


# Closing Remarks

**WARSAW WORKSHOP**  
**ON NON-STANDARD DARK MATTER:**  
MULTICOMPONENT SCENARIOS AND BEYOND  
**June 2-5, 2016**




multi-component  
self-interacting  
strongly interacting  
feebly interacting  
super-cold  
macro size  
...

**International Advisory Committee**  
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<http://multiDM.fuw.edu.pl>



Hai-Bo Yu, UC Riverside

Some of the views are very personal

# Great Success

- ~70 participants, ~43 talks, ~1000 slides
- Covered a lot of interesting, important, and timely topics

**WIMP searches** direct/indirect/collider searches

**Axion Landscape** new search strategies

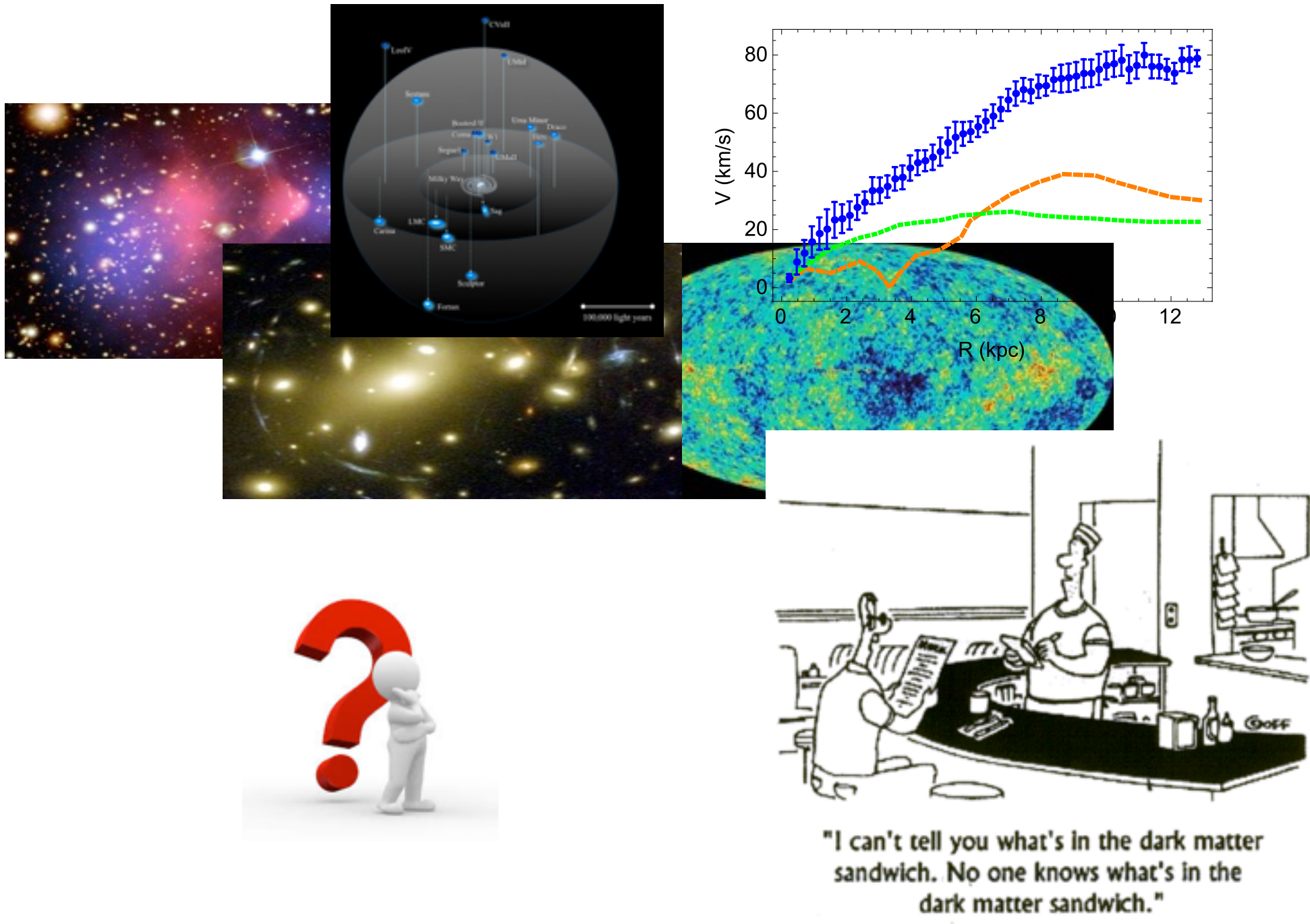
**Non-standard DM candidates (a lot of model-building activities)**

SIDM, SIMP, electromagnetic, giant monopoles, super-heavy, ADM, WISPY, gauge fields, relaxed DM, inflatable, coannihilating, bound state, sneutrino, neutrino-mass-motivated, composite, flavored, multi-component, semi-annihilating...

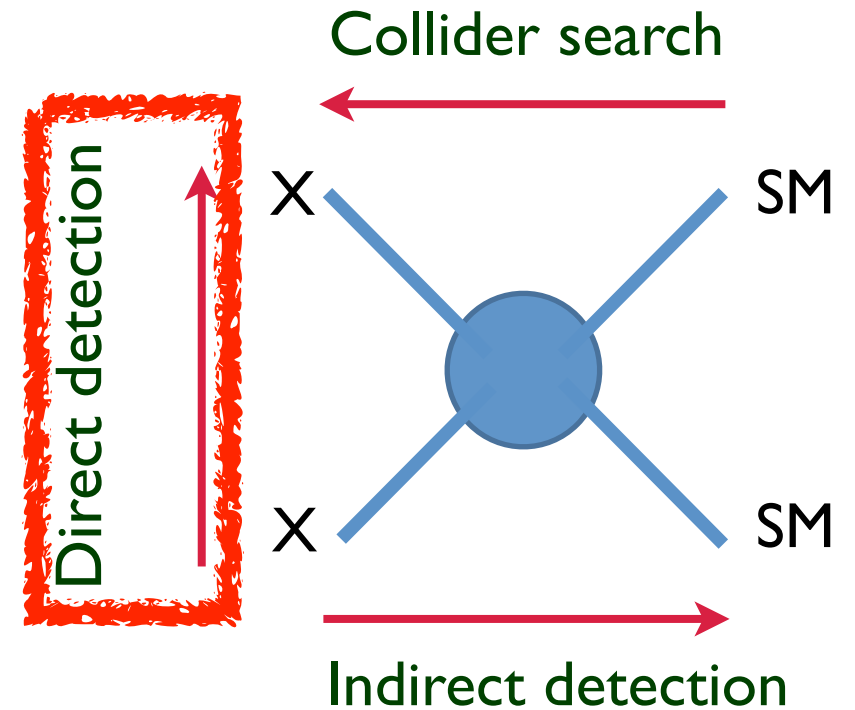
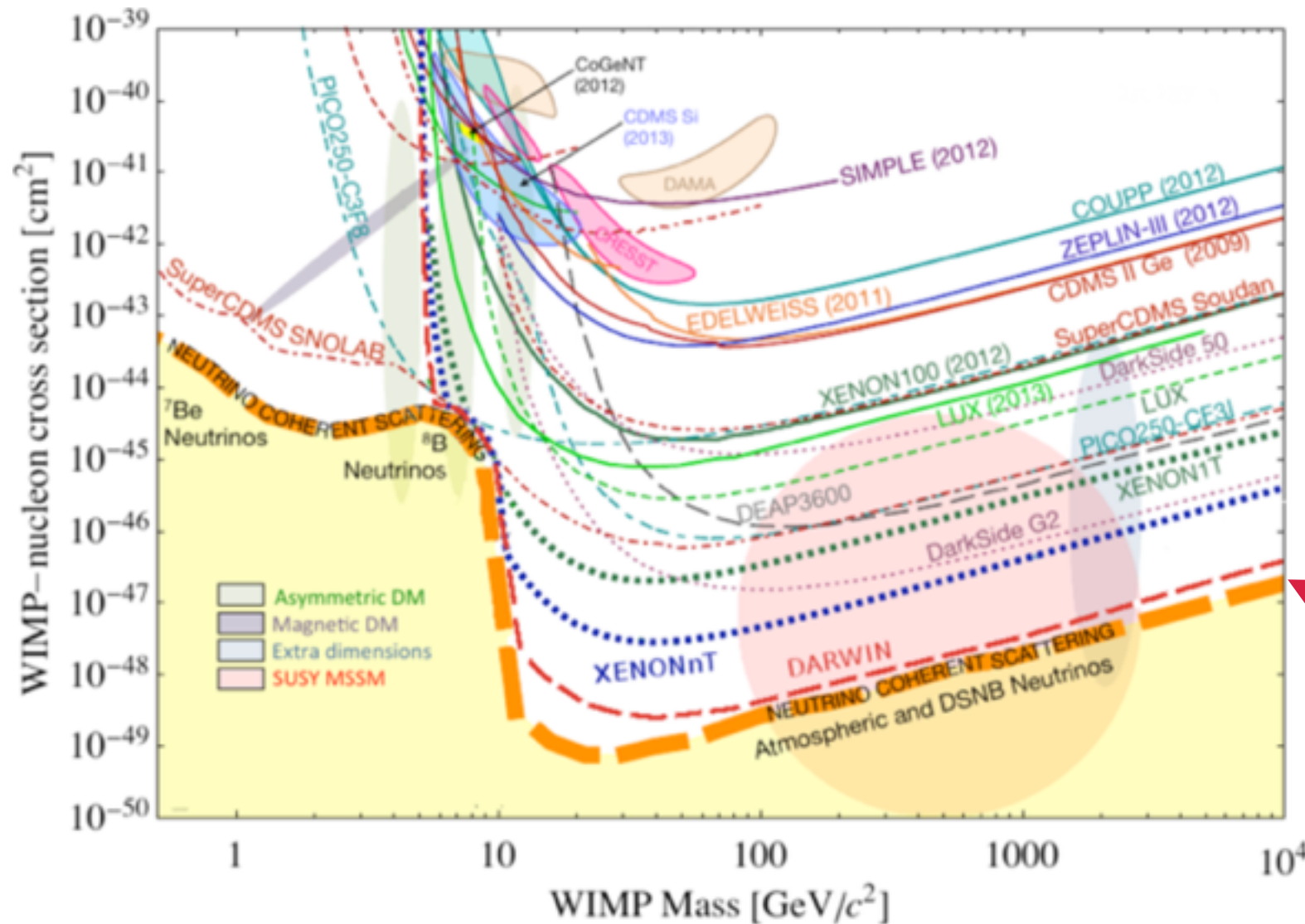
- Both the concert and the banquet were wonderful
- Warsaw is a beautiful city and people are nice

