Research Management Plan (RMP)

for the

STAR Heavy Flavor Tracker (HFT)

Version 4
March 31, 2009

1. Introduction

This document describes the plans of a group of institutions within the STAR collaboration for the management of the research efforts connected with the construction and operation of the STAR Heavy Flavor Tracker (HFT). In contrast to construction, research efforts are not funded by the HFT project but from the research funding of the individual groups involved in the HFT project. Research efforts include simulations of the detector performance, development and execution of calibration procedures for the detector, commissioning of the detector, development of analysis software, physics analysis and operation of the detector. This document is not part of the documents mandated by the Critical Decision process, like the Conceptual Design Report (CDR), and thus is different from those documents.

It is also not the scope of this document to justify the physics case for the HFT. The physics justification is an ongoing process that has started with the HFT proposal for the Science Review[1] and that will be continued with the STAR response to the questions posed by the CD-0 review committee and with the CDR.

This RMP addresses the activities of the participating institutions in the time between FY 09 and FY 14. FY 14 will be the first year of regular operation for the HFT. The physics activities listed for the individual institutions for FY 14 reflect the physics interest of those institutions and not necessarily the specific activities foreseen for the first year of HFT running.

The HFT project is designed to give the STAR experiment the capability to identify charm hadrons through topological reconstruction down to low transverse momenta at mid-rapidity. The scope of the project is defined as building a new two layer silicon pixel detector close to the interaction point, to build a new Intermediate Silicon Tracker (IST), to upgrade the read-out of the existing Silicon Strip Detector (SSD) to be compatible with the STAR data acquisition speed, and to mount and suspend those detectors (including the Forward GEM Tracker, FGT, to be built as a separate construction project) with a new low-mass structure that will replace the existing STAR cone structure.

2. Research Goals

At the HFT Science Review several physics objectives were presented. Not all of them were vetted by robust simulations. As a consequence the STAR collaboration was charged with the task to do further simulations with the goal to generate a list of robust observables and physics measurements that can be accomplished in the first years of HFT running. This list includes topics that will be presented as part of the answer to the questions by the CD0 review committee due by end of April 2009. This list includes:

---

[1] C. Chasman et al., LBNL # 5509-2008, http://rnc.lbl.gov/hft/docs/hft_final_submission_version.pdf

- Measure charm production cross sections in 200 and 500 GeV p+p collisions and in heavy ion collisions.
- Measure v_2 of charm mesons down to low p_T in Au+Au collisions
- Measure R_{CP} of charm mesons in Au+Au collisions

The research milestones in this document are derived from the above list of physics topics.

In parallel, the collaboration has initiated an effort to elevate additional physics topics to the same level of detail. Those topics are:

- Measure the meson to baryon ratio of charm at the example of D^0/Λ_C
- Separate charm and bottom production.
- Measure W production at mid-rapidity in 500 GeV p+p collisions.

Detailed simulations to those topics will be presented in the CDR.

2.1. Charm Cross Sections

Heavy quark production is sensitive to the parton distribution function. Unlike the light quarks, heavy quark masses are not modified by the surrounding QCD medium[2] (or the excitations of the QCD medium) and the value of their masses is much higher than the initial excitation of the system. It is these differences between light and heavy quarks in a medium that make heavy quarks an ideal probe to study the properties of the hot and dense medium created in high-energy nuclear collisions.

Understanding the yield of charmed hadrons in hadron-hadron collisions requires a knowledge of the projectile and target parton distribution functions, the cross section for parton-parton interactions which generate charm quarks and the fragmentation functions for $c(b)$ quarks into charmed (bottom) hadrons. The parton distributions within the proton can be extracted from electron-proton collisions while the cross-sections for gluon fusion and $q\bar{q}$ annihilation are calculated in a perturbative QCD framework up to next-to-leading-order (NLO).[3] However, the parton and gluon distribution functions within the nucleus, relevant for charm and bottom quark production at RHIC energies, are poorly understood.[4] Thus the precise measurement of charm cross sections in p+p, d+Au and Au+Au collisions is very important. Precise charm cross section is also necessary as a base for J/Ψ suppression or enhancement measurements.

Topological identification of charm mesons down to low transverse momentum will minimize the error in cross section determination due to extrapolation.

