VTX Runs Luminosity Summary

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This is an attempt to summarize the luminosity available and minbias data recorded in VTX runs in 2008 (RHIC I) and at RHIC II. Two RHIC II scenarios are presented - PHENIX FEM's remain multiplexed as now, **or** PHENIX FEM's are **de-multiplexed**.

The final slide summarizes the overall trigger rejections required in each scenario.

Only Au-Au and p-p are considered. I assume that if level 1 triggers work for Au-Au and p-p, they will work for all ion combinations.

Assumptions

RHIC I luminosity (circa 2008) from Roser in "2003-0909 RHIC collider projections.pdf".

RHIC II luminosity conditions from Roser in "RHIC II Machine Plans", presented at the Dec 2003 Open Planning Meeting ($\sqrt{s}$ = 500 GeV only for p-p).

5+14 week runs at constant peak luminosity.

Integrated luminosities assume exponential decay of stores (stores are 4 exponential lifetimes long for RHIC I, 0.2 lifetimes for RHIC II).

RHIC uptime 60%, PHENIX uptime 60%, Z vertex cuts all ± 10 cm.

Assume that we will be able to archive data at (before compression) **1.2 GB/s** for RHIC I and **3.6 GB/s** for RHIC II.

The **"mVTX"** trigger is a 100% efficient minbias trigger. It samples ~ twice as many **events** for the same integrated luminosity in p-p.

RHIC I luminosity (~ 2008)

Assumptions:

5+14 week run
Max. DAQ throughput **6 KHz** by ~ 2008
RHIC Z vertex σ = **20 cm**, 80% in central peak
Maximum archiving rate **1200 MB/s** (before compression)
σ_{BBC}(p-p) = 21.8 mb (at 200 and 500 GeV), σ_{mVTX}(p-p) = 42 mb (at 200 and 500 GeV)

Species	Peak RHIC luminosity	Trigger	Z-cut (cm)	Peak MB rate	------Integrated luminosity--------- Total	DAQ	max archived
Au-Au	32 x 10^{26}	BBC	10	6.2 KHz	0.76 nb^{-1}	0.76 nb^{-1}	0.73 nb^{-1}
p-p(200)	0.89 x 10^{32}	BBC	10	0.6 MHz	21.2 pb^{-1}	0.84 pb^{-1}	0.84 pb^{-1}
p-p(200)	0.89 x 10^{32}	**mVTX**	10	1.15 MHz	21.2 pb^{-1}	0.44 pb^{-1}	0.44 pb^{-1}
p-p(500)	1.5 x 10^{32}	BBC	10	1.0 MHz	35.8 pb^{-1}	0.84 pb^{-1}	0.84 pb^{-1}
p-p(500)	1.5 x 10^{32}	**mVTX**	10	1.9 MHz	35.8 pb^{-1}	0.44 pb^{-1}	0.44 pb^{-1}

RHIC II luminosity (FEMS not demultiplexed)

Assumptions:

5+14 week run
Max. DAQ throughput **8 KHz** by RHIC II
RHIC Z vertex σ = **10 cm**, 80% in central peak
Maximum archiving rate **2400 MB/s** (before compression)
σ_{BBC}(p-p) = 21.8 mb (at 200 and 500 GeV), σ_{mVTX}(p-p) = 42 mb (at 200 and 500 GeV)

Species	Peak RHIC luminosity	Trigger	Z-cut (cm)	Peak MB rate	------Integrated luminosity---------- Total	DAQ	max archived
Au-Au	90 x 10^{26}	BBC	10	31 KHz	13.6 nb^{-1}	3.84 nb^{-1}	3.84 nb^{-1}
p-p(200)	3.0 x 10^{32}	BBC	10	3.6 MHz	453 pb^{-1}	1.12 pb^{-1}	1.12 pb^{-1}
p-p(200)	3.0 x 10^{32}	**mVTX**	10	6.9 MHz	453 pb^{-1}	0.58 pb^{-1}	0.58 pb^{-1}
p-p(500)	5.0 x 10^{32}	BBC	10	6.0 MHz	756 pb^{-1}	1.12 pb^{-1}	1.12 pb^{-1}
p-p(500)	5.0 x 10^{32}	**mVTX**	10	11.5 MHz	756 pb^{-1}	0.58 pb^{-1}	0.58 pb^{-1}

RHIC II luminosity (FEMS are demultiplexed)

Assumptions:

5+14 week run
Max. DAQ throughput **16 KHz** by RHIC II
RHIC Z vertex σ = **10 cm**, 80% in central peak
Maximum archiving rate **3600 MB/s** (before compression)
σ_{BBC}(p-p) = 21.8 mb (at 200 and 500 GeV), σ_{mVTX}(p-p) = 42 mb (at 200 and 500 GeV)

Species	Peak RHIC luminosity	Trigger	Z-cut (cm)	Peak MB rate	------Integrated luminosity---------- Total	DAQ	max archived
Au-Au	90 x 10^{26}	BBC	10	31 KHz	13.6 nb^{-1}	7.68 nb^{-1}	6.91 nb^{-1}
p-p(200)	3.0 x 10^{32}	BBC	10	3.6 MHz	453 pb^{-1}	2.24 pb^{-1}	2.24 pb^{-1}
p-p(200)	3.0 x 10^{32}	**mVTX**	10	6.9 MHz	453 pb^{-1}	1.16 pb^{-1}	1.16 pb^{-1}
p-p(500)	5.0 x 10^{32}	BBC	10	6.0 MHz	756 pb^{-1}	2.24 pb^{-1}	2.24 pb^{-1}
p-p(500)	5.0 x 10^{32}	**mVTX**	10	11.5 MHz	756 pb^{-1}	1.16 pb^{-1}	1.16 pb^{-1}

Implications for triggering

Era	Species	Trigger	Z cut	Luminosity available	% at max MB/s	% archived as minbias	trigger rejection
RHIC I	Au-Au	BBC	10	0.76 nb^{-1}	96	96	-
	p-p(500)	BBC	10	35.8 pb^{-1}	2.3	1.2	85
	p-p(500)	mVTX	10	35.8 pb^{-1}	1.2	0.6	160
RHIC II	Au-Au	BBC	10	13.6 nb^{-1}	28.2	14.1	7
	p-p(500)	BBC	10	756 pb^{-1}	0.15	0.07	1350
	p-p(500)	mVTX	10	756 pb^{-1}	0.08	0.04	2600
RHIC II (demuxed)	Au-Au	BBC	10	13.6 nb^{-1}	51	25	4
	p-p(500)	BBC	10	756 pb^{-1}	0.30	0.15	680
	p-p(500)	mVTX	10	756 pb^{-1}	0.15	0.08	1300

For all cases except RHIC I AuAu, assume we use **50% of the bandwidth** to archive minbias data. The trigger rejection is the **overall** trigger rejection needed to fit all rare event triggers into the remaining 50% of the bandwidth.

See the previous three slides for details of each scenario.