



<http://kicp-courses.uchicago.edu/2012/>

## SHORT COURSE MATERIALS



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THE UNIVERSITY OF  
**CHICAGO**

<http://www.uchicago.edu/>

The Kavli Institute for Cosmological Physics (KICP) at the University of Chicago will host the "Dark Matters" Short Cosmology Course on September 26-28, 2012.

### Course Lecturers

**Juan Collar**  
KICP, University of Chicago

**Michael Gladders**  
KICP, University of Chicago

**Dan Hooper**  
Fermilab, KICP, University of Chicago

**Andrey Kravtsov**  
KICP, University of Chicago

**Paolo Privitera**  
KICP, University of Chicago

**Michael Turner**  
KICP, University of Chicago

### Course Directors

**Juan Collar**  
KICP, University of Chicago

**Randall Landsberg**  
KICP, University of Chicago

**Paolo Privitera**  
KICP, University of Chicago

### Course Description: Dark Matters

The past twenty years have brought enormous advances in our understanding of the Universe. Evidence from multiple forms of investigation including: precise measurements of the CMB, supernovae, statistical studies of the structures of the Universe, gravitational lensing, baryon acoustic oscillations, theory and phenomenological simulations all point to the same concordance model: a Universe that started with a big bang and then went through a brief period of superluminal growth (i.e. inflation); which is currently expanding at an accelerated rate and has a matter energy composition of:

- \* 72% dark energy
- \* **23% dark matter**
- \* 4.6% atoms
- \* 0.4% photons

However nice and neat this picture is, it remains full of unknowns. This short course will explore in depth one of the major mysteries on which this model rests: **dark matter**. It will provide you with the current big cosmological picture, gritty details of the on going searches for dark matter, stories from the forefronts of research and resources that will help you to bring **dark matter** back to your home institution in a meaningful way. You will meet the individuals behind the headlines and the course format will provide abundant time for informal interactions with them and your peers.

Beyond the big picture and how dark matter fits into this picture, we will delve much deeper into this mysterious stuff that comprises almost a quarter of the universe. We will explore the evidence for the existence of dark matter, what models and experimental evidence point to as potential candidates for the particles that compose dark matter, and how dark matter might be detected. Dark matter detection and detector hardware will be a special focus of this course. We will explore direct detection, indirect detection, accelerator searchers (i.e., producing it in an accelerator and then detecting the decay particles) and the hardware that makes these searchers possible.

### What you can expect from this course

- \* A better understanding of the BIG Picture of cosmology
- \* To meet and talk with researchers at the forefronts
- \* To tour laboratories and learn about the limits of detector technology
- \* Hands-on experiences with dark matter detectors
- \* To visit the Adler Planetarium & Astronomy Museum to see innovative ways to bring current cosmology into a museum
- \* Tools and resources to bring forefront research into your home institution

**Short Course Program**

September 26-27 @ KICP; September 28 @ Adler Planetarium.

**September 26, 2012**

8:30 AM	<i>COFFEE &amp; WELCOME</i> LASR 152
9:00 AM - 9:15 AM	<b>Randall H. Landsberg</b> , KICP, University of Chicago <b>Course opening</b>
9:15 AM - 10:00 AM	<b>Michael S. Turner</b> , KICP, University of Chicago Lecture: <b>Overview</b>
10:00 AM - 10:30 AM	<i>COFFEE QUESTIONS &amp; ANSWER SESSION</i>
10:30 AM - 12:00 PM	<b>Michael D. Gladders</b> , KICP, University of Chicago Lecture: <b>Observational Evidence for Dark Matter esp. Gravitational Lensing</b>
12:00 PM - 1:00 PM	<i>LUNCH</i>
1:00 PM - 2:30 PM	<b>Andrey V. Kravtsov</b> , KICP, University of Chicago Lecture: <b>Dark Matter &amp; Structure Formation</b>
2:30 PM - 3:00 PM	<i>COFFEE QUESTIONS &amp; ANSWER SESSION</i>
	<b>LAB ACTIVITY</b>
3:00 PM - 6:00 PM	<i>CLUSTER LAB GOOGLE SKY &amp; WINE BOTTLE - GRAVITATIONAL LENSING</i> KPTC 311 <i>Michael D. Gladders, Abby Crites &amp; Denis Erkal</i>
6:30 PM	<i>DINNER &amp; SOCIAL</i>

**September 27, 2012**

8:30 AM - 9:10 AM	<i>COFFEE QUESTIONS &amp; ANSWER SESSION</i>
9:00 AM - 10:30 AM	<b>Dan Hooper</b> , Fermilab, KICP, University of Chicago Lecture: <b>Particle Physics of Dark Matter &amp; Constraining Dark Matter Candidates</b>
10:30 AM - 11:00 AM	<i>BREAK OUT SESSION/COFFEE</i>
11:00 AM - 12:30 PM	<b>Paolo Privitera</b> , KICP, University of Chicago Lecture: <b>Detectors Fundamentals</b>
12:30 PM - 1:30 PM	<i>INFORMAL LUNCH</i>
1:30 PM - 3:00 PM	<b>Juan I. Collar</b> , KICP, University of Chicago Lecture: <b>Directly Detecting Dark Matter</b>
3:00 PM - 3:30 PM	<i>COFFEE QUESTIONS &amp; ANSWER SESSION</i>

