The impact of weak lensing mass bias on the kinematic description of merging galaxy clusters

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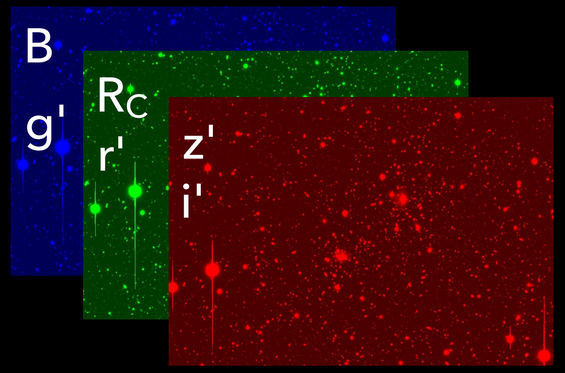
Richards Albuquerque & Rubens E. G. Machado
Universidade Tecnológica Federal do Paraná (Curitiba, Brazil)

11th KIAS workshop on Cosmology and Structure Formation

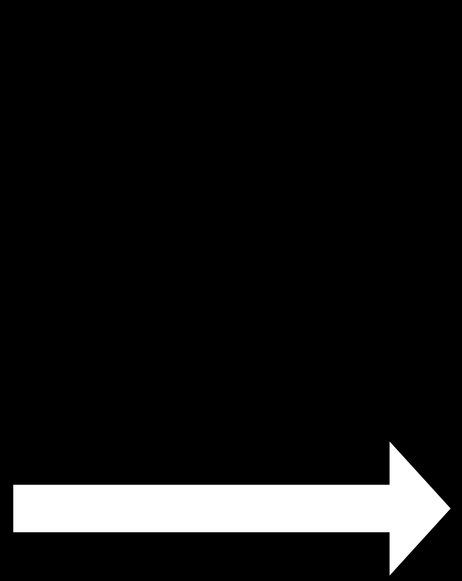
Gyeongju, November 1st, 2024

Post-collision anatomy: a multi-wavelength task

- Deep and large FoV images

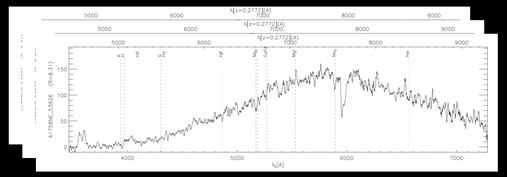


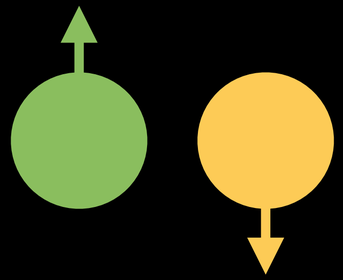




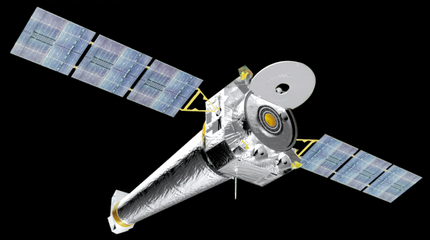


- Low resolution spectra





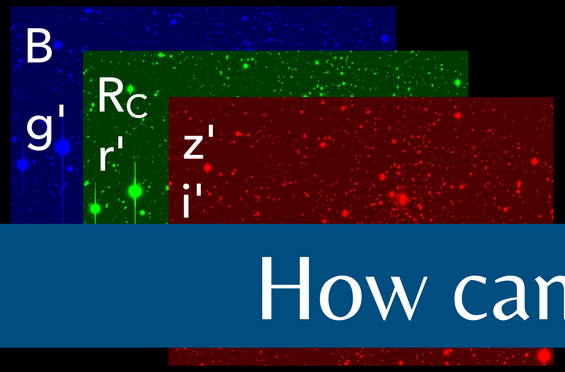
- X-ray, SZ data





Post-collision anatomy: a multi-wavelength task

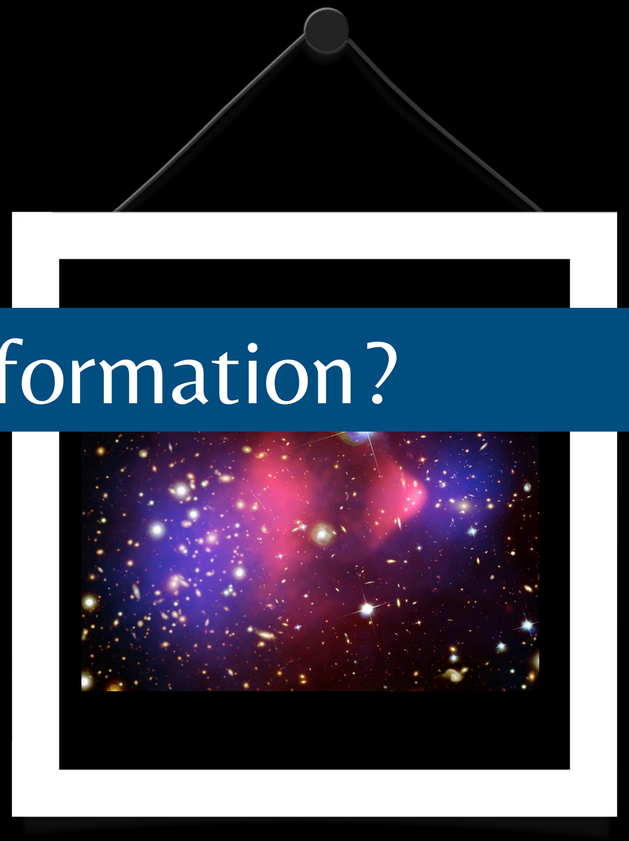
- Deep and large FoV images



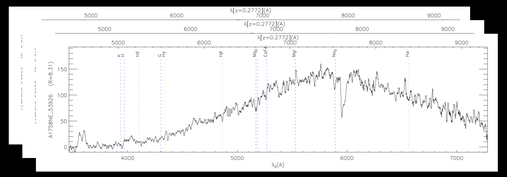


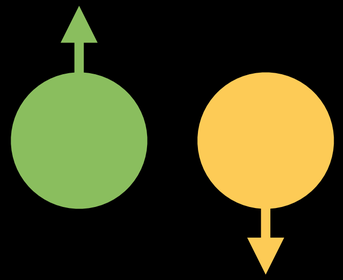
How can we track the history of cluster formation?



