

**Fiscal Unit/Academic Org** Astronomy - D0614  
**Administering College/Academic Group** Mathematical And Physical Sci  
**Co-administering College/Academic Group**  
**Semester Conversion Designation** Re-envisioned with significant changes to program goals and/or curricular requirements (e.g., degree/major name changes, changes in program goals, changes in core requirements, structural changes to tracks/options/courses)  
**Current Program/Plan Name** Astronomy  
**Proposed Program/Plan Name** Astronomy  
**Program/Plan Code Abbreviation** ASTRON-MS  
**Current Degree Title** Master of Science

**Credit Hour Explanation**

Program credit hour requirements		A) Number of credit hours in current program (Quarter credit hours)	B) Calculated result for 2/3rds of current (Semester credit hours)	C) Number of credit hours required for proposed program (Semester credit hours)	D) Change in credit hours
Total minimum credit hours required for completion of program		29	19.3	22	2.7
Required credit hours offered by the unit	Minimum	29	19.3	22	2.7
	Maximum	29	19.3	22	2.7
Required credit hours offered outside of the unit	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	0	0.0
Required prerequisite credit hours not included above	Minimum	0	0.0	0	0.0
	Maximum	0	0.0	0	0.0

**Program Learning Goals**

Note: these are required for all undergraduate degree programs and majors now, and will be required for all graduate and professional degree programs in 2012. Nonetheless, all programs are encouraged to complete these now.

**Program Learning Goals**

**Assessment**

Assessment plan includes student learning goals, how those goals are evaluated, and how the information collected is used to improve student learning. An assessment plan is required for undergraduate majors and degrees. Graduate and professional degree programs are encouraged to complete this now, but will not be required to do so until 2012.

**Is this a degree program (undergraduate, graduate, or professional) or major proposal? Yes**

**Does the degree program or major have an assessment plan on file with the university Office of Academic Affairs? No**

**DIRECT MEASURES (means of assessment that measure performance directly, are authentic and minimize mitigating or intervening factors)**

**Direct assessment methods specifically applicable to graduate programs**

- Thesis/dissertation oral defense and/or other oral presentation
- Publications

**INDIRECT MEASURES (means of assessment that are related to direct measures but are steps removed from those measures)**

**Surveys and Interviews**

- Student evaluation of instruction

**Additional types of indirect evidence**

- Job or post-baccalaureate education placement
- External program review
- Curriculum or syllabus review
- Comparison or benchmarking

**USE OF DATA (how the program uses or will use the evaluation data to make evidence-based improvements to the program periodically)**

- Meet with students directly to discuss their performance
- Analyze and discuss trends with the unit's faculty
- Make improvements in curricular requirements (e.g., add, subtract courses)
- Make improvements in course content
- Make improvements in course delivery and learning activities within courses
- Periodically confirm that current curriculum and courses are facilitating student attainment of program goals
- Benchmark against best programs in the field

**Program Specializations/Sub-Plans**

If you do not specify a program specialization/sub-plan it will be assumed you are submitting this program for all program specializations/sub-plans.

**Pre-Major**

Does this Program have a Pre-Major? No

**Attachments**

- AstronomyMasters.pdf

*(Program Proposal. Owner: Peterson,Bradley Michael)*

**Comments****Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Peterson,Bradley Michael	11/12/2010 03:58 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	11/12/2010 04:00 PM	Unit Approval
Revision Requested	Andereck,Claude David	11/18/2010 01:54 PM	College Approval
Submitted	Peterson,Bradley Michael	11/18/2010 05:41 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	11/18/2010 05:43 PM	Unit Approval
Pending Approval	Andereck,Claude David	11/18/2010 05:43 PM	College Approval



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12 November 2010

Office of Academic Affairs  
203 Bricker Hall  
190 North Oval Mall  
CAMPUS

Re: Astronomy Masters Program under Semesters

Dear colleagues,

The Department of Astronomy offers two degree programs, a Bachelor of Science with a major in Astronomy and Doctor of Philosophy in Astronomy.

The Department additionally offers a minor program in Astronomy. The Department also awards a Master of Science in Astronomy to students who complete the required graduate core courses and pass an oral examination, usually the same examination that admits students to candidacy for the PhD; students are not admitted for a Masters degree only, so we do not list this as a separate program.

