



# Exploring galaxy evolution through wide, deep near-infrared imaging via the ESO Public Survey SHARKS



*Helmut Dannerbauer*  
*Instituto de Astrofísica de Canarias*

*and the SHARKS team*

**Carnero, Cross, Gutierrez, Ivison, Andreani, Baes, Bayo, Bonjean, Bourne, Clements, Cooray, Danese, Davies, De Zotti, Díaz-Sánchez, Ding, Driver, Dunne, Dye, Eales, Edge, Fazio, Furlanetto, Ghaffari, Gonzalez C., Gonzalez E., Gonzalez-Nuevo, Hardcastle, Hughes, Hurley, Ibar, Irwin, Jarvis, Knapen, Lapi, Leiton, Lorezon, Maddox, Manjón-García, Mann, Marchetti, Messias, Michalowski, Muñoz, Negrello, Norris, Oliver, Omont, Oteo, Ramos-Chernenko, Read, Riechers, Rios-López, Rodighiero, Robotham, Saaveder-Esqueviel, Scudder, Shen, Seymour, Shibhana, Smith, Sutherland, Temi, Trujillo, Vaccari, Vuong, Wilner, Van der Werf, Yoshimoto**



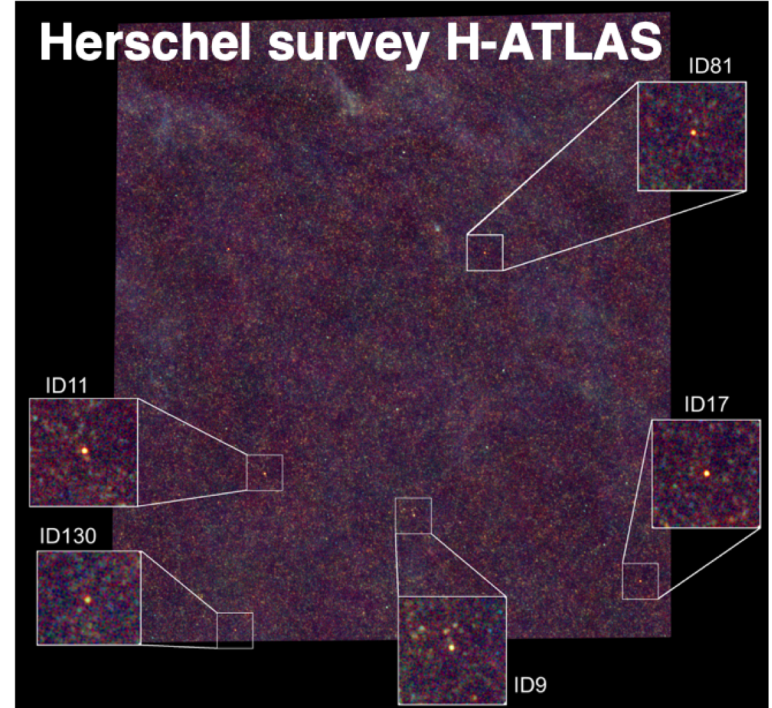
