Stellar and dust emission profiles of IMEGIN galaxies

Angelos Nersesian
Postdoc Fellow, Ghent University

& IMEGIN team
on behalf of the NIKA2 collaboration

Grenoble-28/06/2023

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Context & Goal

- **Galaxy morphology** is essential to understand galaxy formation and evolution.

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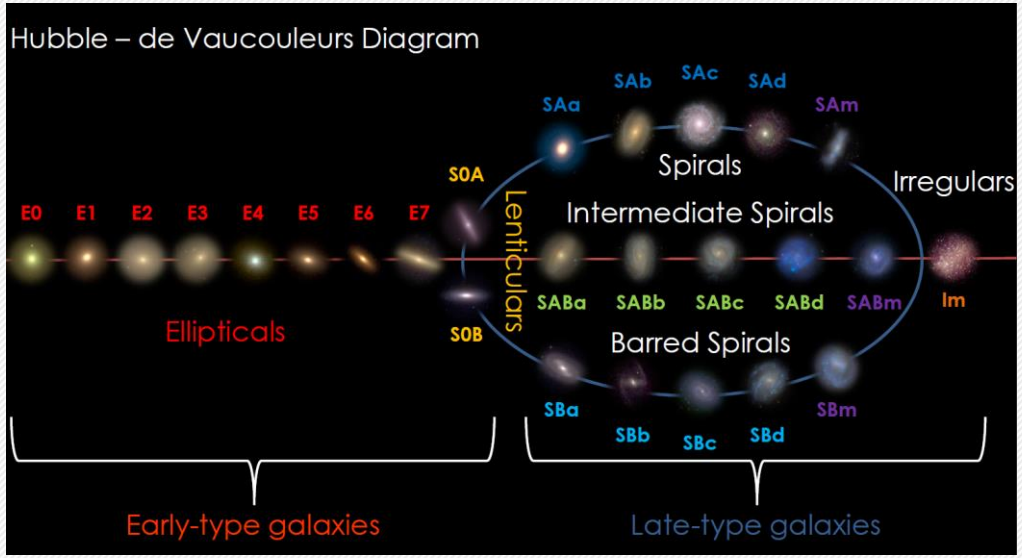
- Basis of the standard classification schemes.



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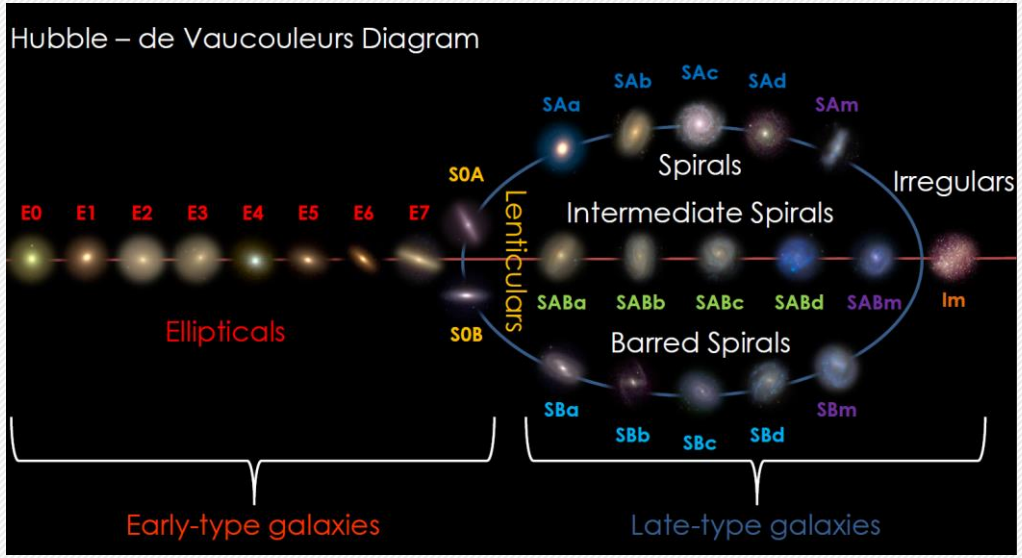
- **Galaxy morphology** is essential to understand galaxy formation and evolution.
- Basis of the standard classification schemes.
- Correlates with a wide range of physical properties.



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Context & Goal

- **Galaxy morphology** is essential to understand galaxy formation and evolution.
- Basis of the standard classification schemes.
- Correlates with a wide range of physical properties.
- **GOAL**: How galaxy morphology changes as a function of wavelength (UV-mm).

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Context & Goal

- Parametric morphology

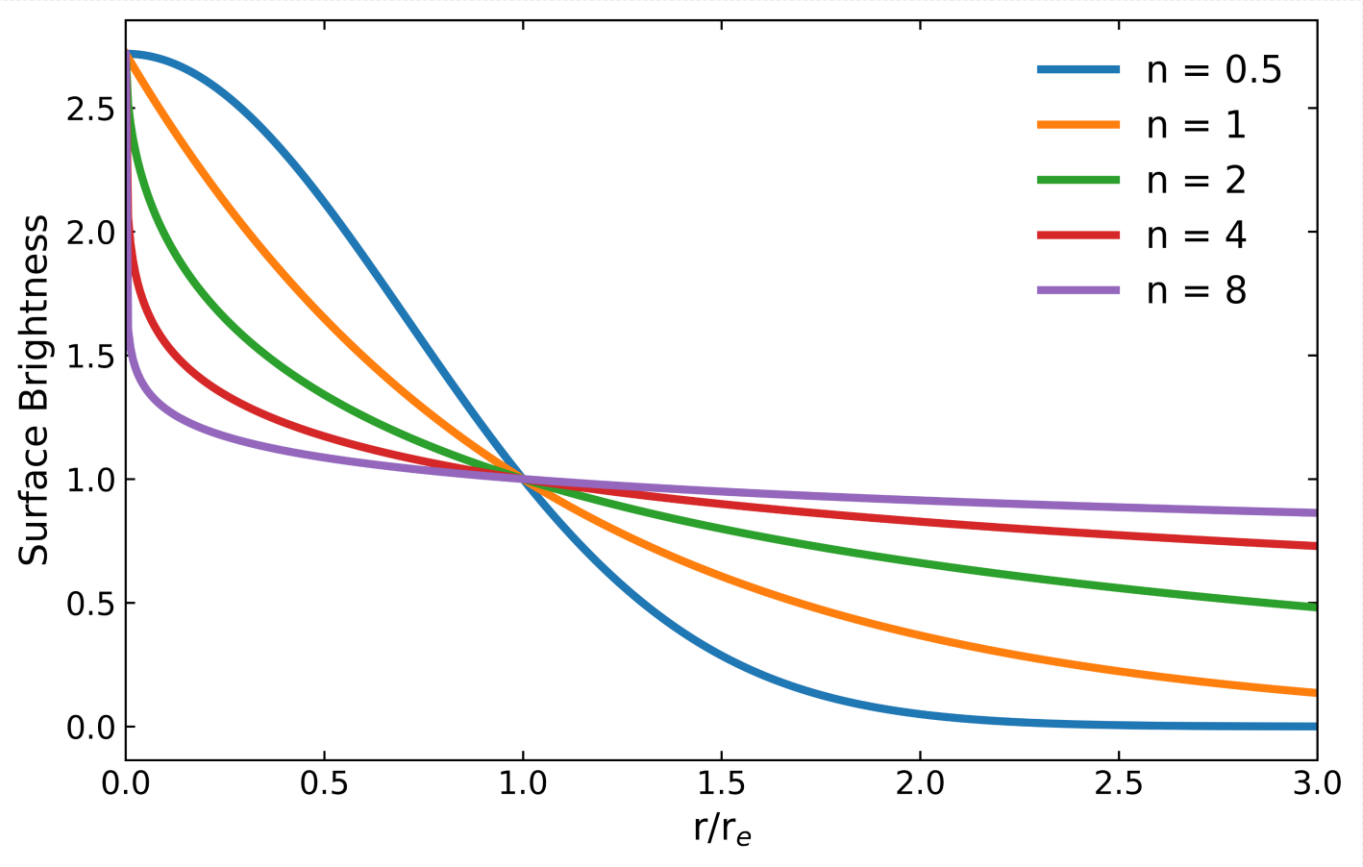
Sérsic profile

$$I(r) = I_e \exp\left\{-b_n\left[\left(\frac{r}{r_e}\right)^{1/n} - 1\right]\right\}$$

n = 0.5 → Gaussian profile

n = 1.0 → Exponential law

n = 4.0 → de Vaucouleurs profile



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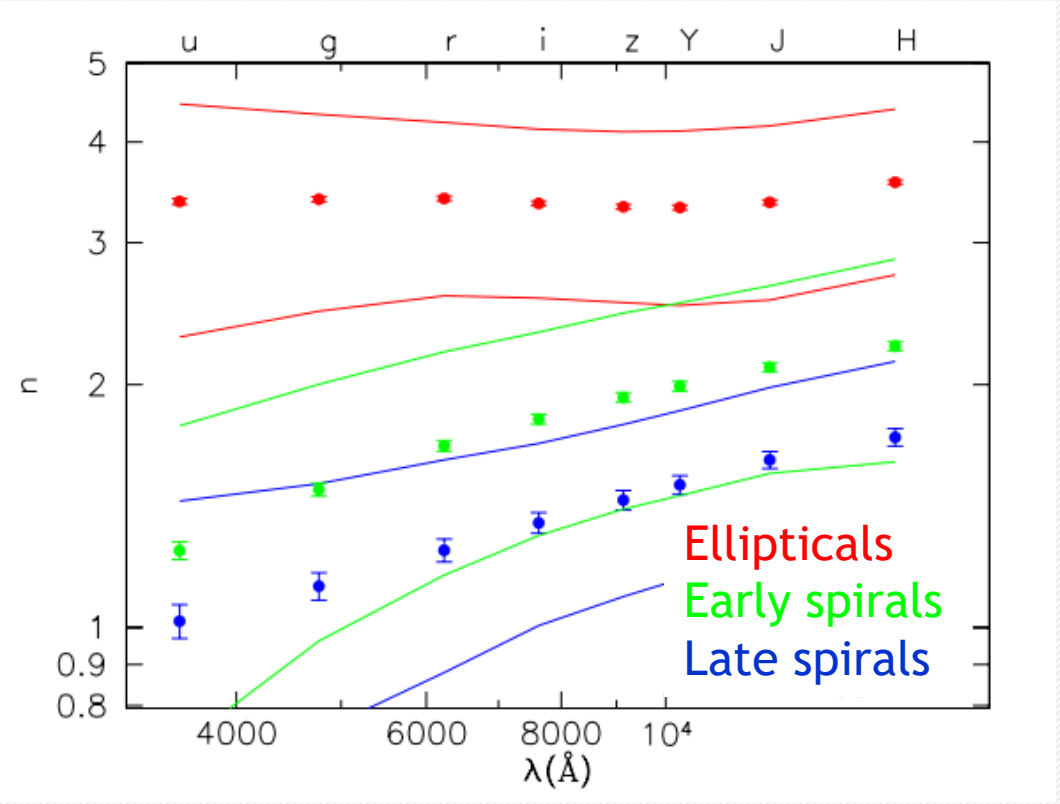
Morphology-wavelength dependence

