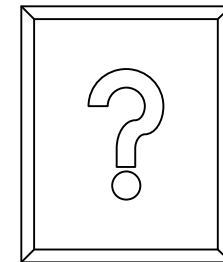
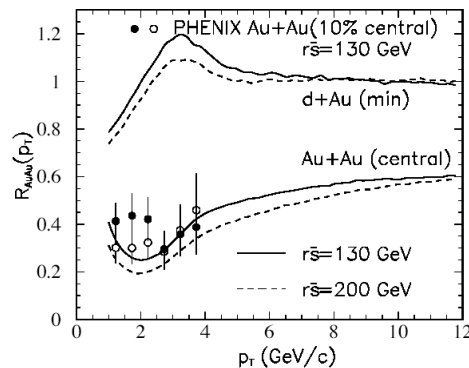
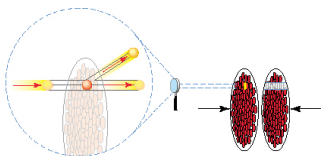


Forward Calorimeters in PHENIX

- Measuring Centrality in d-Au collisions at RHIC
 - p-A collisions a microscopic laboratory to test our understanding of initial state effects in A-A
 - Any signature worth measuring in A-A (*vs. centrality*) is worth measuring in p/d-A (*vs. centrality*)
 - Most interesting signature – d-Au high p_T suppression may differentiate between QGP and CGC



Central d-Au suppression?



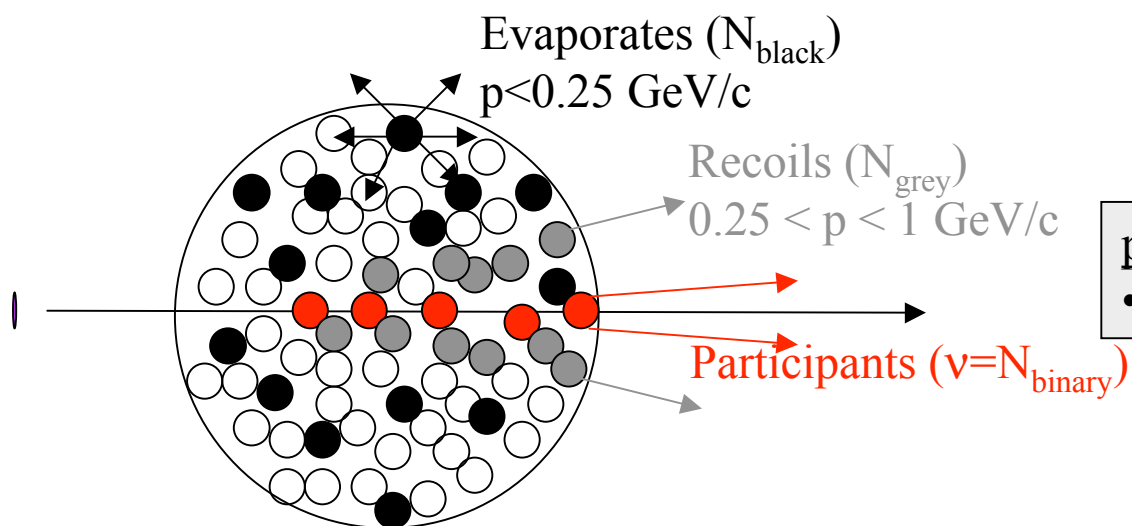
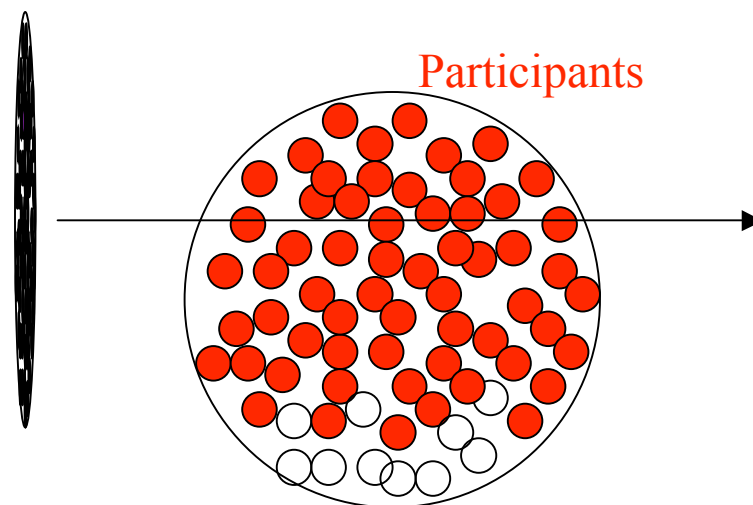
Centrality: p-A vs. A-A

