

PHENIX year-1 Physics

- contributions from Day-1 Task Force
 - Y. Akiba, KEK
 - M. Brooks, LANL
 - B. Cole, Columbia Univ.
 - B. Jacak (chair), Stony Brook
 - E. Kistenev, BNL
 - M. Marx, Stony Brook
 - J. Mitchell, BNL
 - N. Saito, RIKEN
 - P. Stankus, ORNL
- contributions from Physics workshops
convenors:
 - Y. Akiba, KEK *electrons*
 - J. Sullivan, LANL *hadrons*
 - G. David, BNL *photons*
 - K. Read, ORNL *muons*
 - K. Imai and N. Saito, RIKEN *spin*

PHENIX will have on Day-1

- BB
- MVD
- West central arm
- South muon arm
- DAQ and trigger
 - scaled event builder
 - trigger not REQUIRED initially
 - but will develop triggers for when L increases
- North muon ID

PHENIX physics

- PHENIX is optimized to measure rare signals
 - high bandwidth
 - selective triggering capability
 - obviously, we measure less rare things too!
- hierarchy of physics goals
 - do the less rare things first!
 - add physics as luminosity increases
 - will need to maintain single RHIC setting to collect statistics on certain signals

Rates

- Event collection defined by
 - 20 MB/s taping rate
 - approx. 0.5 MB/central Au + Au event
 - smaller for less central, smaller systems
- For initial running (all year-1?) beam limited
 - write less than 20 MB/s initially
 - take ALL Au + Au events until we reach 1/20-1/10 of design luminosity
 - > exact number depends on final event size & background levels
 - > need good minimum bias sample to study backgrounds, performance, etc.

Low luminosity run

- early in year-1
 - approximately 1% of design luminosity
 - PHENIX takes ALL events
 - interaction trigger only
 - central event rate to tape = 100K per day
 - beam limited
 - write approx. 2 MB/sec to tape
 - run time at 1% luminosity is 2-4 weeks
- Physics goals
 - multiplicity and ET
 - distribution and fluctuations
 - charged hadrons
 - mt spectra, ratios, cross sections
 - HBT
 - inclusive photons and neutral pions

Integrated luminosity needed - part 1

physics	# evts central	Integ. L	Int. L with 0.5 DF for PHENIX
multiplicity/ET	200K	$0.35\mu\text{b}^{-1}$	$0.7\mu\text{b}^{-1}$
charged hadrons	200K	$0.35\mu\text{b}^{-1}$	$0.7\mu\text{b}^{-1}$
HBT	1M	$1.7\mu\text{b}^{-1}$	$3.4\mu\text{b}^{-1}$
inclusive photon	1M	$1.7\mu\text{b}^{-1}$	$3.4\mu\text{b}^{-1}$
pi-zero	3M	$5.2\mu\text{b}^{-1}$	$10.4\mu\text{b}^{-1}$

Higher luminosity run

- latter part of year-1
- Integrated luminosity
 - 52 μb^{-1} on tape
 - 104 μb^{-1} delivered from RHIC
 - if PHENIX duty factor is 50%
 - data sample of 30M central events
- at 10% of design luminosity
 - approximately 1 month of taping
 - so approximately 2 months of running
- near rate where PHENIX is tape limited
 - write 1M central collisions per day
 - trigger requirements minimal

Statistical significance

- Hadrons comparable to best existing data
- Multiplicity, E_T will have enormous statistics
- photon measurements driven by π^0
background subtraction
will do a good job by standards of existing data
- $\phi \rightarrow KK$ statistics much larger than in current Heavy ion measurements
true for aperture limited by TOF
- 2K $J/\psi \rightarrow \mu\mu$ comparable to early data sets from NA38/NA50

Other systems

- PHENIX priorities for year-1
 - 1) collect both data sets
 - need 52 inverse microbarns ON TAPE
 - 2) aim for polarized p+p in year-2
 - ensure required machine studies in year-1
- can do physics with other Au + Au energies or other ion species
 - need at least several inverse microbarns, prefer 10-20 μb^{-1}
 - need $>100 \mu\text{b}^{-1}$ for lepton physics

PHENIX PHYSICS ON DAY-1

1% of blue book luminosity, 10-30 days run
collect 1 - 3M central events

- Inclusive photons and p_0
per 1M central events get in .2 GeV/c bin
2.8M p_0 at 1 GeV/c pt with S/B<7%
100K p_0 at 2 GeV/c pt with S/B~27%
12K p_0 at 3 GeV/c pt with S/B~1.0

subsystems required BB + EMCAL

Probably can do physics w/o charged veto
(signal to background - old values)

- Charged particle multiplicity, distribution, fluctuations
and E_t production

requires approx. 200K minimum bias events

subsystems required: BB + MVD / BB + EMCAL

Important first measurement

Allows development of centrality trigger

- Charged hadron pt spectra, production ratios, correlations
and cross sections

per 100K central events TOF sees at 1 GeV/c pt

48K pions (in 0.2 GeV/c bin)

5.3K kaons, 12K protons, 9K antiprotons

can do 3 dimensional pp HBT with >100K events

subsystems required: BB + DC,PC,TEC,TOF + MVD

Physics with small event sample, systematic studies straightforward

PHENIX PHYSICS ON DAY-1.5

10% of blue book luminosity, approx 1 month run
1M central collisions per day

1. $\phi \rightarrow KK$

~11K $\phi \rightarrow KK$ into TOF with $p_t > 0.8$ GeV/c

$$S/B = 1/20$$

~100-200K $\phi \rightarrow KK$ using EMCAL TOF

requires single central arm

2. single high p_t leptons from charm decay

180K single electrons with $p_t > 1$ GeV/c

single high p_t muons also available

higher p_t cut feasible initially

3. $J/\psi \rightarrow$ muon pairs

can collect 2-5K dimuons in one month

$$S/B = 2.7$$

can look at J/ψ to DY vs. centrality