New Science Building Plan

University of Texas at Arlington Physics Department

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1 Introduction

The Physics Department at the University of Texas at Arlington (UTA) consists of 16 research faculty conducting a variety of research primarily in the areas of experimental and theoretical condensed matter physics, experimental high energy particle physics, experimental and theoretical astrophysics and optics. Concurrently, the faculty is responsible for teaching undergraduate physics courses required for many majors throughout the university, teaching physics undergraduate majors, and teaching and supervising physics Masters and Ph.D. students. Table 1 shows a comparison of student credit hours between the Physics and Chemistry Departments, with the Physics department clearly in the lead and growing.

<table>
<thead>
<tr>
<th>Department</th>
<th>FY2000</th>
<th>FY2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>5,063</td>
<td>5,862</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4,393</td>
<td>4,261</td>
</tr>
</tbody>
</table>

Table 1: Comparison of student credit hours for Physics and Chemistry Departments.

<table>
<thead>
<tr>
<th>Department</th>
<th>FY2001</th>
<th>FY1999-FY2001 average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>$1,870,000</td>
<td>$1,411,000</td>
</tr>
<tr>
<td>Chemistry</td>
<td>$1,061,000</td>
<td>$1,269,000</td>
</tr>
<tr>
<td>Biology</td>
<td>$525,000</td>
<td>$756,000</td>
</tr>
<tr>
<td>All others</td>
<td>$888,000</td>
<td>$919,000</td>
</tr>
<tr>
<td>Total</td>
<td>$4,344,000</td>
<td>$4,355,000</td>
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</tbody>
</table>

Table 2: College of Science external research awards.

The Physics Department leads the College of Science in external funding as shown in Table 2, which gives the breakdown by department over the past year and three years. In FY2001, the Physics Department was the highest funded department in the University, out-performing the Computer Science and Engineering Department by 40%. Another key quantity is recovery of indirect, a category in which Physics again led the College of Science with $287,000, nearly 50% more than Biology and 100% more than the Chemistry Department. These facts are all the more
impressive given the gross inequity in space between the Chemistry and Physics Departments that has existed since the recent construction of the Chemistry Research Building. A new state-of-the-art Physics Research Building (PRB) is necessary not only to maintain the high level of research funding of the Physics Department, but also to attract new grants to UTA, serve an increasing number of students, and address many current safety concerns.

2 Motivation for a New Physics Research Building

<table>
<thead>
<tr>
<th>Name</th>
<th>present needs (asq)</th>
<th>ten-year plan (asq)</th>
<th>minimal PRB (asq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Energy Physics</td>
<td>10,400</td>
<td>15,600</td>
<td>10,400</td>
</tr>
<tr>
<td>Condensed Matter and Nanotech</td>
<td>18,800</td>
<td>28,200</td>
<td>15,600</td>
</tr>
<tr>
<td>Planetarium</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Shop</td>
<td>4,000</td>
<td>5,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Teaching Laboratories</td>
<td>12,600</td>
<td>25,200</td>
<td>1,900</td>
</tr>
<tr>
<td>Theory</td>
<td>3,000</td>
<td>4,500</td>
<td>3,000</td>
</tr>
<tr>
<td>Administration</td>
<td>2,500</td>
<td>3,500</td>
<td>2,500</td>
</tr>
<tr>
<td>Faculty Offices</td>
<td>5,700</td>
<td>8,500</td>
<td>5,700</td>
</tr>
<tr>
<td>Student Offices</td>
<td>3,000</td>
<td>4,500</td>
<td>1,500</td>
</tr>
<tr>
<td>Shared Facilities</td>
<td>3,000</td>
<td>4,500</td>
<td>0</td>
</tr>
<tr>
<td>HEP Computing Center</td>
<td>4,200</td>
<td>4,200</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>71,200</strong></td>
<td><strong>107,700</strong></td>
<td><strong>48,600</strong></td>
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</tbody>
</table>

Table 3: Physics Department space needs. Column 2 shows present space requirements; Column 3 shows projected needs after 10 years; Column 4 shows minimal new construction space required.

