UV Probe into the Morphology of NGC 3718

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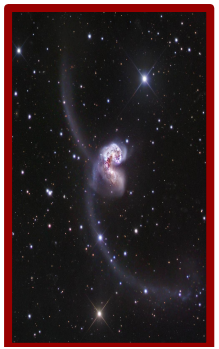
Galaxy Interactions

Galaxy interactions can lead to the distinct morphological structures.

Ongoing



Antennae galaxies

The Mice galaxy

Undergone

NGC 4650a
(Polar ring galaxy)

Centaurus A

Cartwheel galaxy

Credits: ESA

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These interactions can be of two types:-

- First, the distant interactions that occur during the early stages of galaxy mergers or during flybys when the two galaxies are still separate but in a close proximity (Lin et al. 2006).

- Second type comprises galaxies that are either just about to merge or have recently done so (Jogee et al. 2009).
  - Major Merger ($\mu \geq 0.25$)
  - Minor Merger ($0.1 \leq \mu \leq 0.25$)
  - Mini Merger ($0.01 \leq \mu \leq 0.1$)

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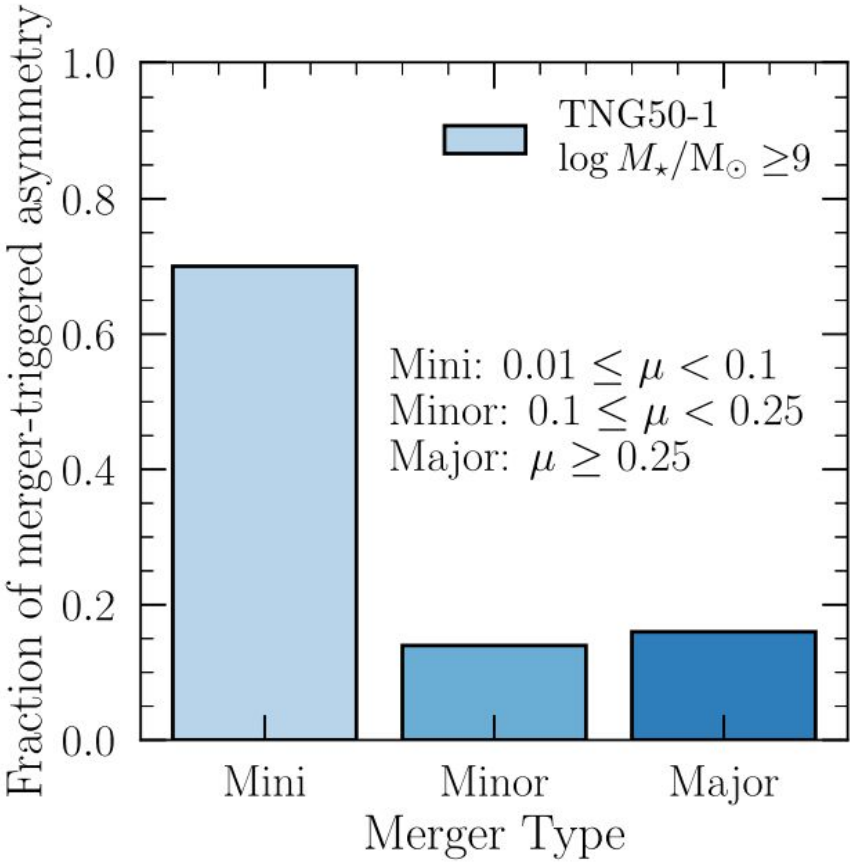

Bottrell et al. (2024)

Role of UV

- Galaxy mergers can trigger the star formation in galaxies, especially if they are gas rich and can lead to the star forming knots along the tidal arms of the galaxies. Therefore, star-formation is an important tracer of galaxy mergers.
- UV observations are the most effective tool to probe the star formation in the galaxies as they can trace the younger and hot stellar populations (Kennicutt and Evans 2012).
  - FUV ~ 0-100 Myr
  - NUV ~ 0-200 Myr

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    - FUV ~ 0-100 Myr
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Our aim is to study similar galaxy NGC 3718 to probe the different features resulting from past interactions.

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NGC 3718

RA	11h32m34.8530s	(Krips et al. 2007)
Dec	+53d04m04.518s	
Luminosity Distance	14.20 Mpc	
Absolute Magnitude (UV)	-16.30 +/- 0.30	(Seibert et al. 2012)
Absolute Magnitude (Visible)	-21.7	(Tully et al. 1996)
R25 (in B-band)	2.338′(9.60 kpc)	(Makarov et al. 2014)

