The IMF in Young Massive Star Clusters:

do we understand the completeness?

18.09.2019

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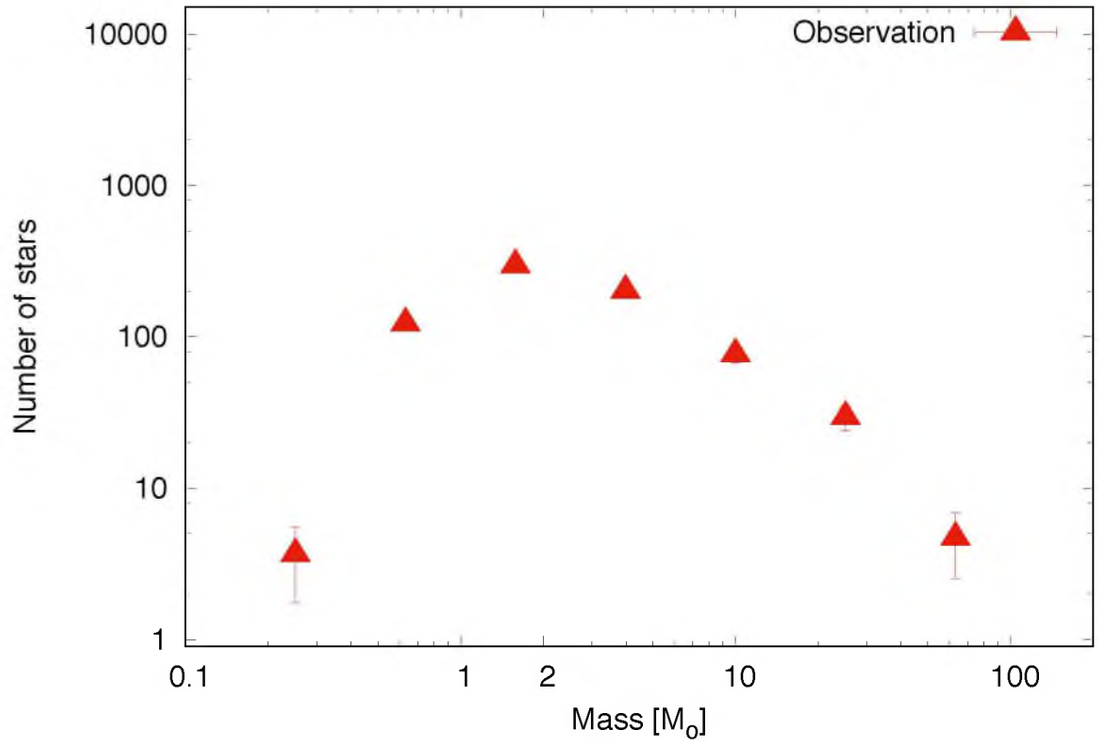
- Introduction on MF
- Artificial star experiment
- Uniform Distribution vs Spatially Varying models
- Synthetic observations (using MYOSOTIS)

- Examples of completeness-corrected MF
- Conclusion

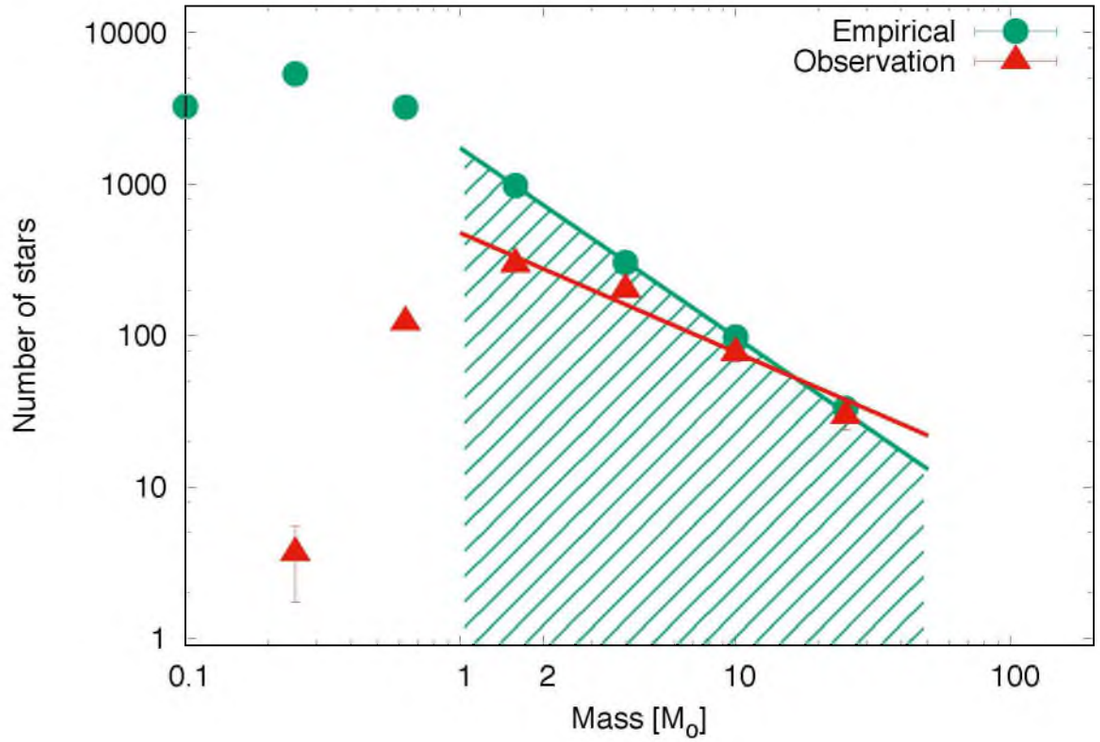
Mass, age, source distribution, stellar parameters, …



Problems:

- **Evolutionary and atmosphere models limitations**
- **Observational/instrumental effects**
- **Chalenges posed by target itself**

Mass, age, source distribution, stellar parameters, …



Mass Uncertainty:

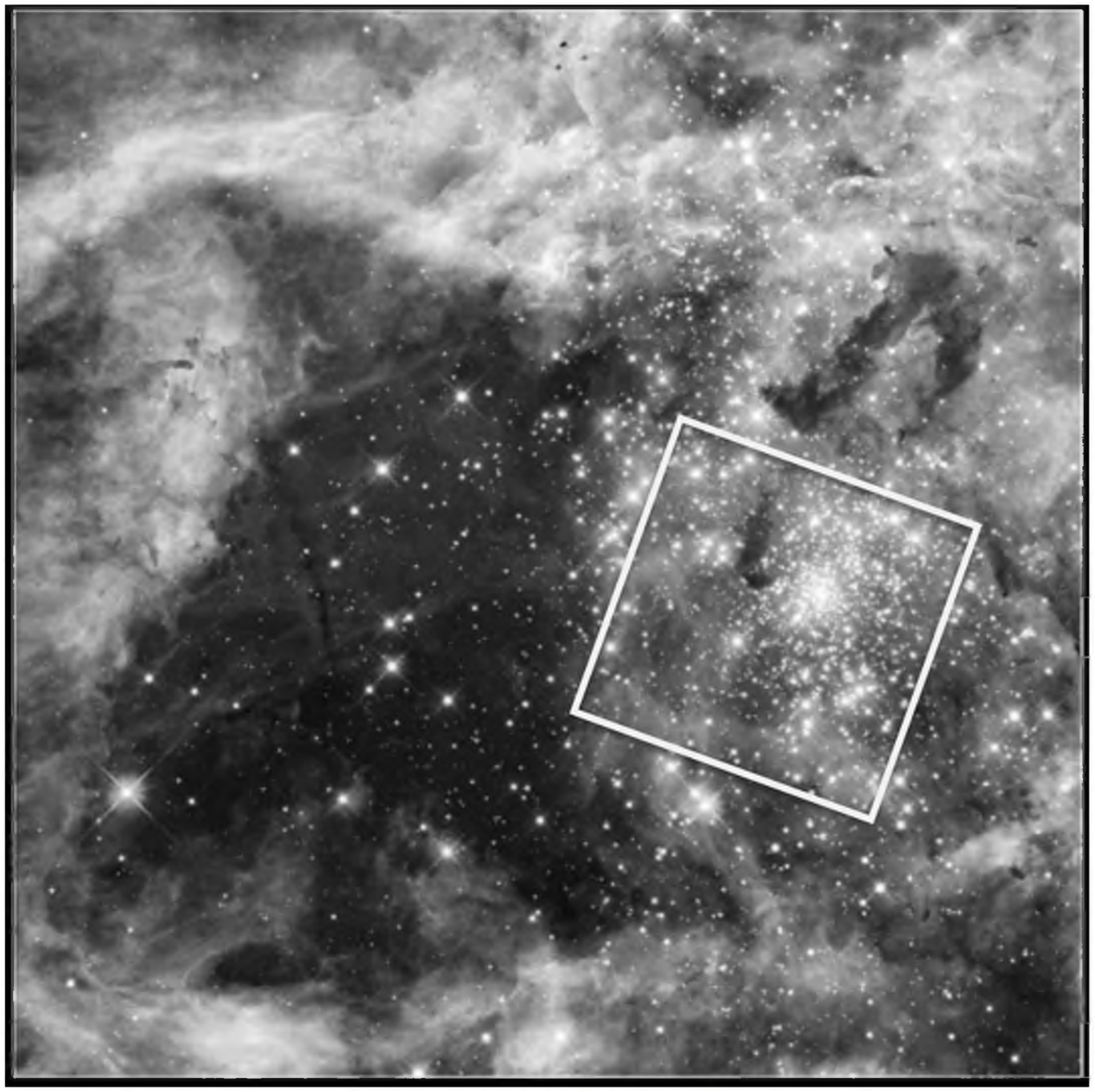
- **Evolutionary and atmosphere models limitations**
- **Observational/instrumental effects**
- **Chalenges posed by target itself**

Observed MF should be corrected for completeness:

- Artificial star experiment is applied on the observed image
- Completeness function is estimated and applied to correct MF

