01 October 2024

SHARP(ening the) view of unresolved globular clusters in the local universe.

Marco Mirabile

INAF-OAAb, ESO & GSSI

Collaborators:

Michele Cantiello, Marina Rejkuba, Steffen Mieske, Enrichetta Iodice, Michael Hilker, Magda Arnaboldi, Chiara Buttitta, Goran Doll, Maurizio Paolillo, Nandini Hazra, Pratik Lonare, Mariangela Raj, Antonio La Marca, Marilena Spavone, Gabriele Riccio, Rebecca Habas

Credit: Euclid

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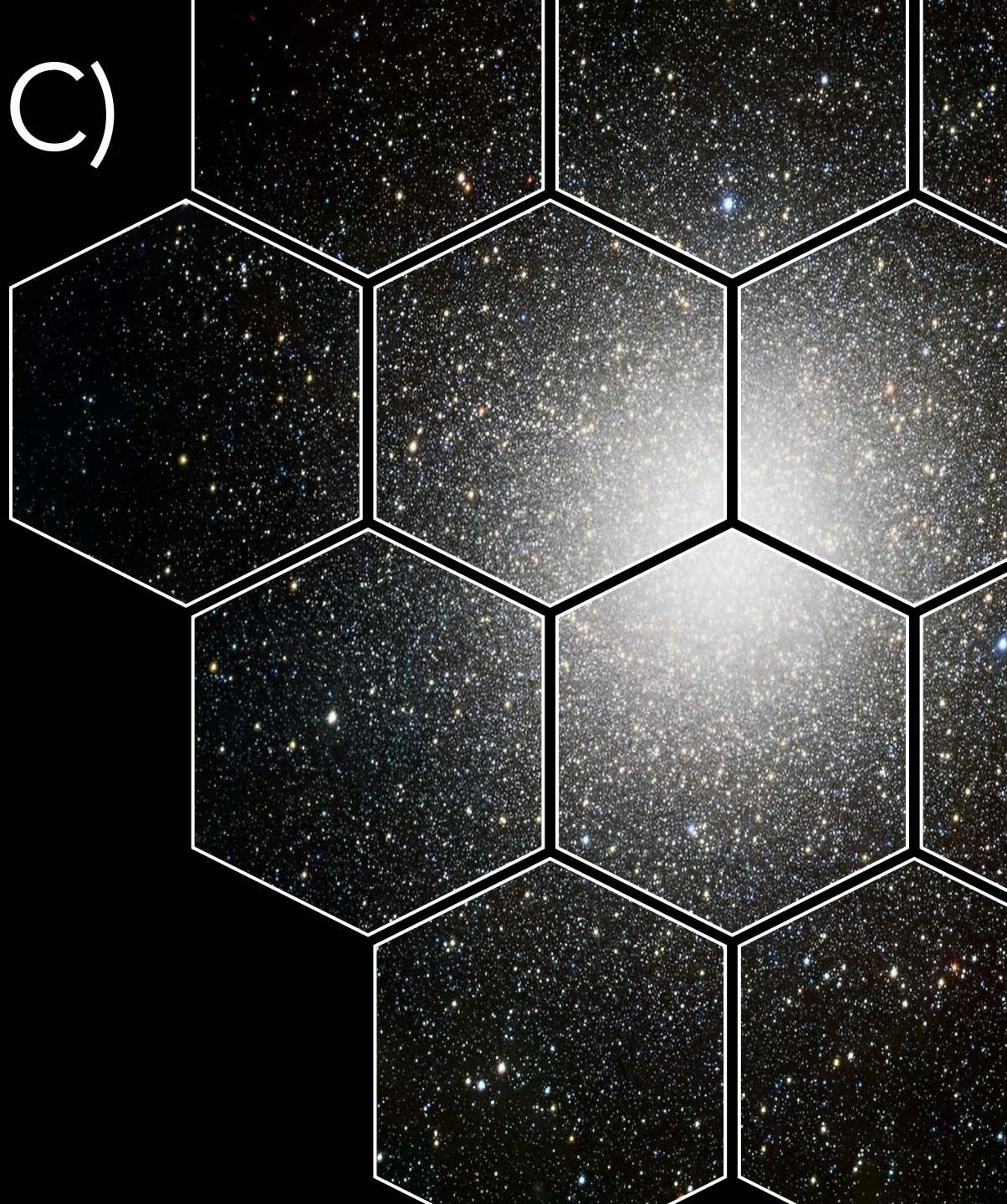
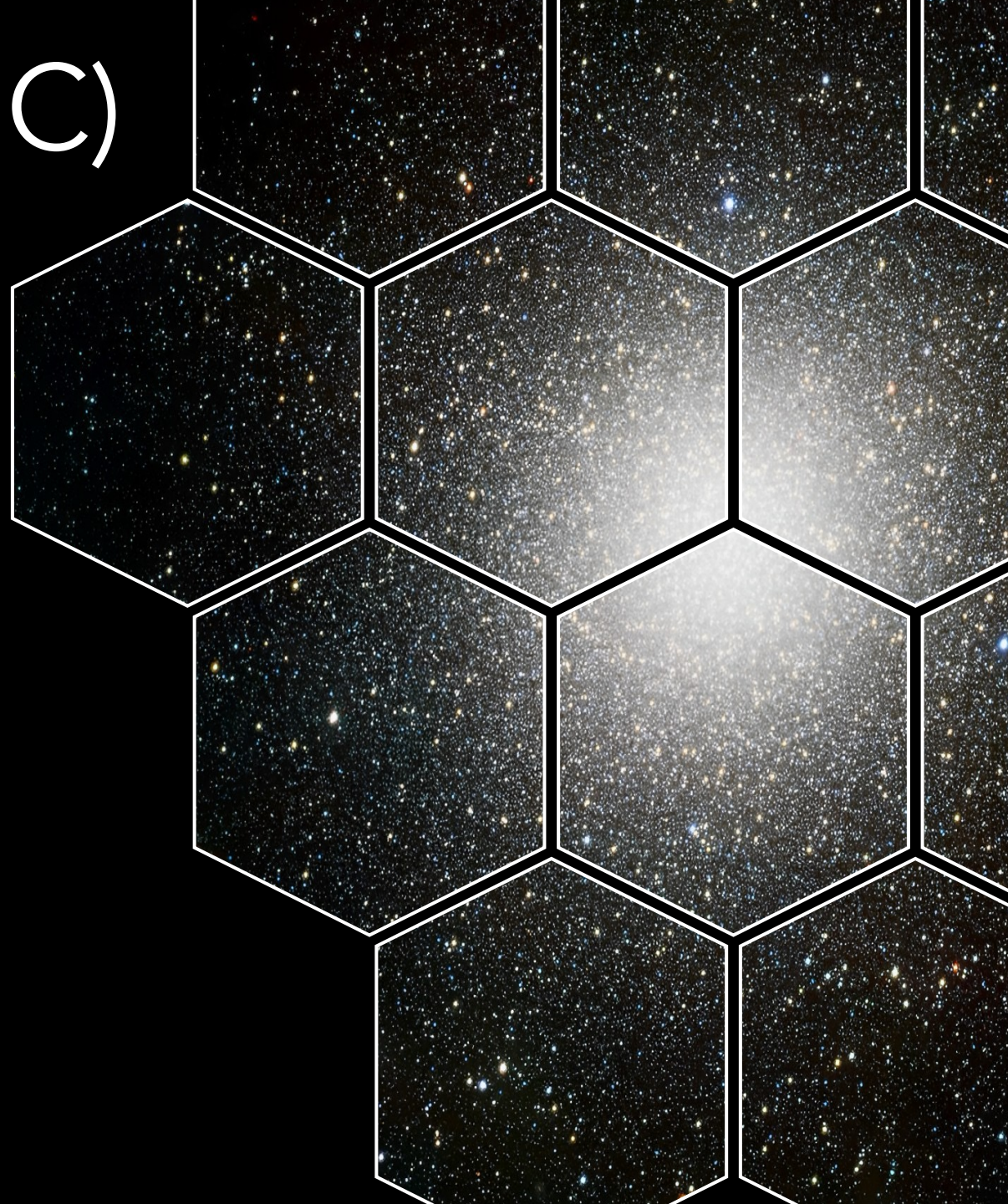
Globular Cluster (GC)



Globular Cluster (GC)

Dense system of old stars (10^4-10^6)



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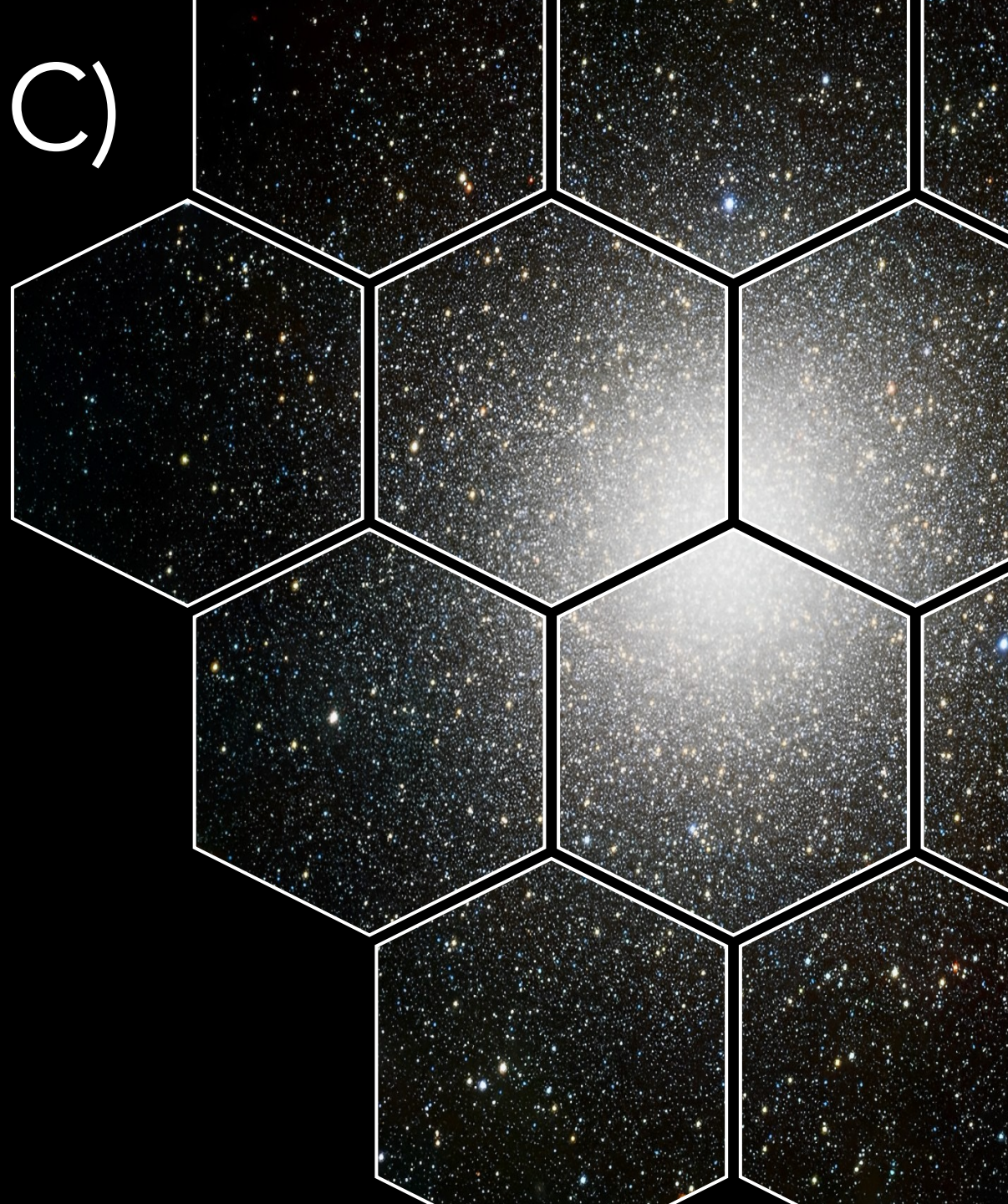
Born at the same time



