Zili Shen, Pieter van Dokkum, and the Dragonfly team

NEARBY DIFFUSE GALAXIES IN THE DRAGONFLY ULTRAWIDE SURVEY
HAVE THE BIGGEST LSB GALAXIES BEEN FOUND?

Tanoglidis+2021

Zaritsky+2021
WHAT ARE THE BIGGEST LSB GALAXIES?

Select: large apparent size + Distance

- Dwarf
- UDG
DRAGONFLY ULTRAWIDE SURVEY (DFUWS)
DRAGONFLY ULTRAWIDE SURVEY (DFUWS)

Dragonfly Ultrawide Survey Coverage

Simulated UDG at 2.5 Mpc
Simulated UDG at 5 Mpc
Simulated UDG at 10 Mpc
### DFUWS FACTS

<table>
<thead>
<tr>
<th>Filters</th>
<th>SDSS g and r (24 lenses each)</th>
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</thead>
<tbody>
<tr>
<td>Exposure time</td>
<td>3 x 7min x 48 lenses</td>
</tr>
<tr>
<td>Field of view per pointing</td>
<td>3 x 2 degrees</td>
</tr>
<tr>
<td>Pixel scale</td>
<td>2.5”</td>
</tr>
<tr>
<td>1-sigma SB at 60”</td>
<td>29.0 g-band 28.5 r-band</td>
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</tbody>
</table>
DFUWS Data Product

After Multi-Resolution Filtering (MRF, van Dokkum+ 2020)
DFUWS Data Product

After Multi-Resolution Filtering (MRF, van Dokkum+ 2020)
MRF ON AWS

Funded by Yale-AWS grant
DRAGONFLY ULTRAWIDE SURVEY (DFUWS)
DRAGONFLY ULTRAWIDE SURVEY (DFUWS)

[Diagram showing Dragonfly Ultrawide Survey Coverage and a zoom-in of the follow-up region with stars highlighting PGC1 galaxies, with a scale for Ks mag.]
DRAGONFLY ULTRAWIDE SURVEY (DFUWS)

Fig 2, Zaritsky+2023

Zoom-in of the follow-up region

Shen+2024

Ks mag of PGC1 galaxies
BIGGEST BLOBS IN DFUWS

Shen+2024
SELECTION CRITERIA

- Large apparent size: $R_{\text{eff}} > 15''$
- Low surface brightness: 8 have $\mu_0(g) > 24$ mag/arcsec$^2$, 3 are between $23 - 24$
- No spirals, no clumps: prefer quenched galaxies
- Examples of galaxies that did not meet these criteria:
KCWI FOLLOW-UP

- Use KCWI large slicer (33” x 20”’) as light bucket —> average over pixels in data cube
- Systematics & sky subtraction —> 40 min on, 40 min off

\[ \nu = 2200 \text{ km/s} \]

Shen+2024
KCWI FOLLOW-UP

Shen+2024
MOST BLOBS ARE WITHIN 25 MPC

Shen+2024
MOST BLOBS ARE WITHIN 25 MPC

Shen+2024
MOST BLOBS ARE WITHIN 25 Mpc
WHAT ARE THEY?

- LSB Dwarf
- UDG
- Dwarf

Fainter than 24 mag/arcsec^2?
- No (Dwarf)
- Yes (LSB Dwarf)

Size > 1.5 kpc?
- No (LSB Dwarf)
- Yes (UDG)

DFUWS Sample
- LSB Dwarf: 9%
- UDG: 64%
- Dwarf: 27%

Shen+2024
MULTIPLE STELLAR POPS?

Shen+2024
MULTIPLE STELLAR POPS?

Template weights from pPXF

Shen+2024
The Dragonfly Ultrawide Survey lets us find the biggest low-surface-brightness galaxies. They are mostly UDGs, spanning a range of environments. Multiple stellar pops —→ formation?
MULTI-RESOLUTION FILTERING

simulated Dragonfly image (2% of FOV)

simulated sky-subtracted 0.75° seeing image

flux model

flux model, convolved with kernel

Dragonfly minus convolved model

van Dokkum+ 2020