Chapter 10

2023 $p+p$ Commissioning Option

There is a definite benefit if sPHENIX would have an opportunity to start commissioning beam conditions, triggering, and detector setup for $p+p$ collisions at 200 GeV in Year-1 (2023) of running. With the commissioning plan for Au+Au detailed in Chapter 5, which takes precedence to make sure sPHENIX operates up to specifications in the highest multiplicity environments, and only 24 or 28 cryo-weeks in Year-1, the plan currently precludes running $p+p$ in the same run. However, if the sPHENIX commissioning were to go faster than expected with positive results and / or additional cryo-weeks might be available, a minimum running time of 6-7 cryo-weeks for unpolarized $p+p$ running would be beneficial ahead of the planned Year-2 (2024). Having this commissioning run as unpolarized will enable C-AD to potentially shorten the setup time and focus on critical beam conditions.

Again, Au+Au running is the highest priority for commissioning, but 6-7 additional cryo-weeks for $p+p$ running could be used for trigger development, a first look at the detector with low-multiplicity events, and potentially collect a sample of triggered photon data which could be used to characterize the jet energy scale using photon-jet events. This run would be a test of the detector and RHIC operation in advance of the longer $p+p$ run planned for Year-2 (2024).

Weeks	Designation
1.0-2.0	Set-up mode 2 ($p+p$ at 200 GeV)
1.0	Ramp-up mode 2 (work to design luminosity with non-zero crossing)
2.0	Timing and trigger development
2.0.	Data taking mode 2 (Physics)
6.0-7.0	Total cryo-weeks

Table 10.1: Potential commissioning and short data taking schedule for $p+p$ 200 GeV running in Year-1.

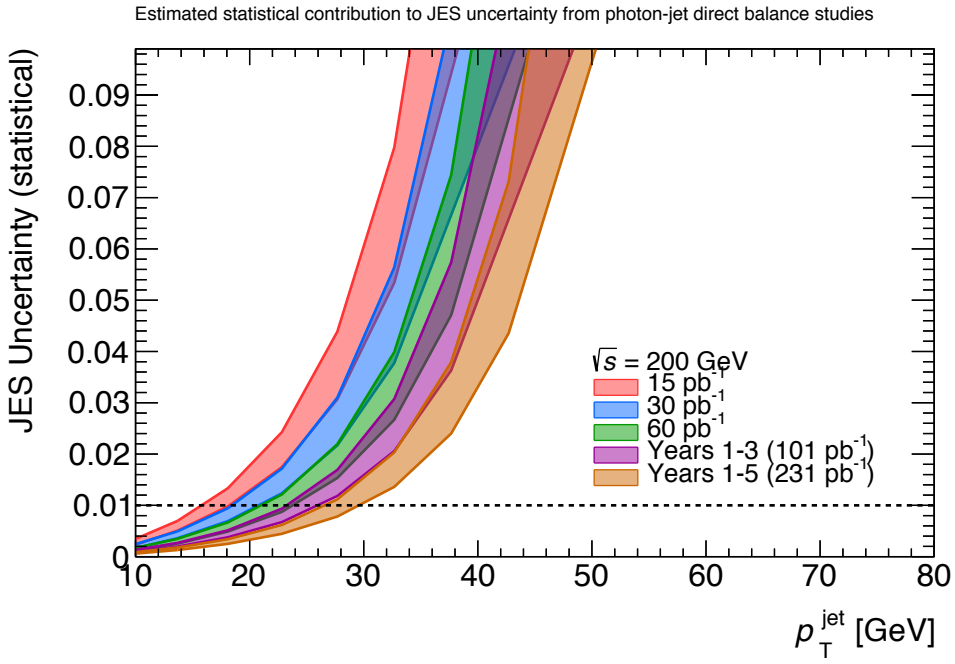

Figure 10.1: The projected sPHENIX statistical uncertainty contribution to the Jet Energy Scale (JES) uncertainty as determined from the "golden channel" via photon-jet direct balance studies.

Two weeks of data taking could potentially provide 10-15 pb^{-1} of triggered photon $p+p$ data with a non-zero crossing angle which would allow a first attempt at determining the jet energy scale in $p+p$ collisions with the sPHENIX detector. We note that even 15 pb^{-1} of collected, triggered photon data would give a 1.5% JES uncertainty in the "golden channel" photon-jet balance at 20 GeV as shown in Figure 10.1. Such an initial commissioning and check on the JES in $p+p$ collisions would be beneficially entering the long $p+p$ running in Year-2.