## Let's thank our organizers!

# Dark Matter



# Direct Detection



It would be a serious issue in 5-10 years

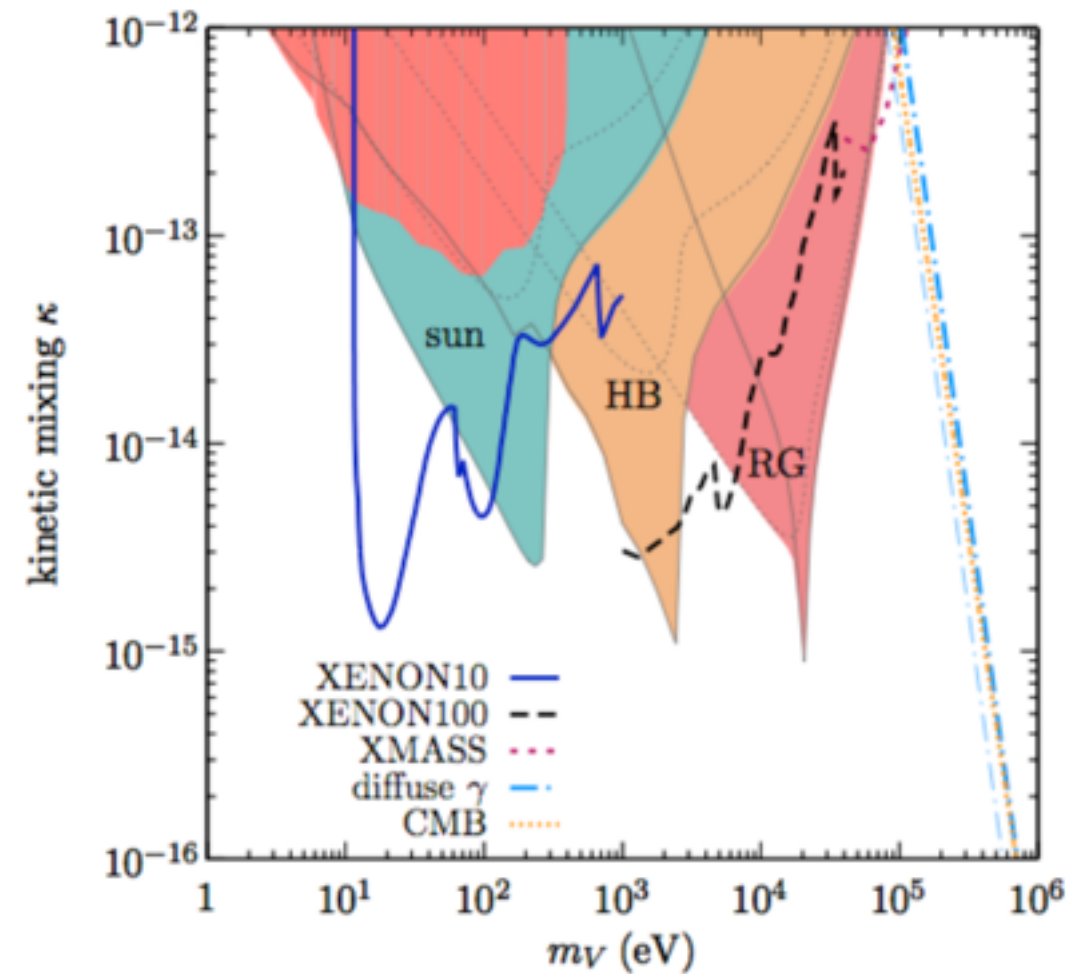
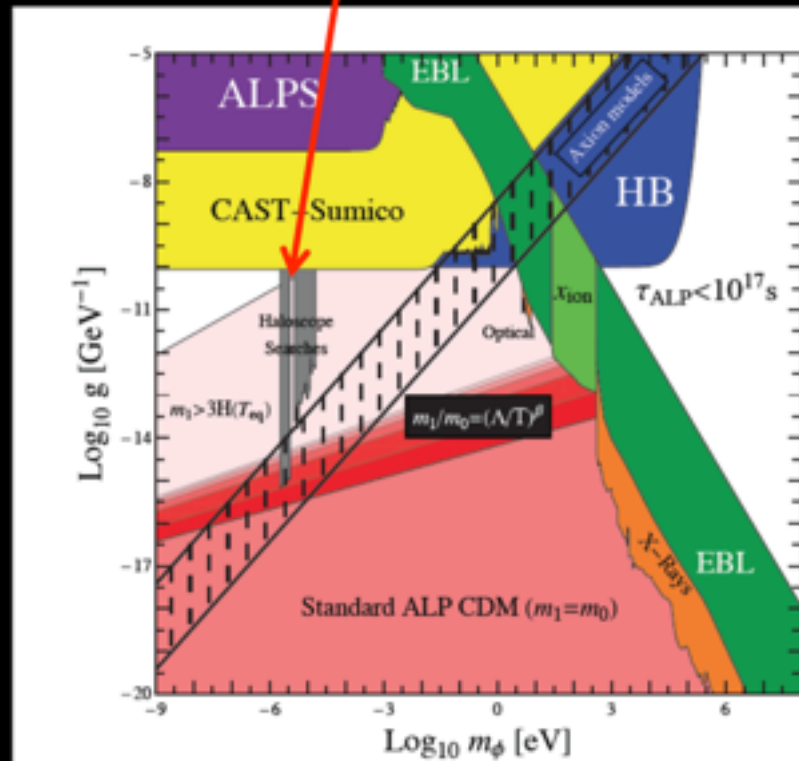
Monroe