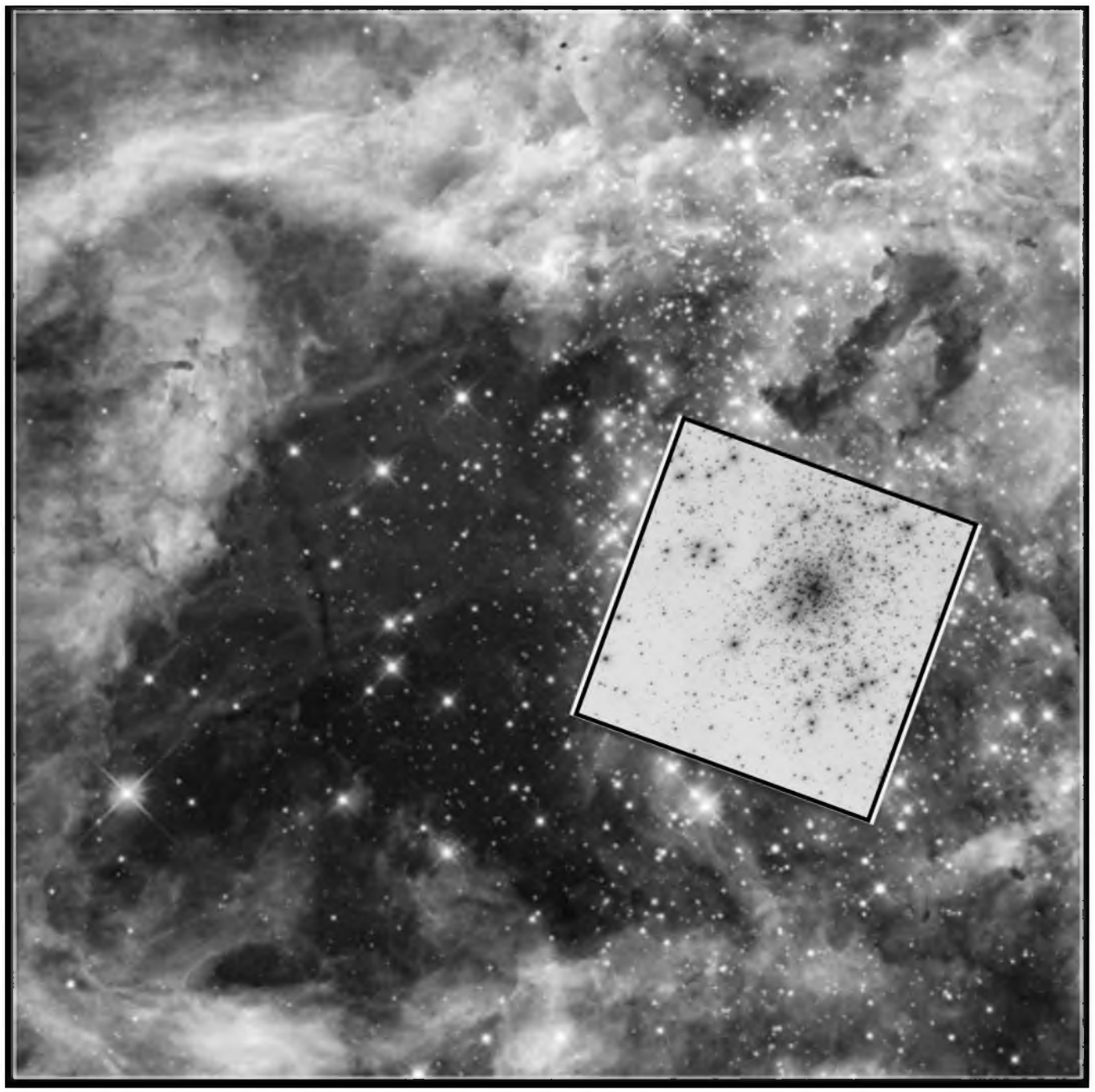
Where to put the artificial stars in the image?

Adding artificial stars with a given magnitude on the original image and estimating the completeness by photometry



Siriani+2000

Adding artificial stars with a given magnitude on the original image and estimating the completeness by photometry



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Adding artificial stars with a given magnitude on the original image

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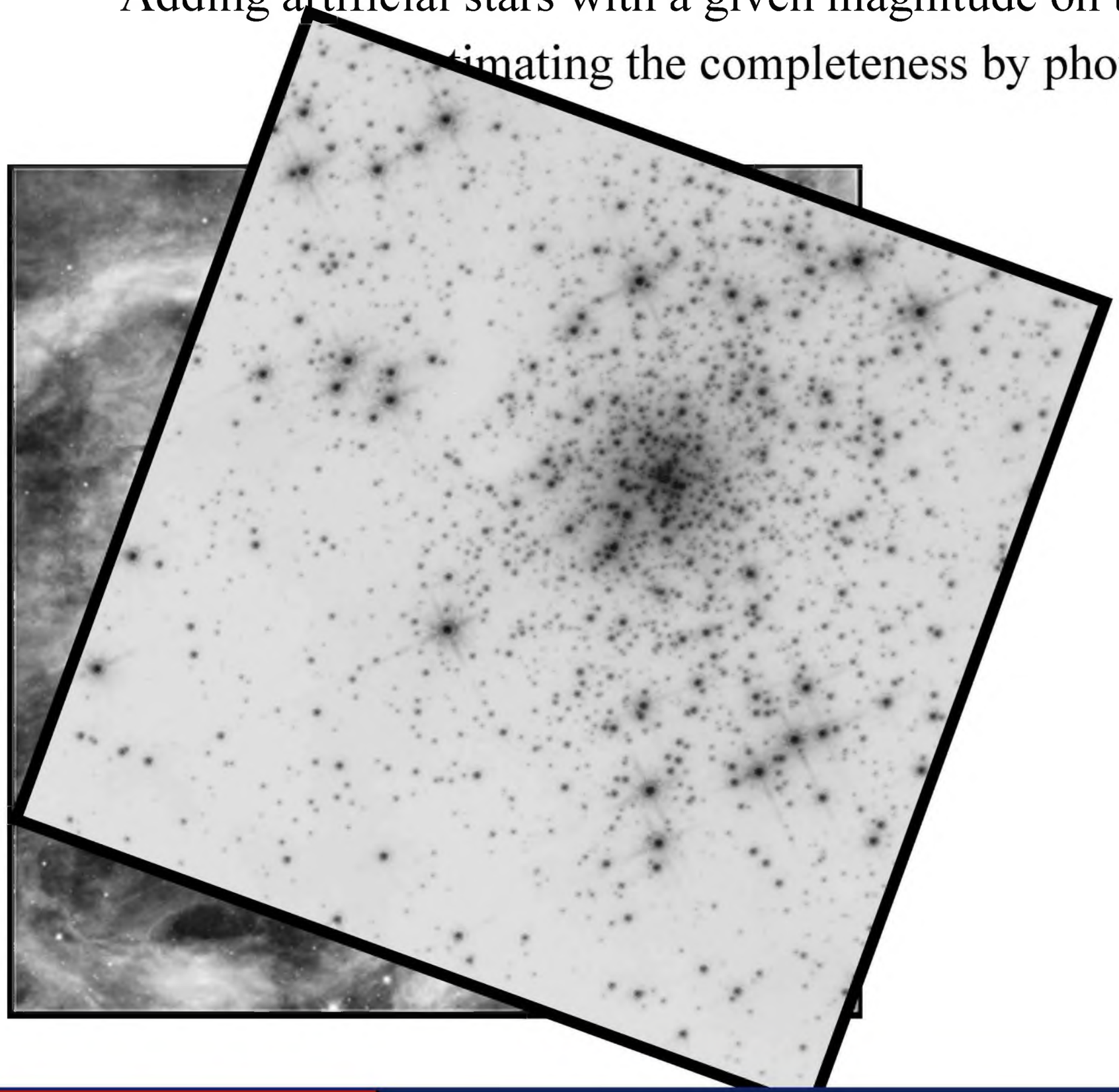

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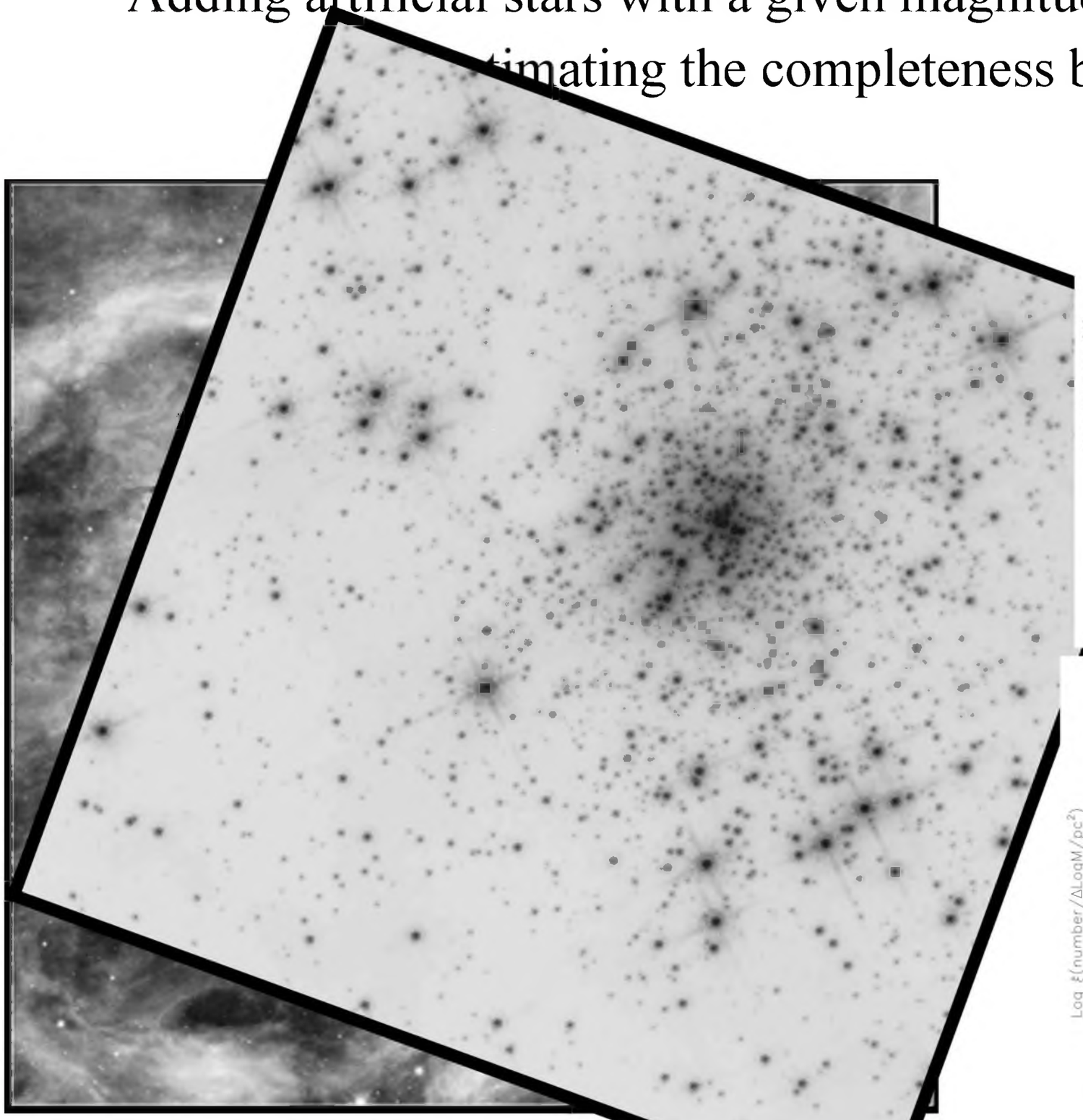
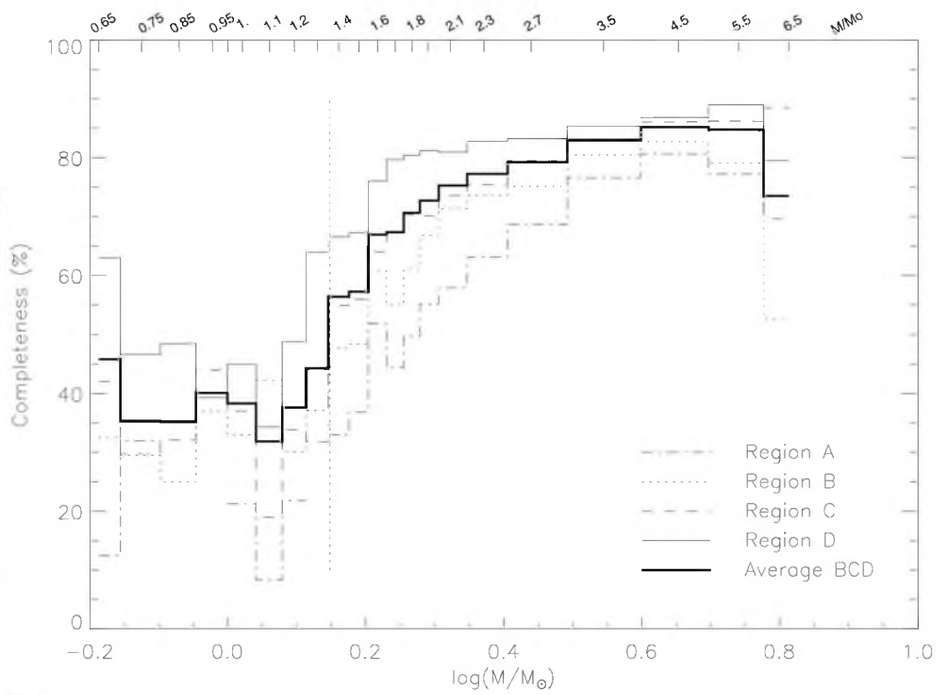
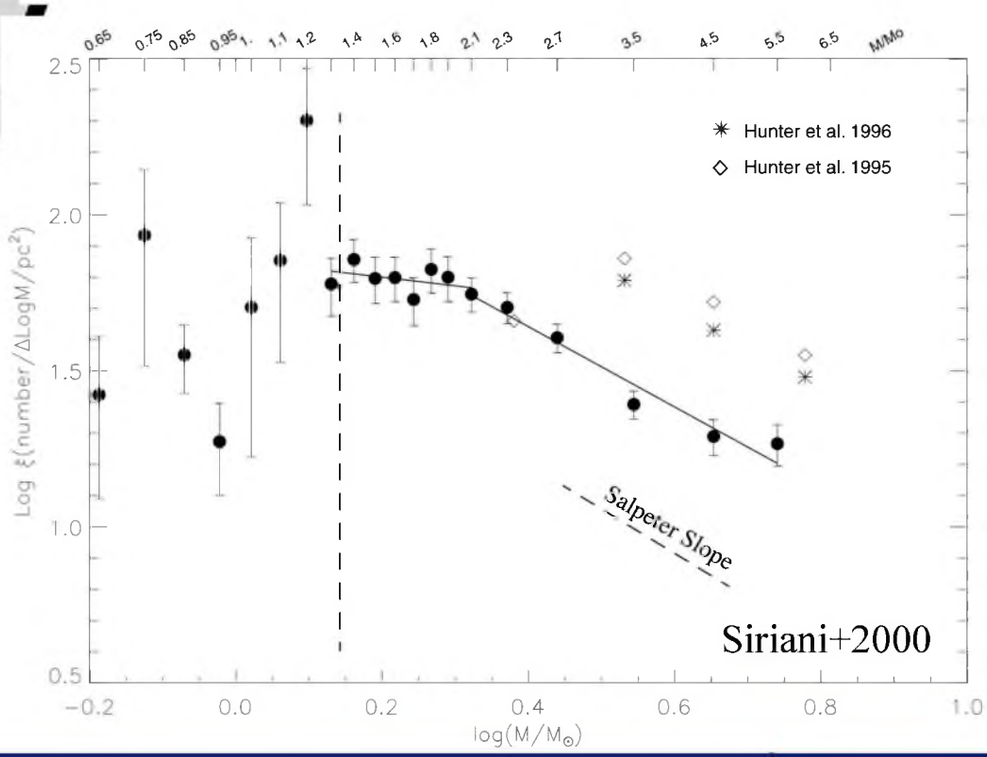