Credits: DECalS grz color composite image

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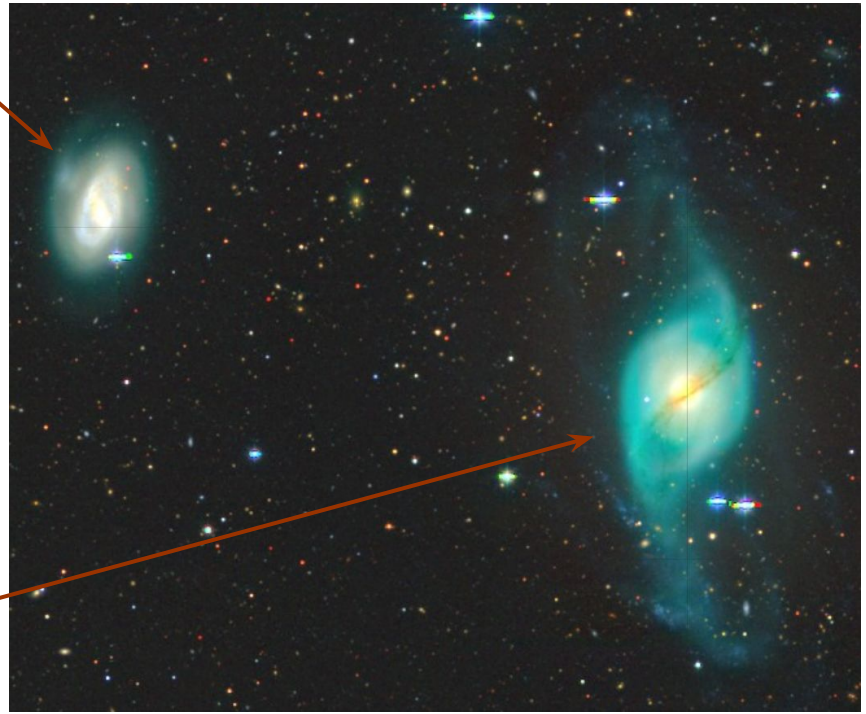

Credits: DECalS grz color composite image

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NGC 3718

- Multiple tidal arms, Warped disk and dust lane.
- Part of loose Ursa Major group.
- Separation between NGC 3718 and NGC 3729 is ~47.93 kpc.

↓

No interaction signature has been found between them.

- Markakis et al. (2015) strongly indicated that it is a merger remnant.

Credits: DECalS grz color composite image

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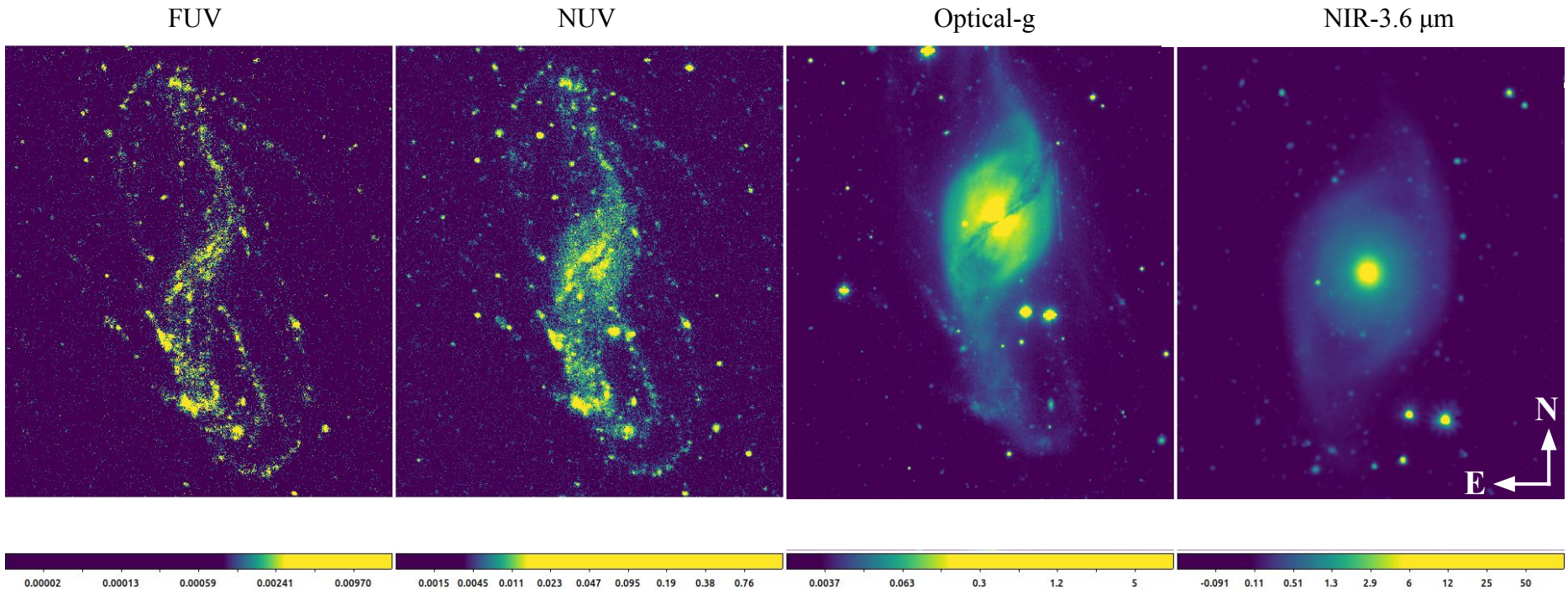
DATA: GALEX *(FUV, NUV)*, UVIT *(F148W, N245M)*, DECaLS *(g band)*, and Spitzer *(3.6 μm)*



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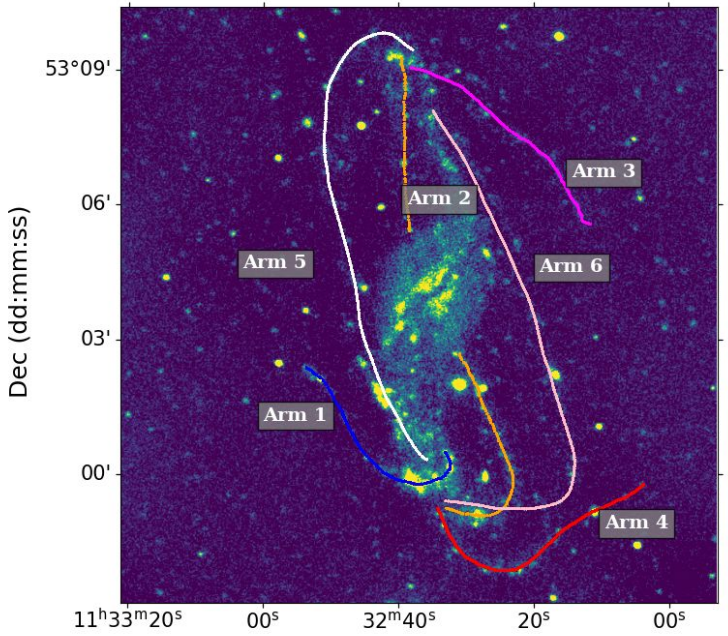
Analysis