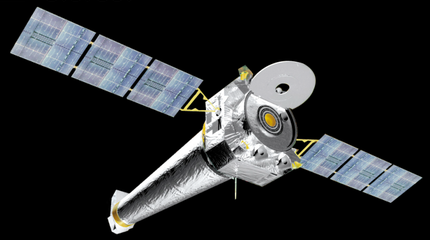


- Low resolution spectra





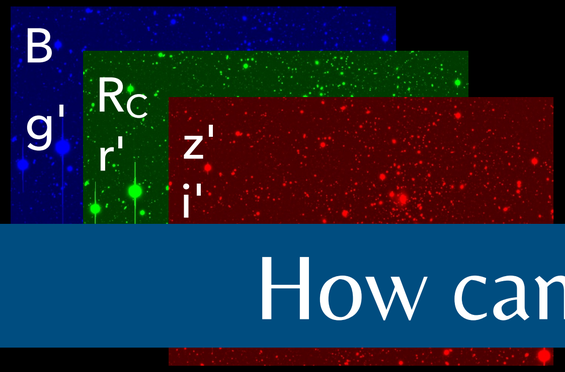
- X-ray, SZ data



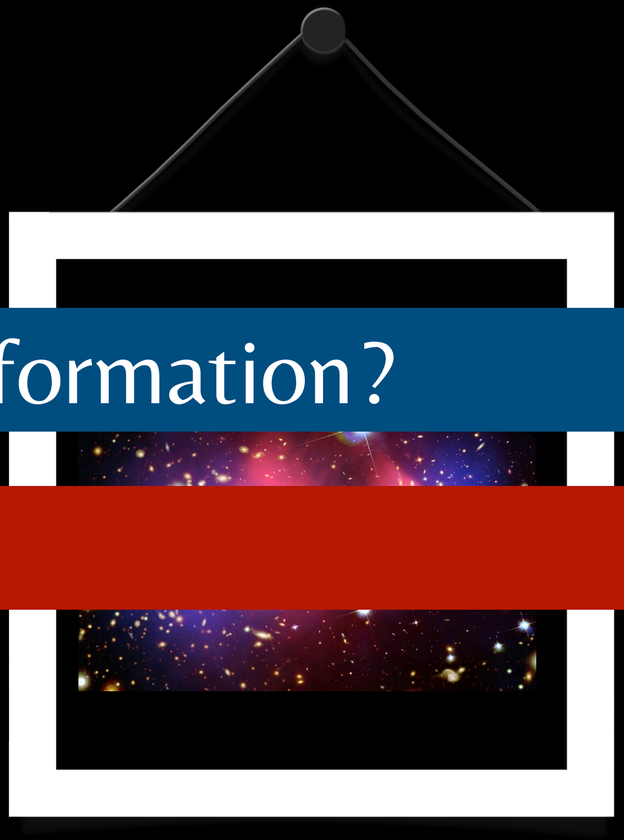


Post-collision anatomy: a multi-wavelength task

- Deep and large FoV images

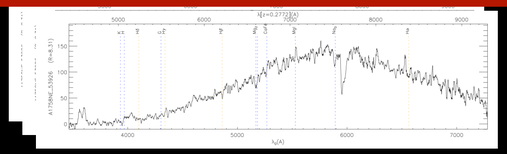




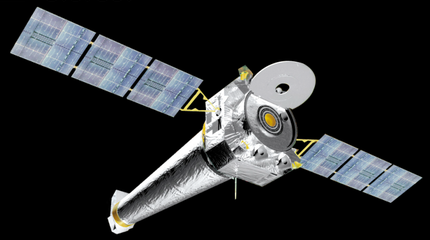


How can we track the history of cluster formation?

hydrodynamical simulations



- X-ray, SZ data

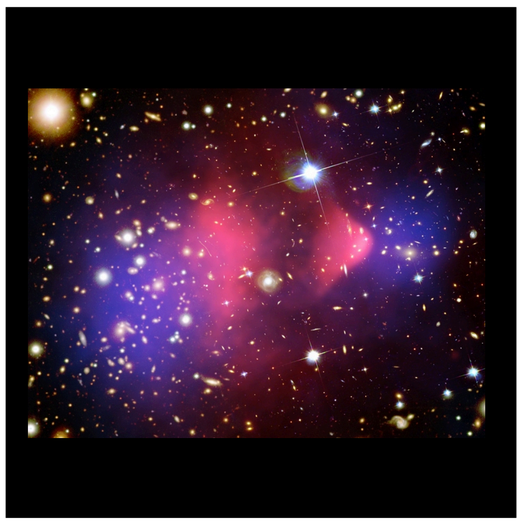




Hydrodynamical simulations

Access to the past and future of cluster formation

input:



mass (M_{200} & spatial distribution)
ICM features (temperature, transient effects)

hydrodynamical simulation to match the post merger anatomy

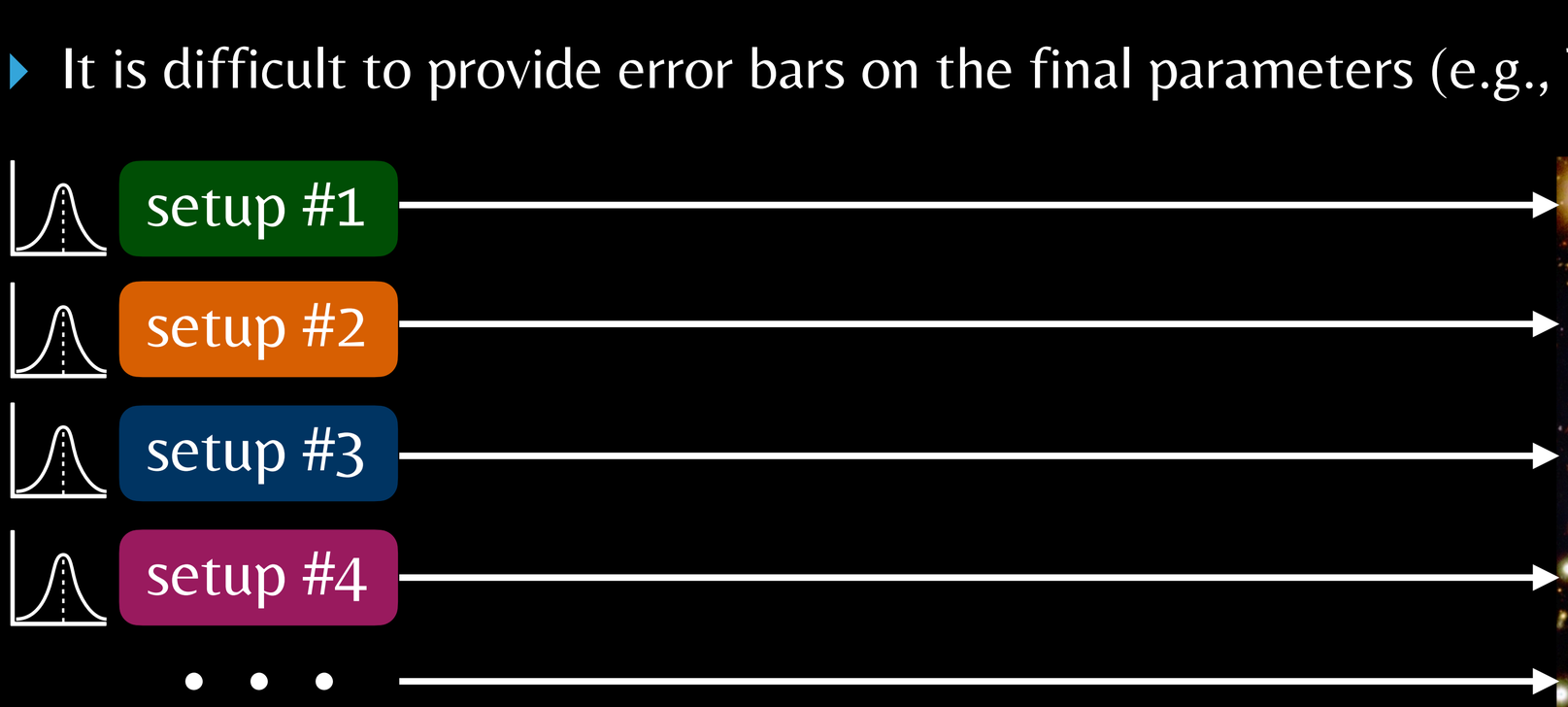
output:

