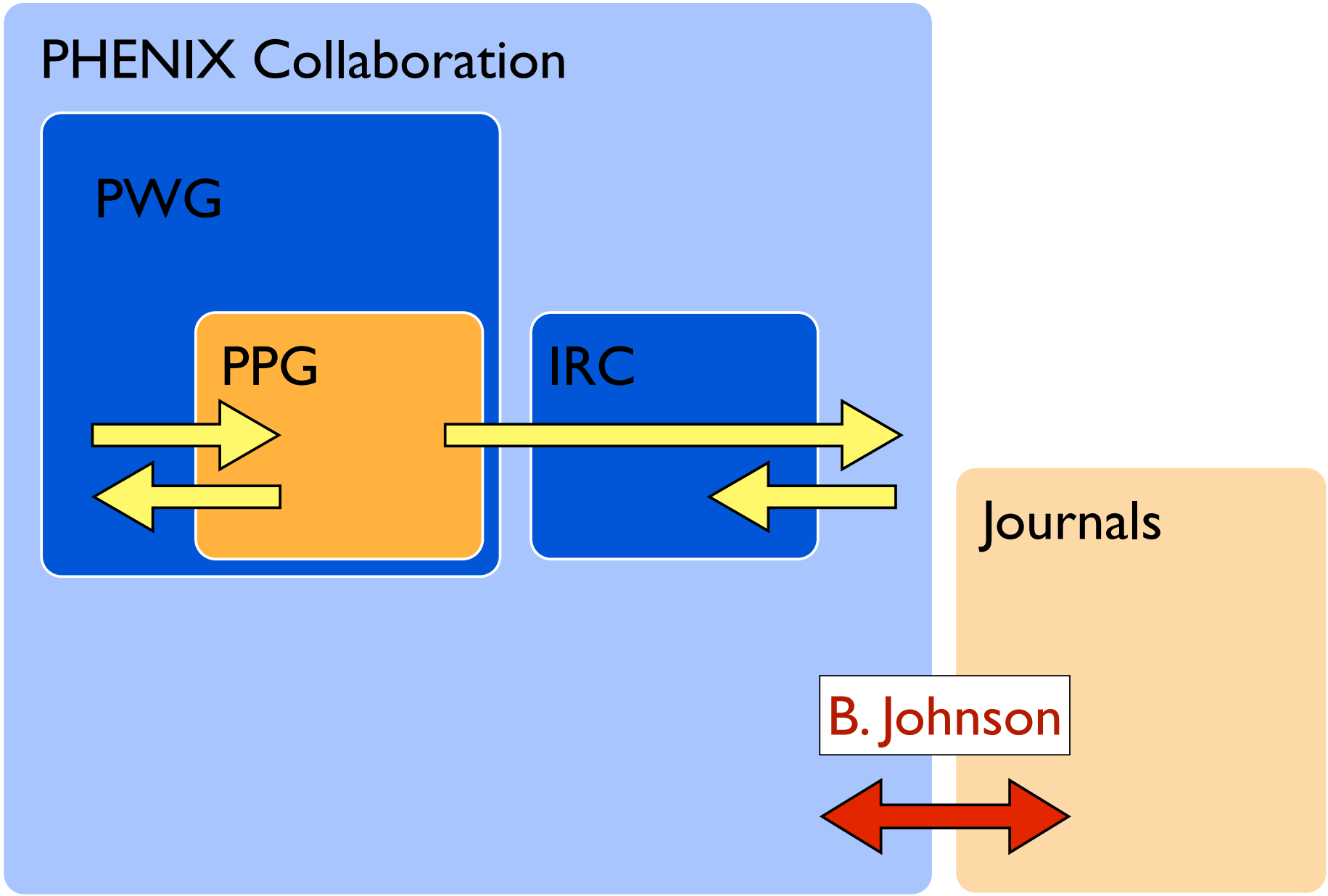
[9] *Department of Physics and Astronomy, Stony Brook University, Stony Brook, SUNY, NY 11794-3400, U.S.*

