Review of MINERvA tertiary data rates

Its hard to do the scaling of data rates
because too much will change
but inspect the pieces from MINERvA experience

trigger rate and readout rate
trigger purity
reduction to final sample

Trigger rate and readout rate

From our second of four configurations, pi+, K+, p

Ran 10 hours a day for six days
one spill per minute, 50 spills per hour
(running was not at all constant, this is averaged)
typically with 300,000 pions on target

beamline triggered at ~30 Hz

MINERvA DAQ readout (NOT the beamline DAQ)
set the actual readout rate at ~5 Hz.

In the end 74,000 triggers written to disk.

Trigger purity

From our second of four configurations, pi+, K+, p

Of the 74,000 triggers on disk
only 26,000 passed the beamline reconstruction

The trigger conditions were essentially:
each WC and TOF must have in-time activity
the first WC must not have too much activity.

Reasons for keeping triggers:
56% had valid fit
45% of valid fits passed fit quality checks
54% passed the time of flight check

trigger purity: 42% pass this combination
Some 40% of triggers were junk
and failed both the fit and the tof criteria.

Guess trigger purity for LArIAT

I think the junk triggers are various types
of accidental triggers from all the particles
flying around the hall. For LArIAT:

our WC and TOF are smaller

we might be able to construct a better TOF trigger

and so have less junk triggers.
maybe our purity is 60% or 80% instead of 40%,
maybe we don't know until we try.

Reduction to final sample

Taking only the triggers that pass the previous cuts

We lose about 10% because we simply did not observe a particle enter our detector in the right place. (large scatter, or a junk trigger that passed cuts).

For some analyses that matter, we throw away another 30% of the triggers because there was a particle in our detector in the same booster batch as the one we triggered on.

(For other analyses we can keep those).

Reduction to final sample LArIAT

I suppose the 10% loss will be similar.

The 30% lost due to another particle within 1 us
is the accelerator structure + extraction pileup
which (thanks to SeaQuest) will be different.

Also MINERvA was a large detector,
the pileup events are not tertiary beam events
they are often muons flying through the hall
sometimes other debris from our target
(We've not analyzed them carefully)

The pileup events are more frequent than random scaling,
The presence of a particle makes the presence of a
second particle more likely.

MINERvA beam pileup rejection

We ran one Booster batch in each MI cycle,
so we usually saw two batches, separated by
10 microseconds in our 16 microsecond readout.
Reject trigger if the same batch is occupied by 2 particles.

Now most of the slots in the MI cycle are filled
(similar to NuMI, I guess).

I'm not sure that changes what we will see.

Changing the intensity on the far upstream SY target
should be a post-target collimator in the secondary beamline
that changes the intensity on the MCenter target.
These might be interesting knobs to play with.

What pileup can LArIAT tolerate?

LArIAT is a smaller detector, so the loss from the pileup cut might not be as bad as 30%.

OR LArIAT is intrinsically more sensitive to pileup
And we have to lengthen the cut from 1 microsecond to (?) 10 microseconds or 100 microseconds.

Not totally sure what happens here.
We leave the non-random pileup effect
And are back into some random scaling with intensity.

After all cuts

In 6 days of 10 hours per day operation

With only beamline quality cuts

13000 pions, 9000 protons, 500 kaons, 2000 e+pi, 1500 p+k

With additional pileup quality cuts
for analyses that are sensitive to it

6500 pions, 4500 protons

Kaons are special, because a large fraction
decay in flight before the detector, worse efficiency
more like 10% or something.

Places to look to do better or worse

1. Beamline trigger rate will fall: smaller WC and TOF,
But expect better purity.
Even more true for a possible kaon enhanced configuraiton.

2. DAQ rate best case is expected to be the same 5Hz
but danger that it could be worse.

So it might matter if #1 falls below #2

Better trigger purity, but LArIAT might be more sensitive
to beam pileup. Need a spec and some engineering runs.
Use knobs to turn the intensity up or down,
Especially if there is room to bring #1 down closer to #2.