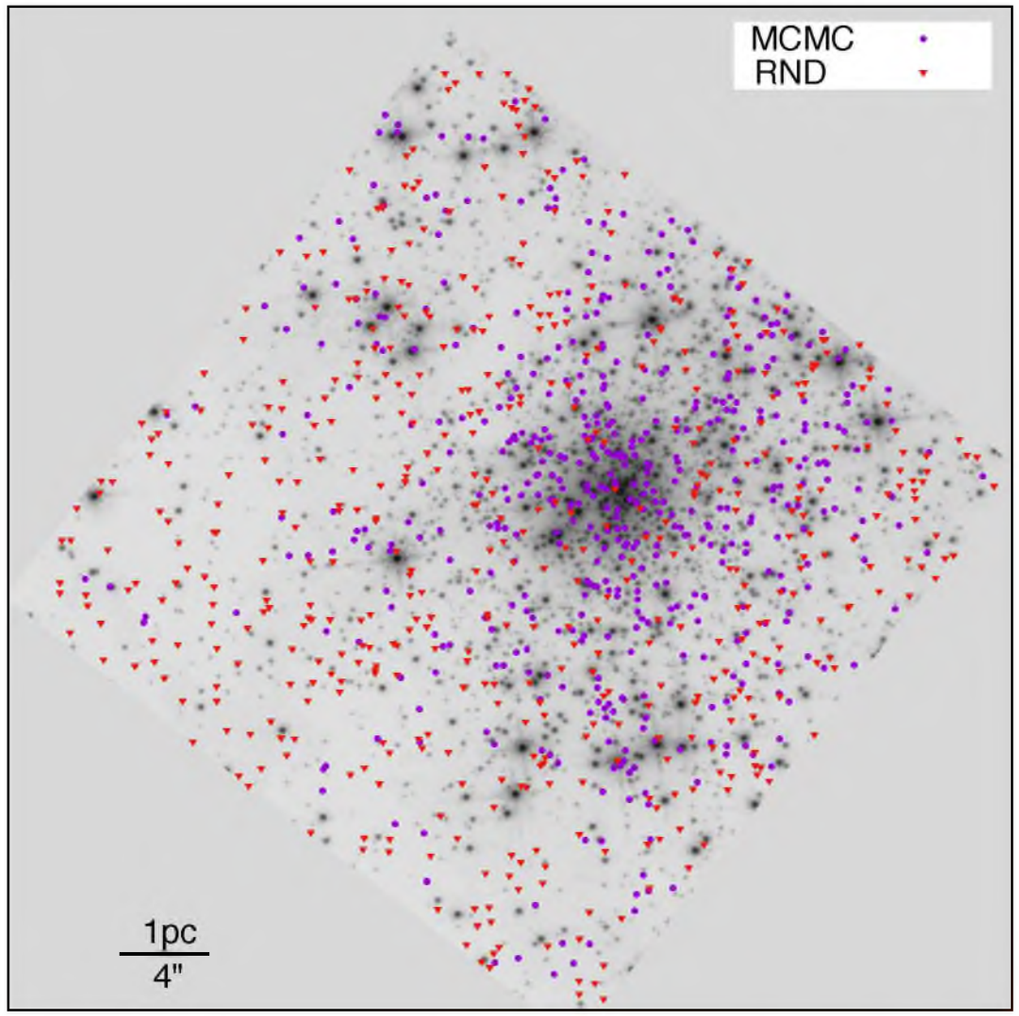


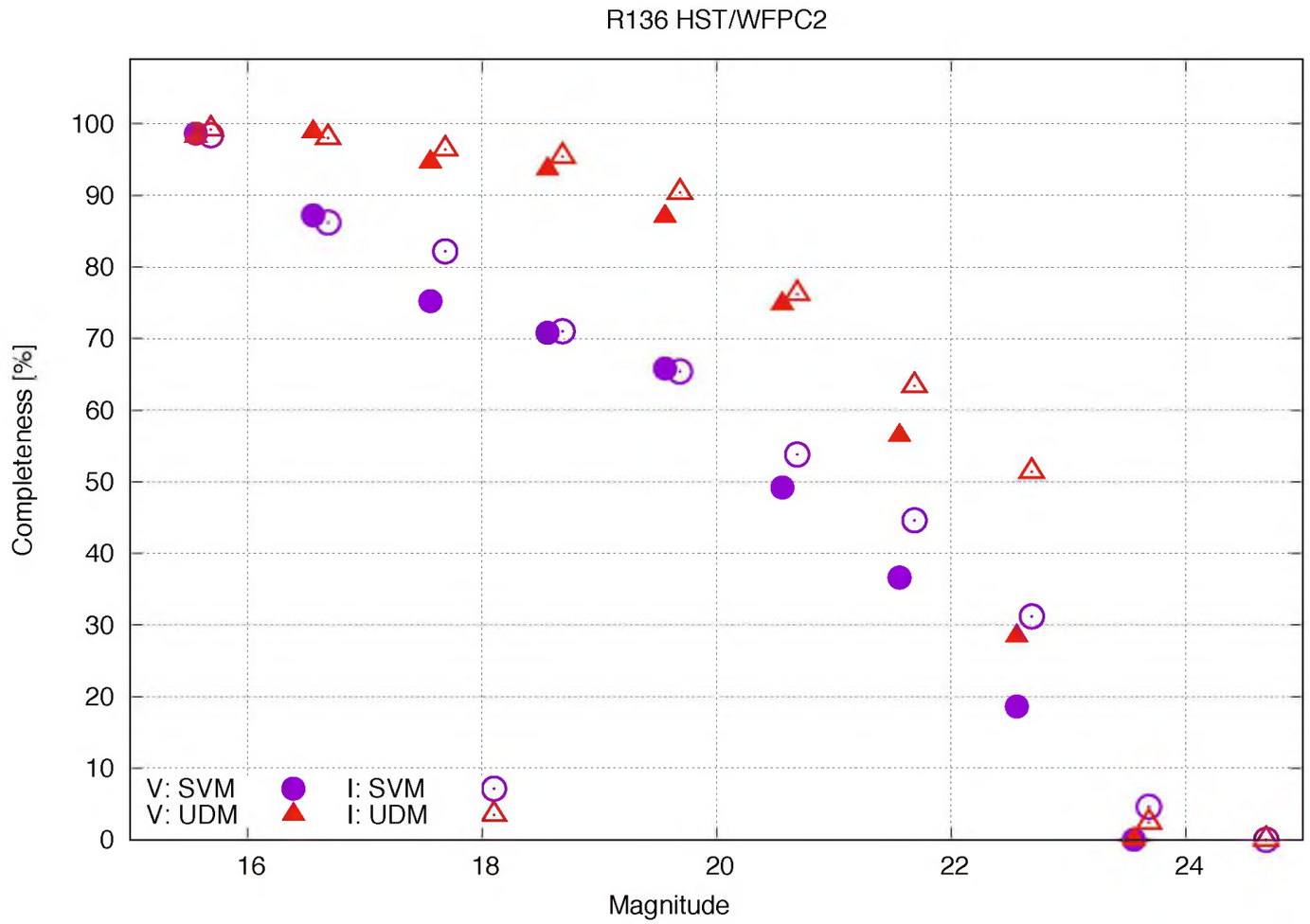


SVM:

- **Sensitive to the shape of the star cluster and its structure**
- **Depends on the magnitude of the artificial star**

RMC136, HST/WFPC2, V_{mag} = 21.56





What is the real completeness?!