Optical regime



Vulcani+2014

Angelos Nersesian angelos.nersesian@ugent.be

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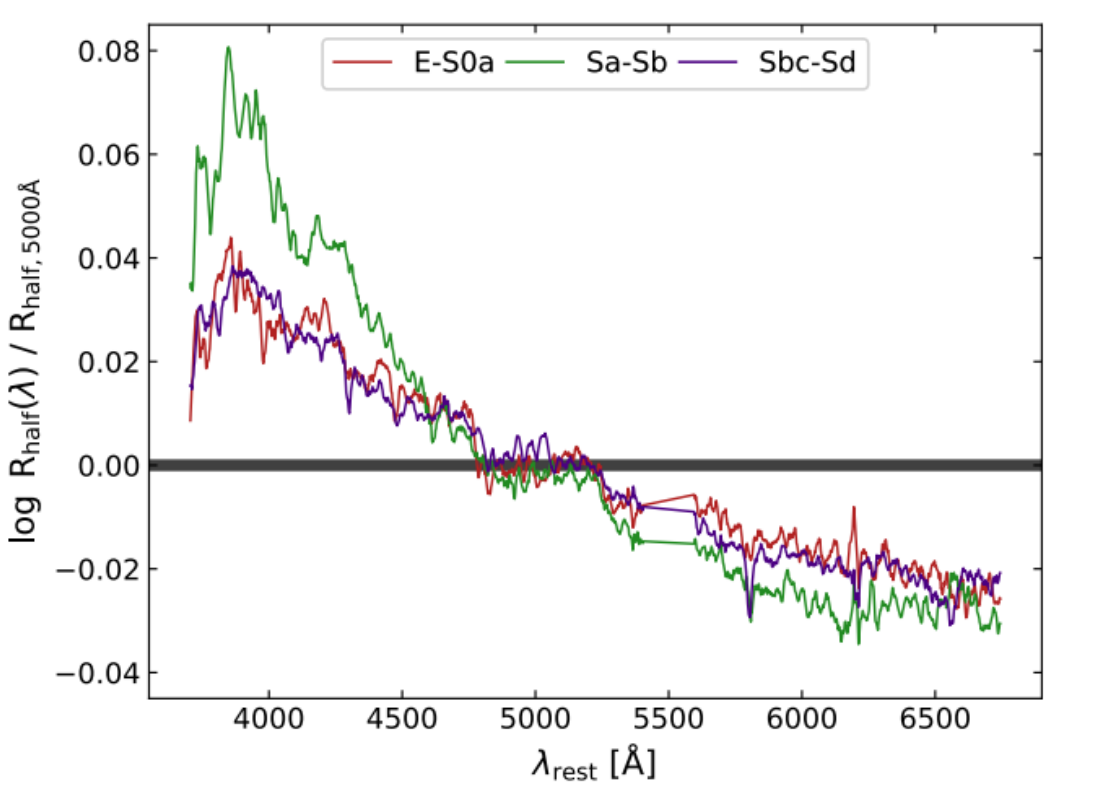
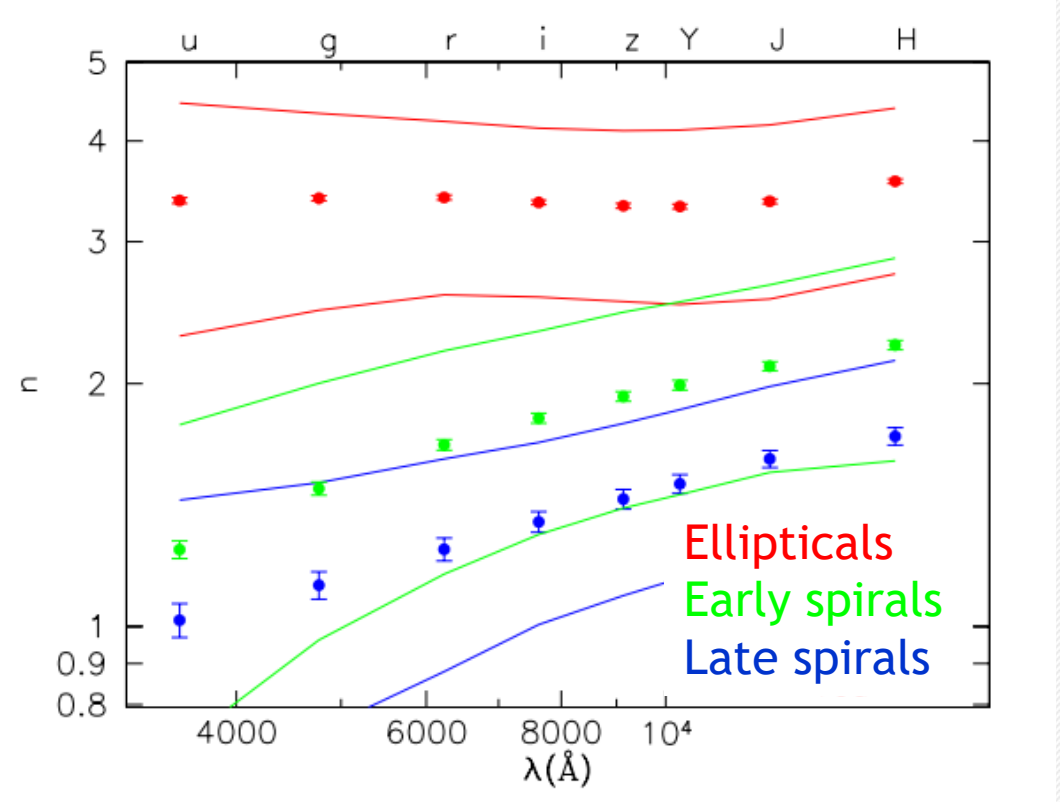


Nersesian+2023



Vulcani+2014

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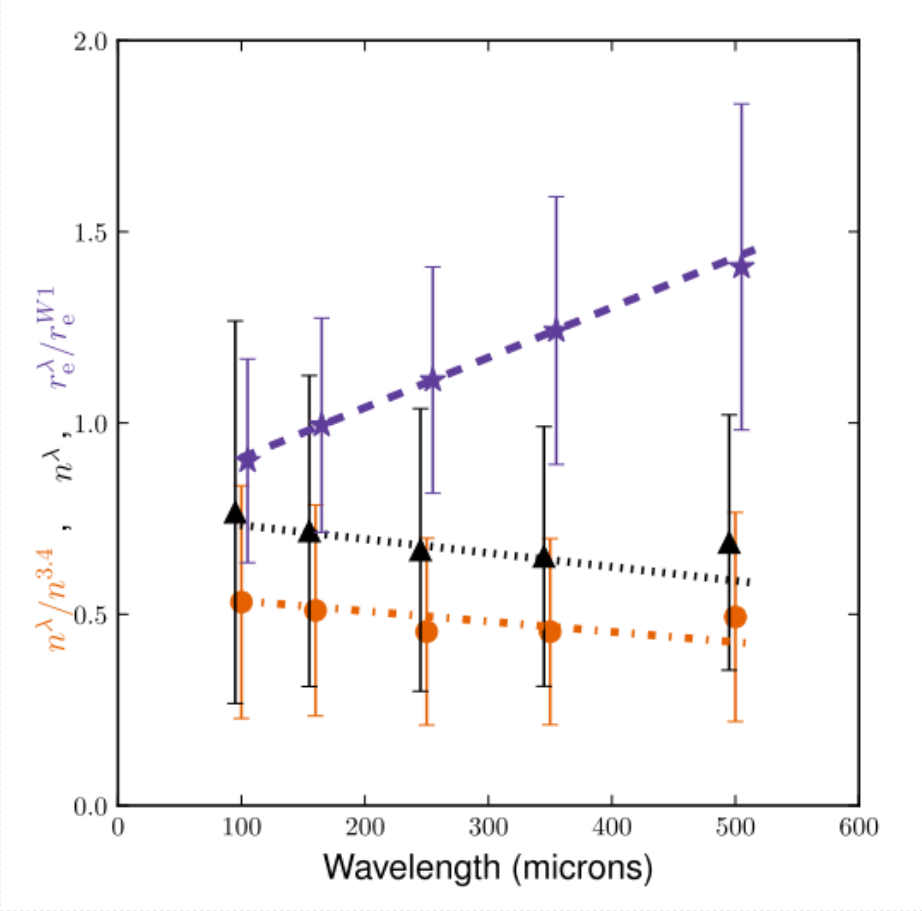
Morphology-wavelength dependence

Far-infrared regime



- Steady increase of galaxy sizes with λ.
- Flat relation of Sérsic index *n* with λ.
- Constant Sérsic index *n* (~0.7) → Gaussian profile

Mosenkov+2019

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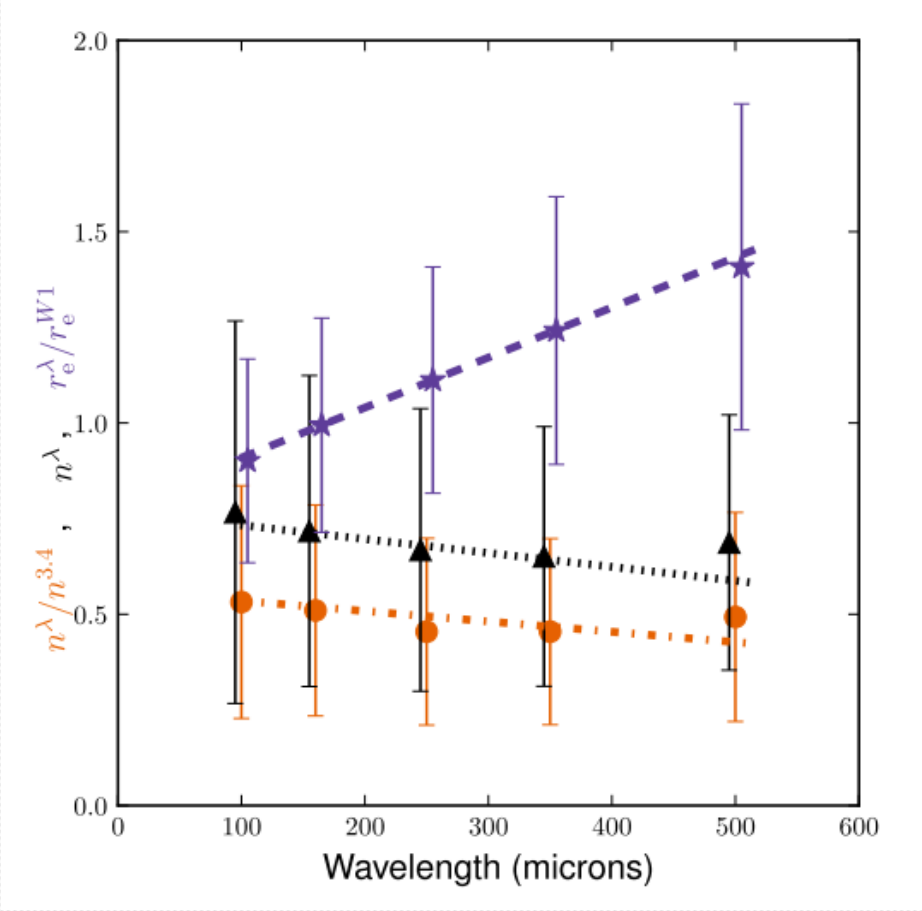
Morphology-wavelength dependence

Far-infrared regime



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- Flat relation of Sérsic index *n* with λ.
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Question: Do these trends continue in the mm?