[10] *GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstr. 1, 64291 Darmstadt, Germany*

2008 run at $\sqrt{s_{NN}}$ = 9.2 GeV

# research summary

- wide ranging progress
- quantitative and increasingly differential
- physics interests drive upgrade interests, activities
  - forward calorimetry/PID
  - central arm calorimetry
  - precision vertexing
  - triggering, DAQ


PHENIX Collaboration
PWG
PPG
IRC
Journals
B. Johnson

**Measurement of Bottom versus Charm as a Function of Transverse Momentum with Electron-Hadron Correlations in p+p Collisions at √s = 200 GeV**

PPG: Yuhei Morino (chair), Yasuyuki Akiba, Mike Leitch, Sergey Butsyk, Kyoichiro Ozawa
IRC: David Silvermyr (chair), Ken Read, Vlad Pantuev
Intended Journal: Physical Review Letters
Preprint: arXiv:0903.4851

**High-pT pi^zero Production with Respect to the Reaction Plane in Au + Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: David Winter (chair), **Gabor David**, Kentaro Miki, **Carla Vale**
IRC: Kenneth Barish (chair), Charles Maguire, Jan Rak
Intended Journal: Physical Review, C
Preprint: arXiv:0903.4886

**Gluon-Spin Contribution to the Proton Spin from the Double-Helicity Asymmetry in Inclusive pi[sup 0] Production in Polarized p+p Collisions at √s = 200 GeV**

PPG: Kieran Boyle (chair), Alexander Bazilevsky, Gerry Bunce, Abhay Deshpande, Swadhin Taneja
IRC: Steve Pate (chair), **Robert Pak**, Dave Kawall
Intended Journal: Physical Review Letters
Preprint: arXiv:0810.0694 SPIRES
Published: Phys. Rev. Lett. 103, 012003 (2009)

**Photon-Hadron Jet Correlations in p+p and Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Justin Frantz (chair), Matt Nguyen, Richard Seto, Andrew Adare, Jamie Nagle, Megan Connors, John Chin-Hao Chen, Wolf Holzmann, **Mike Tannenbaum**
IRC: Nathan Grau (chair), DongJo Kim, Olivier Drapier
Intended Journal: Physical Review, C
Preprint: arXiv:0903.3399

**Inclusive cross section and double helicity asymmetry for pi0 production in p+p collisions at √s = 62.4GeV**

PPG: Kazuya Aoki (chair), Ken Barish, Alexander Bazilevsky, Robert Bennett, Yuji Goto
IRC: Ed Kinney (chair), Vassili Papavassiliou, Henner Buesching
Intended Journal: Physical Review, D
Preprint: arXiv:0810.0701
Published: Phys. Rev. D 79, 012003 (2009)

**Enhanced production of direct photons in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Y. Akiba (chair), Alberica Toia, Torsten Dahms, Yorito Yamaguchi
IRC: John Lajoie (chair), Hans-Ake Gustafsson, John Haggerty, Zeev Fraenkel
Intended Journal: Physical Review Letters
Preprint: arXiv:0804.4168

**Dilepton mass spectra in p+p collisions at $\sqrt{s}$ = 200 GeV and the contribution from open charm**

PPG: Torsten Dahms (chair), Vince Cianciolo, Axel Drees, Alberica Toia
IRC: Ken Imai (chair), Xiaomei Li, Steve Pate
Intended Journal: Physics Letters, B
Preprint: arXiv:0802.0050
Published: Physics Letters B 670, 313 (2009)

**Onset of pi-zero suppression studied in Cu+Cu collisions at $\sqrt{s_{NN}}$ = 22.4, 62.4, and 200 GeV**

PPG: Klaus Reygers (chair), Christoph Baumann, Alexander Bazilevsky, Christian Klein-Boesing, **Jiangyong Jia, Carla Vale**
IRC: Julia Velkovska (chair), Abby Bickley, **Robert Pak**
Intended Journal: Physical Review Letters
Preprint: arXiv:0801.4555
Published: Phys. Rev. Lett. 101, 162301 (2008)