in rest frame of one nucleus

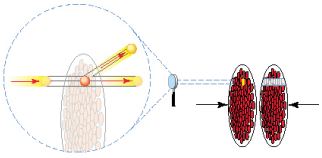


A-A: Count spectators leaving beam pipe

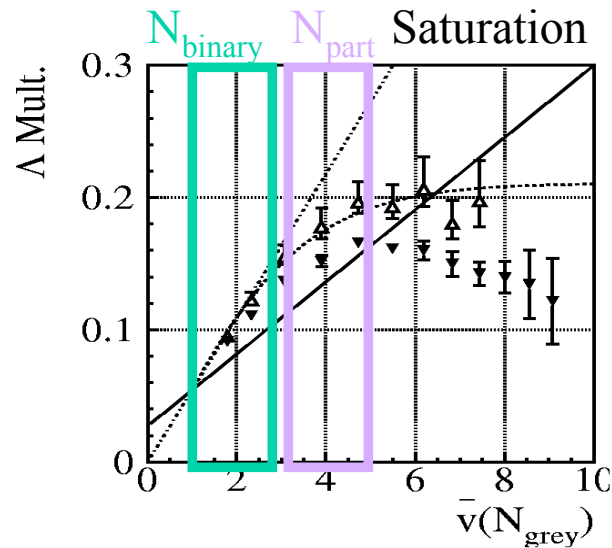
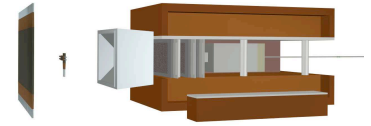
- measure N_{part} directly (fixed target only)
- obtain N_{binary} from Glauber calculation



p-A: Count N_{grey} & N_{black}
• obtain N_{binary} from Glauber + model



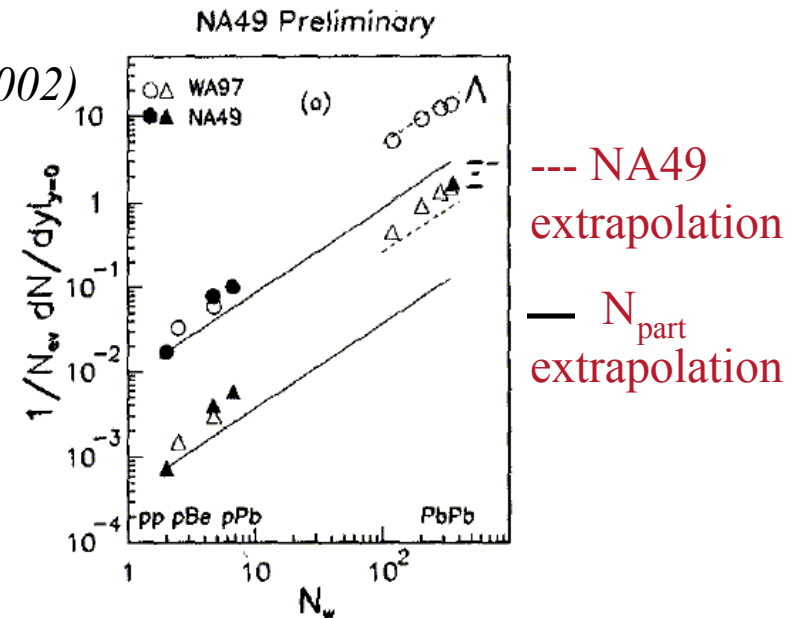
AGS & SPS Examples

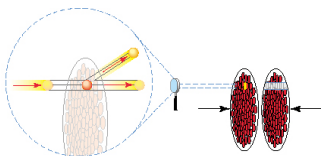


- E910 Λ multiplicity vs. $v = N_{\text{binary}}$
- Additive Quark Model for insight
PRL 85:4868 (2000)

