#### Alejandra Aguirre-Santaella



(and yet, I love programming!)



Vogelsberger+20

What are we??

What do we want?

when do we want it?



CTAN

To be built and operating

2016...2019...2022...2025

van den Bosch+Ogiya18





representation of CTA

DESY Summies Career Talk, 28 Aug 2024

#### Who am I?



- Summerstudent DESY Zeuthen 2016
- PhD at Instituto de Física Teórica (Universidad Autónoma de Madrid) supervisor: Miguel A. Sánchez-Conde
   Stay in University of Waterloo with Go Ogiya
- Currently: postdoc at Institute for Computational Cosmology, Durham University, working with Carlos Frenk, Adrian Jenkins, and Sownak Bose



#### (some) interests beyond science



Swimming 🚵





ALL ORIGINAL TICKETS REMAIN VALID 14/11 THE 02, LONDON



14/11/2022



Reading 듣 (I should do it more)



Travelling 📈 (and taking pics 🖸)



Videogames 🎮 (PC; mostly multiplayer)

Writing 🥖

(also collective stories!)

She was dancing as well as playing the mandoline, while people were huddled around. Her name was Reed. She was used to be seen, to be the focus. But what sh

f the town pointed at her and shouted:

lowever, she was always ready for that kind of

didn't expect was that, suddenly, one of the officers

woman with a strange nurnle cape who decided to take

out her bow, a man who was making a fireball grow on

his hands and a half-demon who started to jump swiftly

So she stopped immediately and drew her

The beginning

-Get her! Now



#### Hot choc 😂



#### Gender&LGBTIAQ+ activism 🌈



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#### **Scientific interests**

- Cosmological simulations
- Astroparticle physics (member of the Cherenkov Telescope Array Consortium, CTAC)

Main questions:
What is dark matter (DM)?
Do small DM substructure exist?
Do small DM substructure survive tidal forces?

# Free Hydrogen and Helium: **Dark Matter Dark Energy**

COMPOSITION OF THE COSMOS

#### Our cosmological model: ΛCDM

- Rotation curves, CMB anisotropies... lots of astrophysical and cosmological evidences of missing mass
- No particle in the SM can explain all these observations. DM should be:
   cold
  - stable at cosmological scales
  - electromagnetically neutral
  - ✤ non-baryonic
- A represents dark energy and explains the accelerated expansion of the Universe





#### **Cosmological simulations**

- Structure formation is hierarchical: bottom-up scenario
- Virialized structures: DM haloes → mergers → subhaloes within
- Majorly studied via:
  - large surveys by ground and space telescopes
  - analytical approaches
  - cosmological simulations
- Cosmological simulations: best tools in the non-linear regime
- Small scales specially relevant



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## DM halo substructure

Dark satellites 📕

luminous matter

Milky Way virial radius

GHALO simulation (Stadel+09)

Credit: Sánchez-Conde

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ixies

## What a cosmological simulation looks like

galaxy stellar mass = 14.668 million suns



Formation of a single massive galaxy through time in the TNG50 cosmic simulation

## Playing with cosmological simulations

- Basic properties of (small) subhaloes (abundance, distribution, structure) remain unclear Goal: characterize and repopulate a high-resolution zoom-in cosmological simulation
- Applications: constrain the DM mass-cross section parameter space, study instruments sensitivity...

Subhalo mass function (SHMF)



#### Focusing on individual subhaloes

- Open debate: disruption or survival of small subhaloes? (van den Bosch+18, van den Bosch & Ogiya 18)
  - Numerical resolution effects
  - Tidal forces within the host

Goal: shed light on subhalo survival via numerical simulations and study its impact for gamma ray searches

- High-resolution numerical simulations (DASH, Ogiya+19) to follow the evolution of the subhalo
- The subhalo will lose mass mainly in every pericentric passage
- Including baryonic material to the host potential induces larger mass and annihilation luminosity loses
- Most subhaloes don't disrupt even after losing more than 99% of their initial mass



#### van den Bosch+Ogiya18



Shedding light on low-mass subhalo survival and annihilation luminosity with numerical simulations, AAS+23, MNRAS, arXiv:2207.08652

## Looking for branons in dSphs with CTA

- Branons: WIMPs in the TeV mass range (Cembranos+03,11)
- Branching ratios depend on branon mass

Goal: Study CTA sensitivity to branon dark matter pointing to dwarf spheroidal galaxies





blue dash-dotted: Carr+15, only W<sup>+</sup>W<sup>-</sup> channel, 500h

## THANK YOU!

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