# SHARKS

## Southern H-ATLAS Regions K<sub>s</sub> band Survey

### 198.A-2006

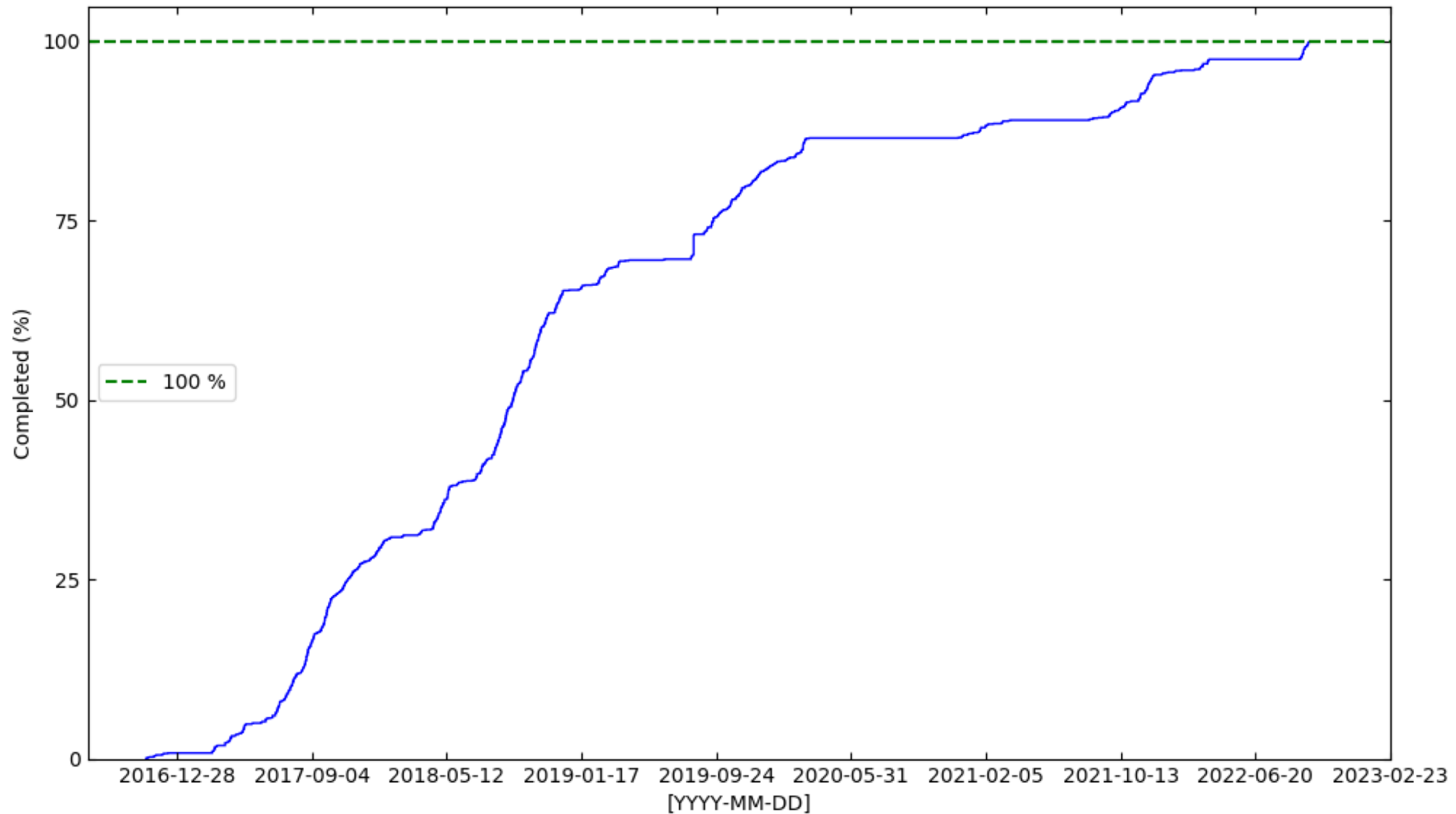


*A lot of thanks to the ESO survey team for the great support* 🙌





# SHARKS observations are done😊





# SHARKS in a Nutshell

- 1200hrs of observing time with ESO 4m telescope VISTA and instrument VIRCAM are approved, started in Nov 2016 and finished in September 2022☺
- 300 square degree in  $K_s$ -band down to 22.7mag (AB, 5sigma)
- we will detect around 20 million sources
- H-ATLAS fields: GAMA12, GAMA15 and SGP
- **1<sup>st</sup> ESO Data Release on 31 January 2022**
- huge legacy value (Euclid, LSST, WEAVE, radio surveys from LOFAR, ASKAP, MeerKAT, SKA)
- article this year in the ESO Messenger, #187, p.12-15