A new Physics Research Building is necessary for several reasons. The physics department has functioned well in the antiquated Science Hall, but there are serious safety issues that can only adequately be addressed by new construction.

- The basement research labs do not have adequate ventilation or cooling.
- The planetarium does not meet fire safety codes.
- The remoteness of Swift Center makes it difficult to adequately supervise students.
- The dual Swift Center/Science Hall machine shop can lead to unsafe operating conditions.

Safety is only a part of the story, however, and cannot alone be used to justify a $30M building, as true safety concerns for Chemistry and Physics can be addressed for a fraction of this cost.
The major motivation for a new building should be to help establish UTA as a first-rate research university, and attract excellent students and new research funding. The Chemistry Department has recently added such a new facility, and the lack of one for the Physics Department is hampering our potential growth in research and students.

The present, future, and minimal new PRB space requirements are given in Table 3, with details and motivation provided in the following sections. The ten-year plan is based on the Coordinating Board study that the enrollments at UTA will double to 40,000 at the end of this period. We have assumed a 50% increase in faculty from 16 to 24 and 100% in teaching space to accommodate this growth.

2.1 High Energy Physics

The high energy physics (HEP) group is a “Center of Excellence” at UTA, performing internationally recognized research at the forefront particle physics experiments in the world. The HEP group’s research laboratories are currently located off campus at the Swift Center. This arrangement is inefficient and significantly limits the performance of the HEP group. An HEP research area integrated into the new PRB would provide many advantages and is critical in attracting new large scale projects to UTA.

The HEP area would be integrated with the physics shop, allowing for construction projects to proceed efficiently without the necessity of shipping parts from one facility to the other. The same crane equipment could be used for both areas. The faculty and student offices would also be integrated into this area allowing the faculty to supervise the construction and research activities much more effectively, providing increased efficiency and a safer working environment. Construction of part of a new Linear Collider is one of the main goals of the HEP group.

The computing farm would be adjacent to the construction area and faculty offices, allowing improved farm monitoring and operations, which will be essential in the establishment of UTA as a full-fledged Tier 2 Computing Center for the Large Hadron Collider. This project, which could bring an NSF-funded $1M/year advanced grid computing center to UTA, is a centerpiece of the HEP long range plan.

The preferred HEP space consists of a configurable construction area of 8,700 sq ft, 4,200 sq ft for a computer farm, 1,500 sq ft for student space, an electronics shop of 700 sq ft, and a work/conference
room of 1000 asq. We will minimally put the construction area, shop, and conference space in the PRB with the remainder at Science Hall.

2.2 Nanoscience

Nanotechnology is a major new discipline concerned with developing materials and techniques on the nanometer scale. UTA, with its new NanoFab facility, is in an ideal position to take advantage in developing this new sub-field. Physics research is needed to complement the engineering capabilities of the NanoFab Center, and the Physics department is currently in the middle of a faculty search in this area. The new building should include a 2,600 asq state-of-the-art research lab to allow the new hires to succeed in turning UTA into a leader in nanoscience.

2.3 Condensed Matter

The condensed matter research group is a main stay of the physics department. Their laboratories are currently in the Science Hall basement and suffer from a number of problems which hamper the effectiveness of their research. Vibrations due to tunnels under the basement limit the performance of some of the experiments and make others impossible. The low ceilings and inadequate ventilation are a safety hazard, especially due to fumes from vacuum pumps necessary for operation. Dust from heating and cooling ducts interfere with the operation of some of the sensitive equipment. The building cooling system is not adequate to counter the heat generated by some of the research equipment, making some of the rooms almost uninhabitable and introducing temperature dependent effects. All of these issues would be addressed by new high quality research labs in the new building.