**Dihadron azimuthal correlations in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: **Jiangyong Jia (chair)**, Nuggehalli Ajitanand, Roy Lacey, Justin Frantz, Mike McCumber, Alberica Toia, Paul Stankus
IRC: Nathan Grau (chair), David d'Enterria, Andry Rakotozafindrabe
Intended Journal: Physical Review, C
Preprint: arXiv:0801.4545
Published: Phys. Rev. C 78, 014901 (2008)

most cited nuclear expt. paper of 2008

**Kaon interferometric probes of space-time evolution in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Akitomo Enokizono (chair), Paul Chung, Tamas Csorgo, Ron Soltz, Victoria Greene
IRC: **Achim Franz (chair)**, Toru Sugitate, Shinlchi Esumi
Intended Journal: Physical Review Letters
Preprint: arXiv:0903.4863

**Photoproduction of J/psi and of high mass e+e- in ultra-peripheral Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: J. Nystrand (chair), Y. Akiba, **M. Chiu**, Z. Conesa del Valle, M. Csanad, D. d'Enterria, D. Silvermyr, **S. White**
IRC: Gerd Kunde (chair), Hideki Hamagaki, Torsten Dahms
Intended Journal: Physics Letters, B
Preprint: arXiv:0903.2041

**Suppression pattern of neutral pions at high transverse momentum in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV and constraints on medium transport coefficients**

PPG: **Takao Sakaguchi (chair), Gabor David**, Christian Klein-Boesing, Jozsef Imrek, TadaAki Isobe, **Martin Purschke**, Baldo Sahlmueller, Dave Winter
IRC: Victor Riabov (chair), Wolf Holzmann, Terry Awes, John Alexander
Preprint: arXiv:0801.4020
Published: Phys. Rev. Lett. 101, 232301 (2008)

**Quantitative constraints on the transport properties of hot partonic matter from semi-inclusive single high transverse momentum pion suppression in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Jamie Nagle (chair), **Mike Tannenbaum**, Tadaaki Isobe, Henner Buesching
IRC: Victor Riabov (chair), Wolf Holzmann, Terry Awes
Preprint: arXiv:0801.1665
Published: Phys. Rev. C 77, 064907 (2008)

**Erratum - Cold Nuclear Matter Effects on J/Psi Production as Constrainted by Deuteron-Gold Measurements at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Matt Wysocki (chair), Yasuyuki Akiba, Abby Bickley, Raphael Granier de Cassagnac, Mike Leitch, Jamie Nagle, Hugo Pereira, Xie Wei
IRC: **Anne Sickles (chair)**, Ken Imai, Ken Read
Preprint: arXiv:0903.4845
Published: Phys. Rev. C 79, 059901 (2009)

**Cold Nuclear Matter Effects on J/Psi Production as Constrainted by Deuteron-Gold Measurements at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Matt Wysocki (chair), Yasuyuki Akiba, Abby Bickley, Raphael Granier de Cassagnac, Mike Leitch, Jamie Nagle, Hugo Pereira, Xie Wei
IRC: **Anne Sickles (chair)**, Ken Imai, Ken Read
Preprint: arXiv:0711.3917
Published: Phys. Rev. C 77, 024912 (2008)

**J/psi Production in $\sqrt{s_{NN}}$ = 200 GeV Cu+Cu Collisions**

PPG: Tony Frawley (co-chair), David Silvermyr (co-chair), Yasuyuki Akiba, Kushal Das, Wei Xie, Susumu Oda, Abby Bickley, Vince Cianciolo, Frederic Fleuret, Andy Glenn, Andry Rakotozafindrabe
IRC: Dave Lee (chair), Philippe Rosnet, Alan Dion
Preprint: arXiv:0801.0220
Published: Phys. Rev. Lett. 101, 122301 (2008)