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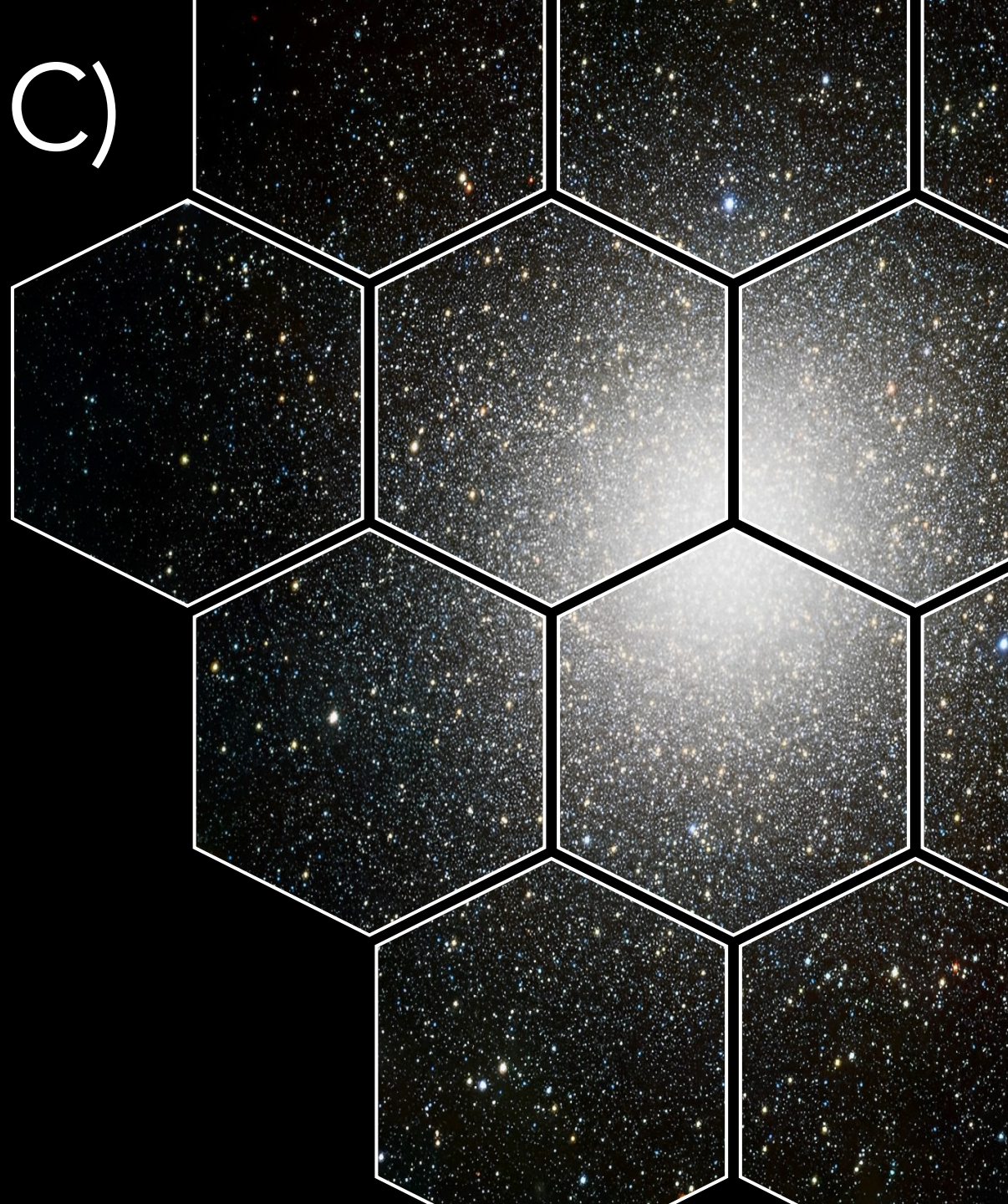

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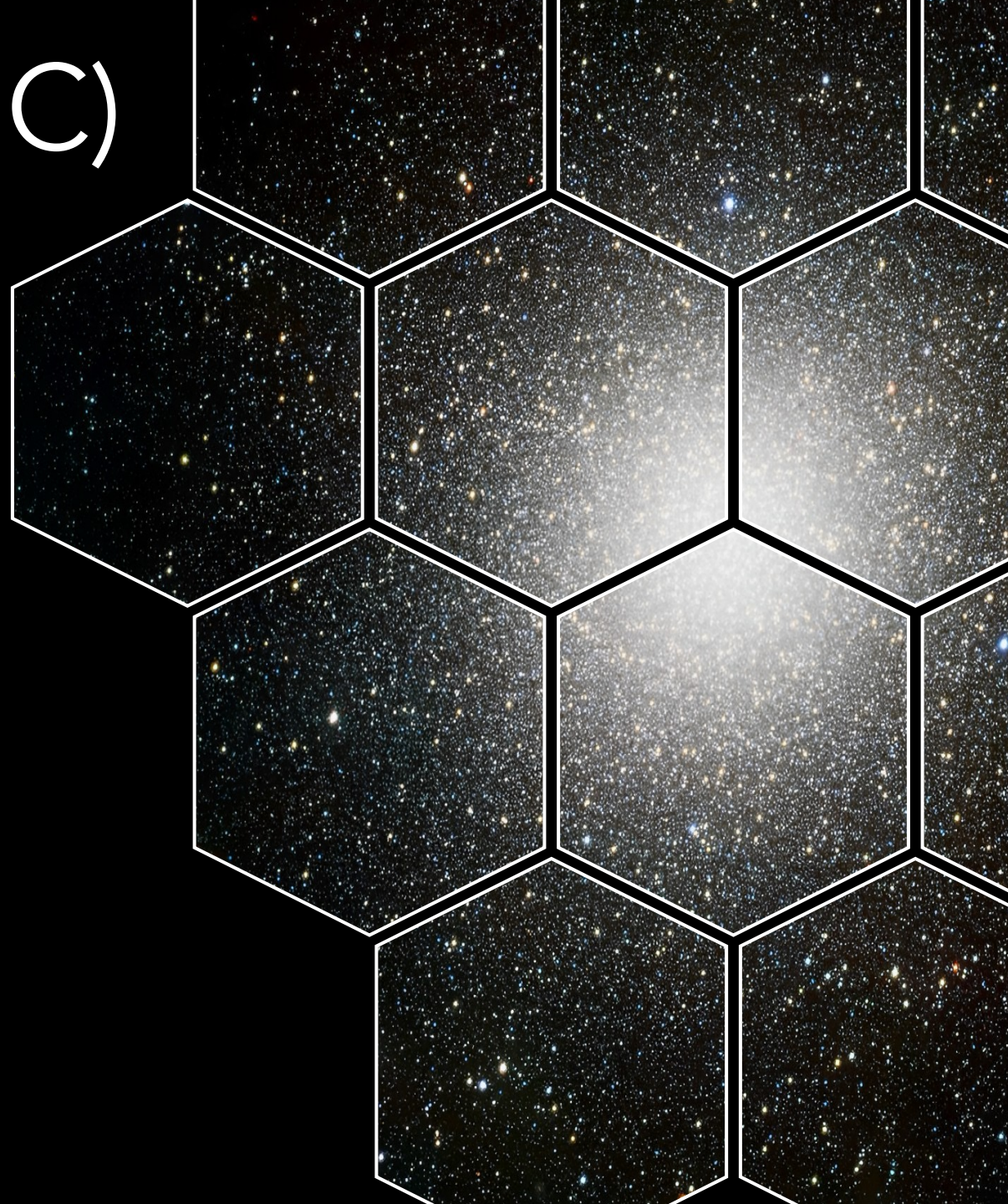

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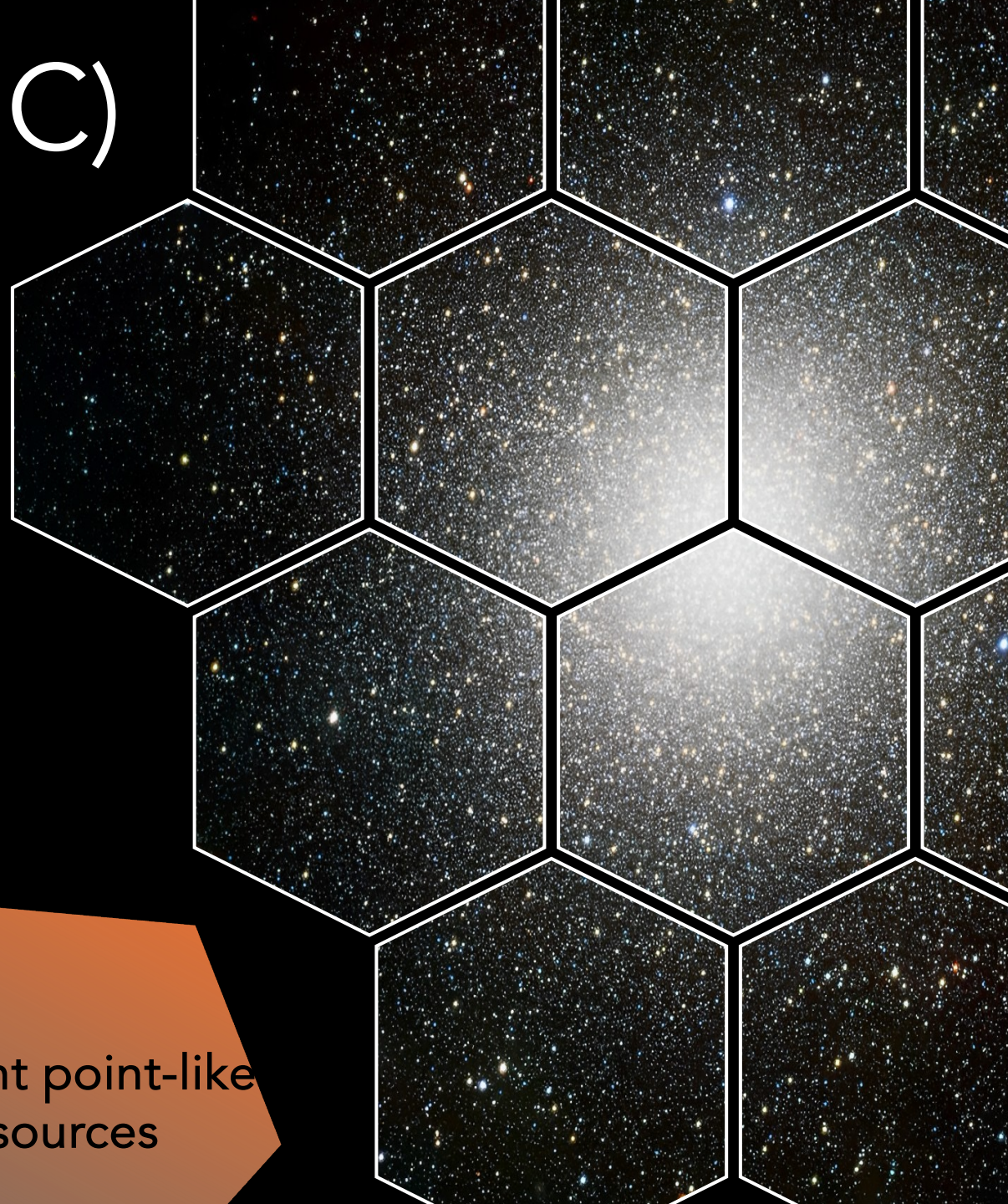
Bright point-like sources



Extragalactic GC (EGC) properties: Why to study them?

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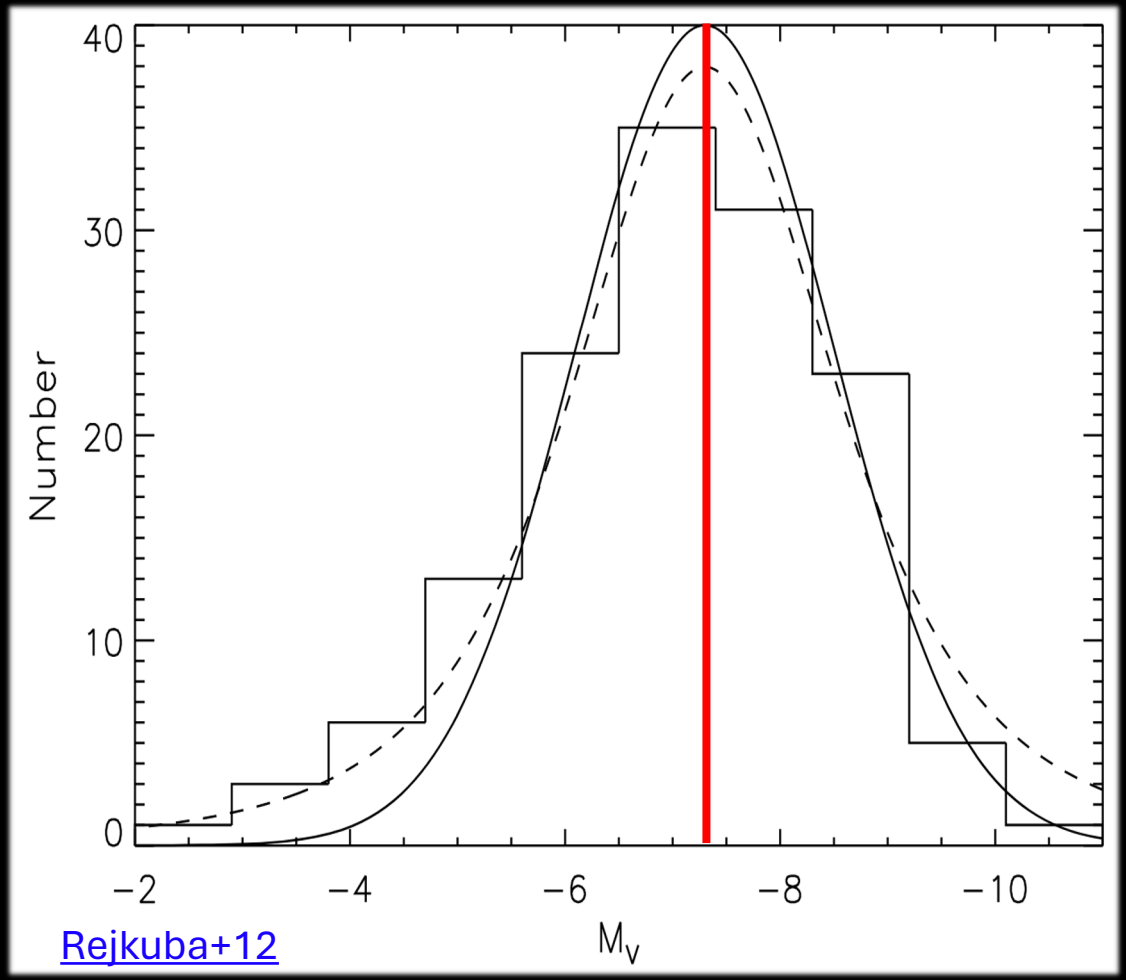

$M_V^{TOM} \sim -7.5\ mag$

Extragalactic GC (EGC) properties: Why to study them?

