

# ASTRONOMY - DOCTOR OF PHILOSOPHY

The Astronomy Department at NMSU offers programs leading to the Master of Science and the Doctor of Philosophy degrees. Graduate courses ([http://astronomy.nmsu.edu/?page\\_id=2503](http://astronomy.nmsu.edu/?page_id=2503)) cover topics across all of astrophysics, including stellar atmospheres, observational techniques, the interstellar medium, galactic structure, extragalactic objects, cosmology, the Sun, and planets. Students may also take courses in other relevant fields to broaden their knowledge and capabilities. NOTE: This table is only a minimum. As students must register for minimum 9 credits per semester to remain full time, a student will usually obtain more than the minimum 6 credits of ASTR 600 Pre-dissertation Research and 18 credits of ASTR 700 Doctoral Dissertation in order to complete their thesis.

## Requirements

In order to complete the comprehensive exam by preparing a Doctor of Philosophy proposal.

The student will normally submit their proposed thesis title, and then complete their written and oral thesis proposal, as the final part of their comprehensive exam in Year 3. The following table can be used to run a Degree Audit at this stage. Student must have already completed the written coursework comprehensive and oral coursework comprehensive components. After the completion of their comprehensive through passing the PhD proposal, the student will normally apply for and obtain a masters and continue with their progress on the PhD track.

Prefix	Title	Credits
ASTR 500	Seminar ((Take the 1 credit course four times))	4
Choose nine courses from among the following ASTR graduate courses <sup>2</sup>		27
ASTR 503	Fundamentals of Astrophysics	
ASTR 506	Dynamics and Hydrodynamics	
ASTR 530	Gas and Radiative Processes	
ASTR 535	Observational Techniques	
ASTR 545	Stellar Spectroscopy	
ASTR 555	Galaxies I	
ASTR 565	Stellar Interiors	
ASTR 605	Interstellar Medium	
ASTR 616	Galaxies II	
ASTR 620	Planetary Processes	
ASTR 621	Planetary System Formation	
ASTR 630	Statistical and Numerical Methods in Astrophysics	
ASTR 670	Heliophysics, Space Plasmas, and Space Weather	
ASTR 698	Special Topics.	
Select additional six credits from the ASTR courses above OR from the courses below <sup>3</sup>		6
PHYS 462	Intermediate Electricity and Magnetism II	
PHYS 511	Mathematical Methods of Physics I	
PHYS 554	Quantum Mechanics I	
PHYS 562	Electromagnetic Theory II	
PHYS 571	Advanced Experimental Optics	
PHYS 576	Advanced Computational Physics I	
E E 528	Fundamentals of Photonics	

E E 577	Fourier Methods in Electro-Optics	
CSCI 5994	Master's Project	
Special Research Programs <sup>4</sup>		
Pre-dissertation Research <sup>5</sup>		
ASTR 600	Pre-dissertation Research	6
ASTR 598	Special Research Programs	3
<b>Total Credits</b>		<b>46</b>

<sup>1</sup> ASTR 500 Seminar is 1-credit course. It should be taken each of the first 4 semesters, for 4 total credits over the program

<sup>2</sup> Any 27 credits (9 courses) selected from these. Each course may only be taken for 3 credits.

<sup>3</sup> In addition to 9 courses from above, students should select another 2 courses (3 credits each, 6 credits total). This can be either another two astronomy graduate classes from above (which will make 11 total different astronomy courses) OR student may opt to take up to 2 out-of-department classes to fulfill the overall credit requirements if these classes are deemed by the student's committee to be appropriate to the student's program-of-study.

A maximum of one 3-credit course numbered between 450 and 499 can be applied to the out-of-department course/credit-hour requirement, and only with the approval of the student's Committee. Otherwise, out of department classes must be at the 500 or greater level.

If more than 6 credits of out-of-department classes are taken, they may potentially count toward the required total courses/credit hours, but only with the approval of the student's Committee.

