

UQ Astrophysics

Overview

Cosmology

Supernova cosmology (DES and LSST):

- Type Ia supernovae
- Supernova time dilation

Large-scale structure cosmology (DESI and 4HS):

- Baryon Acoustic Oscillations
- Large-Scale Structure Correlations
- Peculiar Velocities

Gravitational Waves (OzGrav)

Theory and other fun stuff



Tamara Davis



Cullan
Howlett

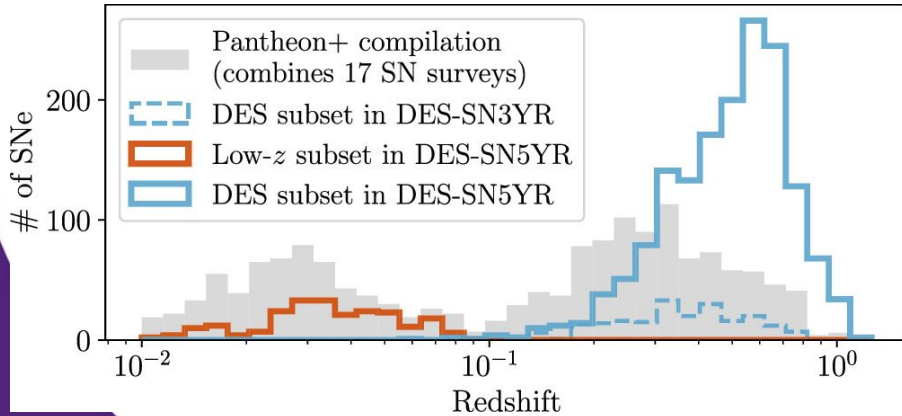


Ryan