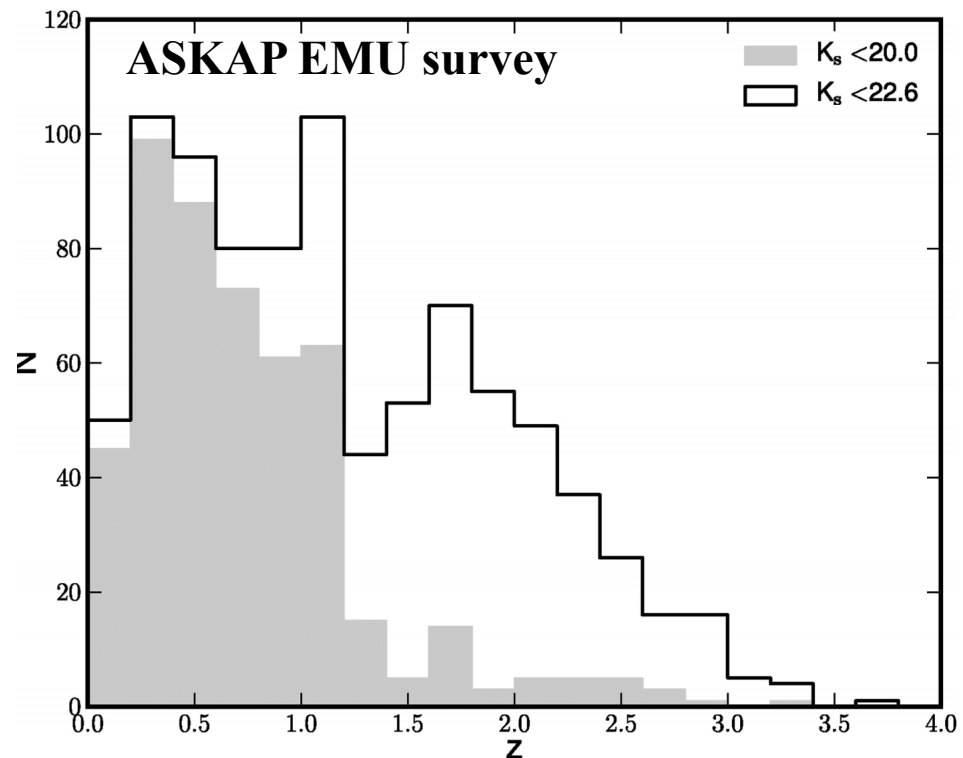
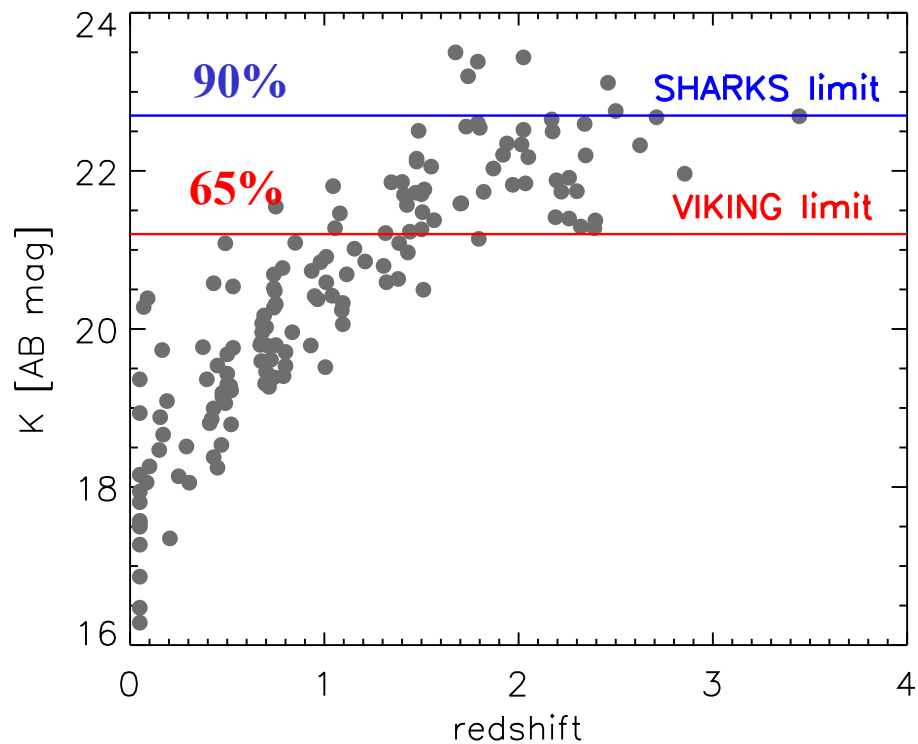
# Survey Aims

from original proposal

- **increase depth of VIKING fields from  $K=21.2$  to  $22.7\text{mag}$  (AB,  $5\sigma$ ) over 300 square degree in three fields with VISTA-VIRCAM: equatorial fields GAMA12, GAMA15 and the South Galactic Pole**
- **provide counterparts of (high- $z$ ) sources selected through on-going and future infrared and radio surveys**
  - **IR: Herschel survey H-ATLAS, WISE and NEOWISE**
  - **radio: LOFAR, ASKAP, MeerKAT, SKA**



# Why SHARKS?



# **the Major Scientific Aims are**

**from original proposal**

- to provide the best possible counterpart identification for 90% of the sources detected at  $0 < z < 3$  by H-ATLAS, SKA and LOFAR