Having the labs physically near to the high energy and nanoscience labs will foster collaboration between these groups, perhaps in the area of nanoscale tracking detectors. The 16,200 asq is composed of five principal research labs, a microscope lab, x-ray lab, Raman spectrometer lab, laser ablation lab, and a dark room. Of this 13,000 asq must be placed in PRB for the above reasons.

2.4 Planetarium

The astronomy program has undergone dramatic growth over the last several years. The current planetarium is not adequate: it is of insufficient size to accommodate the large number of astronomy
students and does not meet fire code standards. The astronomy labs are also inadequate for the approximately 1000 students a year who make use of them. A new larger planetarium is needed, along with larger astronomy labs. This 4,000 asq facility could be a centerpiece of new community outreach efforts as well.

2.5 Shop

The shop operations are currently split between Science Hall and the Swift Center. This leads to delays and inefficiency and is also a serious safety concern since OSHA standards require two shop workers at all times. The current loading dock is also a safety hazard. A minimal space of 4,000 asq adjacent to the HEP construction area is needed in the new building.

2.6 Theory

The theory group, consisting of two astrophysicists and four condensed matter theorists, is engaged in a broad spectrum of theoretical and computational research. Some of the areas include astrobilology, computational studies of nanostructures, semiconductors, actinides, stellar and solar magnetohydro-dynamics, theoretical stellar spectroscopy, classical and quantum chaos, and quantum field theory. Their record of research, teaching, and service parallels, if not exceeds, the record of any other group. The facilities currently available to the theory group is scattered across Science Hall and need to be integrated into a convenient, localized space just like any other group. To that end, the theory group needs space for computer laboratories, conferences, and student offices totaling 3,000 asq in the new building.

2.7 Teaching Laboratories

The teaching labs consist of five freshmen labs of 1,100 asq, three upper class labs of 1,000 asq, with storerooms of 600 and 300 asq, respectively, for a total of 9,400 asq. A computer teaching lab of 600 asq and a physics clinic of 700 asq brings the total to 10,700 asq, with the balance of 1,900 asq made up by the astronomy lab (1,000 asq) and clinic. In a scenario where limited funds are available and difficult choices have to be made, all but the 1,900 asq for astronomy could be left in Science Hall.
2.8 Offices

The new building motivated by the above concerns should include modern offices for faculty, students, and administration. The 2,500 asq administrative offices house the chair, associate chair, staff offices, mail room, conference room, etc. Eighteen faculty offices are included at 250 asq (assuming two nanotech hires), and eight adjunct faculty offices of 150 asq comprises the 5,700 asq faculty space.

2.9 PRB Summary

Given the current fiscal climate we are aware that it will be difficult to finance the expansion, and a 70,000 asq building dedicated to physics seems unlikely. In this case we could leave 10,700 asq of the teaching labs in Science Hall (excluding the astronomy labs). We would also leave some research labs, shared facilities (conference rooms, video room, lounges, etc.), and student offices in Science Hall. This would require a new building of 48,600 asq, and we would request that the other 22,600 asq be left as shell space until further funds become available. We feel that this is the minimal option to not be hopelessly out of date before the building is even completed. This size building seems consistent with the current estimates if there are 17 M$ available for physics. Assuming a cost of $210/square foot and that 60% of the total square feet are assignable, this gives about 48,600 asq building for 17$M. It should be noted that this is a minimal building, and a lower cost should be translated into more space for physics.

Given the limited resources available for a new building, the physics faculty voted unanimously for:

A new physics research building to accommodate research and office space including the new planetarium with a minimum of 48,600 assignable square feet adjacent to Science Hall. In addition we require space in Science Hall to satisfy other needs of the department.
3 Advantages of the Two Building Plan

In the building plan of September 24, 2001 (the 43M$ plan), the space allocated to chemistry was 39,300 sq with 52,000 sq assigned to physics. By keeping Science Hall, it is possible for both departments to end up better off. Classrooms can be kept in Science Hall, and if necessary we would keep 22,600 sq feet of teaching labs and other space in Science Hall. Assuming 17M$ available each for chemistry and physics that means two new buildings of approximately 48,600 sq could be built, yielding a net gain of new building space of 9,300 sq for Chemistry. Note if the Chemistry space ends up being more expensive, their net gain may be somewhat reduced, but will still be better than the original building plan.

