MEMORANDUM

TO: Steve Halperin
Dean, College of Computer, Mathematical and Physical Sciences

FROM: Elizabeth Beise
Interim Associate Provost for Academic Planning and Programs

SUBJECT: Proposal for a joint Ph.D. program in Astronomy (PCC log no. 09081)

Your proposal to establish a joint Ph.D. program between the Department of Astronomy and the Department of Astronomy and Astrophysics at the Pontificia Universidad Católica de Chile has been administratively approved. A copy of the approved proposal is attached.

The changes are effective Fall 2010. The College should ensure that the changes are fully described in the Graduate Catalog and in all relevant descriptive materials, and that all advisors are informed.

EJB/

Enclosure

cc: Alex Chen, Chair, Senate PCC Committee
Sarah Bauder, Office of Student Financial Aid
Reka Montfort, University Senate
Erin Howard, Data Administration
Donna Williams, Institutional Research & Planning
Anne Turkos, Archives
Linda Yokoi, Office of the Registrar
Thomas Castonguay, Graduate School
Paul Smith, Computer, Mathematical and Physical Sciences
Stuart Vogel, Chair of Astronomy
College/School: College of Computer, Mathematical and Physical Sciences

Department/Program: Astronomy

Type of Action (choose one):

- Curriculum change (including informal specializations)
- Renaming of program or formal Area of Concentration
- Addition/deletion of formal Area of Concentration
- Suspend/delete program

New academic degree/award program
New Professional Studies award iteration
New Minor
Other

Italics indicate that the proposed program action must be presented to the full University Senate for consideration.

Summary of Proposed Action:

We propose a joint Ph.D. program between the Department of Astronomy at the University of Maryland and the Department of Astronomy and Astrophysics at the Pontificia Universidad Católica de Chile. Students from either institution may pursue this option, which is a partial modification of the standard Ph.D. curricula at each institution.

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APPROVAL SIGNATURES - Please print name, sign, and date. Use additional lines for multi-unit programs.

1. Department Committee Chair
   Eric McKenzie
   3/4/12

2. Department Chair
   Stuart Vogel
   2/16/10

3. College/School PCC Chair
   Paul J. Smith
   4/6/2010

4. Dean

5. Dean of the Graduate School (if required)
   5/2/10

6. Chair, Senate PCC

7. University Senate Chair (if required)

8. Vice President for Academic Affairs & Provost
   6/3/10
Joint doctoral degree in Astronomy with Pontificia Universidad Católica de Chile

The Department of Astronomy of the University of Maryland (UM) is seeking to form a partnership with the Departamento de Astronomía y Astrofísica de la Pontificia Universidad Católica de Chile (PUC). The following discussion covers an important aspect of this partnership: a proposal to add a joint Ph.D. degree option that is operated by both departments. Students from either institution may pursue this option, which is a partial modification of the standard Ph.D. curricula at each institution. Students will qualify after they have completed their host institution's standard requirements (including coursework) for admission to the Ph.D. program.

For UM, a joint doctoral degree has the fundamental advantage of providing a firm infrastructure to carry out a long-term research and education partnership. The high, dry, dark mountains of northern Chile are widely considered to be the best sites for telescopes anywhere. Many of the premier telescopes in the world are in Chile, and by law Chilean universities get access. UM students who choose the joint Ph.D. option will enjoy full access to these world-class telescopes for development and enhancement of their thesis research. UM can showcase this to attract the best U.S. and international students into its Ph.D. program. Further, due to the high visibility and prestige of astronomy in Chile, astronomy attracts some of the best students in Chile. PUC has the top research astronomy program in Chile and excellent students that would be recruited into the proposed joint degree.

For PUC, a joint Ph.D. degree will help them to retain their best students, who may otherwise pursue a Ph.D. in foreign institutions and depart the PUC program at the master level. The offering of a joint Ph.D. will also be a magnet within Chile, attracting the best students into the PUC program. Finally, it is perceived that a joint degree granted by a Chilean and a U.S. institution will increase the competitiveness of Chilean doctoral recipients in the international postdoctoral market.

