



JOHANNES GUTENBERG  
UNIVERSITÄT MAINZ



Mainz Institute for  
Theoretical Physics

# Catch-up

Dark Matter in the Milky Way  
Mainz, May 2-13 2016

# Bringing together three communities: motivations

- Dark matter searches bring together Astronomy, Astrophysics, Cosmology, Particle Physics
- Virtuous interplay in all directions, but also... misinterpretation of jargon in all directions
- Need to question widely-used astrophysical assumptions in the astroparticle community
- Need to question assumptions behind widely-used particle physics models often created to solve “astro-simulations” problems

# The Milky Way as a benchmark

Milky Way is crucial to understand the dark matter distribution within galaxies  
(ultimately linked to our understanding of galaxy formation)

- What is the impact of Milky Way observations on dark matter searches and on simulations?
- How do hydrodynamical simulations contribute to understanding the Milky Way? (a seemingly special Galaxy, or a very normal one?)
- How can we use upcoming astronomical data to refine numerical simulations including baryons?
- How can we use upcoming astronomical data to constrain the dark matter distribution in the Milky Way?

# Things we have learned

Baryons are crucial in any simulation to understand DM distribution.

Identification of MW-like halo currently does not follow one single criteria.

The “center” ( $< 1\text{kpc}$ -ish) of MW-mass Galaxy is not suff. resolved in hydro-sims to be univocally agreed upon (contraction/expansion).

Impact of AGN feedback on MW-like galaxies yet unclear. Field in infancy.

Baryon and WDM effects are degenerate down to scales observable right now.

Which  $f(v)$ ? Simulations agree on sizable difference between CDMO and Hydro case.

What about Hydro with (SIDM/WDM)? Effects on DD?

# Things we have learned

DM is beyond WIMP paradigm: non-thermal, PBH, sterile neutrinos, gravitinos...

SUSY is not generally dead (and never will be). But your favorite model may be.

Galactic Center (gamma-ray) emission can not be explained by current astrophysics, it is solid against systematics, and pretty well characterized. GC excess lives.

Low-mass WIMP situation unclear:

- Intrinsic confusion from experimental data;

- Potential effects on small-masses (only) from  $f(v)$ .

Neutrino floor is a real bummer for DM direct detection (but: directionality, modulation, spectrum and non-standard interactions).