Camilleri

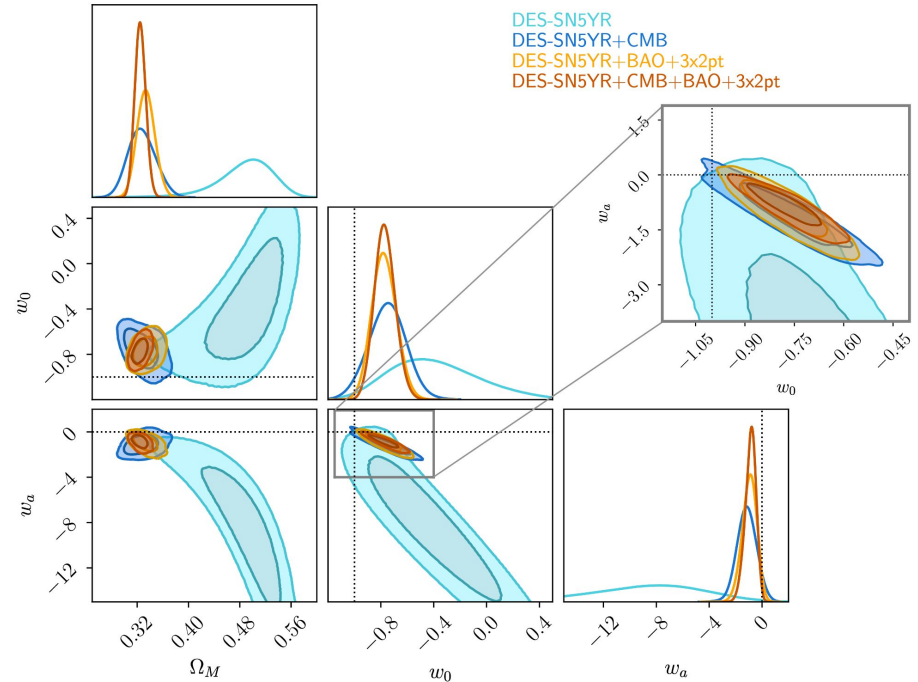
Dark Energy Survey Supernovae

80% of high-z supernova sample

Found hints of Dark Energy
time-variation in 2024



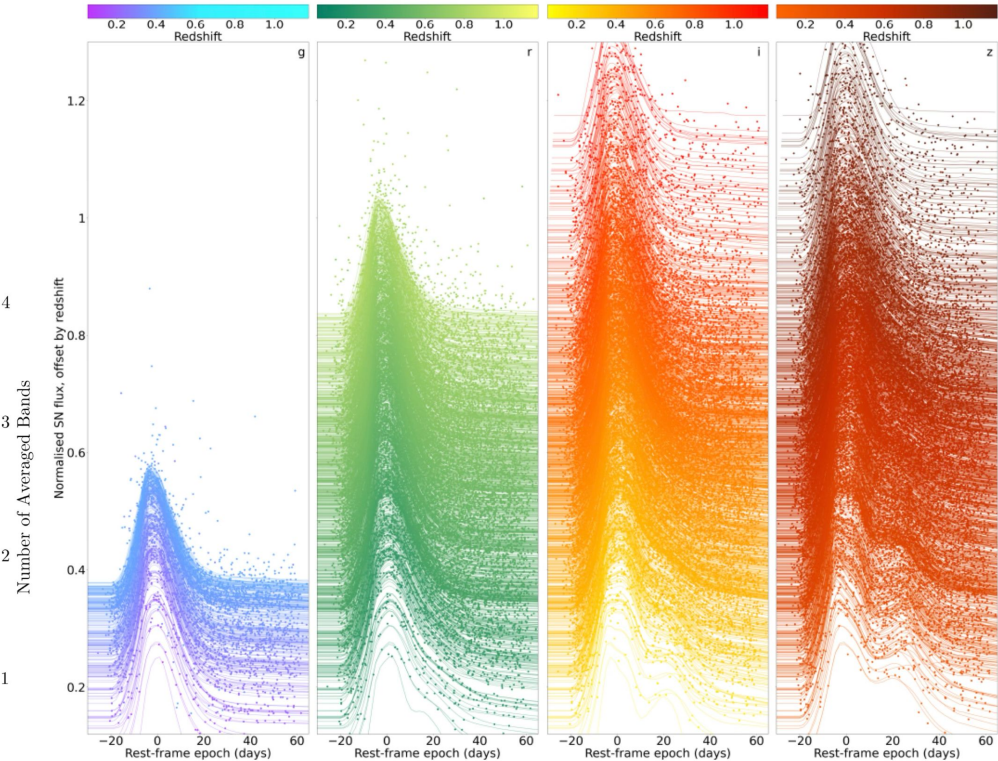
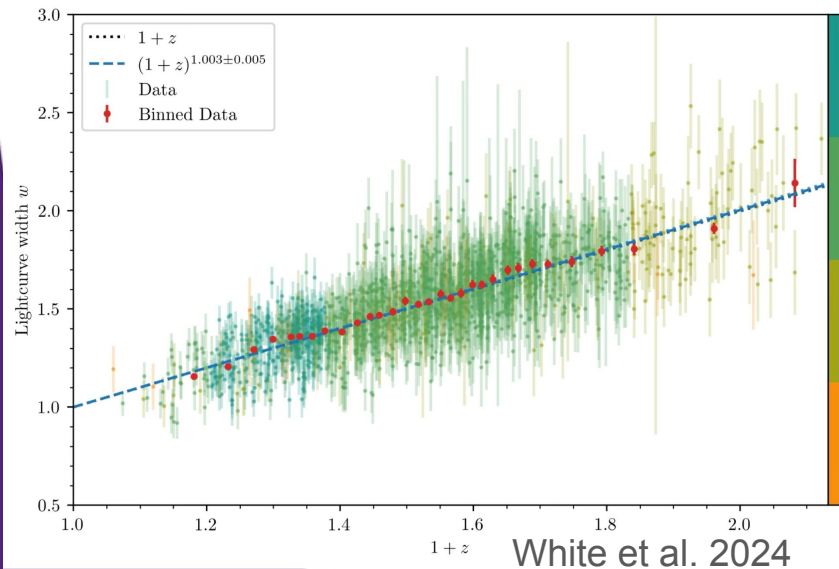
DES Collaboration 2024



DES supernovae, time dilation

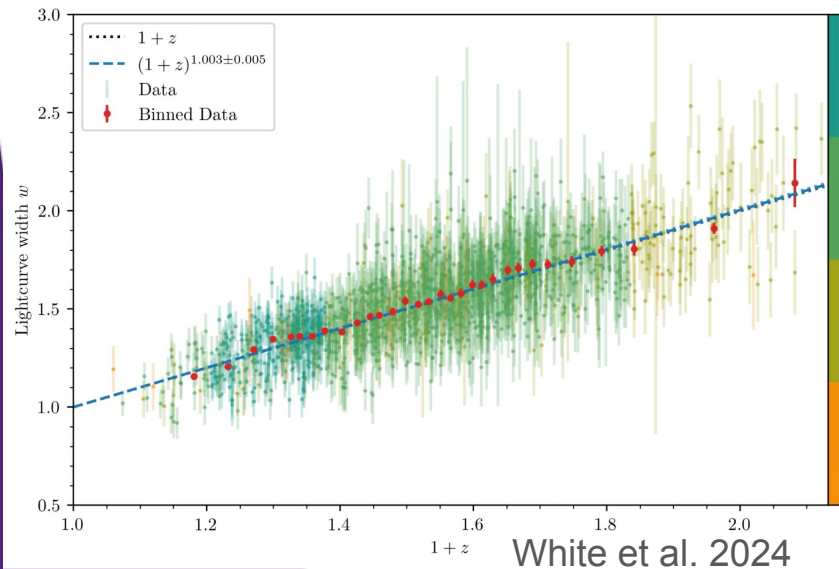
Measured time-dilation
due to the expansion of
the Universe