Make Your Own Synthetic ObservaTIonS (MYOSOTIS)

Inputs:

Stars info : Position, velocity, mass, age of stars (e.g. From Nbody simulations)
Cloud info : Cloud particle's position, mass, smoothing lengths (e.g. from SPH codes)
Telescope info : Resolution, detector, Filter, FoV
Observing conditions : Atmospheric condition, Adaptive Optics, Line-of-sight, distance of the object

Outputs:

***_image.fits** : 2D fits image
***_star_info.txt** : contains the information of the stellar sources in the FoV

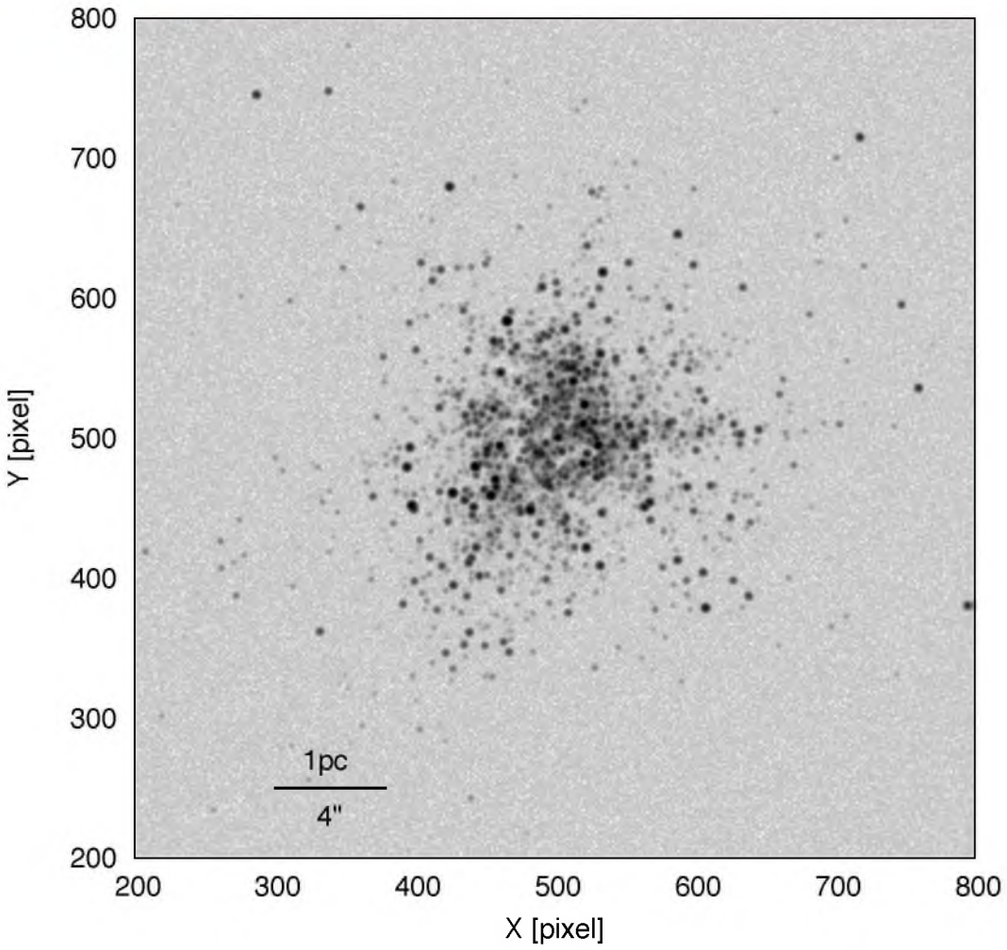
If spectroscopy='yes' the two other outputs:
***_cube_spectra.fits** : 3D cube, X-Y is the position of stellar sources, z is flux in different wavelengths
***_Lambda.txt** : the wavelengths [A] which is used for the 3rd dimension of the spectral_cube

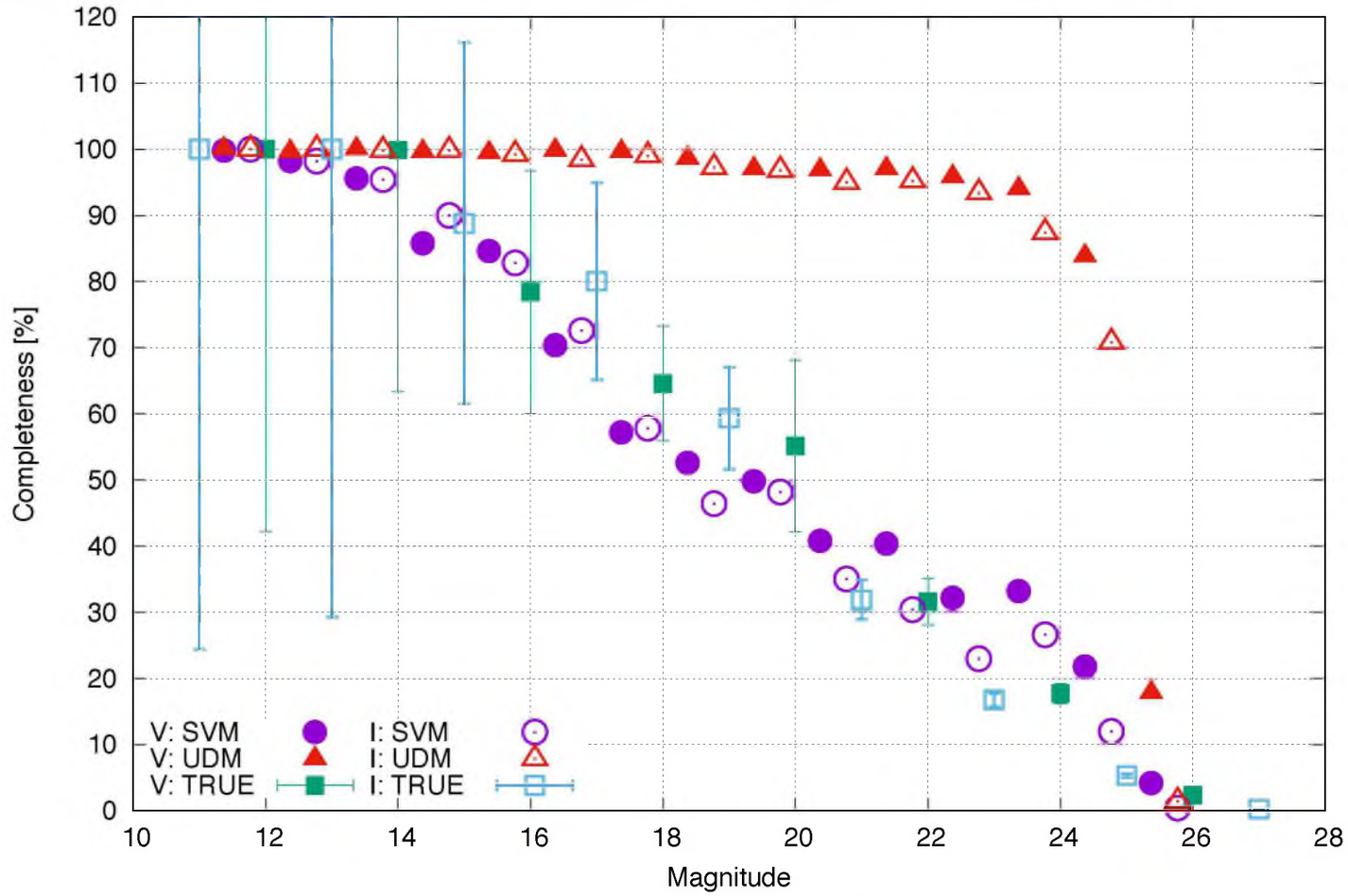
Khorrami et al. 2019

Written in IDL and PYTHON available in: *http://github.com/zkhorrami/MYOSOTIS*

Try MYOSOTIS on Thursday at Demonstrations

Example of completeness-corrected MF





$$M = 10^4 M_\odot$$

$$R_h = 0.5pc$$

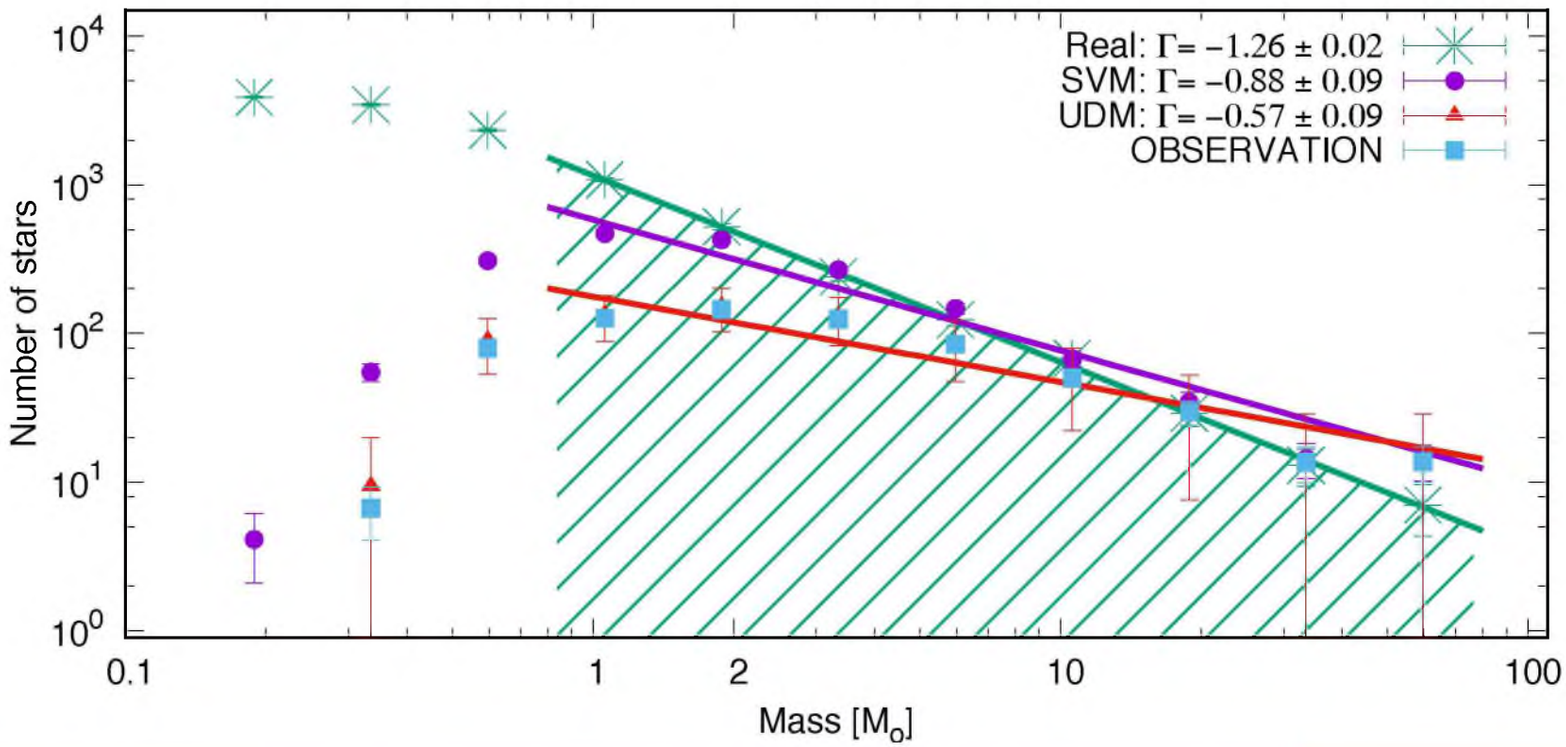
$$Age = 2Myr$$

$$Distance = 50Kpc$$

HST resolution in V- & I-band

No Binaries, No extinction
Very simple case!

