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TITLE OF PROPOSED PROJECT **Physics Analysis Frontier Center**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
$ 12,675,362	60 months	08/01/01	

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PI/PD DEPARTMENT	PI/PD POSTAL ADDRESS
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CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators:

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this proposal.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Social Security No.*	Date
PI/PD Kaushik De		SSNs are confidential and are not displayed *ON FASTLANE SUBMISSIONS*	
Co-PI/PD David L Adams			
Co-PI/PD Andrew G Brandt			
Co-PI/PD Asok K Ray			
Co-PI/PD Andrew P White			

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 00-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuring award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflict which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

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Is the organization delinquent on any Federal debt?	Yes ☐	No ☒
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This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure Form to Report Lobbying,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) Dr. Robert E. Witt		09/18/00

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Appendix Items:

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Physics Frontier Analysis Center

We request support for an advanced computational center at the University of Texas at Arlington (UTA) to provide innovative data analysis and data mining facilities for leading experimental and theoretical research in the fields of high energy, astro-, atomic, molecular, and mathematical physics.

The proposed Physics Frontier Analysis Center (PFAC) will consist of seven major research components (MRCs): (a) *National Off-site Computing Facility* for the Dzero Experiment[1] at Fermilab, providing new physics analysis capabilities at the energy frontier, serving over 40 collaborating institutions; (b) *Regional Computer Center* for the ATLAS Experiment[2] at CERN, to support intensive physics analysis at the next energy frontier; (c) *Computing Support Center* for the data analysis and parton distribution function (PDF) project of the CTEQ collaboration, which provides PDFs used by every hadron-initiated high energy physics analysis; (d) *Parallel Processing Center* for Lattice Gauge calculations, to explore alternatives to super-computers in calculating fundamental parameters of the strong force; (e) *Theoretical Computational Center* to support the Origins Program at NASA, in search of terrestrial extrasolar planets and life beyond the solar system; (f) *Parallel Computing Center* to develop algorithms for first principles relativistic electronic structure computations to study atomic and molecular actinides and post-actinide molecular complexes; and (g) *Numerical Simulation and Modelling Center* for direct numerical simulation of real time-dependent compressible transitional and turbulent flow.

During Run I of the D0 experiment, UTA operated the most successful off-site simulation facility[3] within the D0 collaboration, directly supporting the publication of over 50 new physics results. A new Linux Farm[4] is being deployed at UTA for Run II. Funding from NSF is crucial in expanding the capabilities of this successful Farm into a PFAC that can meet the computing needs of D0 and provide full support for physics analysis. Simultaneously, the PFAC would be a leading developmental and test facility for ATLAS computing. The CTEQ and Lattice MRCs would provide complementary phenomenological and theoretical activities. Use of the PFAC for astrophysics, molecular physics, and fluid dynamics calculations will ensure full utilization of available CPU cycles and provide a comprehensive educational environment. Brown University and Southern Methodist University will work with UTA in developing the PFAC, while the users will be physicists from hundreds of universities and laboratories.

Recruiting and training students for careers in science and the technology industry will be a primary goal of this university-based center. Located in the heart of the Dallas-Ft.Worth Metroplex, UTA serves a diverse student population, with a third from under-represented minorities: 11.3% African American, 10.3% Asian American, and 9.8% Hispanic American students enrolled in 1999-2000. UTA was one of the first pilot QuarkNet centers[5] and hosts three different summer programs for K12 teachers[6] and AP students every year.

The hardware and personnel of the proposed PFAC at UTA has been carefully optimized. We present a plan for 10k SPECInt95[7] CPU capability in 2001, growing to over 200k SPECInt95 by 2005. High speed data storage would grow from 20 Terabytes to the Petabyte scale during the same time. Network bandwidth is expected to increase from a 3xDS3 configuration to 2xGigabit ethernet. Information technology companies in the Metroplex have expressed an interest in partnerships with the UTA PFAC. Shared physical facilities, high speed network connectivity, data storage and database solutions, and student internships would become available to the UTA PFAC through these partners in private industry.

PI Current NSF support

Kaushik De is the Level 3 manager for the ATLAS Intermediate Tile Calorimeter (ITC) project, which includes UTA, Michigan State University, Argonne National Laboratory, University of Chicago and the University of Illinois at Urbana-Champaign. Construction of ITC at UTA is funded by NSF through a sub-contract with Columbia University. During the two year period 1998-2000, UTA received $703,800 from the NSF for this project. About 40% of the ITC submodules have been constructed and shipped. This project is currently ahead of schedule and proceeding smoothly. De spends 30% of his research time supervising this project. He is assisted in this project by Physicist-Engineer Dr. Jia Li, Post-doctoral Fellow Dr. Armen Vartapetian, five graduate students and numerous undergraduate students. Construction of the ITC will be essentially completed by the end of 2001, when the PFAC project starts.

D0 MRC

The D0 experiment at Fermi National Accelerator Laboratory (Fermilab) will be the major emphasis of the UTA frontier center for the first few years. The Fermilab Tevatron provides proton-antiproton collisions which are measured by the D0 detector. One highlight of the first run with this detector (and her sister CDF) was discovery of the elusive top quark. Increased luminosity for the upcoming Run II will boost the sensitivity by at least a factor of twenty and enable searches for processes with cross sections measured in femtobarns.

This combination of energy and luminosity is well beyond that available in any previous particle physics experiment. D0 investigators will measure properties of the top quark, search for supersymmetry and other extensions to the standard model, and look for the Higgs boson, which is postulated to be the origin of the mass observed in ordinary matter. Initial signs of these phenomena may appear as subtle patterns of correlations only visible with simulation resources and techniques beyond those existing, or likely to exist, at central laboratory facilities. In order to study these and other frontier physics issues, more than 500 researchers will also need to access the many hundreds of terabytes of data that D0 will produce each year.

The D0 Computing Plan provides a blueprint for accomplishing this complex task through the parallel development of a primary facility at Fermilab, a major university center, and secondary facilities at other collaborating institutions. Fermilab will provide raw data reconstruction and storage for the experiment, and provide access to the data for users at Fermilab. The proposed NSF-funded UTA PFAC will be the primary off-site center and will extend and complement these capabilities in three major ways:

1. **Processing and storage of simulated data**. There is a complicated chain connecting fundamental physical processes to the observation of detector signals in D0 collisions. Extensive simulations allow us to understand our observations and to select the appropriate events as they occur. The UTA Linux Farm for Run II has already produced about half a million events, comparable to Fermilab[8] and much more than any other D0 site. We plan to enhance our capability to produce such data and to serve as the central site for storing, reconstructing and analyzing this data. An example requiring intensive simulation is the search for supersymmetry, which requires full detector simulation of millions of events in order to explore thousands of points in a multi-dimensional parameter space.
2. **Data Reconstruction**. The Fermilab Farm will be required to reconstruct data as it comes off the detector. The UTA frontier center will extend this capability by providing additional Farm

nodes that can be used for more extensive analysis of selected streams or to reprocess data when better algorithms are developed. We will also provide software developers to optimize the code. B-quark tagging is an example of an algorithm that will need to be refined after the upgraded tracking detectors are well-understood. This capability is crucial for top quark studies, Higgs searches and supersymmetry searches, and will require re-reconstruction of a substantial fraction of the D0 data sample.

3. **Novel and innovative approaches to data analysis**. The combination of a large number of researchers and a large amount of data with limited computational resources will force D0 to restrict the manner in which the data is accessed. The UTA frontier center will encourage the development of innovative methods of data analysis to confirm and improve the quality of mainstream observations and to uncover physics signals that might otherwise be overlooked. We expect such developments to come from researchers both at the center and at remote sites. The Brown database project PHASER (described below) is an excellent example.

These capabilities have important implications for the scale of the UTA center. D0 would like to produce simulated data in the range of 10-20% of the collider data, requiring a sample of 50-100 million events per year. This requires 500-1000 processors for production and 50-100 TB/year for storage. We plan to perform a majority of the simulation and provide most of the storage in addition to re-reconstructing a fraction of the collider data as better algorithms are developed.