JPG 28:1675 (2002)

- NA49's extrapolation to A-A differs from N_{part} (wounded-nucleon) model
- Without measuring $v(N_{\text{grey}})$, such extrapolations are not possible



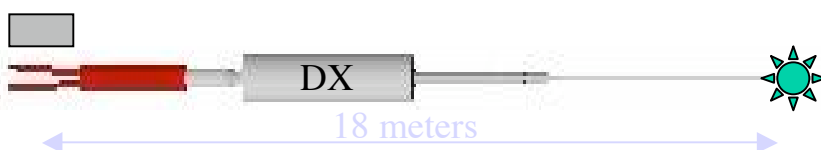


d-Au in RHIC tunnels



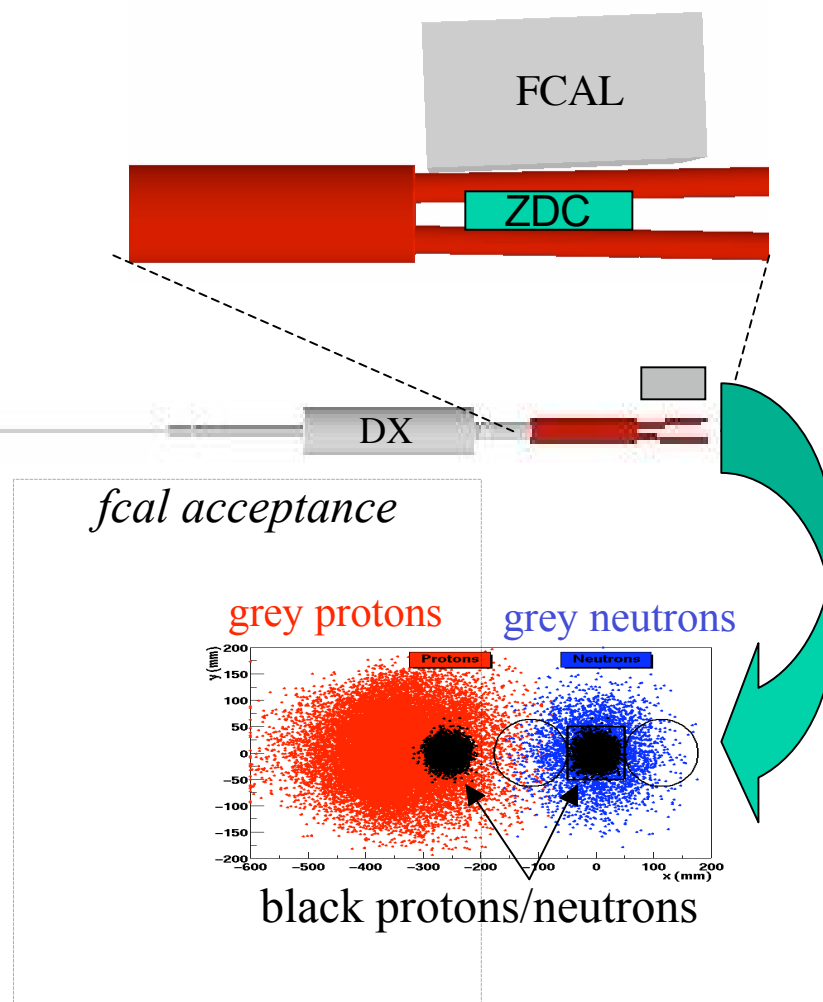
➤ We also instrumented d-side tunnel

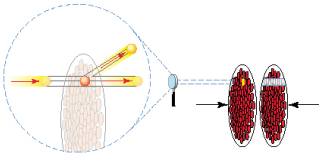
- to calibrate detector
- to identify n-Au interactions



➤ Phobos has also instrumented forward calorimeters (pcal)