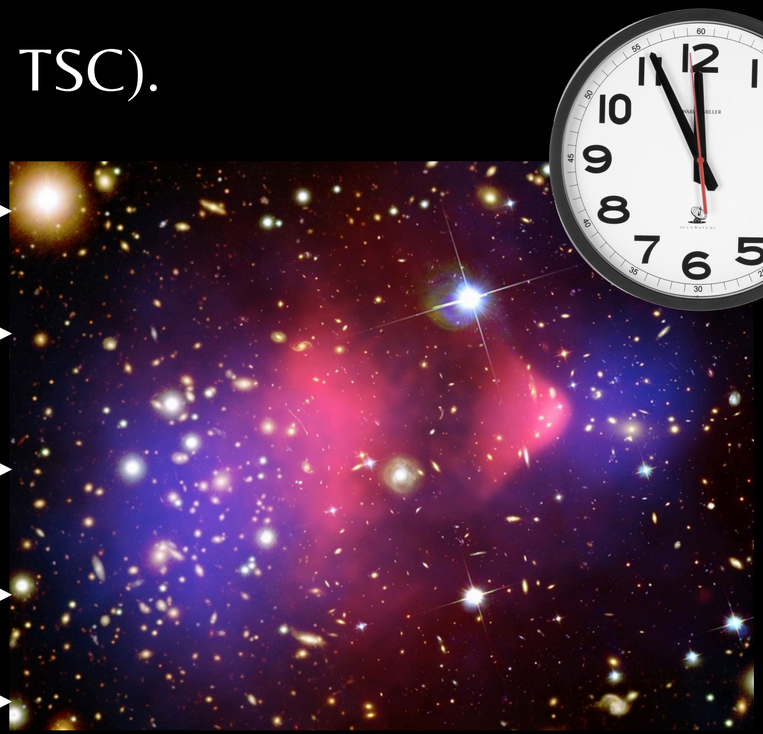
time since collision
(TSC — “merger phase”)

Hydrodynamical simulations

Challenges

- It is difficult to provide error bars on the final parameters (e.g., TSC).



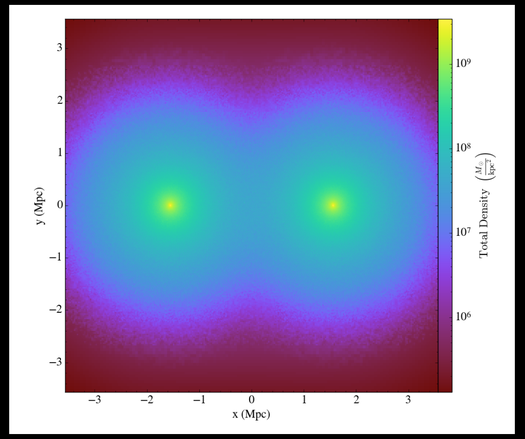


Weak lensing mass bias (WLMB)

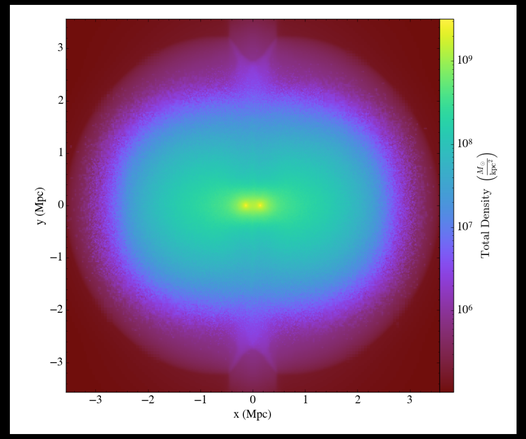
Lee et al. 2023

- WL masses measured by assuming an analytical profile (e.g., NFW) can be biased by up to ~60% in merging clusters.
- The WLMB is modulated by the halo concentration c_{200}.