Traditionally, these have been in the area of PHYS, E E and CSCI, as listed. Other Physics courses, or courses offered by other departments such as Engineering, Geology, or Math, are also viable as out-of-department courses. Additionally, for those students intending to specialize in planetary science, courses taught in the Geology department and Geophysics courses taught in the Physics department should be considered.

<sup>4</sup> ASTR 598 Special Research Programs is generally taken in the student's 2nd year (fall or spring) and is intended to provide a semi-formal introduction to doing a research project. It may involve research that subsequently develops into a thesis project.

<sup>5</sup> Generally, ASTR 600 Pre-dissertation Research credits are prior to completion of the thesis proposal. A student may take anywhere from 1-9 credits of these in a semester. Students typically take 9 credits of this course each semester until they have completed their thesis proposal. However, only a minimum of 6 are actually required over the program. ASTR 600 Pre-dissertation Research credits may be in progress.

## In order to complete a PhD thesis defense

The MINIMUM course and credit-hour requirements of the NMSU Department of Astronomy toward completion of the Ph.D. program are

Prefix	Title	Credits
<b>Requirements</b>		
ASTR 500	Seminar (Take the 1 credit course four times)	4
Choose nine courses from among the following ASTR graduate courses <sup>2</sup>		27
ASTR 503	Fundamentals of Astrophysics	
ASTR 506	Dynamics and Hydrodynamics	
ASTR 530	Gas and Radiative Processes	
ASTR 535	Observational Techniques	
ASTR 545	Stellar Spectroscopy	

ASTR 555	Galaxies I	
ASTR 565	Stellar Interiors	
ASTR 605	Interstellar Medium	
ASTR 616	Galaxies II	
ASTR 620	Planetary Processes	
ASTR 621	Planetary System Formation	
ASTR 630	Statistical and Numerical Methods in Astrophysics	
ASTR 670	Heliophysics, Space Plasmas, and Space Weather	
ASTR 671	Solar Astrophysics	
ASTR 698	Special Topics.	
Select additional six credits from the ASTR courses above OR from the courses below <sup>3</sup>		6
PHYS 462	Intermediate Electricity and Magnetism II	
PHYS 511	Mathematical Methods of Physics I	
PHYS 554	Quantum Mechanics I	
PHYS 562	Electromagnetic Theory II	
PHYS 571	Advanced Experimental Optics	
PHYS 576	Advanced Computational Physics I	
E E 528	Fundamentals of Photonics	
E E 565	Machine Learning I	
E E 577	Fourier Methods in Electro-Optics	
CSCI 5996	Special Topics	
<i>Special Research Programs</i> <sup>4</sup>		
ASTR 598	Special Research Programs	3
<i>Pre-dissertation Research</i> <sup>5</sup>		
ASTR 600	Pre-dissertation Research	6
<i>Doctoral Dissertation</i> <sup>6</sup>		
ASTR 700	Doctoral Dissertation	1-15
<b>Total Credits</b>		<b>65-79</b>

<sup>1</sup> ASTR 500 Seminar is 1-credit course. It should be taken each of the first 4 semesters, for 4 total credits over the program

<sup>2</sup> Any 27 credits (9 courses) selected from these. Each course may only be taken for 3 credits.

<sup>3</sup> In addition to 9 courses from above, students should select another 2 courses (3 credits each, 6 credits total). This can be either another two astronomy graduate classes from above (which will make 11 total different astronomy courses) OR student may opt to take up to 2 out-of-department classes to fulfill the overall credit requirements if these classes are deemed by the student's committee to be appropriate to the student's program-of-study.

A maximum of one 3-credit course numbered between 450 and 499 can be applied to the out-of-department course/credit-hour requirement, and only with the approval of the student's Committee. Otherwise, out of department classes must be at the 500 or greater level.

If more than 6 credits of out-of-department classes are taken, they may potentially count toward the required total courses/credit hours, but only with the approval of the student's Committee.

