Final wrap-up

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

SOC: Di Cintio, Iocco, Pato, Weniger

Workshop funded by MITP

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 (1st week)

Baryons are crucial in any simulation to understand DM distribution.

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

The “center” (< 1kpc-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 (1st week)

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).

Things we have learned (2nd week)

The future of astronomical data is not only Gaia: PanSTARRS, WEAVE, HERMES, 4MOST, MSE, MOONS, WFIRST.

Possibility to detect dark matter haloes using stellar stream gaps with potential consequences to disentangle the nature of dark matter.

Dark matter profile close to the Galactic centre (radii < 2-3 kpc) currently not measurable. Possible improvement with upcoming infrared surveys/instruments such as MOONS (2019) and WFIRST (2025-2030?).

Unclear the role of GR in galactic rotation curves:
does GR really differ from Newtonian at galactic scales?
if yes, does it reproduce the observed rotation curve using the observed luminous distribution?

Things we have learned (2nd week)

Possibility of having multiple dark matter components is usually overlooked but it is entirely feasible - more difficult to detect and simulate.

Future increase of computing power: more statistics (boxes) vs more resolution (zoom-ins). Ability to start looking at detailed physical processes important for galaxy formation: magnetic fields, thermal conduction, cosmic rays, radiative transfer

Measurement of local dark matter density tough but possible in near future; local velocity distribution much more difficult and currently just constrained indirectly.

Dwarfs is a hot target for indirect detection: the exact density profile is not so important at the current angular resolution of gamma-ray instruments, but more objects and more precise spectroscopy will improve the limits.

Project brainstorming

Effect of contraction vs expansion on the metallicity gradients of the inner region of Milky Way: can we get a signature of different contraction/expansion looking at different simulations? (Brook)

MW DM halo comparison project: study the contraction vs expansion in MW galaxies as a function of radius. Plot Mhydro(r)/Mdm(r) vs r/R200: also compare axis ratios, upper and lower limit on inner slope? (Dutton)

Calibrate adiabatic contraction models with simulations of MW-like haloes and observed baryonic distribution (Iocco)

How to define a Milky Way galaxy? (Calore, Bozorgnia)

Derive the f(v) of MW with different simulations (CDM,WDM,SIDM + baryons) (Cerdeño, Di Cintio)

Project brainstorming

Comparison project to understand the effect of AGN at MW scales (Marinacci)

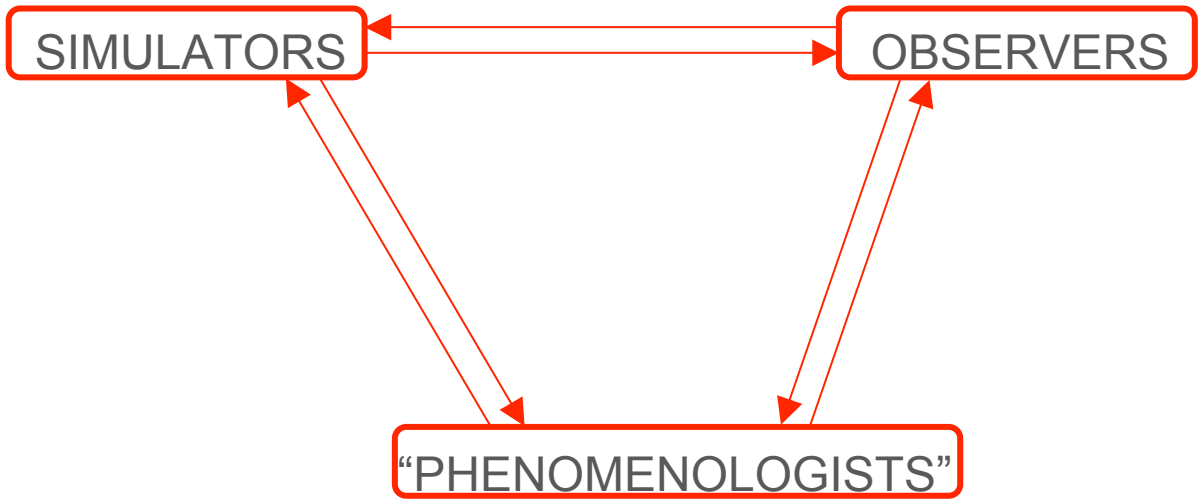
Check if the scatter in V2kpc-Vmax is similar/different between the various simulations and how we can explain it (Oman)

Close to the neutrino floor, can we disentangle neutrino new physics and WIMP scattering? (Kopp)

Leptonic constraints on effective operators for dark matter searches at colliders (Queiroz da Silva)

Density profile of subhalos (dwarfs) as a function of their position in the Galaxy - what can we learn from simulations? (Linden)

Inter-community synergies



Check-out

Acknowledgements to MITP in papers. (Form in flier + website)

Don’t forget to checkout and get your money back.

Don’t forget to drop your electronic key in big mailbox when leaving.

Let’s share them pictures, if you took any.

Let us stop by our secretaries’ offices and thank them for the royal hospitality.

Thanks to each and every one of you for the great participation!