Mosenkov+2019

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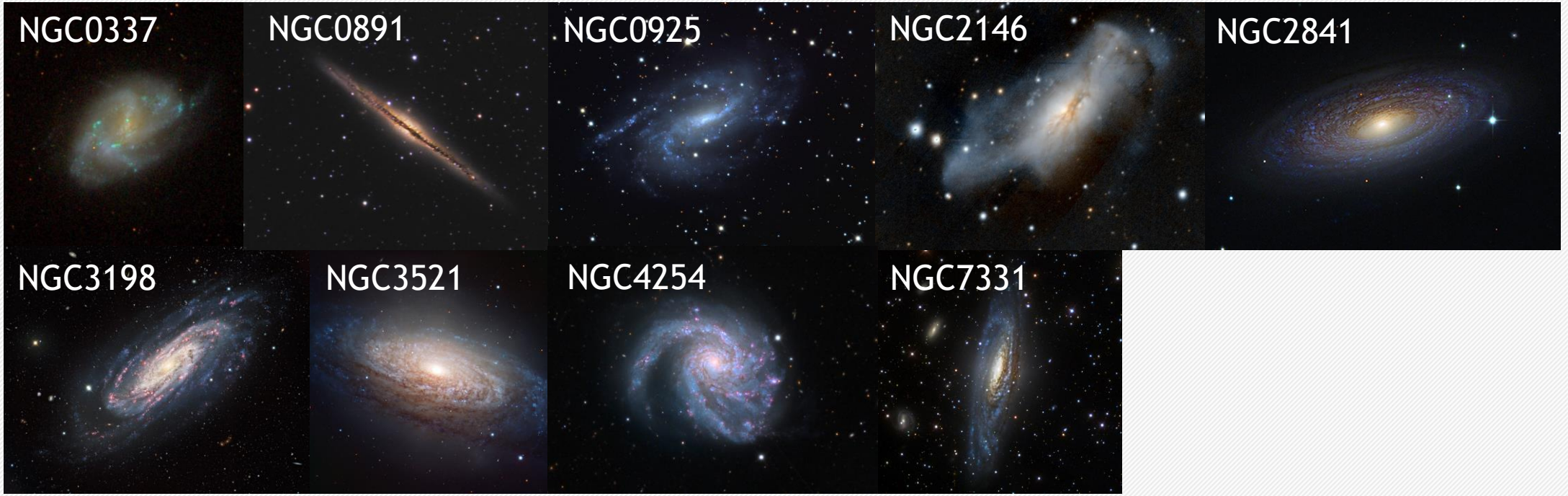
IMEGIN

iram Institut de Radioastronomie Millimétrique

NIKA2

- Observations of nearby spiral galaxies at mm wavelength range (200h GT).
- Detecting the very cold dust emission (<15K).
- Looking for evidence of variation in dust properties between and within galaxies.



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NIKA2

Upcoming talks on individual galaxies by the IMEGIN team ☺

Lara Pantoni
(later this session)

Stavroula Katsioli
(Friday)

Golshan Ejlali
(Friday)

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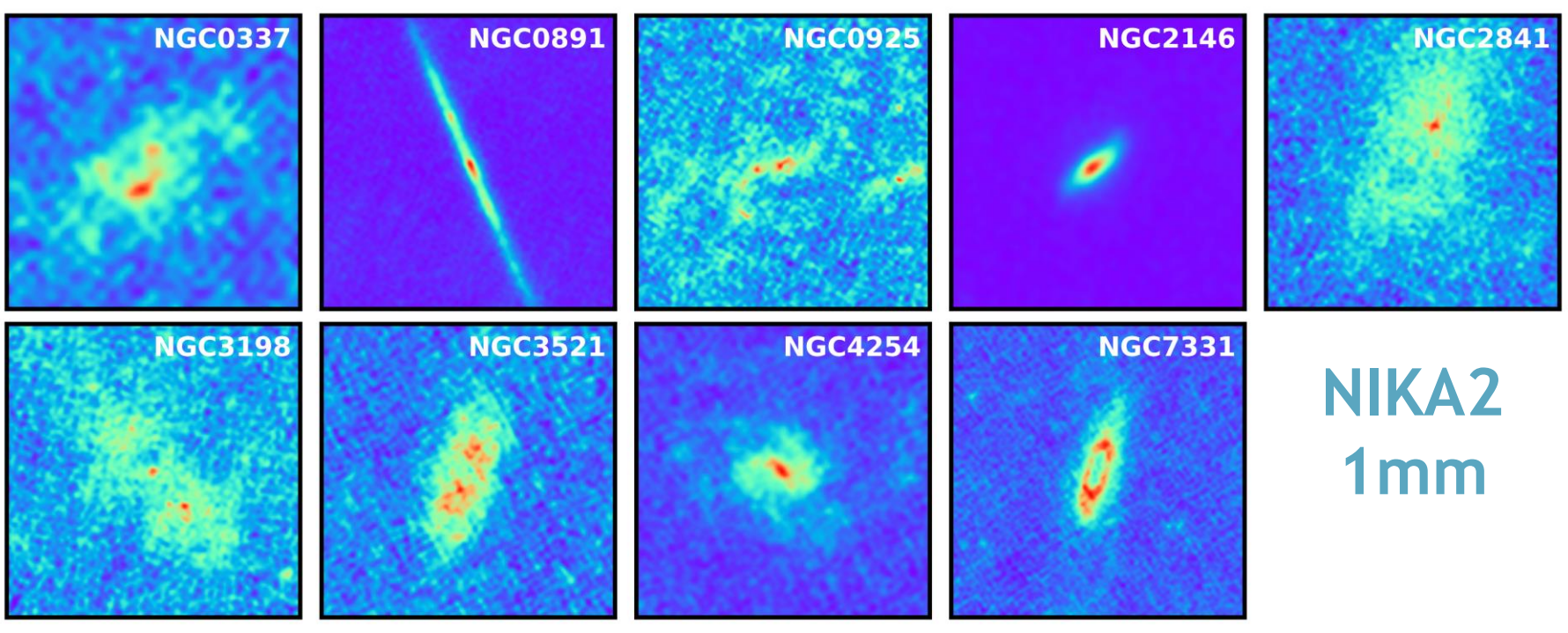
IMEGIN

iram Institut de Radioastronomie Millimétrique NIKA2

- Observations conducted with NIKA2 camera at IRAM-30m (Oct 2019 – Jan 2023)
- Images reduced and calibrated with *piic* (Zylka+2013)
- Images at 1.15mm (11.1")



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- Observations conducted with NIKA2 camera at IRAM-30m (Oct 2019 – Jan 2023)
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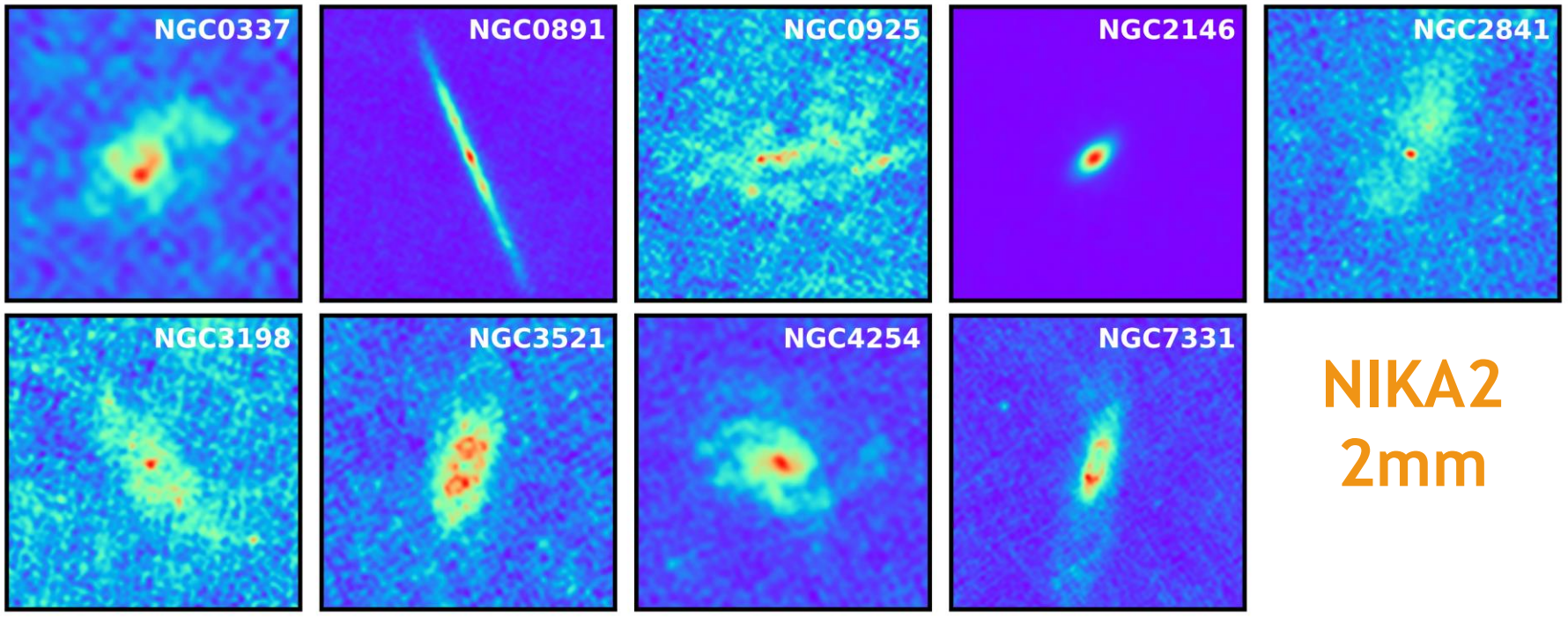
- Images at 1.15mm (11.1") and 2mm (17.6 ")