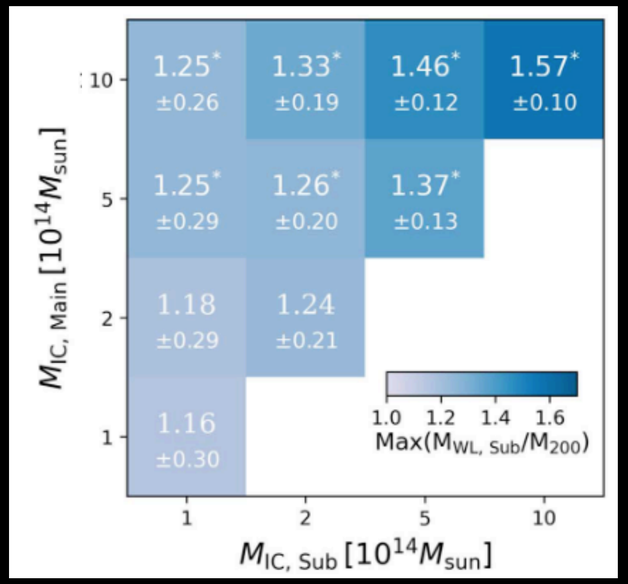
pre-coliision



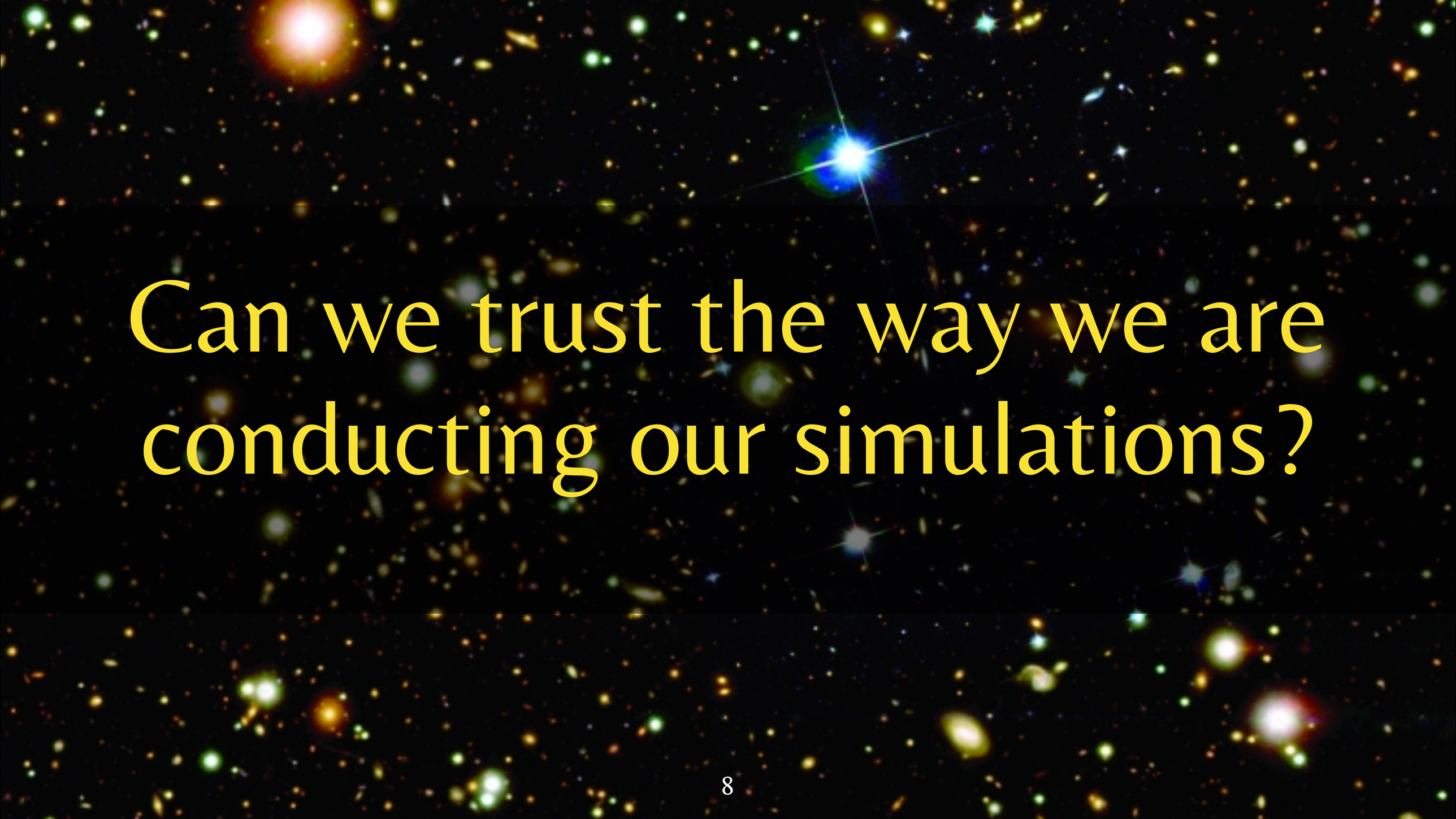
post-coliision



John ZuHone (gcmc.hub.yt)



Lee et al. 2023


Can we trust the way we are conducting our simulations?

Abell 56

Post-merger anatomy

Collision axis near plane of the sky
($\Delta v_{\rm LOS} = 153 \pm 281$ km s^{-1})

Large gas-BCG spatial offset

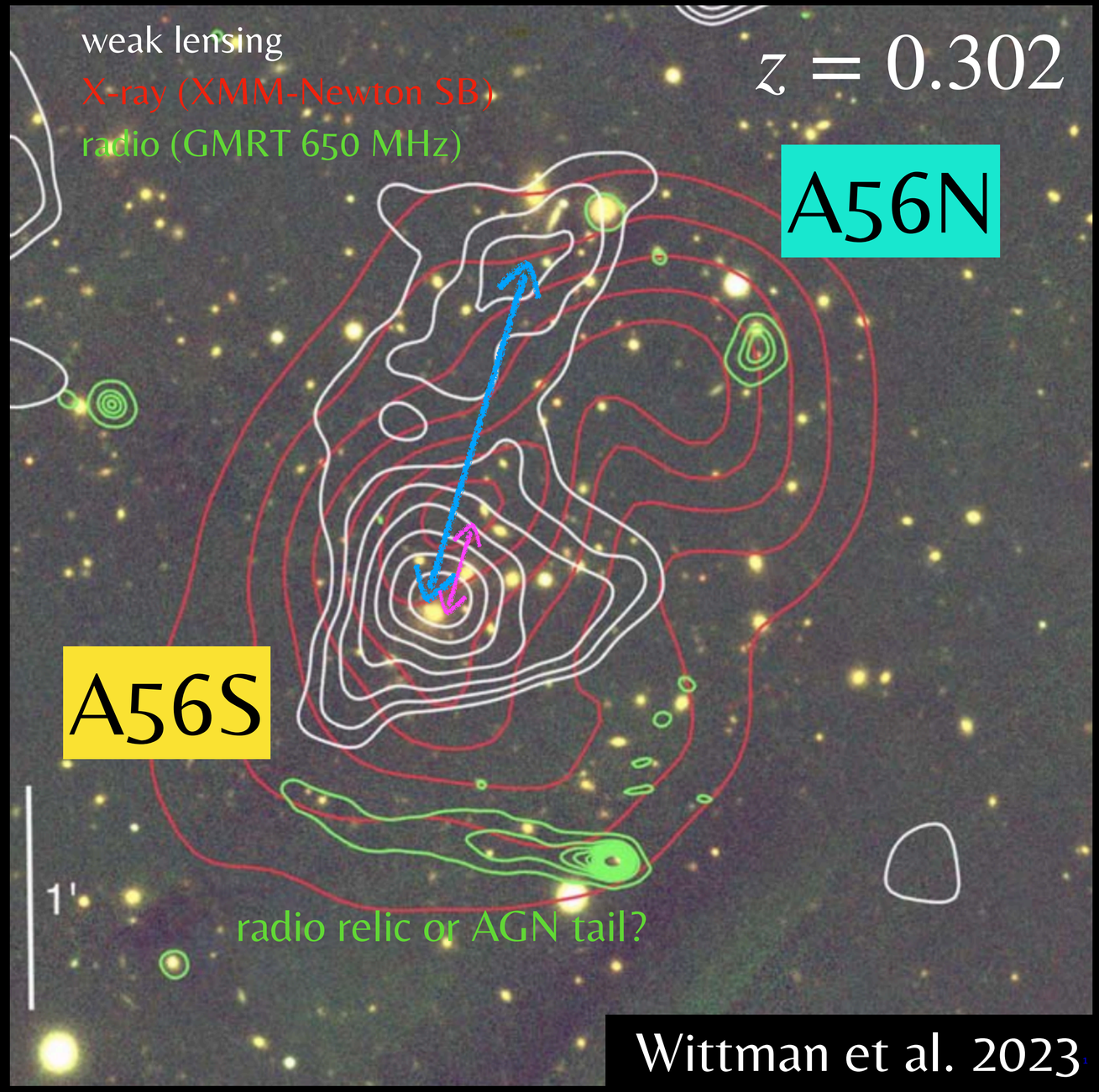
Potential laboratory for SIDM investigation

