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LHC at 2 TeV

If one makes the following assumptions:

- LHC is not able to provide the 200pb^{-1} at 10 TeV required to be competitive (link to Chamonix) with the Tevatron in the 2009 run
- the experiments decide that they want a lower energy run starting in 2009 instead of waiting for a full repair of the splices

What energy should the experiments request? This is a compilation of the motivations to run the LHC at a collision energy of 2 TeV for a 'short' time in the initial data taking period starting in 2009.

Remove Physics Uncertainties from Commissioning

At 2 TeV, the physics is 'known'. We have PDF's that are well measured and Pythia parameters that have been carefully tuned by the Tevatron experiments. The recent publication from CDF on minbias measurements (arXiv:0904.1098v2) shows that even at 2 TeV, the Pythia tunings used in ATLAS are off by approximately 20%, as shown in 0904.1098v2_fig8.pdf. At higher energy our uncertainties grow even more (but I do not have a quantitative estimate). A charged track multiplicity result is often considered to be a 'first' result to demonstrate detector understanding. By removing the uncertainties from this basic physics, we will be able to focus on what really matters in initial running - the detector!

Compare to Previous Results

We can make a direct (except p vs. pbar) comparison of LHC data to Tevatron data. This will give additional confidence in our results and detector understanding. More... How much lumi would we need to make reasonable comparisons to Tevatron results? (minbias, jets, anything else?)

Luminosity

The pp cross section is known at 2 TeV. This should allow for a commissioning of the luminosity detectors, like LUCID. Note that LUCID is copy of CDF's CLC detector who's luminosity monitoring strategy is based on the ppbar cross section measured by Run I. (more content here by Jim)

Minimize Risk to the LHC

The lower the collision energy, the safer it is for the LHC. Every increase in the LHC collision energy represents increased risk to the machine. Therefore every increase in energy above 900 GeV should be very clearly motivated by our commissioning goals. We do not want to see another situation where it would have been possible to run at a lower energy, but encouraged the LHC to push to the limit of what they felt safe, and find ourselves again in a situation where we are waiting for repairs with no collision data to occupy ourselves.

What do we Gain at Higher Energy?

Estimates of the cross section of the core SM processes as a function of sqrt{s} can be seen in xsec.pdf. For clarity, below are the cross sections and estimated event yields for the electron channel (a la CSC, scaled by sigma to get lower energy) for W and Z (our 'golden' calibration channels):

Collision Energy (TeV)	sigma W (nb)	W yield (evts/pb^{-1})	sigma Z (nb)	Z yield (evts/pb^{-1})
14	200	3200	60	350
10	100	1600	40	230
6	70	1100	20	120
2	20	320	6	35

Moving from 2 TeV to 6 TeV, we gain a factor ~3 in the cross section for Z and W production. By running at 2 TeV we will have fewer of these golden calibration events. This is clearly a disadvantage if we collect 100pb^{-1}, but with ~10pb^{-1} the advantage is not clear because we don't get much with ~10pb^{-1} at 6 TeV anyways. So, if the 2009 run will be ~10pb^{-1}, there is not much gained in W and Z at 6 TeV. We need to think about whether the statistics gained in these channels will really make a difference when considering a 'short' run.

These are *very* rough estimates. See Tom's slides for better estimates: http://indico.cern.ch/getFile.py/access?contribId=2&resId=1&materialId=slides&c

Focus our manpower

By removing the possibility to search for new physics, we will focus the entire collaboration on commissioning.

-- AndrewHamilton - 14 Jul 2009

- 0904.1098v2_fig8.pdf: Figure 8 from arXiv:0904.1098v2
- xsec.pdf: cross sections as function of sqrt{s}

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