2.2. Charm Flow

Charm quarks are abundantly produced at RHIC energies. Due to their high mass and small interaction cross section, the strength of elliptic flow of heavy flavor hadrons may

---

[2] B. Mueller, nucl-th/0404015.

[3] R. Vogt, hep-ph/0203151.

[4] K.J. Eskola, V.J. Kolhinen, and R. Vogt, *Nucl. Phys.* A696, 729 (2001).

be a good indicator of thermalization occurring at the partonic level. If all quarks in heavy flavor hadrons flow with the same pattern as the quarks in the light flavor hadrons, this indicates frequent interactions between all quarks. Hence, thermalization of light quarks is likely to have been reached through partonic re-scattering.

Figure 1 shows what precision in flow measurement can be reached with 500 M minimum bias events taken in STAR with the HFT. The red points show expectations from a cascade model[5] for the case that the charm quark has the same size partonic flow as measured for the light quarks. The green points show the limiting case where the charm quark has zero partonic v_2. Our measurement is expected to fall between those limits. It is obvious that the HFT will allow for a precision measurement that will shed light on the question of thermalization.

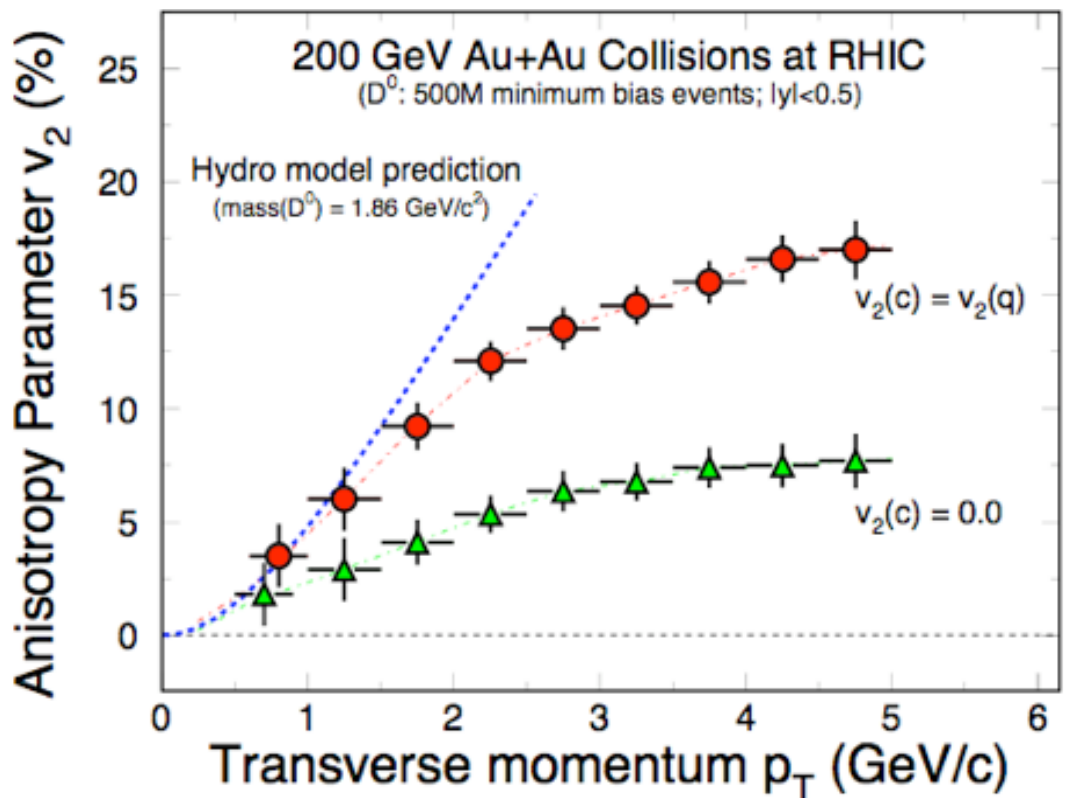

Figure 1: v2 as a function of p_T for the case of charm flow the same as light quark flow (red) and for the case where charm does not flow (green).