Students in the joint Ph.D. option will be simultaneous full-time students of both institutions. Students in either program will be able to apply to participate in the option after they are admitted to the Ph.D. program of their home institution (typically at the start of their third year of graduate school). They will have co-advisors from each program and will have one or more semester-long stays at the partner institution. All theses will be written in English. Doctoral candidacy presentations and dissertation defenses will take place at the home institution of the student and will be transmitted by videoconference to the partner institution. The Ph.D. degree will be presented by the student's home institution and will include the names of both institutions as the degree grantors.

The following section provides a side-by-side comparison of the current and proposed graduate curricula; the current curriculum is drawn largely from the Graduate Handbook which Astronomy provides to its graduate students. Following this is a brief discussion of several relevant topics: 1) the Joint Doctoral Program Committee which will evaluate applicants, 2) program resources, and 3) program evaluation. Finally, an appendix discusses the background of the partnership with PUC and its advantages to UM in greater detail.
### Ph.D. Requirements:

<table>
<thead>
<tr>
<th>Current Curriculum</th>
<th>Proposed Curriculum</th>
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<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td><strong>Joint PhD with PUC</strong></td>
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<tr>
<td></td>
<td>After admission to the Ph.D. program (typically at the beginning of the 3rd year of study), UM students may either pursue the standard Ph.D. path or pursue a joint Ph.D. option with the Pontificia Universidad Católica de Chile (PUC). The joint Ph.D. option is similarly open to PUC graduate students who have fulfilled the requirements for a M.S. degree from the Departamento de Astronomía y Astrofísica.</td>
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<tr>
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<td>Students in the joint Ph.D. option will be simultaneous full-time students of both institutions. Curriculum details are provided in the various curricular stages discussed below.</td>
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<tr>
<th><strong>Courses, 2nd Year Research Project, and Qualifying Exam</strong></th>
<th>**PUC students follow the requirements of their department.**¹</th>
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<tr>
<td><strong>Admission to the PhD Program</strong></td>
<td>PUC students follow the requirements of their department.²</td>
</tr>
<tr>
<td>This is decided by the graduate faculty of the Department of Astronomy on the basis of the student's coursework, second-year research project, and performance on the qualifying exam. The decision would normally be made soon after the qualifier, typically by mid-September of the student's third year. The decisions which can be reached are:</td>
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<tr>
<td>1. Admission to the PhD program.</td>
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<td>2. Conditional admission. The conditions will be specified but normally consist of revisions to the research paper or additional coursework.</td>
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<tr>
<td>3. Rejection from the PhD program. In this case the student may petition the faculty for reconsideration.</td>
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¹ The PUC Departamento de Astronomía y Astrofísica requires the following for advancement in its Ph.D. program: 8 graduate-level astrophysics/physics courses, a qualifying exam, three 1-semester research modules, and demonstrated English language proficiency through an international test such as the TOEFL.
<table>
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<td>[No equivalent in current curriculum]</td>
<td><strong>Joint PhD with PUC</strong>&lt;br&gt;After admission to the Ph.D. program, UM or PUC students interested in pursuing a joint doctoral degree must identify a Chilean and a U.S. co-advisor among the professorial faculty at both institutions. Each student then applies to the partner institution (PUC or the UM Graduate School). Each student also prepares an application for the Joint Doctoral Program Committee [see p. 6]. The latter application package should contain 1) a transcript of courses and grades; 2) a copy of the completed research projects; 3) a two-page description of the intended thesis project, the observations and/or simulations necessary and how they will be obtained, and the expected stays at both institutions; and 4) letters from both co-advisors supporting the application and describing how the student will be funded throughout his or her thesis work.&lt;br&gt;The Joint Doctoral Program Committee will rank the candidates based on their submitted application materials. The chairpersons at UM and PUC will then recommend a number of the candidates thus ranked for acceptance into the joint doctoral program. They will then become registered as students at both institutions. Students that are not admitted into the joint doctoral program option are free to pursue the standard doctoral program at their home institutions.</td>
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**From Program Admission to Candidacy**<br>After admission to the Ph.D. program, students should concentrate on selecting and beginning work on a research project which will eventually become their Ph.D. thesis. A thesis committee will be constituted to reflect the student's research interests. The University requires that a member of the Graduate Faculty of the University of Maryland must be an advisor for the thesis even if much of the work is done with another scientist (e.g., at a Research Advisory Committee and Ph.D Candidacy<br>All students, whether following the standard or joint Ph.D. options, should concentrate on selecting and beginning work on a research project which will eventually become their Ph.D. thesis. A research advisory committee will be constituted to reflect the student's research interests. As per UM requirements, the advisor(s) must be a member of the Graduate Faculty of the University of
### Current Curriculum

- neighboring institution. The Department of Astronomy further requires that a member of the Graduate faculty within Astronomy unofficially look after the student if the primary advisor of the thesis is outside the Department.