- to produce a sample of a thousand strong lenses for cosmography studies

- to study the evolution of the most massive structures in the Universe

# Multi-wavelength coverage

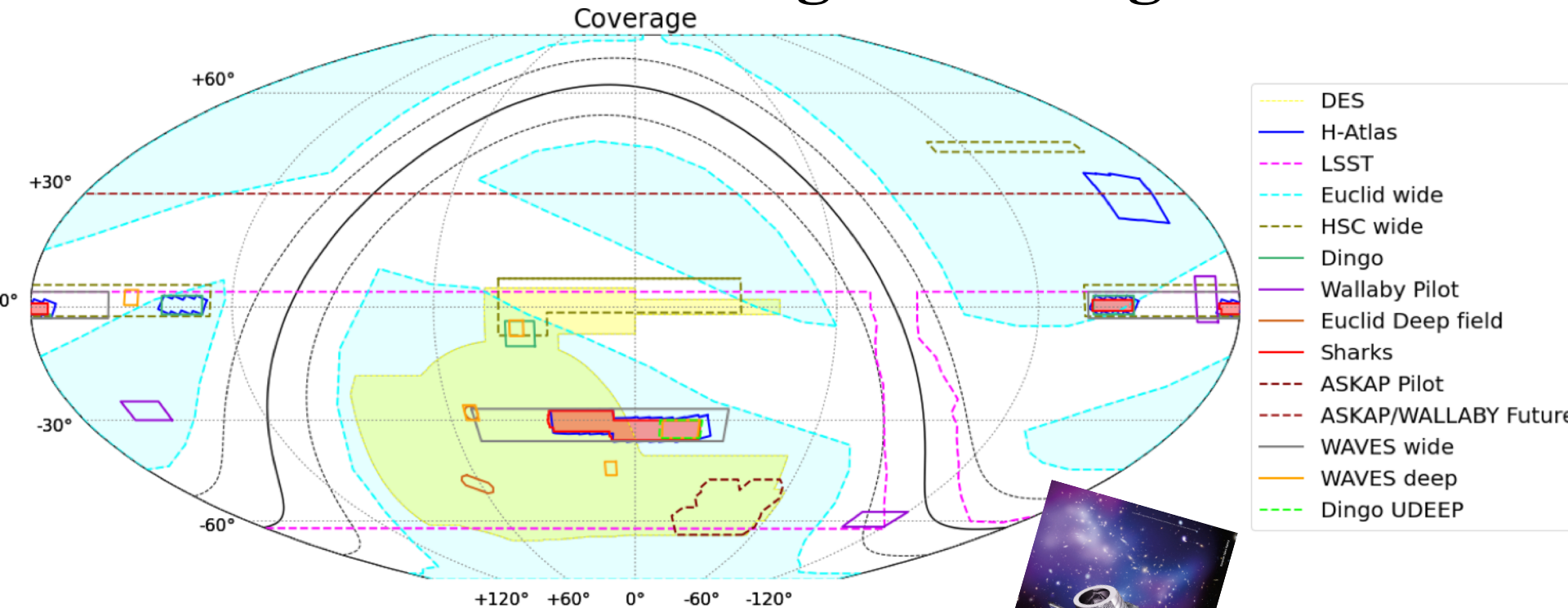


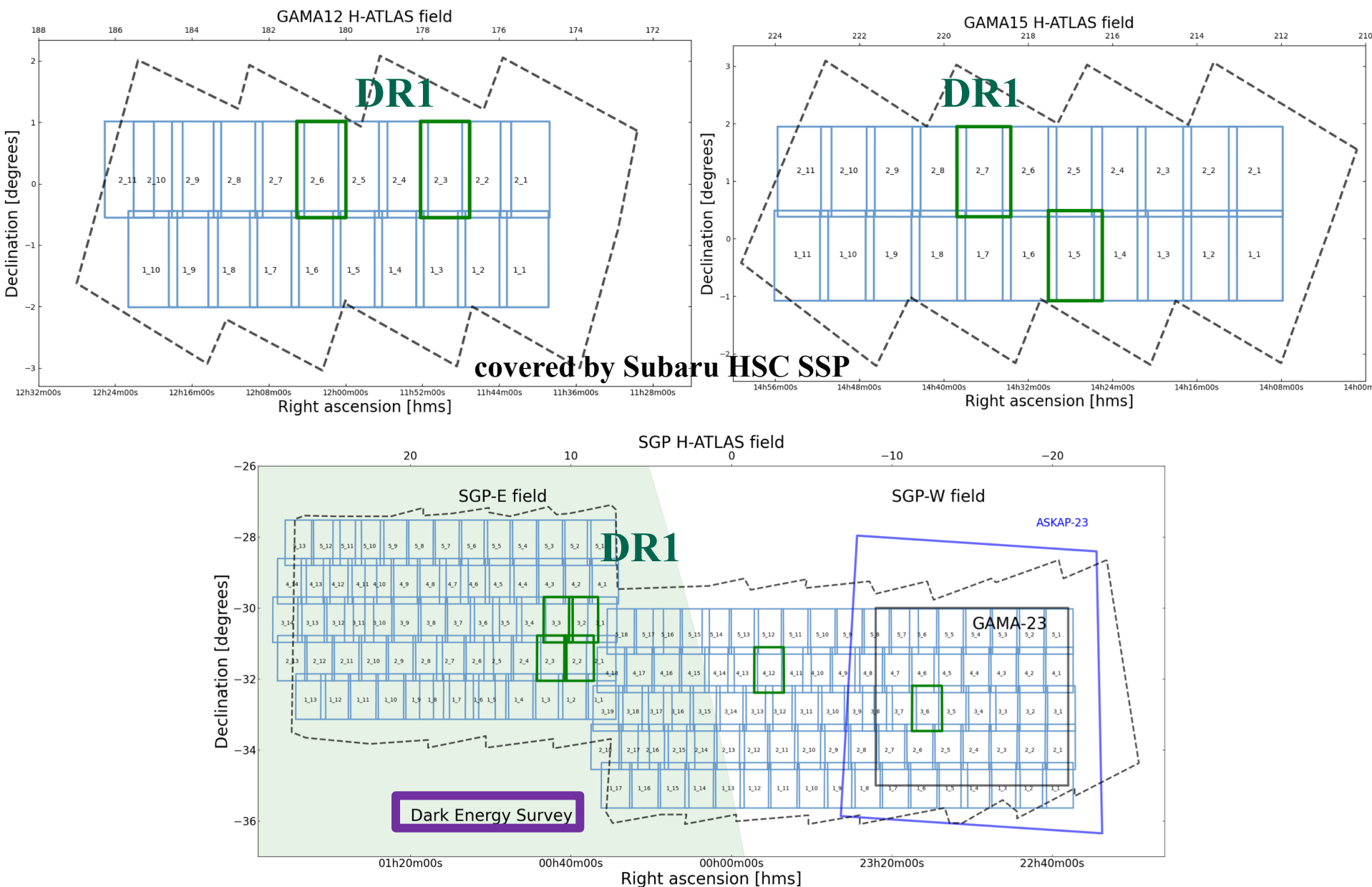
Table 1: Existing and future surveys overlapping with SHARKS

Survey	Frequency	Overlapping Area	Depth ( $5\sigma$ )
H-ATLAS	100–500 $\mu\text{m}$	100% in SGP and GAMA	$\sim 30 \text{ mJy at } 250 \mu\text{m}$
EMU	$\sim 1.3 \text{ GHz}$	100% in SGP and GAMA	$\sim 50 \mu\text{Jy at } 20 \text{ cm}$
LOFAR Tier 2	$\sim 150 \text{ MHz}$	100% in GAMA	$\sim 0.1 \text{ mJy at } 150 \text{ MHz}$
WALLABY	HI survey	100% in SGP	$M_{\text{HI}} > 10^8 M_*$
DINGO	HI survey	100% in SGP and GAMA	$M_{\text{HI}} > 10^7 M_*$