Measuring charm quark flow through v_2 of topologically identified D-mesons down to low pT allows for a far superior measurement compared to v_2 of electrons or muons from semi-leptonic charm decay. The transverse momentum of decay products is not well defined (within a few GeV) and hydrodynamic effects manifest themselves at low transverse momentum. In addition, the contribution to electron or muon production from B-meson decay is not known.

[5] V. Greco, C.M. Ko, and R. Rapp, *Phys. Lett.* B595, 202 (2004).

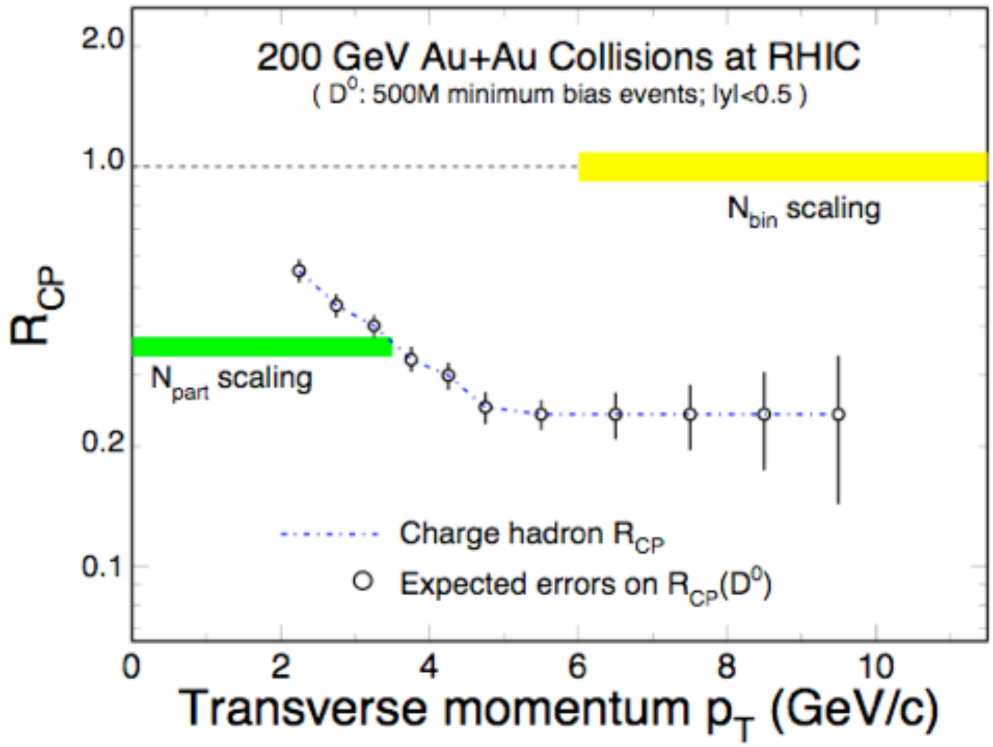

Figure 2: Expected errors for a R_{CP} measurement as a function of p_T.

2.3. Heavy Quark Energy Loss

The discovery of a factor of 5 suppression of high p_T hadrons ($5 < p_T < 10$ GeV/c) produced in Au+Au collisions at RHIC and the disappearance of the away-side jet has been interpreted as evidence for jet quenching.[6,7] This effect was predicted to occur due to radiative energy loss of high energy partons that propagate through a dense and strongly interacting medium.[8] The energy loss of heavy quarks is predicted to be significantly less compared to light quarks because of a suppression of gluon radiation at angles $\Theta < M_Q/E$, where M_Q is the heavy quark mass and E is the heavy quark energy. This kinematic effect is known as the "dead cone" effect.[9] However, a recent measurement of the nuclear modification factor,[10] R_{AA}, for non-photonic electrons, the products of D- and B-meson decay, yielded the surprising result that D- and B-mesons apparently show the same large suppression of light hadrons. This clearly indicates that the energy loss mechanism is not yet understood and has triggered new theoretical development.[11,12] In order to make progress in understanding the nature of the energy loss

---

[6] J. Adams et al. (STAR Collaboration), *Phys. Rev. Lett.* 91, 172302 (2003).

[7] C. Adler et al. (STAR Collaboration), *Phys. Rev. Lett.* 90, 082302 (2003).

[8] M. Gyulassy and M. Plümer, *Nucl. Phys.* A527, 641c (1991).