GALEX NUV Image

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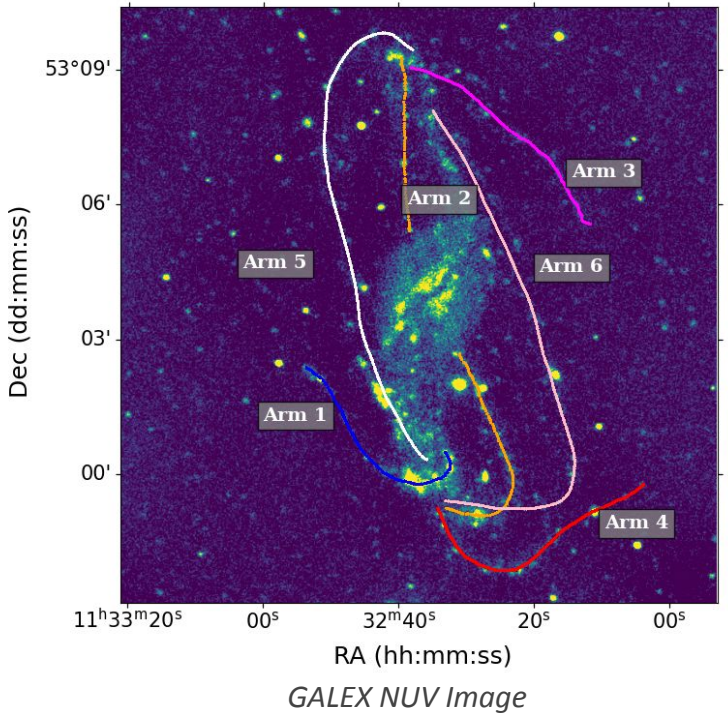
Analysis



GALEX NUV Image

- To get the idea of no. of arms (on the basis of visualization) and how much they are extended.
- Cubic Spline fitting ----------

Arms	Projected Length (kpc)
Arm 1	21.01 ± 0.36
Arm 2	50.79 ± 3.59
Arm 3	23.09 ± 0.39
Arm 4	22.24 ± 2.32
Arm 5	46.27 ± 0.33
Arm 6	49.02 ± 0.39
UV Diameter	51.84

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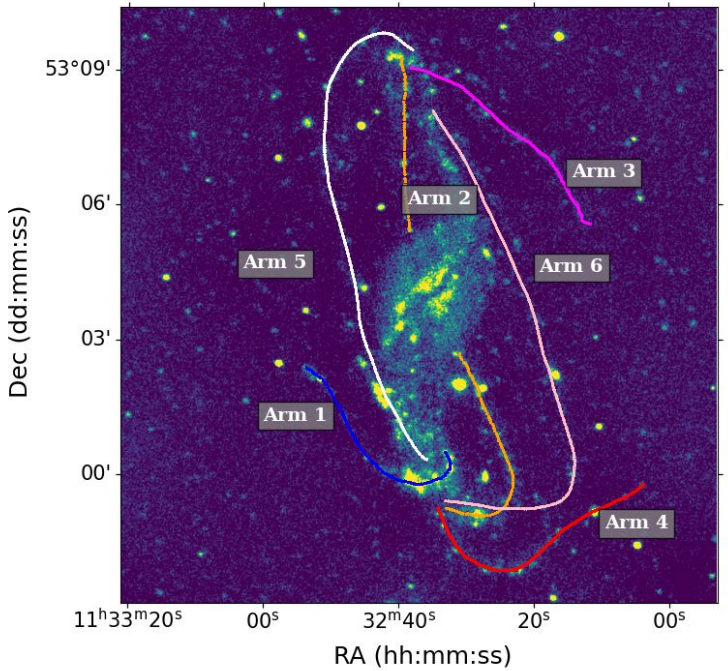
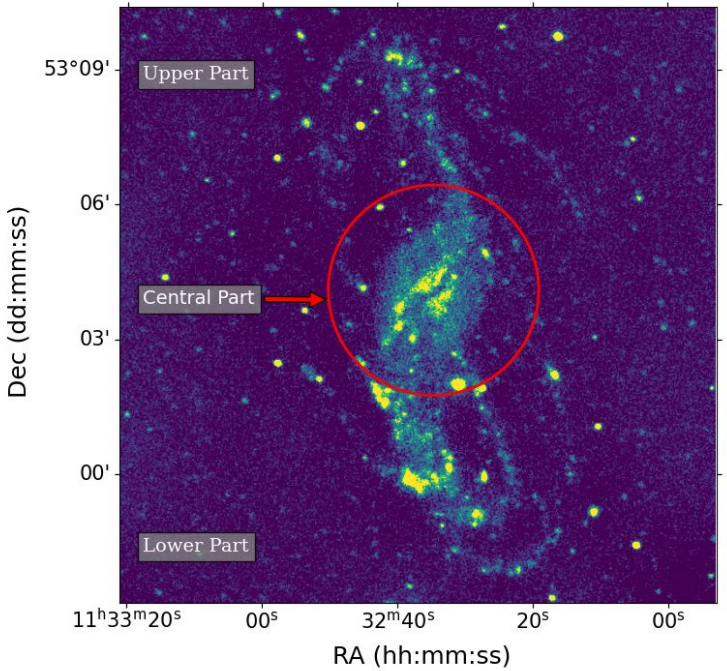
Analysis