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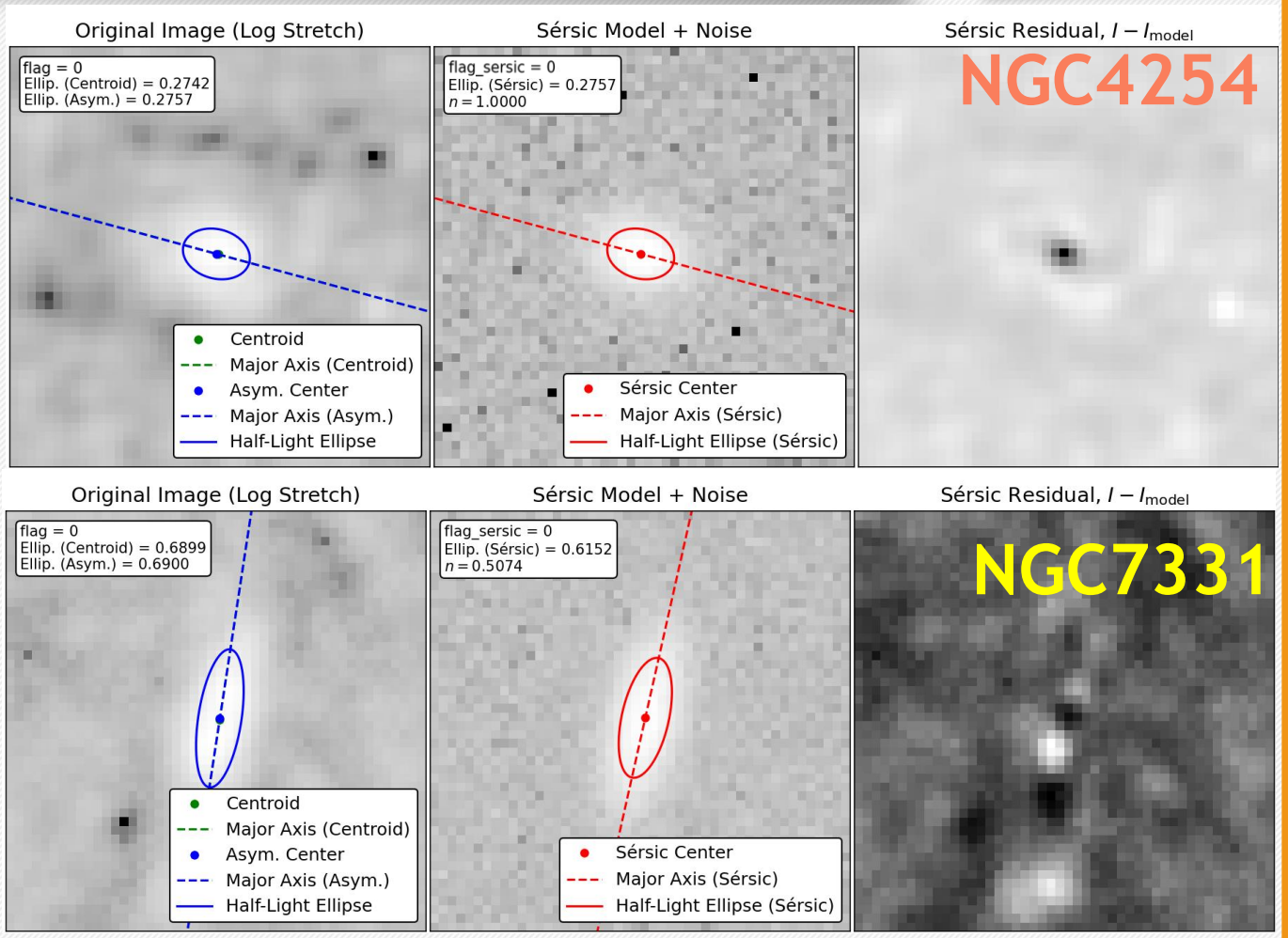
Morphological diagnostics: 2D Sérsic profile modelling

statmorph

2D Sérsic profile fitting:
5 free parameters

$[I_e, n, R_{half}]$
[ellipticity, orientation of isophotes]

NIKA2
1mm



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Morphological diagnostics: 2D Sérsic profile modelling

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2D Sérsic profile fitting:
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NIKA2
2mm

$[I_e, n, R_{half}]$
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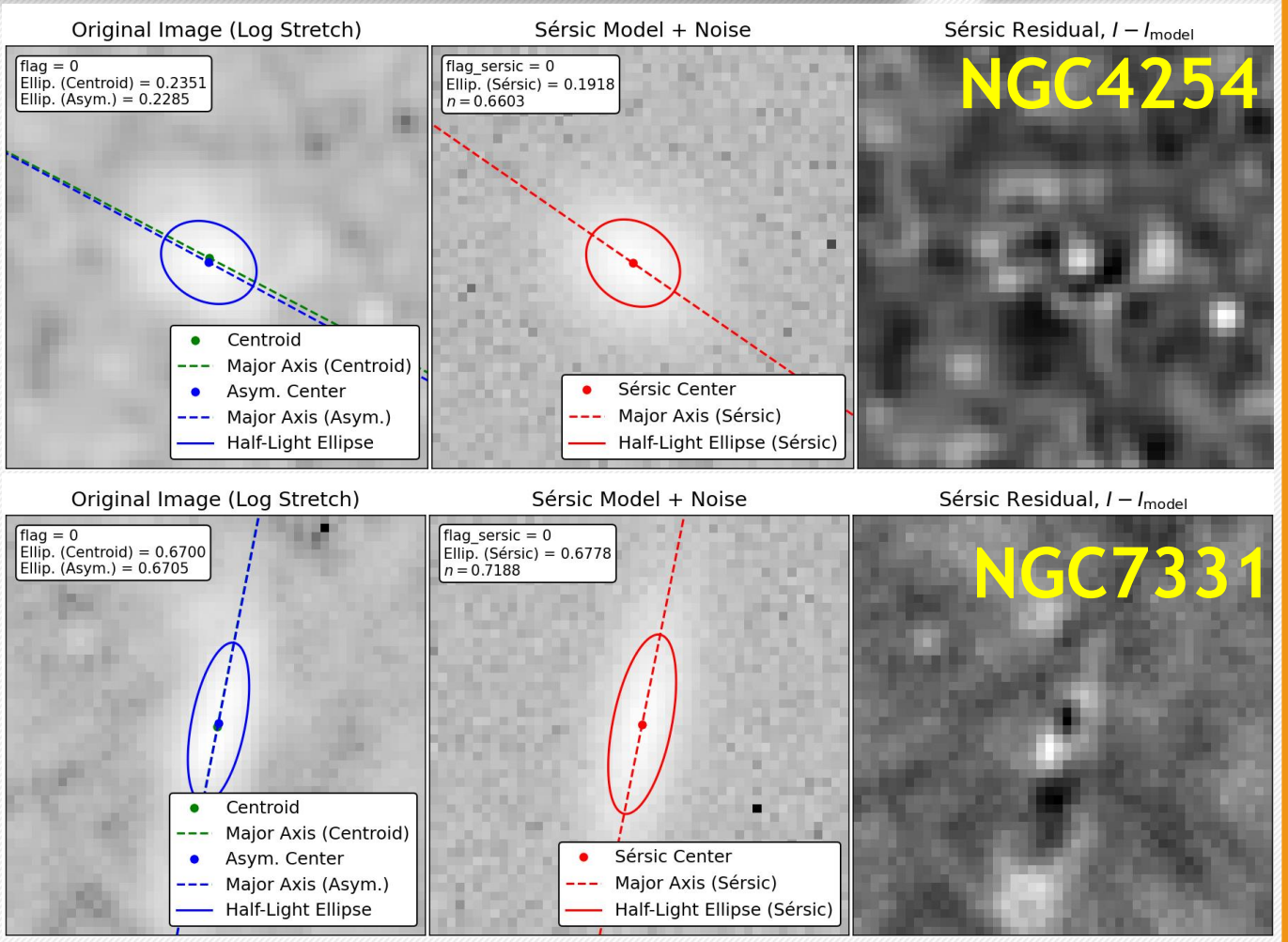

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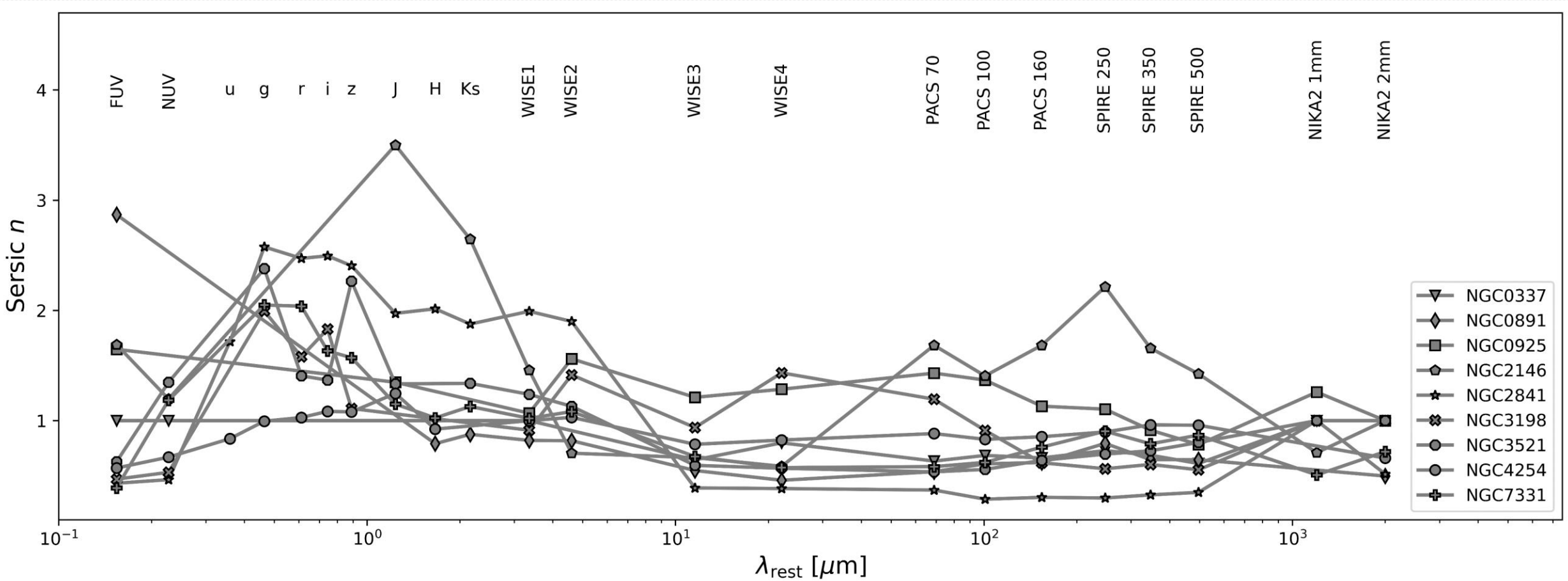
Sérsic *n* vs wavelength/Preliminary



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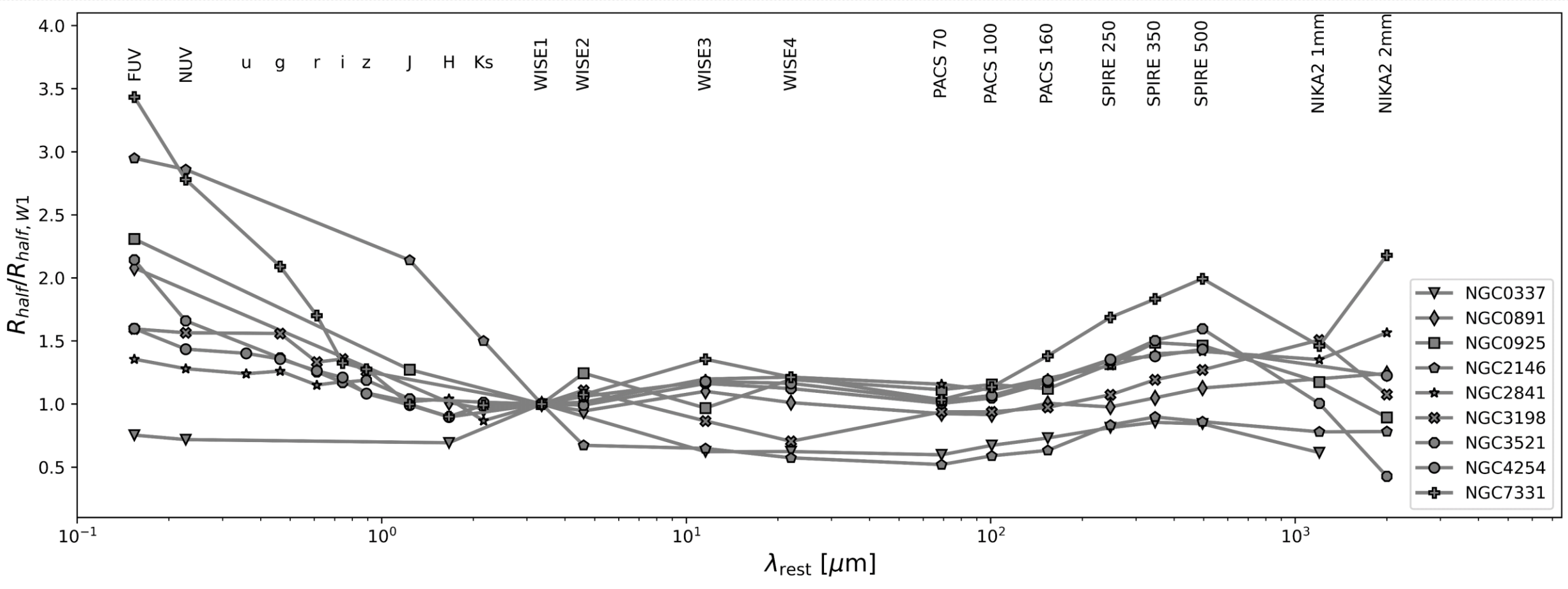
Galaxy size vs wavelength/Preliminary