The center will be used both to develop new analysis techniques and to apply them to the full D0 data set. We will keep copies of all the DSTs (data summary tapes) at the center. This requires 75 TB/year. We would also keep all of the micro-DSTs (7 TB/year) on disk. A large-scale multi-processor system will provide the entry point to the center for most users. It will also provide access to the micro-DSTs and other reduced data sets for rapid analysis. High-bandwidth network access is required to serve remote users and investigators and to transfer data to the center. The system will be open for use by all members of the D0 collaboration.

David Adams (UTA Visiting Assistant Professor) will lead the D0 MRC. He is co-leader of the D0 Global Tracking Software Group and has led the implementation of the Linux Farm at UTA for Run II. He will be assisted by Mark Sosebee, Ph.D. physicist and systems specialist.

Richard Partridge (Professor) and Greg Landsberg (Assistant Professor) of Brown University will contribute to the development of novel and innovative techniques for analyzing very large data sets. The size of research data sets is growing at a tremendous pace, far surpassing the modest improvements in data access time. PHysics Analysis SERver (PHASER), which provides fast and versatile extraction of small data subsets for further high-level data analysis, is an approach to fully exploit the physics opportunities presented by these large data sets.

The PHASER concept was developed at Brown University[9] and is based on a fast commercial relational database that is used to store the key features of physics events. The database information is not meant to be an unabridged representation of the data set, but rather provides a compact "thumbnail" preview for each event in the data sample. The thumbnails are used to quickly select events based on their topology, kinematic properties, and run conditions. While there have been efforts by other high energy physics experiments (e.g., BaBar and ZEUS) to map their event data model onto an object-oriented database, we have taken an orthogonal approach that organizes the stored data according to characteristics used for event selection. Each such characteristic typically has a fixed set of attributes, so the PHASER approach is well matched to a relational database model. Since typical event selections require one or more characteristics that occur rarely in the data set, a search is quickly narrowed to a small number of candidate events. Advantages of the PHASER approach include very fast event selection, the ability to quickly update or add new characteristics, and the presence of a very competitive market for high-end relational databases.

The potential of the PHASER approach has been demonstrated using the data set from D0's first run. A Microsoft SQL Server database was loaded with thumbnails for 62 million events, occupying ~100 GB of storage. Database query times depended on the complexity of event selection and typically ranged from a few seconds to a few minutes. These preliminary results are very encouraging, especially when compared to the ~1000 CPU hours required to make a pass through the same data set using the traditional data streaming approach.

ATLAS MRC

The ATLAS experiment at LHC will have seven times the collision energy available at D0. Scheduled to start in 2006, ATLAS will be only one of two experiments capable of making a comprehensive search for the Higgs particle and supersymmetric particles after Run II at the Tevatron. The experience of operating the PFAC as the primary off-site facility for D0 will be invaluable in developing computing expertise for ATLAS. We plan a seamless transition of PFAC usage from D0 to ATLAS analysis. Users of the UTA PFAC will participate in the NSF supported GriPhyn project to develop the next generation information technology paradigm for Peta-scale Virtual Data Grid computing.

A variety of new physics processes are expected to be discovered at the LHC. The Higgs particle can be discovered up to the mass of a few TeV. Based on current precision measurements of the top quark and W masses from D0, the Higgs should be observable by ATLAS at the 95% confidence level. A large number of supersymmetric particles are also expected, otherwise severe fine tuning problems will arise with the Higgs mass. Multiple Higgs particles are possible, especially if supersymmetry exists. Finding all of these particles in the challenging high luminosity environment at the LHC will require cutting edge computational capabilities.

ATLAS plans to implement a distributed Grid approach to computing in the U.S., as described in the GriPhyN proposal to the NSF. BNL has been selected as the Tier 1 ATLAS computing facility, and will provide full mirroring of all ATLAS data, code, and documentation. Five or six Tier 2 centers will be selected in 2002 to provide simulation, analysis, and database facilities. Each Tier 2 facility is expected to provide at least 20 kSPECint95 of CPU capability, 20 Tbytes of data storage, and a dedicated gigabit network connection to BNL by 2005. The PFAC at UTA can serve as a Tier 2 facility within the ATLAS Grid with very little additional resources. Centrally located in the Dallas-Ft.Worth metroplex, UTA can readily serve a large region in southern and central U.S. comprising a large number of ATLAS institutions. The computing expertise and infrastructure developed for D0 will be invaluable in the design and implementation of an ATLAS Tier 2 center.

Various Monte Carlo Challenges to test all components of ATLAS software and analysis routines are expected, approximately one every year starting in 2003. Large CPU capacity will be needed to generate the simulated events. The GRID concept of distributed computing must be functional and effective by this time. A gentle but steady ramp up of ATLAS computing resources is shown in the budget for this proposal.

Kaushik De (Associate Professor) will lead the ATLAS MRC at the UTA PFAC. He currently supervises five physics graduate students and five engineering graduate students, and numerous Honors undergraduate students. Andrew Brandt (Assistant Professor), and Andrew White (Professor) will also contribute to ATLAS projects. Senior scientists and post-doctoral fellows include Dr. Jia Li, Dr. Armen Vartapetian, and Dr. Tomasz Wlodek. Adams and Sosebee will participate in the ATLAS MRC in later years, as their workload decreases for the D0 MRC.

CTEQ MRC

CTEQ is a multi-institutional collaboration devoted to a broad program of research projects and cooperative enterprises in high-energy physics centered on Quantum Chromodynamics (QCD) and its implications in all areas of the Standard Model and beyond[10]. This initiative evolved naturally from collaborative work on QCD phenomenology, and concentrates on tasks which demand a combined effort of theorists and experimentalists. Research topics include: global QCD analysis and extraction of parton distributions; di-muon production in deep-inelastic scattering and the strange-quark distribution; direct photon production; W- and Z-boson production; jet cross sections; heavy flavor production; higher-order calculations and resummations; higher-twist effects; and spin effects. One of the more visible products of the CTEQ collaboration are the widely used CTEQ Parton Distribution Functions (PDF's)[11]. PDF's play a fundamental role in any hadron-initiated process; as such, they are necessary for both precision tests of the standard model, as well as searches for new physics.

Fred Olness (Associate Professor) at Southern Methodist University (SMU) is a member of the CTEQ collaboration, and has been active in interpreting the heavy quark production data for use in the global parton distribution function (PDF) analysis. At SMU he collaborates with Staff Scientist Randall Scalise (who also has been active in CTEQ projects), and supervises a theory graduate student Tamara Trout. Olness will lead the activities of this MRC.

Access to the PFAC personnel and computer resources would greatly benefit the ongoing CTEQ efforts at SMU; below, we cite some specific projects where the PFAC could have significant impact:

1. The discrepancy between charged and neutral current structure functions and the determination of the strange quark PDF are long-standing puzzles. The recently collected data from the NuTeV experiment can provide the opportunity to resolve these issues. However, to properly analyze this data at the next-to-leading-order (NLO) level requires an order of magnitude more CPU than was necessary for the leading-order (LO) analysis. The result of this analysis will provide important input for the Tevatron and LHC facilities.

2. As the precision of the experimental data increases, it is important to properly assess the corresponding theoretical uncertainty; for many calculations, the uncertainty of the PDF's are the limiting factor. A number of solutions have been explored. One approach follows the Bayesian methodology where the user is given not a single PDF, but rather an ensemble of *many* PDF's distributed in PDF-parameter space; this approach is conceptually simple, but it requires an order of magnitude increase in CPU power.

3. As the data analysis and the theoretical calculations become more complex, there is a need for a more advanced programs to perform these studies. On the theoretical front, various recursion relations and resummation techniques are being used to maximize the information extracted from a given order of perturbation theory. Such techniques do reduce the manpower necessary to perform a calculation, but correspondingly increases the computer power needed.

A PFAC would have the CPU available to take on such large projects; in the process, improved algorithms would be devised to extend the scope of applicable processes.

