How to Give an Effective Talk

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Pitt Astro Research Boot Camp
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Presentation Goal

- Provide a principled overview on how to structure and give an effective science talk in the fields of physics and astronomy.
  - Philosophy
  - Practical advice
  - Model effective practices
- Topics NOT explicitly discussed:
  - Software (Beamer, PowerPoint, Google Slides, etc.)
  - Specific Talk Layout (Introduction, Outline, Body, Conclusions, etc.)
  - **Feel free to ask questions about these topics if you would like!!**

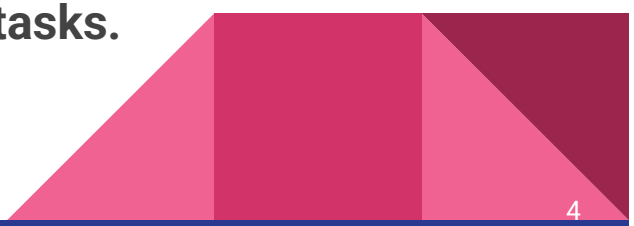
Outline

1. Why Do We Give talks?
2. Effective Talk “Myths”
3. Designing a Talk
4. Writing the Talk
5. Elements of a Good Slide
6. Backup Slides
7. How to Practice

Why Do We Give Talks?

- To transmit knowledge/information to a broader community
  - **Teaching Function**
- To organize/frame our research inside a larger scope
  - **Learning Function**
- To advertise our expertise to future collaborators and employers
  - **Marketing Function**

Giving an effective talk requires being mindful of these tasks.



Effective Talk “Myths”

- Design your slides/talk with your target audience in mind.
- Use lots of figures/plots to convey your message.

- Yes. Yet, audiences vary in expertise, but they do not vary much in patience and attentiveness!
- Figures are great, but they require *decoding*. Beware of overstimulating the listeners.

Be mindful of the tendency to overestimate the audience’s “processing speed.” Even the most expert audience is unlikely to be an expert in ***your work*****!!**

Guiding Reflection: How long did it take you to understand your results?

How to Design a Talk: Takeaways/Upshots

Given the small amount of time available, it is helpful to ask what is the *point of your talk?* What are you trying to say?

- Non-experts: Someone with a physics/astronomy background but not in your subfield.
  - Broad themes and most fundamental conclusions
  - Question: “What did you do?”
- Experts: Someone working in your subfield of research
  - Connect your results with open questions of the field
  - Question: “Why should I care about these results?”
- Specialists: Someone working on your research question
  - Connect your results with the existing literature
  - Question: “How does this impact my own research?”

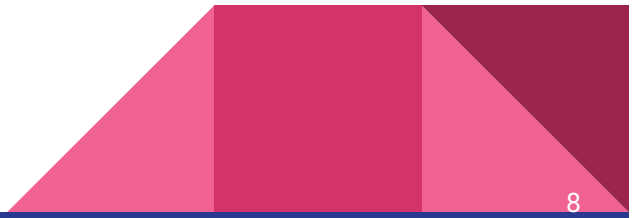
How to Design a Talk: The Narrative Frame

Effective talks *tell a story*. Humans use narratives to intuitively understand complex issues.

- Beginning: Start with the familiar and comfortable
  - Review relevant results and open questions
  - Win your audience's attention
- Middle: Transition to novel material
  - Advertise new developments and original results
  - Research methods/approach
  - Audience attention starts to wane
- End: Finish with pivotal conclusions
  - Recapitulate the important findings
  - Be clear-- most important part for majority of the audience

Writing the Talk: Four Stages

1. Prewriting: Formulate the “takeaways” and determine the layout of the talk.
    a. Outline
    b. “Shower talk”
2. Writing: Design the slides for the talk
    a. Just start--it’s only a rough draft!
    b. Choose important figures/equations
3. Editing: Refine the slides and their order
    a. Eliminate excess text, figures, etc.
    b. Experiment with different orders
4. Revise: Polish the slides after the talk
    a. Reflect on the experience and re-edit your slides
    b. You will likely use elements of the talk again



Elements of a Good Slide

- Text *complements* the speech.
  - Emphasizes your points but does not replace you!
- Figures/Equations are vital and straightforward to explain.
  - Clarity and concision!
- The slide has something for everyone: Non-experts, experts, and specialists.
  - What should each type of person glean?