[9] Y.L. Dokshitzer and D.E. Karzeev, Phys. Lett. **B 519**, 199 (2001).

[10] B.I. Abelev *et al.* (STAR Collaboration), Phys. Rev. Lett. **98**, 192301 (2007).

[11] G.D. Moore and D. Teaney, Phys. Rev. C **71,** 064904 (2005).

mechanism, it is important to measure R_{AA} or R_{CP} for identified D-mesons.

Figure 2 shows the precision for R_{CP} that can be achieved with 500 M minimum bias events in STAR with the HFT under the assumption that the suppression for heavy quarks is of the same size as the suppression for the light quarks.

Topologically identified D-mesons will allow for a precise measurement of the p_T dependence and potentially flavor dependence of R_{AA}.

3. Milestones

The milestones in this document are research milestones that are derived from a technically feasible project time line. We will update those milestones as the project time line will be refined, especially by including a realistic funding profile.

The research milestones are based on the following project milestones:

Q4 FY 09	CD-1
Q4 FY 10	CD-2/3
Q4 FY11	New STAR beam pipe installed (off- project funding)
Q4 FY 11	Engineering prototype installed
Q4 FY 12	Pixel detector installed
Q4 FY 13	HFT fully installed
Q2 FY 14	CD-4

FY2009 Milestones

Q3 FY 09	Complete simulations for CD0 homework
Q4 FY 09	Complete CD1 simulations
Q4 FY 09	Concept for spatial calibration of Pixel
Q4 FY 09	IST detector response simulator implemented

FY2010 Milestones

Q2 FY 10	Concept for HFT Calibration
Q2 FY 10	IST pre-prototype module cosmic ray test, calibrated and analyzed
Q2 FY 10	Pad Monitor functioning
Q2 FY 10	Calibrate Pixel prototype
Q4 FY 10	Cosmic ray test of engineering prototype done and analyzed
Q4 FY 10	Update geometry in simulations

[12] H. van Hees *et al.*, Phy. Rev. C **73**, 034913 (2006).

FY2011 Milestones

Q1 FY 11	Functional Pixel Calibration
Q3 FY 11	Cosmic ray test for Pixel prototype and SSD performed and analyzed
Q4 FY 11	Tracker/Vertex finders upgraded/tuned/ debugged
Q4 FY 11	IST prototype module cosmic ray test
Q4 FY 11	Calibration Databases finalized

FY2012 Milestones

Q1 FY 12	Pixel prototype calibrated
Q1 FY 12	Cosmic ray test of fully integrated IST barrel analyzed
Q3 FY 12	Reconstruction software finalized/ready for physics
Q3 FY 12	Finalize geometry in simulations
Q3 FY 12	Functional HFT calibration
Q4 FY 12	Analyze data from prototype run

FY2013 Milestones

Q2 FY 13	IST online and calibration software commissioned
Q4 FY 13	Analyze data from Pixel detector
Q4 FY 13	Cosmic ray test of fully integrated HFT system analyzed

FY2014 Milestones

Q1 FY 14	In beam calibration of HFT
Q4 FY 14	First physics data from HFT analyzed

4. List of Tasks

The following list is a list of research tasks only, it does not include project tasks. The tasks are divided into the three subsystems, Pixel, IST, and SSD, and into software. Some of the tasks involve more than one detector, like the IST alignment with the help of information from the Pixel. Also, division between general software tasks and tasks related to an individual detector component is somewhat arbitrary.

Pixel:

1. Develop procedure to map pixels into Tracker for calibration
2. Develop procedure to align pixel through tracking in overlap region (Stand alone on-line check with cosmic rays)
3. Develop alignment software for Pixel
4. Develop calibration for SSD and IST and use pixel info for TPC space charge corrections
5. Design Pixel pad monitor
6. Slow control monitoring

IST:

1. Develop procedure to map pixels into Tracker
2. Develop procedure to align IST through survey data and tracks by minimizing residuals (checked with cosmic ray data).
3. Develop alignment software
4. Slow control monitoring; pedestal, noise level and gain to monitor calibration and functionality for each channel
5. Develop software framework to implement calibration in off-line data analysis

SSD:

1. Slow control monitoring
2. Develop alignment software for the SSD
3. Update monitoring software

Software:

1. **Complete simulations for CD0 homework:** This refers to simulations targeted to answer the report's questions.
2. **Complete CD1 simulations:** This includes simulations that will evaluate/refine the performance of current HFT in reconstructing e.g. D^0, D^{+-}, D^+_S, L_C and B-mesons.
3. **Concept for spatial calibration of Pixel/HFT:** This is the determination of the complete sequence of steps taken to perform the survey of Pixel half-shells with a hardware resolution of about 5 microns. This includes careful evaluation of the interaction of survey equipment, hardware (e.g. location of fiducials) and software mapping procedures.