Synthetic images produced by MYOSOTIS (Khorrami et al. 2018)



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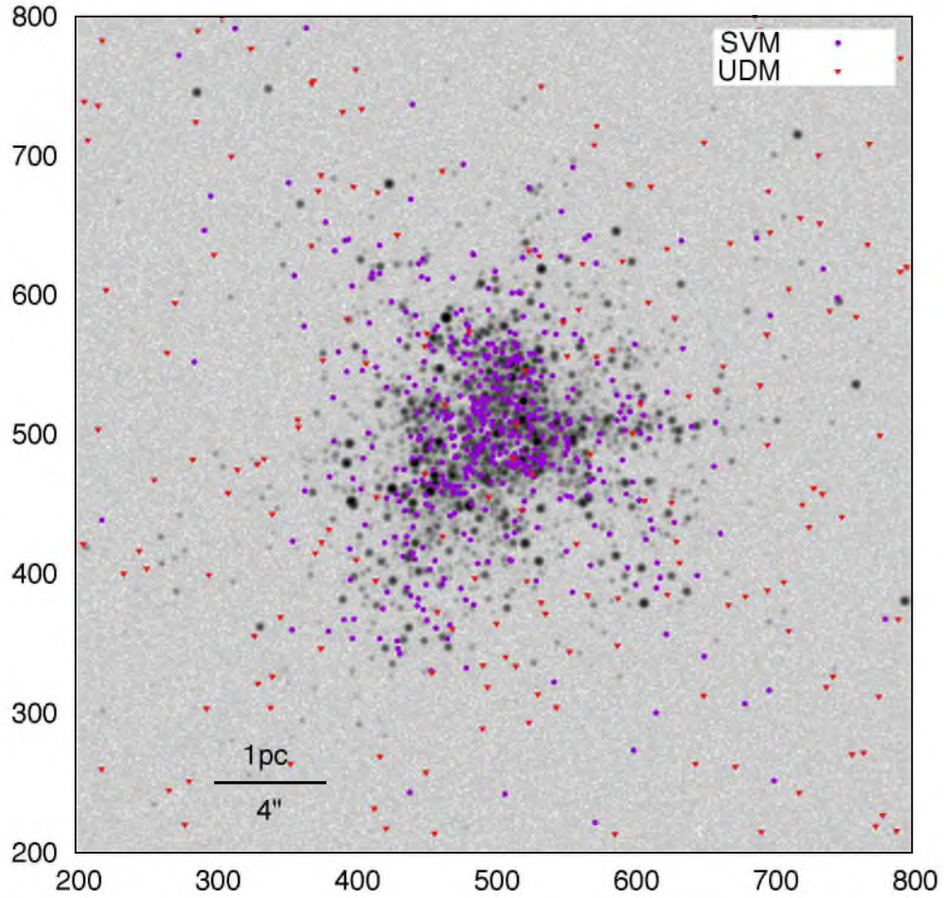

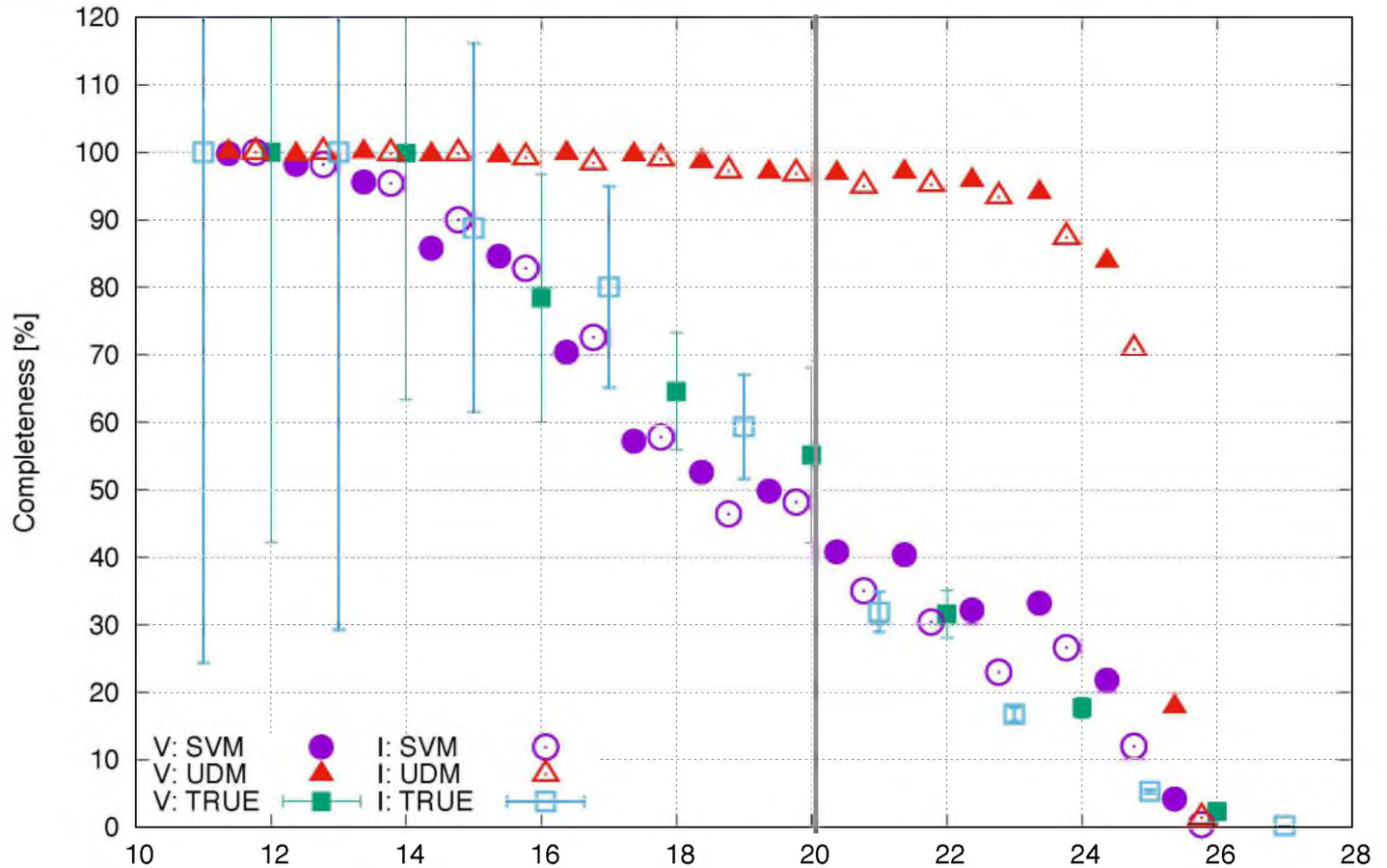

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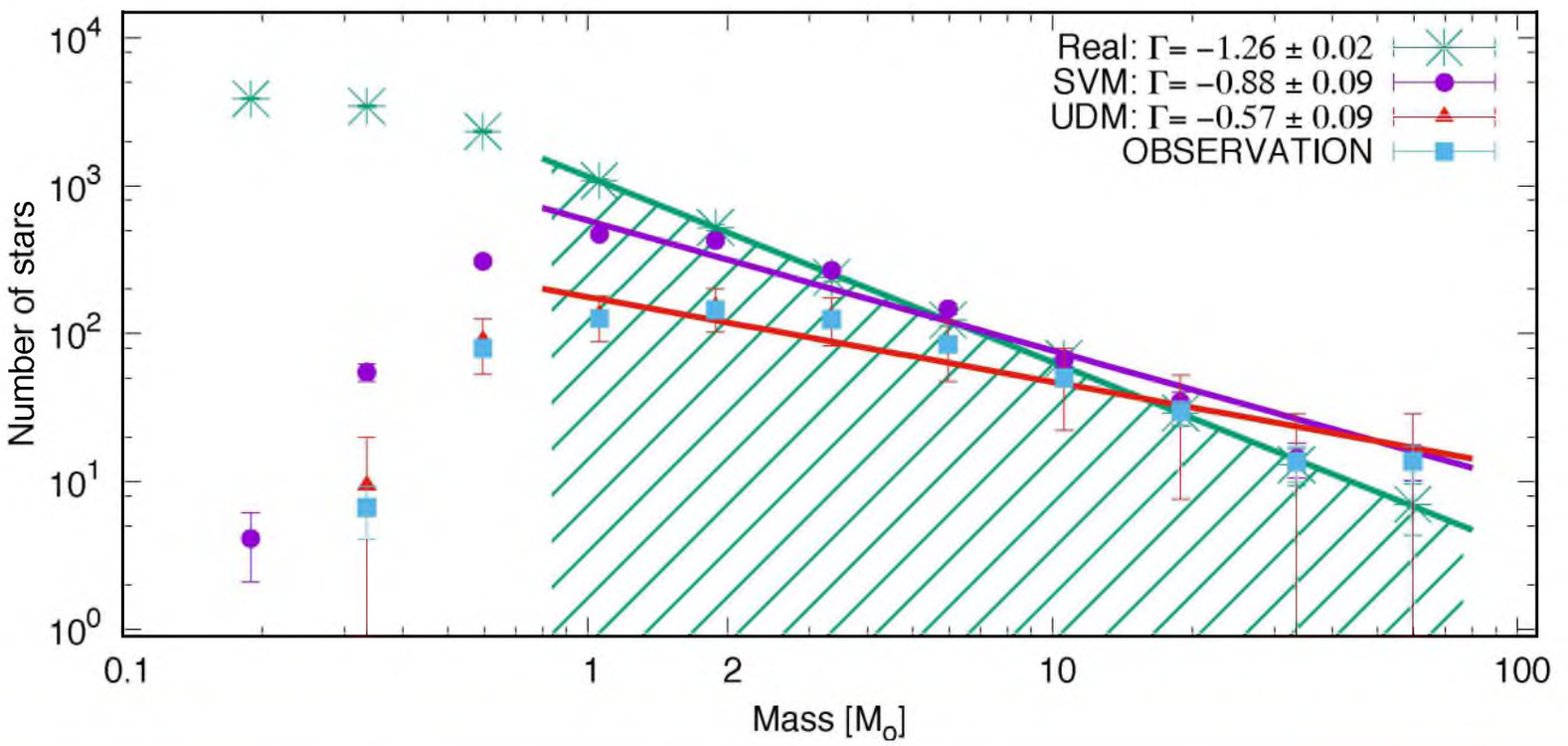

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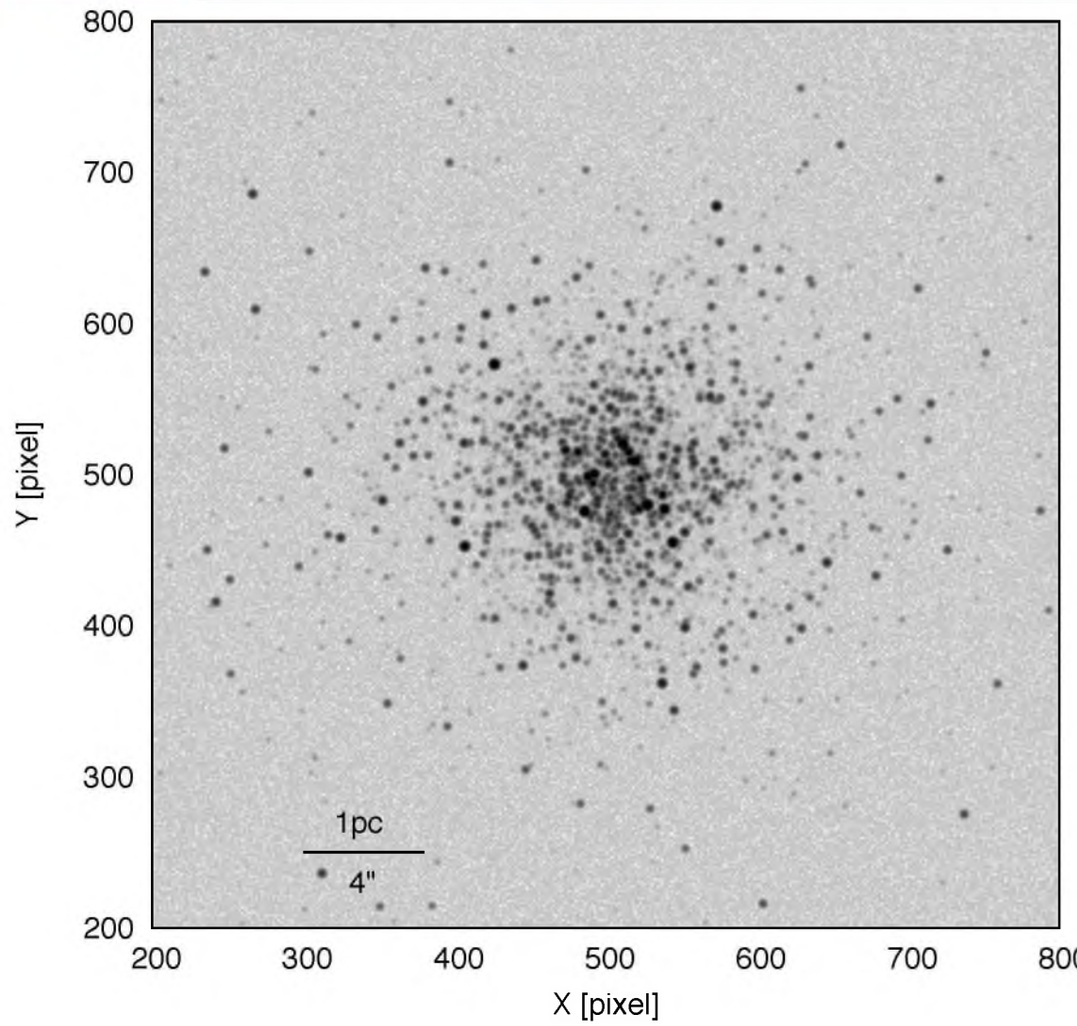