# Direct Detection+

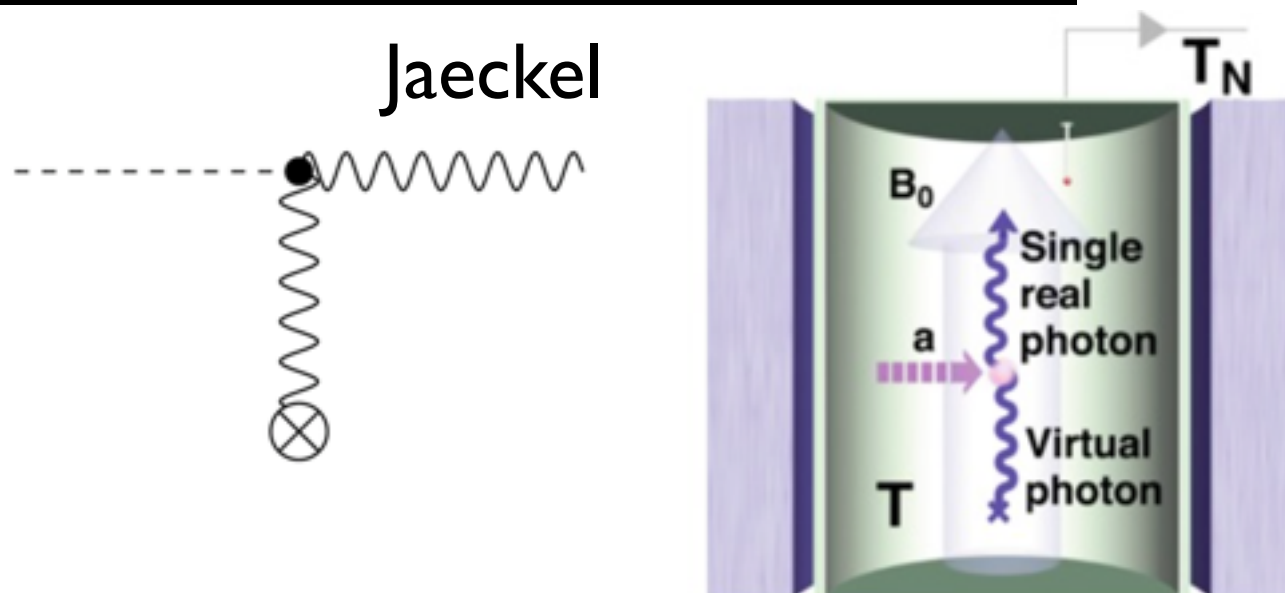
An extremely sensitive probe!!!

INSTITUT FÜR  
THEORETISCHE PHYSIK  
Heidelberg  
University



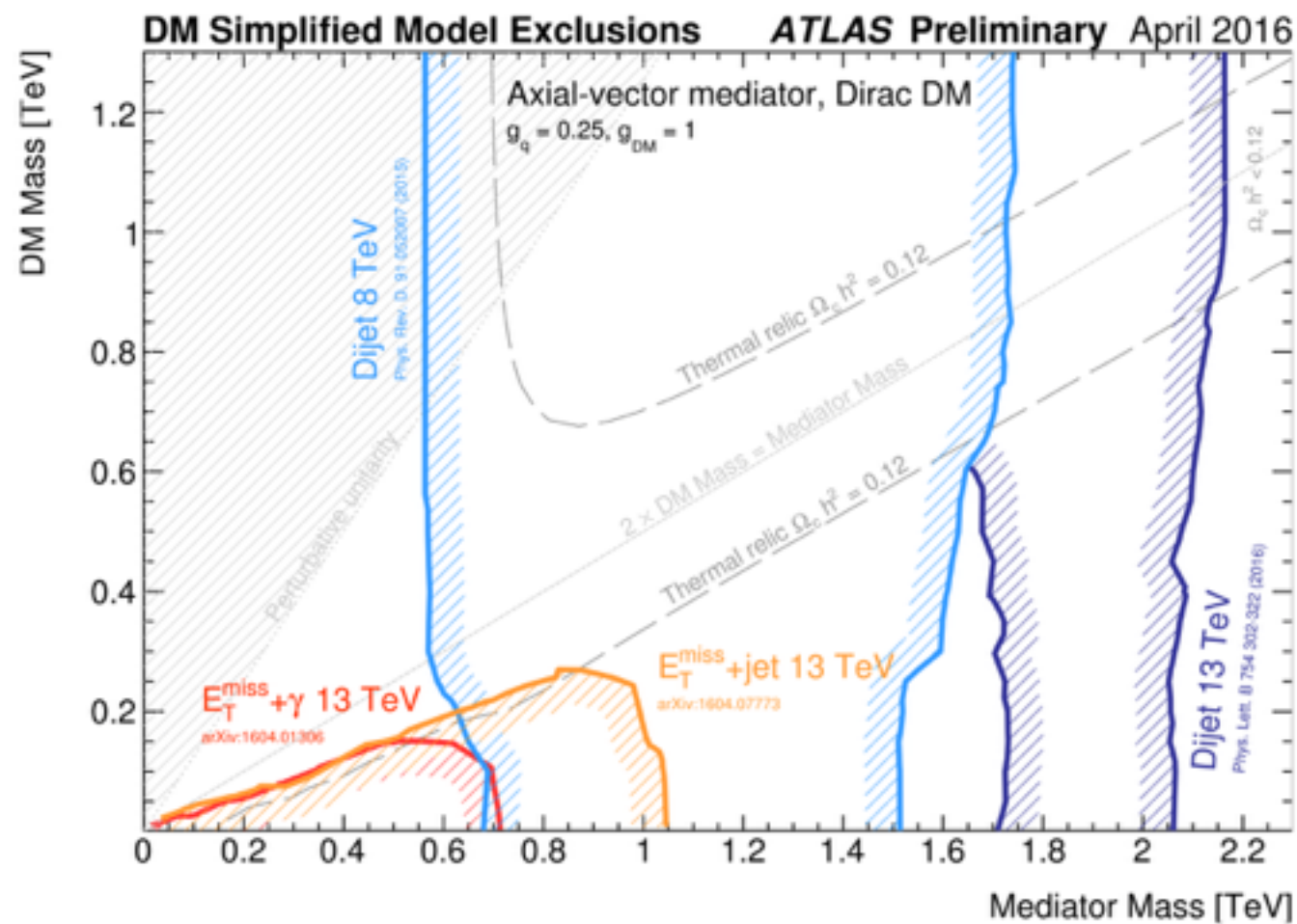
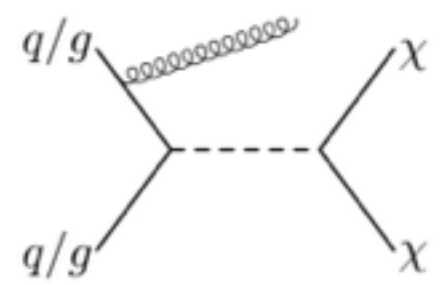
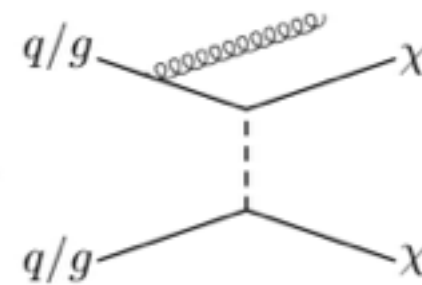
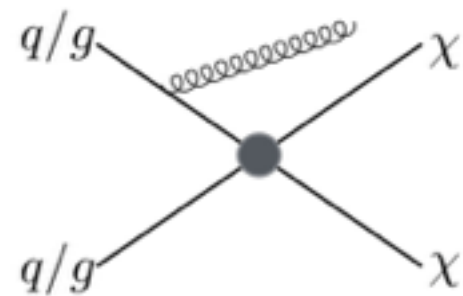
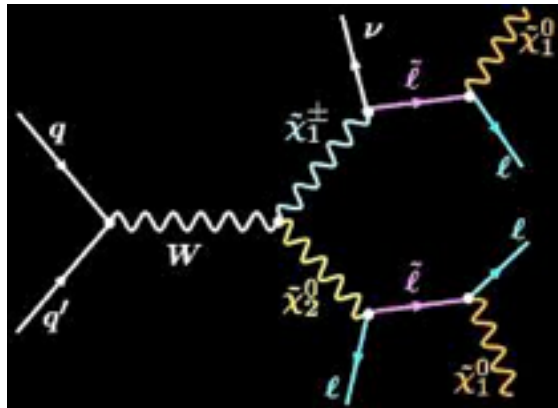
Monroe