GALEX NUV Image



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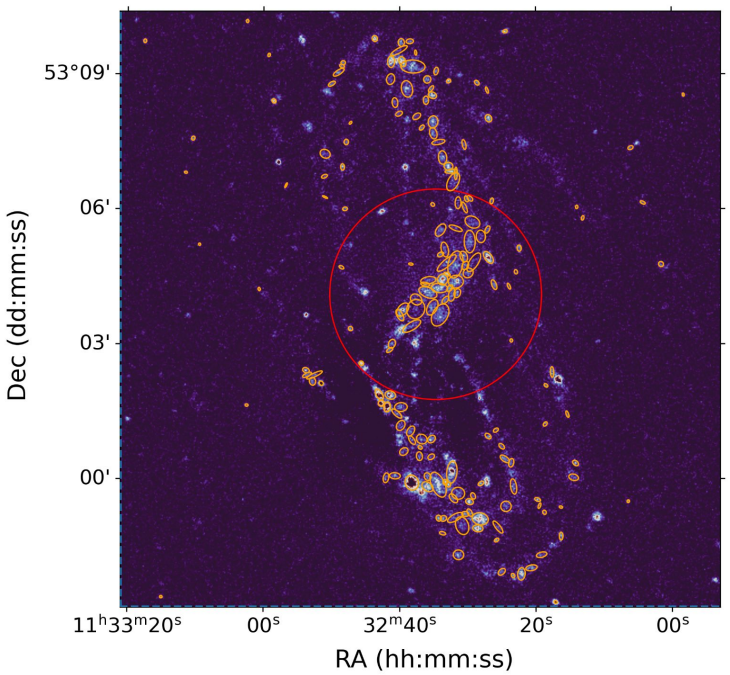

GALEX FUV Image

- SExtractor (Barbary 2016)
  - *detection_threshold: 3.5σ*
  - *minarea: 7*
  - *deblend_nthresh: 32*

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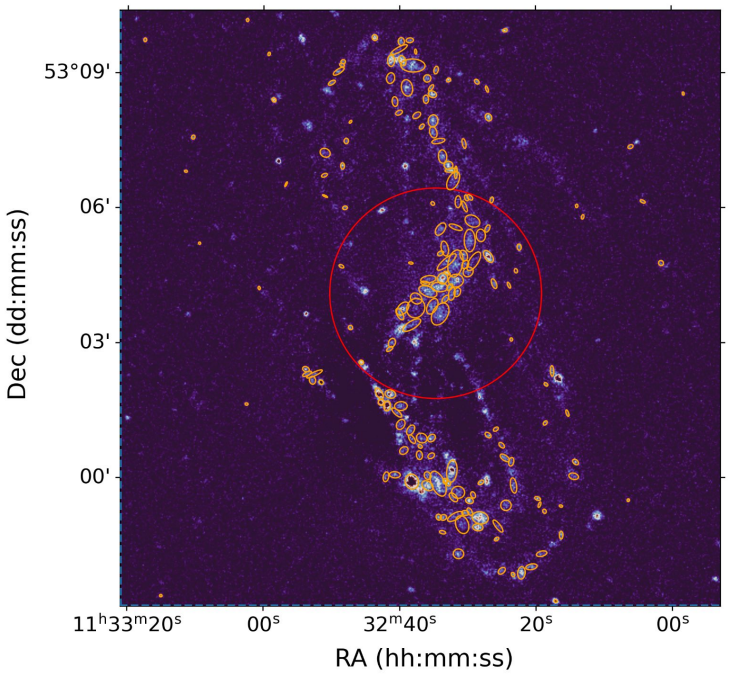
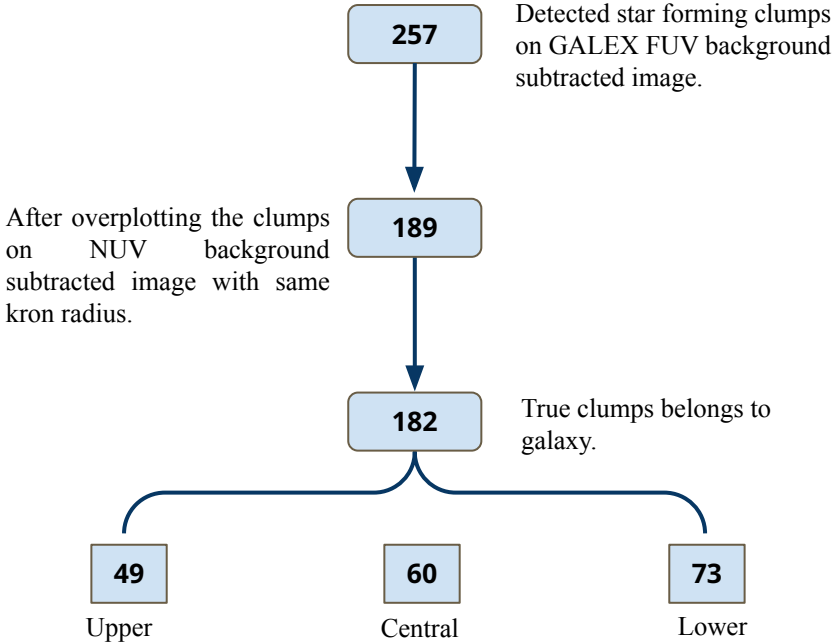
- SExtractor (Barbary 2016)