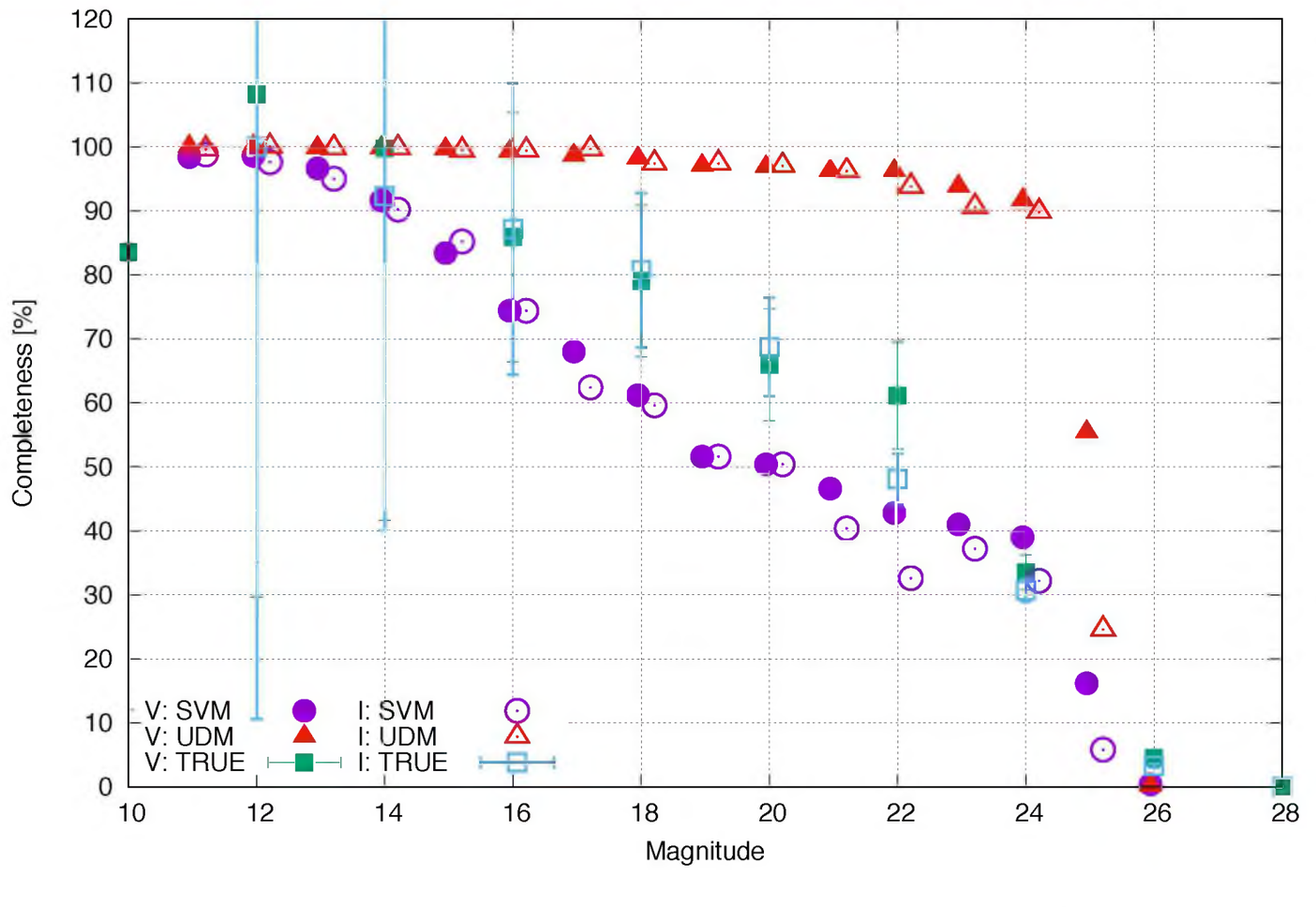

$$M = 8.5 \times 10^3 M_\odot$$

$$R_h = 1.1pc$$

$$Age = 5Myr$$

$$Distance = 50Kpc$$

HST resolution in V- & I-band

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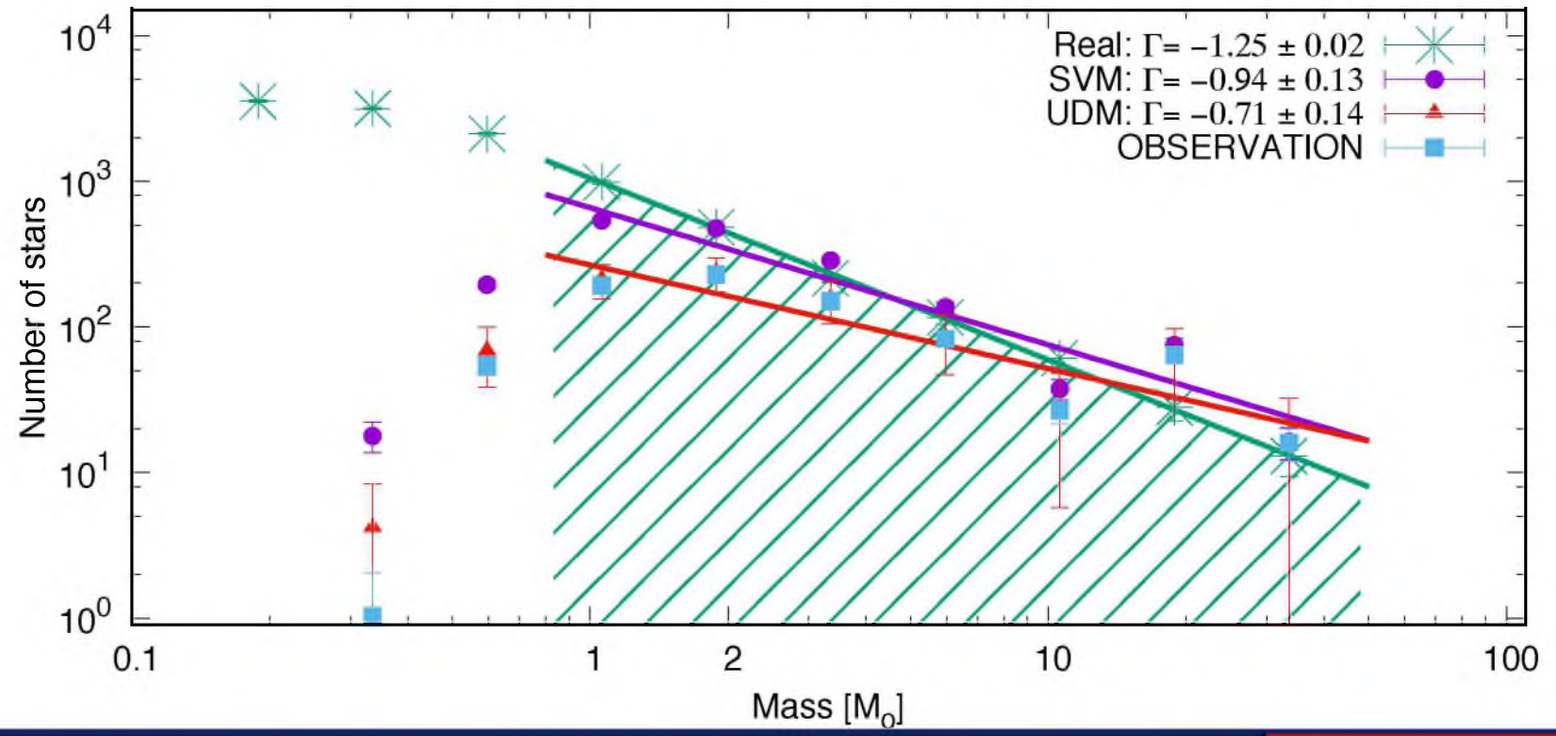
Synthetic images produced by MYOSOTIS (Khorrami et al. 2018)



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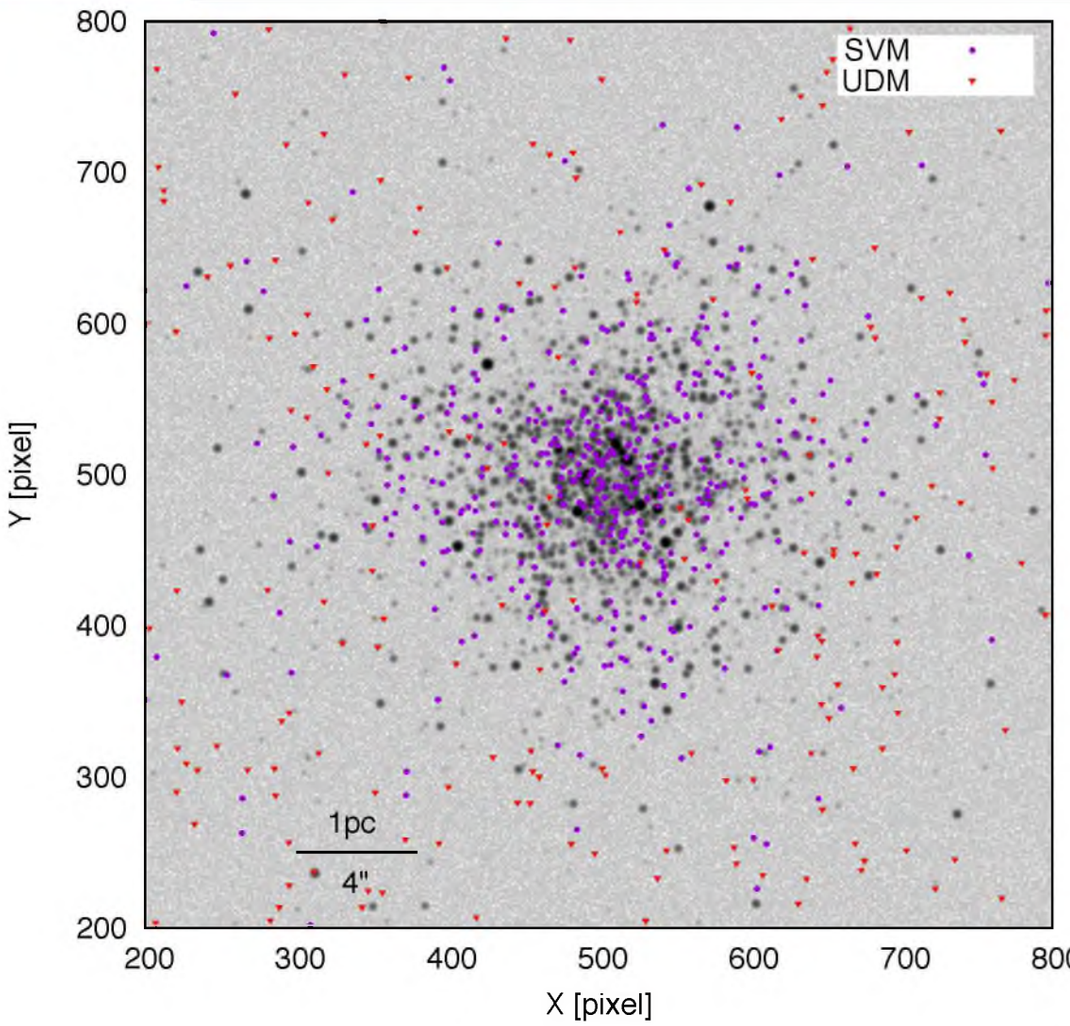

