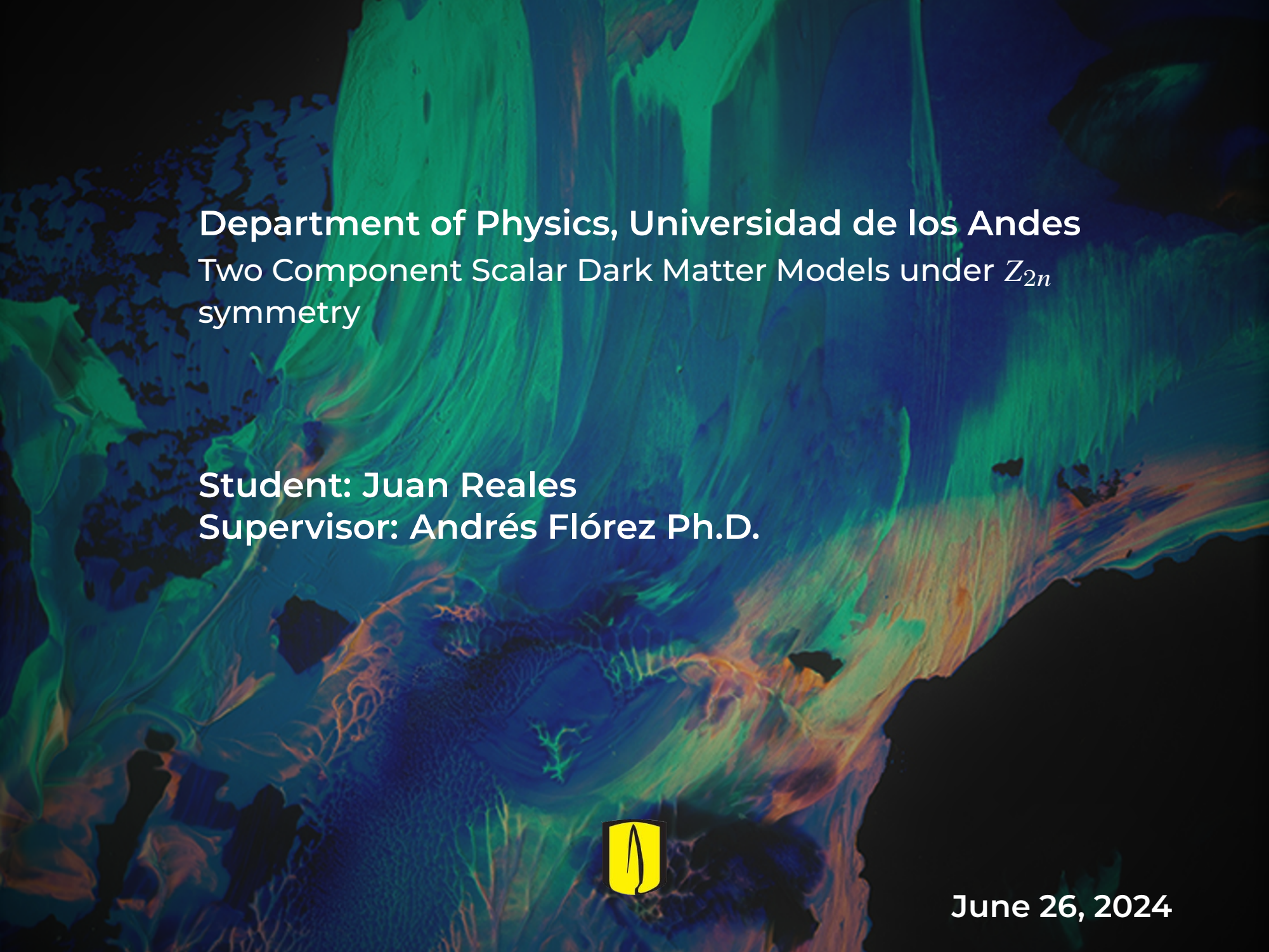

Department of Physics, Universidad de los Andes

Two Component Scalar Dark Matter Models under Z_{2n} symmetry

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Contents

Dark Matter?