$M_{200} = 4.5 \pm 0.8 \times 10^{14}$ M$_\odot$

$M_{200} = 2.8 \pm 0.7 \times 10^{14}$ M$_\odot$

438 ± 206 kpc
projected separation between mass peaks

118 ± 41 kpc
projected separation between the single X-ray peak and the southern mass peak

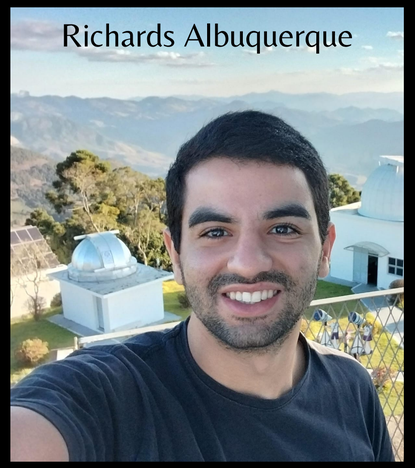


Wittman et al. 2023

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Simulation setup

Time is short today.
Please check at the paper.





Albuquerque, Machado & Monteiro-Oliveira, 2024

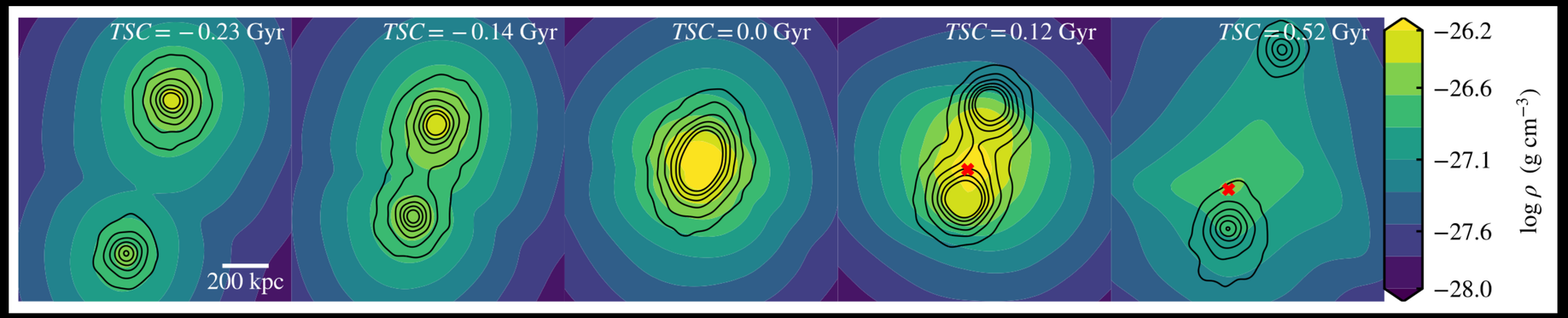