4. **Update Pixel/HFT geometry in simulations:** This involves the detailed and accurate representation of the detector in simulations. It is foreseen to be done in two more major releases before final use in physics (embedding etc).
5. **Tracker/Vertex finder upgraded/tuned/debugged:** This includes the evaluation and actual implementation of techniques that will maximize the performance of the tracking and vertex finding software modules. This includes the optimization and the tuning of the search criteria specifically to HFT as well as the implementation of established techniques like momentum ordering, event-vertex constraint, silicon-based vertex seed finder etc.
6. **Calibration Databases finalized:** This includes the definition of bank structures as well as the procedures associated with a given Calibration task of HFT (e.g. alignment).

Data Taking and Physics Analysis:

1. Calibrate Detector
2. Prepare Analysis Software
3. Analyze Data
4. Operate Detector

5. Institutional Responsibilities

The tables list the responsibilities and the manpower available for the research tasks connected with the construction and operation of the HFT. We start with an overview detailing the responsibilities of all institutes and then list the responsibilities and tasks of the individual institutions by year and task. The manpower listed is sufficient to perform all the tasks listed in the task list. In addition to this manpower, the STAR collaboration as a whole will be involved in the physics analysis of data derived from the HFT detector as indicated by the “statement from the STAR spokesperson”.

BNL	Simulations Physics Analysis
IPHC	Simulations Analysis software Physics Analysis
KSU	Software Coordination Simulations Tracking, calibration and alignment SSD Software

	Physics analysis
LBNL	Simulations Pixel calibration and alignment Pixel commissioning Test data analysis Pixel operation SSD commissioning SSD operation Physics analysis
MIT	Simulations IST calibration and alignment IST Test data analysis IST operation IST Slow controls Physics analysis
Prague	Simulations Slow controls Cosmic ray tests Physics analysis
Purdue	Simulations Tracking development Calibration and alignment Analyze test data Cosmic ray tests Pixel operation Physics analysis
UCLA	Simulations Tracking software Detector operation Physics analysis
USTC	Simulations Analysis software Calibrations Physics analysis

Statement by the STAR Spokesperson

After completion of the TOF upgrade, the HFT will be the most important STAR upgrade project that will greatly extend the physics capabilities of STAR. Analyzing the data from the completed HFT and extracting physics results will be STAR's highest physics priority at that time. The heavy flavor data analysis will be done in the STAR "Heavy Flavor" physics working group (PWG). Already now this group is one of the most active groups in STAR the moment, the heavy flavor group consists of about 45 physicists, 17 of them do not belong to institutions that are presently involved in the HFT construction effort. With the operation of the HFT this group is expected to grow. I am convinced that a very large fraction of STAR collaborators that perform analysis will be eager to analyze HFT related data.

Detailed Institutional Responsibilities

BNL

Year	FTE	Name	Task
2009			
2010			
2011			
2012	0.4	JH.Lee	Simulations
2013	0.5	JH.Lee	Simulations, Physics analysis
	0.5	Student /Postdoc	Analysis software, Physics analysis
2014	0.5	JH.Lee	Analysis software, Physics analysis
	0.5	Student/Postdoc	Analysis software, Physics analysis

IPHC Strasbourg

Year	FTE	Name	Task
2009	0.5	Student	Simulations
2010	0.5	Student	Simulations
2011	0.5	Student	Simulations, analysis software

2012	0.5	Postdoc	Analysis software
	0.5	Student	Simulations
2013	0.5	Postdoc	Analysis software, Physics analysis
	0.5	Student	Analysis software, Physics analysis
2014	0.5	Postdoc	Analysis software, Physics analysis
	0.5	Student	Analysis software, Physics analysis

IPHC will concentrate on B meson physics.

