# Musings on $\rho$ –> ee Trigger Rates in PHENIX with a HBD

**Tony frawley, May 7, 2002**

# Rough Estimate of $\rho$ Rates in PHENIX

**Following Y. Akiba:**

From ISR p–p data: $\rho^0/\pi^0 = 0.2$ $\omega/\rho^0 = 1.0$ $\phi/\pi^0 = 0.02$

This ignores $\rho$ production in the fireball. Also $\rho$ destruction in any QGP

$dN(\pi^0)/dy \sim 80$ so $dN(\rho^0)/dy \sim 16$, $\rho \rightarrow ee$ branching ratio is 4.5 x 10–5

Acceptance is ~ 3.5% for $\phi \rightarrow ee$ at midrapidity, **assume also for** $\rho$

Then $N(\rho^0) \sim 2.5 \times 10^{-5}$ / minbias event

eg, **for 240 $\mu b^{-1}$**, we expect **$1.74 \times 10^9$ minbias** collisions, yielding **44,000 $\rho \rightarrow$ ee** in PHENIX acceptance

(compare **35,000 $\phi \rightarrow$ ee** and **8,000 J/$\Psi \rightarrow$ ee**)

# Can we get enough ρ data from the minbias Sample?

Assume we archive data at **60 MB/s**

Assume we use **20%** of that bandwidth to archive minbias data

Then at 180 KB/event, we would archive minbias events at **66 Hz**

After **8 weeks at 25% duty factor**, we would archive **8 x $10^7$ minbias**

The $\rho^0$ content of the minbias sample would be:

$N(\rho^0) = 2.5 \times 10^{-5}$ / minbias x 8 x $10^7$ minbias events = **2,000**

Note that this yield would be approximately **independent of luminosity**

# How about a level 2 (& perhaps level 3) $\rho \to ee$ Trigger?

Assume we have a **HBD** that could be used in a level 2 $\rho \to ee$ trigger

Assume we get **8 KHz rate to the back of the EVB** (Run 3 max rate) (this is 5.5 x design average luminosity)

After 8 weeks at 25% duty factor at high luminosity we get $9.7 \times 10^{9}$ events to the back of the EVB

This sample would contain

$$N(\rho^{0}) = 2.5 \times 10^{-5} \times 9.7 \times 10^{9} = \mathbf{240{,}000}$$

That's better! Again, this yield would be **independent of luminosity until luminosity dropped below ~ 4 x design average**

But note – this assumes that the 10 KHz to the back of the EVB is **all minbias.** ie. it assumes **no level 1 triggers of any kind** are running.

# How about a level 1 $\rho \rightarrow ee$ Trigger?

Assume we have a **HBD** that could be used in a level 1 $\rho \rightarrow ee$ trigger

Assume we reach **40 x design average luminosity**

After 8 weeks at 25% duty factor we had $6.97 \times 10^{10}$ minbias collisions

This sample would contain

$$N(\rho^0) = 2.5 \times 10^{-5} \times 6.97 \times 10^{10} = \mathbf{1{,}740{,}000}$$

**Which is about 7 times the sample seen from analyzing an 8 KHz subset of the data**

# High Luminosity Running

in Run 3, we expect the collision rate to be ~ 10 KHz, and the rate to the back of the event builder to be about 8 KHz – a good match!

But **at 40 x average design luminosity**, the Au−Au collision rates are:

Peak minbias rate: 100 x 1440 = **144 KHz**

Average minbias rate: 40 x 1440 = **58 KHz**

but the rate to the back of the event builder will still be limited to **~ 10 KHz** unless something in the DAQ changes drastically.

**How will we reduce the event rate at the back of the EVB to 10 KHz?**

This is very much an open question! At present we do not have a way to do this. The level 1 rejection for dielectron and dimuon triggers is not much different from 1 in Au−Au. **For the dielectron case, a level 1 trigger using a HBD would probably be necessary.**

# Scenarios for ρ –> ee Running with HBD

**No level 1 low mass dielectron trigger:**

Probably will need a **dedicated run**

Have to rely on level 2 and level 3 triggers

Prescale minbias data at level 1 to **10 KHz rate**

After **4 weeks** at 25% we would get **N($\rho^0$ –> ee) ~ 120,000**

**Level 1 low mass dielectron trigger:**

No dedicated run, use full luminosity

After 8 weeks at 25% we would get **N($\rho^0$ –> ee) ~ 1,740,000**