MNRAS, 530, 2146

arXiv:2401.15044



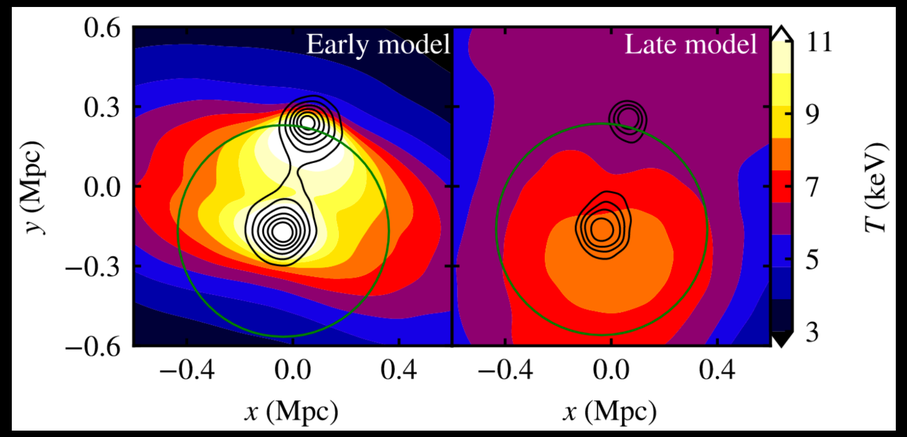
Abell 56: merger history reconstruction

1) time evolution of the gas density

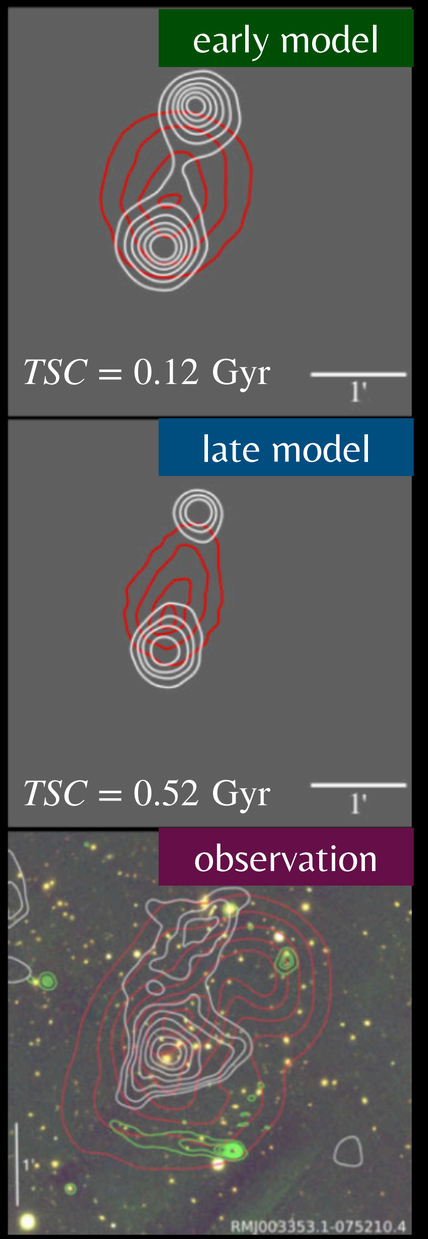


early model | late model

3) temperature map weighted by density

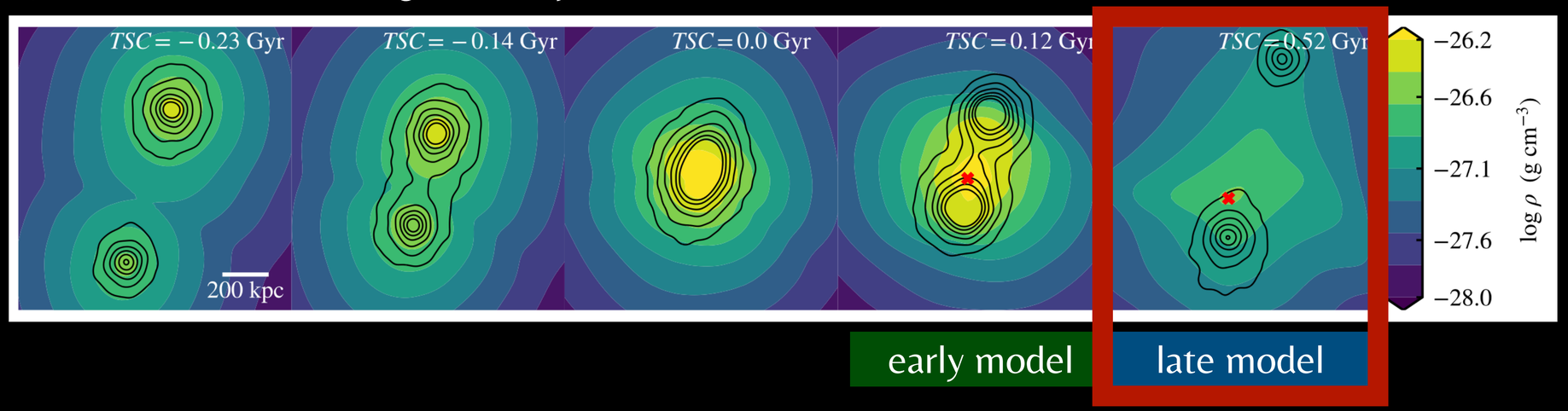


2) best moments

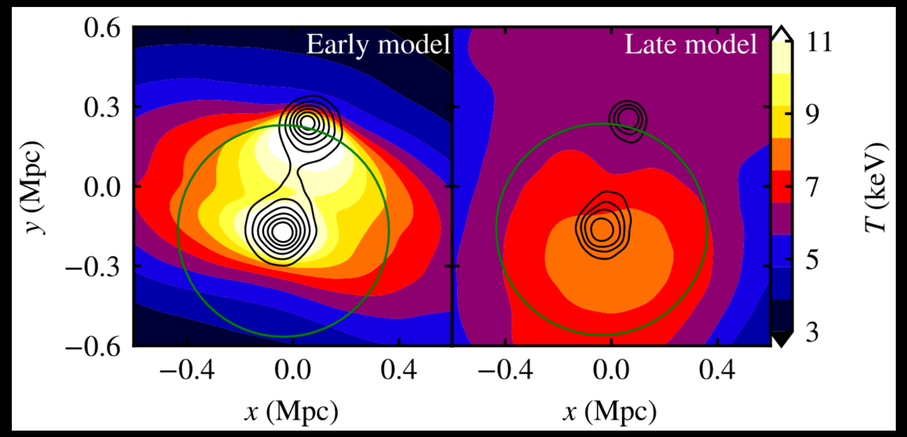


Abell 56: merger history reconstruction

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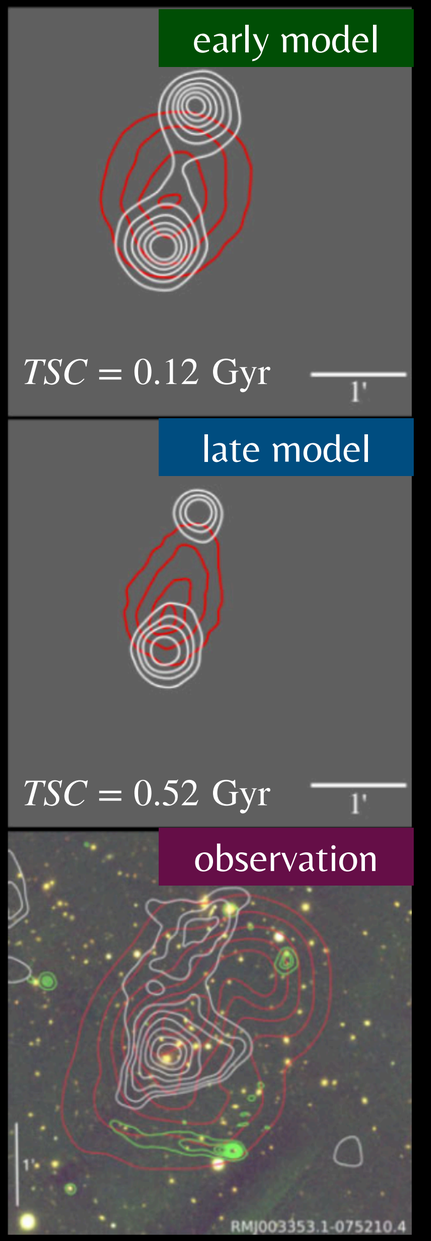