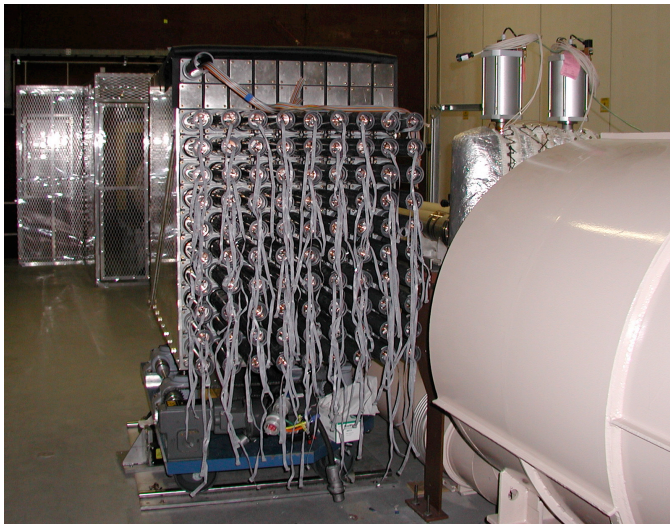
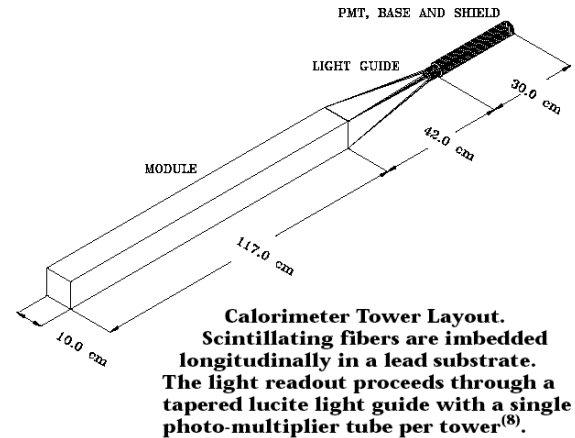
- their d-side detector is smaller



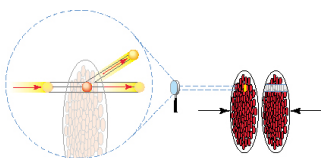


Calorimeter Design PHENIX

(Re) use E864 Pb-Sc modules
NIM A406 (1998) 227
 10x10 cm x 117 cm length
 47x47 spaghetti fibers
 AGS Resolution 0.35/sqrt(E)

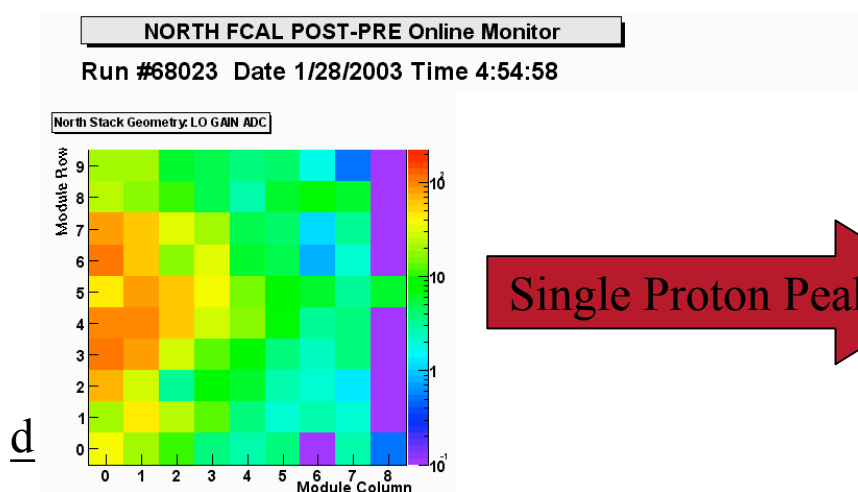


~400 modules rescued from “graveyard”
 tested with cosmics Jun-Sep. by
 PHENIX & PHOBOS
 Assembled two 9x10 arrays Nov-Dec
 Calibrated during run with cosmic
 trigger and movable stands