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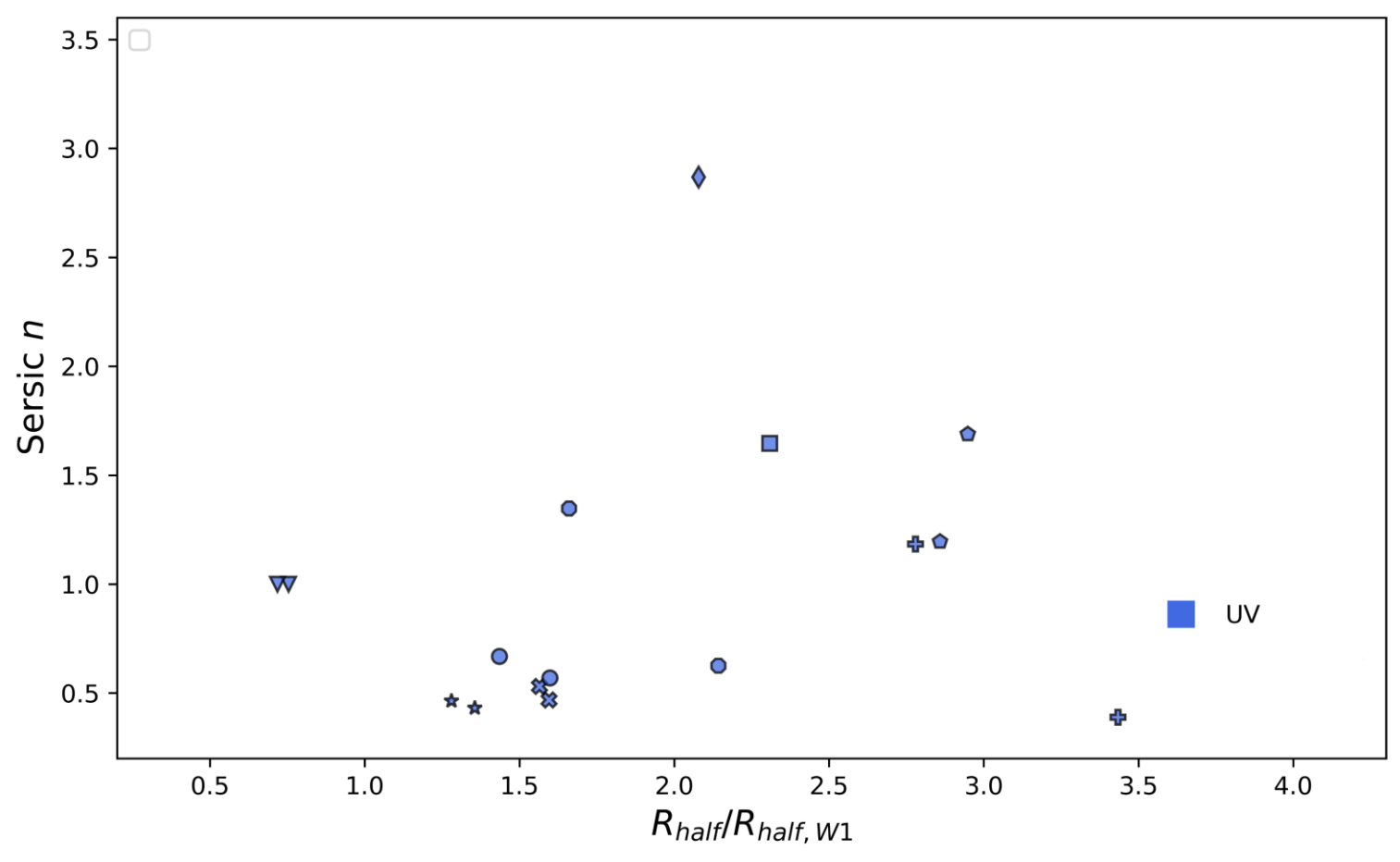
Sérsic *n* vs. R_{half}/Preliminary



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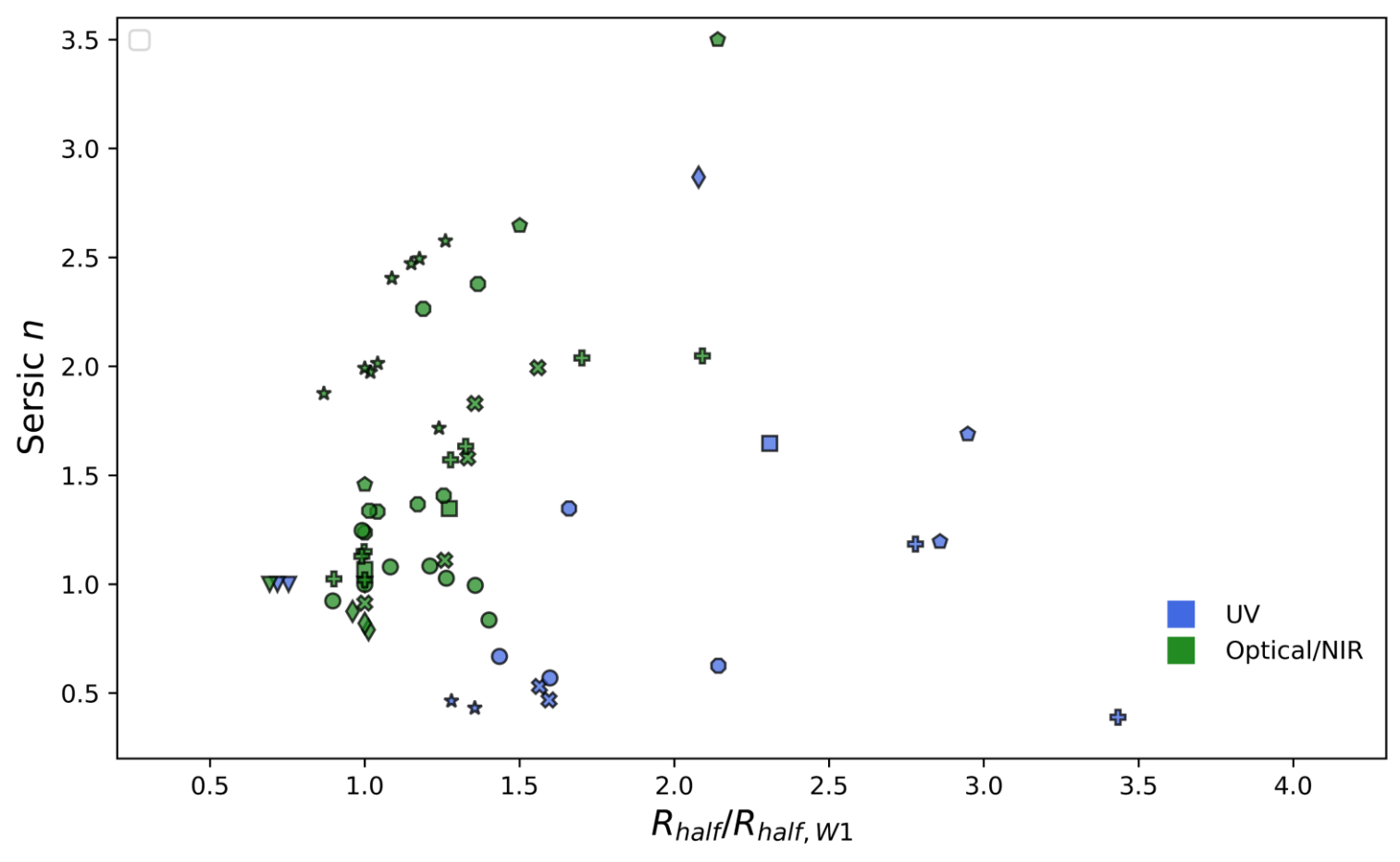

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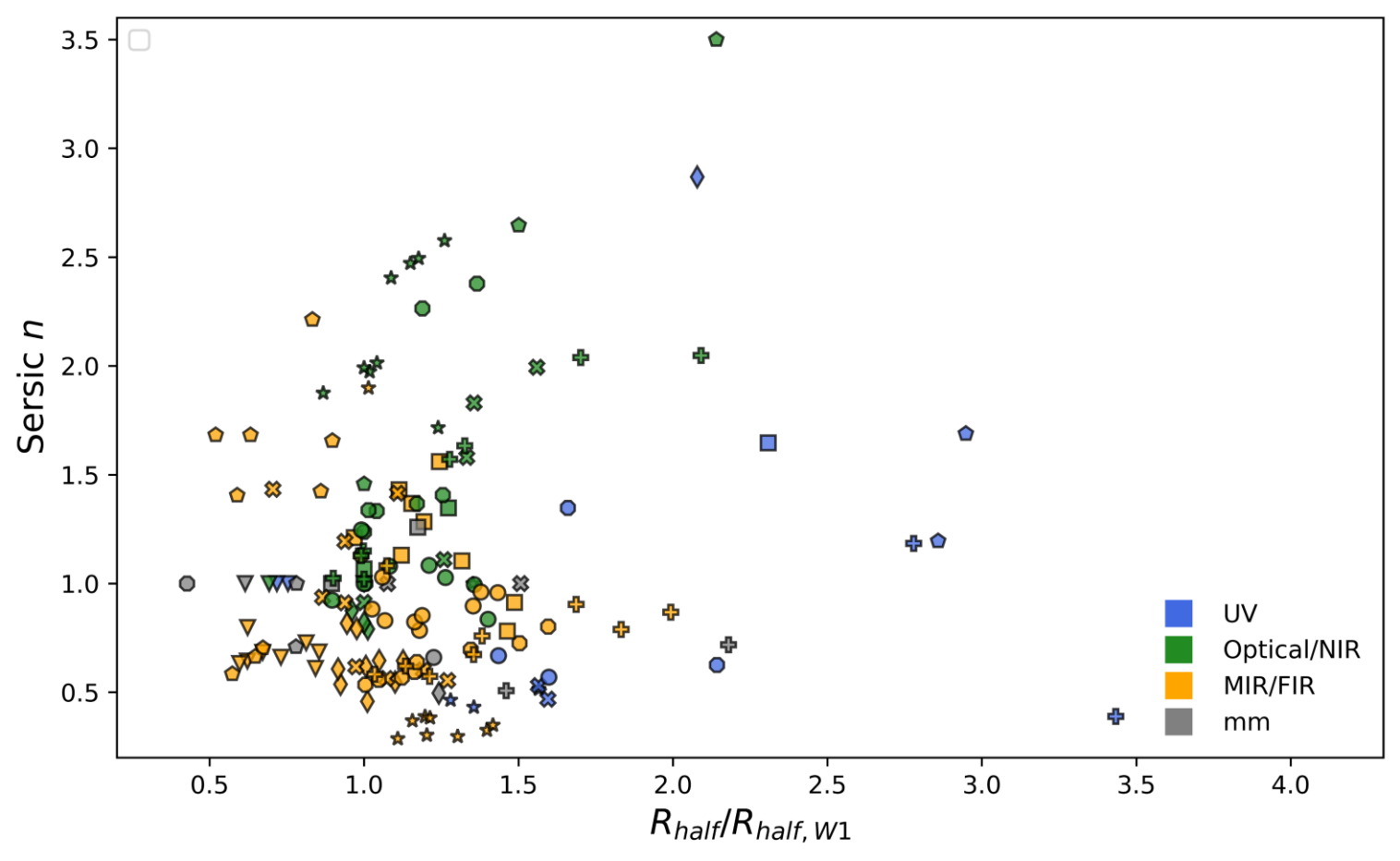