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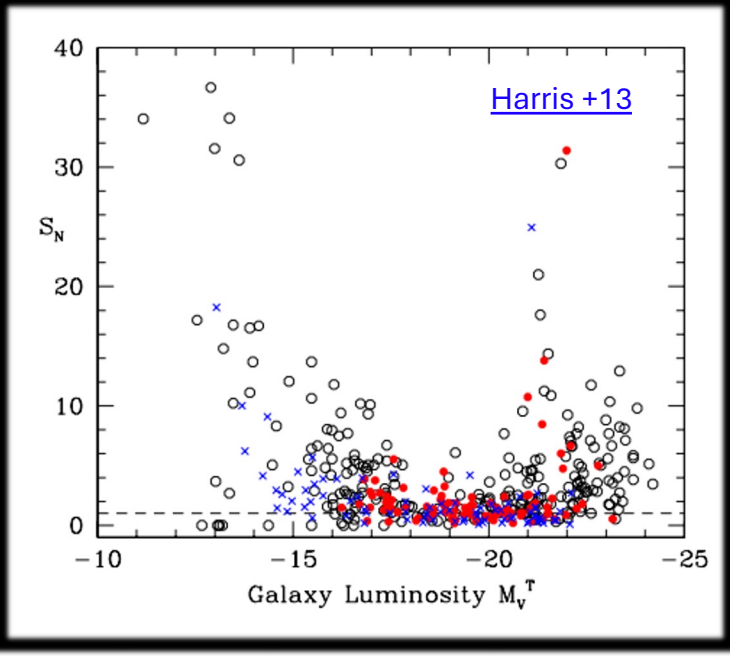

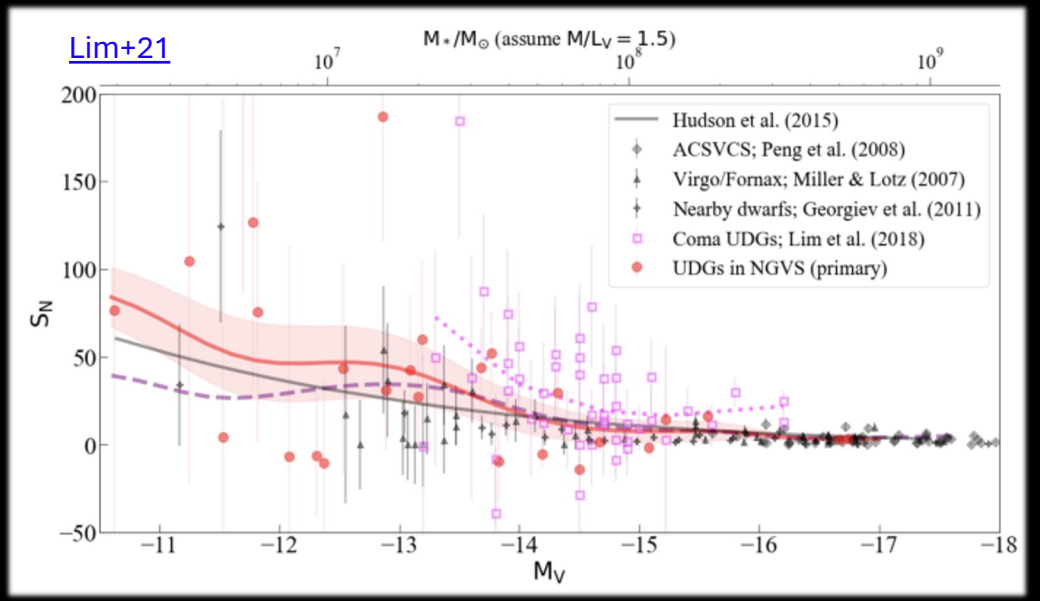

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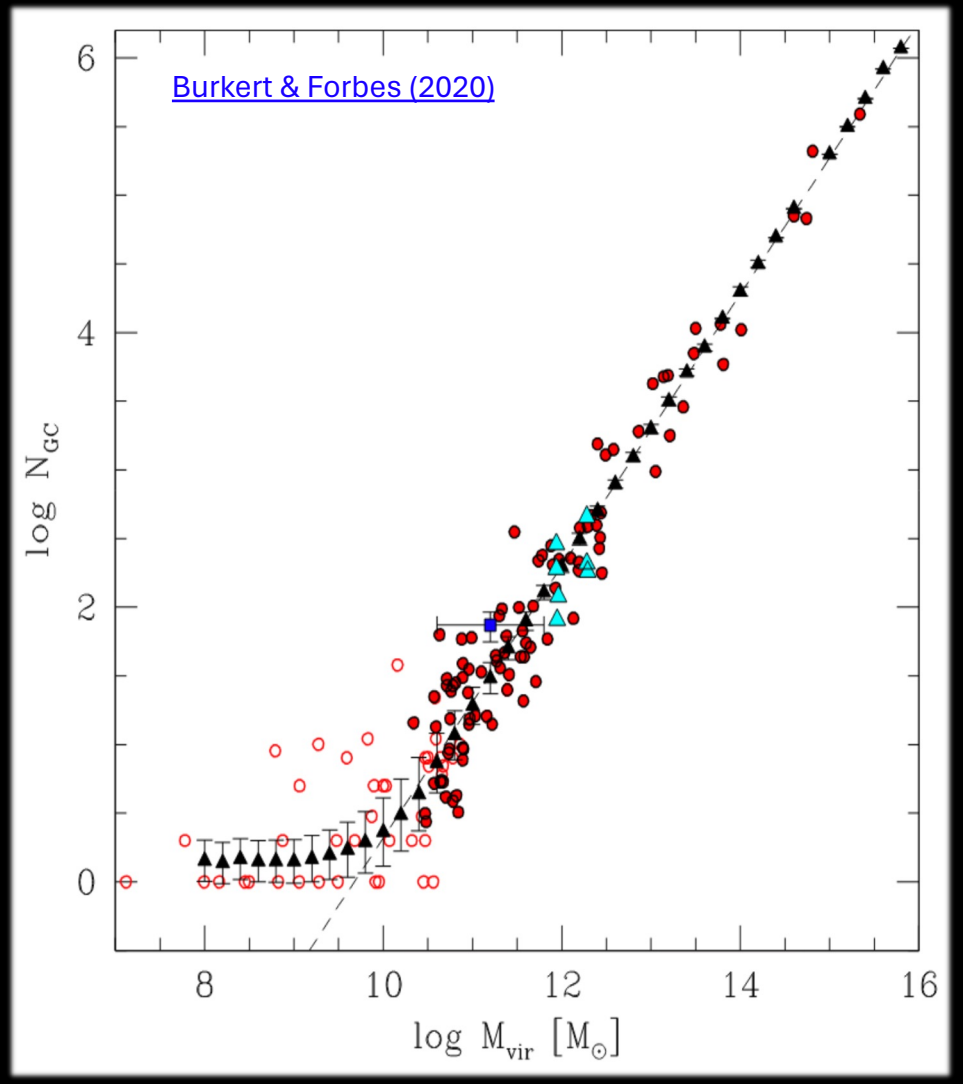

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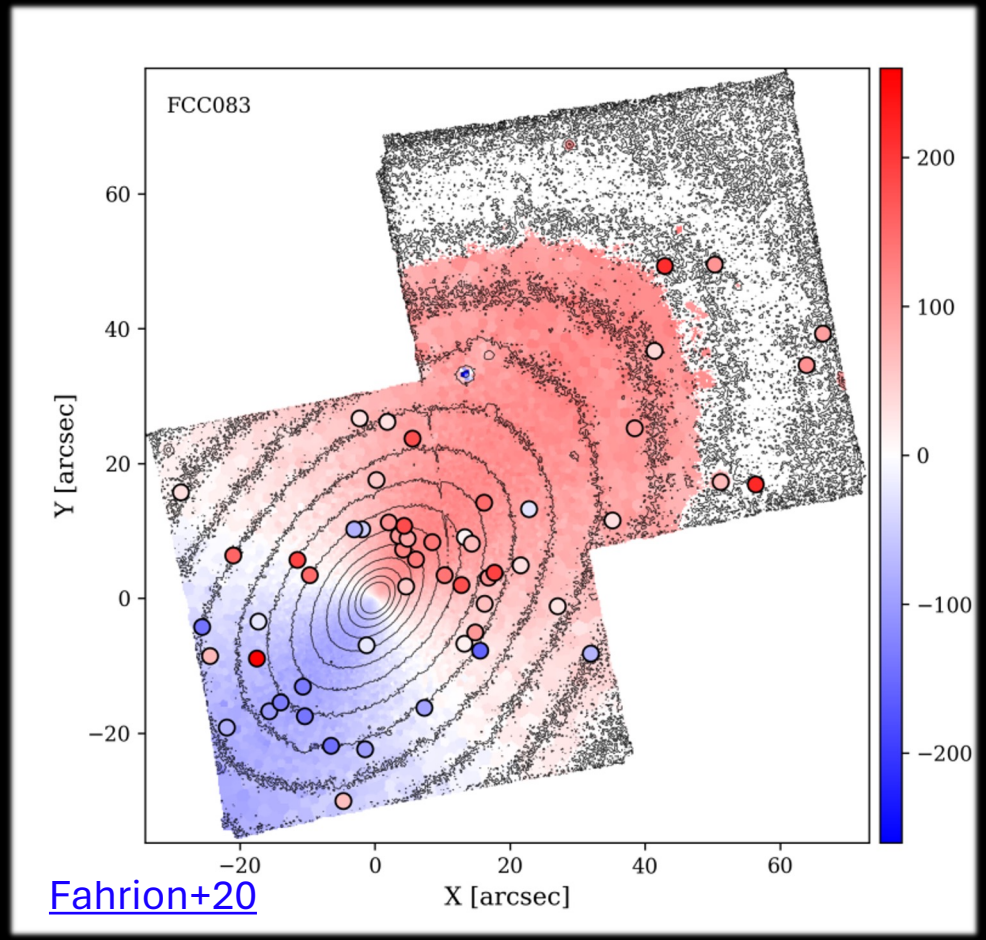

Fahrion+20

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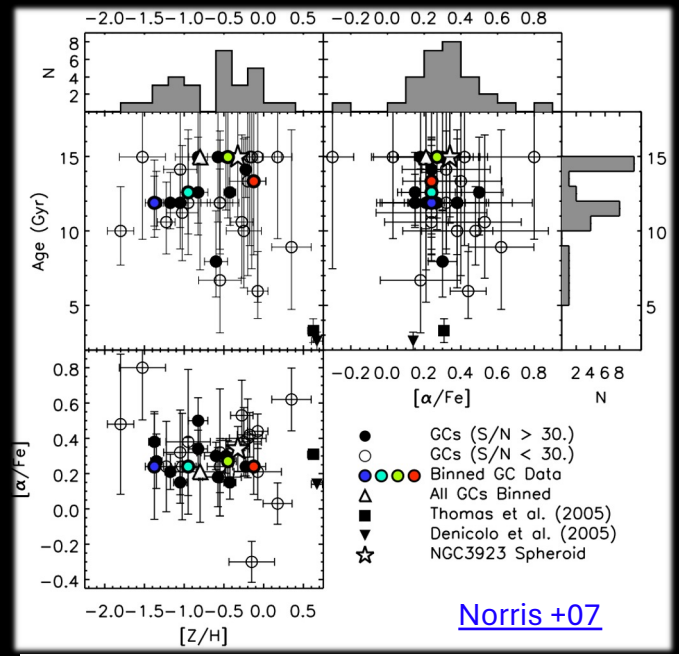
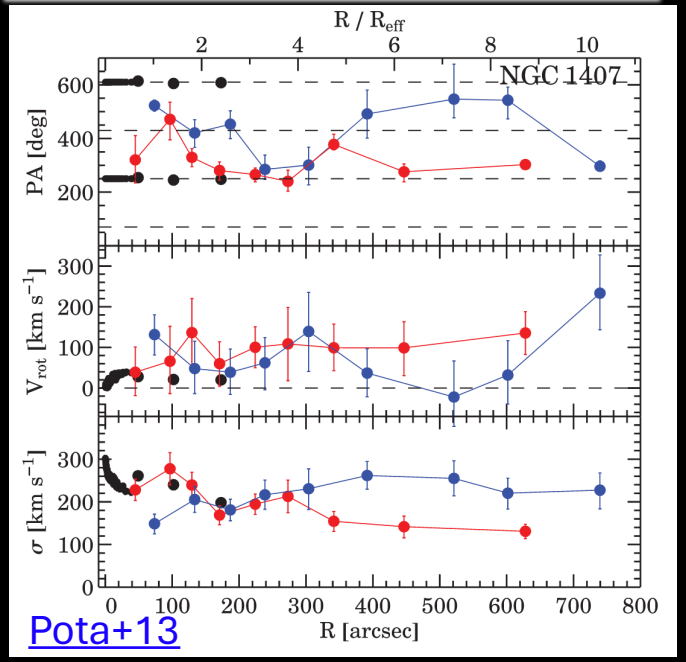
- ✓ Tight (~) relation between galaxy **halo mass** and total **GCs mass**/population
- ✓ GC dispersion velocity→ DM content
- ✓ And more…



Norris +07



Pota+13

How extragalactic EGC look like?

