

Status: PENDING

**PROGRAM REQUEST**  
Astronomy

Last Updated: Myers,Dena Elizabeth  
01/03/2011

**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		45	30.0	30	0.0
Required credit hours offered by the unit	Minimum	45	30.0	30	0.0
	Maximum	45	30.0	30	0.0
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

**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

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**Attachments**

- AstronomyMasters.pdf  
*(Program Proposal. Owner: Peterson,Bradley Michael)*
- Astronomy MS cover letter.doc: NMS Division of Arts and Sciences cover letter  
*(Letter from the College to OAA. Owner: Andereck,Claude David)*

**Comments**

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Peterson,Bradley Michael	12/18/2010 08:09 PM	Submitted for Approval
Revision Requested	Peterson,Bradley Michael	12/18/2010 08:10 PM	Unit Approval
Submitted	Peterson,Bradley Michael	12/18/2010 08:12 PM	Submitted for Approval
Revision Requested	Peterson,Bradley Michael	12/29/2010 01:21 PM	Unit Approval
Submitted	Peterson,Bradley Michael	12/29/2010 01:23 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	12/29/2010 01:25 PM	Unit Approval
Approved	Andereck,Claude David	12/30/2010 03:47 PM	College Approval
Approved	Myers,Dena Elizabeth	01/03/2011 09:19 AM	GradSchool Approval
Pending Approval	Soave,Melissa A	01/03/2011 09:19 AM	CAA Approval



Division of Natural and Mathematical Sciences

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December 30, 2010

Dena Myers  
Graduate School  
250 University Hall  
230 North Oval Mall  
Campus

Dear Dena:

It is a pleasure to forward to you the proposal for the masters program in Astronomy under semesters. The department proposes a modernization and re-packaging of course materials, particularly with a new course (8824) that emphasizes statistical and computational methods applicable to astronomical research. While students are not admitted specifically to this program, some students will either acquire the degree along the way to a Ph.D. or will leave the Ph.D. program (and OSU) with the MS. As a result, the MS program is constructed of courses that are also used for the doctoral students, but the core courses required as a minimum for the MS are clearly delineated in the attachment to the proposal.

Beyond my own review of the documents, the proposal has been discussed by colleagues from other NMS units at a meeting on November 24, 2010. Feedback from these discussions has been incorporated in the proposal.

If you have any questions, I would be happy to address them.

Sincerely,

A handwritten signature in black ink, appearing to read "David Andereck".

David Andereck  
Professor of Physics  
Associate Dean of Natural and Mathematical Sciences, College of Arts and Sciences



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29 December 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. The Astronomy Masters is a non-thesis degree.

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. The vote to support the program as described here was passed unanimously 14-0 on 12 November 2010.

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:*

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 schedule of classes suggested in this document is thus designed specifically for students who intend to pursue the Ph.D. and thus exceed what is formally required for the Masters degree. For the Masters degree, we require completion of a set of “core courses” (highlighted in the tables) plus additional electives to total 45 credit hours under the quarter calendar or 30 hours under the semester calendar.

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.

### *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 during the May term 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 Masters degree at this point, While we do not admit students whose intent is to pursue a terminal Master's degree, it is unavoidable that after making some progress in the program some students opt for a terminal Masters degree, which requires completion of the core courses plus electives.
- (2) We note that all of the core courses (semester courses Astron 5830, 8823, 8824, 8831, 8870, 8871, and 8873) are explicitly required for both the Ph.D. and the Masters. The quarter-based core courses sum to 29 hours and the semester-based core courses sum to 22 hours. The Ph.D. also requires two semesters of order-of-magnitude astrophysics (Astron 7810), and four semesters of seminar (Astron 6891 and 6892), which are electives for terminal Masters students.
- (3) Most core courses are taught in alternate years because each entering graduate class is small (typically 5 individuals). All students will take Astron 5830 "Observed Properties of Astronomical Systems" (formerly Astron 830 "Observed Properties of Stars and Galaxies") during their first term as graduate students because this is an important introduction to the fundamental knowledge and nomenclature of the field. This course is therefore taught every year. Other core courses will be taught in even-numbered years (e.g., 2012-13 academic year), specifically Astron 8823 "Atomic and Radiative Processes in Astrophysics", Astron 8831 "Stellar Structure and Evolution", and Astron 8871 "The Interstellar Medium and the Intergalactic Medium), or in odd-numbered years (e.g., 2013-14 academic year), specifically Astron 8824 "Numerical and Statistical Methods in Astrophysics", Astron 8870 "Dynamics", and Astron 8873 "Cosmology".