SN in rest frame

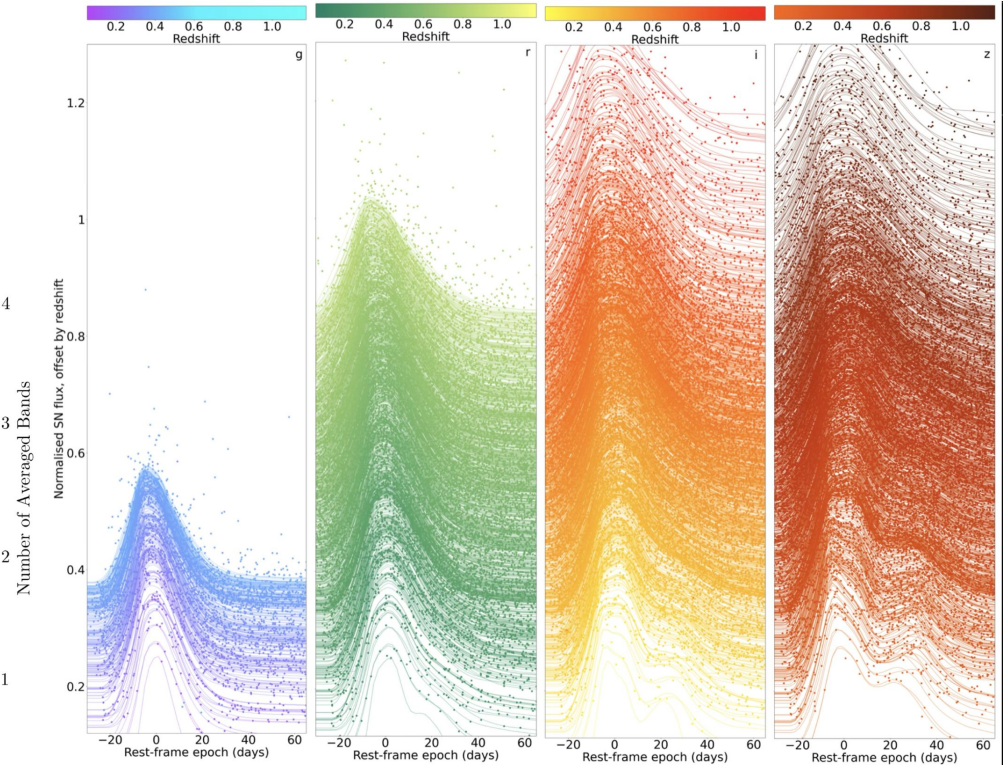


DES supernovae, time dilation

Measured time-dilation due to the expansion of the Universe



SN in observer frame

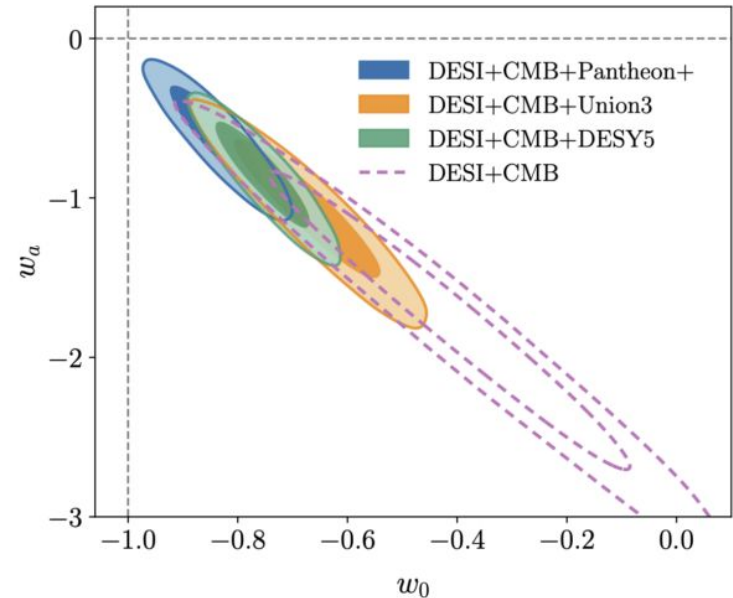
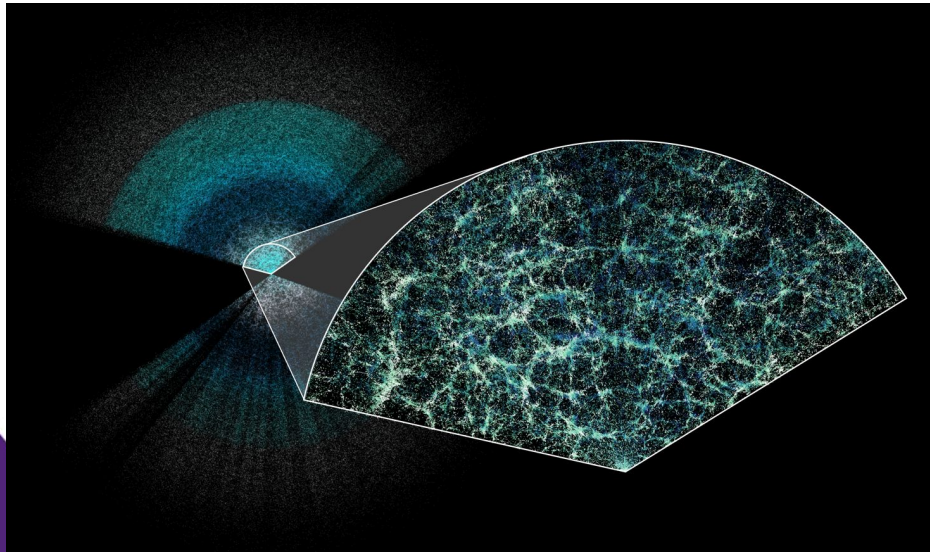


Dark Energy Spectroscopic Instrument BAO+LSS

Biggest spectroscopic large-scale structure survey ever

Found additional hints of Dark Energy time-variation

DESI Collaboration 2024





Caitlin Ross



Rianna Bell



Pratyush
Mishra



James
Simpson



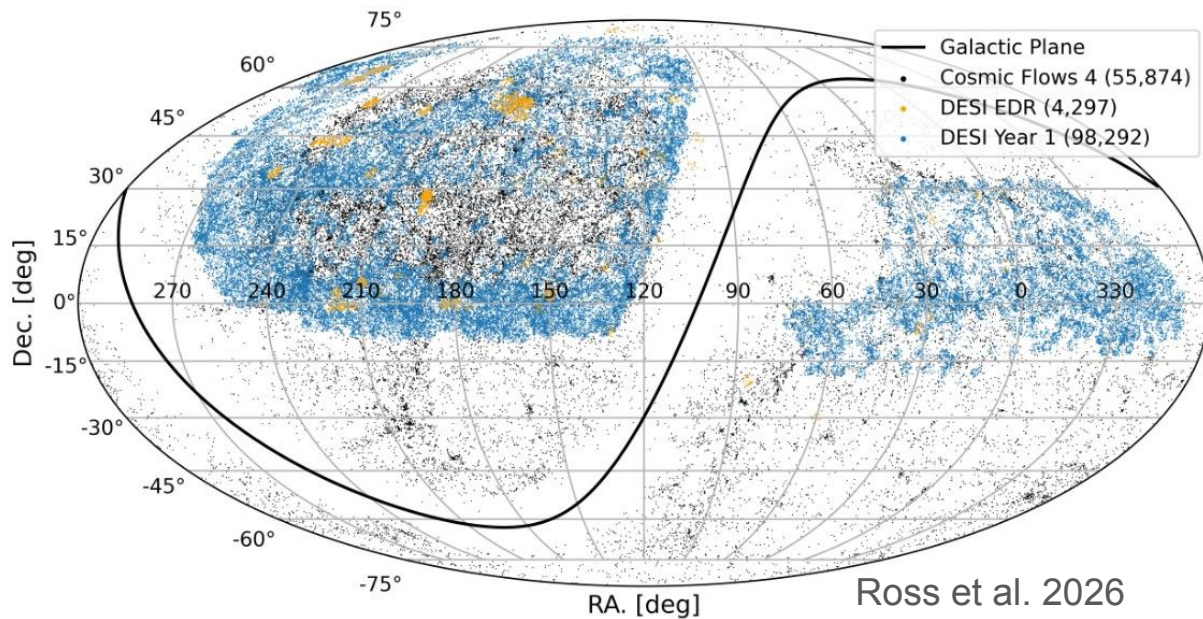
Khaled
Said

Peculiar Velocities

98,000 peculiar velocities in
DESI Data Release 1

Provides biggest map of
low- z velocity distribution for:

- Fitting cosmology
- Testing gravity
- Making better models/measurements
- Understanding our local Universe





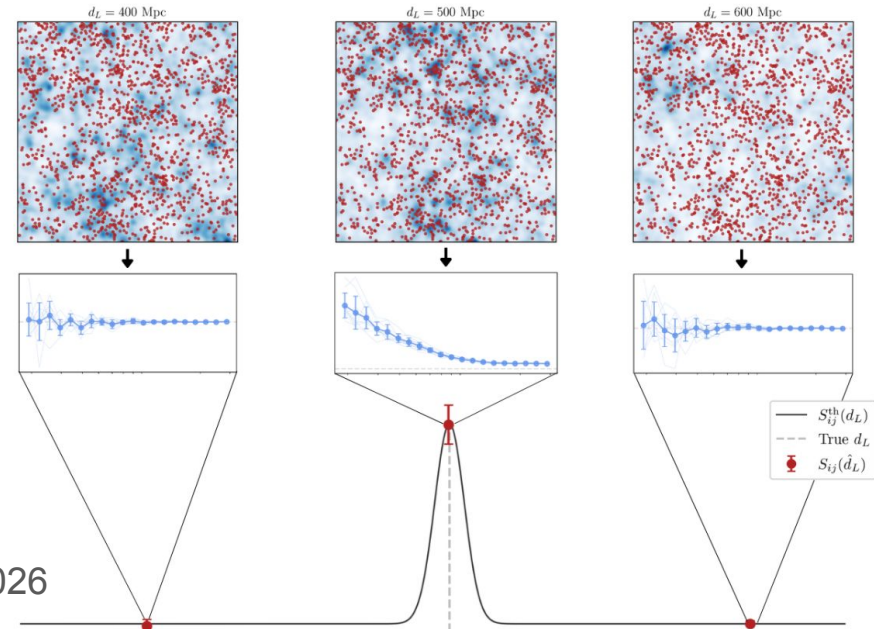
Maddy
Cross-Parkin



Nandita
Khetan

Gravitational Waves

- Part of the ARC OzGrav Centre of Excellence
- Interested in using GWs for measuring the expansion rate
- Improving GW followup
- Other cool uses of GWs



Cross-Parkin et al. 2026

Other Fun Stuff

Filzinger et al., 2025

- Dark Matter indirect detection



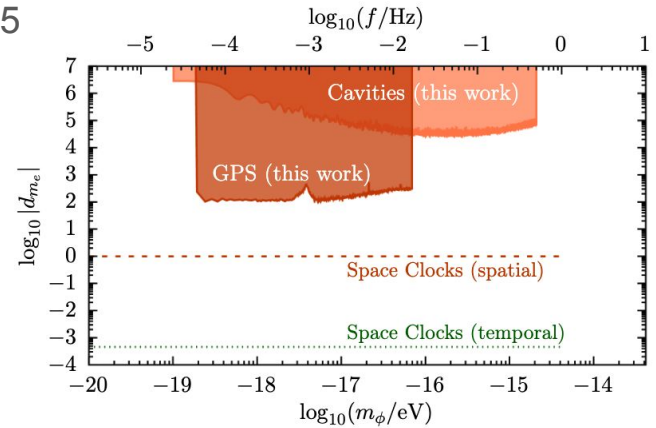
Narise
Williams



Ashlee
Caddell



Ben
Roberts



Other Fun Stuff

Filzinger et al., 2025

- Dark Matter indirect detection



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Ashlee
Caddell



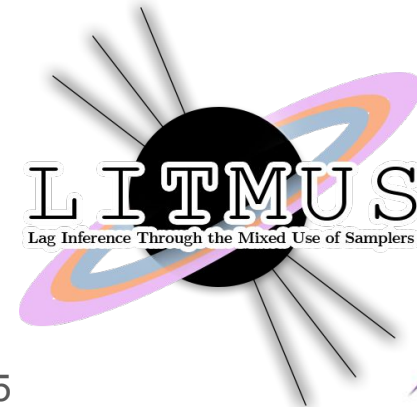
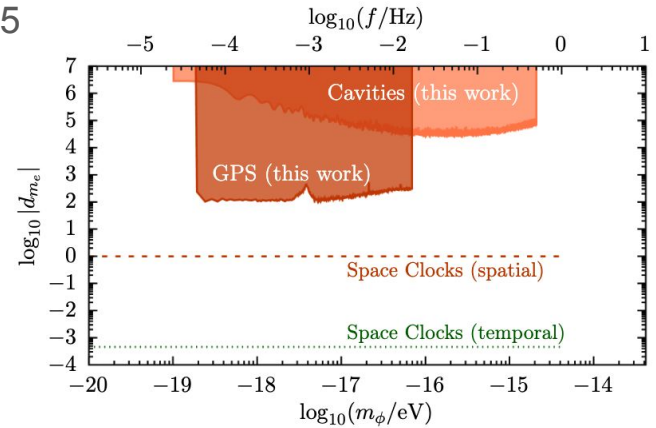
Ben
Roberts