**Charged hadron multiplicity fluctuations in Au+Au and Cu+Cu collisions from $\sqrt{s_{NN}}$ = 22.5 to 200 GeV**

PPG: **Jeffery Mitchell (chair), Mike Tannenbaum**, Kensuke Homma, Tomoaki Nakamura, Raul Armendariz
IRC: Shin Ichi Esumi (chair), Sergey Butsyk, Jan Rak
Preprint: arXiv:0805.1521 SPIRES
Published: Phys. Rev. C 78, 044902 (2008)

**Centrality dependence of charged hadron production in deuteron-gold and nucleon-gold collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: V.Pantuev (chair), Z.Citron, **D.Morrison, J.Jia**
IRC: Ming Liu (chair), Byungsik Hong, Jen-Chieh Peng
Preprint: arXiv:0708.2416
Published: Phys. Rev. C77, 014905

**Particle-species dependent modification of jet-induced correlations in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

PPG: Nuggehalli Ajitanand (chair), John Lajoie, **Anne Sickles**, Roy Lacey, Axel Drees
IRC: Hubert van Hecke (chair), Sun-Yiu Fung, Doug Fields
Preprint: arXiv:0712.3033
Published: Phys. Rev. Lett. 101, 082301 (2008)

# PHOBOS Publications

**High transverse momentum triggered correlations over a large pseudorapidity acceptance in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

arXiv:0903:2811 [nucl-ex],
submitted to PRL

**System size dependence of cluster properties from two-particle angular correlations in Cu+Cu and Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV**

arXiv: 0812:1172 [nucl-ex]
submitted to PRC

**Scaling Properties in Bulk and pT-dependent Particle Production near Midrapidity in Relativistic Heavy Ion Collisions**

Phys. Rev. C (2009 in press)
arXiv:0808.1895

**System Size, Energy and Centrality Dependence of Pseudorapidity Distributions of Charged Particles in Relativistic Heavy Ion Collisions**