M87
Virgo

Longobardi et al. 2015

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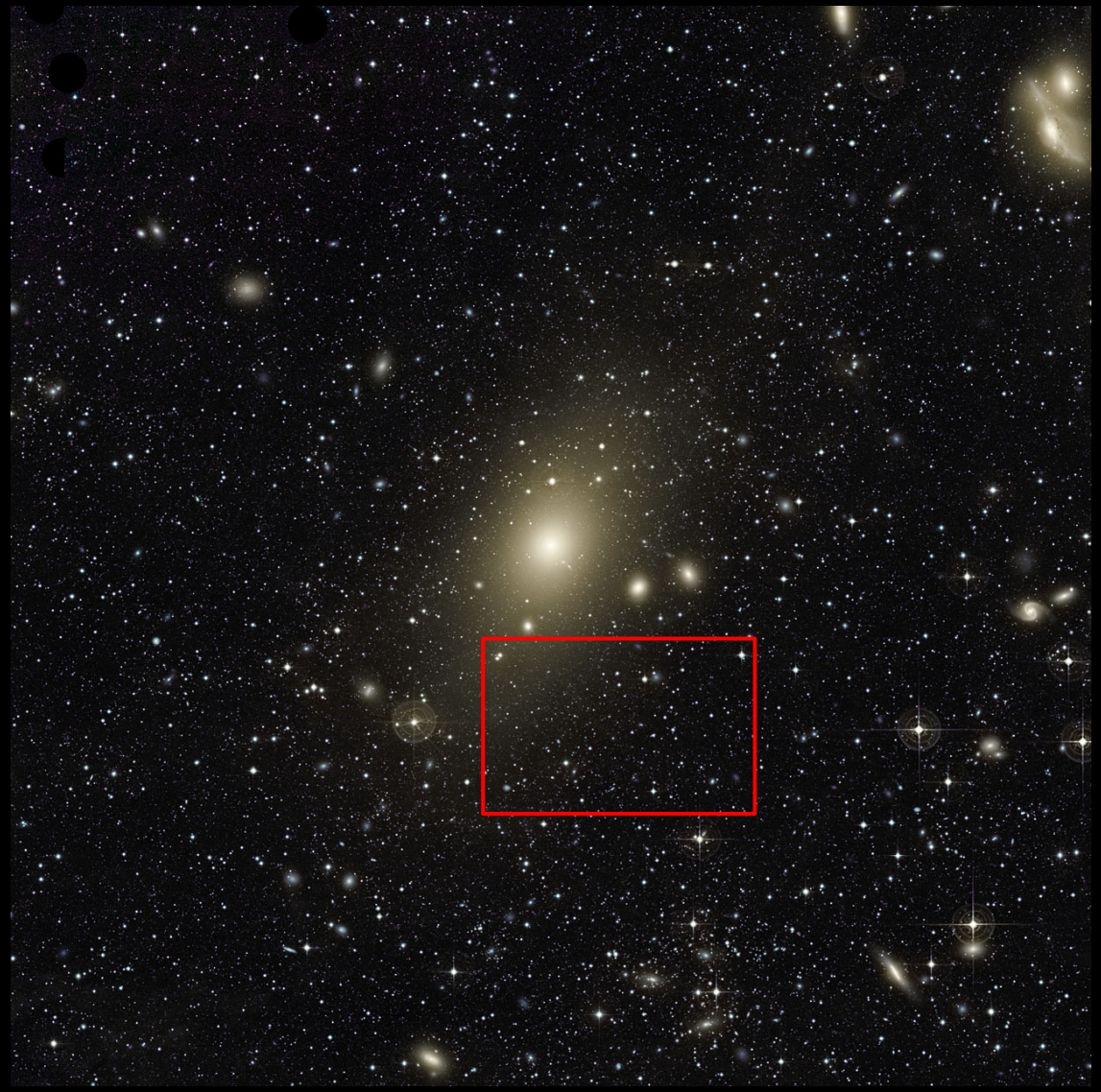

Longobardi et al. 2015

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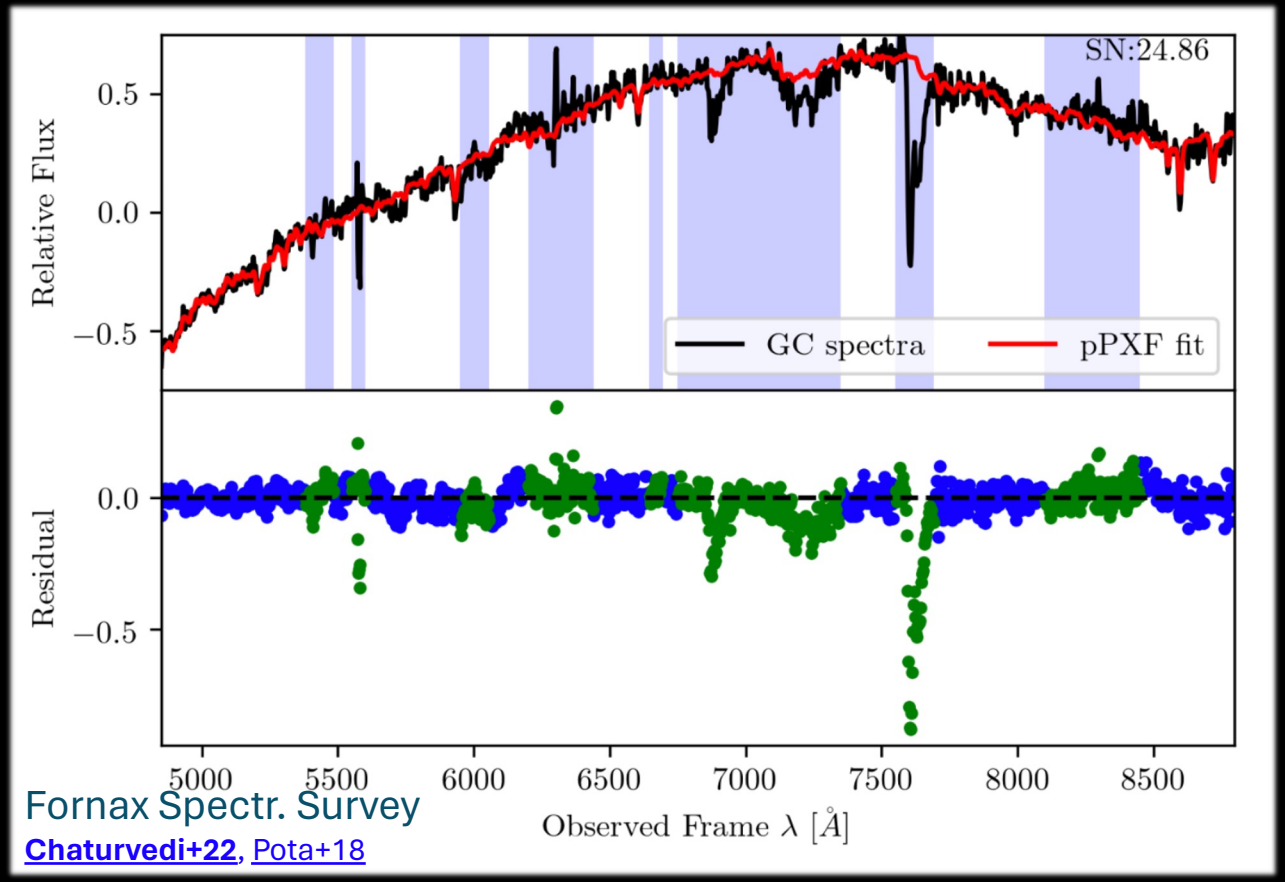
Back- & fore-ground contaminants!