Once a dissertation topic is selected, the suitability of the topic as a Ph.D. thesis as well as its viability (i.e. the likelihood of completing it in a reasonable time period) is discussed at a meeting of the thesis committee. The entire Graduate faculty of the department is to be informed of this meeting and invited to attend. At this meeting, the student will give a brief presentation followed by questions.

Once the dissertation topic is approved and all other departmental requirements have been met, the student may apply to the Graduate School for Admission to Candidacy.

### Proposed Curriculum

- Maryland. The Department of Astronomy further requires that a member of the Graduate Faculty within Astronomy unofficially look after the student if the primary advisor of the thesis is outside the department.

In the case of a joint Ph.D. student, the research advisory committee members may be from either institution but will always include at least one member from each (the co-advisors). PUC faculty will be established as Special Members of the Graduate Faculty as necessary.

Once a thesis topic is selected, the student should present his or her topic in a meeting of the research advisory committee. At this meeting, the student will give a brief presentation followed by questions. The role of the research advisory committee is to judge in detail the viability and suitability of the thesis plan and topic, and to advise changes whenever necessary. The entire graduate faculty of the department is to be informed of this meeting and invited to attend.

In the case of a joint Ph.D. student, the meeting is advertised and open to both departments. The presentation is expected to take place at the home institution of the student and will be transmitted by videoconference to the partner institution.

Once the thesis topic is approved and all other departmental requirements have been met, the student may apply to the Graduate School for Admission to Candidacy.

### From Candidacy to the Ph.D.

During this period, the student should concentrate on completing the Ph.D. research work and on writing the dissertation. The thesis must involve significant, original, and independent research, performed under the supervision of the advisor. The thesis must be of the quality normally required for publication in recognized research journals. It is usual that several drafts are gone through before the final

### From Candidacy to the Ph.D. Defense

During this period, the student should concentrate on completing the Ph.D. research work and on writing the dissertation. The thesis must involve significant, original, and independent research, performed under the supervision of the advisor. The thesis must be of the quality normally required for publication in recognized research journals. It is usual that several drafts are gone through before the final
thesis is produced. The Department will normally bear the cost of reproducing the final draft of the thesis. There are University regulations as to the format of the thesis and the mechanics of submitting it to the Graduate School. (See the Graduate School's web site at www.gradschool.umd.edu.)

**Current Curriculum**

**Proposed Curriculum**

<table>
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<th>Ph.D. Defense</th>
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<td>Once the dissertation is completed, it is defended in front of a committee consisting of members of the Department of Astronomy, members of the University faculty who are not members of the Department of Astronomy, and external examiners who are not members of the faculty of the University of Maryland. A discussion of the guidelines for the Ph.D. oral can be found on the Graduate School's web site. Once the committee has approved the dissertation, it can be submitted to the Graduate School.</td>
<td>Once the dissertation is completed, it is defended in front of a committee consisting of members of the Department of Astronomy, members of the University faculty who are not members of the Department of Astronomy (e.g. the Dean's Representative), and external examiners from other universities who have been made members of the University of Maryland's Graduate Faculty. A discussion of the guidelines for the Ph.D. oral can be found on the Graduate School's web site. Once the committee has approved the dissertation, it can be submitted to the Graduate School.</td>
</tr>
<tr>
<td><strong>Standard PhD Option</strong></td>
<td><strong>Joint Ph.D. Option</strong></td>
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| Once the dissertation is completed, it will be defended in front of a dissertation review committee. The committee membership will consist of members of both Departments of Astronomy, members of each university's faculty from other departments (including official representatives such as the University of Maryland's Dean's Representative), and external examiners from other universities. Both the latter and all PUC faculty must be established as members of the University of Maryland's Graduate Faculty in order to serve on the committee.  
  The defense will physically take place at one of the partner institutions, and be transmitted by videoconference to the other. Physical presence of the student's co-advisor from the partner institution is required; physical presence of the partner institutions' other committee | Once the dissertation is completed, it will be defended in front of a dissertation review committee. The committee membership will consist of members of both Departments of Astronomy, members of each university's faculty from other departments (including official representatives such as the University of Maryland's Dean's Representative), and external examiners from other universities. Both the latter and all PUC faculty must be established as members of the University of Maryland's Graduate Faculty in order to serve on the committee.  
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Current Curriculum | Proposed Curriculum
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members will not be required. The examination date and time will be advertised to the entire Graduate Faculty of both institutions. Final drafts of the thesis, written in English and incorporating the recommendations from the dissertation review committee, should be submitted by the candidate to the Graduate Schools of both institutions compliant with their required formats. Acceptance of the dissertation by both schools will complete the Ph.D.