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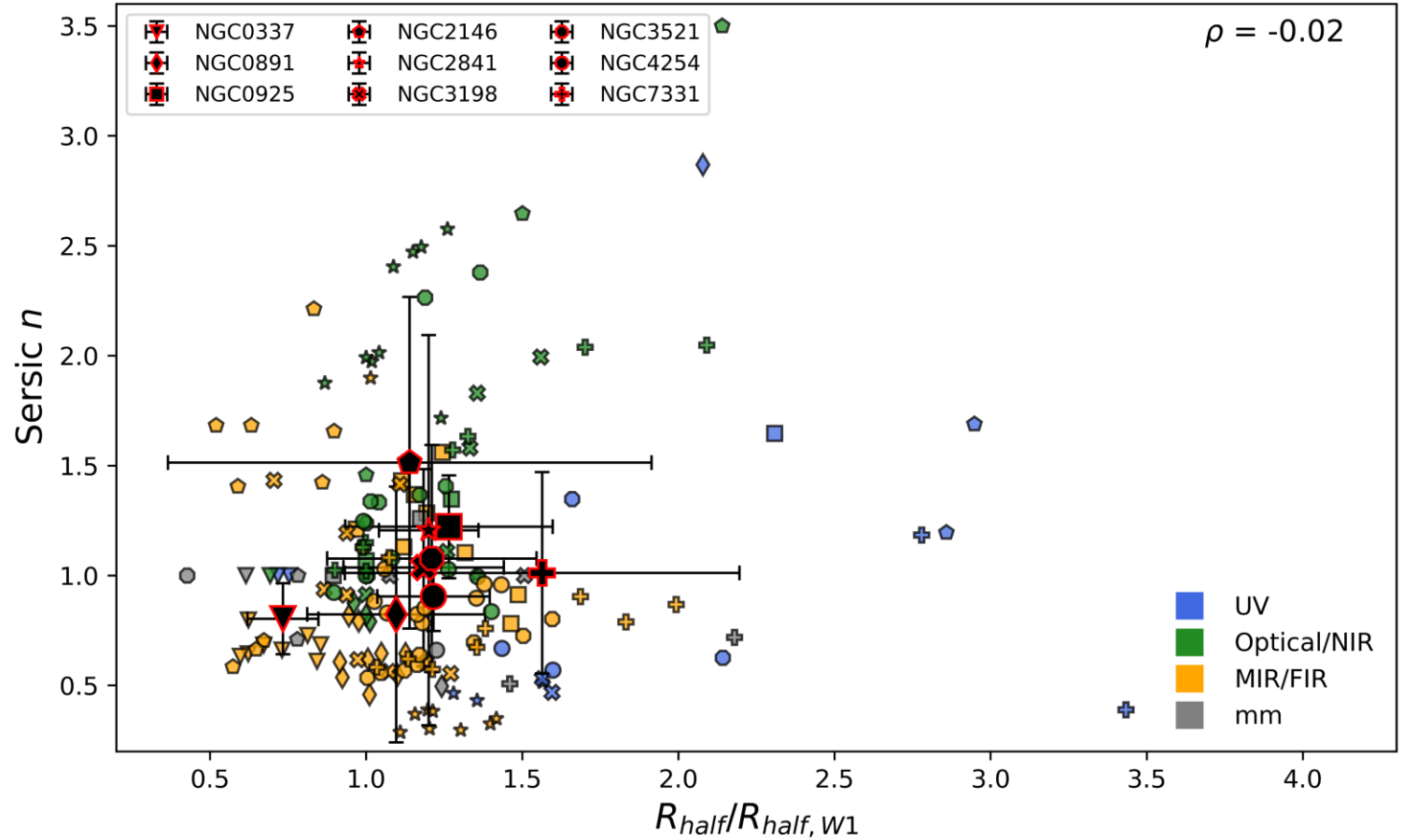
Sérsic *n* vs. R_{half}/Preliminary



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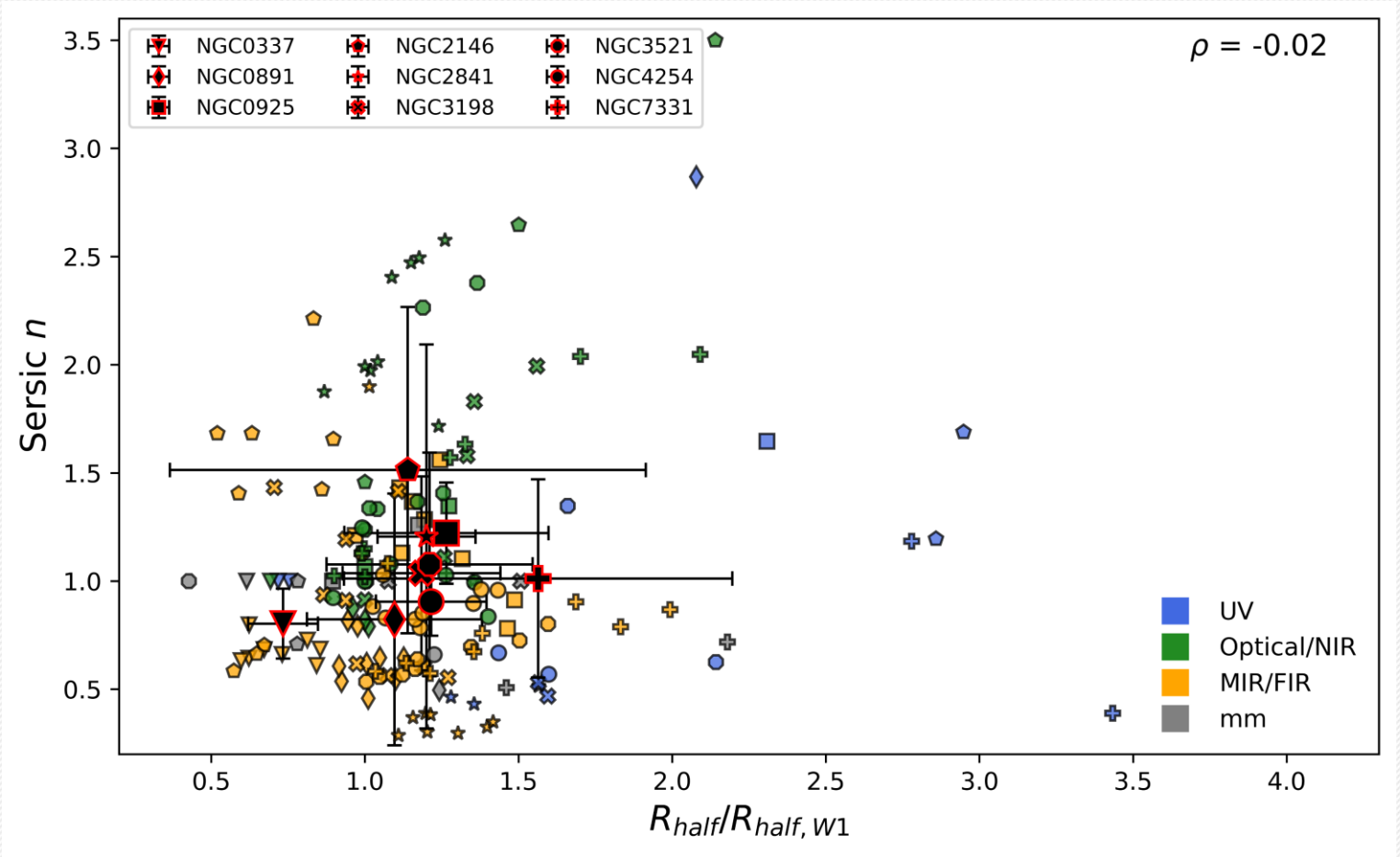
Sérsic *n* vs. R_{half}/Preliminary

No correlation between Sérsic *n* and R_{half} → No degeneracy between the two main free parameters.

On average, the light distribution of our galaxy sample resembles that of an exponential profile (as expected).



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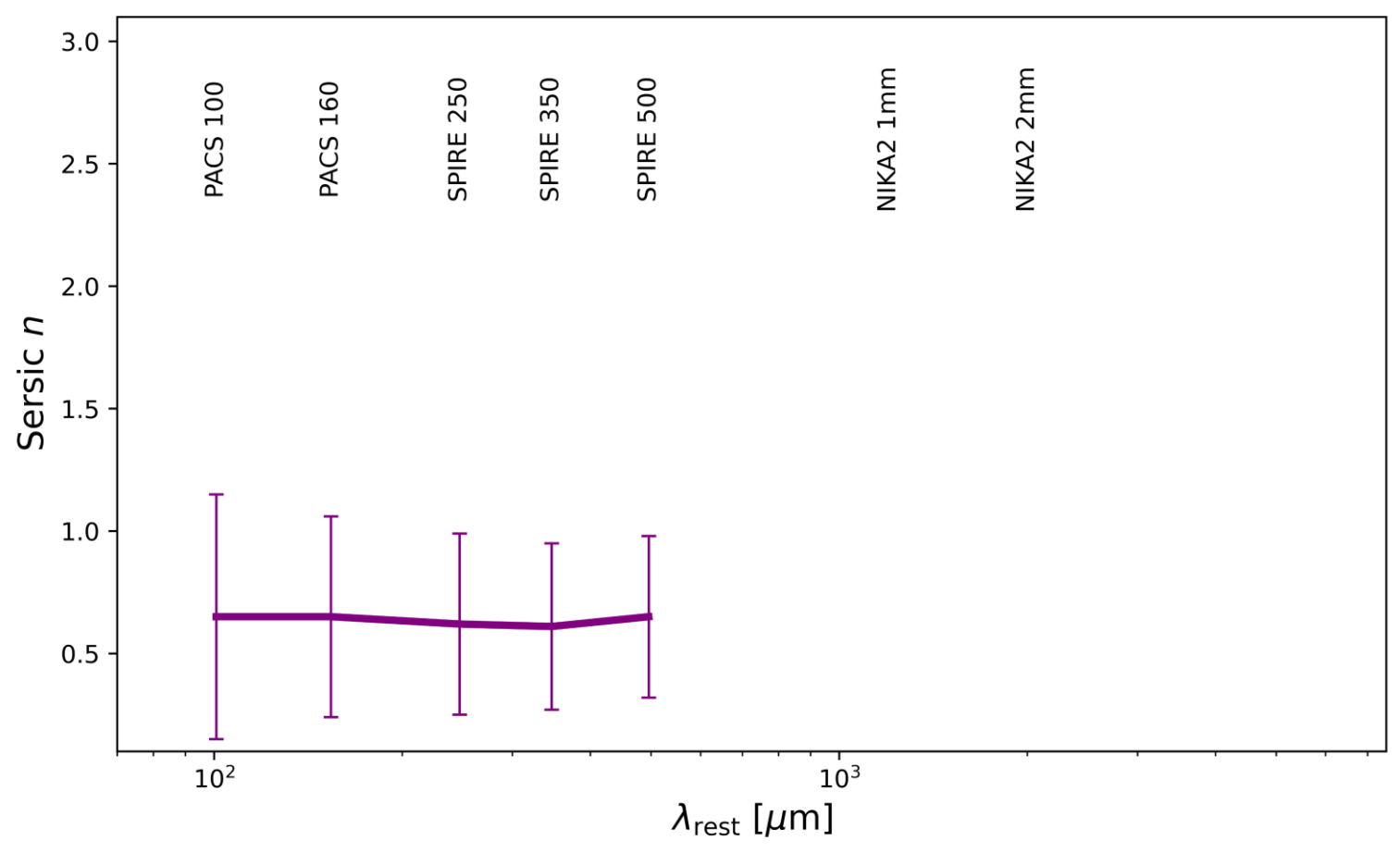
Dust emission profiles in mm/Preliminary