Longobardi et al. 2015

EGCs Identification

Ideal datasets for low/contamination-free samples

Spectroscopy



Fornax Spectr. Survey

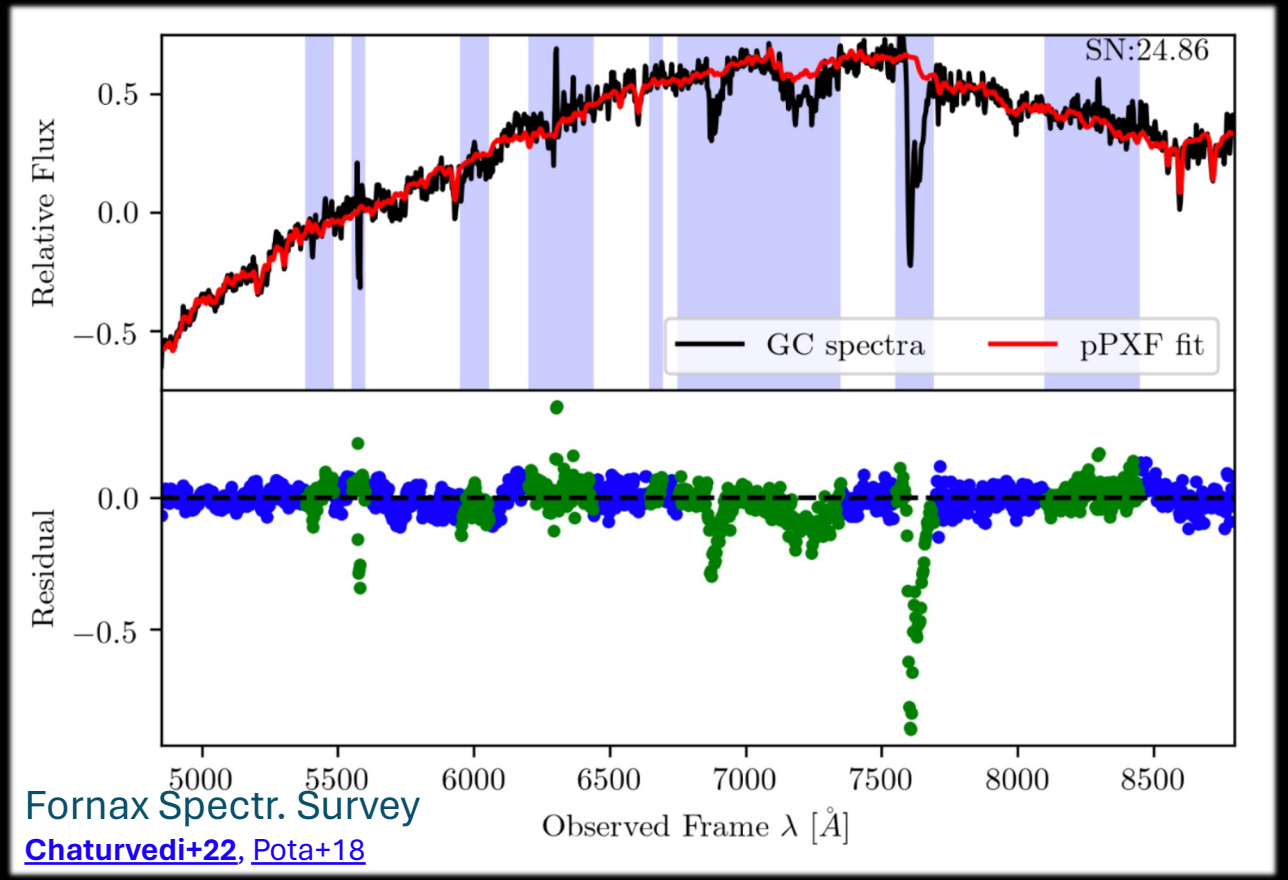
Chaturvedi+22, Pota+18

EGCs Identification

Ideal datasets for low/contamination-free samples

Spectroscopy

✓ Very time consuming in telescope time



Fornax Spectr. Survey

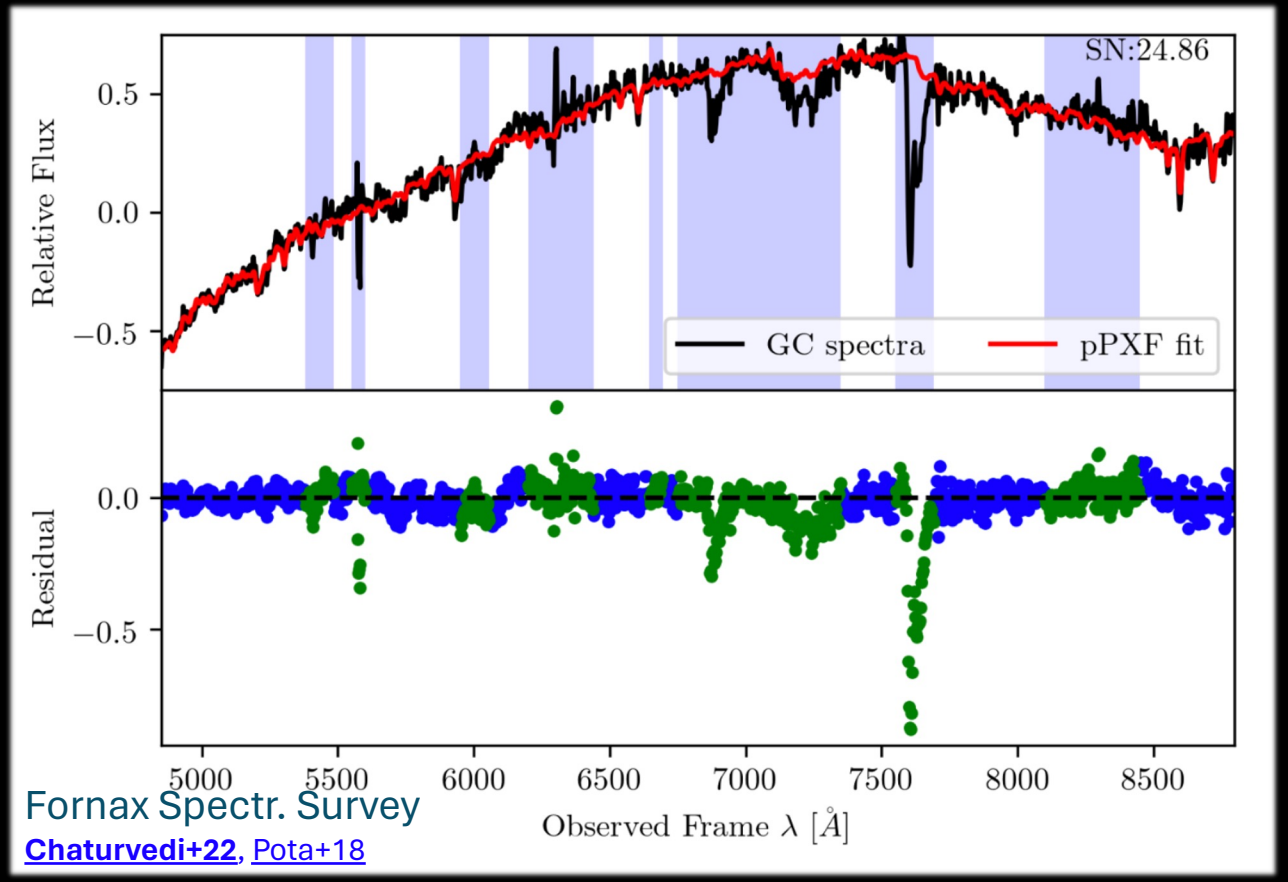
Chaturvedi+22, Pota+18

EGCs Identification

Ideal datasets for low/contamination-free samples

Spectroscopy

- ✓ Very time consuming in telescope time
- ✓ Limited to bright objects



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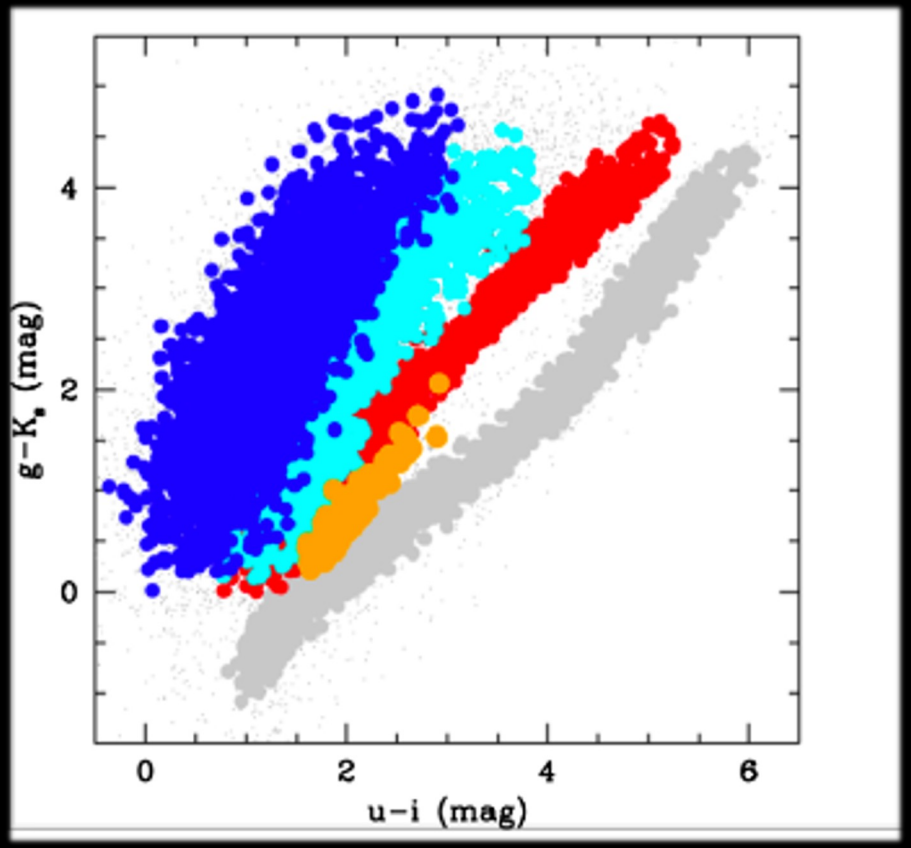
EGCs Identification

Photometric data



Obj. type

- EGCs
- SF Galaxies (z~1)
- SF Galaxies (z<1)
- Passive Galaxies
- Stars

Cantiello+18

Looking into the faintEst WIth MUSE (LEWIS)

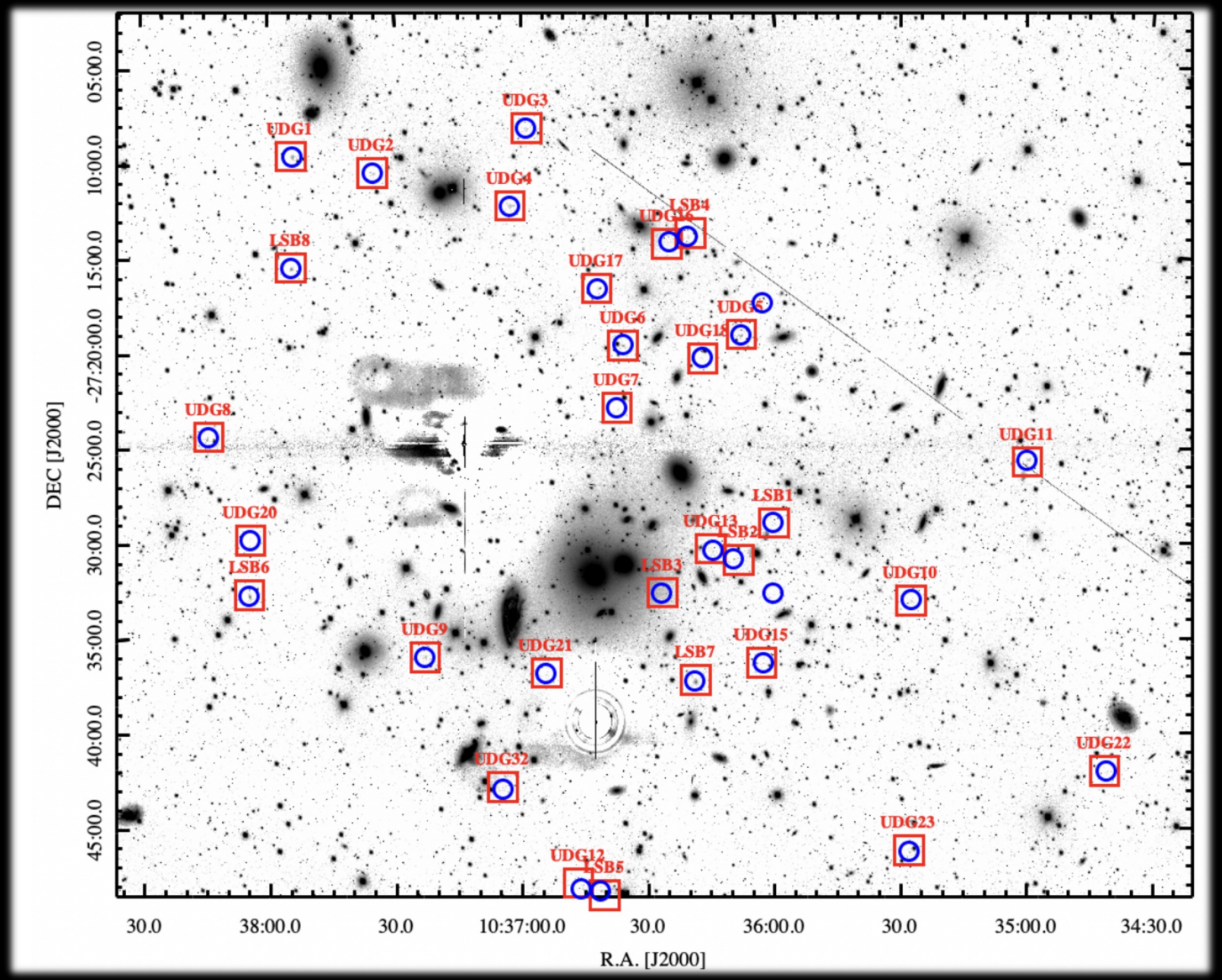
- ESO LP (P.I. E. Iodice) @ MUSE
- 133.5 hrs over 2021-2023