GALEX MIS	UV phot.	100% in SGP and GAMA	$\sim 22.7 \text{ AB mag}$
Deep-WAVES	optical spec.	100% in SGP	$r < 22 \text{ ABmag}$
WEAVE	optical spec.	100% in GAMA	
LSST	u,g,R,I,z phot.	100% in SGP and GAMA	$\sim 26\text{--}27 \text{ AB mag}$
EUCLID	Y, J, H phot.	100% in SGP	$\sim 24 \text{ AB mag}$


**power of SHARKS is  
combination of MW-data  
e.g. *Euclid* will do YHJ but  
not K!**



# Current Status




# ESO Data Release 1 @ 31 January 2022



European  
Southern  
Observatory

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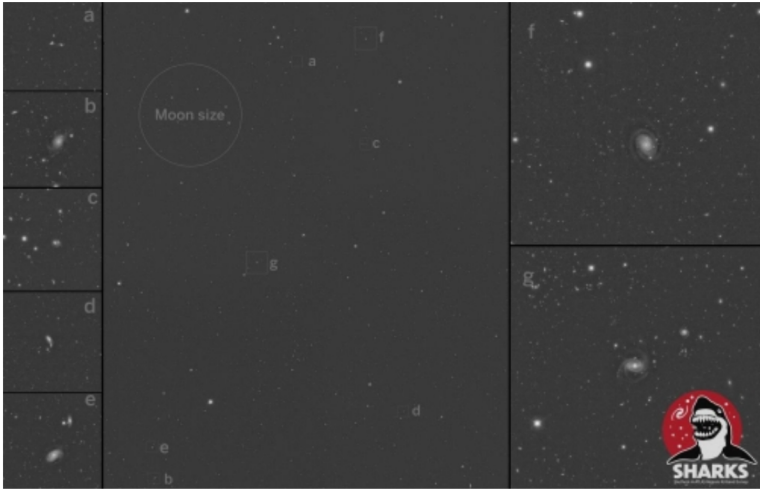
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## First Data Release from the ESO VISTA Public Survey - Southern H-ATLAS Regions in Ks-band (SHARKS)