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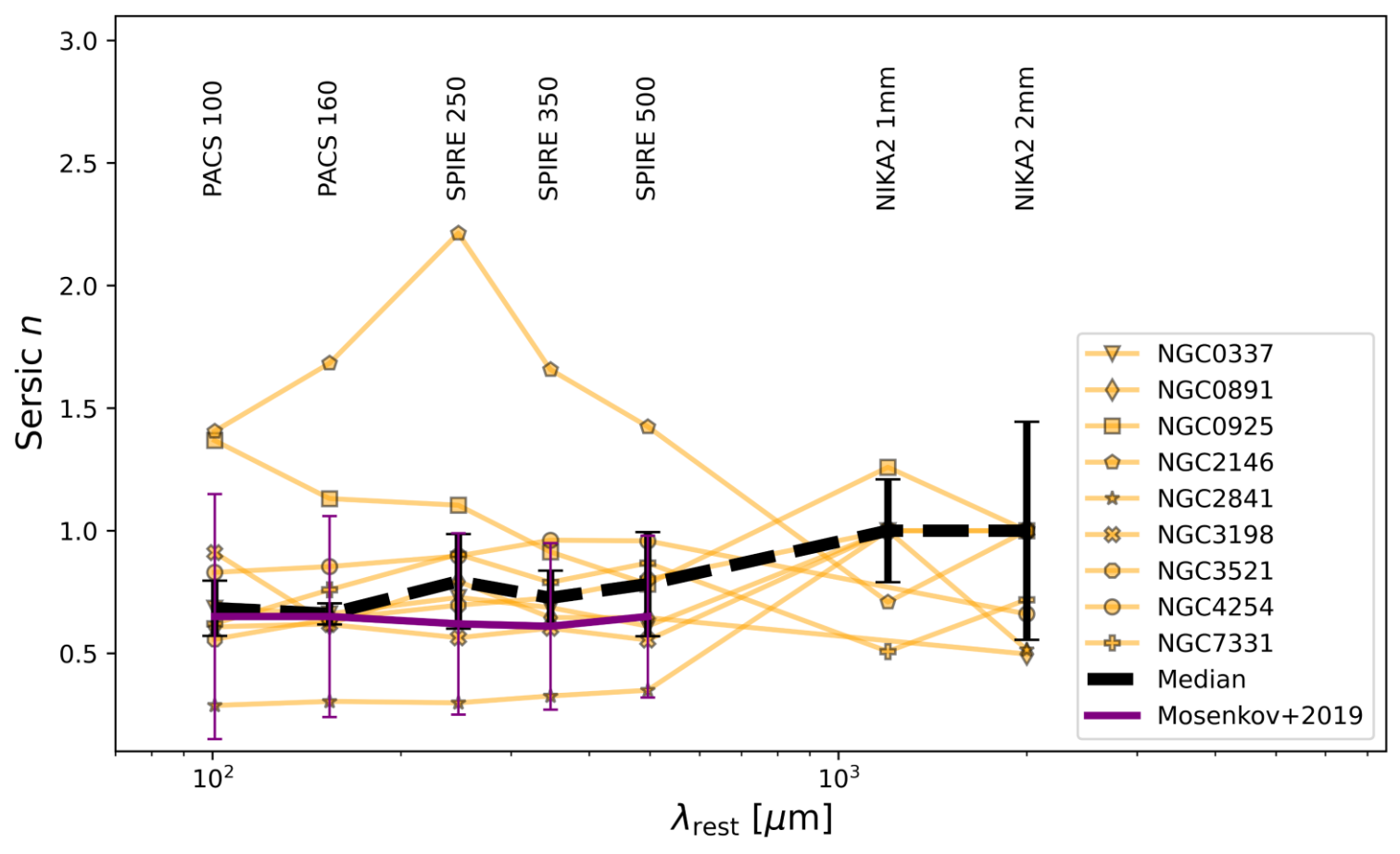

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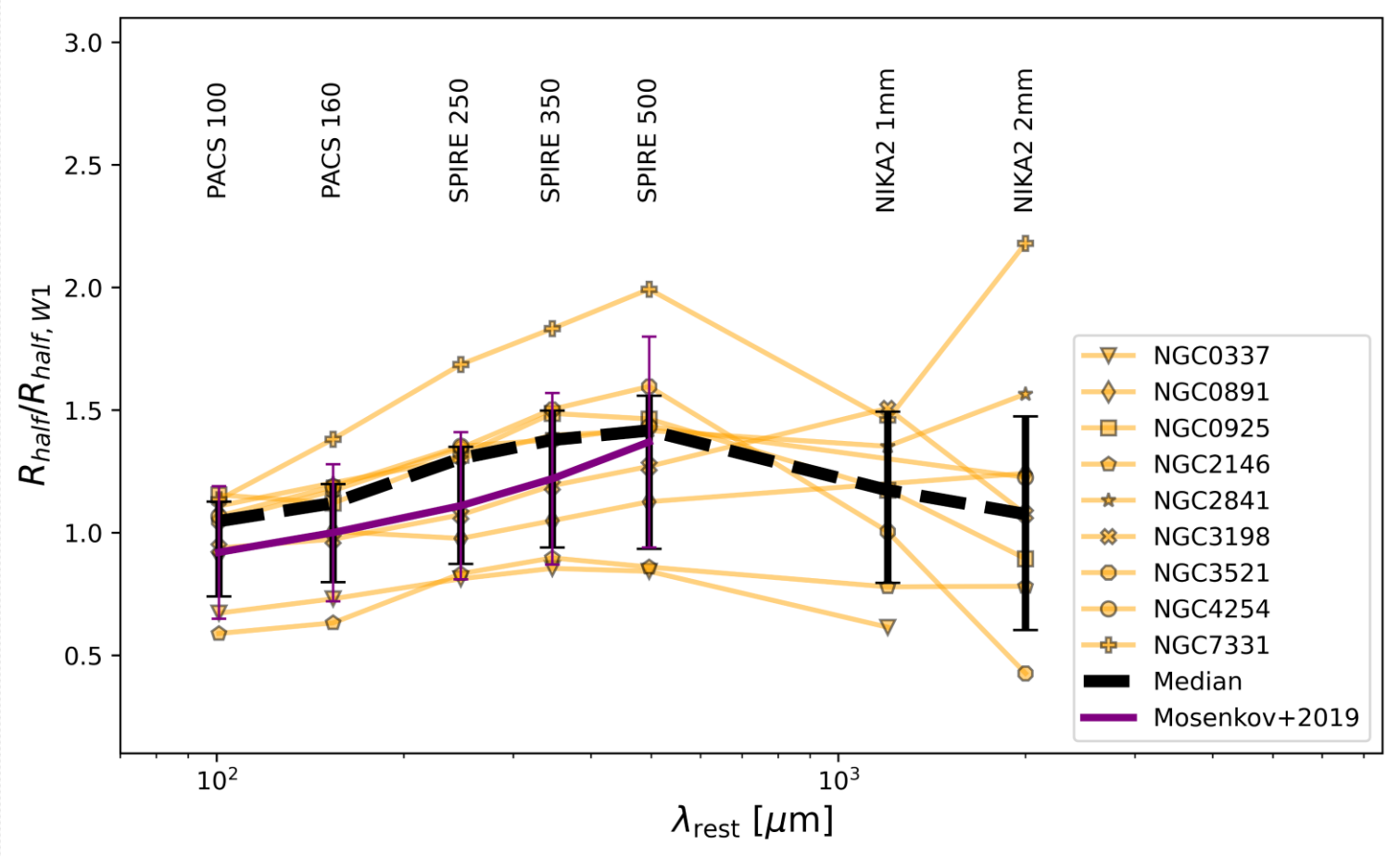

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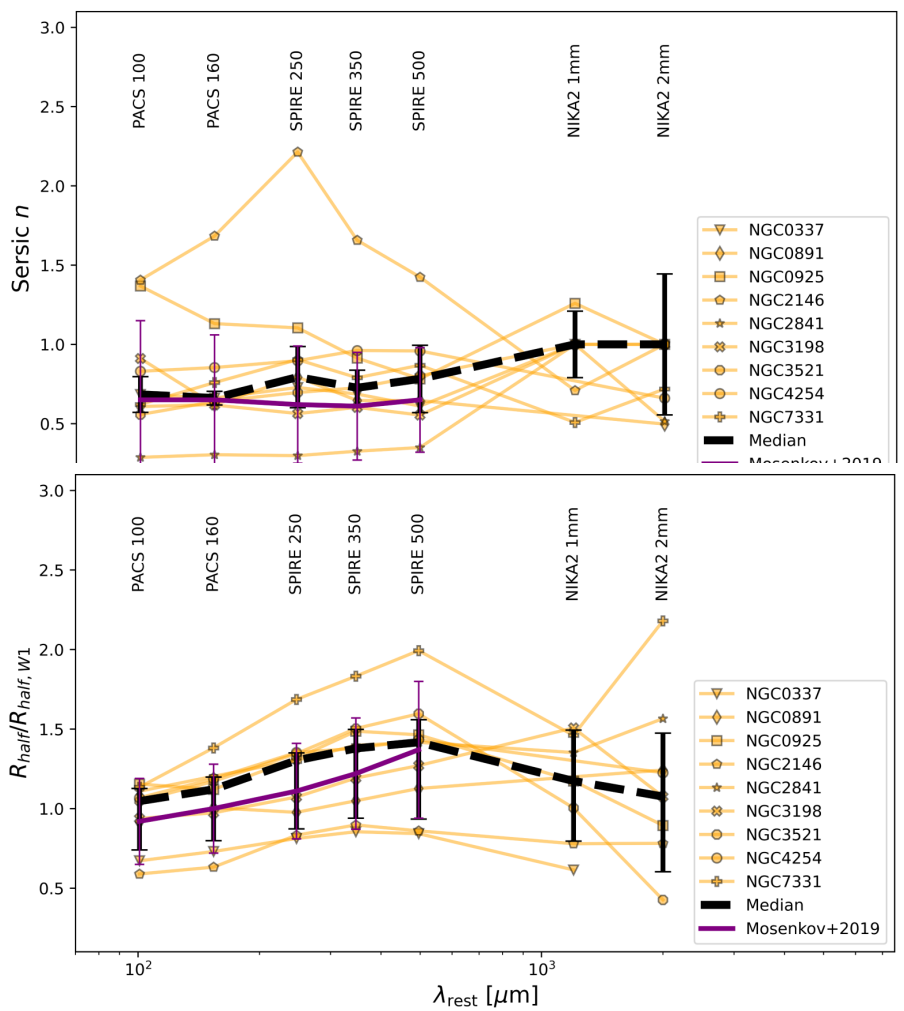
Discussion



Two possible explanations for these results

1) Non-thermal emission/SF is dominant at mm and responsible for the exponential profiles.