Example Slides

Renormalization: Decay of Dressed State

1. Time-Integration yields Decay Rate as before
2. Remove divergences by introducing Renormalization Time Scale
3. “Wave Function” Renormalization
4. Finite Survival Probability and Decay Rate of Dressed State
5. Evolution by DRG

BAD SLIDE!!

$$\int_{\eta_i}^{\eta} \Gamma_\Phi(\eta')\, d\eta' = \frac{Y^2}{8\pi^2}\, I(\Lambda, k, \eta)$$

$$I_S(k, \eta, \eta_b) = I(\Lambda, k, \eta) - I(\Lambda, k, \eta_b)$$

$$\mathcal{P}_{\Phi,r}(\eta_b) = Z(\eta_b)\, \mathcal{P}_\Phi(\eta_i) \quad ; \quad Z(\eta_b) = e^{-\int_{\eta_i}^{\eta_b} \Gamma_\Phi(\eta')d\eta'}$$

$$\int_{\eta_i}^{\eta_b} \Gamma_\Phi(\eta')d\eta' = \frac{Y^2}{8\pi^2}\, I(\Lambda, k, \eta_b)$$

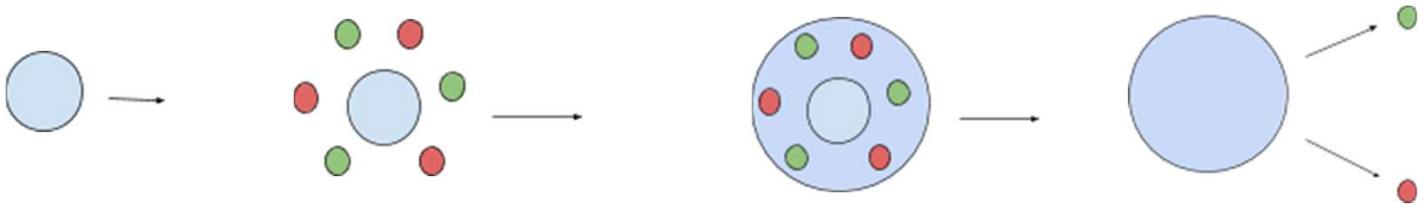
$$\mathcal{P}_\Phi(\eta) = e^{-\int_{\eta_i}^{\eta} \Gamma_\Phi(\eta')d\eta'}\, \mathcal{P}_\Phi(\eta_i) \equiv e^{-\int_{\eta_b}^{\eta} \Gamma_\Phi(\eta')d\eta'}\, \mathcal{P}_{\Phi,r}(\eta_b)$$

$$\mathcal{P}_{\Phi,r}(\eta_A) = e^{-\int_{\eta_B}^{\eta_A} \Gamma_\Phi(\eta')d\eta'}\, \mathcal{P}_{\Phi,r}(\eta_B)$$

Using Transitions & Pictures

Renormalization: Decay of Dressed State

- Dressing of the bare state by virtual particle pairs causes divergences
  - Short Time Scale
- The decay of the particle
  - Long Time Scale
- Dynamical Renormalization: evolve the system up to an intermediate time, then describe the decay of *quasiparticle* state.



BETTER SLIDE!

↑ Schematic for non-experts

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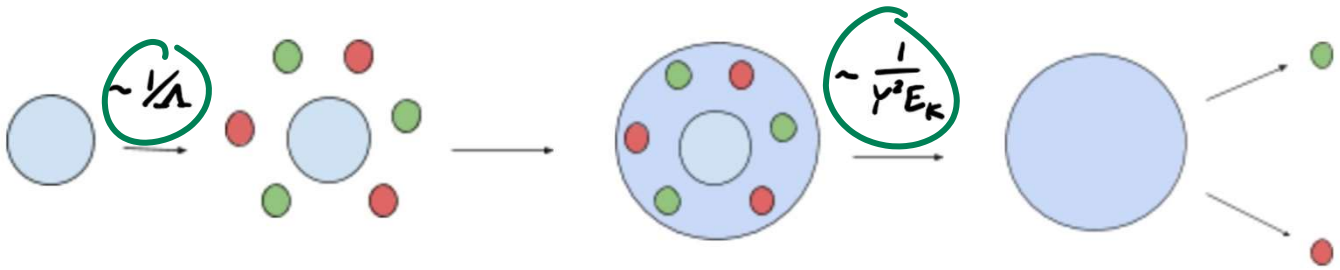

BETTER SLIDE!