Curricular changes are made through the Department's standing Curriculum Committee upon approval by the entire regular faculty. The basic structure of the current graduate curriculum was put in place nearly 20 years ago, and with small changes made on a few occasions, has generally served our students well. However, we decided that the change to the semester calendar affords an opportunity to rethink the curriculum. Most of the changes proposed here are not changes in content, but merely in packaging. There is one new course, Astron 8824, that attempts to capture numerical and statistical methods that are now either scattered through the curriculum or missing from the curriculum.

The plan proposed here has been presented to the Astronomy faculty and they have voted to support it.

As chair of the Department, I recommend approval of the Masters program as submitted here.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Bradley M. Peterson".

Bradley M. Peterson  
Professor and Chair

## **Program Rationale**

### *Background:*

The current (quarter-based) graduate program in astronomy has been in place for nearly 20 years, though with some revisions in 2003 and with the somewhat later addition of Astron 810 (Order of Magnitude Astrophysics) as a formal course. The Astronomy faculty decided to revisit the entire graduate curriculum at this time for two reasons:

- (1) The current quarter-based curriculum does not map well into a semester calendar. To first approximation, first and second year students take two courses that meet three hours per week. It is trivial to schedule instead three courses that meet two hours per week and preserve the content exactly. However, we want to avoid increasing the number of courses taken at one time. Although the total work load could in principle be preserved, adding an additional course would require a higher level of multitasking ability, a skill that we find is one of the most difficult for our graduate students to master, and is typically lacking in our first and second-year students. Furthermore, our students are required to carry out research projects concurrently with their classwork. Thus, we believe that the increased number of classes would result in a dramatic reduction in productivity.
- (2) It is an appropriate time to re-examine content. For example, the study of planets around other stars has developed into a major subfield in astronomy during the past 20 years, due to the discovery of over 500 planets orbiting other stars. We must adjust the content of our coursework to reflect this and other developments to give our students a firm grounding in cutting-edge astronomical research.

Our program philosophy is that students acquire their breadth of knowledge in astronomy by taking a set of courses that are required of all students. They acquire depth by working with professors on research projects. Our classes are thus aimed at teaching the breadth of astronomy at the level we feel every PhD astronomer should know it.

### *Basic Structure:*

In the transition from quarters to semesters, we have attempted to preserve many of the features of the quarter-based formal curriculum, specifically:

- (1) All students will take a mixture of formal courses, seminars, and directed research courses during their first two years of study. They will be expected to take the candidacy exam for the PhD at the end of their second year: passing the candidacy exam after completing the required courses is deemed to qualify the student to receive a Master's degree at this point: we do not, however, admit students whose intent is to pursue a terminal Master's degree. After admission to candidacy for the doctorate, students will take sufficient credits in Astron 8999 to be able to graduate with a PhD within five years of admission to the program.
- (2) All students will take Astron 5830 (formerly Astron 830) during their first term as graduate students. This is an important introduction to the fundamental knowledge and nomenclature of the field.

- (3) All first and second year students will take Astron 7810 (formerly Astron 810). Repeated exercise in order-of-magnitude calculations is an important part of their development as scientists.
- (4) All students will be required to participate in Department colloquia and journal club for their first two years as Astron 6801-6802 (formerly Astron 801-802-803).
- (5) We will continue to emphasize directed research during the two years of formal classes through Astron 8898 (formerly Astron 693).

*Curriculum Changes:*

The map between the semesters and courses is provided in this attachment. Some courses (Astron 825 and 869) will disappear entirely with their content moved to other courses and in some cases reduced. An expanded Astron 5830 will include all of Astron 830 plus some material from Astron 869 and new content on the modern solar system studies and extrasolar planets. An expanded Astron 8870 will include all the material from Astron 870 plus additional material from 825. An expanded Astron 8871 will include all the material from Astron 871 plus other additional material from 825. An expanded Astron 8873 will include all the material from Astron 873 plus additional material from 869. Astron 8831 will be a slightly expanded version of Astron 831 with additional material. Astron 822 and 823 will be combined, but with somewhat reduced content.

Astron 8824 is the only all new course and will be a substantial change to the curriculum. While this material is important to our students' success as researchers, they are currently expected to pick it up from a combination of ad hoc lectures and seminars, problem sets in some courses, and their own research. We think that a formal course will give students a stronger and more uniform base of preparation. Also, while it is not our primary consideration, this course would be responsive to recommendations from the Graduate School and from Astro2010/AAS that we provide training that will be valuable for students who ultimately move to other fields.