Kent State University

Year	FTE	Name	Task
2009	0.4	S. Margetis	Software Coordinator – Pixel mapping
	0.8	Postdoc	CD- 0/1 Simulations – SSD software
	0.3	Student	Fast MC – CD1 simulations
2010	0.4	S. Margetis	Software Coordinator – Simulations/Alignment/Analysis
	0.8	Postdoc	Simulations – prepare analysis code – SSD software
	0.5	Student	Simulations – prepare analysis code
2011	0.5	S. Margetis	Software Coordinator – Simulations/Alignment/Analysis
	1.0	Postdoc	Simulations – Analysis – SSD software
	1.5	Students	Calibration - Tracking - Analysis
2012	0.5	S. Margetis	Software Coordinator – Simulations/Alignment/Analysis
	1.0	Postdoc	Simulations – Analysis – SSD software
	2.0	Students	Calibration - Tracking - Analysis
2013	0.5	S. Margetis	Software Coordinator – Simulations/Alignment/Analysis
	1.0	Postdoc	Simulations – Analysis – SSD software
	2.0	Students	Calibration - Tracking - Analysis
2014	0.5	S. Margetis	Software Coordinator – Simulations/Alignment/Analysis
	1.0	Postdoc	Simulations – Physics Analysis – SSD software
	2.0	Students	Calibration - Tracking – Physics Analysis

KSU is responsible for the overall tracking and analysis software design. KSU's physics analysis will concentrate on the analysis of R_{CP} initially.

LBNL

Year	FTE	Name	Task
2009	0.5	Postdoc	CD1 Simulations
	0.5	Student	Calibration, Pixel mapping into Tracker
2010	0.5	Postdoc	Prepare analysis codes
	0.5	Student	Design Pad Monitor
	0.5	Postdoc	Pixel calibation
	0.5	Student	Pixel Calibration
	0.2	E. Sichtermann	Work with Postdoc and Student on simulations and analysis code
2011	0.5	Postdoc	Prepare analysis code, Slow Control
	0.5	Student	Design Pad Monitor, Slow Control
	0.5	Postdoc	Pixel calibation
	0.5	Student	Pixel Calibration
	0.2	E. Sichtermann	Work with Postdoc and Student on simulations and analysis code
2012	0.5	Postdoc	Prepare analysis code, Slow Control
	0.5	Student	Prepare analysis code, Slow Control
	0.5	Postdoc	Pixel calibation
	0.5	Student	Pixel Calibration
	0.2	E. Sichtermann	Work with Postdoc and Student on simulations and analysis code
2013	0.5	H. Wieman	Detector Operator (Pixel)
	0.3	E. Sichtermann	Work with Postdoc and Student on simulations and analysis code
	0.5	H. Matis	Detector Operator (SSD)
	0.5	H.G. Ritter	Work with Postdocs and Students on Physics Analysis
	0.5	N. Xu	Work with Postdocs and Students on Physics Analysis
	1	Postdoc	Calibration, Physics Analysis
	1	Postdoc	Calibration, Physics Analysis

	0.5	Student	Calibration, Physics Analysis
	0.5	Student	Calibration, Physics Analysis
2014	0.5	H. Wieman	Detector Operator (Pixel)
	0.5	E. Sichtermann	Work with Postdoc and Student on physics analysis
	0.5	H. Matis	Detector Operator (SSD)
	0.5	H.G. Ritter	Work with Postdoc and Student on physics analysis
	0.5	N. Xu	Physics Analysis
	1	Postdoc	Calibration, D^0 and v_2 Analysis
	1	Postdoc	Λ_C Analysis
	0.5	Student	Calibration, D^0 and v_2 Analysis
	0.5	Student	Λ_C Analysis

LBNL is responsible for the calibration software of the Pixel detector and for analysis software. LBN also is participating in the SSD upgrade. LBL also will be responsible for the operation of the Pixel and the SSD detector. Initially, LBNL will concentrate on the D^0 analysis and extracting v_2 for D mesons.