- Symbols for Experts

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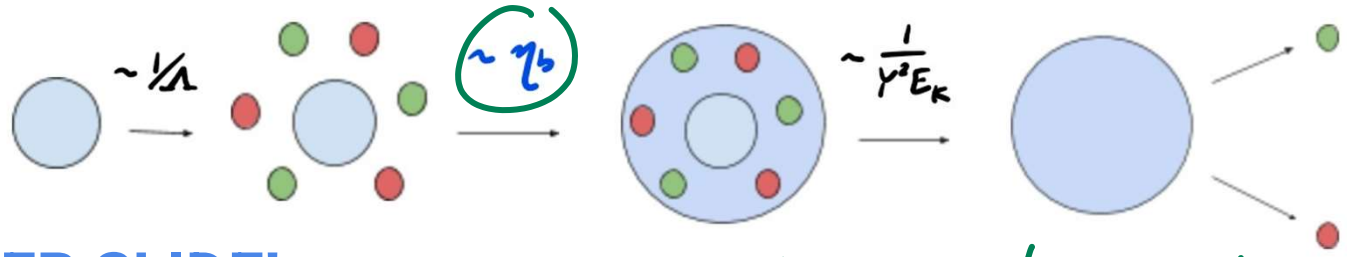

BETTER SLIDE!

- New Symbol for Novel Concept

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BETTER SLIDE!

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Final Equation for Specialist

Backup Slides

Feel free to include extra slides at the end of your presentation.

- Extra figures or equations which can help you answer likely questions.
- Intermediate parts of your analysis to help explain your approach.
- Many of the slides you originally design for your first draft will make excellent backups!

Note: Often you will not use these slides. That's okay! Making the slides will help you prepare for the talk.

How to Practice

Giving effective talks is a highly useful career skill which is independent of being a good student or researcher. Start practicing early!

Opportunities here at Pitt:

- Group Meetings
- Astrosnacks
- Conferences
- Seminars
- Teaching
- Outreach Events

Practical Advice

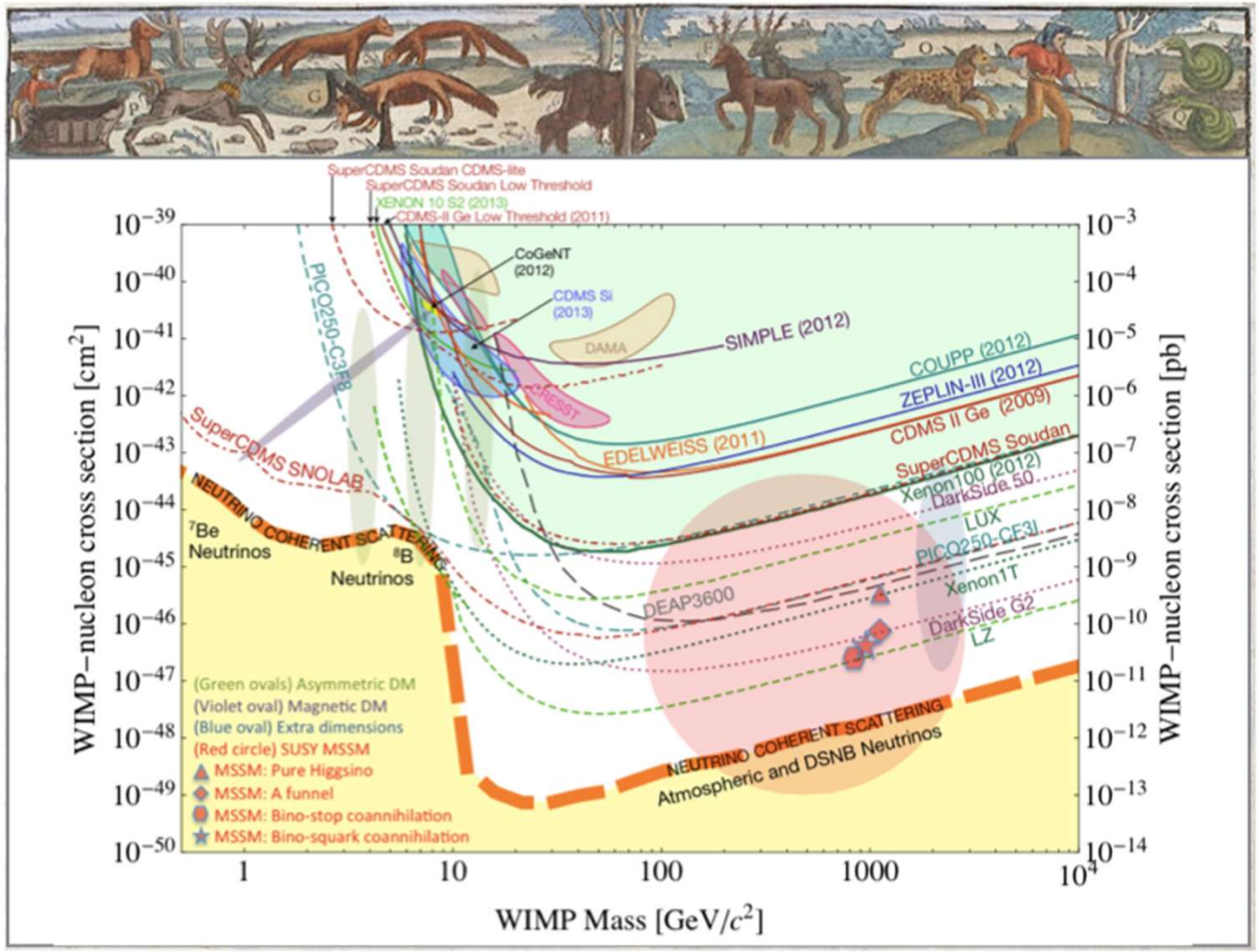
- It is better to finish the talk early than to go over the allotted time.
- Avoid “skipping” slides in the interest of time.
- Speak slowly and clearly without rushing.
- Practice the talk many times especially early in your career.
- Pay attention to the audience’s body language and adjust accordingly.
- Do not over-explain; allow the audience to ask questions.