Traditionally, these have been in the area of PHYS, E E and CSCI, as listed. Other Physics courses, or courses offered by other departments such as Engineering, Geology, or Math, are also viable as out-of-department courses. Additionally, for those students intending to specialize in planetary science, courses taught in the Geology department and Geophysics courses taught in the Physics department should be considered.

<sup>4</sup> ASTR 598 Special Research Programs is generally taken in the student's 2nd year (fall or spring) and is intended to provide a semi-

formal introduction to doing a research project. It may involve research that subsequently develops into a thesis project.

<sup>5</sup> Generally, ASTR 600 Pre-dissertation Research credits are prior to completion of the thesis proposal. A student may take anywhere from 1-9 credits of these in a semester. Students typically take 9 credits of this course each semester until they have completed their thesis proposal. However, only a minimum of 6 are actually required over the program.

<sup>6</sup> Generally, ASTR 700 Doctoral Dissertation credits are taken after the thesis proposal is done. A student may take anywhere from 1-9 credits of these in a semester. Typically a student will do 9 credits of this per semester while completing their thesis research, in order to remain full time. However a student may register for fewer in their final semester of completing their thesis, after confirming with their advisor as to how that affects their eligibility at the graduate school. A minimum of 18 credits are required over the program

## Year A

### A Suggested Plan of Study For Students

A typical roadmap for the PhD program, including course and credit-hour minimum requirements, towards completion of the Ph.D. program are summarized in the following table. Note there is some flexibility for each of these components, so students should confirm all their selections directly with their advisor. Most regular graduate courses (501-597, 601-699) are offered on a 2 year rotation. So specific courses will depend on whether a student is on a year A or Year B cycle. ASTR 503 Fundamentals of Astrophysics is offered each fall and should be taken by all students in their first year only. Students may opt for up to 2 courses (6 credits) from outside the department (See Course Requirements). ASTR 598 Special Research Programs, ASTR 600 Pre-dissertation Research and ASTR 700 Doctoral Dissertation are offered every semester, as one-on-one research credits with an advisor

#### First Year

Fall		Credits
ASTR 500	Seminar <sup>1</sup>	1
ASTR 503	Fundamentals of Astrophysics	3
Choose two from the following:		6
ASTR 535	Observational Techniques	
ASTR 565	Stellar Interiors	
ASTR 605	Interstellar Medium	
<b>Credits</b>		<b>10</b>

#### Spring

ASTR 500	Seminar <sup>1</sup>	1
Choose three from the following:		9
ASTR 621	Planetary System Formation	
ASTR 630	Statistical and Numerical Methods in Astrophysics	
ASTR 670	Heliophysics, Space Plasmas, and Space Weather	
<b>Credits</b>		<b>10</b>

#### Second Year

Fall		
ASTR 500	Seminar <sup>1</sup>	1
Choose three of the following <sup>2</sup>		9
ASTR 555	Galaxies I	
ASTR 620	Planetary Processes	
ASTR 698	Special Topics.	