4. The physics community is currently shifting from FORTRAN based languages to more adaptable object-oriented models such as C++. These tools provide the flexibility necessary to adapt to a wider variety of problems; however, it requires more care (and manpower) in designing the conventions and interfaces--specifically, the class library. For example, the CLHEP (Class Library for HEP) is a set of HEP-specific foundation and utility classes such as random generators, physics vectors, geometry and linear algebra, and is structured in a set of packages independent of any external package. A natural extension of this is a PDF class library which would define a uniform interface for interacting with PDF's. Some CTEQ members have already done some initial work on such an extension, and it would be valuable to have a central location to serve as a clearing house to distribute, update, and support such software.

In conclusion, the PFAC resources would significantly advance many important physics projects, and these projects (most notably the data and PDF analysis and PDF access to the physics community) provide significant benefits to the broader community.

Lattice QCD MRC

Quantum Chromodynamics (QCD) provides in principle a complete description of the strong interactions, responsible for the confinement of quarks and gluons within protons and neutrons, and their binding within nuclei. QCD has successfully confronted experimental data at short distances, where the effective coupling is weak and perturbation theory is applicable. Calculations of quantities where the coupling is strong, such as hadronic masses and matrix elements, have proven more challenging. Nevertheless, the ability to compute in this region is essential to fully test the current theory of particle interactions, to determine its fundamental parameters, and to interpret experiments designed to discover more fundamental theories. Presently, lattice gauge theory, wherein one approximates space and time by a four-dimensional lattice to allow numerical computation, provides the only viable approach.

Lattice QCD is undergoing a revolution due to several fundamental improvements in lattice calculation techniques. As a result, accurate measurements of a host of basic quantities until recently thought to be many years away, are now attainable. These improvements include a simple method for removing large tadpole renormalizations peculiar to lattice gauge fields, and the demonstration that use of a renormalized coupling constant with an appropriately chosen scale renders lattice perturbation theory reliable at scales as low as a few GeV. With these tools, effective interactions may be added to improve the lattice action on lattices with spacings as large as half a fermi, by removing lattice-spacing errors in a way that is perturbatively calculable and introduces no new parameters. This creates a Lagrangian much closer to that of continuum QCD, and allows for accurate calculations on relatively coarse lattices.

Kent Hornbostel (SMU Associate Professor) is part of a collaboration[*] which has employed these methods during the past six years to compute the properties of the Υ, Ψ, B_c systems, composed of heavy *b* and *c* quarks. The unprecedented accuracy of these calculations

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[*] Collaboration members include P. Lepage (Prof and Chair, Cornell), C. T. H. Davies (Prof, Glasgow), J. Shigemitsu (Prof, Ohio State), C. Morningstar (Asst Prof, Carnegie Mellon), and H. Trottier (Assoc Prof, Simon Fraser). Past collaborators have included J. Sloan (Research Assoc, Kentucky), and A. Lidsey and P. McCallum (Research Assocs, Glasgow).

allowed the extraction of several fundamental parameters of QCD, including the strong coupling constant α_s, and the masses of the *b* and *c* quarks. The value for α_s remains among the most precise available. The accuracy of renormalized lattice perturbation theory combined with tadpole improvement allows the coefficients of the higher-dimension interactions needed to improve actions to be computed perturbatively, without the introduction of additional parameters or numerical tuning (though this provides a viable alternate approach). As a first stage in this proposal, we plan to investigate a method in which these expansions in α_s can be deduced by comparing simulations at extremely small lattice spacings, where nonperturbative effects are negligible, to exact continuum results. Once known, the expansions can be used to fix coefficients on coarser lattices. If successful, this will automate the computation of coefficients, allowing flexibility in designing and redesigning actions. Because these simulations are sensitive to short distances, they require relatively modestly sized lattices, and the initial 100 processor Farm of the Physics Frontier Analysis Center will provide more than adequate resources.

In the second stage, we plan to employ the results of the first stage to compute several of the hadronic matrix elements needed to extract from experiment the fundamental parameters which describe quark mixing and CP violation. Obtaining the necessary accuracy will require the inclusion of the effects of light quarks. These are computationally expensive, and have been neglected in lattice simulations until recently. Current plans at other institutions envision, at the high end, multiple teraflop machines dedicated to similar computations in the next several years (Columbia Univ., and the Italian APE collaboration). Access to the proposed PFAC 1000-processor Farm would allow us to provide competitive contributions toward this effort. In addition to significant CPU, efficient use of resources dictates that intermediate results be stored. The multiple terabytes of disk space, and hundreds of terabyte of tape storage proposed should be more than adequate. Finally, the proposed professional staff would be invaluable in adapting our current C++ code and developing new algorithms to take full advantage of this parallel environment.

Astrophysics MRC

The existence of planets around many solar-type stars has been recently demonstrated by the cyclic Doppler shift of stellar spectral lines. Since the Doppler technique favors massive planets with small orbits, most detected extrasolar planets are giant (Jupiter-like) planets or brown dwarfs with orbits close to their host stars[12]. The first extrasolar planetary system has also been recently discovered[13]. The discovery of extrasolar planets and planetary systems has profound scientific and philosophical implications, including planet formation theories, dynamical stability of their orbits, their effects on the host stars, the existence of terrestrial planets in extrasolar planetary systems, formation of life on these planets, and many other related topics. Recently, NASA has started its Origins Program and scheduled several space missions in the next few years. The main goals of this program is to search for terrestrial extrasolar planets and the existence of life beyond the Solar System.

The NASA Origins program requires strong theoretical support from the scientific community and we plan to perform a series of direct numerical simulations relevant to the main objectives of the program. We are currently developing new algorithms for computations of dynamical stability of planetary orbits in newly discovered planetary systems. The algorithms will be used to study the dynamical stability of orbits of hypothetical terrestrial planets existing in habitable zones (water plausible in liquid form) near their host stars. In addition, we shall determine regions of stable planetary orbits and the extent of habitable zones in several closely located binary stars and multiple stellar systems; this will extend our previous work on HR 4374, 4375 and 6212[14]. The results of these computations will be important in selecting the best candidates for detecting first terrestrial size planets located in habitable zones of both single and multiple stars.

All known solar-type stars are sources of UV and X-ray emissions and hot tenuous winds, which originate in the most outer atmospheric layers of these stars[15]. The efficiency of these emissions and winds strongly depends on stellar age but it may also be affected by the proximity of giant planets[16]. To study the interaction between giant extrasolar planets and their host stars, we propose to construct theoretical models of stellar atmospheres by taking into account three basic physical processes: rotational synchronization, tidal interaction and magnetic interaction. These numerical models will be used to determine possible changes in the stellar UV, X-ray and wind output caused by either different age of stars[17], or the proximity of giant planets, or both. Since stellar UV and X-rays are likely to play important role in the origin of life in the extrasolar planetary systems and since stellar winds are responsible for forming and shaping planetary magnetospheres, the proposed research will be an important step towards understanding the basic physical conditions required for the origin of life in the Solar System and beyond.

Analyzing and modeling of stellar winds and mass loss from late-type stars other than the Sun is of important relevance for a variety of topics in astrophysics. First of all, it is important to understand mass loss in general because the mass loss of stars largely determines the final fate of evolved stars. Detailed studies of mass loss and stellar winds furthermore allow to quantitatively describe the changes of stellar activity and dynamos during the course of stellar evolution, as well as the physical nature of HRD dividing lines, which separate stars of different types of (magnetic) activity in the HR diagram. Eventually, studies of mass loss and stellar winds will also allow us to investigate the chemical evolution of galaxies including the process of star formation.

Investigations of mass loss and stellar winds are highly demanding, both theoretically and computationally. In fact, it is necessary to give simultaneous solutions of wave propagation and radiative transfer for multi-level atoms in generalized geometry given by the wind outflow for the particular type of star. To compute theoretical models of stellar winds, we will solve the full set of single-fluid MHD equations by using a modified version of the ZEUS 2-D MHD code[18,19]. The obtained models will be tested against the most recent observational data.