- Measuring black hole masses using AGN reverberation mapping (OzDES)

Hugh
McDougall



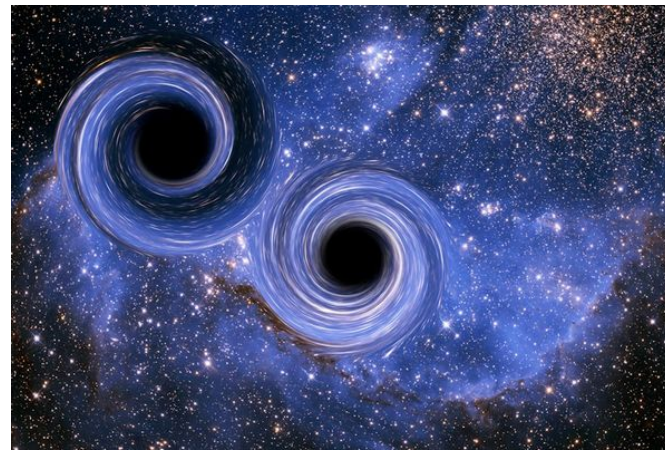
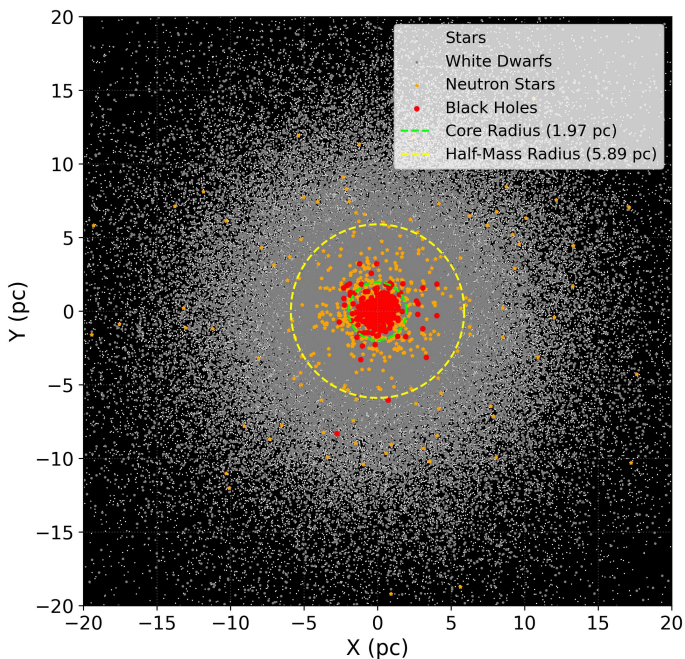
McDougall et al., 2025



Stellar Dynamics

- ❑ **Globular Clusters/Stellar Nuclei:**
 - Modelling Milky Way GCs (Stellar mass black holes/tidal tails, gravitational waves)
 - Growth of Intermediate-mass black holes
- ❑ **Open Clusters:**
 - Stellar mass function & Comparison with Gaia
- ❑ **Dwarf Galaxies:**
 - Finding the smallest galaxies as a probe of dark matter

Dynamics of Stellar-mass Black Holes in GCs

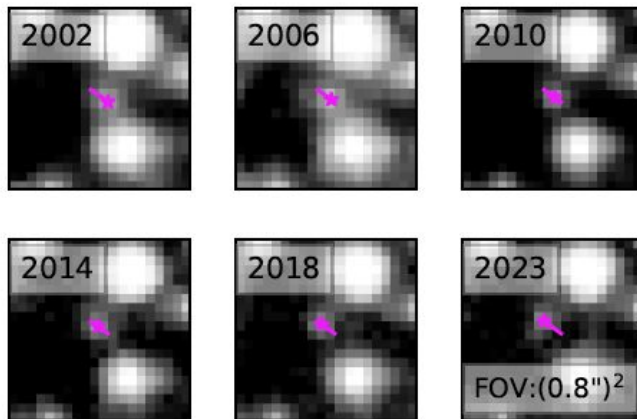
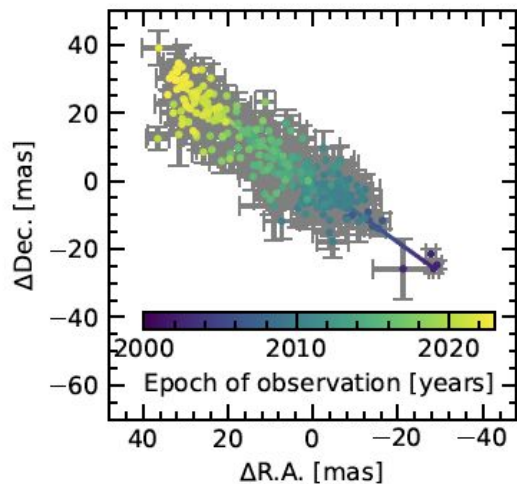


People involved:

Mitchell Hooymans, Sarah Sweet & HB



Formation of Intermediate Mass Black Holes



from Haeberle et al.
(2024)