Research Programs Course <sup>2</sup>		0-3
ASTR 598	Special Research Programs <sup>2</sup>	
	<b>Credits</b>	<b>10-13</b>
<b>Spring</b>		
ASTR 500	Seminar <sup>1</sup>	1
Choose three of the following: <sup>2</sup>		
ASTR 506	Dynamics and Hydrodynamics	
ASTR 545	Stellar Spectroscopy	
ASTR 616	Galaxies II	
Research Programs Course <sup>2</sup>		0-3
ASTR 598	Special Research Programs <sup>2</sup>	
ASTR 671	Solar Astrophysics	
	<b>Credits</b>	<b>10-13</b>
<b>Third Year</b>		
<b>Fall</b>		
ASTR 600	Pre-dissertation Research <sup>3</sup>	6-9
ASTR 698	Special Topics. <sup>5</sup>	1
	<b>Credits</b>	<b>7-10</b>
<b>Spring</b>		
ASTR 600 or ASTR 700	Pre-dissertation Research <sup>4</sup> or Doctoral Dissertation	6-9
	<b>Credits</b>	<b>6-9</b>
<b>Fourth Year</b>		
<b>Fall</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
	<b>Credits</b>	<b>3-9</b>
<b>Spring</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
	<b>Credits</b>	<b>3-9</b>
<b>Fifth Year</b>		
<b>Fall</b>		
ASTR 700 <sup>4</sup>		3-9
	<b>Credits</b>	<b>3-9</b>
<b>Spring</b>		
ASTR 700 <sup>4</sup>		3-9
	<b>Credits</b>	<b>3-9</b>
<b>Sixth Year</b>		
<b>Fall</b>		
ASTR 700 as required to complete the PhD <sup>6</sup>		-
	<b>Credits</b>	<b>0</b>
<b>Spring</b>		
ASTR 700 as required to complete the PhD <sup>6</sup>		-
	<b>Credits</b>	<b>0</b>
	<b>Total Credits</b>	<b>65-101</b>

<sup>1</sup> Students **must** take ASTR 500 Seminar as 1-credit in each of their first 4 semesters, for a total of 4 credits over 2 years

<sup>2</sup> Students **must** take ASTR 598 Special Research Programs for 3 credits during fall of Yr2 or Spring of Yr2

<sup>3</sup> Students **must** continue taking ASTR 600 Pre-dissertation Research until they have completed their Comprehensive Exam. Once a student had completed their Comprehensive Exam, they should start taking ASTR 700 Doctoral Dissertation the following semester. The **minimum total number** of ASTR 600 Pre-dissertation Research credits for Course Requirements is 6, but students must enroll in 9 credits each semester in order to remain full time and retain eligibility for an GA.

Usually students will take 8 ASTR 600 Pre-dissertation Research and 1 ASTR 698 Special Topics. in Fall of Yr 3.

<sup>4</sup> Assumes a student has completed their Comprehensive Exam - see footnote 3. The minimum number of ASTR 700 Doctoral Dissertation credits for Course Requirements is 18, but students must enroll in 9 credits each semester in order to remain full time and retain eligibility for an GA.

<sup>5</sup> ASTR 698 Special Topics. in Yr 3 Fall is a 1-credit Thesis Preparation class for all students who are also taking ASTR 600 Pre-dissertation Research that semester

<sup>6</sup> For students who do not complete their PhD in 5 years, they must continue to enroll in 9 credits of ASTR 700 Doctoral Dissertation each semester in order to remain full time and retain eligibility for an GA. For students in their final semester of dissertation writing, it is possible to petition the Graduate School for permission to enroll in fewer credits, for that one semester only, to reduce tuition expenses.

## Year B

### A Suggested Plan of Study For Students

A typical roadmap for the PhD program, including course and credit-hour minimum requirements, towards completion of the Ph.D. program are summarized in the following table. Note there is some flexibility for each of these components, so students should confirm all their selections directly with their advisor. Most regular graduate courses (501-597, 601-699) are offered on a 2 year rotation. So specific courses will depend on whether a student is on a year A or Year B cycle. ASTR 503 Fundamentals of Astrophysics is offered each fall and should be taken by all students in their first year only. Students may opt for up to 2 courses (6 credits) from outside the department (See Course Requirements). ASTR 598 Special Research Programs, ASTR 600 Pre-dissertation Research and ASTR 700 Doctoral Dissertation are offered every semester, as one-on-one research credits with an advisor

#### First Year

Fall		Credits
ASTR 500	Seminar <sup>1</sup>	1
ASTR 503	Fundamentals of Astrophysics	3
Choose two from the following:		6
ASTR 555	Galaxies I	
ASTR 620	Planetary Processes	
ASTR 698	Special Topics.	
	<b>Credits</b>	<b>10</b>