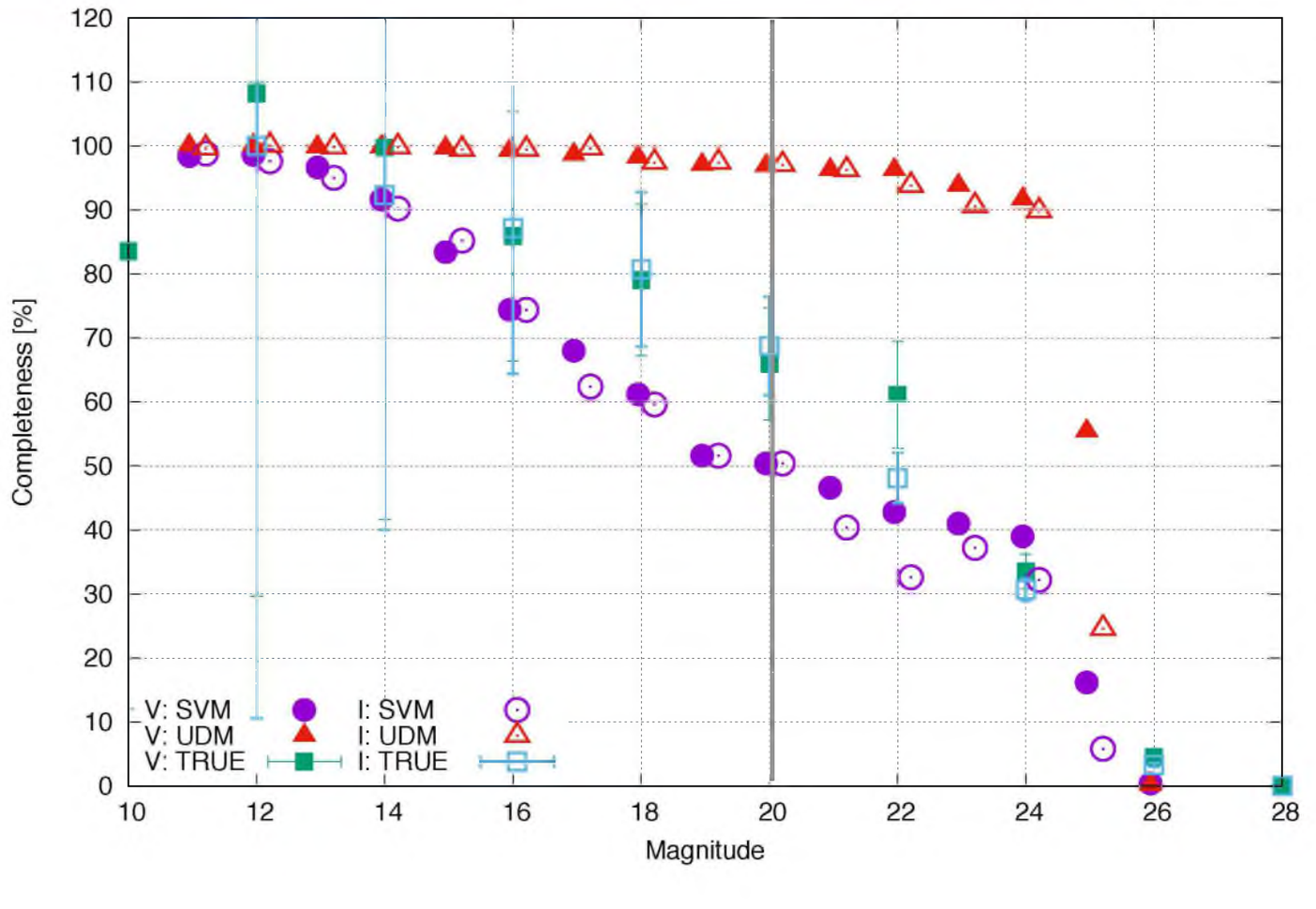

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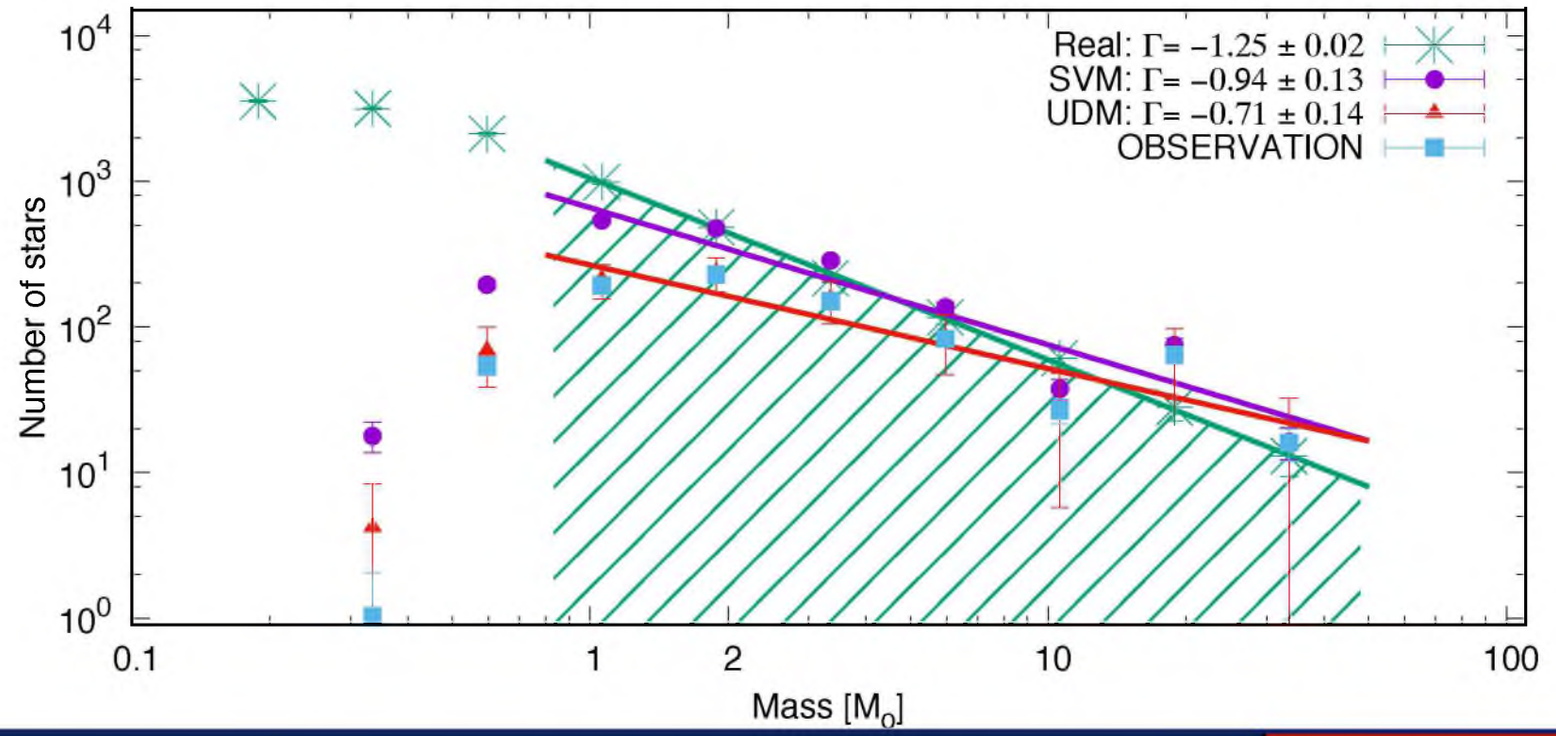


Take home message!

- **Observations**: MF should be corrected for completeness

  Completeness function is different for different observations!

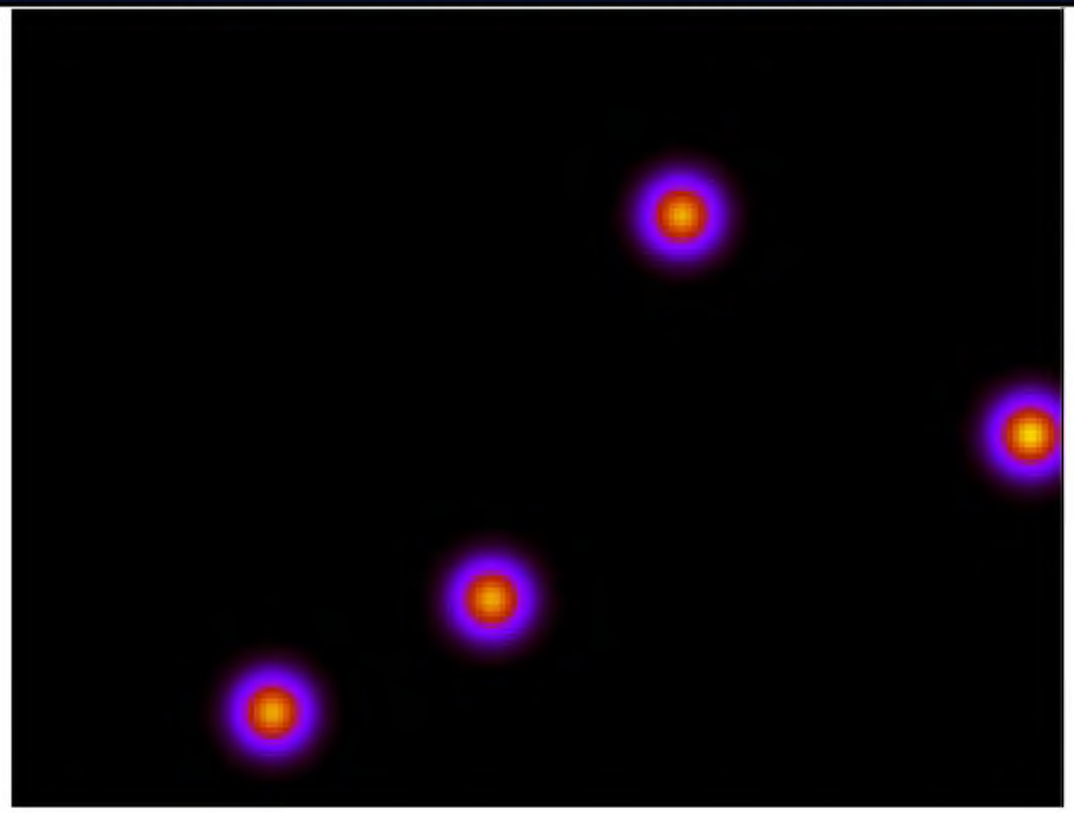
- **Simulations**: NOT to be compared directly with the observation