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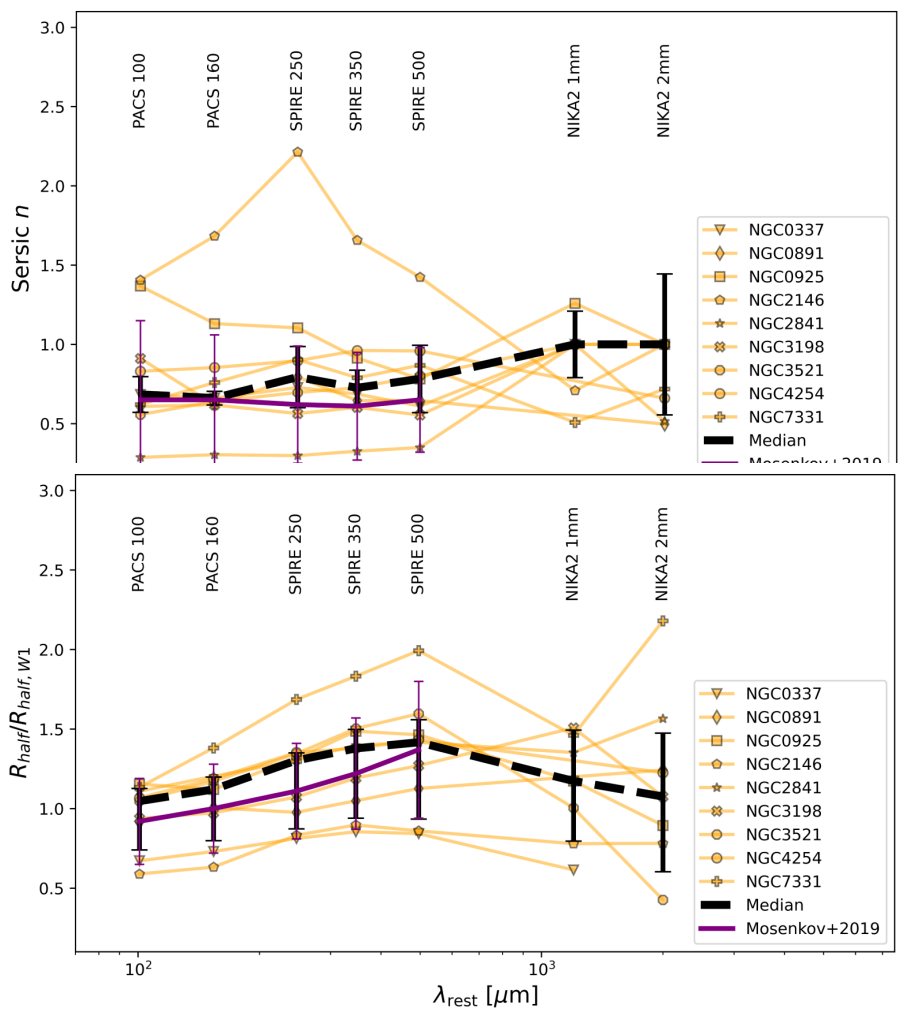

Two possible explanations for these results

1) Non-thermal emission/SF is dominant at mm and responsible for the exponential profiles.

2) Detection of the very cold dust in the center of galaxies, but low sensitivity in the outskirts.

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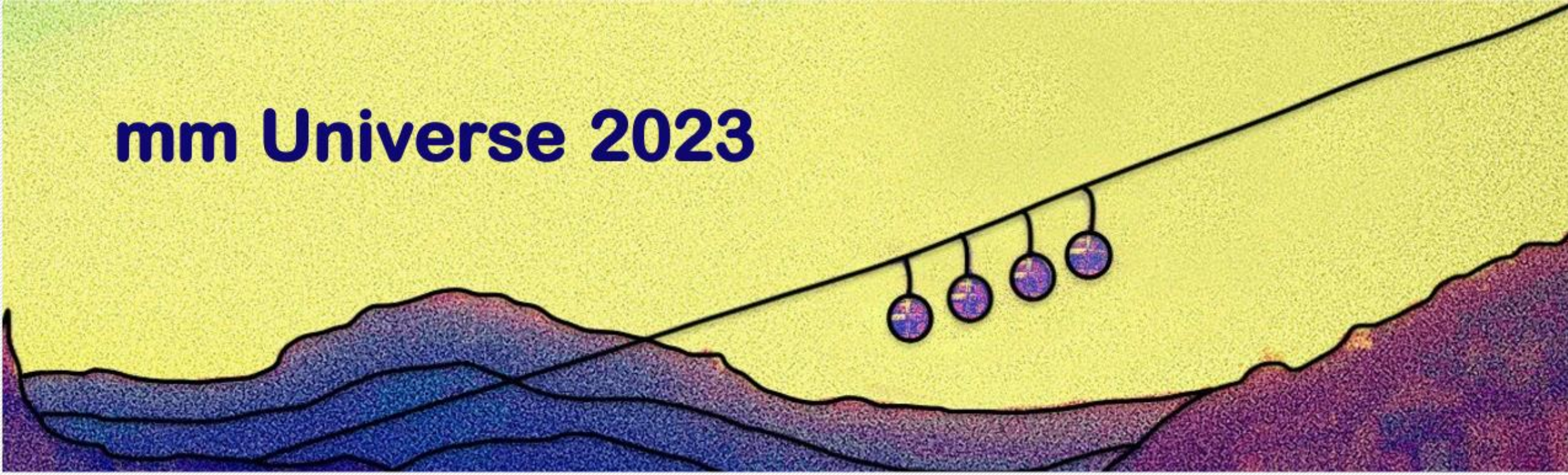
Summary & Conclusions

We derived structural parameters for the IMEGIN galaxies based on multiwavelength images (UV-mm).

These parameters are the Sérsic index (galaxy morphology), the effective radius (galaxy size)

- Based on the Sérsic index, the stellar disk in our galaxies is close to an exponential profile.
- At 100-500μm, the dust emission resembles a Gaussian profile.
- At 1mm and 2mm, emission is distributed by an exponential profile.
- The R_e of the dust profile steadily increases with λ up to 500μm and declines at 1-2mm.



Thank you for your attention!

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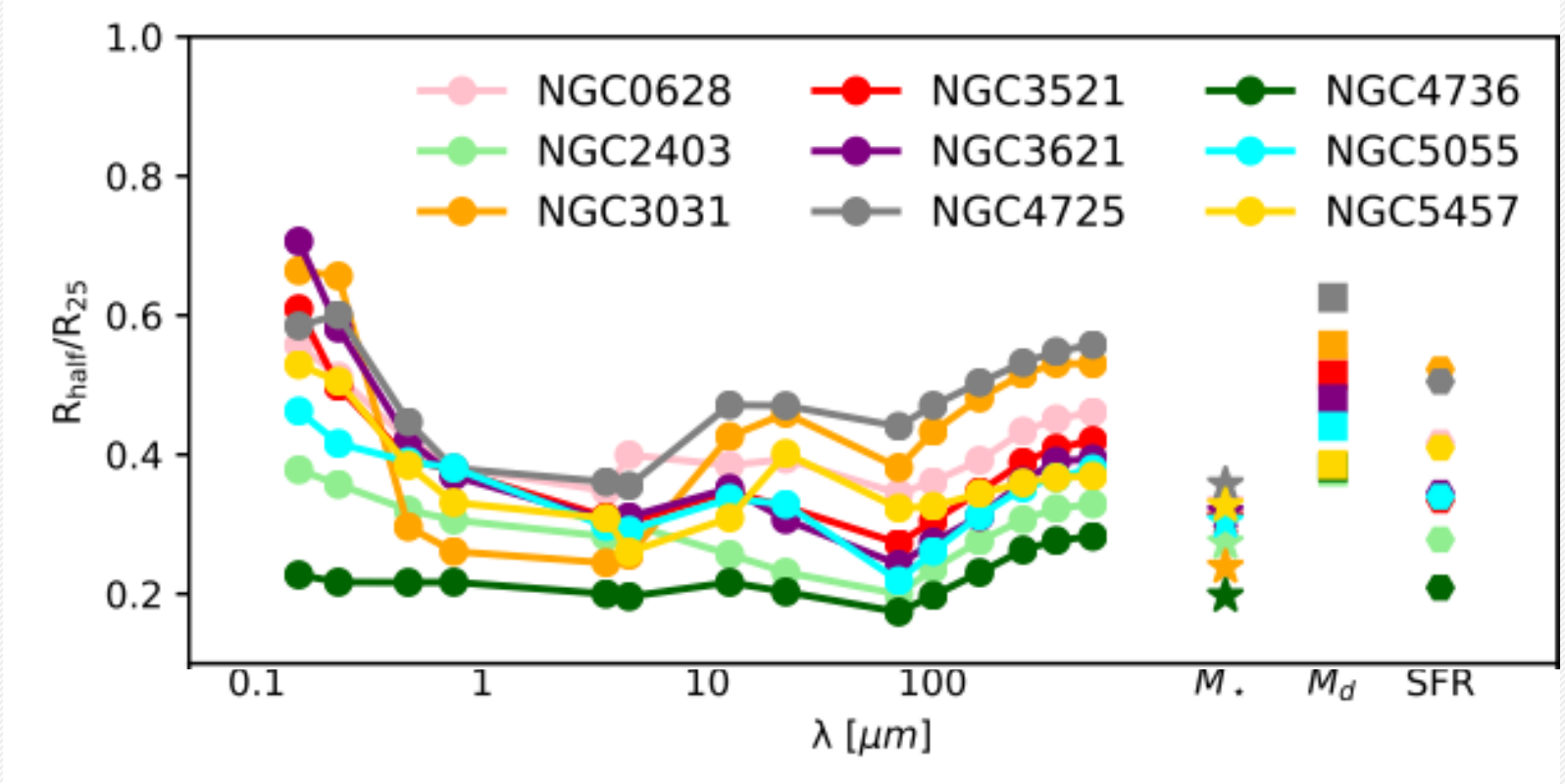
Morphology-wavelength dependence

X

Multi-wavelength



Baes+2020