3) temperature map weighted by density





2) best moments



Abell 56: effects of WLMB

then: original inputs

$M_{200} = 4.5 \pm 0.8 \times 10^{14}\ \mathrm{M}_\odot$

$M_{200} = 2.8 \pm 0.7 \times 10^{14}\ \mathrm{M}_\odot$

$-28\ \%$

Lee et al. 2023

now: WLMB corrected

$M_{200} = 3.5 \times 10^{14}\ \mathrm{M}_\odot$

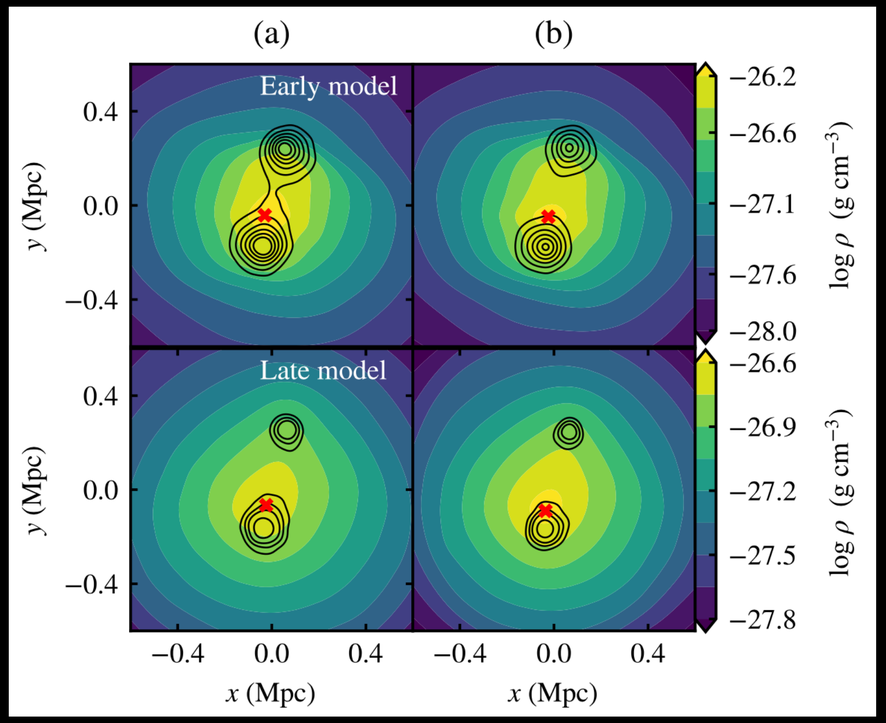
$M_{200} = 2.2 \times 10^{14}\ \mathrm{M}_\odot$

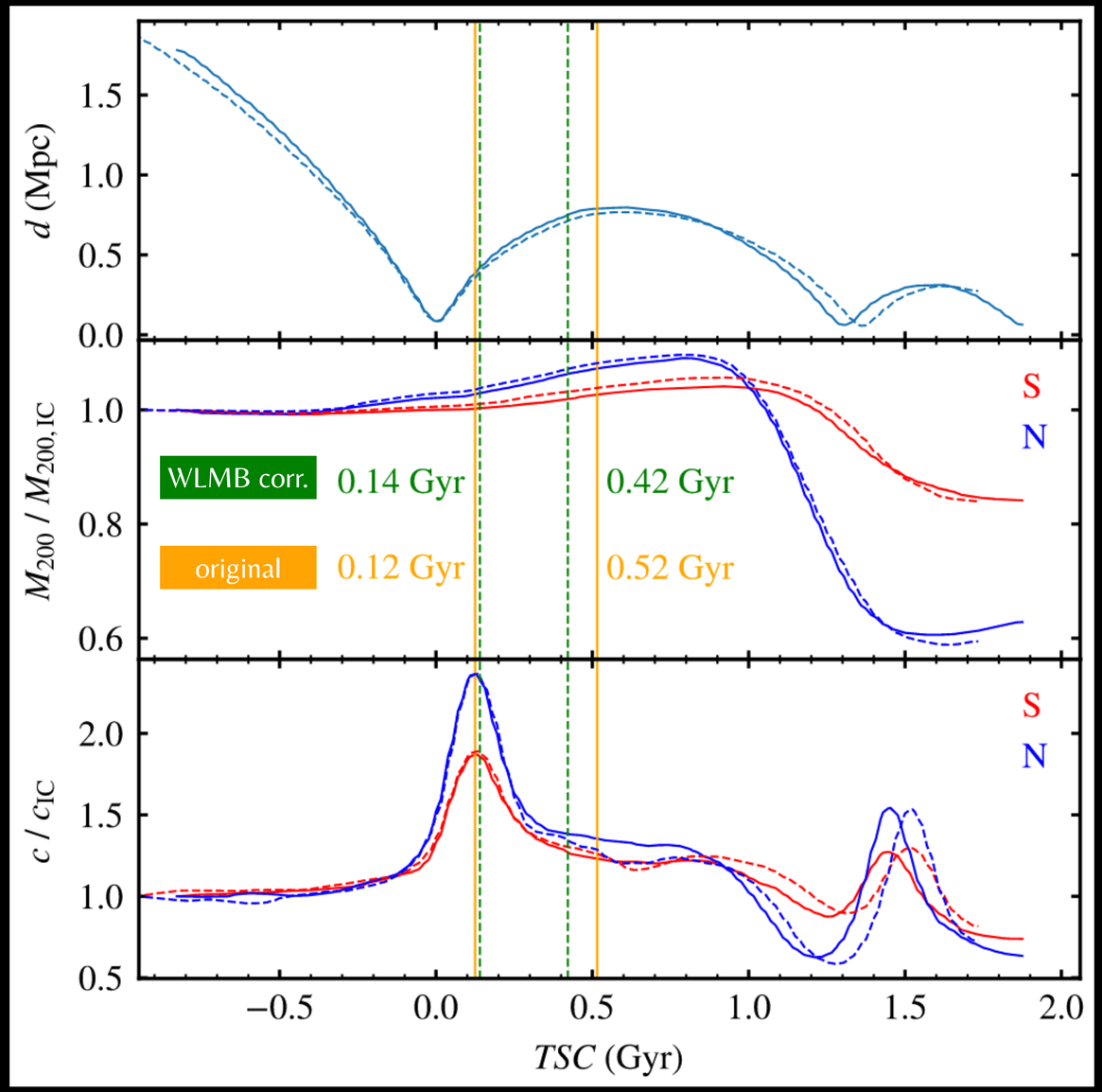
Abell 56: effects of WLMB

Results

original

WLMB corrected





original

WLMB corrected

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- WLMB correction does not substantially alter the description of the cluster's merger history.
- However, it is still premature to consider this a generalizable result.
- Further investigations into various configurations, particularly exploring different mass ratios and merger phases, are still needed.