MIT

Year	FTE	Name	Task
2009	0.3	G.J. Van Nieuwenhuizen	CD1 Simulations
	0.3	Student	CD1 Simulations
	0.2	Student	Detector response
2010	0.3	G.J van Nieuwenhuizen	IST Calibration, alignment, test data anal.
	0.5	Postdoc	Prepare IST calibration, software
	0.5	Student	Prepare IST calibration, software
2011	0.3	G.J van Nieuwenhuizen	IST calibration and alignment
	0.5	Postdoc	Prepare IST calibration, software
	0.5	Student	Prepare IST calibration, software
2012	0.3	G.J van Nieuwenhuizen	IST calibration, alignment, analysis
	0.5	Postdoc	Analyze cosmic ray tests
	0.5	Postdoc	Prepare physics analysis code

Year	FTE	Name	Task
	0.5	Student	Slow Controls
	0.5	Student	Alignment
2013	0.3	B. Surrow	Work with Students on analysis
	0.6	G.J van Nieuwenhuizen	IST Detector operation, calibration, analysis
	0.5	Postdoc	Physics Analysis
	0.5	Postdoc	Detector operation
	0.5	Student	Physics Analysis
	0.5	Student	Detector operation
2014	0.3	B. Surrow	Work with Students on analysis
	0.6	G.J van Nieuwenhuizen	IST Detector operation, calibration, analysis
	0.5	Postdoc	Physics Analysis
	0.5	Postdoc	Detector operation
	0.5	Student	Physics Analysis
	0.5	Student	Detector operation

The MIT group will deliver and maintain the IST detector software, including slow controls, calibration software and detector specific software. This will be achieved by a phased approach with the software development closely following the detector development. The MIT physics program focuses on the study of heavy quarks in proton-proton collisions at a center-of-mass energy of 200GeV and 500GeV. Here, the main objective is the cross-section measurement of heavy quark production. In addition, the MIT group is planning to use the IST and SSD to aid the charge sign discrimination for mid-rapidity W production in the electron/positron decay mode at a center-of-mass energy of 500GeV in proton-proton collisions.

NPI ASCR/CTU Prague

Year	FTE	Name	Task
2009	1.0	Student	CD1 Simulations
	0.3	J. Bielcik	CD1 Simulations
	0.5	V. Kouchpil	Slow Control
	0.5	Student	Prepare analysis code
2010	0.5	Student	Prepare analysis code

	0.3	J. Bielcik	Cosmic ray tests
	0.5	V. Kouchpil	Slow Control
	0.5	Student	Slow Control
	0.5	Student	Prepare analysis code
2011	0.5	V. Kouchpil	Slow Control
	0.5	Student	Slow Control, Prepare analysis code
	0.5	Student	Cosmis ray tests
	0.3	J. Bielcik	Cosmic ray tests
2012	0.5	V. Kouchpil	Slow Control
	0.5	Student	Slow Control
2013	0.5	V. Kouchpil	Slow Control
	0.5	Student	Slow Control
	0.5	Student	Physics Analysis
	0.5	J. Bielcik	Physics Analysis
	0.3	M. Sumbera	Work with students and postdocs on Physics Analysis
2014	0.5	V. Kouchpil	Slow Control
	0.5	Student	Slow Control
	0.5	Student	Physics Analysis
	0.5	J. Bielcik	Physics Analysis
	0.3	M. Sumbera	Work with students and postdocs on Physics Analysis

The Prague group will initially concentrate on developing the analysis tools and analyzing the Λ_C.

Purdue University

Year	FTE	Name	Task
2009	0.5	W. Xie	Work with Students on CD1 simulations and PIXEL detector slow simulator and clustering algorithm development.
	0.25	Student	CD1 Simulations PIXEL slow simulator
	0.25	Student	CD1 simulation Study PIXEL clustering algorithm.