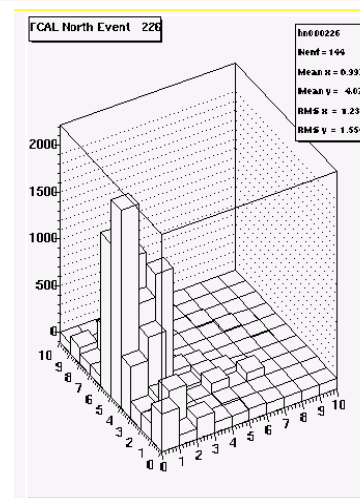


Uncalibrated FCAL Data PHENIX

Monitor
n-events



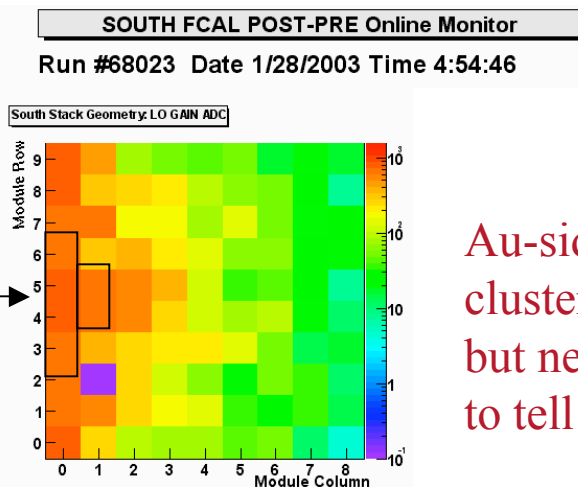
Single Proton Peak



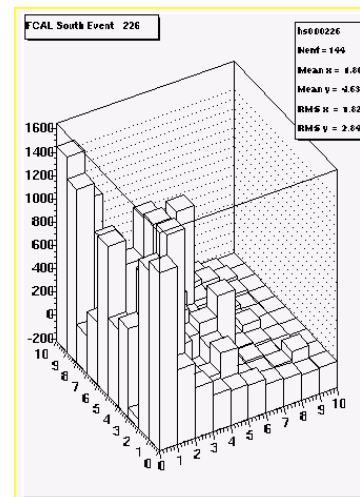
E-display
1-event

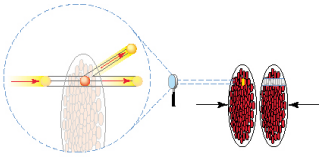
lower
gain
tubes

Au



Au-side proton
clusters not expected,
but need calibrations
to tell



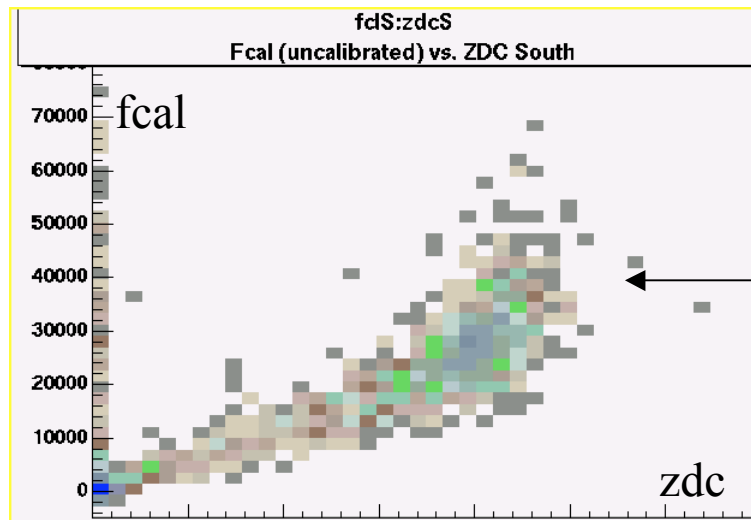
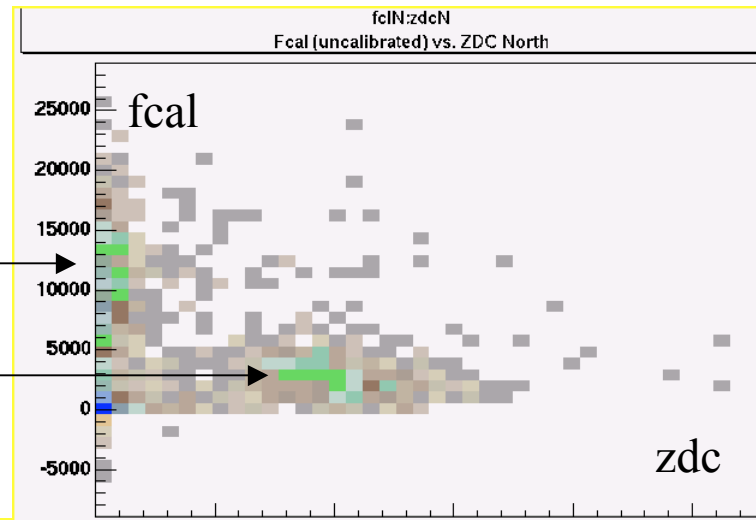