Visit my poster!



No Evidence of a Dichotomy in the Elliptical Galaxy Population

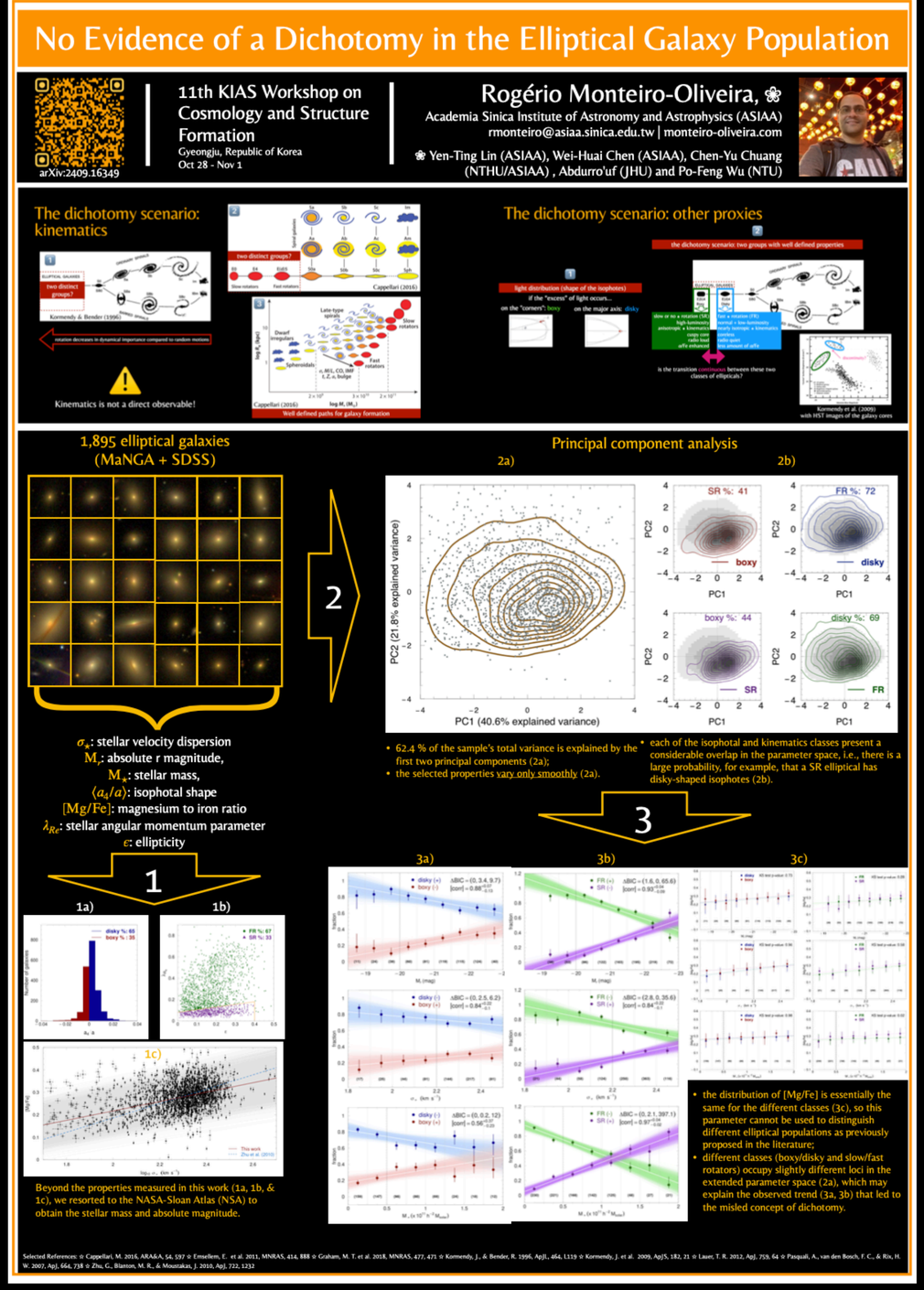
Rogério Monteiro-Oliveira [1], Yen-Ting Lin [1], Wei-Huai Chen [2,1], Chen-Yu Chuang [3,1,4], Abdurro'uf [5,1] and Po-Feng Wu [2,6]

[1] *Institute of Astronomy and Astrophysics, Academia Sinica, Taipei 10617, Taiwan*
[2] *Department of Physics, National Taiwan University, Taipei 10617, Taiwan*
[3] *Institute of Astronomy, National Tsing Hua University, Hsinchu 30013, Taiwan*
[4] *Department of Astronomy, University of Arizona, Tucson, AZ 85721, USA*
[5] *Department of Physics and Astronomy, Johns Hopkins University, Baltimore, MD 21210, USA*
[6] *Institute of Astrophysics, National Taiwan University, Taipei 10617, Taiwan*

ABSTRACT

The advent of large integral field spectroscopic surveys has found that elliptical galaxies (EGs) can be classified into two classes: the fast rotators (whose kinematics are dominated by rotation) and the slow rotators (which exhibit slow or no rotation pattern). It is often suggested that while the slow rotators typically have boxy isophotal shapes, have a high α-to-iron abundance ratio, and are quite massive, the fast rotators often exhibit the opposite properties (that is, having disky isophotes, lower α-to-iron ratio, and of typical masses). Whether the EGs consist of two distinct populations (i.e., a dichotomy exists), remains an unsolved issue. To examine the existence of the dichotomy, we used a sample of 1,895 EGs from the SDSS-IV MaNGA survey, and measured robustly the stellar kinematics, isophotal shapes, and [Mg/Fe] ratio. We confirmed the previous finding that the bulk of the EGs are disky (65 %) and fast rotators (67 %), but found no evidence supporting a dichotomy, based on a principal component analysis. The different classes (boxy/disky and slow/fast rotators) of EGs occupy slightly different loci in the principal component space. This may explain the observed trends that led to the premature support of a dichotomy based on small samples of galaxies.

arXiv:2409.16349



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