To perform the numerical simulations described above, advanced computational facilities are necessary. For example, modeling of the interaction of stellar atmospheres with giant planets and calculations of the stellar UV, X-ray and wind output will require extensive parallel computing. Currently, some of these calculations are done on DEC-Alpha workstations and the available CPU time is the main restriction for performing full scale modeling of these extraordinarily interesting stellar phenomena. The proposed PFAC at UTA will be essential for performing the described computations.

Zdzislaw Musielak (Professor) will lead the astrophysics MRC. Manfred Cuntz (Visiting Professor), Diaa E. Fawzy (Post-doc), and Rupam Das and Matthew Noble (graduate students) will participate in the work for this MRC.

Atomic and Molecular MRC

Research interest in the chemistry and physics of the actinides and the elements beyond has continued to grow over the years and computational investigations of the bonding and spectroscopy of these compounds remain very active and challenging. The quest for a better understanding of the electronic and geometric structures of these complexes continues, and in this proposal, we plan to concentrate particularly on the monomers, dimers, hydrides, and oxides of the actinide elements and beyond. Specifically, we intend to further develop an experimental code and study the electronic and geometric structures of these molecular complexes. Basic importance of the work lies in the complete understandings of high-Z elements, an area where advances have been very limited primarily due to computational reasons

To develop a proper theoretical and computational method for the actinide and post-actinide atomic and molecular systems, we note that both correlation and relativistic effects play major roles in the electronic and geometric properties of these systems. It is our belief that highly efficient computational algorithms, taking these into account, are necessary to study high-Z atomic systems and molecular complexes. Most reported research has included relativistic effects through approximations to the Dirac equation or by replacing the core electrons by a relativistic effective core potential. Indeed, we have used both of these approaches in our actinide research, using the suite of programs GTOFF and GAUSSIAN98 for molecular systems[20]. The purpose of our proposed work is to proceed beyond these approaches and develop fully relativistic computational solutions for the properties of actinide and post-actinide molecular complexes. The initial approach has been implemented in an experimental fortran code named DIRAC in serial platforms. This approach would be well-suited to the multi-processor format of the PFAC Linux Farm. We also intend to develop this code for the fully relativistic computations in massively parallel platforms and include extensive correlation treatments, which would require the SGI multi-processor system.

The proposed research will be carried out in three distinct steps for the molecular systems. We will initially concentrate on possible dimers, followed by the hydrides and then, the oxides. We intend to extend our previous calculations to all possible actinide and post-actinide dimers with fully relativistic 4-component computations. The results will provide us with very clear insight about the possibilities of the existence of these dimers, the molecular bonding in these systems as also the behavior of the f electrons. We then intend to compute the excitation spectra of the dimers, thus providing a very clear and consistent picture. We then plan to carry out a detailed study of the ground and excited states of the hydride and dihydride systems and their ions. Finally, we intend to carry out similar calculations at the fully relativistic levels, for the monoxides, dioxides and their ions.

The principal investigator in the atomic and molecular MRC is Dr. A. K. Ray, Professor of Physics at UTA. Dr. Q. Zhang, Assistant Professor of Physics, will be the co-PI. Drs. J. C. Boettger, Research Scientist and Dr. P. J. Hay, Lab Fellow, both from Theoretical Division, Los Alamos National Laboratory and Dr. G. Scoles, Donner Professor of Science, Chemistry Department, Princeton University will collaborate with us in this project. Dr. R. Hoffmann, Nobel Laureate, Department of Chemistry, Cornell University is also expected to collaborate with us.

Fluid Mechanics MRC

Fluid dynamics problems are among the most difficult in physics, involving non-linear effects such as unsteady turbulent flow, turbulent heat transfer, wakes, and vortex dynamics. These problems have practical application in design and operation of advanced flight vehicles. The overall purpose of Chaoqun Liu's (Professor) research is to develop very accurate and very efficient direct numerical simulation (DNS) and large eddy simulation (LES) code to simulate the real time-dependent compressible transitional and turbulent flow. The code will provide assistance not only for understanding the basic physics of transition and turbulence, but also for the design and operations of Air Force flight vehicles. This requires a simulation of the transitional and turbulent flow around complex configurations at all speeds, from subsonic through hypersonic. This requires significant advances in numerical algorithm development to dramatically reduce the DNS/LES cost in memory and computation time and very accurate finite difference schemes to achieve high-order accuracy even for complex geometries.

The Numerical Simulation Group (NSG) at the UTA Math Department has a large research group supported by US Air Force Office of Scientific Research (AFOSR) for more than 6 years, but his research progress has been limited by lack of computing resources at UTA. To avoid waiting for days or even weeks on a busy CRAY users queue and many hours for huge data transfer from CRAY to our local computer for each computational job, they need an SGI Origin 2000 with 16 CPUs and 10 GB memory. The SGI Origin 2000 is an advanced shared memory machine with CRAY linkage technology which is scaleable for large number of processors. SGI also has a so-called VARSITY program which can provide half-million dollar software package including FORTRAN 90, C++, and MPI to users for an annual cost of three thousand dollars. In addition, SGI has a nice reputation for its graphic technology. The access to this PFAC would dramatically enhance the capability of faculty and students, who are working on the AFOSR project, in scientific research and research-related education at University of Texas at Arlington.

This MRC will be headed by Chaoqun Liu, Professor, Department of Mathematics, assisted by Dr. Hua Shan, Post-doctoral Fellow, Dr. Li Jiang, Post-doctoral Fellow, Balaji Sreenivasa Iyangar, PhD student at Louisiana Tech University, and Sheng Luo, PhD student.

Education, Collaborations, and Facilities

One of the major problems in today's educational process is the lack of students pursuing studies in the physical and mathematical sciences. We see the proposed PFAC as a magnet to attract students through active participation in leading scientific enterprises. We will build on the success of the UTA High Energy Physics program. At any given time, we have over twenty-five undergraduate and graduate students actively involved in our work. These students gain invaluable experience working alongside faculty seeking solutions to some of the most challenging problems in experimental particle physics. Undergraduate students have received awards for the results of their research work.

The Center will allow even richer research experiences as faculty use its resources to collaborate with Center member institutes in the US, and worldwide through the international D0 and ATLAS collaborations. Through this program students will not only be encouraged to pursue careers related to the research, but will also receive training in advanced computational and data handling techniques. We are also pursuing partnerships with local information technology companies, which are relocating to the Arlington area. We expect to have completed negotiations prior to the submission deadline for the full PFC proposal.

The UTA student body is extremely diverse (approximately 1/3 minority students) and we thrive on the participation of students and staff from many different ethnic and cultural backgrounds. We educate and train large numbers of students from developing nations as well as actively encouraging students from local minorities.

UTA Physics has had a long tradition of outreach to our local high schools. Faculty have made many visits to high school classes to talk about their research and careers as physicists. Reciprocally, we have organized many visits to UTA by high school students who have spent days visiting research groups and trying out activities in undergraduate laboratories. UTA is a founding member of the NSF-funded QuarkNet initiative. Through participation of lead and associate teachers over the last two years we have directly conveyed the excitement of our research to over 600 students, particularly those from our local Hispanic population. We will continue this program and expand our contacts with teachers and students.

The UTA Physics Depatrment has an exchange program with Charles University in the Czech Republic and has established a summer school in Prague for UTA students. A female high energy physics graduate student, Petra Krivkova, is currently in residence at UTA and working on the D0 experiment. A similar exchange program is being sought with Brazilian and Mexican institutes that collaborate on the D0 experiment.

The Brown HEP group has been active in finding ways to disseminate the knowledge garnered by our research program. The PHASER project has tremendous potential for providing novel and innovative means for relating particle physics to the public. With the agreement of our collaborators, we would make available a web-based tool that would let the public perform simple searches of the PHASER database. The result of these searches would be visualizations of events of the type selected by the criteria entered on the web to provide a real sense of how particle physics is done.