#### Spring

ASTR 500	Seminar <sup>1</sup>	1
Choose three from the following:		9
ASTR 506	Dynamics and Hydrodynamics	
ASTR 545	Stellar Spectroscopy	
ASTR 616	Galaxies II	
ASTR 598	Special Research Programs	
	<b>Credits</b>	<b>10</b>

#### Second Year

Fall		Credits
ASTR 500	Seminar <sup>1</sup>	1
ASTR 555	Galaxies I	-
Choose three from the following:		9
ASTR 535	Observational Techniques	
ASTR 565	Stellar Interiors	
ASTR 605	Interstellar Medium	

ASTR 598	Special Research Programs <sup>1</sup>	3
<b>Credits</b>		<b>13</b>
<b>Spring</b>		
ASTR 500	Seminar <sup>1</sup>	1
Choose two from the following: <sup>2</sup>		6
ASTR 621	Planetary System Formation	
ASTR 630	Statistical and Numerical Methods in Astrophysics	
ASTR 670	Heliophysics, Space Plasmas, and Space Weather	
ASTR 598	Special Research Programs	1-6
<b>Credits</b>		<b>8-13</b>
<b>Third Year</b>		
<b>Fall</b>		
ASTR 600	Pre-dissertation Research <sup>3</sup>	6-9
ASTR 698	Special Topics.	1
<b>Credits</b>		<b>7-10</b>
<b>Spring</b>		
ASTR 700 or ASTR 600	Doctoral Dissertation <sup>4</sup> or Pre-dissertation Research	6-9
<b>Credits</b>		<b>6-9</b>
<b>Fourth Year</b>		
<b>Fall</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
<b>Credits</b>		<b>3-9</b>
<b>Spring</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
<b>Credits</b>		<b>3-9</b>
<b>Fifth Year</b>		
<b>Fall</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
<b>Credits</b>		<b>3-9</b>
<b>Spring</b>		
ASTR 700	Doctoral Dissertation <sup>4</sup>	3-9
<b>Credits</b>		<b>3-9</b>
<b>Sixth Year</b>		
<b>Fall</b>		
ASTR 700 as required to complete the PhD <sup>6</sup>		-
<b>Credits</b>		<b>0</b>
<b>Spring</b>		
ASTR 700 as required to complete the PhD <sup>6</sup>		-
<b>Credits</b>		<b>0</b>
<b>Total Credits</b>		<b>66-101</b>

<sup>4</sup> Assumes a student has completed their Comprehensive Exam - see footnote 3. The minimum number of ASTR 700 Doctoral Dissertation credits for Course Requirements is 18, but students must enroll in 9 credits each semester in order to remain full time and retain eligibility for an GA.

<sup>5</sup> ASTR 698 Special Topics. in Yr 3 Fall is a 1-credit Thesis Preparation class for all students who are also taking ASTR 600 Pre-dissertation Research that semester

<sup>6</sup> For students who do not complete their PhD in 5 years, they must continue to enroll in 9 credits of ASTR 700 Doctoral Dissertation each semester in order to remain full time and retain eligibility for an GA. For students in their final semester of dissertation writing, it is possible to petition the Graduate School for permission to enroll in fewer credits, for that one semester only, to reduce tuition expenses.

<sup>1</sup> Students **must** take ASTR 500 Seminar as 1-credit in each of their first 4 semesters, for a total of 4 credits over 2 years

<sup>2</sup> Students **must** take ASTR 598 Special Research Programs for 3 credits during fall of Yr2 or Spring of Yr2

<sup>3</sup> Students **must** continue taking ASTR 600 Pre-dissertation Research until they have completed their Comprehensive Exam. Once a student had completed their Comprehensive Exam, they should start taking ASTR 700 Doctoral Dissertation the following semester. The **minimum total number** of ASTR 600 Pre-dissertation Research credits for Course Requirements is 6, but students must enroll in 9 credits each semester in order to remain full time and retain eligibility for an GA. Usually students will take 8 ASTR 600 Pre-dissertation Research and 1 ASTR 698 Special Topics. in Fall of Yr 3.