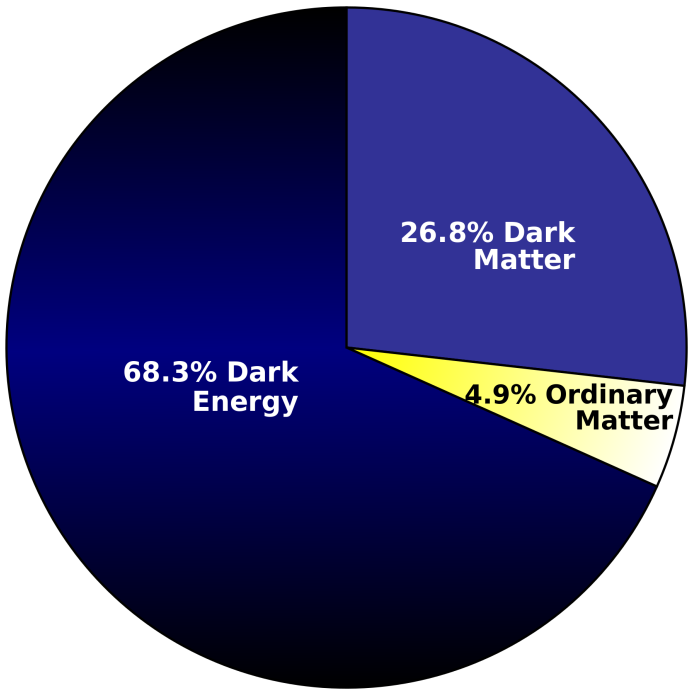


Figure: Energy distribution of the universe. 2011, Caltech.

DM Particles:

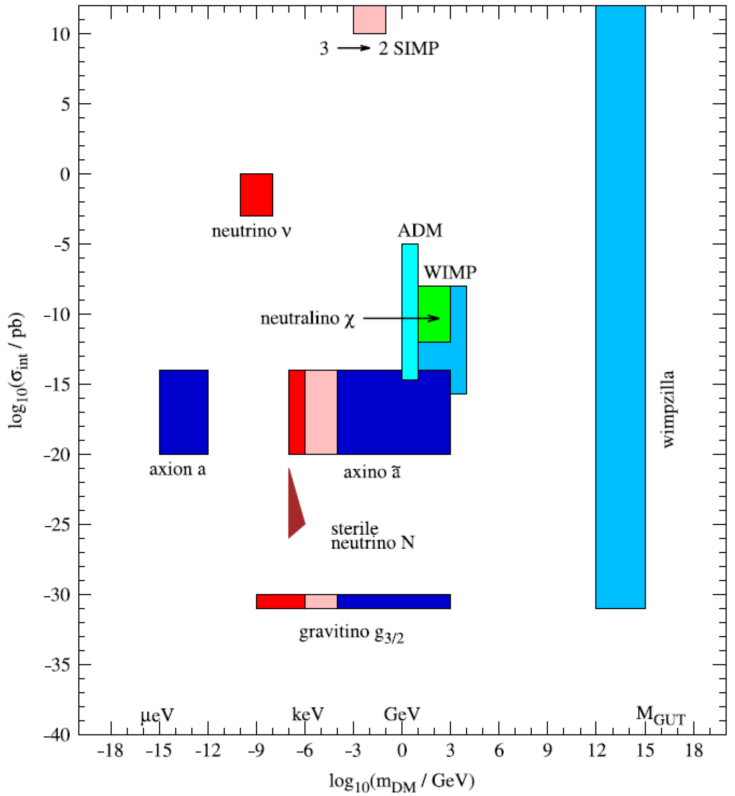
- Non baryonic, elec.neutral, massive.
- Non-Relativistic at the decoupling.
- Longlived (stables)
- $\Omega_{DM} \approx 1/4$

Evidence for dark matter

- Big Bang nucleosynthesis
- Cluster and supernova data
- Bullet cluster
- CMB anisotropies, etc

Multicomponent Dark Matter

- Typically, dark matter (DM) is thought to be accounted for by a single candidate, such as $\tilde{\chi}_1^0$, N_S, a, S, etc. However, what if DM consists of multiple species, similar to the visible sector? In this scenario, the total DM density would be the sum of the densities of these individual components: $\Omega_{DM} = \Omega_1 + \Omega_2 + \ldots$.