The SMU physics department presents lectures and public demonstrations for area schools and local groups including: North Dallas Rotary, AAUW (American Association of University Women), "Expanding your Horizons in Science and Mathematics" (an AAUW sponsored workshop for 7th and 8th grade women), and North Texas PREP program for high school students[21]. SMU also participates in the WISE (Women In Science and Engineering) Science Day and Dallas Regional Science Fair as well as individual school science fairs and the QuarkNet program.

The Center will provide extensive opportunities for students at all levels to participate in the collection and analysis of real data from experiments in the front line of research. With the computing skills being acquired by even young students it is possible to create projects that demonstrate the nature of research, challenge young minds, and encourage scientific careers. We will set up web-based virtual experiments in order to take full advantage of the increased computer literacy of the students and new technology. We will also be able to give demonstrations and lectures using a new streaming video system.

Utilization of the PFAC will be shared by the seven MRCs included in this proposal. Table 1 shows the projected CPU capacity of the UTA PFAC Linux Farm and the proposed usage profile of the MRCs. Historical SPEC data from the past 4 years was used to extrapolate the total capacity for future years. Note the rapid increase in CPU cycles planned for D0 as the integrated luminosity grows for Run II. In 2005, D0 will have a total capacity of over 120k SPECInt95, which is 15 times the CPU capacity in 2001. ATLAS shows an increase in CPU usage starting in 2003 in order to participate in the Mock Data Challenges.

Table 1 - Projected MRC CPU Usage

	FY01	FY02	FY03	FY04	FY05
Total SPECInt95 capacity (k units)	8	23	53	110	218
D0 MRC usage	75%	70%	65%	60%	60%
ATLAS MRC usage	5%	5%	10%	15%	15%

Table 1 - Projected MRC CPU Usage

CTEQ MRC usage	5%	5%	5%	5%	5%
Lattice MRC usage	5%	10%	10%	10%	10%
Astro MRC usage	5%	5%	5%	5%	5%
Atomic MRC usage (mostly SGI)	5%	5%	5%	5%	5%
Math MRC usage (mostly SGI)	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

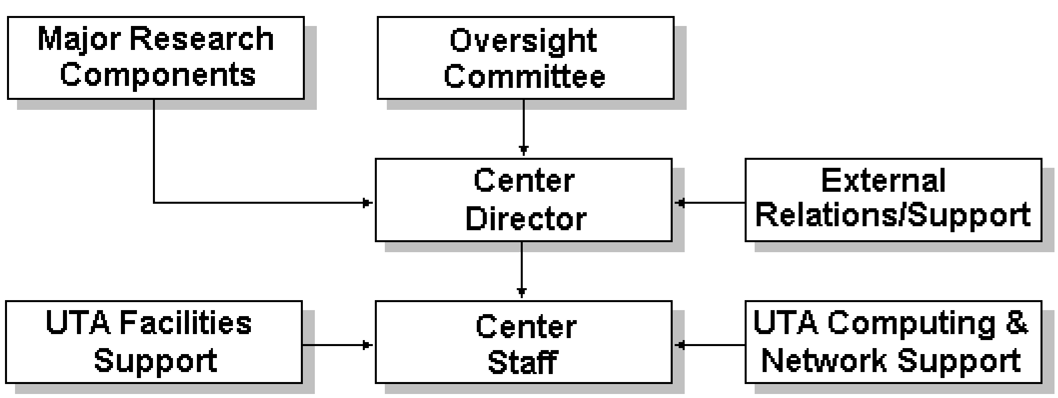
Table 2 shows the disk storage usage profile. Historical pricing data from the past 6 years was used to extrapolate the price/GB for future years. Once again, rapid increase in storage capability for the D0 experiment is foreseen.

Table 2 - Projected Server Disk Usage

	Total FY01	Total FY02	Total FY03	Total FY04	Total FY05
Server storage (TB)	20	67	178	438	1052
D0 MRC usage	14	47	124	294	736
ATLAS MRC usage	1	3	9	35	53
CTEQ MRC usage	1	3	9	22	53
Lattice MRC usage	1	3	9	22	53
Astro MRC usage	1	3	9	22	53
Atomic MRC usage	1	3	7	22	53
Math MRC usage	1	3	9	22	53
Total	**20**	**66**	**176**	**438**	**1052**

Administration and Management

Administration of the Center and management of its operations will require a close cooperation between leaders of the major research components, collaborating institutions, individual users, Center staff, and UTA Academic Computing Services. A schematic of the proposed administration and management organization is shown below.



Oversight Committee: Composed of one representative (including the PI) from each MRC, a UTA administrative representative, and representative(s) from local industry supporting the Center. A Chairperson will be elected on a rotating basis. This body sets the scientific policy for the Center within the context of the PFAC program. It also has responsibility for receiving reports of Center activities, monitoring Center performance, reviewing the Center budget, setting guidelines for the operation and use of the Center, making decisions on resource allocations, and handling new requests for use of the Center. The Committee is also responsible for preparing the annual proposal for funding to the NSF.

Center Director: A physicist appointed from participating UTA faculty, from whom he/she would draw support for the successful operation of the Center. Responsible for supervising the work of the Center computer professionals and students. The director is also the point of contact for external entities involved in the operation of the Center (computer system, network, database, software providers and maintainers).

Center Staff and Students: Various professionals, such as system managers, software developers, and database administrators, and graduate and undergraduate students will directly support the daily operations of the Center. They will also work with physics faculty to develop the computational tools to support the Center's physics mission.

UTA/ACS Computing Support: Full and/or partial FTE's providing support for systems installation and maintenance, and first line help for questions or problems arising from systems operation.

UTA/ACS Network Support: Full and/or partial FTE's providing support for local area networking at PFAC.

References

1) See http://www-d0.fnal.gov for information about the D0 experiment
2) For information about ATLAS see http://atlasinfo.cern.ch/Atlas/Welcome.html
3) See http://www-hep.uta.edu/hep/stephens/d0/utalfhist.html
4) See http://www-d0.fnal.gov/~dladams/utaFarm/
5) See http://quarknet.fnal.gov/
6) See http://honors.uta.edu/apsi/
7) See http://www.spec.org/
8) See http://www-d0.fnal.gov/~ggraham/prod_mcc99_2.html
9) "The Physics Analysis Server Project," M. Bowen, G. Landsberg, and R. Partridge, in Proceedings of CHEP 2000, p. 478 (Padova, Italy, 2000).
10) A detailed description of the collaboration, as well as a list of members is available on the web at http://www.cteq.org
11) The CTEQ4 paper (PRD55, 1280) was the most cited paper from the hep-ph archive in 1999. Details are available on the web at: http://www.slac.stanford.edu/library/topcites/top40.1999.E.hep-ph.2.html
12) Marcy G.W., and Butler R.P., 1998, Ann. Rev. Astron. Astrophys., 36, 57
13) Butler R.P., et al., 1999, Astrophys. J., 526, 916
14) Stuit T.D., and Musielak Z.E., 2000, submitted to Celest. Mech. & Dyn. Astron.
15) Narain, U., and Ulmschneider, P. 1996, Space Sci Rev., 75, 453
16) Cuntz M., Saar S.H., and Musielak Z.E., 2000, Astrophys. J. Let., 533, L151
17) Cuntz M., Ulmschneider P., and Musielak Z.E., 1998, Astrophys. J. Let., 493, L143; Musielak Z.E., Rosner R., and Ulmschneider P., 2000, Astrophys. J., 540, 281
18) Sutmann, G., and Cuntz, M. 1995, ApJ, 442, L61
19) Musielak, Z.E., and Moore, R.L. 1995, ApJ, 452, 434; Ong, K.K., Musielak, Z.E., Rosner, R., Suess, S.T., and Sulkanen, M.E. 1997, ApJ, 474, L143
20) Archibong E.F. and Ray A. K., Phys. Rev. A, 60, 5105 (1999); X. Wu and A. K. Ray, accepted by Physica B, 2000
21) See http://www.physics.smu.edu/~olness/www/demos/index.html

List of Senior Principal Investigators

David Adams, Visiting Assistant Professor, Physics Department, UTA

Andrew Brandt, Assistant Professor, Physics Department, UTA

Manfred Cuntz, Visiting Assistant Professor, Physics Department, UTA

Kaushik De, Associate Professor, Physics Department, UTA

Kent Hornbostel, Associate Professor, Department of Physics, Southern Methodist Univ.