Jaeckel



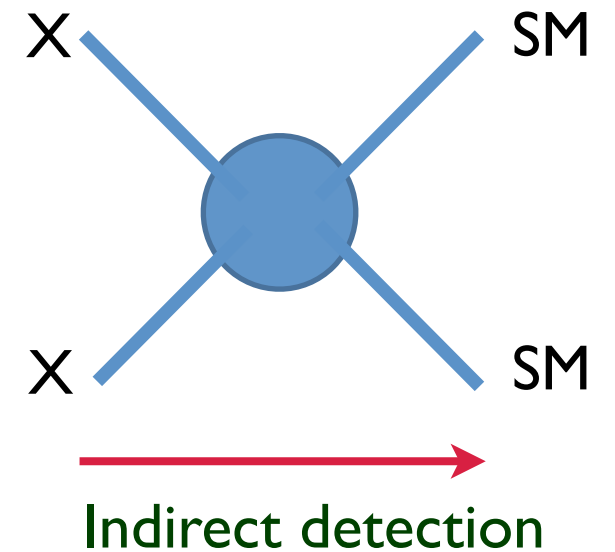
Remarkable!

# Collider Searches



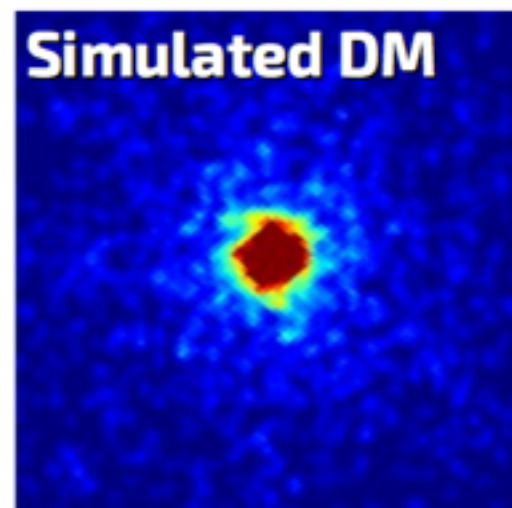
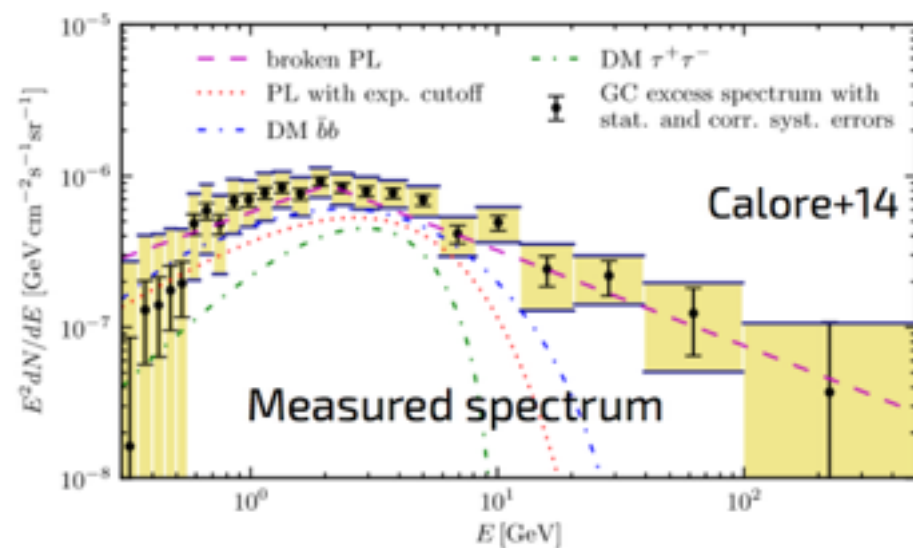
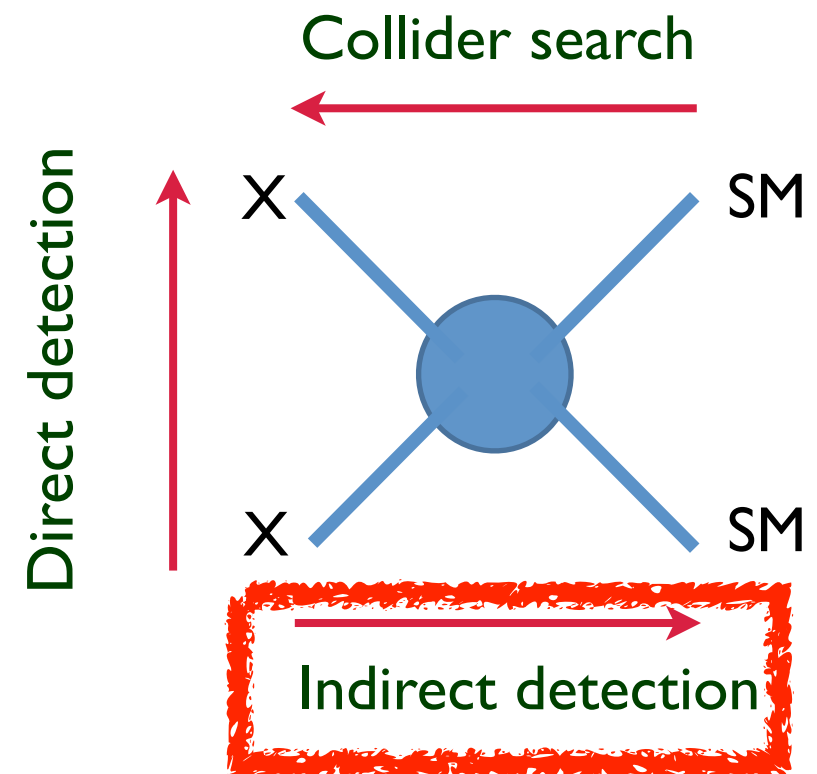
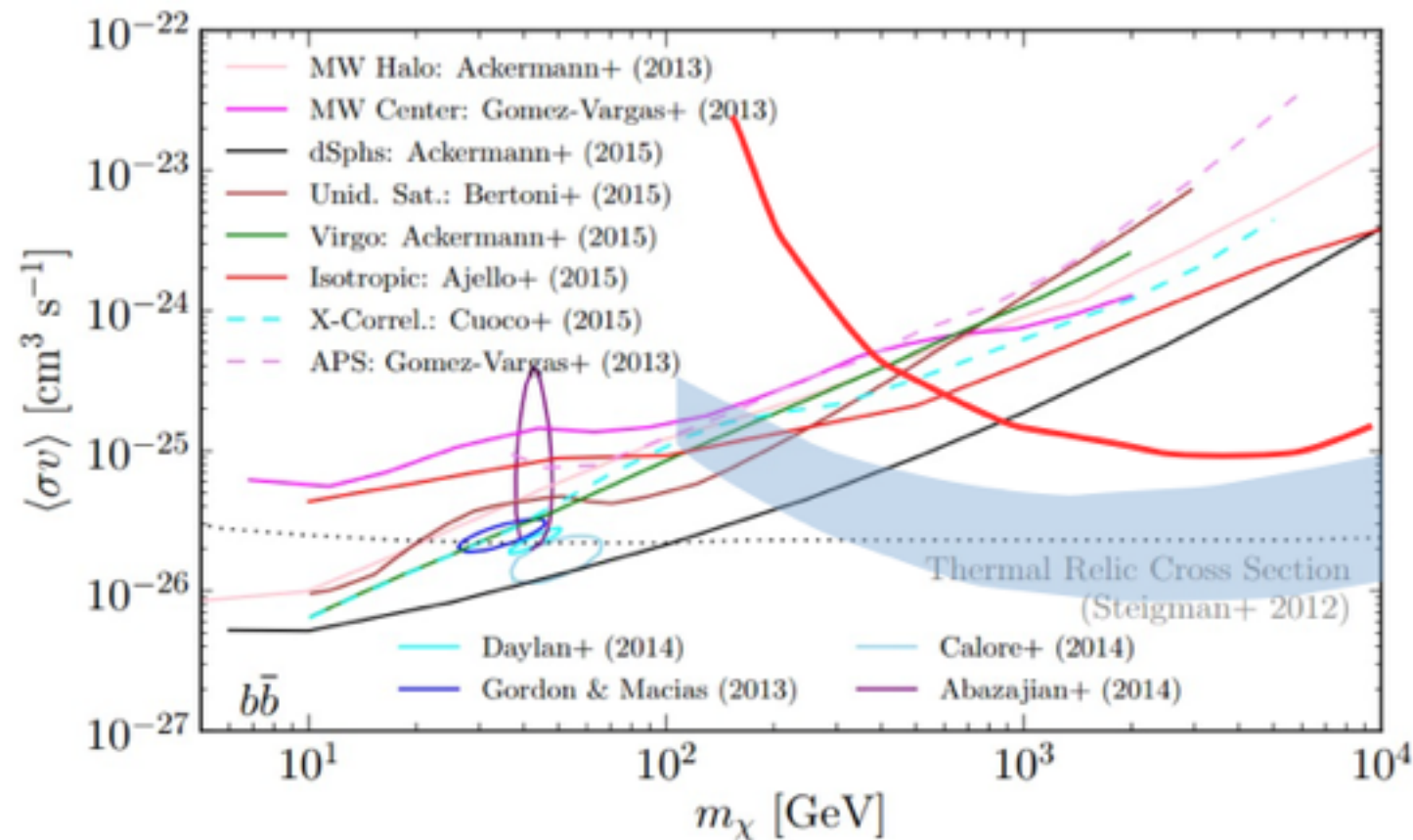
Direct detection