**LAB ACTIVITY**

- 3:30 PM - 6:30 PM      *DETECTORS*  
LASR sub-basement & 262  
*Paolo Privitera & Juan Collar*
- 6:45 PM                *DINNER & SOCIAL*

**September 28, 2012**

- 7:00 AM - 8:30 AM      *BREAKFAST & QUESTIONS @ I-HOUSE*

**TRANSPORTATION TO ADLER PLANETARIUM**

- 8:30 AM                *BUS BOARDS*  
transportation to Adler Planetarium
- 8:45 AM                *BUS DEPARTS*  
for the Adler Planetarium

**ADLER PLANETARIUM**

- 9:30 AM - 10:30 AM    *DEMOS*  
Grainger Theater  
*Mark SubbaRao + KICP researchers*
- 10:30 AM                *WELCOME TO THE UNIVERSE*  
Universe Theater (3D) and/or WWT the dome
- 11:00 AM - 11:30 AM    *COFFEE BREAK @ CAFE*
- 11:30 AM - 12:00 PM    *GALLERY TOUR*
- 12:00 PM - 12:30 PM    **Michael S. Turner**, KICP, University of Chicago  
Lecture: **Wrap Up**
- 12:30 PM - 2:30 PM    *LUNCH & INFORMAL Q&A - CLOSE OUT @ CAFE*  
*Michael S. Turner*
- 2:30 PM                *TRAVEL OR MORE TIME @ ADLER*

**Course Lecturers & Participants**

1. Mary J. Becker           Starryboards LLC
2. Daniel B Bellot         Planetario Max Scherier
3. Jeanne E. Bishop       Westlake Schools Planetarium
4. Alexandre Cherman     Rio de Janeiro Planetarium
5. Joseph Childers         Boonshoft Museum of Discovery
6. Larry A Ciupik          Adler Planetarium
7. Juan I. Collar          KICP, University of Chicago
8. Jason S Davis          The Cleveland Museum of Natural History
9. Jon W. Elvert          Louisiana Art & Science Museum
10. Steve Fentress         Strasenburgh Planetarium, Rochester Museum & Science Center
11. Michael D. Gladders    KICP, University of Chicago
12. Dan Hooper             Fermilab, KICP, University of Chicago
13. Dimitri Klebe         Denver Museum of Nature and Science
14. Andrey V. Kravtsov     KICP, University of Chicago
15. Paul J Krupinski        Rochester Museum & Science Center's Strasenburgh Planetarium AND Mr. K's Mobile Dome Planetarium
16. Randall H. Landsberg   KICP, University of Chicago
17. Mary Leighton         Dept of Anthropology, University of Chicago
18. Sarah E Littler         Fort Worth Museum of Science and History
19. Trevor McNeill         University of Michigan (student - senior)
20. Mark Paternostro       Adler Planetarium
21. Paolo Privitera         KICP, University of Chicago
22. Martin Ratcliffe        Sky-Skan, Inc
23. Kyle N Sater          Adler Planetarium
24. Amy Sayle             Morehead Planetarium and Science Center
25. John A Schroer         Michigan Science Center
26. Patricia (Patty) Seaton  Howard B. Owens Science Center
27. Laatsch Shawn         Imiloa Astronomy Center
28. Michael Sperry         Sky-Skan, Inc
29. Michael S. Turner       KICP, University of Chicago
30. Amy Ziffer             John J. McCarthy Observatory

## Short Course Lectures & Talks

1. **Juan I. Collar**, KICP, University of Chicago  
*Lecture: Directly Detecting Dark Matter*  
  
September 27, 2012 (1:30 PM - 3:00 PM)
2. **Michael D. Gladders**, KICP, University of Chicago  
*Lecture: Observational Evidence for Dark Matter esp. Gravitational Lensing*  
  
September 26, 2012 (10:30 AM - 12:00 PM)
3. **Dan Hooper**, Fermilab, KICP, University of Chicago  
*Lecture: Particle Physics of Dark Matter & Constraining Dark Matter Candidates*  
  
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*Lecture: Dark Matter & Structure Formation*  
  
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5. **Randall H. Landsberg**, KICP, University of Chicago  
*Talk: Course opening*  
  
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6. **Paolo Privitera**, KICP, University of Chicago  
*Lecture: Detectors Fundamentals*  
  
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*Lecture: Wrap Up*  
  
September 28, 2012 (12:00 PM - 12:30 PM)