**Published: 01 Feb 2022**



The Southern H-ATLAS Regions in Ks-band (SHARKS) is a deep  $K_s$ -band imaging survey conducted with the wide-field VIRCAM imager at the VISTA telescope. The project was granted 1200 hours of observing time under the ESO programme 198.A-2006 (PI H. Dannerbauer) as one of seven approved second cycle VISTA Public Surveys. It covers  $\sim 300 \text{ deg}^2$ , including large parts of the South Galactic Plane (SGP), GAMA-12h (G12) and GAMA-15h (G15) fields from the H-ATLAS survey, the largest Herschel program. The survey has been designed to provide the best possible counterpart identification for  $\sim 90\%$  of the sources detected at  $0 < z < 3$  by H-ATLAS, ASKAP, SKA and LOFAR; to produce a sample of strong lenses for cosmography studies; to study the evolution of the most massive structures in the Universe.

SHARKS DR1 consists of calibrated images and single band source catalogues from observations taken between March 2017 and January 2019. It covers a sky area of about  $20 \text{ deg}^2$ , divided in 10 mosaics of  $\sim 2 \text{ deg}^2$  each. The 10 mosaics are distributed as following: four contiguous mosaics in the SGP-E region, and two unrelated mosaics each in the SGP-W, G15 and G12 fields. The mean depth reaches the expected Ks magnitude of  $\sim 22.7$  (AB, 5sigma) with a mean seeing of  $\sim 1''$ . The products are available via the [ESO Science Portal](#) or [programmatically](#). More information about the release is available in the related [documentation](#).

SHARKS DR1 has been produced in collaboration with the Instituto de Astrofísica de Canarias ([E-IAC](#)) and the Wide-Field Astronomy Unit ([E-WFAU](#)) at the Royal Observatory of Edinburgh.

# **ESO Data Release 1 @ 31 January 2022**

- **consists of calibrated images and single band source catalogues**
- **10 mosaics of  $\sim 2$  sq. degrees,  $\sim 5\%$  of the total survey**
- **four contiguous mosaics in the SGP-E region and two unrelated mosaics each in the SGP-W, G12 and G15 fields.**
- **mean depth of  $K_s \sim 22.7$  mag (AB, 5sigma) and mean seeing of  $\sim 1$  arcsec, around 1 million sources**
- **SHARKS DR1 has been produced in collaboration with the Instituto de Astrofísica de Canarias (IAC) and the Wide-Field Astronomy Unit (WFAU) at the Royal Observatory of Edinburgh**
- **retrieve data via ESO archive or our project page**  
[\(<http://research.iac.es/proyecto/sharks/pages/en/data-releases/dr1.php>\)](http://research.iac.es/proyecto/sharks/pages/en/data-releases/dr1.php)
- **provided a detailed data release document**