#### *Curriculum Changes:*

The map between the semesters and courses is provided in this attachment. Course numbers were selected to identify as clearly as possible in the last three digits the quarter-based heritage of each of the semester-based classes. 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 "Observed Properties of Astronomical Systems" 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 "Dynamics" will include all the material from Astron 870 plus additional material from 825. An expanded Astron 8871 "The Interstellar Medium and Intergalactic Medium" will include all the material from Astron 871 plus other additional material from 825. An expanded Astron 8873 "Cosmology" 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 in Astron 8823 "Atomic and Radiative Processes in Astrophysics", but with somewhat reduced content. Astron 8824 "Numerical and Statistical Methods in Astrophysics" 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 Astro2010 (the National Research Council Decadal Review of Astronomy) and the American Astronomical Society 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. Students may take these as electives.

*Summary of Requirements for the Masters Degree:*

The Masters degree requires 30 semester credit hours, 22 of which are earned in required core courses. The remaining 8 credit hours are earned in elective graduate-level courses in Astronomy. The Masters degree in Astronomy does not require a thesis. 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>Courses: Quarters</b>		
<b>Required Courses</b>		<b>Total Credit Hours</b>
Astron 822	Electromagnetic Radiation	3
Astron 823	Astrophysical Spectroscopy	3
Astron 825	Radiative Gas Dynamics	3
Astron 830	Observed Properties of Stars and Galaxies	5
Astron 831	Stellar Interiors	3
Astron 869	Observational Cosmology and Active Galaxies	3
Astron 870	Stellar Systems	3
Astron 871	Interstellar Medium	3
Astron 873	Cosmology and Structure Formation	3
<b>Total Required</b>		<b>29</b>
<b>Elective Courses</b>		
Astron 801	Astronomy Seminar I	2
Astron 802	Astronomy Seminar II	2
Astron 803	Astronomy Seminar III	2
Astron 810	Order-of-Magnitude Astrophysics	2
Astron 693	Directed Research	variable
Astron 890	Topical Seminars in Astronomy	
<b>Total Credit Hours Required</b>		<b>45</b>

<b>Courses: Semesters</b>		
<b>Required Courses</b>		
Astron 5830	Observed Properties of Astronomical Systems	5
Astron 8823	Atomic and Radiative Processes in Astrophysics	3
Astron 8824	Numerical and Statistical Methods in Astrophysics	2
Astron 8831	Stellar Structure and Evolution	3
Astron 8870	Dynamics	3
Astron 8871	The Interstellar Medium and Intergalactic Medium	3
Astron 8873	Cosmology	3
<b>Total Required</b>		<b>22</b>
<b>Elective Courses</b>		
Astron 6891	Astronomy Seminar I	2
Astron 6892	Astronomy Seminar II	2
Astron 7810	Order-of-Magnitude Astrophysics	2
Astron 7890	Topical Seminars in Astronomy	1
Astron 8998	Directed Research in Astronomy and Astrophysics	variable
<b>Total Credit Hours Required</b>		<b>30</b>



