A proposal for a Low mass electron pair trigger.

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Total yields

- Assumptions
  - 10 week run - 3M secs
  - Assuming 0.2 to min bias
  - min bias event size 250 Kb
  - 20 MB/sec /250 KB/minbiasevent * 0.2(fraction of bandwidth)=16 min bias/sec
- 50M min bias collected
  - 2B min bias for design Lumin-scale down ~40
- ~ 1200 omega to ee, 750 phi to ee

Cent	relative yield going to omega~phi
0-5%	18
5-10	14
10-20	25
20-30	13
30-40	10
40-100	20

Lousy – we need a trigger

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What would we like? (from Tom's stuff)

- Say we want ~5sigma in all centralities
- With min bias only ~20 signal, 100 bkgd

$$Significance = \frac{N_{sig}}{\sqrt{N_{sig} + N_{Background}}}$$

- S=20/sqrt(120)=2
- We need an enrichment factor of 10, I.e. 200/sqrt(1200)=6
  - I.e. look for a rejection factor in a trigger
- First check to see what the best we can do
  - s~20

Signal pairs over all centralities

- Integrating the yield over all p_T, we see the following yields per bin in various centrality classes.
- Remember that PHENIX scales the widths of its centrality classes inversely to the multiplicity so for many classes the physical statistics is roughly the same.

0-5% 5-15% 15-30% 30-60% 60-80% 80-92%

Background Pairs

- Background pairs scale with multiplicity squared and so even though the signal is roughly the same in many centrality classes, the background is highest in the most central.

0-5% 5-15% 15-30% 30-60% 60-80% 80-92%

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Statistical Significance

- The minimum bias sample in this (incomplete) simulation provides marginal statistical significance for ω, ϕ, J/ψ
- Although the production rates of ω,ϕ are much higher that J/ψ, their statistical significance is only about twice that of J/ψ!

$$Significance = \frac{N_{sig}}{\sqrt{N_{sig} + N_{Background}}}$$

0-5% 5-15% 15-30% 30-60% 60-80% 80-92%

NOTE: If we recorded EVERY event, stat.sig. rises by 6X.

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Statistical Significance Possible

- If we were to collect all available statistics, we would have the significance shown on the right.
- In this case, each centrality bin has a significant mass peak, but no significance to the continuum.

$$Significance = \frac{N_{sig}}{\sqrt{N_{sig} + N_{Background}}}$$

0-5% 5-15% 15-30% 30-60% 60-80% 80-92%

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2D Statistical Significance

- Both background and signal fall off with p_T.
- Background falls more steeply.
- What happens if we put all this together:
- Marginal in one centrality bin.

NOTE: The stat. Sig. in each p_T bin is similar to the integral.

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Rejection factors for the phi,omega (wei)

- Phi
- emcal threshold of 380 MeV,
- m> 0.7 GeV
- Eff ~ 80%
- centrality RF
- 0-5% 1
- 5-20% 1
- 20-30% 2
- 30-40% 8
- 40-100% 200

- Omega
- emcal threshold 380 MeV,
- m> 0.5 GeV,
- centrality RF
- 0-5% 1
- 5-20% 1
- 20-30% 1
- 30-40% 4 (8)
- 40-100% 85

- Note: we will get an additional factor ~2 from matching with pc3

- With this additional factor I hope we can find a combination which gives us a RF ~ 10 for centrality > 30%

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Muon triggers as “min bias”

- Assume
  - <5% of Band width goes to this measurement
  - Min bias event 250 kB, central event 400 Kb, periph-100kB, 30-40%-200kB
- We will be able to use the muon triggers as a way to increase "min bias triggers". The argument goes as follows:
  - The rapidity difference between the muon arms and the central arm is large enough that stuff happening in one is largely independent of the other, save for dependence on centrality. Hence these triggers will be biased toward central events.
- use 3% BW – go after omega and phi
  - 1% of BW goes to 40-100% rf ~85
  - 2% of BW goes to 30-40% rf ~ 8
    - Note – eff for phi is ~80% (for omega – yet to do)

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To get enrichment factors

- 40-100%
  - 20MB/sec0.01(frac of Band width) /100kB/event*85(rf)/0.6(centrality)* = 283 events/sec
  - So we have enriched the 40-100% piece by a factor of 283/16=18 (we wanted 10)
- 30-40%
  - 20MB/sec*0.02(frac of Band width) /200kB/event*8(rf)/0.1(centrality)* = 160 events/sec
  - So we have enriched the 30-14% piece by a factor of 160/16=10
- 0-30%
  - We use the muon triggers here

A summary of deep-deep muon triggers (Jason)

%	rf	frac of events
0-5	6	.40
5-15	14	.30
15-30	30	.22
30-60	300	.04
60-100	300	.04
Total	50	
eff j/psi	.70	

Most of events come from 0-30% centrality!

Enhancement factors

- To get enhancement factor
  - X2 (to get to 40% of BW)
  - X “fraction of events”/centrality
  - But I can take less events because average event size is larger ~ 250/350 ~ .7
  - 0-5% enhancement factor = 16 *.7 = 11
  - 5-15% 6 *.7 =4
  - 15-30% 3*.7=2 (maybe we want to boost this using the electron trigger?)

A summary of muon triggers

%	b	dd-rf	frac	ds-rf	frac	ss-rf	1d-rf
0-5 (5)	1.6	5.5479	.9(.4)	2.9688	1.7(.34)	1.9257	2.2246
5-15 (10)	4.5	14.172	.7(.3)	5.2873	1.9(.38)	3.5986	3.1909
15-30 (15)	7.0	30.594	.5(.22)	11.692	1.2(.24)	8.3497	5.2873
30-60 (30)	10.	~300	.1(.04)	~300	0.1(.02)	300.47	76.297
60-100(40)	12.5	~300	.1(.04)	~300	0.1(.02)	300	66.046
Total		50		30?(20)		14	
eff j/psi		.70		.88		.88	

Conclusions/work

- I can trigger on peripherals
- Is triggering on the muons really OK?
  - Any homework?