Astron 7810 will have fewer 1-1/2 hour sessions per year (14) than it currently does under quarters (20), although on average 4-6 of the quarter sessions are lost to statistics lectures or for other reasons. We feel that given the new Astron 8824 course, the loss will be minor.

We will also occasionally offer elective special topics courses as Astron 7890 during the May Term.

*Requirements for the Masters Degree:*

In general, students are not admitted to the Astronomy graduate program with the intent of pursuing a terminal Masters degree. However, we do offer the Masters degree since there are circumstances where a student leaves the program prior to completion of the PhD; moreover, we encourage continuing to the PhD to apply for the Masters degree upon completing all the requirements.

The Masters degree requires 30 semester credit hours, 22 of which are earned in required courses. The remaining 8 credit hours are earned in elective graduate-level courses in Astronomy. Upon completion of all required courses, the student must pass an oral examination; successful completion of the oral portion of the PhD candidacy examination is deemed to meet this requirement.

<b>Required Courses: Semesters</b>		
<b>Course</b>	<b>Credit</b>	<b>Total credit hours</b>
Astron 5830	5	5
Astron 6801	2 x 2	4
Astron 6802	2 x 2	4
Astron 7810	2 x 2	4
Astron 8823	3	3
Astron 8824	2	2
Astron 8831	3	3
Astron 8870	3	3
Astron 8871	3	3
Astron 8873	3	3
Total		34
Astron 8998/8999	to total	46 cr

<b>Required Courses: Quarters</b>	
<b>Required Courses</b>	<b>Credit Hours</b>
Astron 822	3
Astron 823	3
Astron 825	3
Astron 830	5
Astron 831	3
Astron 869	3
Astron 870	3
Astron 871	3
Astron 873	3
Total Required	29
<b>Elective Courses</b>	
Astron 693	1-15
Astron 801	2
Astron 802	2
Astron 803	2
Astron 810	2
Astron 890	1

Even-Numbered Years: Quarters								Cumulative
AU		WI		SP		SU		
Astron 801	2	Astron 802	2	Astron 803	2	Astron 693	15	
Astron 810	2	Astron 810	2	Astron 871	3			
Astron 830	5	Astron 825	3	Astron 693	10			
Astron 823	3	Astron 869	3					
Astron 693	3	Astron 693	5					
	15		15		15		15	60
Odd-Numbered Years: Quarters								
Astron 801	2	Astron 802	2	Astron 803	2	Astron 693	15	
Astron 810	2	Astron 810	2	Astron 873	3			
Astron 830	(5)	Astron 822	3	Astron 693	10			
Astron 831	3	Astron 870	3					
Astron 693	8	Astron 693	5					
	15		15		15		90	120
Even-Numbered Years: Semesters								
AU		SP		SU				
Astron 6801	2	Astron 6802	2	Astron 8998	15			
Astron 5830	5	Astron 7810	2					
Astron 8823	3	Astron 8831	3					
Astron 8998	5	Astron 8871	3					
		Astron 8998	5					
	15		15		15			45
Odd-Numbered Years: Semesters								
Astron 6801	2	Astron 6802	2	Astron 8998	15			
Astron 5830	(5)	Astron 8870	3					
Astron 8824	2	Astron 8873	3					
Astron 8998	11 (6)	Astron 7810	2					
		Astron 8998	5					
	15		15		15			90

Course	Semester Credit Hours	Semester Contact Hours	Quarter Courses	Quarter Hours	Quarter Contact Hours (est)	Content
Astron 5830 (Properties of Stars, Galaxies, and AGNs)	4	51.3	Astron 830 (Properties of Stars and Galaxies) Astron 869 (Observational Cosmology and AGNs)	5 3	40 (8)	All of 830 plus AGN part of 860 (1/3 of 869) and new material on planets and exoplanets.
Astron 8823 (Atomic and Radiative Processes in Astrophysics)	3	38.5	Astron 822 (Radiative Processes) Astron 823 (Astrophysical Spectroscopy)	3 3	24 24	Consolidation of 822 and 823 with compression of material.
Astron 8824 (Numerical and Statistical Methods in Astrophysics)	3	38.5	New course			See New Course Description
Astron 8831 (Stellar Structure and Evolution)	3	38.5	Astron 831 (Stellar Interiors) Astron 832 (Stellar Atmospheres)	3 (3)	24	All of 831 plus some material from 832 (not currently offered) plus new material on stellar populations and connection to observable properties of galaxies
Astron 8870 (Stellar and Gas Dynamics)	3	38.5	Astron 870 (Stellar Systems) Astron 825 (Radiative Gas Dynamics)	3 3	(18) 24	Merger of 870 and 825, less material from 870 already moved to 8871 and numerical methods material in 870 moved to 8824
Astron 8871 (Interstellar Medium and Intergalactic Medium)	3	38.5	Astron 871 (Interstellar Medium) Astron 869 (Observational Cosmology and AGNs) Astron 870 (Stellar Systems)	3 3 3	24 (3) (3)	All of 871 plus IGM from 869 plus shocks from 870 additional new IGM material.
Astron 8873 (Cosmology)	3	38.5	Astron 873 (Cosmology and Structure Formation) Astron 869 (Observational Cosmology and AGNs)	3 3	24 (8)	All of 873 plus cosmology part of 869 plus new material.