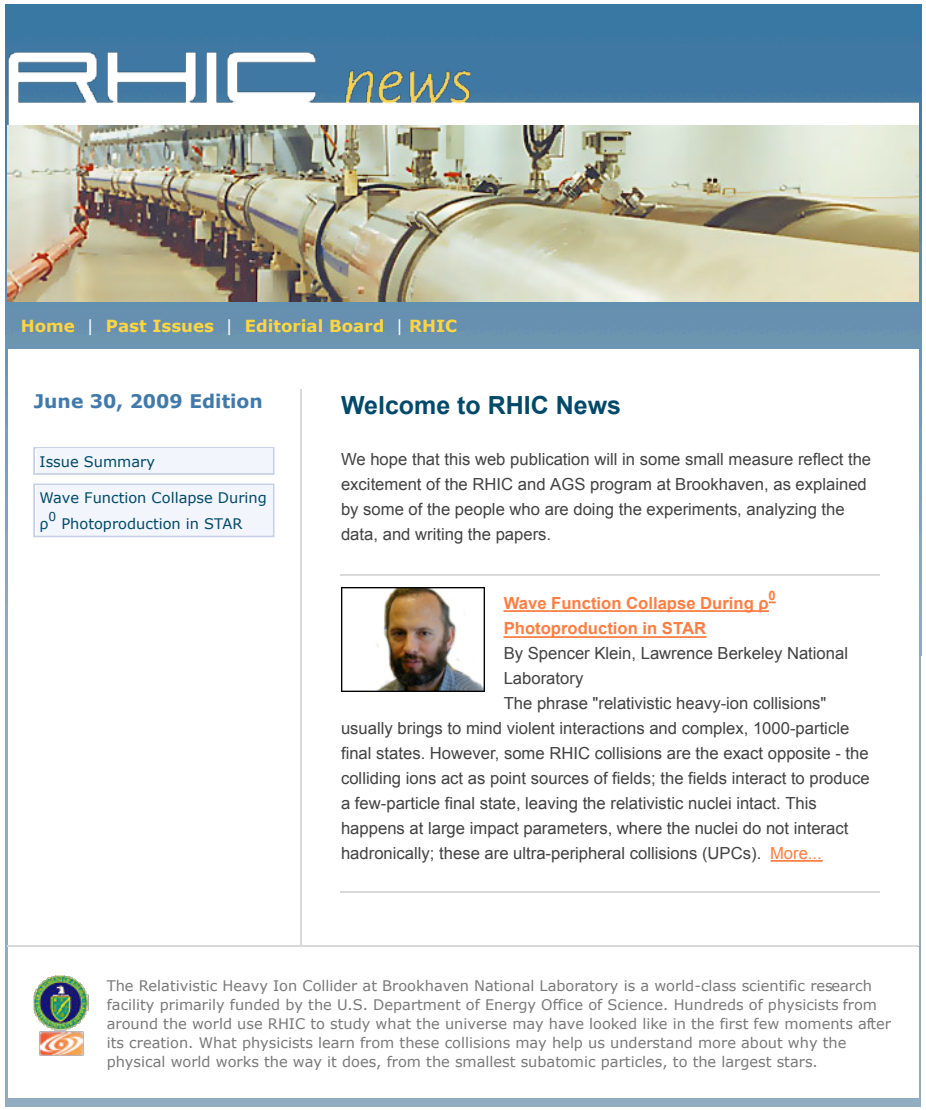
Phys. Rev. Lett. 102 (2009) 142301

M. Baker, P. Steinberg, R. Nouicer, R. Pak, C. Vale

# education and outreach

Carla Vale conducting a "Summer Sunday" tour.
From Peter Steinberg's *Quantum Diaries* blog:
`qd.typepad.com/5/2005/08/rhic_summer_sun.html`

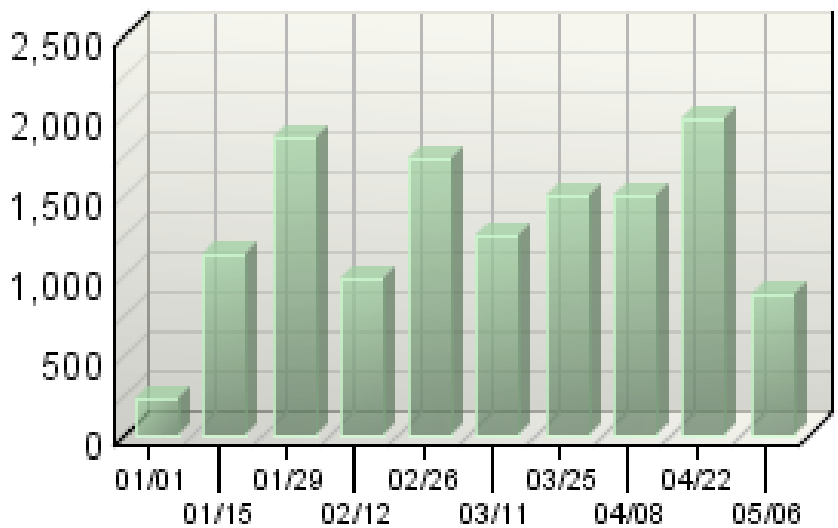
- Apprenticing of graduate students, post-docs
- Tours: $\sim$ 30/year, general public, foreign dignitaries, Congressional reps
- *RHIC News* newsletter:
  - `www.bnl.gov/rhic/news`
- *PHENIX Focus* topical series
- *uBNL* journal club
- Mentoring graduate students
- Summer student lectures
- Thesis committees




Started by J. Haggerty

P. Steinberg current editor

~1000 regular readers



# AAAS Symposium

"The Quest for the Perfect Liquid: Connecting Heavy Ions, String Theory, and Cold Atoms" at the 2009 AAAS Meeting, Chicago, February 15, 2009.

P. Steinberg
B. Jacak
W. Zajc
G. Chui (SLAC)
J. Thomas (Duke)
C. Johnson (USC)

RHIC physics, string theory, cold fermionic atoms

# summary

- good progress on planned research and promising new avenues of investigation – both are driving detector development and upgrade interests
- involved in and leading many analyses
- effective in preparing, presenting and publishing timely results and involving larger community
- additional staff position is welcome development (in trade for a current post-doc opening)
- operations burden growth continues to be issue