Collider search

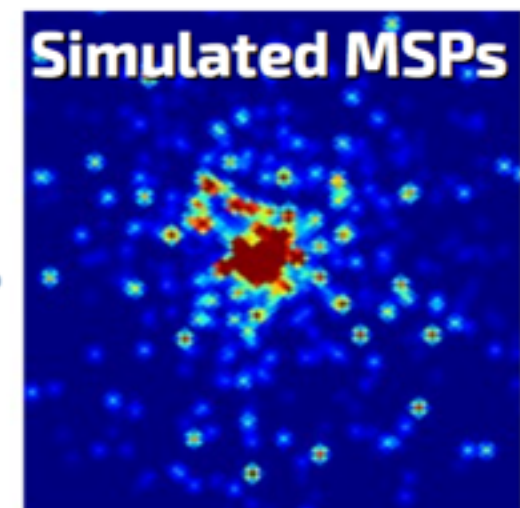


Khurana

# Indirect Detection



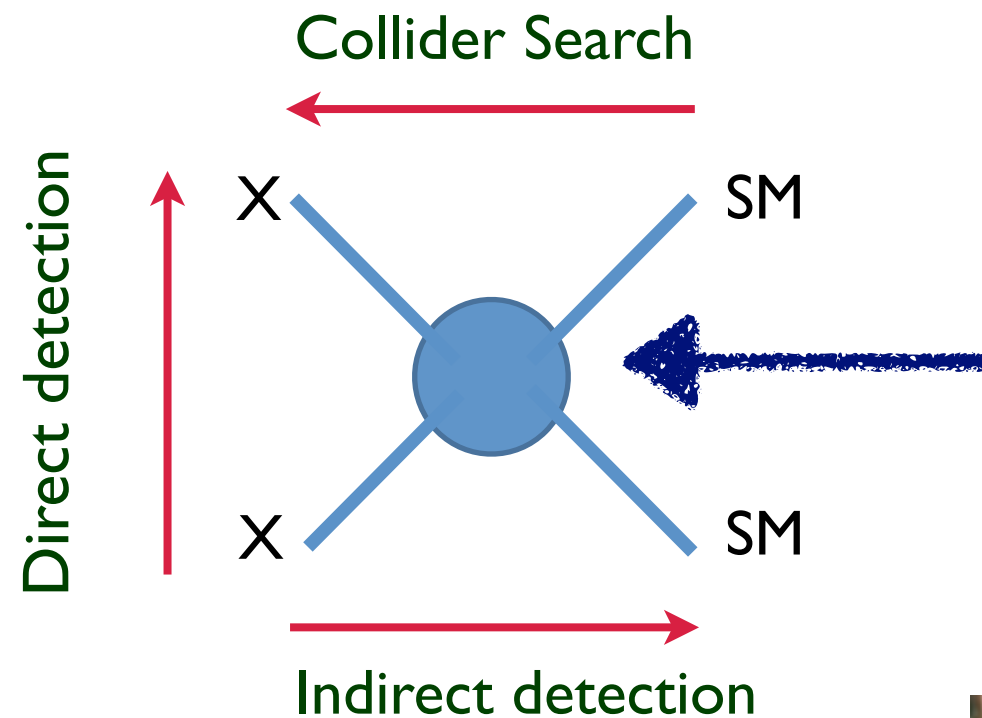
vs.



Weniger



# What if DM is not a WIMP



“nightmare” scenario

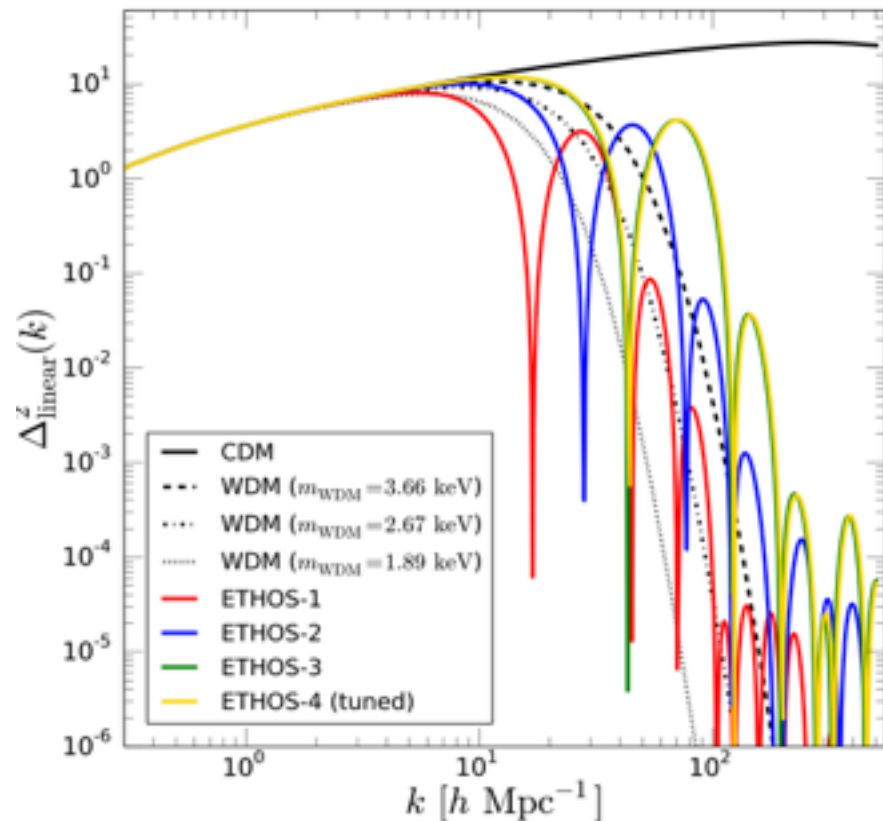


- We should be happy, because we have more freedom to be naive/creative
- Ask simple and naive questions