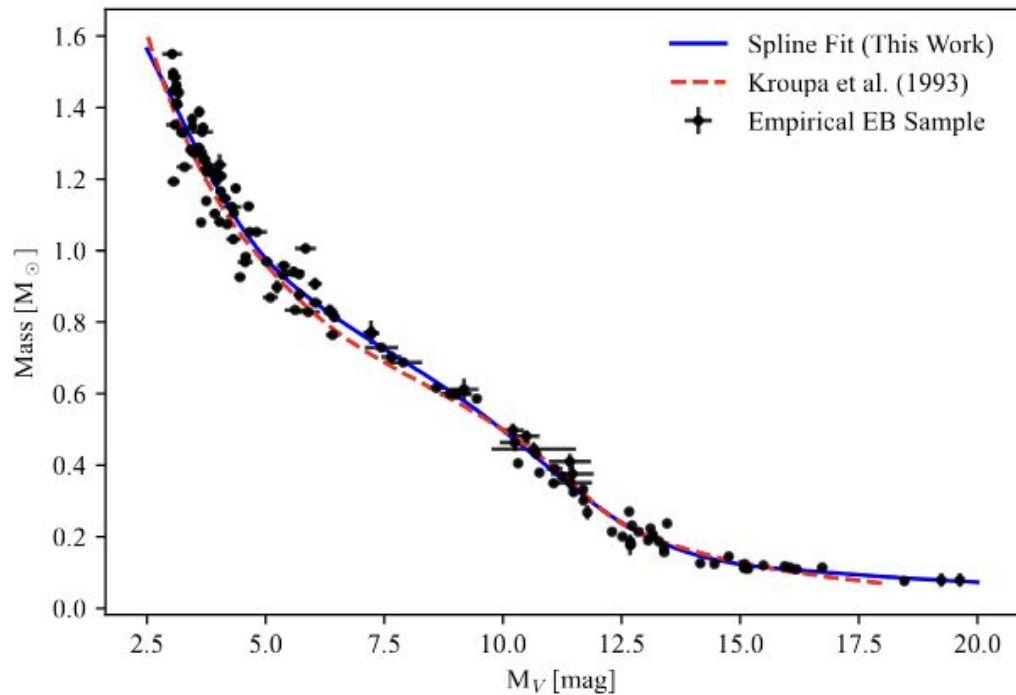


People involved:

Arshia Anjum, Sarah Sweet &
HB

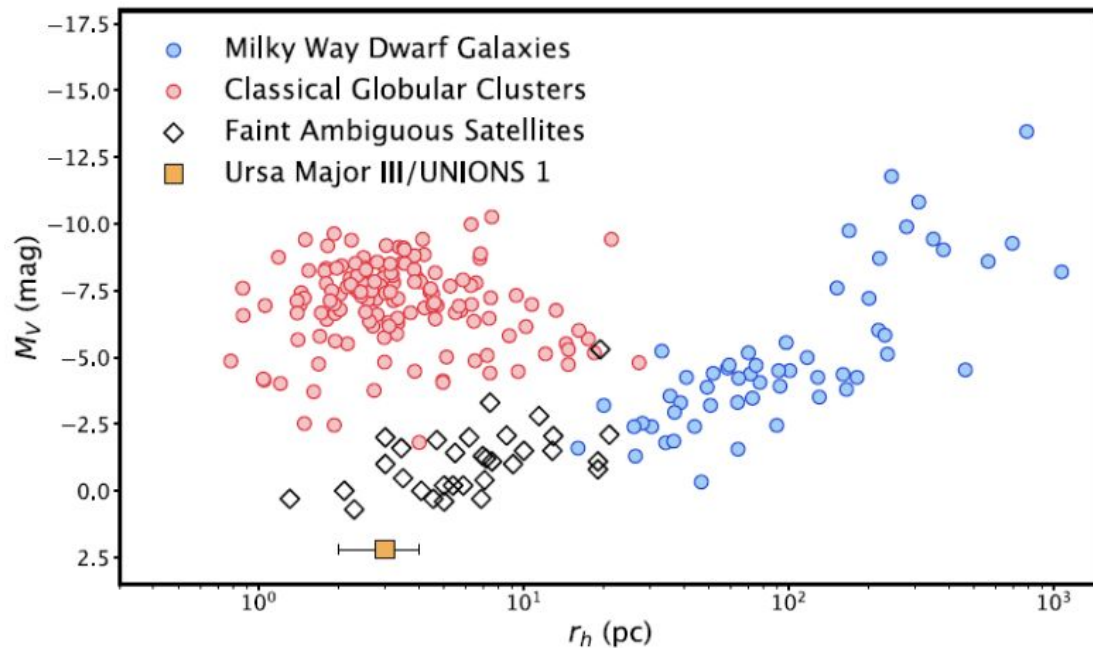


Stellar IMF, Gaia and Open Clusters



People involved: **Lachlan Hobart**, Sarah Sweet & HB

Dwarf Galaxies



People involved: **Scot Devlin**, Sarah Sweet & HB

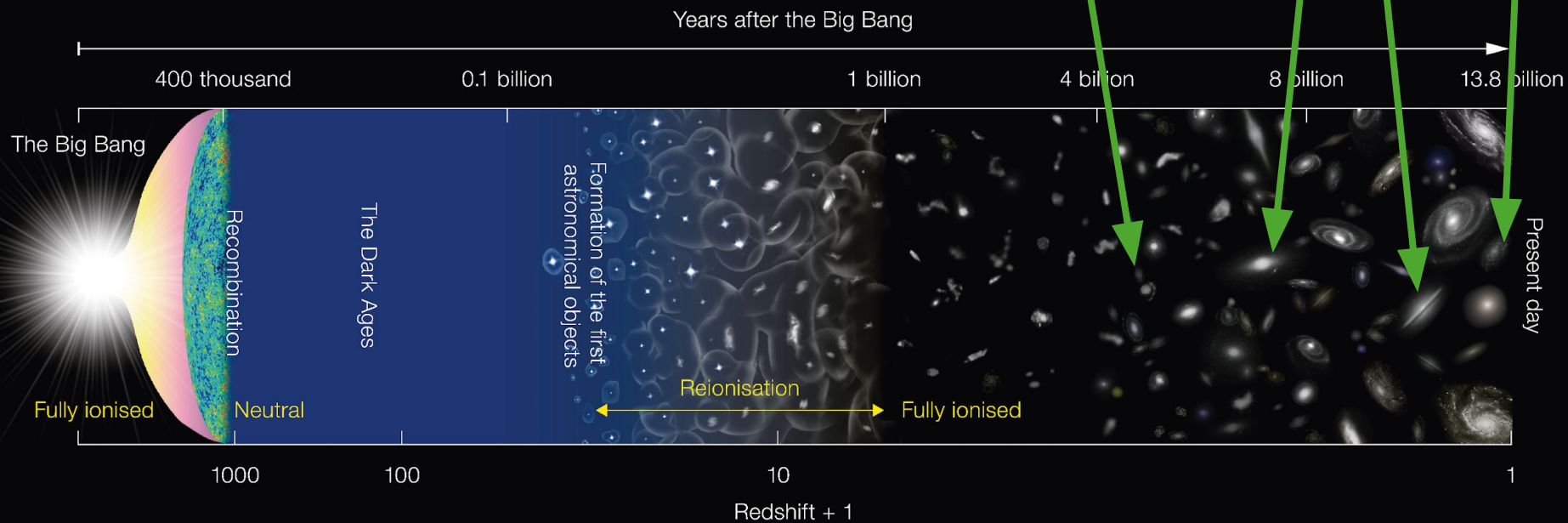


Galaxies

- ❖ Spatially (semi-)resolved galaxy evolution
- ❖ Fundamental physical properties & visual morphology, and the effect of environment

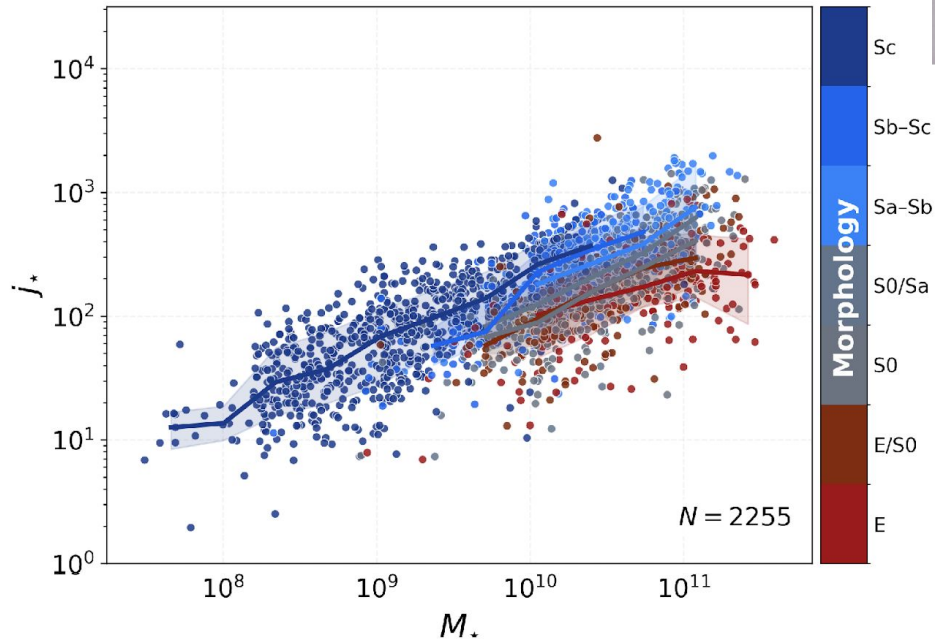
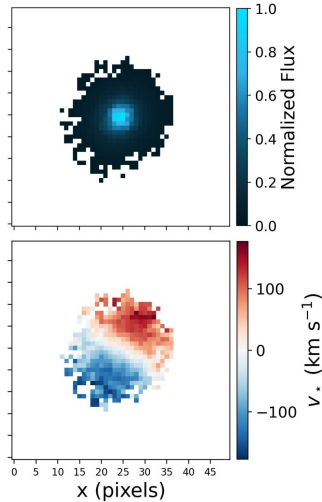
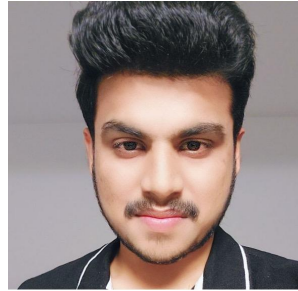


Sarah Sweet Delegate (n.)