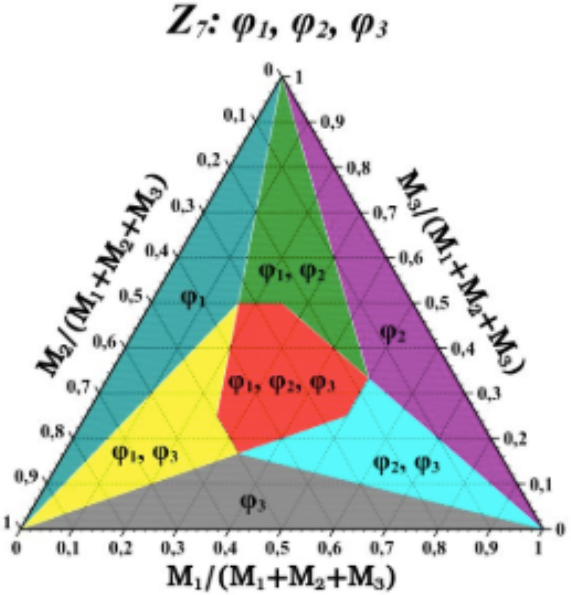


What underlying symmetry ensures the stability of these different particles?

Z_N Multicomponent Scenarios

It appears that employing a single Z_N symmetry is the most straightforward approach to simultaneously stabilizing multiple dark matter (DM) particles, Yaguna and Zapata 2020.

- Models utilizing scalar fields are especially attractive in this context.
- For k DM particles, these models necessitate k complex scalar fields that are singlets under the SM but possess distinct charges under Z_N ($N \geq 2k$).
- The Z_N symmetry may originate from the spontaneous breaking of a $U(1)$ gauge symmetry, potentially linking it to gauge extensions of the SM.



What are we going to do?

To investigate and analyze the phenomenology of two-component scalar dark matter models under Z_{2n} symmetry, with a focus on exploring their theoretical coherence, phenomenological validity, and experimental testability., following these steps:

- Theoretical Calculations: We primarily want to reproduce and adjust if necessary the results in: Carlos E Yaguna and Oscar Zapata (2020). “Multi-component scalar dark matter from a ZN symmetry: a systematic analysis”. In: *Journal of High Energy Physics* 2020.3, pp. 1–33.
- Simulation: to explore the parameter space and analyze the phenomenology of the Z_4 and Z_6 models. We will mainly be using micrOmegas.
- Analysis of Simulated Data:XENON1T, LZ and DARWIN.
- Model Testing and comparison.

What happens when N is odd or even?

Visit our GitHub organization,

https://github.com/Dark-Matter-Physics

1st Week Progress

Next Steps

Bibliography I

Gial Ackbar (n.d.). “It’s a trap! How to avoid common LaTeX mistakes”. In: *Proceedings of the 42nd Intergalactic Conference on Overused Internet Memes*.

Galen Erso (n.d.). “Construction plans of the Death Star 1 Orbital Battle Station”. In: *Journal of Horrible Plot Flaws* 2 (), pp. 1977–2015.

John Smith (2017a). “A repeated article just to show you a multiple slide bibliography”. In: *Proceedings of the First conference on Placeholder Documents*.

– (2017b). “A repeated article just to show you a multiple slide bibliography”. In: *Proceedings of the First conference on Placeholder Documents*.

– (2017c). “A repeated article just to show you a multiple slide bibliography”. In: *Proceedings of the First conference on Placeholder Documents*.

Bibliography II

John Smith (2017d). “A repeated article just to show you a multiple slide bibliography”. In: *Proceedings of the First conference on Placeholder Documents*.

Carlos E Yaguna and Oscar Zapata (2020). “Multi-component scalar dark matter from a ZN symmetry: a systematic analysis”. In: *Journal of High Energy Physics* 2020.3, pp. 1–33.


Luke,
I am your supervisor