Greg Landsberg, Assistant Professor, Department of Physics, Brown University

Chaoqun Liu, Professor, Department of Mathematics, UTA

Zdzislaw Musielak, Professor, Physics Department, UTA

Fred Olness, Associate Professor, Department of Physics, Southern Methodist Univ.

Richard Partridge, Professor, Department of Physics, Brown University

Asok Ray, Professor, Physics Department, UTA

Andrew White, Professor, Physics Department, UTA

Qiming Zhang, Assistant Professor, Physics Department, UTA

Institutional and Industrial Commitment

UTA administration is fully committed to the establishment and successful operation of the PFAC proposed here and will provide at least 15% of the total cost as a matching contribution. Brown University and Southern Methodist University have also agreed to provide 15% cost share for their subcontracts. Negotiations are underway to seek significant private sponsorship for the Center from local information technology companies.

The Office of Information Technology at UTA provides excellent infrastructure and resources in support of research. The algorithms for the proposed MRCs will be debugged and tested using the existing SGI Origin 2000 on campus, with sixteen R10000 processors, 4GB of memory and 153GB of disk space. This system will be replaced within 6 months with a new SMP machine from SGI. A large Beowulf cluster will also be available in early 2001 to support research. Hundreds of additional UNIX and Windows NT servers are deployed on campus to support academic computing.

Buildings on campus are being upgraded from 100 Mbps internet backbone to Gigabit ethernet. A new Science Building, which will house the Physics Department, is planned for 2003. The PFAC will ultimately either be housed in this building, or in the renovated facilities of a local industrial partner. The High Energy Physics (HEP) group at UTA uses a 10,000 sq. ft. building to build detectors for ATLAS and D0. This building was renovated with NSF support for use by HEP. Sufficient space is available in this building to house the Run II Linux farm and the PFAC until the new facilities become available. We anticipate using 1,700 sq.ft. during the first year rising to 3,000 sq.ft. by Year 5.

Higher bandwith network connection from UTA will soon be available through Internet II and THEnet. UTA is a member of both consortiums and will provide the necessary resources for connecting the PFAC to these high speed networks. By the end of 2000, the total capacity will be the equivalent of two DS3 connections. Upgrades will continue till Internet II reaches its planned maximum Gigabit capacity.

The UTA Honors College is one of only three such colleges in the state of Texas. All students graduating from the Honors College are required to participate in research projects and write a thesis. The experimental particle physics group supports dozens of Honors students on D0 and ATLAS. Additional gifted and motivated students from the Honors College will be available for physics analysis and code development projects at the UTA PFAC.

Summary Table of Requested NSF Support

Activity	Year 1	5 Year Total
MRC 1 - D0 Experiment	$1,683,036	$5,668,116
MRC 2 - ATLAS Experiment	$230,605	$1,308,544
MRC 3 - CTEQ PDF	$102,918	$231,007
MRC 4 - Lattice Gauge	$42,500	$221,500
MRC 5 - Astrophysics	$42,500	$191,500
MRC 6 - Atomic Physics	$51,000	$235,500
MRC 7 - Fluid Dynamics	$47,500	$206,000
Shared Experimental Facilities	$811,599	$4,087,757
Seed Funding and Emerging Areas		
Education and Human Resources	$34,040	$188,095
Outreach	$7,400	$40,890
Administration	$53,650	$296,453
Total	**$3,106,748**	**$12,675,363**

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION **University of Texas at Arlington**				FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Kaushik De**				AWARD NO.	

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES	12.00	0.00	0.00	80,000	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	250,000	
3. (8) GRADUATE STUDENTS				92,400	
4. (4) UNDERGRADUATE STUDENTS				20,000	
5. (1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				25,000	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				467,400	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				154,830	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				622,230	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
DB RAID disks			$ 40,000		
DB server			30,000		
Desktop computers			25,000		
Others (See Budget Comments Page...)			1,805,000		
TOTAL EQUIPMENT				1,900,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				20,000	
2. FOREIGN				20,000	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				20,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				173,048	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				193,048	
H. TOTAL DIRECT COSTS (A THROUGH G)				2,755,278	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) A+B+C+E+G1+((Rate: 48.0000, Base: 732230)					
TOTAL INDIRECT COSTS (F&A)				351,470	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				3,106,748	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 3,106,748	$
M. COST SHARING PROPOSED LEVEL $ 466,013	AGREED LEVEL IF DIFFERENT $				

PI / PD TYPED NAME & SIGNATURE* **Kaushik De**	DATE	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

**** D- Equipment**
DB RAID disks (Amount: $ 40000)
DB server (Amount: $ 30000)
Desktop computers (Amount: $ 25000)
Disk drives (Amount: $ 200000)
Farm CPUs (Amount: $ 150000)
Network (Amount: $ 380000)
SMP 16 system (Amount: $ 250000)
Software (Amount: $ 20000)
Tape drives+movers (Amount: $ 30000)
Tape robot (Amount: $ 525000)
Tapes (Amount: $ 250000)

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	FOR NSF USE ONLY		
University of Texas at Arlington	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Kaushik De	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES	12.00	0.00	0.00	84,000	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	315,000	
3. (8) GRADUATE STUDENTS				97,020	
4. (4) UNDERGRADUATE STUDENTS				21,000	
5. (1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				26,250	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				543,270	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				178,322	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				721,592	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
DB RAID Disks			$ 40,000		
Desktop Computers			10,000		
Disk Drives			200,000		
Others (See Budget Comments Page...)			825,000		
TOTAL EQUIPMENT				1,075,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				21,000	
2. FOREIGN				21,000	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				21,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				143,701	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				164,701	
H. TOTAL DIRECT COSTS (A THROUGH G)				2,003,293	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) A+B+C+E+G1+((Rate: 48.0000, Base: 784592)					
TOTAL INDIRECT COSTS (F&A)				376,604	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				2,379,897	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 2,379,897	$

M. COST SHARING PROPOSED LEVEL $ 356,985 AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Kaushik De		INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

**** D- Equipment**
DB RAID Disks (Amount: $ 40000)
Desktop Computers (Amount: $ 10000)
Disk Drives (Amount: $ 200000)
Farm CPUs (Amount: $ 150000)
Network (Amount: $ 150000)
SMP 16 System (Amount: $ 200000)
Software (Amount: $ 10000)
Tape Drives and Movers (Amount: $ 15000)
Tape Robot (Amount: $ 50000)
Tapes (Amount: $ 250000)

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION
University of Texas at Arlington

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Kaushik De

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES	12.00	0.00	0.00	88,200	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	330,750	
3. (8) GRADUATE STUDENTS				101,871	
4. (4) UNDERGRADUATE STUDENTS				22,050	
5. (1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				27,563	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				570,434	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				187,238	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				757,672	

D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

DB RAID disks	$ 40,000
Desktop computers	10,000
Disk drives	200,000
Others (See Budget Comments Page...)	945,000

	Funds Requested By proposer	Funds granted by NSF (if different)
TOTAL EQUIPMENT	1,195,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)	22,050	
2. FOREIGN	22,050	

F. PARTICIPANT SUPPORT COSTS

1. STIPENDS $ 0
2. TRAVEL 0
3. SUBSISTENCE 0
4. OTHER 0

	Funds Requested By proposer	Funds granted by NSF (if different)
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS	0	
G. OTHER DIRECT COSTS		
1. MATERIALS AND SUPPLIES	22,050	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION	0	
3. CONSULTANT SERVICES	0	
4. COMPUTER SERVICES	0	
5. SUBAWARDS	0	
6. OTHER	0	
TOTAL OTHER DIRECT COSTS	22,050	
H. TOTAL DIRECT COSTS (A THROUGH G)	2,018,822	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) A+B+C+E+G1 (Rate: 48.0000, Base: 823822)		
TOTAL INDIRECT COSTS (F&A)	395,434	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)	2,414,256	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)	0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)	$ 2,414,256	$