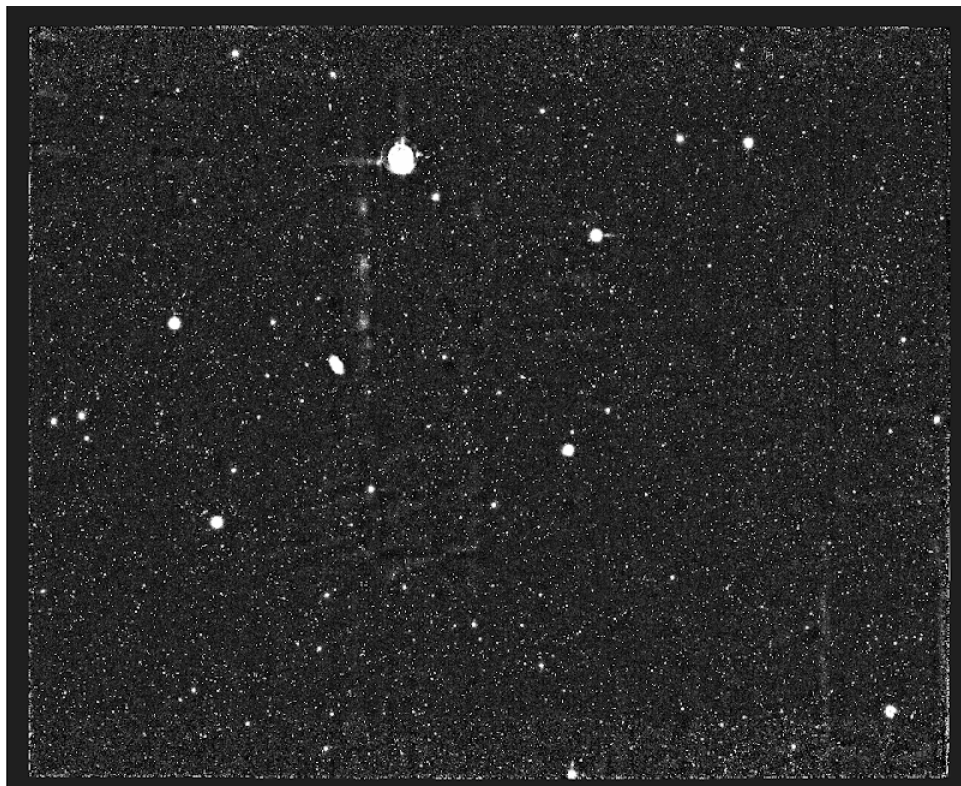
# ESO Data Release 1 @ 31 January 2022



# Sky Background Subtraction



**Aurelio Carnero (IAC)**



# Sky Background Subtraction

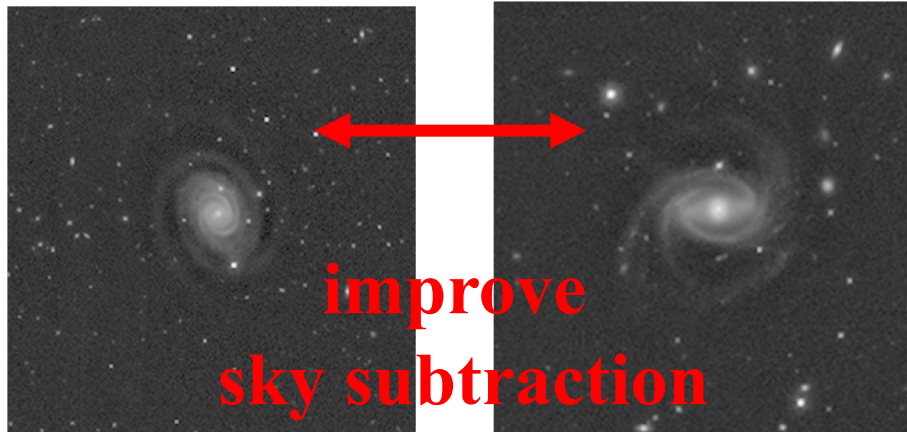


**Aurelio Carnero (IAC)**

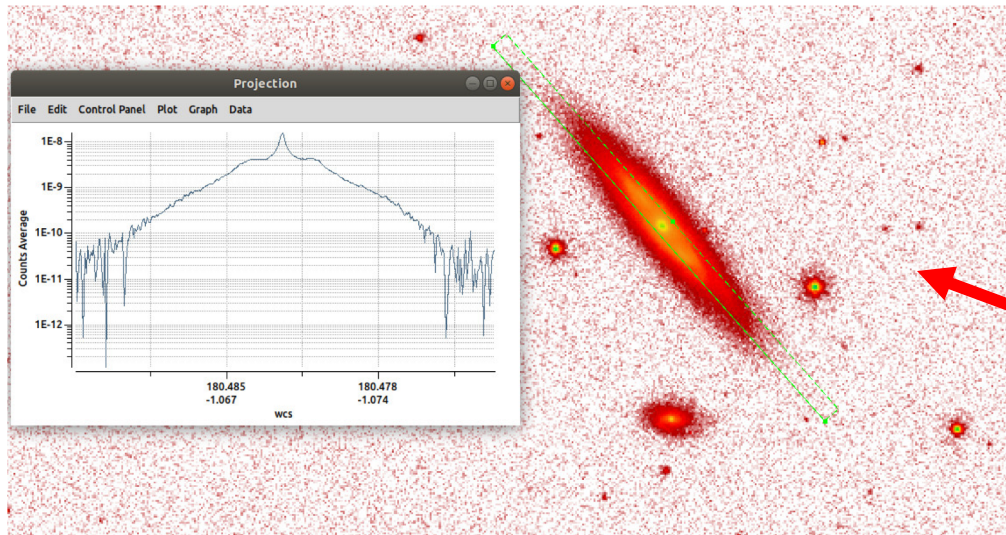
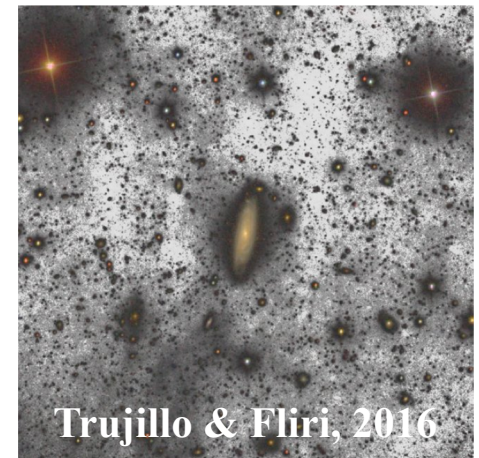




