Experiments

1. Experiments

Since the BRAHMS experiment successfully accomplished its physics program in 2006, the RHIC Spin program is being carried out by two principal experiments, PHENIX and STAR. Both experiments have been improving their capabilities for spin measurements. Extended electromagnetic calorimetry acceptance, including the Nose Cone Calorimeters and Muon Piston Calorimeters in PHENIX and the Forward Meson Spectrometer in STAR, will allow not only to improve kinematic coverage for well utilized probes in spin measurements, such as π^0, photon, jet and di-jet, but also will add the ability for γ+jet measurements over a wide kinematic range. Silicon vertex trackers, including the VTX and FVTX in PHENIX and the HFT in STAR, will open an opportunity to study charm and bottom quark production by measuring the displaced decay vertex. These trackers will also considerably extend the kinematic coverage for γ+jet measurements in PHENIX. A number of detector upgrades are necessary for measurements of the flavour separated quark and antiquark polarizations through parity-violating W production. They include the muon trigger upgrade for the PHENIX muon arms and the Forward GEM Tracker (FGT) in STAR, and are discussed in detail below. An upgrade to the STAR TPC front-end readout electronics and data acquisition system will be accomplished by Run 9. It will increase the STAR event rate capability by an order of magnitude to $\sim$1 kHz, which will extend measurements to lower p_T and provide considerably better sensitivity for lower x measurements.

Only part of the RHIC delivered luminosity is sampled by experiments, due to data acquisition live time, experiment up time etc. In PHENIX, this fraction, ϵ_{sample} is approximately 30%. It is mainly limited by the fraction of collisions within the PHENIX interaction region, about 50%. It will be improved by a factor of 1.2–1.3 after the new 9 MHz rf system is installed in RHIC rings, which will lead to a reduction of bunch length. Bunch length dynamic reduction at higher beam energies will lead to additional increase in the PHENIX ϵ_{sample} by a factor of 1.3–1.4 for $\sqrt{s}$ =500 GeV program. In STAR, ϵ_{sample} historically has been about 25%, due to the combined effects of experiment up time and data acquisition live time. Beginning in Run 2009, this fraction is expected to increase to 50% for measurements such as jets and photons, which don't require a tight constraint on the collision vertex. This fraction will be 45% for W asymmetry measurements, because a moderate vertex constraint will be needed to obtain good charge-sign discrimination with the FGT.

Achieved ϵ_{sample} along with expected improvements in next runs are summarized in Table 1.

Table 1
Fraction of luminosity sampled by RHIC experiments over delivered luminosity, ϵ_{sample}.

	Acheived (Run 2008)	Projected for $\sqrt{s} = 200$ GeV	Projected for $\sqrt{s} = 500$ GeV
PHENIX	0.30	0.35–0.40	0.50–0.55
STAR	0.25	$\sim$0.50	$\sim$0.45