The STAR collaboration has organized two workshops on future STAR upgrades and eSTAR recently: one in December 2011 at UCLA and the other in June 2012 at BNL. The focus of these meetings was on physics cases with pp, pA, and ep/eA collisions in the later part of the decade, outlined in the decadal plan, and the associated upgrades following the completion of the HFT and MTD.

The identified key physics measurements for 2016-2020 are 1) Drell-Yan cross-sections in pp and pA collisions, 2) the transverse single spin asymmetry A_N for Drell Yan, photon, and jet production in polarized pp collisions; 3) Interference Fragmentation Functions using identified pi+pi- in polarized p+p collisions. For the eSTAR period, the following measurements were considered in ep/eA collisions with 5-10 GeV electron beams a) the inclusive structure functions $g_1(x, Q^2)$, $F_2(x,Q^2)$, and $F_L(x,Q^2)$, b) single particle semi-inclusive deep-inelastic measurements, c) di-hadron azimuthal correlations with tagged electrons, and d) J/Ψ exclusive production. In addition, the scientific observations from data obtained during the BES-I compel STAR to propose a BES-II to consolidate the tentative hints of a possible transition from QGP dominant evolution to a hadronic dominant evolution below the RHIC injection energy at $\sqrt{s}$=20 GeV.

Three major (phased) upgrades are considered:

1) The STAR forward instrumentation upgrade as described in the STAR decadal plan includes three key detector elements: tracking – Very Forward Gem Tracker (VFGT), the possibility of a PID detector for π/k/p or (π-k)/p separation, and a Forward Calorimeter System (FCS) with or without a pre-shower detector.

It is generally agreed that STAR will take a phased approach towards the forward upgrade. In Phase-I, STAR will pursue the forward tracking and calorimetric capability. Particle identification is currently considered for Phase II.

For the FCS possible technical choices: a) complete new FCS with compact EMC in the front, followed by a hadron catcher calorimeter (UCLA); b) combined FCS+Hcal (HCal (E864) only replaces ~50% of the hadron catcher part of the FCS, the system takes more spaces, but the performances should be close to FCS); c) combined FCS +(FMS+HCal) (50% FCS and 50% FMS+HCal). Hank Crawford showed the status of the E864 HCal modules from AnDY and proposed possible options to improve the HCal performance. It is important that we understand the HCal performance in terms of its energy resolution and other properties. Possible mechanical/read-out modifications can also be investigated if the HCal is a viable option to replace some of the hadron catcher calorimeter with comparable performances.

The initial aim is to articulate and work out with simulations the physics case for the upgrade and general detector requirements by Nov/Dec 2012. Several collaborators have expressed interest in aspects of this upgrade and additional collaboration involvement will be essential. Huan Huang will be the initial contact person in this effort.

2) An Inner TPC Sector Upgrade (iTPC) to replace the aging inner TPC sectors with fully instrumented sectors and possibly new electronics (ALICE upgrade of Super ALTRO). Currently, only 20% of STAR TPC inner sectors have been instrumented and readout. The upgrade would enhance dE/dx capability; provide the necessary hits for low-momentum and/or

high-eta tracks, and could potentially also reduce the material in the end-plane, in front of envisioned eSTAR instrumentation. Key physics cases for the iTPC upgrade were identified as:

a) BES-II (Dan Cebra will act as main contact for the BES group to articulate this case)

b) IFF in polarized pp

c) high-pt PID and electron identification

d) hyperon polarization in polarized pp and exotics searches in AA

The iTPC, if implemented, will improve the near-term (i.e. 3 year+) program for the BES-II and the assurance that the TPC will continue to be the base for the STAR physics program removing the uncertainty in regard to high-luminosity running. This upgrade will also position STAR for the phase-I of eRHIC.

The project seems to be in fairly sound ground technical, and current efforts at CERN to replace the existing ALTRO chips seems well matched to future needs. The estimates for effort and costs are still uncertain, but are likely in the 2-4M$ range, about equally split between mechanics and electronics. During the discussions at the BNL workshop, Zhangbu Xu, Dan Cebra and Jim Thomas agreed to organize the initial effort to move this project toward a draft-proposal.

3) A third, longer term, upgade is eSTAR. The main current efforts are EIC related detector R&D projects, currently including a Tungsten powder spaghetti calorimeter, a crystal calorimeter and a TRD have been progressed nicely. Computing/simulations have also progressed toward obtaining detector resolutions and a physics event generator interface. The simulations now have necessary geometries (iTPC, FCS, VFGT, ETTIE) to quantify resolution and acceptance in (x, Q^2). Further progress will be documented as part of updates/addenda to the decadal plan.

In addition to these three major upgrades, near-term upgrades at a smaller scale were discussed as well. These include Roman-pot phase II, Trigger Upgrade and the near-complete DAQ-10k upgrade. Funding for these upgrades will likely need to be found from operation and capital equipment funds.

The next upgrade workshop is anticipated to be in 6 months, at around the next analysis meeting. The subgroups will (continue to) communicate in phone meetings and face-to-face meetings as necessary.