GALEX FUV Image



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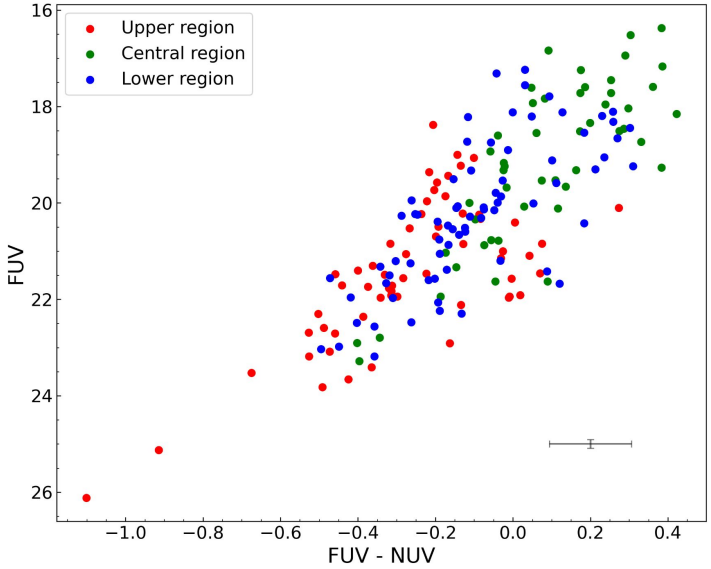
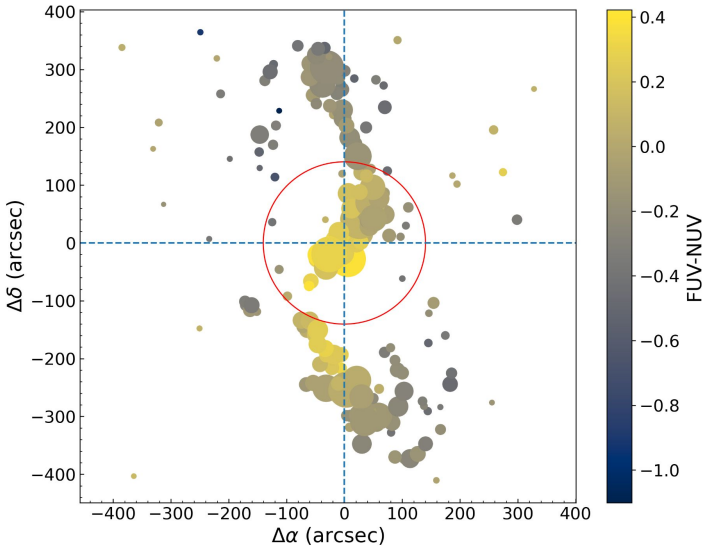
UV Color-Magnitude Diagram(extinction-corrected)





- **Upper Part**: FUV emission.
- **Central Part**: Both FUV and NUV emission.
- **Lower Part**: (FUV +NUV), but dominated by FUV emission.

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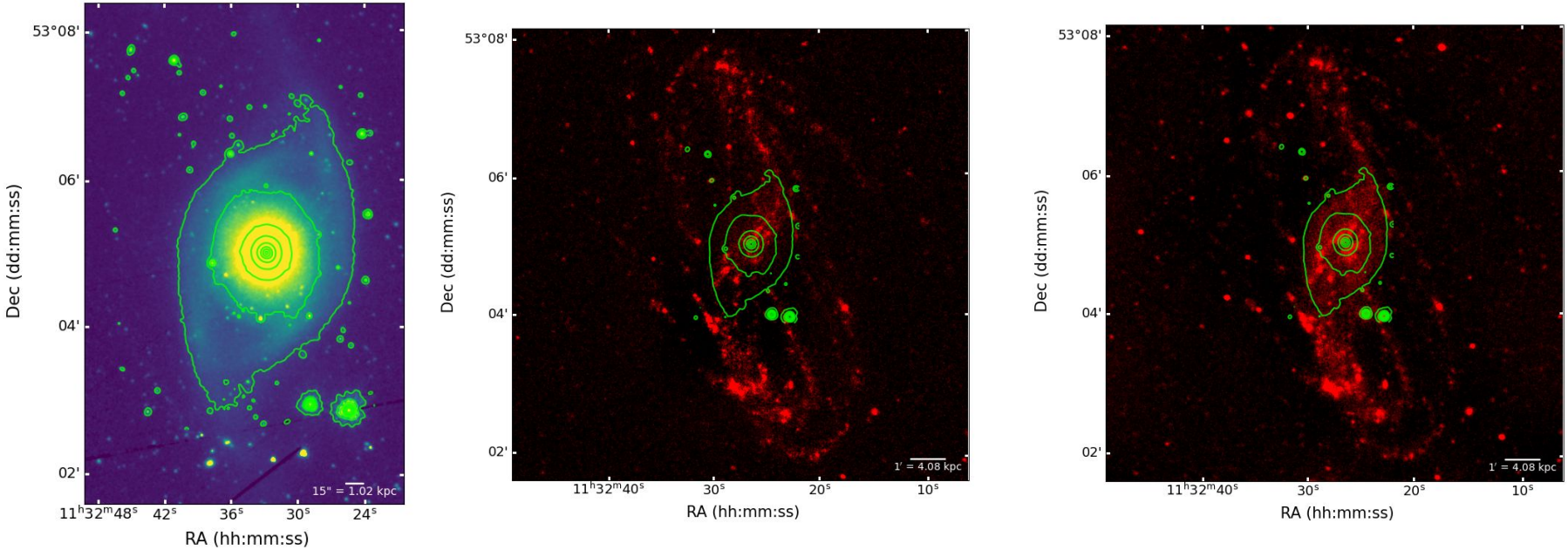

Spitzer 3.6 μm image with contours (Green) above 3σ noise overlaid on GALEX FUV and NUV images (Red color).