The first homogeneous integral-field spectroscopic survey of UDGs

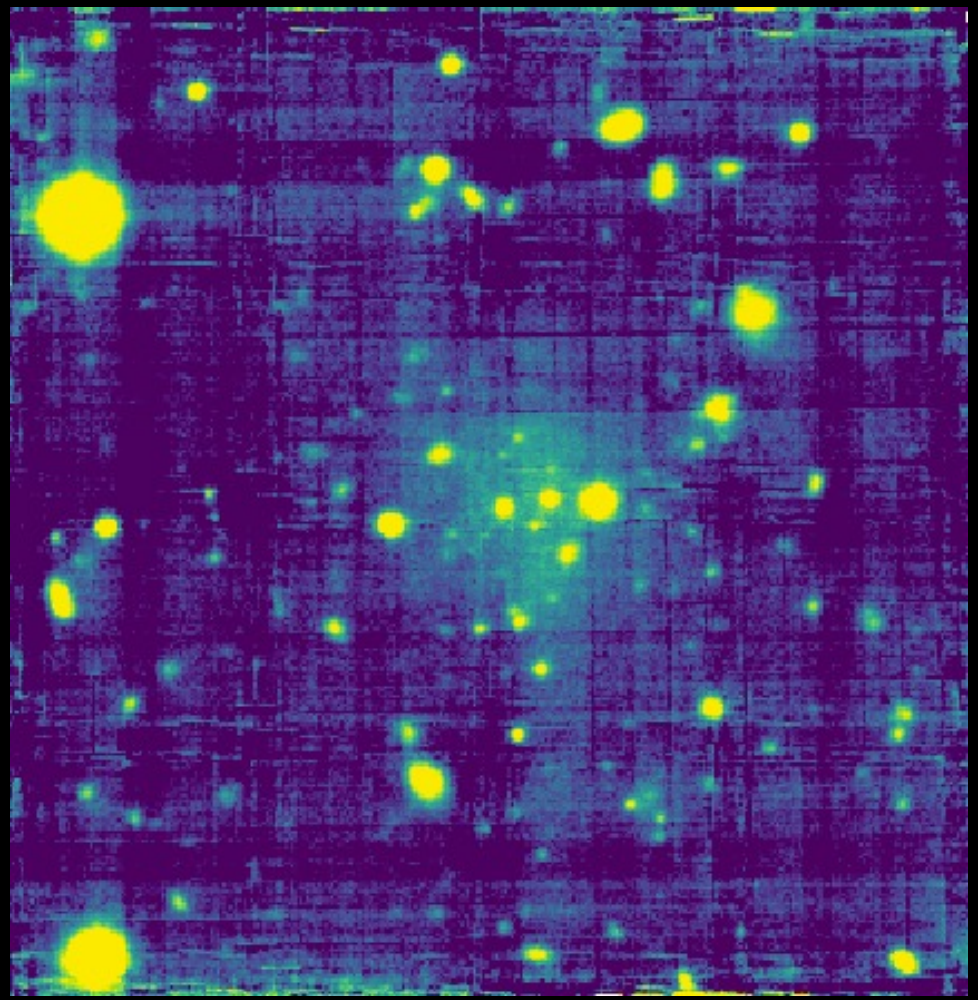
LEWIS

Hydra I

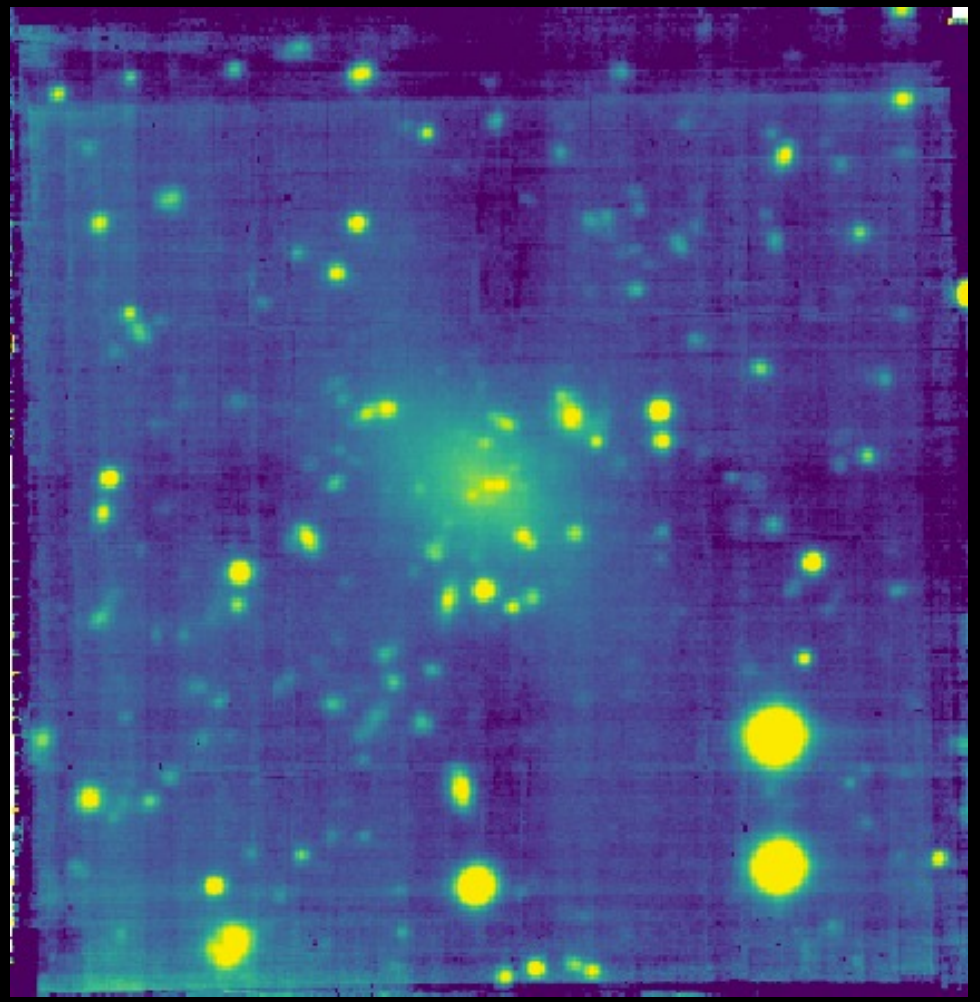
~50 Mpc



LEWIS Science cases: UDG3 & UDG11

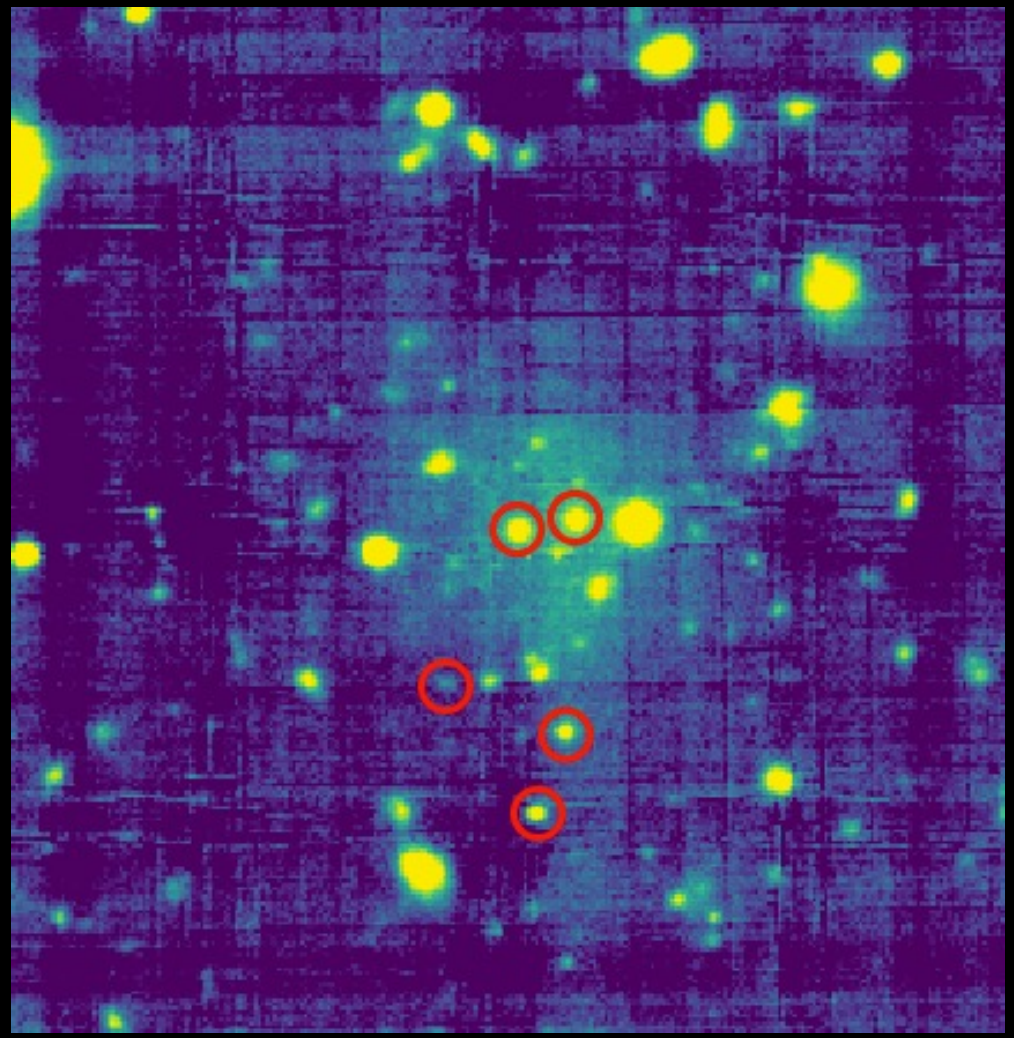


UDG3



UDG11

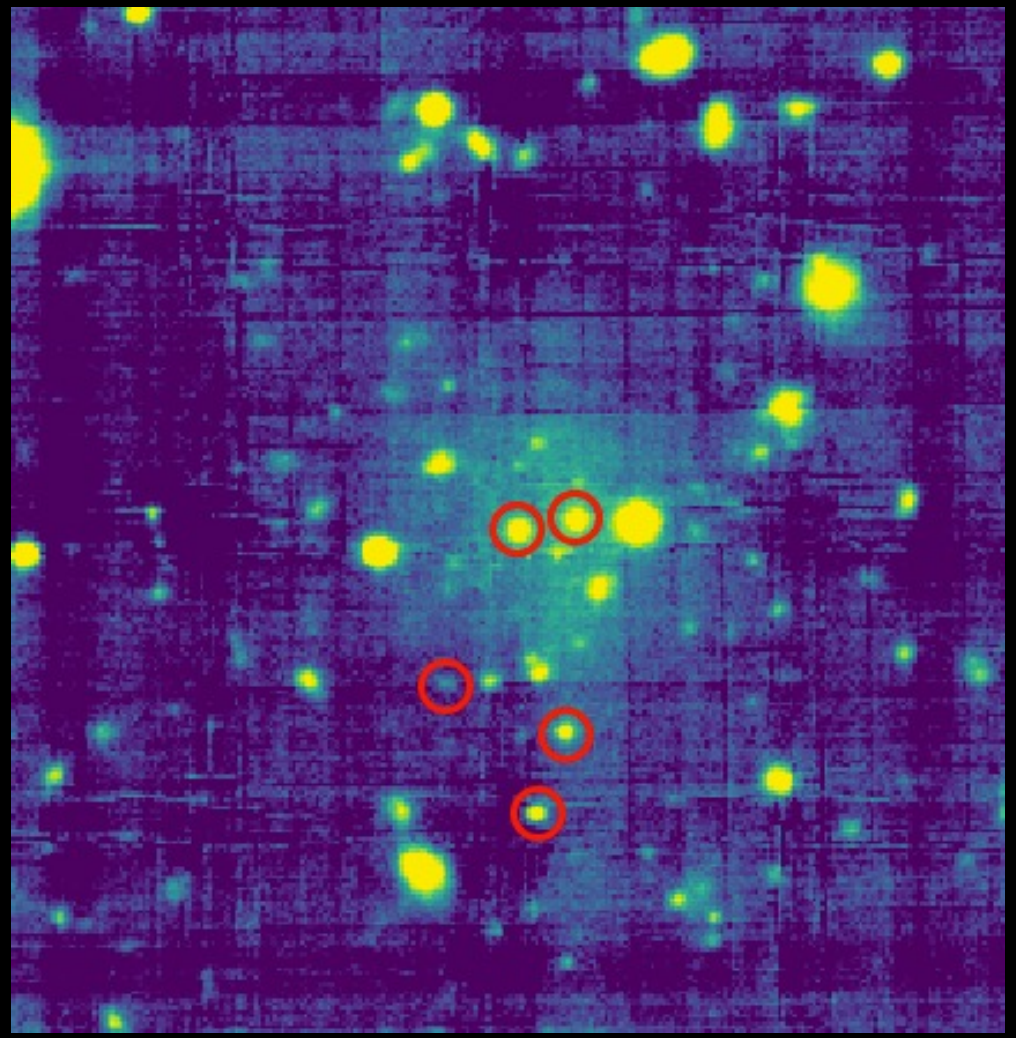
UDG3



Red circles are GCs from VEGAS (Iodice et al. 2020)

Mirabile et al. (in prep)

UDG3



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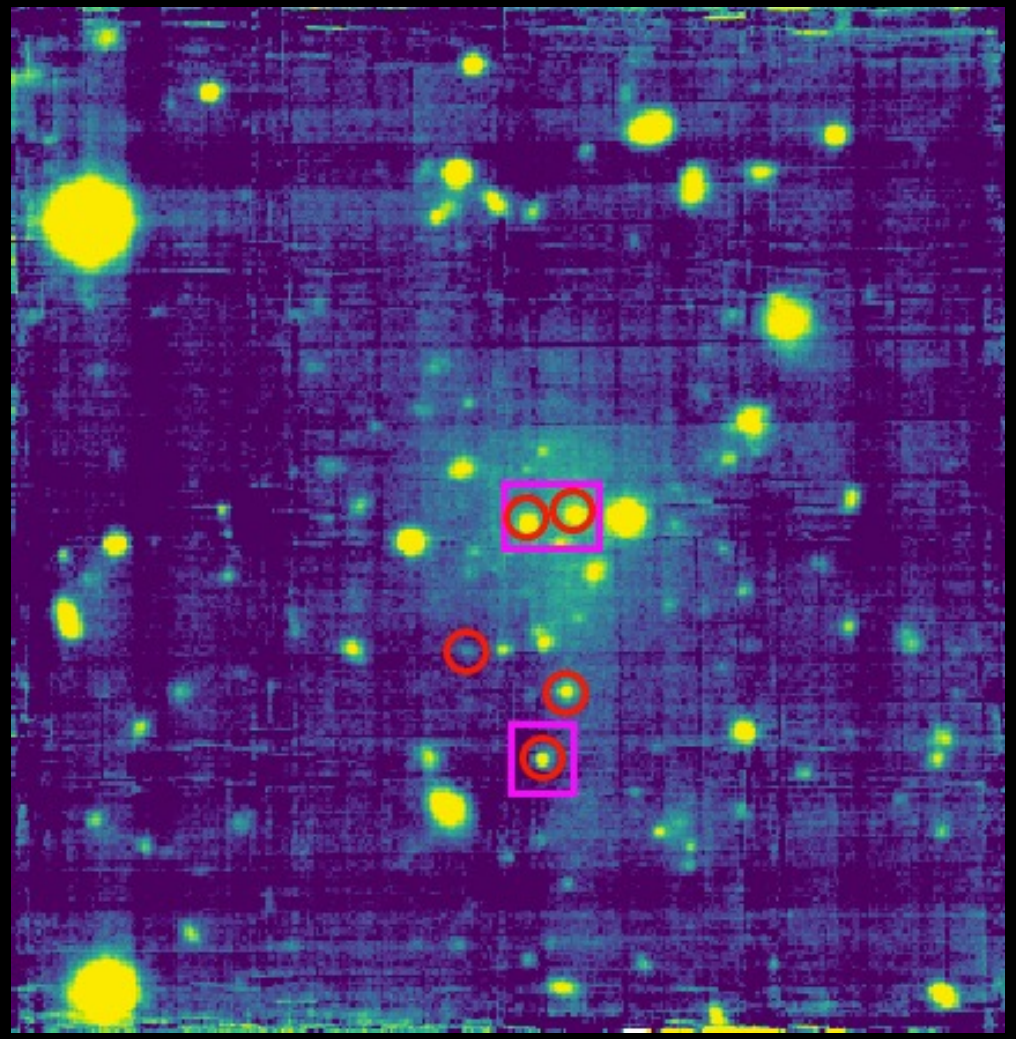