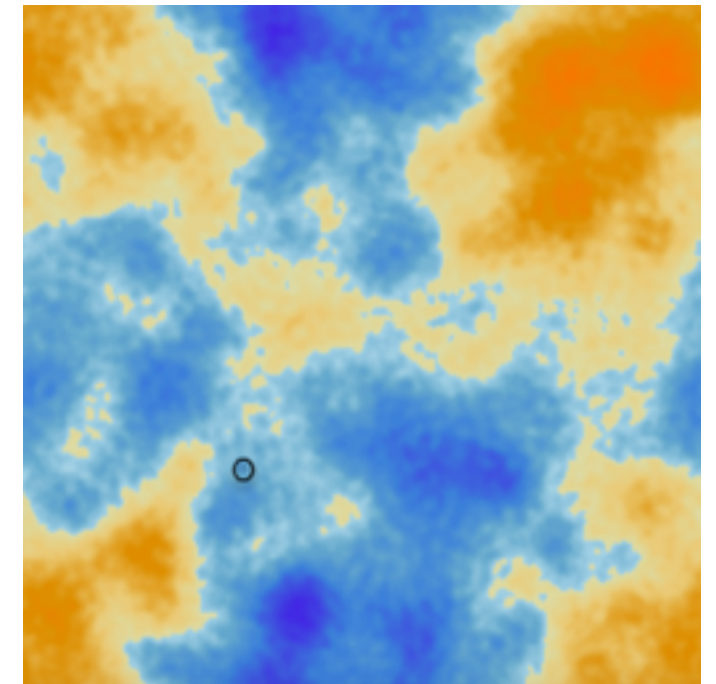
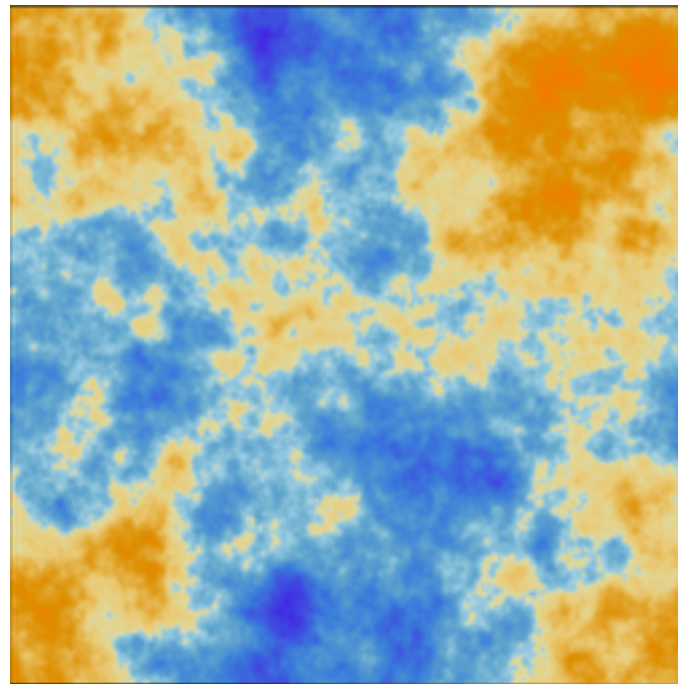