**Transition Policy:**

Students who began their degree under quarters will not be penalized as the university moves to a semester schedule, either in terms of progress towards their degree or their expected date of graduation for the PhD. We note that the transition will delay by one semester the time it will take students who enter the graduate program in 2010 or 2011 to obtain their Masters degree: however, this is not intended to be a terminal degree and the transition will not affect the time it will take to complete their PhD.

In switching from the quarter to the semester schedule, students who entered the program in 2010 will miss some content from Astron 822 that will move into Astron 8823; we will not offer Astron 822 in 2011-12 as we normally would because it will be replaced by Astron 8823 which will be offered the following year. Students entering in 2010 will make up this content by enrolling in Astron 8194 in Autumn 2012 and attending the parts of Astron 8823 in which Astron 822 content is covered.

Students who enter the program in 2011 will miss content from Astron 869 (on active galactic nuclei) and new material on planets that will be covered in Astron 5830 but was not covered in Astron 830. These students will register in another section of Astron 8194 (Group Studies) and will attend the parts of Astron 5830 that were not covered in Astron 830.

Students who entered the program in 2010 or 2011 will be encouraged, but not required, to take Astron 8824 when it is offered for the first time in Autumn 2013.

<b>Transition Plan for 2010 First Year Students</b>								
	AU		WI		SP		SU	
<b>2010-11</b>	Astron 801	2	Astron 802	2	Astron 803	2	Astron 693	15
	Astron 810	2	Astron 810	2	Astron 871	3		
	Astron 830	5	Astron 825	3	Astron 693	10		
	Astron 823	3	Astron 869	3				
	Astron 693	3	Astron 693	5				
		15		15		15		15
<b>2011-12</b>	Astron 801	2	Astron 802	2	Astron 803	2	Astron 8998	15
	Astron 810	2	Astron 810	2	Astron 873	3		
	Astron 830	(5)	Astron 870	3	Astron 693	10		
	Astron 831	3	Astron 693	8				
	Astron 693	8						
		15		15		15		15
	AU		SP		SU			
<b>2012-13</b>	<b>Astron 8194*</b>	2	Astron 8999	3	Astron 8999	3		
	Astron 8998	13						
		15		3		3		
<b>2013-14</b>	<b>Astron 8824**</b>	2	Astron 8999	3	Astron 8999	3		
	Astron 8999	(1-3)						
		3		3		3		
<p>*Astron 8194 is a Group Studies course. 2010 First Years will participate in the parts of Astron 8823 that covers material formerly in Astron 822.  **Astron 8824 may be taken as an elective.</p>								

Transition Plan for 2011 First Year Students								
	AU		WI		SP		SU	
<b>2011-12</b>	Astron 801	2	Astron 802	2	Astron 803	2	Astron 8998	15
	Astron 810	2	Astron 810	2	Astron 873	3		
	Astron 830	(5)	Astron 870	3	Astron 693	10		
	Astron 831	3	Astron 693	8				
	Astron 693	8						
		15		15		15		15
<b>2012-13</b>	AU		SP		SU			
	Astron 6801	2	Astron 6802	2	Astron 8999	3		
	<b>Astron 8194*</b>	2	Astron 7810	2				
	Astron 8823	3	Astron 8831	3				
	Astron 8998	8	Astron 8871	3				
			Astron 8998	5				
		15		15		3		
<b>2013-14</b>	<b>Astron 8824**</b>	2	Astron 8999	3	Astron 8999	3		
	Astron 8999	(1-3)						
		3		3		3		
<p>*Astron 8194 is a Group Studies course. Students will participate in the parts of Astron 5830 that were not covered in Astron 830.</p> <p>**Astron 8824 may be taken as an elective.</p>								