**Additional Notes:**

**Joint Doctoral Program Committee:**

The Joint Doctoral Program Committee will be established jointly by the astronomy departments at UM and PUC and will study all student applications to pursue the joint doctoral option. The directors of graduate studies at UM and PUC will be ex officio members of this committee. The role of the Joint Doctoral Program Committee will be to interpret the student credentials and to rank and recommend the applicants. We envision a committee membership between 4 and 6, with symmetrical representation for PUC and UM.

**Resources:**

A common source of funding will be from grants awarded to U. Maryland PIs (or affiliated PIs, e.g. at NASA-Goddard) who have interest in working with a PUC student at UM. For each student applicant to the program, the plan presented to the Joint Doctoral Program Committee will detail the funding source and the length of time that the student will spend in residence at the other institution.

For Maryland students living in Chile, external grants (NSF, NASA) awarded to US PIs can fund them as an RA as usual. Grants can also cover expenses where specified in the grant budget or with permission from the funding agency. PUC has an inexpensive health care option.

The Chilean system provides funding for students enrolled in the PUC Ph.D. program; this funding would continue for Chilean students living in Maryland. It would typically be supplemented by partial RA support.

The pursuit of a joint Ph.D. will likely require the allocation of departmental resources beyond those necessary for a standard Ph.D., for example to support student travel or faculty visits. The Department will use its DRIF (research incentive funds) to support this. The applicant ranking provided by the Joint Doctoral Program Committee will be used to best administer limited resources by the chairpersons at both departments.

**Evaluation:**

The joint doctoral program will be officially evaluated after five years by both departments for success and mutual satisfaction. Metrics of success will be the number of students accepted into the
program and the quality and impact of the ensuing Ph.D. theses. The departments will agree to continue or to stop accepting new students into the program at this point.
Appendix: Proposal Background

Rationale

Chile has some of the best developed sites for optical, infrared, and radio astronomy on the planet. Thanks to its privileged location, wedged between the Southern Pacific ocean and the tallest peaks of the Andes, it features some of the driest and highest locations on Earth together with undisturbed Western laminar airflows from the ocean. This combination has led to the establishment of a number of top-of-the-line optical/IR and radio facilities on Chilean soil: notably the four VLT 8m-class telescopes, Gemini South, Magellan, and the 50-antenna radio-interferometer ALMA currently under construction, besides a number of planned facilities. Through agreements signed with the different international partners, Chilean astronomical institutions share 10% national access to any facility built on Chilean soil.

The concentration of so many world-class facilities on Chilean territory has resulted in the rapid expansion of astronomy during the last two decades. This expansion has been prompted by investment by foreign observatories, as well as by continuous strategic funding allocations by the Chilean government. Astronomy is justifiably seen as an area of excellence in which Chile is competing, producing world-class science. This has resulted in the more-than doubling of faculty-level positions and university astronomy programs over the last two decades.

Because this expansion has been driven by the availability of existing observational facilities on Chilean soil, it has primarily taken place in areas of astronomy that make heavy use of optical and near-infrared facilities – such as observational cosmology. Chilean astronomical development in areas such as radio, short-wavelength interferometry, high-energy astrophysics, planetary astronomy, astronomical instrumentation, and theoretical astrophysics has not proceeded as rapidly. Further development and maturity in these areas, however, is essential to fully realize the potential of Chile’s astronomical community.