M. COST SHARING PROPOSED LEVEL $ 362,139 AGREED LEVEL IF DIFFERENT $

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Kaushik De		INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

**** D- Equipment**
DB RAID disks (Amount: $ 40000)
Desktop computers (Amount: $ 10000)
Disk drives (Amount: $ 200000)
Farm CPUs (Amount: $ 150000)
Network (Amount: $ 120000)
SMP 16 system (Amount: $ 180000)
Software (Amount: $ 10000)
Tape drives+movers (Amount: $ 15000)
Tape robot (Amount: $ 220000)
Tapes (Amount: $ 250000)

SUMMARY PROPOSAL BUDGET — YEAR 4

ORGANIZATION: **University of Texas at Arlington**				FOR NSF USE ONLY		
				PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Kaushik De**				AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES	12.00	0.00	0.00	92,610	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	347,288	
3. (8) GRADUATE STUDENTS				106,965	
4. (4) UNDERGRADUATE STUDENTS				23,153	
5. (1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				28,941	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				598,957	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				196,600	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				795,557	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
DB RAID disks			$ 40,000		
DB server			30,000		
Desktop computers			10,000		
Others (See Budget Comments Page...)			945,000		
TOTAL EQUIPMENT				1,025,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				23,153	
2. FOREIGN				23,153	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				23,153	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				23,153	
H. TOTAL DIRECT COSTS (A THROUGH G)				1,890,016	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) A+B+C+E+G1 (Rate: 48.0000, Base: 865016)					
TOTAL INDIRECT COSTS (F&A)				415,207	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				2,305,223	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 2,305,223	$

M. COST SHARING PROPOSED LEVEL $ 345,784	AGREED LEVEL IF DIFFERENT $			
PI / PD TYPED NAME & SIGNATURE* Kaushik De	DATE	FOR NSF USE ONLY — INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 4

**** D- Equipment**
DB RAID disks (Amount: $ 40000)
DB server (Amount: $ 30000)
Desktop computers (Amount: $ 10000)
Disk drives (Amount: $ 200000)
Farm servers (Amount: $ 150000)
Network (Amount: $ 90000)
SMP 16 system (Amount: $ 160000)
Software (Amount: $ 10000)
Tape drives+movers (Amount: $ 15000)
Tape robot (Amount: $ 70000)
Tapes (Amount: $ 250000)

SUMMARY PROPOSAL BUDGET

YEAR 5

ORGANIZATION	FOR NSF USE ONLY		
University of Texas at Arlington	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Kaushik De	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (2) POST DOCTORAL ASSOCIATES	12.00	0.00	0.00	97,241	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	12.00	0.00	0.00	364,652	
3. (8) GRADUATE STUDENTS				112,313	
4. (4) UNDERGRADUATE STUDENTS				24,311	
5. (1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				30,388	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				628,905	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				206,430	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				835,335	

D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)			
DB RAID disks	$ 40,000		
Desktop computers	10,000		
Disk drives	200,000		
Others (See Budget Comments Page...)	875,000		
TOTAL EQUIPMENT		1,125,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)		24,311	
2. FOREIGN		24,311	

F. PARTICIPANT SUPPORT COSTS			
1. STIPENDS	$ 0		
2. TRAVEL	0		
3. SUBSISTENCE	0		
4. OTHER	0		
TOTAL NUMBER OF PARTICIPANTS (0)	TOTAL PARTICIPANT COSTS	0	
G. OTHER DIRECT COSTS			
1. MATERIALS AND SUPPLIES		24,311	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION		0	
3. CONSULTANT SERVICES		0	
4. COMPUTER SERVICES		0	
5. SUBAWARDS		0	
6. OTHER		0	
TOTAL OTHER DIRECT COSTS		24,311	
H. TOTAL DIRECT COSTS (A THROUGH G)		2,033,268	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) A+B+C+E+G1 (Rate: 48.0000, Base: 908268)			
TOTAL INDIRECT COSTS (F&A)		435,968	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)		2,469,236	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)		0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)		$ 2,469,236	$
M. COST SHARING PROPOSED LEVEL $ 370,386	AGREED LEVEL IF DIFFERENT $		

PI / PD TYPED NAME & SIGNATURE*	DATE	FOR NSF USE ONLY		
Kaushik De		INDIRECT COST RATE VERIFICATION		
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked	Date Of Rate Sheet	Initials - ORG

SUMMARY PROPOSAL BUDGET COMMENTS - Year 5

**** D- Equipment**
DB RAID disks (Amount: $ 40000)
Desktop computers (Amount: $ 10000)
Disk drives (Amount: $ 200000)
Farm CPUs (Amount: $ 150000)
Network (Amount: $ 130000)
SMP 16 system (Amount: $ 250000)
Software (Amount: $ 10000)
Tape drives+movers (Amount: $ 15000)
Tape robot (Amount: $ 70000)
Tapes (Amount: $ 250000)

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION: University of Texas at Arlington	FOR NSF USE ONLY				
	PROPOSAL NO.	DURATION (months) Proposed	Granted		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Kaushik De	AWARD NO.				

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-mos. CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Kaushik De - none	0.00	0.00	0.00	$ 0	$
2. David Adams - none	0.00	0.00	0.00	0	
3. Andrew G Brandt - none	0.00	0.00	0.00	0	
4. Asok K Ray - none	0.00	0.00	0.00	0	
5. Andrew P White - none	0.00	0.00	0.00	0	
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (5) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	0.00	0.00	0	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (10) POST DOCTORAL ASSOCIATES	60.00	0.00	0.00	442,051	
2. (25) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	60.00	0.00	0.00	1,607,690	
3. (40) GRADUATE STUDENTS				510,569	
4. (20) UNDERGRADUATE STUDENTS				110,514	
5. (5) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				138,142	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				2,808,966	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				923,420	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				3,732,386	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) $ 6,320,000					
TOTAL EQUIPMENT				6,320,000	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				110,514	
2. FOREIGN				110,514	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				110,514	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				316,749	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				427,263	
H. TOTAL DIRECT COSTS (A THROUGH G)				10,700,677	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				1,974,685	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				12,675,362	
K. RESIDUAL FUNDS (IF FOR FURTHER SUPPORT OF CURRENT PROJECTS SEE GPG II.D.7.j.)				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ 12,675,362	$

M. COST SHARING PROPOSED LEVEL $ 1,901,307	AGREED LEVEL IF DIFFERENT $	
PI / PD TYPED NAME & SIGNATURE* Kaushik De	DATE	FOR NSF USE ONLY — INDIRECT COST RATE VERIFICATION
ORG. REP. TYPED NAME & SIGNATURE*	DATE	Date Checked / Date Of Rate Sheet / Initials - ORG

Budget Justification

The computing equipment for the proposed UTA PFAC has five components: CPU farm, SMP processor with RAID disk, database server, mass storage, and networking. The Linux CPU farm provides the bulk of the processing capability. We will buy approximately 100 CPU's each year. We assume that the cost per CPU remains roughly constant and that increasing performance (processor speed, disk, memory and cache sizes) enables us to keep up with increasing demand.

The SMP processor acts as a central login facility, as a file and web server, and provides a home for the bulk of our disk storage with fast access and significant CPU capability. Jobs with more extensive processing requirements will be transferred to the farm. Our budget assumes that the cost of adding nodes decreases by 20% each year. The scale of disk storage for the first two years is set by D0 and we assume historical price trends to meet increasing demands after that.

To deploy the PHASER database, we are requesting funds for a database server and 1 TB/year of high-performance disk for database storage. We are also requesting 12 months of support for a software professional (over a two-year period) to develop the tools needed for loading the database, enhance the existing client and middleware software, and integrate the database with the DST and microDST event storage at the center. The development work will take place at Brown, with deployment of the production system at the UTA PFAC center.