# Start with Naive Questions

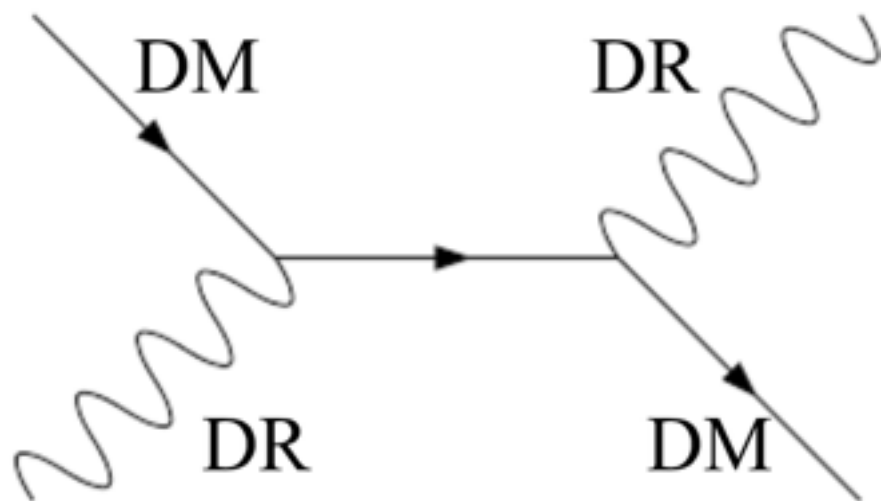
CDM



Damped DM

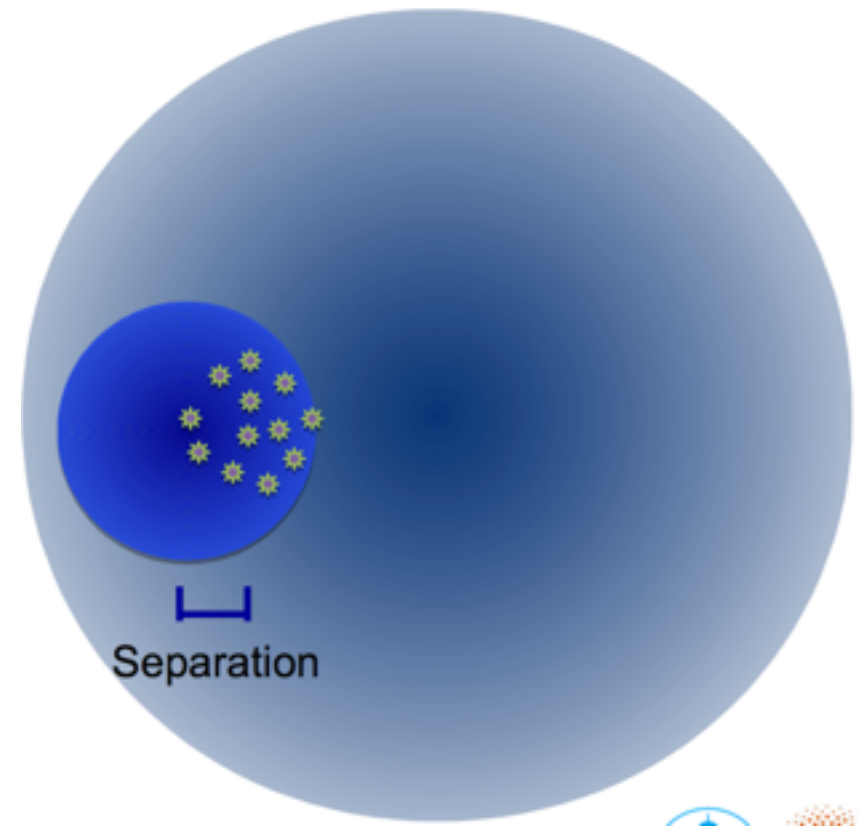
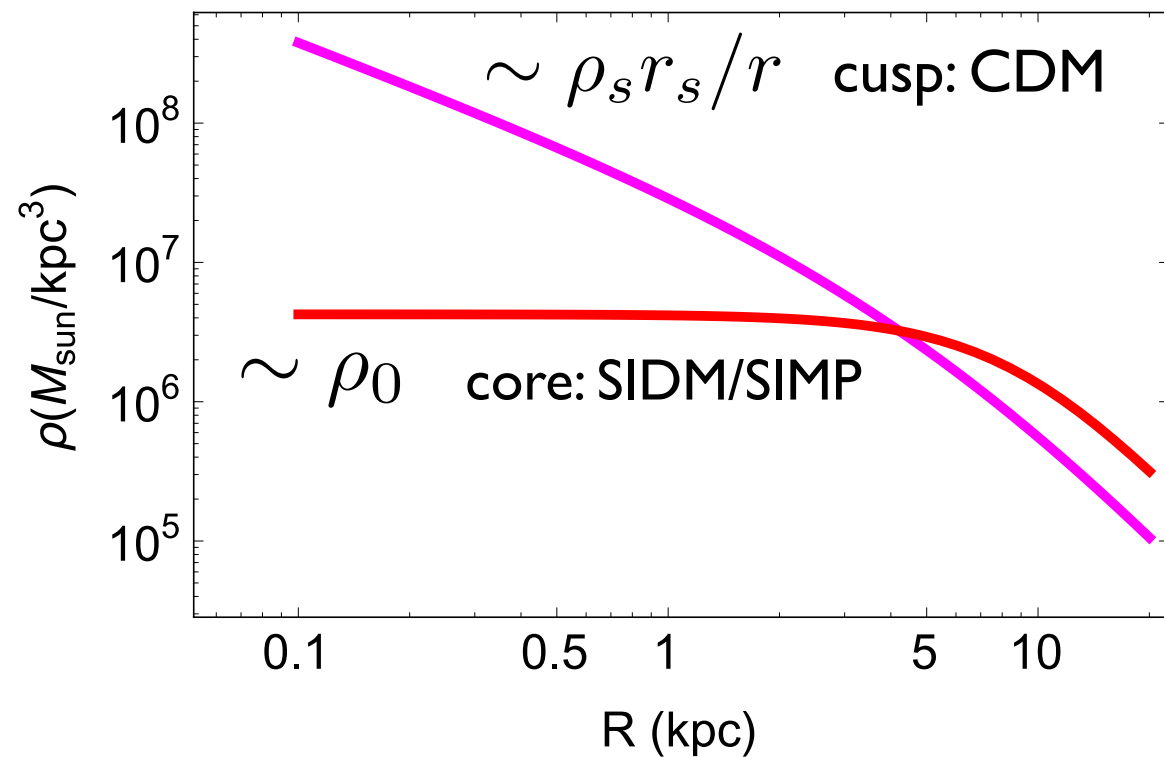


Cyr-Racine

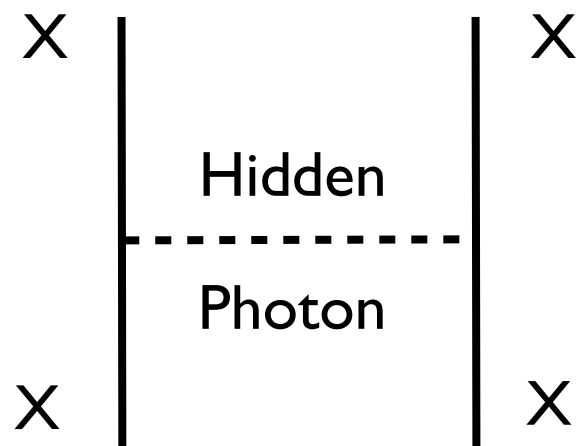


- Extra d. o. f.
- Reduce the number of sub-halos

# Start with Naive Questions



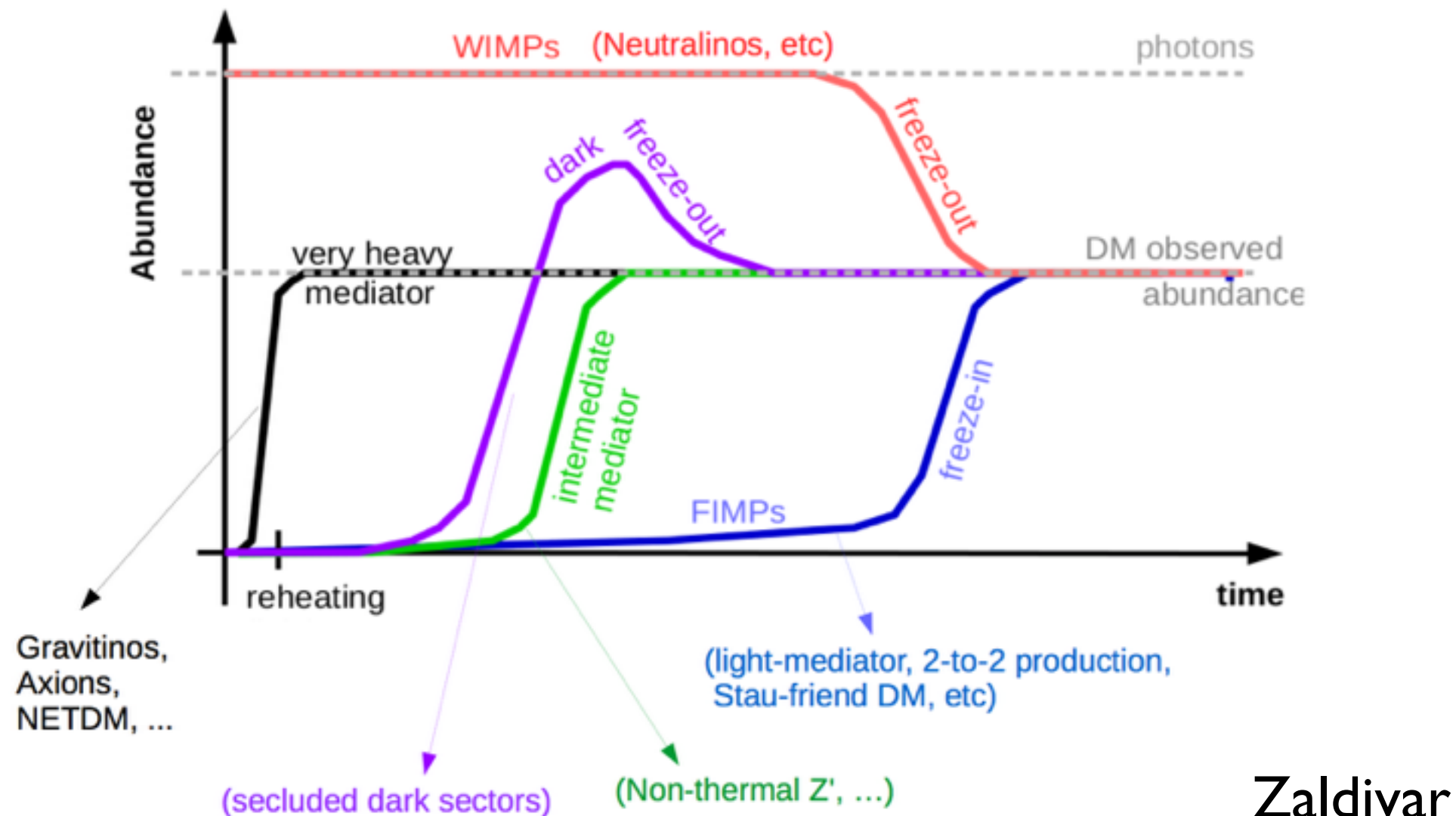
Schmidt-Hoberg



- Create cores, agree better with data
- DM mass could be determined using self-scattering kinematics