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Age Distribution

- **Starburst99** (Leitherer et al. 1999)
  - Parameters:
    - Masses: 10^3, 10^4, 10^5,10^6 $M_{\odot}$.
    - IMF : Kroupa
    - Padova tracks with solar metallicity (z=0.020).
  - Model fluxes are convolved with the GALEX filter's effective area to get the flux corresponding to the filter wavelength.
  - We generated evolutionary tracks from the models in order to compare the observations with them.

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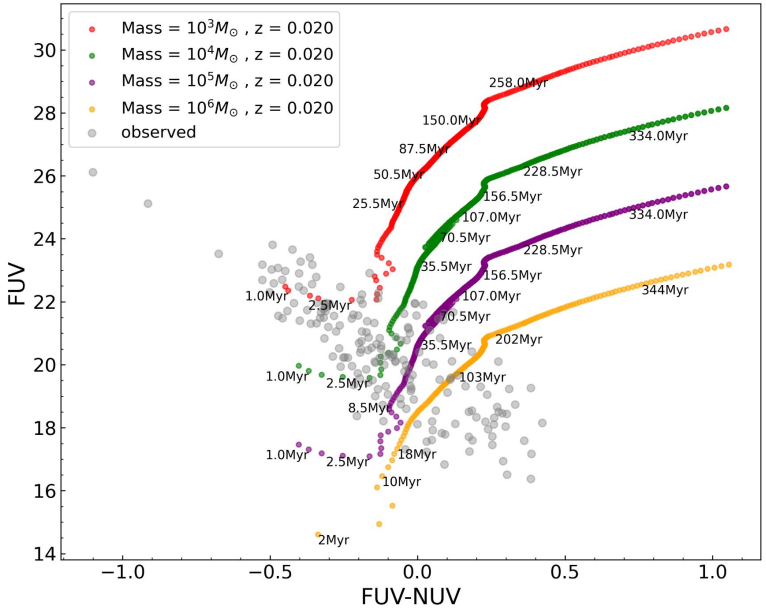

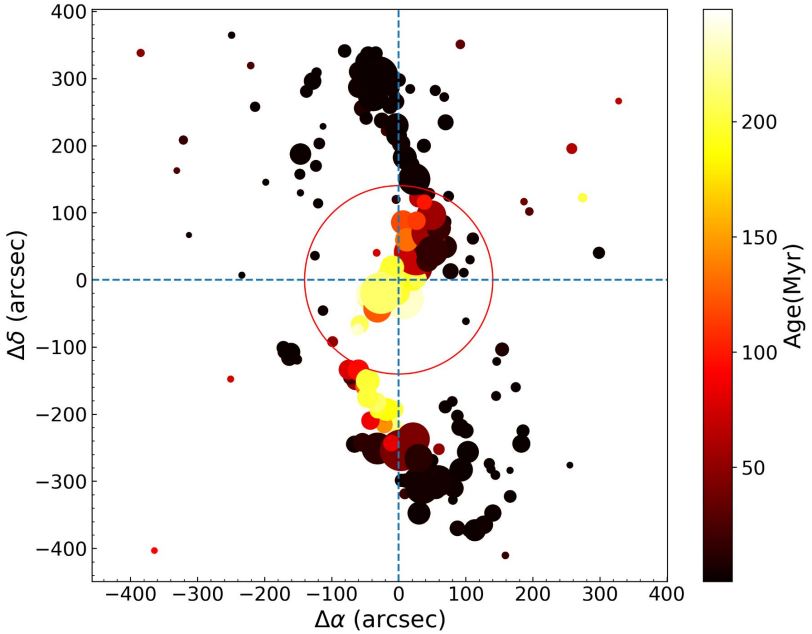

Among all the tracks, only the one with z = 0.020 and 10^5 $M_\odot$ covers the FUV magnitude range of the observed clumps the best.