Correlation with ZDC

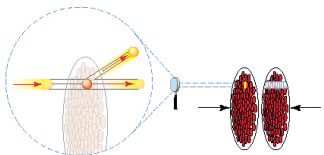


single proton in FCAL (n-Au events)

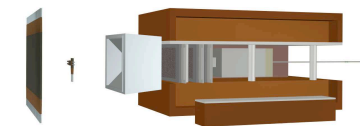
single neutron in ZDC (p-Au events)



Strong correlation on Au-side



Centrality determination



$$P(N_{grey}) = \sum_v P(N_{grey} | v) \pi(v) \quad \text{Glauber}$$

Geometric Cascade Model - *Andersson et al. PLB 73:343 (1978)*

Negative binomial, w/ $\overline{N_{grey}}(v) \propto v$

Intra-Nuclear Cascade - *Hegab and Hufner, PLB 105:103 (1981)*

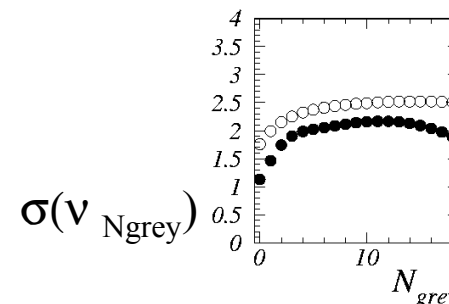
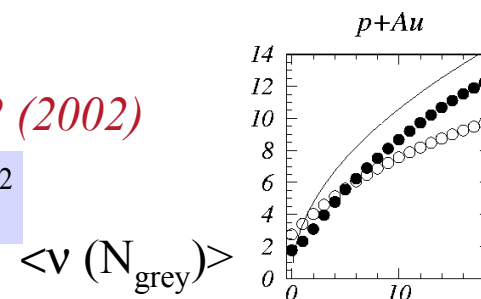
Secondary Recoil, w/ $\overline{N_{grey}}(v) \propto v^2$

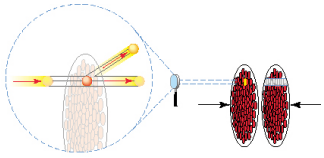
E910

Polynomial Model - *Chemakin et al., PRC 60:024902 (2002)*

Regular binomial, w/ $\overline{N_{grey}}(v) = c_0 + c_1 v + c_2 v^2$

- All methods acceptance dependent by definition
- First and last give distribution $P(N_{grey}|v)$





Conclusions & Centrality



- An important new detector has been added to PHENIX to improve the centrality measurement in d-Au
- The Forward Calorimeters work!
- Full calibrations, simulations, analysis are underway
- Centrality determined from various forms for $P(N_{\text{FCAL}}|v)$, beginning with the second order polynomial for $\langle N_{\text{FCAL}} \rangle$
- We are not limited to FCAL, e.g. $P(N_{\text{FCAL}}, N_{\text{ZDC}}, N_{\text{BBC}}|v)$,
- Systematic errors determined from different models
- And finally, study physics of high p_T suppression, J/ψ , di-leptons, strangeness, and perhaps even HBT