We request a half time software programmer and a database server at Southern Methodist University to develop the on-line interactive CTEQ application. Once this application is deployed at the UTA PFAC, users from around the world will be able to generate and access PDFs.

The scale of mass tape storage is set by the D0 data collection rate for 2001 and 2002. We assume that the needs of ATLAS and the increasing needs of D0 after two years can be met with slowly decreasing tape costs. Our budget allows us to purchase a 500 TB tape robot in the first year and to double its capacity in the third year. We have budgeted for four tape drives (each 12 MB/s) the first year and an additional two in subsequent years. We plan to use the SAM software developed at FNAL to manage the data in the mass store.

The networking costs have two components. The local area network for PFAC will consist of an expandable Gigabit switch and router with most nodes served by 100 Mbps ethernet. Our wide area network needs are fulfilled by existing and planned UTA internet connections, which include THEnet and connection to Internet II. We plan to lease a direct DS3 (45 Mbps) line to FNAL to allow us to capture the DSTs as they are produced and to provide reliable connection for interactive work. We assume that the leasing cost decreases significantly in future years. In the fourth year we also add a leased DS3 or OC3 line to BNL for ATLAS.

Our personnel request fall into five categories: system administration, software development, scientific, educational and administrative. We have included two system administrators to maintain the PFAC hardware, in conjunction with existing support staff. The system is expected to grow in size but not complexity and we expect two will be sufficient for the duration of the project. Software developers will work with scientists to develop codes to run at the center and to develop the control software to make use of the combined SMP and farm system. We expect two people to be resident at the center during the first two years and three during the last three. We will support half a position at Brown and SMU during the first two years. We will draw a mix of postdocs and students from physics and computer science to help with the MRCs. Support for travel and a full-time secretary is also requested for the PFAC.

Fermilab

Fermi National Accelerator Laboratory • Particle Physics Division • DØ Project
Mail Station 357 • P.O. Box 500 • Batavia, Illinois 60510 • Telephone (630) 840-4618 • Fax (630) 840-8481

The National Science Foundation
4201 Wilson Boulevard
Arlington, Virginia 22230

September 18, 2000

To whom it may concern,

This is a letter of support, on behalf of the DØ Collaboration, for the Physics Frontier Center pre-proposal submitted by the University of Texas at Arlington (UTA) together with Brown University and Southern Methodist University. UTA and Brown are collaborating in the DØ experiment at the Fermilab Tevatron proton-antiproton collider, and the principals propose a center that would strengthen and enhance the physics analysis capabilities of the whole experiment.

The DØ experiment at the Fermilab Tevatron Collider was one of the two instruments which made the first observation, in 1995, of the top quark. In addition the experiment has made a series of high precision studies of all sectors of what is known as the Standard Model of elementary particle physics and set limits on possible extensions beyond the Standard Model. Over the course of the last several years a major upgrade has been developed and constructed, which will enable the experiment to significantly improve on the existing measurements and extend the physics reach of many observables, including the possibility of discovering the Higgs boson and/or supersymmetric particles. The upgraded detector will start running in March, 2001, with the goal of accumulating 2 fb^{-1} of data (twenty times the present dataset) by 2003 and 15 fb^{-1} by 2007. The detector was built and operated by a worldwide collaboration of roughly 450 physicists from 58 institutions in 16 nations.

This proposal seeks to site substantial computing resources in the form of a center at the University of Texas at Arlington. Such a center would significantly enhance the ability of DØ to analyze the data from the next Tevatron run and improve the physics output. Firstly, it has always been assumed in DØ's computing planning that almost all simulated events (Monte Carlo data) would be generated away from Fermilab. Tevatron physics analyses usually require large amounts of simulated data in order to understand the backgrounds, signals and efficiencies, and the ability to generate samples of Monte Carlo which are comparable in statistics to real data will measurably improve our physics output. Secondly, the central computing facilities at Fermilab are not sufficient in capacity, nor really designed with the aim, of multiple repeated reprocessing of sub-samples of the data, nor of the development of innovative data access techniques. Again, we have always felt that such tasks were more suitably carried out at universities, though dedicated computing resources would be needed. Thirdly, we know from past experience that to carry out a physics analysis remotely from Fermilab is hard. A significant part of the problem is maintaining up-to-date copies of both the software and data from the experiment. By locating significant computing resources and, crucially, support personnel at a remote site, we will provide the critical mass that will ensure the center is viable and useful. We hope it can also serve as a role model, source of expertise and distribution center for data and software throughout the experiment. This experience will be very valuable as we move into the LHC era where regional centers of this kind form a central part of the computing strategy.

NSF-funded researchers from a large number of institutions have played an enormous role in DØ. Since its proposal in 1983, Grannis (NSF-Stony Brook) was sole spokesman until 1993 and co-spokesman from 1993 to 1996. From 1996 to the present one of the spokesmen (Weerts) is also NSF supported. The NSF has already made significant contributions to the detector in the form of the Level 2 Trigger (1996) and the Silicon Track Trigger (1999).

The proponents of this proposal are some of our most active faculty, some relatively early in their careers. Their efforts are fully supported by the whole collaboration. The DØ experiment fully supports the initiative embodied in this proposal and urges NSF to take this opportunity to provide support for university research at the highest energies available in the world in the next decade.

Yours sincerely, for the DØ collaboration

John Womersley
Co-spokesman, DØ Experiment

Supplementary Documentation: Letter of support from Prof. John Huth, Harvard University, Associate Project Manager, Computing and Physics, U.S. ATLAS

From huth@huhepl.harvard.edu Mon Sep 18 13:17:03 2000
Date: Mon, 18 Sep 2000 14:11:06 -0400 (EDT)
From: John Huth <huth@huhepl.harvard.edu>
To: kaushik@uta.edu
Subject: Letter

To Whom it May Concern:

I am writing this letter support of Professor Kaushik De, who is applying for NSF PFC Program Support. Kaushik and his group are very talented in the area of large scale data analysis for high energy physics. They are members of the International ATLAS Collaboration and have been discussing with us the possibilities of establishing U.T. Arlington as a potential "Tier 2" Site for ATLAS. We are welcoming their particpation in the computing aspects of this project, in particular, aspects of linking together Tier 1 and Tier 2 sites in a virtual data grid. At the moment we are leveraging our research on virtual data grids with existing resources at universities. Having a strong group, with a strong analysis center would be a tremendous asset to our collaboration. I hope you look favorably upon this proposal, as we could profit tremendously with their help.

Sincerely,

John Huth

THE UNIVERSITY OF TEXAS AT ARLINGTON

OFFICE OF THE PRESIDENT

September 18, 2000

National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Dear Sir or Madam:

This letter is in support of the proposal for the "Physics Frontier Analysis Center" submitted by Dr. Kaushik De, Professor of Physics at The University of Texas at Arlington. Should this proposal be funded, our institution would be willing to commit to a cost share of 15% of the total funds requested from NSF during the five year project.

We appreciate your consideration of this request and would be pleased to provide any additional information that may be required.

Sincerely,

Robert E. Witt
President

REW:pavg

Cc: Dr. Kaushik De

BOX 19125 701 SOUTH NEDDERMAN DRIVE ARLINGTON, TEXAS 76019-0125 T 817.272.2101 F 817.272.5656 e witt@uta.edu

BROWN UNIVERSITY
Providence, Rhode Island 02912

Department of Physics

September 18, 2000

TO WHOM IT MAY CONCERN:

Brown University is a member of the group submitting a pre-proposal for a Physics Frontier Analysis Center (PFAC), at the University of Texas at Arlington. In association with this work, it is proposed that some funds be directed to Brown University, and such are itemized in the PFAC budget.

I have been assured that Brown University will supply the appropriate cost sharing funds as required by the Proposal Guidelines and as described in the PFAC budget.

Sincerely yours,

David Cutts
Chair
Department of Physics