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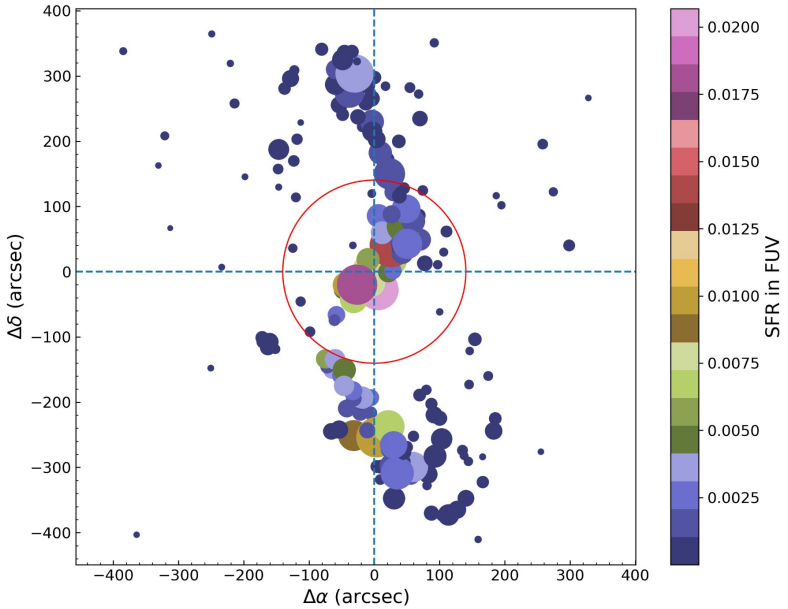
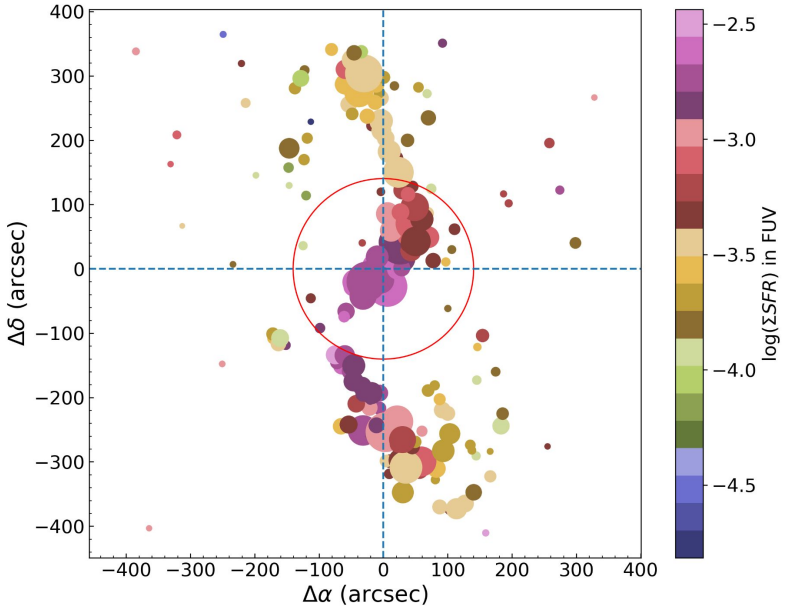
Star Formation Rate (Erroz-Ferrer et al. 2013)





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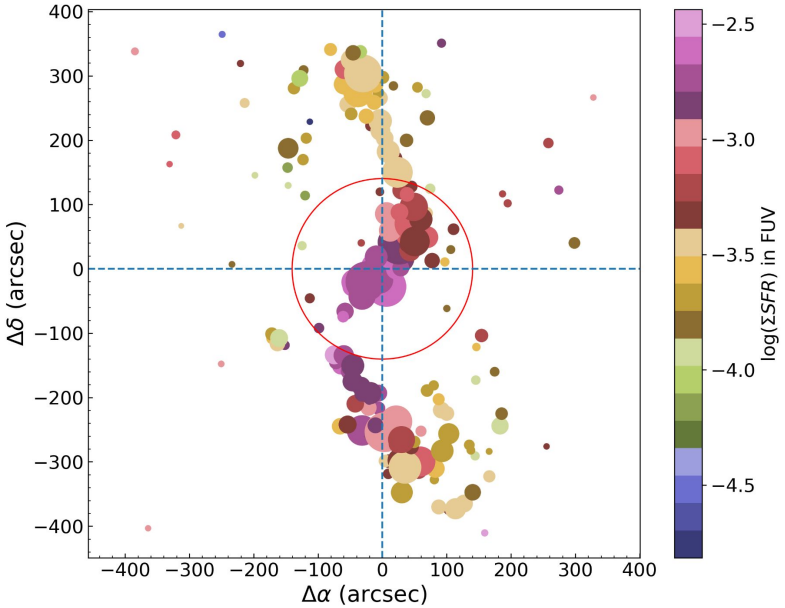
Star Formation Rate (Erroz-Ferrer et al. 2013)

	Mean SFD (x 10^{-3} $M_\odot$/yr/kpc^2)	
	FUV	NUV
Upper Part	*0.373 ± 0.058*	*0.354 ± 0.051*
Central Part	***1.254 ± 0.352***	***1.578 ± 0.344***
Lower Part	*0.793 ± 0.129*	*0.854 ± 0.108*



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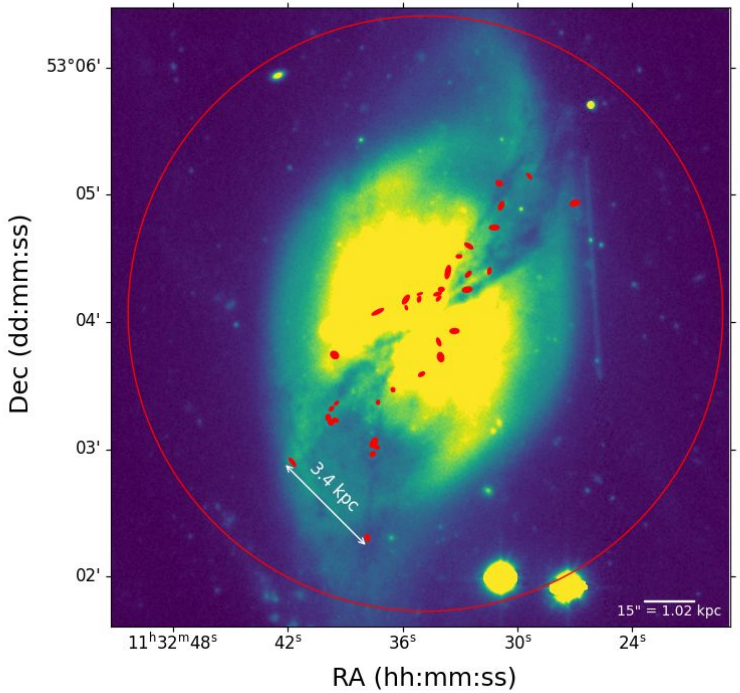
Dust Lane



Clumps detected on UVIT image overlaid on Optical g-band image.

