

Advanced Cosmology

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SS 2022

University of Heidelberg

with help from

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Thanks to C.Pfrommer for some of his slides

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My teaching pages:

<https://www.thphys.uni-heidelberg.de/~amendola/teaching.html>

Course material and information:

<https://www.thphys.uni-heidelberg.de/~amendola/advcosm-ss2022.html>

Goals

- Learn about current cosmological research
- **Educate** your classmates
- Develop scientific presentations **skills** and improve public **speaking** (in English!)
- Learn how to **learn** quickly and effectively **read** scientific literature
- Become comfortable **discussing** science given only a ‘shallow’ understanding

Format of the seminars

- We have compiled a list of several cosmology topics
- Work in pairs and jointly present a given topic
- Each person should plan to speak for 20 minutes, and expect about 5 minutes of interruptions

Topics

- 1. Supernovae and cosmology
- 2. Cold Dark Matter and numerical cosmology
- 3. From dark matter halos to galaxies
- 4. Alternatives to a cosmological constant
- 5. Cosmic Microwave Background
- 6. Gravitational Lensing
- 7. Gravitational Lensing of the CMB
- 8. CMB polarisation and GW from inflation
- 9. Galaxy clusters as cosmological probes
- 10. The Sunyaev-Zel'dovich effect
- 11. Strong gravitational lensing
- 12. Non-Einsteinian gravity
- 13. Gravitational waves and cosmology
- 14. Galaxy clustering and baryon acoustic oscillations
- 15. The Lyman-alpha Forest & the Intergalactic Medium
- 16. First Light & Cosmic Reionization
- 17. Cosmological tests of gravity
- 18. Growth of linear cosmological fluctuations
- 19. Baryogenesis
- 20. Reheating in inflation

Elements of a Seminar Talk

- Spend your time to convey the most
 - new
 - important
 - likely correct

insights to be gained from the paper(s)

[Don't need to discuss everything in the paper(s)!]

- Briefly set the stage:
 - What is the question, puzzle, observation to be understood
 - You may draw a (few) plot(s) from other articles as well

Elements of a Seminar Talk

- What are the “punchline(s)” or key insight(s)?
- Is that based on a new
 - calculation
 - idea
 - data
 - technology
- What are broader implications of the results?
 - based on the author’s view, filtered by your judgement
- Are these insights/conclusions (in your judgement)
 - clearly presented?
 - persuasive?
 - is speculation clearly separated from sound fact?
 - [much of the refereed literature is good, innovative, but not all. Don’t believe everything you read!!]

Preparation

- Plan to spend about 2 weeks preparing your presentation with your partner
 - could be longer depending on fluency in English
 - read a few other papers/references to enhance understanding
- The references in the topic list are:
 - popular articles, commentary
 - project/telescope websites
 - online tutorials
 - review articles
 - journal articles
- We are available to answer questions and go over slides beforehand (Fri 15:00-17:00 @ ITP). Contact us via email to set up a meeting.

9. The Sunyaev-Zel'dovich Effect

South Pole Telescope: <http://pole.uchicago.edu>

Atacama Cosmology Telescope: <http://www.physics.princeton.edu/act>

Planck Satellite: <http://sci.esa.int/planck/>

Review Article: *Cosmology with the Sunyaev-Zel'dovich Effect*

Carlstrom, J. E., Holder, G. P., & Reese, E. D. 2002, ARAA, 40, 643

<http://adsabs.harvard.edu/abs/2002ARA%26A..40..643C>

Review Article: *Tracing cosmic evolution with clusters of galaxies*

Voit, G. M. 2005, Reviews of Modern Physics, 77, 207

http://rmp.aps.org/abstract/RMP/v77/i1/p207_1

Article: *The Atacama Cosmology Telescope: Cosmology from Galaxy Clusters Detected via the Sunyaev-Zel'dovich Effect*

Sehgal, N., Trac, H., Acquaviva, V., et al. 2011, ApJ, 732, 44

<http://adsabs.harvard.edu/abs/2011ApJ...732...44S>

Article: *A Sunyaev-Zel'dovich-selected Sample of the Most Massive Galaxy Clusters in the 2500 deg² South Pole Telescope Survey*

Williamson, R., Benson, B. A., High, F. W., et al. 2011, ApJ, 738, 139

<http://adsabs.harvard.edu/abs/2011ApJ...738..139W>

Article: *Discovery and Cosmological Implications of SPT-CL J2106-5844, the Most Massive Known Cluster at $z > 1$*

Foley, R. J., Andersson, K., Bazin, G., et al. 2011, ApJ, 731, 86

<http://adsabs.harvard.edu/abs/2011ApJ...731...86F>

Article: *Planck 2013 results. XX. Cosmology from Sunyaev-Zeldovich cluster counts*

Planck Collaboration 2013, arXiv:1303.5080

<http://adsabs.harvard.edu/abs/2013arXiv1303.5080P>

Choose Your Topics

- We will soon set up a doodle poll with the topics. Please indicate 4 possible topics in this list by next Friday. **And leave your email in the doodle comments!**
- Topics will be assigned on a first-come first-serve basis

Your Grade

- Seminar is 6LP
- **Regular attendance is mandatory!** If more than 1 meetings is missed, you will fail unless special arrangements are made.

Schedule

- Apr. 29, today
- May: free
- Then every Friday
- Meet 14:15–15:00

Scientifically Speaking

Generalities

- Think about your audience first
 - what do they already know?
 - what will get them excited about your topic?
 - what is minimal & sufficient information to make your point?
- The first and last slides are most important
 - spell out your first 5 and last 5 sentences verbatim
- Two days later your audience will remember either **0** or **1** of your points. So tell a story

Generalities

- Give a clear exposition of the scientific issue
 - what is the question being addressed?
 - why is it interesting?
 - state the obvious, but only briefly
- Practice your talk all the way through before you present it.
- Put your name on every slide!

Practicalities

- Budget 2-3 minutes per slide
 - never, ever run over your time limit
 - make intermediate time marks for yourself
 - recognize which slides you can skip if you are behind
 - never say “I think I’ll stop here” or “I’m running out of time”

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 - legible axes! (modify or annotate original plots)
 - if there are several lines, add labels with colors
 - don’t show dense tables

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 - don’t show dense tables
- Explain everything on slide, or don’t put it on the slide
- Streamline: if a slide has no bearing on your conclusions, omit it

Equations??

- Complicated equations usually add very little to a presentation.
 - if you must show equations, talk through meaning
 - remember this will slow you down
 - substitute heuristics whenever possible

Fonts??

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- Use readable font size. Recommended font > 24 pt.
This is 38pt.

Colors??

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- **Colorized text** is **useful** for **highlighting** an **issue**, but do not **over-colorize!**

Logic??

- Complicated equations usually add very little to a presentation.
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 - substitute heuristics whenever possible
- Use readable font size. Recommended font > 24 pt. This is 38pt.
- Colorized text is useful for highlighting an issue, but do not over-colorize!
- If you make complex arguments, or switch topics, provide a summary of preceding logical progression

Delivery

- Studies of interpersonal communication show that:
 - 55% comes from facial expressions and body language
 - 38% comes from vocal quality or tone of voice
 - 7% comes from content, actual meaning of the words
- Speak in a conversational tone
- Smile!
- Make eye contact with members of the audience
- Never simply read what is on the screen!
- Face the audience, don't talk to the screen
- Animations can be useful, but if overdone they are very distracting

Most Importantly

HAVE FUN!!!!