Even-Numbered Years: Quarters						
AU		WI		SP		SU
Astron 801	2	Astron 802	2	Astron 803	2	Astron 693* 15
Astron 810	2	Astron 810	2	<b>Astron 871</b>	3	
<b>Astron 830†</b>	5	<b>Astron 825</b>	3	Astron 693*	10	
<b>Astron 823</b>	3	<b>Astron 869</b>	3			
Astron 693†*	3	Astron 693*	5			
Astron 693‡*	8					
	15		15		15	15
Odd-Numbered Years: Quarters						
Astron 801	2	Astron 802	2	Astron 803	2	
Astron 810	2	Astron 810	2	<b>Astron 873</b>	3	
<b>Astron 830†</b>	5	<b>Astron 822</b>	3	Astron 693*	10	
<b>Astron 831</b>	3	<b>Astron 870</b>	3			
Astron 693†*	3	Astron 693*	5			
Astron 693‡*	8					
	15		15		15	
Even-Numbered Years: Semesters						
AU		SP		SU		
Astron 6891	2	Astron 6892	2	Astron 8998*	8	
<b>Astron 5830†</b>	5	Astron 7810	2			
<b>Astron 8823</b>	3	<b>Astron 8831</b>	3			
Astron 8998†*	5	<b>Astron 8871</b>	3			
Astron 8998‡*	10	Astron 8998*	5			
	15		15		8	
Odd-Numbered Years: Semesters						
Astron 6891	2	Astron 6892	2			
<b>Astron 5830†</b>	5	<b>Astron 8870</b>	3			
<b>Astron 8824</b>	2	<b>Astron 8873</b>	3			
Astron 8998†*	6	Astron 7810	2			
Astron 8998‡*	11	Astron 8998*	5			
	15		15			

†Taken by first year students only.

‡Taken by second-year students only.

\*Variable credit-hour research class that is not explicitly required during any particular quarter or semester, except to reach total credit hour requirement.

Courses specifically required for the Masters Degree are **highlighted in bold face**.

Course	Semester Credit Hours	Semester Contact Hours	Quarter Courses	Quarter Contact Hours (est)	Quarter Hours	Quarter Contact Hours (est)	Content
Astron 8830 (Properties of Stars, Galaxies, and AGNs)	4	51.3	Astron 830 (Properties of Stars and Galaxies) Astron 869 (Observational Cosmology and AGNs)	5 3	5 (8)	40 (8)	All of 830 plus AGN part of 860 (1/3 of 869) and new material on planets and exoplanets.
Astron 6891 (Astronomy Seminar I)	2	28	Astron 801 (Astronomy Seminar I)	2	2	20	Semester version of quarter sequence.
Astron 6892 (Astronomy Seminar II)	2	28	Astron 802 (Astronomy Seminar II)	2	2	20	
Astron 7193 (Individual Studies)	variable	variable	Astron 803 (Astronomy Seminar III) Astron 693 (Individual Studies)	2 variable	2 variable	20 variable	
Astron 7810 (Order of Magnitude Astrophysics)	4	42	Astron 810 (Order of Magnitude Astrophysics)	8	8	60	Some material from 810 moved to 8824.
Astron 7890 (Topical Seminars in Astronomy)	1	6	Astron 890 (Topical Seminars in Astronomy)	1	6	6	Topical Seminars in May Term
Astron 8194 (Group Studies)	variable	variable	Astron 694 (Group Studies)	variable	variable	variable	
Astron 8823 (Atomic and Radiative Processes in Astrophysics)	3	38.5	Astron 822 (Radiative Processes) Astron 823 (Astrophysical Spectroscopy)	3 3	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)	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	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	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	3 (8)	24 (8)	All of 873 plus cosmology part of 869 plus new material.
Astron 8898 (Directed Research in Astronomy and Astrophysics)	variable	variable	Astron 693 (Individual Studies)	variable	variable	variable	

**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 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. Terminal masters students entering in 2010 will not be required to take Astron 822 or Astron 8823. Students who entered the program in 2010 are able to complete a terminal Masters degree before the conversion to semesters begins so no further transition policy is required.

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. Terminal Masters students who entered the program in 2011 will not be required to take Astron 8824.

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	8
	Astron 810	2	Astron 810	2	<b>Astron 873</b>	3		
	<b>Astron 830</b>	(5)	<b>Astron 870</b>	3	Astron 693	10		
	<b>Astron 831</b>	3	Astron 693	8				
	Astron 693	8						
		15		15		15		8
<b>2012-13</b>	AU		SP					
	Astron 6891	2	Astron 6892	2				
	<b>Astron 8194*</b>	2	Astron 7810	2				
	<b>Astron 8823</b>	3	<b>Astron 8831</b>	3				
	Astron 8998	8	<b>Astron 8871</b>	3				
			Astron 8998	5				
		15		15				
*Astron 8194 is a Group Studies course. Students will participate in the parts of Astron 5830 that were not covered in Astron 830.								