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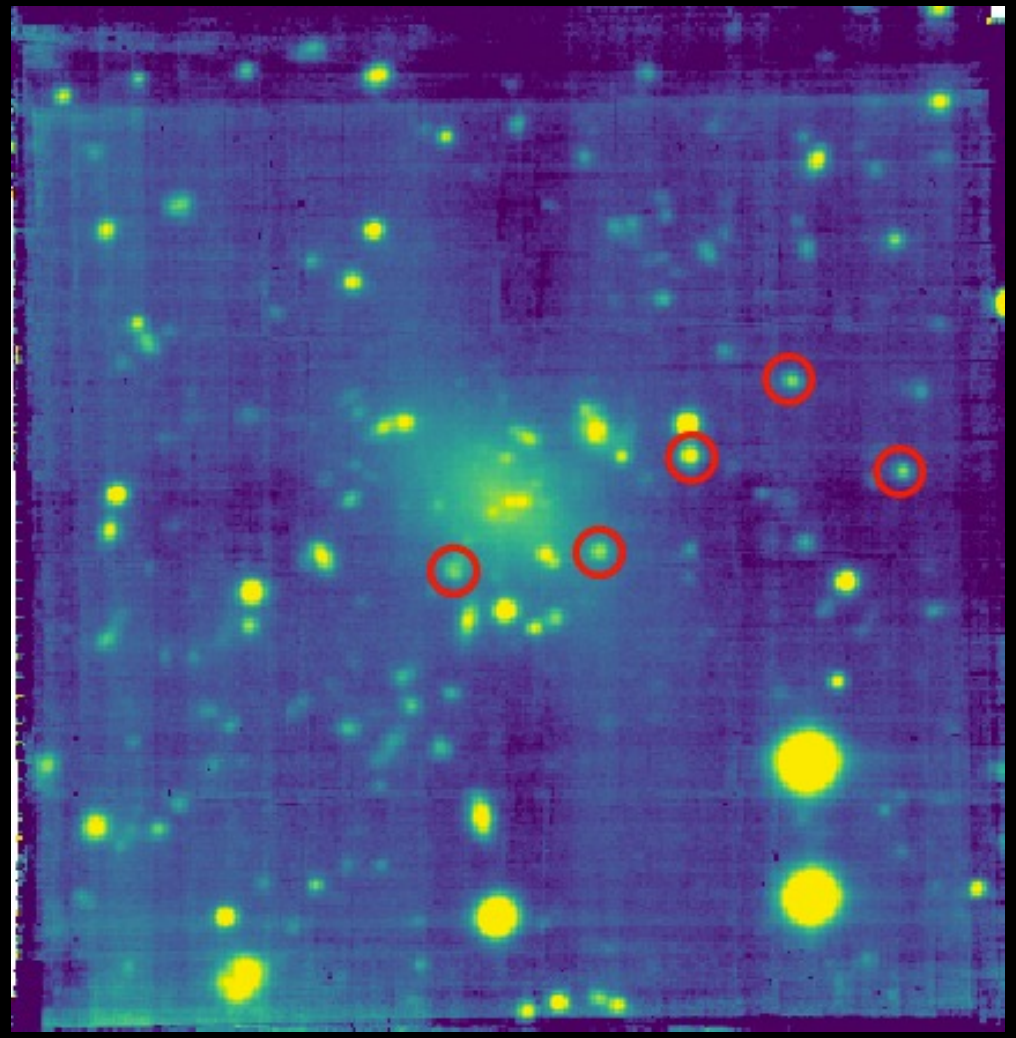

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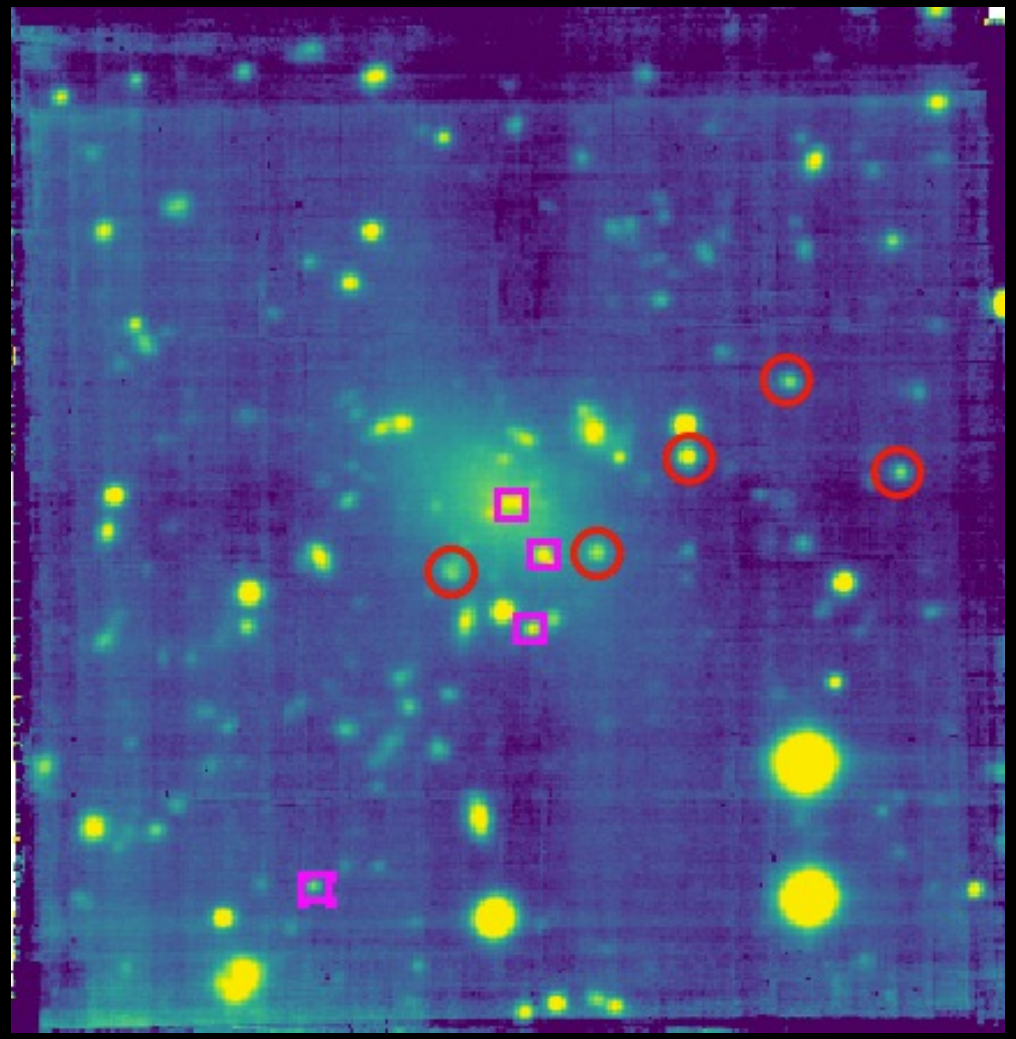

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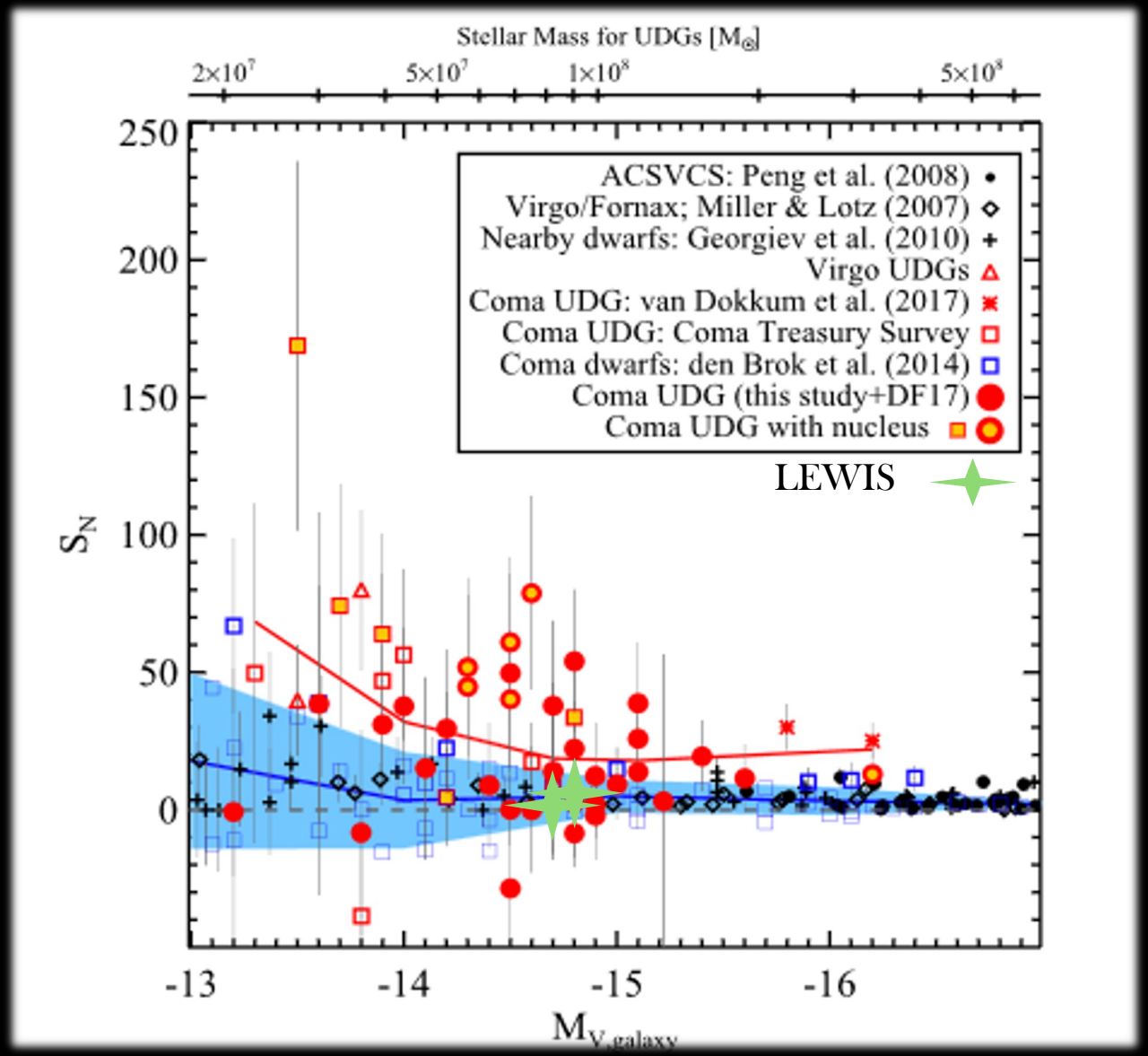

Mirabile et al. (in prep)