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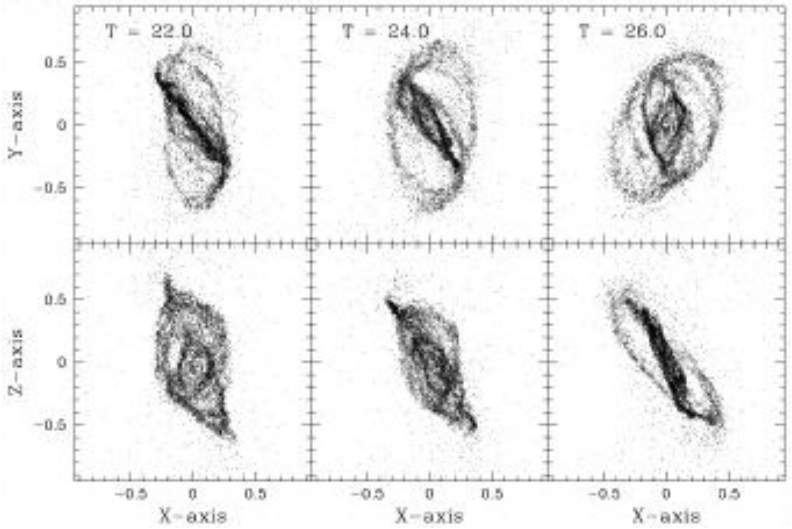
Similarities with Polar ring galaxies



(Bekki 1998)

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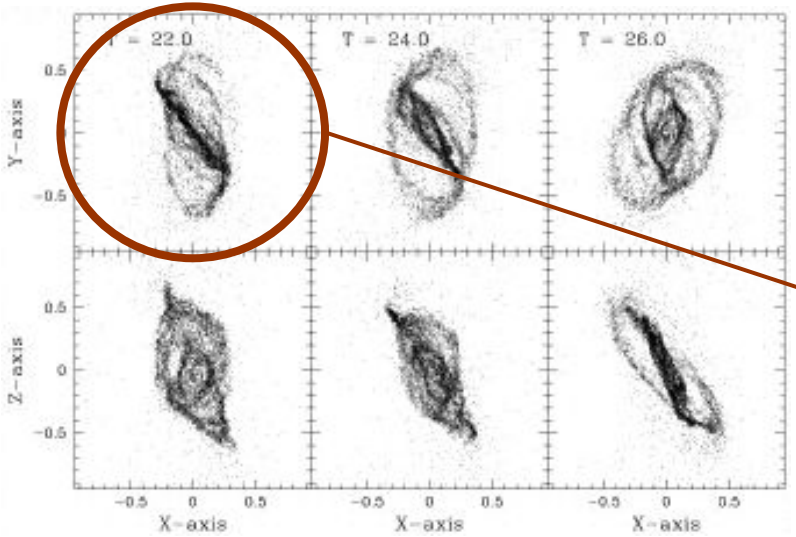

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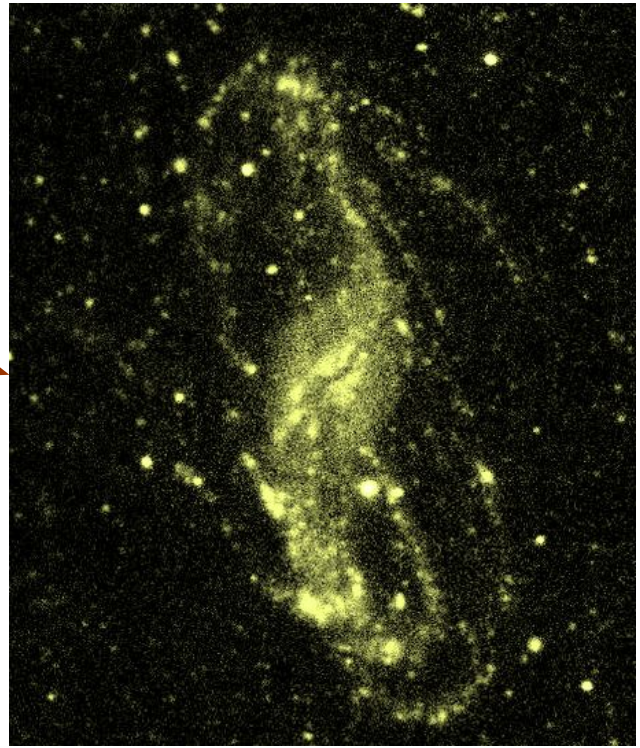

GALEX

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Conclusions

- The UV color-magnitude diagram and age distribution shows that central part of galaxy has older population compared to the upper and lower part.
- Our result also confirms that NGC 3718 has undergone merger in the past.
- It is in the intermediate state to become a multi ring or polar ring galaxy.
- Our analysis indicates that in these kind of mergers star formation happens more rapidly in the inner part than in the diffuse tidal arms.

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Thank You all for your attention!

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