2010	0.5	W. Xie	Work with Students and Postdoc on HFT calibration and data analysis.
	0.5	Postdoc	HFT Calibration software development
	0.25	Student	HFT Calibration software development Analyze data from cosmic ray test of prototype
	0.25	Student	HFT Calibration software development Calibrate Pixel prototype
2011	0.5	W. Xie	Work with Student and Postdoc on HFT calibration and data analysis.
	1.0	Postdoc	HFT Calibration software development Tracker/Vertex finders development
	0.5	Student	Tracker/Vertex finders development
	0.5	Student	Tracker/Vertex finders development
2012	0.5	W. Xie	Work with Students and Postdoc on data analysis and reconstruction software development
	0.15	Fuqiang Wang	Work with Students and Postdoc on data analysis
	1.0	Postdoc	Development of reconstruction software for physics
	0.5	Student	Data analysis from prototype run
	0.5	Student	Data analysis from prototype run
2013	0.5	W. Xie	Work with Student and Postdoc on data analysis and analysis software development
	0.25	Fuqiang Wang	Work with Student and Postdoc on data analysis
	0.10	Andy Hirsh	Work with Student and Postdoc on data analysis
	1.0	Postdoc	Analyzing cosmic ray test of fully integrated HFT system Analyze data from Pixel detector
	0.5	Student	Analysis software development Analyzing cosmic ray test of fully integrated HFT system
	0.5	Student	Analysis software development Physics Analysis from PIXEL detector data
	0.5	Student	Analysis software development Physics Analysis from PIXEL detector data
2014	0.5	W. Xie	Work with Student and Postdoc on data analysis and analysis software development
	0.25	Fuqiang Wang	Work with Student and Postdoc on data analysis
	0.10	Andy Hirsh	Work with Student and Postdoc on data analysis

	1.0	Postdoc	Help on the Detector Operation (Pixel) Participate detector calibration Physics analysis
	0.5	Student	Analysis software development Physics Analysis
	0.5	Student	Analysis software development Physics Analysis
	0.5	Student	Analysis software development Physics Analysis

Purdue University will focus on simulations and software development, e.g. the slow simulator. We will also participate in the calibration effort. For the data analysis we will develop the tools for charm and bottom separation and concentrate on this analysis.

UCLA

Year	FTE	Name	Task
2009	0.1	H Huang	HFT Physics Issues
	0.2	G Wang	CD1 Simulations
	0.2	Student	CD1 Simulations
2010	0.1	H Huang	HFT Physics
	0.3	G Wang	Prepare Physics Analysis Code
	0.3	Student	Physics Simulations
2011	0.1	H Huang	HFT Physics
	0.3	Post-doc	Physics Simulation/Analysis code development
	0.5	Student	Physics Simulation/Analysis code development
2012	0.2	H Huang	HFT Physics
	0.4	Post-doc	Physics Analysis/Tracking Software
	0.5	Student	Physics Analysis/Tracking Software
	0.5	Student	Physics Analysis/Tracking Software
2013	0.2	H Huang	HFT Physics/Operation
	0.5	Post-doc	Physics Analysis/HFT Operation
	0.5	Student	Physics Analysis/HFT Operation
	0.5	Student	Physics Analysis/HFT Operation
2014	0.2	H Huang	HFT Physics/Operation

	0.5	Post-doc	Physics Analysis/HFT Operation
	0.5	Student	Physics Analysis/HFT Operation
	0.5	Student	Physics Analysis/HFT Operation

The heavy quark physics in nucleus-nucleus collisions is one of the research topics that the UCLA group will focus on in the coming years. Our involvement in the HFT project will begin with physics simulations related to the detector performance, in particular about the measurement of B and D decay contributions to non-photonic electrons at high transverse momentum. We will also devote graduate Student to analyze open charm production from hadronic decays. Our post-doc and graduate Students will work on analysis software and evaluation of tracking using HFT in the coming years.

USTC Hefei

Year	FTE	Name	Task
2009	0.5	Student	Calibrations
2010	0.5	Student	Calibrations
2011	0.5	Student	Simulations, analysis software
2012	0.5	Postdoc	Analysis software
	0.5	Student	Simulations, Analysis software
2013	0.5	Postdoc	Analysis software, Physics analysis
	0.5	Student	Analysis software, Physics analysis
	0.5	Sun Yongjie	Work with Postdocs and Students on preparation of physics analysis
2014	0.5	Postdoc	Analysis software, Physics analysis
	0.5	Student	Analysis software, Physics analysis
	0.5	Sun Yongjie	Work with Postdocs and Students on physics analysis

The University of Science and Technology of China would participate mainly in the work related with HFT/pixel, including calibration/software development, cosmic ray test and data analysis. As for physics topics, we are interested in measuring charm production cross section, and the separation of charm and bottom production.