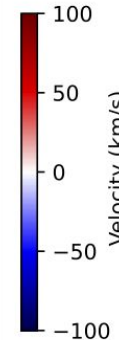
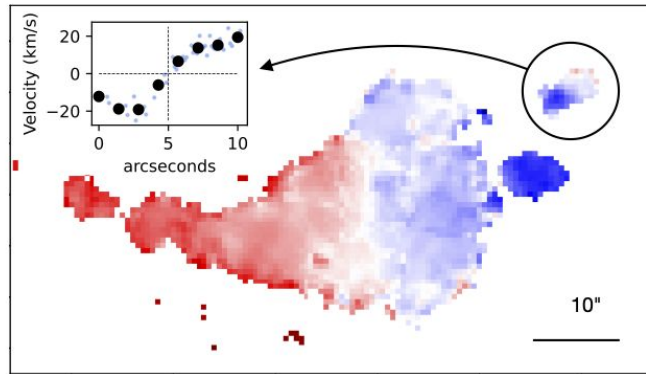
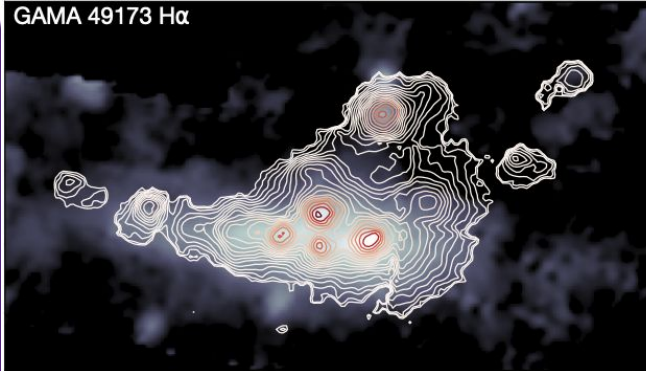
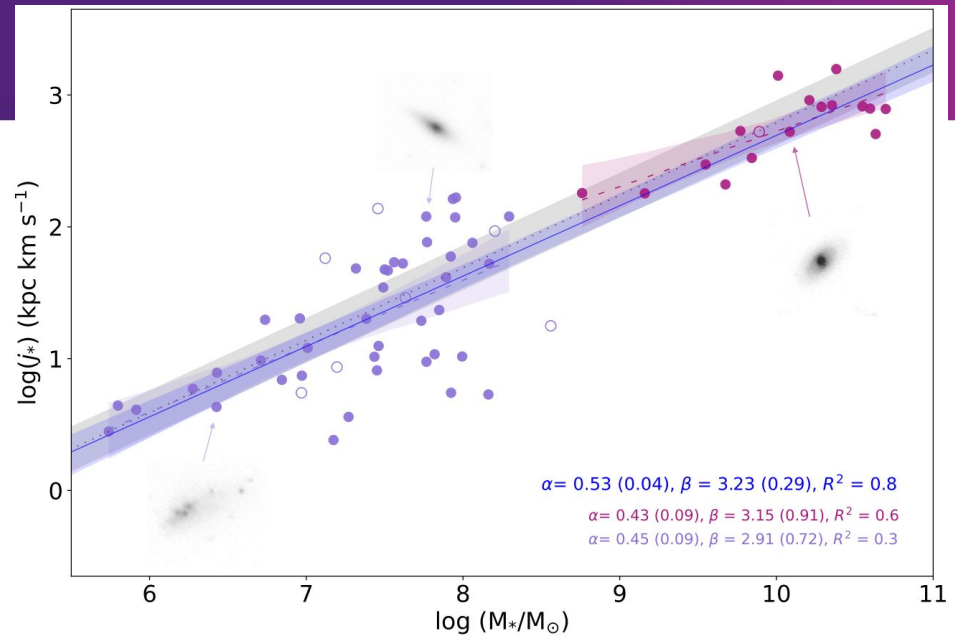
Angular momentum

❖ Pratyush Das: Morphology in Motion with SAMI & beyond



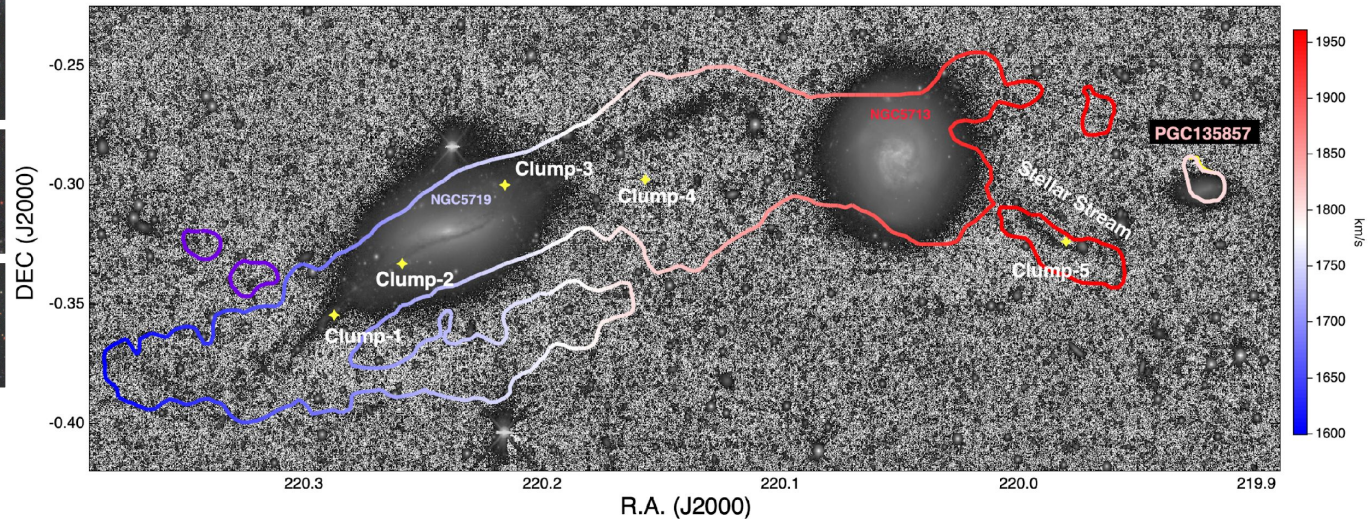
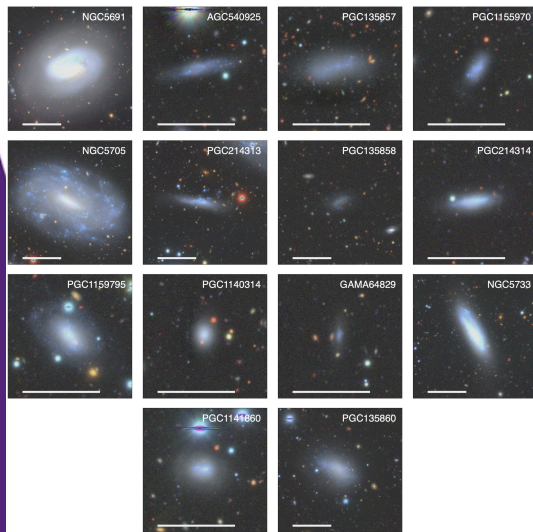
Dwarf galaxy kinematics

❖ Simon Deeley



Delegate (*n.*): dwarf galaxies in Local Group Analogues

- ❖ Jerjen, Baumgart, Deeley, SS 2025: The coherent satellite velocity field around the interacting spiral galaxy pair NGC5713/19: signature of two galaxy groups merging



Delegate (*n.*): dwarf galaxies in Local Group Analogues

- ❖ Julian Groth:
The Local Group at 15 Mpc