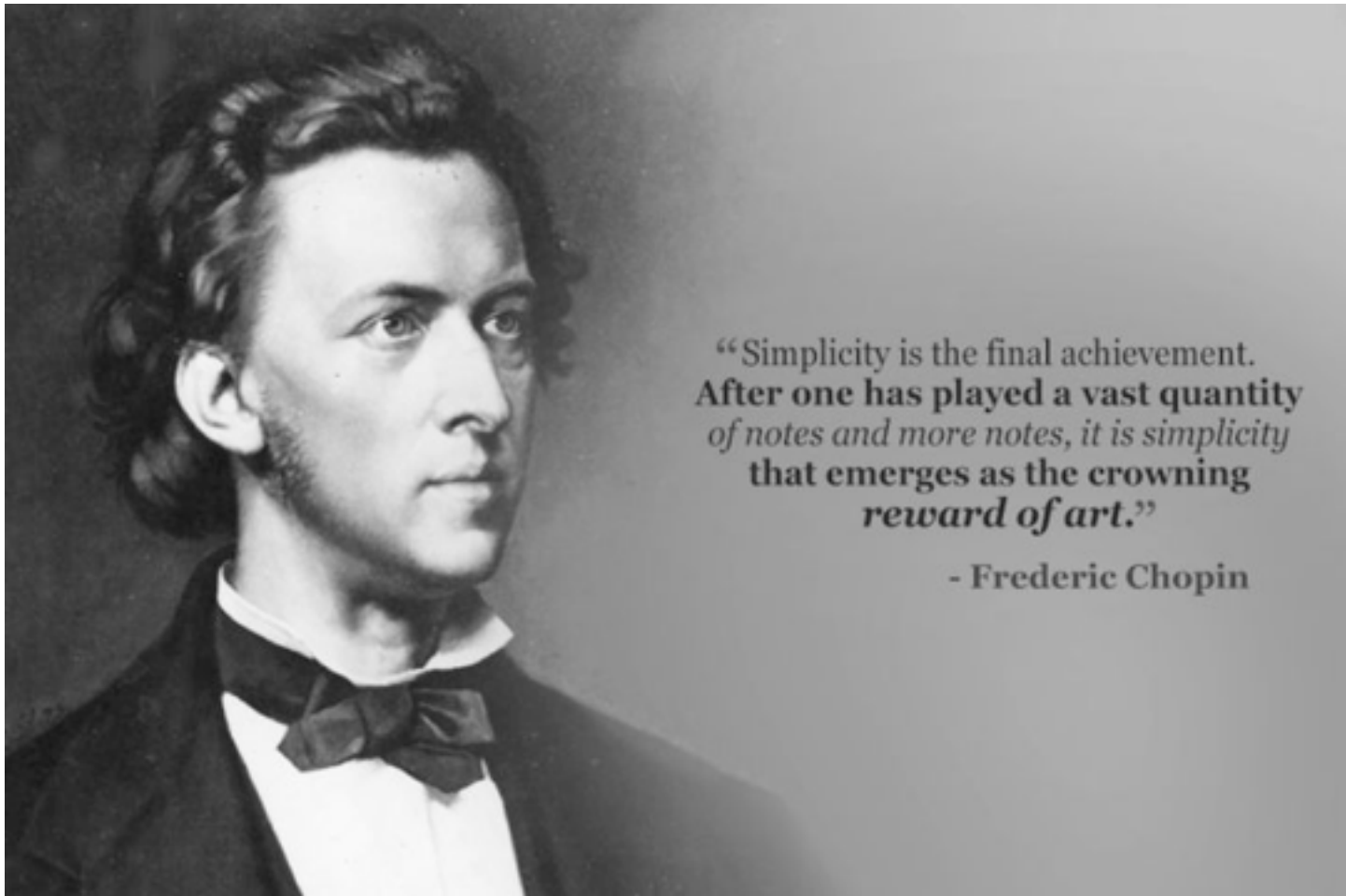
# Start with Naive Questions

## Different thermal histories



Give up the WIMP miracle?

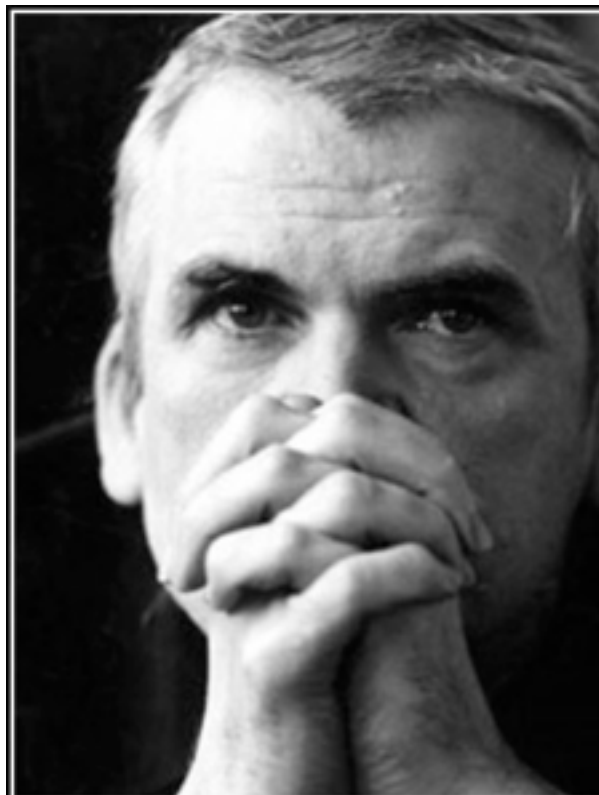




“Simplicity is the final achievement.  
After one has played a vast quantity  
of notes and more notes, it is simplicity  
that emerges as the crowning  
*reward of art.*”

- Frederic Chopin

Being simple and  
naive might be  
OK!



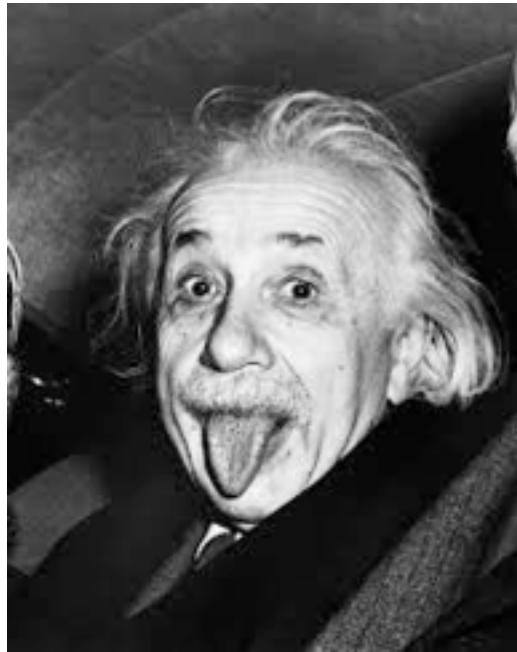
Indeed, the only truly serious  
questions are ones that even a child  
can formulate. Only the most naive  
of questions are truly serious.

— Milan Kundera —

AZ QUOTES

# Looking Forward

- Be optimistic



Gravitational Waves

Predicted in 1916

Search started in the 1970s

Discovered in 2016



Predicted in 1933

based on observations

Lab search started in the 1980s

Will be discovered by 2033?

# Looking Forward

- Be prepared for the “nightmare” scenario
  - Astrophysical and cosmological probes would be the only hope

Long-standing small-scale issues with  $\Lambda$ CDM (only deviations): missing satellites, too-big-to-fail, core vs. cup, diversity of spirals, disk-halo conspiracy...

- Have more communication with astronomers and cosmologists



no DM in galaxies,  
but MOND



all about baryons



do not trust their data,  
messy anyway



It could be a great opportunity for us to make a difference

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Zygmunt Lalak

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I believe this is the purpose of this workshop