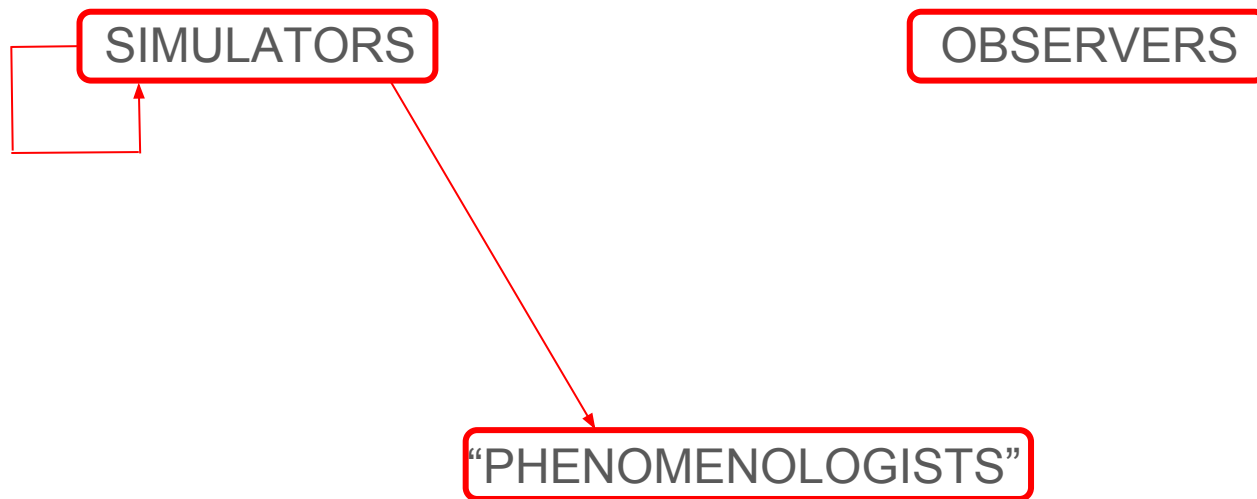
# Inter-community synergies

SIMULATORS

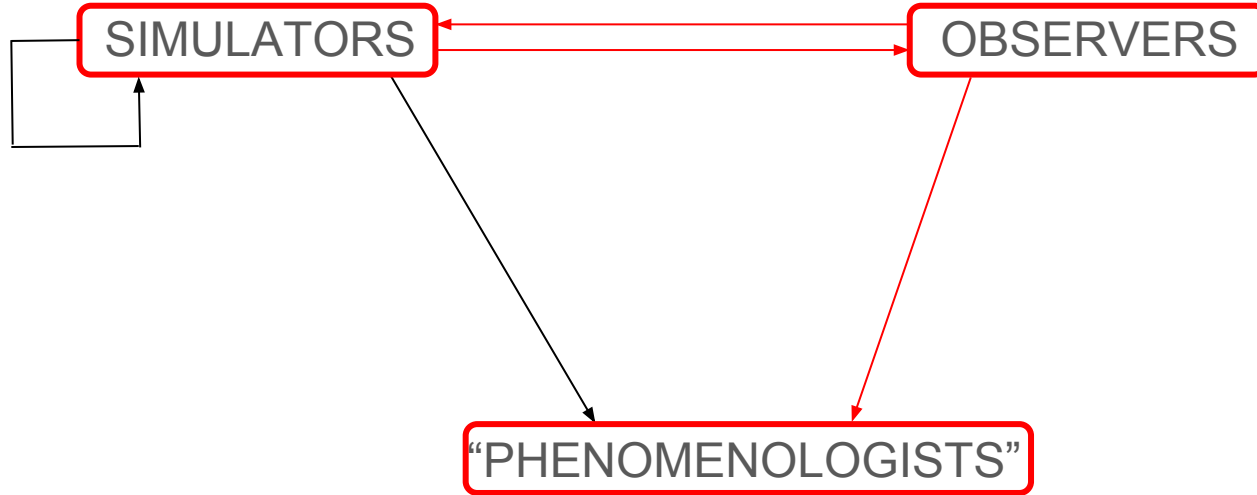
OBSERVERS

“PHENOMENOLOGISTS”

# Inter-community synergies



# Inter-community synergies





# Logistics: timetable

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Coffee/Lunch/Dinner

Review talks:

save questions for general discussion

Open talks:

discussions on selected hot topics

Q&A:

think of a question to ask to a member of another community

Journal club:

select and prepare a recent paper for discussion

Project brainstorming:

think of what your contribution to this session might be

Add-ons:

schedule is dynamical, feel free to propose additional social activities or talks

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## **DARK MATTER IN THE MILKY WAY**

**MITP, May 2-13, 2016**

**– Second week, May 9-13 –**

### **Your to-do list**

**Q&A**

Think of a question you would like to pose to one of the other communities in the workshop.  
Send it to [dm16mw@gmail.com](mailto:dm16mw@gmail.com) by **Mon, 14:00**.

**Journal club**

Identify (and read) a recent paper in your field to bring it to the attention of all at the journal club.  
Send it to [dm16mw@gmail.com](mailto:dm16mw@gmail.com) by **Wed, 23:00**.

**Project brainstorming**

Sketch here the ideas you would like to discuss during the project brainstorming session:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

# Logistics: template

## Your contribution to the general discussion

Please use the space below to write down your questions to each talk; they will feed the general discussion session on Fri, 10:15.

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1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

### **Open talk: "Future simulations and astronomical data", Federico Marinacci & Jose Onorbe**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

### **Open talk: "Direct detection and simulations/data", Riccardo Catena & Mattia Fornasa**

1. \_\_\_\_\_
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3. \_\_\_\_\_

### **Open talk: "Indirect detection and simulations/data", Miguel Sanchez Conde**

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2. \_\_\_\_\_
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