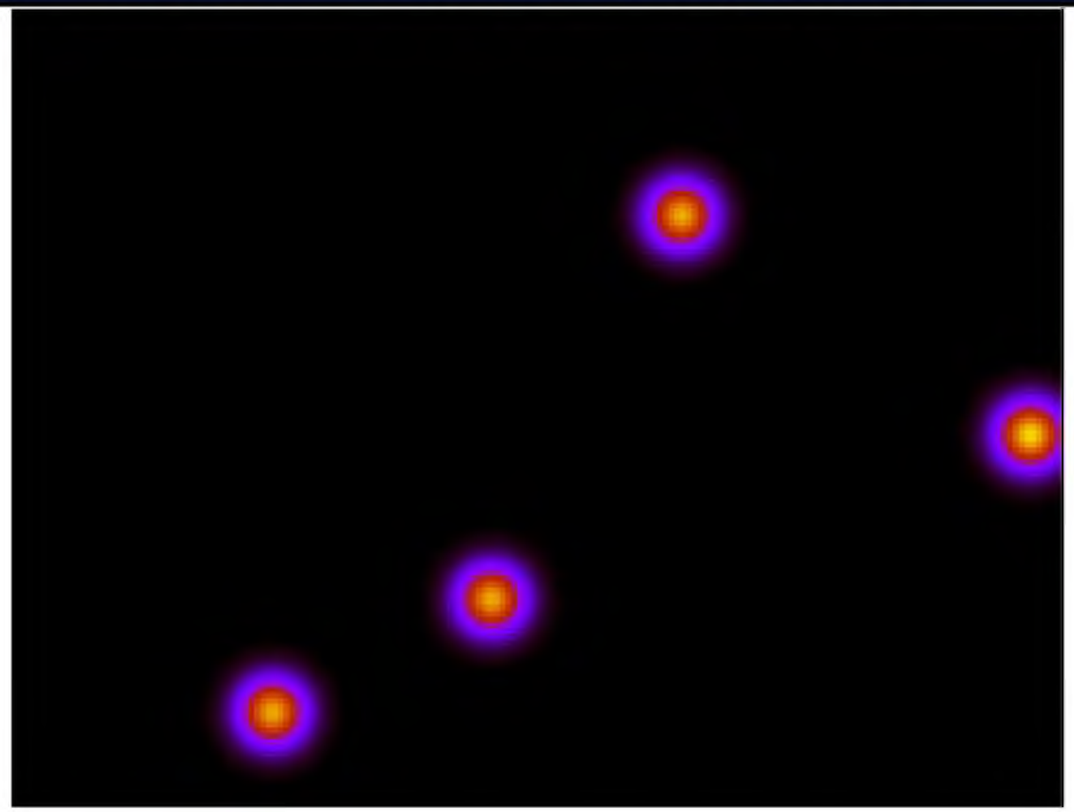
  Make synthetic observations first!

Spatially Varying Model: *https://github.com/zkhorrami/SpatiallyVaryingModel.git*

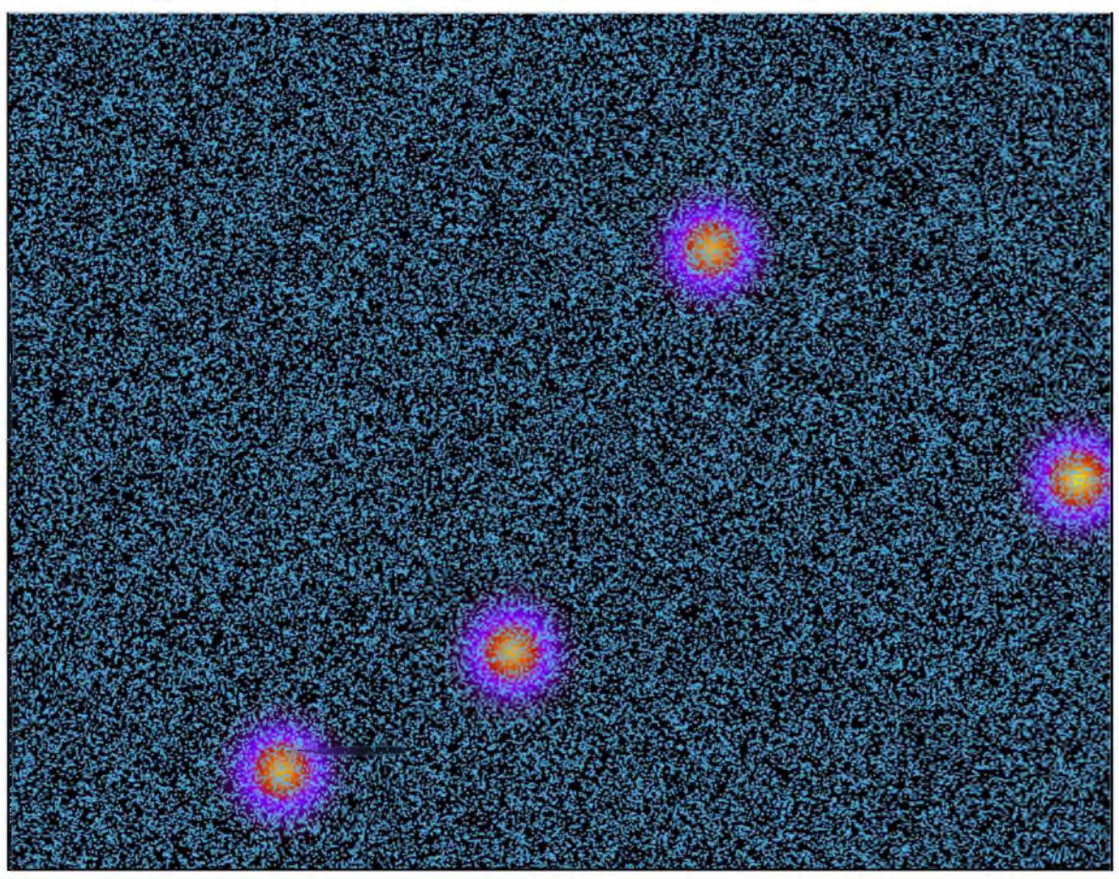
MYOSOTIS: *http://github.com/zkhorrami/MYOSOTIS*

Uniform distribution or spatially varying model?





Uniform Distribution Model



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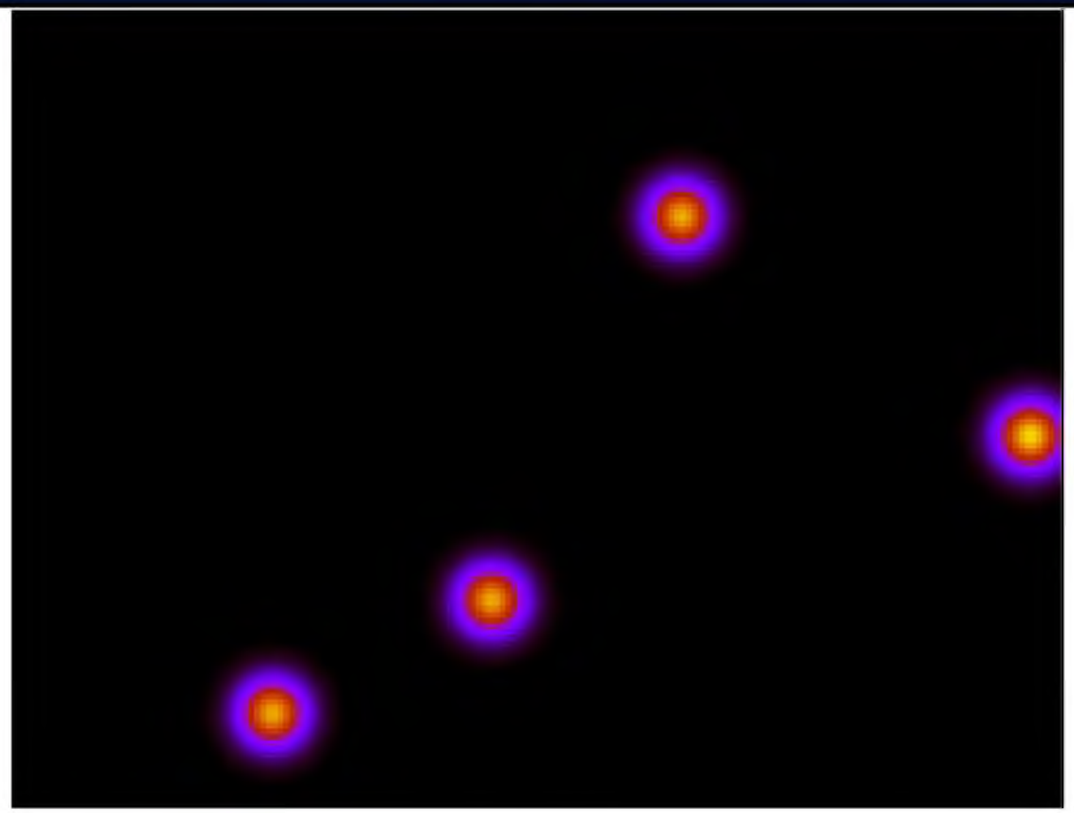

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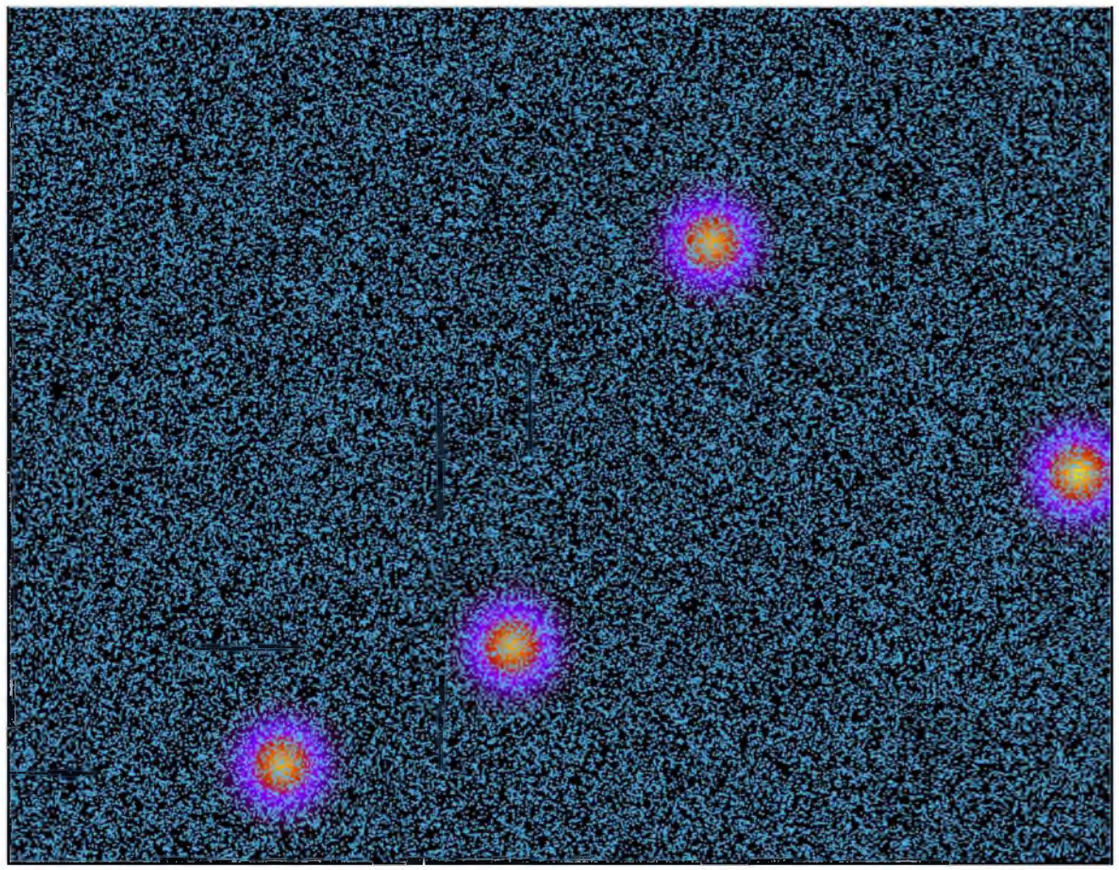

Spatially Varying Model