Credit: Lim et al. 2018

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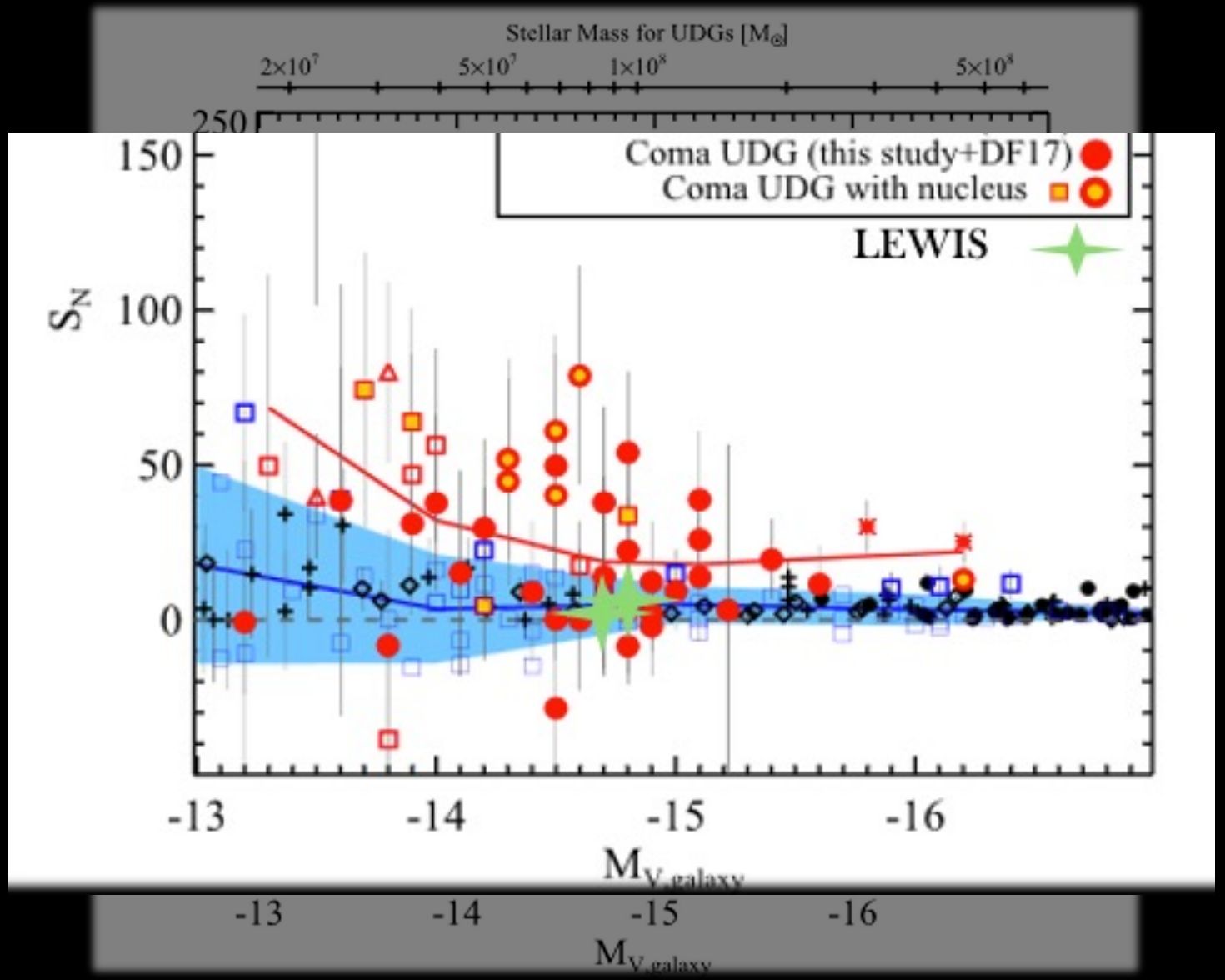

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What did we learn?

Credit: ESO

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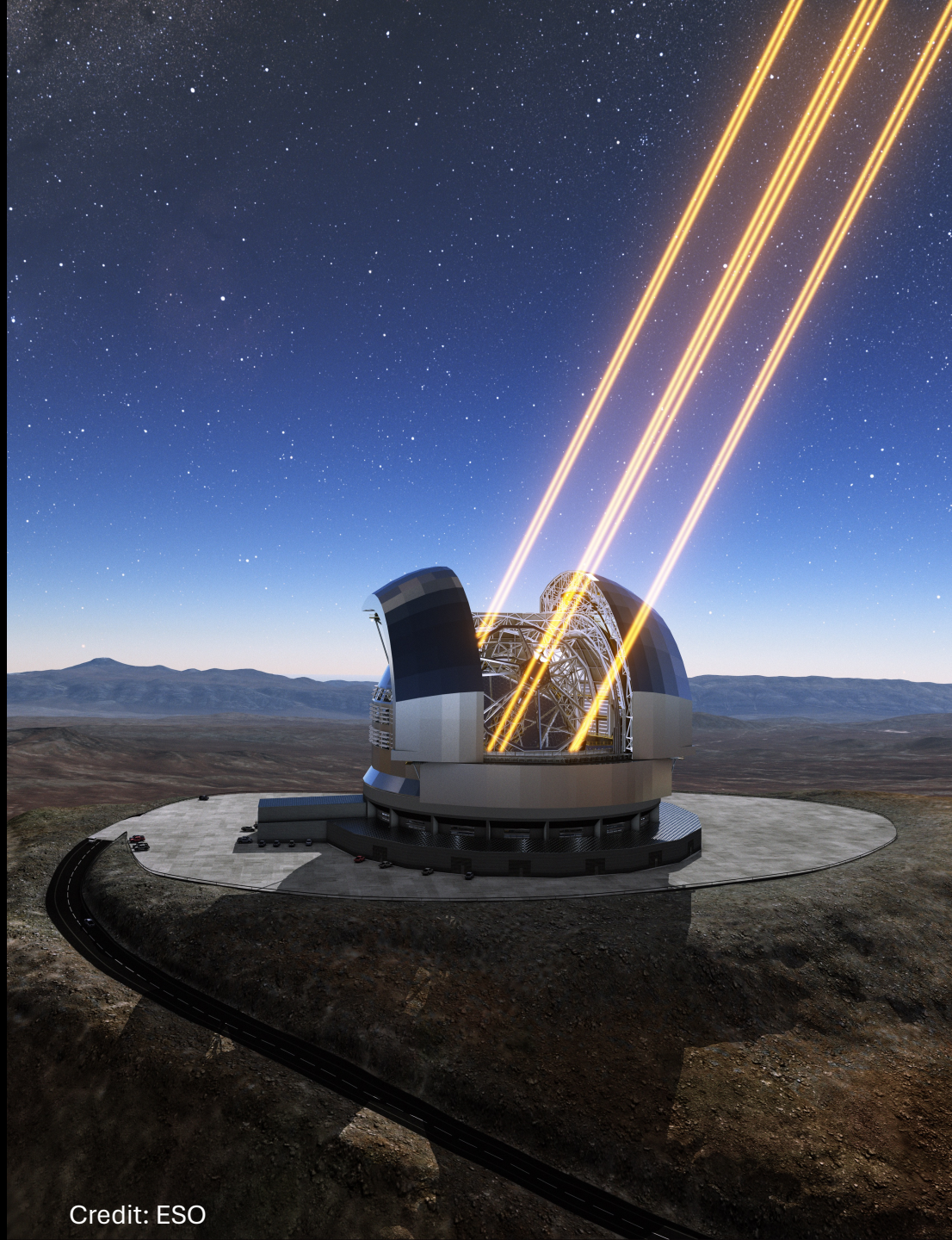
- $SNR \sim 3 \text{Å}^{-1}$
- $t \gg 6h$ to reach the GC Turn-over magnitude (TOM) [Single Target]

Credit: ESO

What can we do with SHARP@ELT?

Credit: ESO

Sharp@ELT



Credit: ESO

Sharp@ELT

- ***VESPER*: the multi-integral field unit**

Sharp@ELT

- ***VESPER***: **the multi-integral field unit**
- ***NEXUS***: **the multi-object spectrograph**

Credit: ESO

Sharp@ELT

- ***VESPER*: the multi-integral field unit**
- ***NEXUS*: the multi-object spectrograph**

•Field of view: ~ 1.2′x1.2′ AO corrected

•Multiplexing: ~ 30 slits (2.4″ slit length)

•Pixel scale: 35 mas/pix

•Spectral resolutions: ~ 2000

Credit: ESO

Science Cases with SHARP

Credit: ESO

Science Cases with SHARP

Let's see some numbers!

Credit: ESO

Science Cases with SHARP

Let's see some numbers!

	Virgo	Fornax	Hydra I	Perseus
D (Mpc)				
m-M (mag)				
m_V^{TOM} **(mag)**				
Exp. Time (h)				

Credit: ESO

Science Cases with SHARP

Let's see some numbers!

	Virgo	Fornax	Hydra I	Perseus
D (Mpc)	~16	~20	~50	~70
m-M (mag)				
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Science Cases with SHARP

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m_V^{TOM} **(mag)**	23.5	25	26	26.8
Exp. Time (h)				

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Science Cases with SHARP

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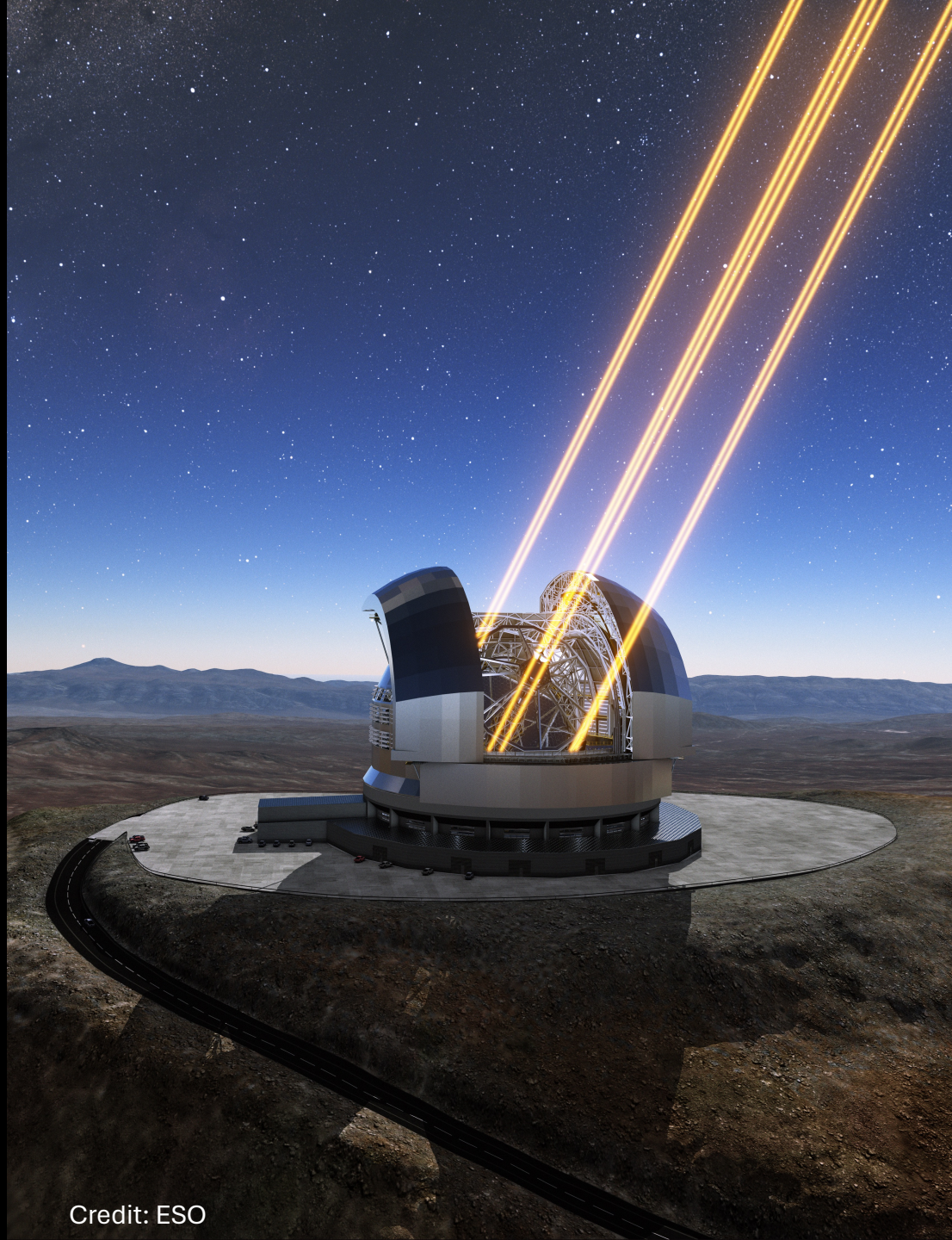
	Virgo	Fornax	Hydra I	Perseus
D (Mpc)	~16	~20	~50	~70
m-M (mag)	31	31.5	33.5	34.3
m_V^{TOM} **(mag)**	23.5	24	26	26.8
Exp. Time (h)	**~0.08 (5min)**	**~0.1 (8 min)**	**~4**	**~7**

- SSP BC016 Chabrier Z=0.004 10Gyr
- Airmass of 1.5
- R=2000
- ETC Version 0.2
- SNR=5

Take home massage



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Take home massage

- SHARP@ELT will allow us:
  - To map the GC population in dwarf and massive galaxies and intra-cluster/group environment

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- SHARP@ELT will allow us:
  - To map the GC population in dwarf and massive galaxies and intra-cluster/group environment

  - Identify the GC properties (S_N, σ_{GC}, DM content, …)

Credit: ESO

Take home massage

- SHARP@ELT will allow us:
  - To map the GC population in dwarf and massive galaxies and intra-cluster/group environment

  - Identify the GC properties (S_N, σ_{GC}, DM content, …)

Characterizing the galaxies history

Credit: ESO

Thank you

MUSE VS SHARP

	MUSE	SHARP
m_V^{TOM} (mag)	25.5	25.5
Exp. Time (h)	~6h	~0.5 (30min)

- SSP BC016 Chabrier Z004 10Gyr
- Airmass of 1.5
- R=2000
- SNR=3

Science Cases

Let's see some numbers!

	MUSE	SHARP
m_V^{TOM} (mag)	25.5	25.5
Exp. Time (h)	~6h	~0.5 (30min)

- SSP BC016 Chabrier Z004 10Gyr
- Airmass of 1.5
- R=2000
- SNR=3

SHARP your sight to the future

Credit: ESO