Conclusions

- Determine the main takeaways
  - What did you do? (Non-expert)
  - Why should we care? (Expert)
  - How does this affect my research? (Specialist)
- Use a narrative frame
  - What story are you trying to tell?
  - Beginning (familiar), Middle (new developments), End (important conclusions)
- Four stage writing process
  - Prewriting, Writing, Editing, Revising
- Good slides
  - Avoid using figures and equations as crutches!
  - Have something for everyone
  - Use text to complement speech.

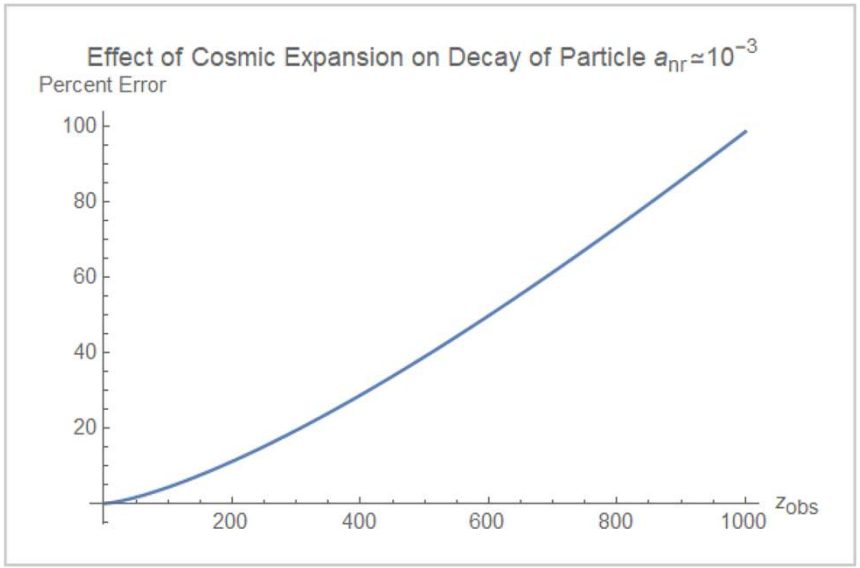
Practice early and often!!

Backup Slides



credit: J. Pradler (2015), CF1 Snowmass Report

Implications: Long-Lived Particles



Minkowski spacetime results underestimates particle lifetime!

Consider a massive scalar decaying to massless fermions with the following assumptions:

- Particle produced at $T \simeq T_{GUT} \simeq 10^{15}$ GeV
- $a_{nr} \simeq 10^{-3}$ (Matter-Radiation Equality)
- Recall $a_{nr} \stackrel{\text{def}}{=} k/m$
- Very small Yukawa coupling

1. Plotted is Minkowski Rate/FRW Rate error as a function of redshift.
2. The error is large when $z_{obs} \gtrsim 1/a_{nr}$