Additional benefits include:

- A smaller new chemistry building may not interfere with the central utilities building reducing the overall cost.

- The new planetarium could be a centerpiece of the campus and improve overall campus aesthetics and outreach.

- The new buildings can be completed while operations continue in Science Hall, which will allow research and teaching activities to continue without disruption.

- Since Science Hall will not be torn down, it allows expansion space for chemistry and physics as renovation funds becomes available and allows significant class room space, which can also be increased through gradual renovation.

- The Swift Center can be torn down with the land available for student housing.

- This new PRB can be seamlessly incorporated into the campus master plan (see following section).

4 Physics Building Location

One of the goals of building a new physics building is to increase the functionality of the physics department. This can best be achieved by a building located adjacent to Science Hall, where
the physics classrooms and teaching labs will remain. There is sufficient space on the south side of Science Hall to build a new Physics Research Building, while maintaining a sizable mall area. Figure 1 shows this layout, while Fig. 2 shows a three-dimensional view—the planetarium dome would be visible from Cooper St. It would also be possible to locate this building on the north side between Science Hall and the Geology building as shown in Fig. 3 and Fig. 4—this plan has the advantage of having a terminus with the new residence hall on one end and the planetarium on the other. Either location would centralize the physics activities and be convenient for student and faculty. Minor aesthetic renovations of Science Hall could be undertaken and the resulting Science Complex would be modern, compelling, and efficient.

Figure 1: A plan showing the new PRB located to the south of Science Hall.
Figure 2: A three-dimensional rendering of the new PRB located to the south of Science Hall.

Figure 3: A plan showing the new PRB located to the north of Science Hall.
5 Comparison of Chemistry and Physics Space Needs

The new building(s) are a zero sum game pitting the space needs of the Physics and Chemistry Departments against each other. We feel that by any objective measure: size of faculty, number of students, research funding, etc., the two departments are comparable, with physics slightly ahead in all areas except for space and budget. There has long been an inexplicable inequity in space between physics and chemistry that was exacerbated by the construction of the 60,000 sq ft Chemistry Research Building, after which nearly 65% of the combined chemistry and physics space has been allocated to chemistry. For some reason the CRB is not being considered in the discussion of space even though it has offices to house more than half of the chemistry faculty and labs that have never been used.

The argument of the chemistry department appears to be: we have safety concerns, so build what we need and if there is any money left give it to the physicists. We find this argument to be unfair, unacceptable, and not in the best interests of the long range future of the College of Science or UTA. We admit there are some valid safety concerns of the Chemistry Department involving
new teaching and to a lesser extent research labs, that do need to be addressed in the new building. We believe that this can be accomplished using 10-15M$ depending on the amount of teaching lab space that is deemed necessary (in the 43M$ building plan at most 34,000 sq could be attributed to safety concerns which corresponds to only about 9M$, so any arguments that now 20-30M$ are needed for chemistry safety should be rigorously examined). Given a limited budget, these safety concerns may necessitate that some fraction of the chemistry faculty and/or administrative offices remain in Science Hall, or that CRB is more effectively utilized. We note that splitting the chemistry department is not an optimal solution, but it will be happening anyway with class rooms in Science Hall, and teaching labs, research labs, and offices in CRB I and II. The Physics Department space is currently more divided, with significant research space off campus in the Swift Center. Given limited resources, we realize that compromise is necessary, and are proposing to keep some space in Science Hall, but require a minimum of 48,600 sq in the new building, which ideally would be a separate new Physics Research Building.