FTPC review committee report

Abstract

The FTPC review committee is charged with recommending a strategy for the utilization and decommissioning of STAR's FTPCs. We have considered 1) the physics goals of STAR, 2) interferences between the FTPCs and STAR upgrades, 3) the resources required to operate the FTPCs, and 4) the impact on STAR of removing the FTPCs. We have consulted with and received valuable guidance and input from members of the FMS group, PMD group, HFT group, FGT group and the Beam-energy-scan focus group. Based on the information we have gathered, we make the following recommendations for the utilization of the FTPCs.

Recommendations

The committee recommends that the east FTPC remain operational until run 11 when it must be removed to make way for the HFT support frame. There are strong physics motivations for maintaining forward tracking during the beam-energy-scan scheduled for run 10. The committees understanding is that the HFT support frame will be installed between run 10 and 11 so that the east FTPC will be operational during the beam-energy-scan. This timing is beneficial for STAR's physics program and should therefore be adhered to if possible.

The committee recommends that the west FTPC remain in place through run 9. Between run 9 and 10, the FGT will be installed with a new support cone. The outermost GEM disk in the FGT overlaps with the current position of the FTPC. We recommend therefore that after run 9, the west FTPC be moved 20cm further out in z from the nominal interaction vertex to give clearance for the outermost GEM disk and it's electronics and that it remain operational in that position during run 10. This shift will move the pseudo-rapidity acceptance window up 0.1 units. Measures should be taken to ensure compatibility between the FGT upgrade and the west FTPC.

To ensure successful utilization of the FTPC data, the committee recommends that an institution be sought which will provide a person responsible for FTPC calibrations and software support through run 10. This person should be available to travel to BNL as needed.

After run 10, the east FTPC will be decommissioned but the west FTPC should be kept as an optional installation depending on the evolving upgrades and physics goals of the STAR program.

Those are our recommendations. Below we give a more in-depth report on the committee’s findings and the motivations behind these recommendations.

Considerations

Important considerations in developing our recommendations were the physics goals in STAR that might require or benefit from the continued operation of the FTPCs. Data from the FTPCs have been and continue to be crucial for several analysis topics within STAR. Analysis topics that make use of or can make use of the FTPCs include the following:

1) Azimuthal correlations in pp and dAu to address the low-x gluon distribution in Au nuclei.
2) Azimuthal correlations in AuAu to address jet energy loss and the response of the medium to impinging jets.
3) Directed flow at forward and mid-rapidity as a sensitive probe of the speed of sound in the medium produced in AuAu.
4) Elliptic flow measurements using the wide separation in rapidity to eliminate multi-particle non-flow correlations.
5) Forward-backward multiplicity correlations to study long-range correlations and multi-parton interactions.
6) Lambda and phi meson production at forward rapidity in polarized pp to measure the strangeness quark spin structure function in the nucleon.
7) Forward jets triggered by the FPD
8) Forward J/psi triggered by the FPD

The FTPCs and the run 10 beam-energy-scan

Of particular concern to the Beam-energy-scan focus group, was the availability of tracking at forward rapidity during the beam-energy scan in run 10. During this run, signatures of a first order phase transition and a critical point will be sought. One such signal is an increase in the value of directed flow caused by a drop in the speed of sound in the QCD medium near a phase transition. This focus group is also interested in v_2 measurements for a variety of particle species. Particularly at low beam energies, these measurements can be made more accurate by correlating tracks at mid-rapidity with spectator nucleons. For beam energies between 5 GeV and ~15 GeV, a significant number of spectators will be produced in the FTPC acceptance. These spectators provide the most direct possible access to the geometry of the colliding nuclei. Since multiplicities can be low in this region and at these low energies, a large acceptance is important. For this reason, it is advantageous to have both FTPCs operational.

The FTPCs are slow detectors

There are currently no plans to upgrade the FTPC readout electronics so that they can be read-out more quickly and there are technical problems that would make doing so a challenge. Although this doesn't present a problem for the beam-energy-scan, it limits the usefulness of the FTPCs in the RHIC II high-luminosity era. The committee did hear ideas, however, on ways to make use of

the FTPCs, particularly in conjunction with the FPD. Les Bland raised the possibility of using the FPD to trigger on forward jets or J/psi's and using the west FTPC for tracking. The possibility to use the west FTPC for future measurements like this suggests that, barring other conflicting forward tracking upgrades, the west FTPC could be considered as a possible component of the STAR detector even beyond run 10. This would be contingent on the availability of support for the detector and software.

Interferences with planned upgrades

The FTPCs in their current location are incompatible with the FGT upgrade on the west side of the TPC and the HFT support frame on the east side of the TPC. Alexei Lebedev pointed out that the west FTPC can be moved to larger z so that it doesn't interfere with the FGT. The committee also sought input from Howard Wieman and Jim Kelsey to ensure that the FTPC could indeed be made compatible with the FGT. The available models and latest designs indicate that the west FTPC overlaps with the outermost GEM disk by several centimeters. Consulting the GEANT geometry for y2007, we find that there is approximately 22.5 cm between the electronics extending from the rear of the west FTPC and the west BBC. Moving the west FTPC back 20 cm will leave a gap between the face of the FTPC and the last disk of the FGT to accommodate FGT electronics. From current models, it appears that there will be a 1-inch annular gap between the FTPC and the west support cone. It is anticipated that this space can accommodate the services for the inner detectors (GEMS, SSD, and perhaps IST) although some of these service requirements have not yet been defined. Given the strong physics motivations for maintaining the capabilities of the FTPCs, and given that no interferences have been identified between the shifted west FTPC and the FGT, the committee made the above recommendation that the west FTPC be moved to larger z and that efforts be made to accommodate it's continued operation.

The FTPC support arms

Four arms attached to the TPC support wheel support the FTPCs. Moving the west FTPC by 20 cm will require either a modification to the support arms, a change to how the support arms are connected to the FTPCs, or both. The modifications will need to be completed before run 10.