In parallel with the expansion of telescopes and astronomy faculties, Chilean universities have seen an increasing influx of students into their graduate and post-graduate programs. Astronomy has been in an excellent place to capitalize on this thirst for tertiary education. Because of its prestige as one of the top science areas in Chile, it has been able to attract many of the best, brightest, most mature, and most highly motivated incoming students.

The described situation represents a unique opportunity to develop a mutually beneficial partnership between the Astronomy Department at the University of Maryland and a Chilean counterpart. UM Astronomy is traditionally strong in the areas of expertise where Chilean astronomy is less developed, and in fact it is one of the top Departments in the United States in several of them. One example is the leading role of UM in the construction and operation of mm-wave interferometers (BIMA, CARMA), and the excellent track record at training students in the relevant science and techniques of the field. Another example is the leadership of UM in space exploration missions, such as Deep Impact and the subsequent EPOXI. In addition, UM is highly regarded in computational theory. Finally, we note the great strength of the high-energy astrophysics program and the unique partnership with Goddard Space Flight Center.
Moreover, UM has in place a mature astronomy Ph.D. program that has produced some of the leaders in U.S. Astronomy. Student exchanges between well-established and newer graduate programs benefit students at both institutions, who get to experience how research is accomplished at both places and develop lifelong relations with their peers. This is in line with the renewed emphasis at UM in the development of international exchange programs and educational opportunities. Finally, collaborative access to observatories on Chilean soil for observations and/or instrument development would benefit the UM astronomy program, as would an influx of well-prepared and highly motivated Chilean students.

Partnership

In recent years we have explored the availability of partners among Chilean institutions, and have found an interested interlocutor in the Pontificia Universidad Católica de Chile (PUC). The PUC Astronomy and Astrophysics Department has fully partaken in the rapid growth of Chilean astronomy in recent times. It currently hosts 12 professorial faculty (a number similar to UM), over 20 graduate and 100 undergraduate students, and plans to continue expanding.

Although it is the second largest astronomy department by size in Chile, the youth and dynamism of PUC astronomy have helped establish it as the top Chilean research institution measured by number of refereed publications for the last several years. Moreover, PUC has an incipient initiative in astronomical instrumentation that is being developed jointly by the departments of Astronomy, Engineering and Physics. At the same time, the lack of in-house radio astronomy and interferometry expertise is a self-identified strategic weakness, and a partnership with UM is recognized as an excellent way to tackle this problem. Finally, the faculty at PUC includes top researchers in areas of astronomy that are not currently developed at UM, such as stellar astrophysics, supernovae, and extrasolar planets, conferring to the partnership a high degree of complementarity in academic expertise.

During 2008 and 2009 we have maintained a dialog with the PUC Astronomy and Astrophysics Department. Its chairman, Prof. Alejandro Clocchiatti, visited UM in December and discussed a draft framework that described a number points as mutually interesting and worth exploring: joint Ph.D. thesis research, long-term exchanges between institutions, and joint postdoctoral appointments. Profs. Stuart Vogel and Alberto Bolatto returned the visit in June, and had the opportunity to meet the full faculty and student body.

During the latter visit it became clear that an expansion of the original scope of the draft framework to include a joint doctoral program would have advantages for both institutions. A joint Ph.D. degree would allow PUC to retain its best students, who may otherwise pursue a Ph.D. in foreign institutions and depart the PUC program at the master level. The offering of such joint Ph.D. will also be a magnet within Chile, attracting the best students into the PUC program. Finally, it is perceived that a joint degree granted by a Chilean and a U.S. institution will increase the competitiveness of Chilean doctoral recipients in the international postdoctoral market.

From the standpoint of UM a joint doctoral degree has the fundamental advantage of providing a firm infrastructure to carry out a long-term research and education partnership. Students entering the joint program will be simultaneous full-time students of both institutions, and enjoy full access to the available facilities for development of their thesis research. This is also something UM can showcase to
attract the best U.S. and international students into its Ph.D. program.