DETECTOR LIMITATIONS, STAR

D. Underwood

High Energy Physics

Argonne National Laboratory

Presented at

Spin Meeting

BNL

April 28, 1998

Every detector has limitations in terms of solid angle, particular technologies chosen, cracks due to mechanical structure, etc. If all of the presently planned parts of STAR were in place, these factors would not seriously limit our ability to exploit the spin physics possible in RHIC.

What is of greater concern at the moment is the construction schedule for components such as the Electromagnetic Calorimeters, and the limited funding for various levels of triggers.

What is good in STAR

(before I launch into a limitations talk)

Large solid angle

Good tracking with Momentum	-1 < eta < 1 ~all phi
Some tracking with some Momentum info	1 < eta < 2 ~all phi
Tracking	2.5 < eta < 4 ~all phi
EMC	-1 < eta < 2 ~all phi
SVT	--1 < eta < 1 ~all phi

This is good for Gamma + Jet, Jet-Jet, e+ e- , etc

Kinematic coverage over a range in x for gluon (see S. Vigdor Talk)

Z0 statistics

W statistics

options for h1 x h1 other than h1 x h1 bar

TALKS YESTERDAY:

→ DIRECT PHOTON AT STAR - STEVE VIGDOR
JETS - STAR - STEVE HEPPELMAN

Limitations

No Hadron Calorimeter > Jet trigger is not sharp
Must set EM threshold low to be efficient,
and then take lots of low energy stuff

EM Calorimeter coming on Late in Program > Partial Detector for
Early Spin Physics

Year	Fraction of Barrel coverage	End Cap
End-1999 /2000	10%	?
End 2001 /2002	50%	?
End 2003 /2004	100%	?

Much of Trigger is Unfunded > Low level trigger rate is limited to
DAQ and Tape rate

so energy thresholds are driven up
in order to to get rate down

(miss low x physics until funded)
(low statistics until funded)

Vertex Pos. Det. Unfunded > More processing to find correct vertex
out of 800 in TPC

Trigger

The basic idea is that with all the STAR trigger present we could have 1000 HZ at level 0 (summed over all triggers) , and certain thresholds.

However, since most of STAR trigger is deferred,
the Level 0 rate can't be more than 60 Hz with < 50% deadtime
(and maybe the rate is lower)

This drives some of the thresholds up about a factor of 4
to get the rate down.

Particularly:

jets | (large EMC patch trigger)

less so:

electrons |
gammas | (single EMC tower trigger)
di-electrons |

Trigger that will be there : EARLY

Level 0

towers 0.2 x 0.2 for jet trigger
highest .05 x .05 tower for gamma / e trigger
Global Et for jet-jet
maybe simple 2-hits
charge multiplicity (CTB , MWC)

Unfunded Trigger:

Level 0

VPD to select 20 out of 800 vertices stored in TPC
SMD to get a factor of 3-5 on single tower trig rate

Level 2 Spatial Information using:

Calorimeter
Shower Max. Detector
Charged Multiplicity Counters
Silicon Vertex

A factor ~ 5 in trigger rate

Shower width for e to pi
Size of Jet in EM
Charged multiplicity(CTB + MWC) + neutral energy (EMC)
to define jet
refined jet-jet, gamma-jet, e+ e-
possible isolation cut for gamma using energy ratios
finding correct interaction point for tracking using SVT

Level 3

- Using momentum in trigger (as opposed to just writing to tape)
- Using Momentum + EMC to sharpen jet trigger threshold
- Tracking using EMC hits as seeds
  (fast way to find 30 tracks out of 2400)
- Optimizing tracking so that at least some raw data can go to tape
  from a few tracks to improve momentum resolution offline

Signal	$\sqrt{s}$ (GeV)	Events	x Range	Sensitivity
W^+	500	72,000	0.05-0.3	$\Delta u(x)/u(x) \sim 0.01 - 0.02$ $\Delta \bar{d}(x)/\bar{d}(x) \sim 0.01 - 0.02$
W^-	500	21,000	0.05-0.3	$\Delta d(x)/d(x) \sim 0.02 - 0.04$ $\Delta \bar{u}(x)/\bar{u}(x) \sim 0.02 - 0.04$
Z^0	500	3,200	0.05-0.3	$\Delta h_1/q \sim 0.2$
γ + jet	500	3×10^6	0.02-.3	$\Delta G(x)/G(x) \sim 0.03$
	200	3×10^5	0.05-.3	$\Delta G(x)/G(x) \sim 0.04$
Dijets	500	5×10^7	0.03-.4	$\Delta G(x)/G(x) \sim 0.03$
	200	2×10^7	0.08-.4	$\Delta G(x)/G(x) \sim 0.05$