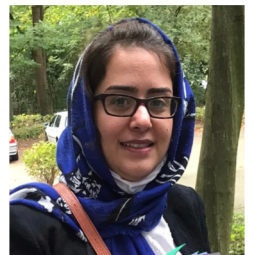
# Optimized Low-Surface Brightness emission Data Reduction



team at IAC led by Ignacio Trujillo with expertise on this topic->collaboration

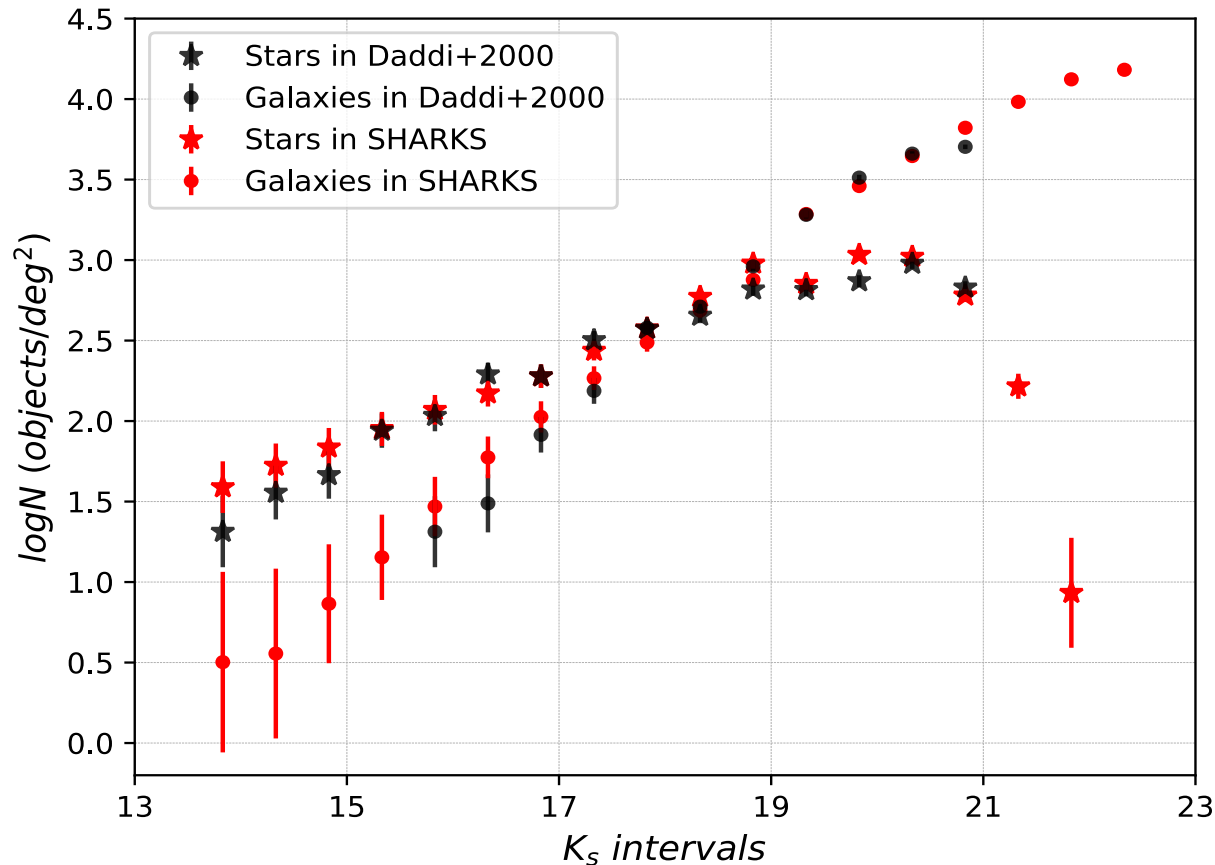


Zohreh Ghaffari focuses on such a pipeline for SHARKS



# First Science: Focus on Galaxy Evolution

## Number counts



Sergio Saavedera-Esqueviel, ULL, 2021

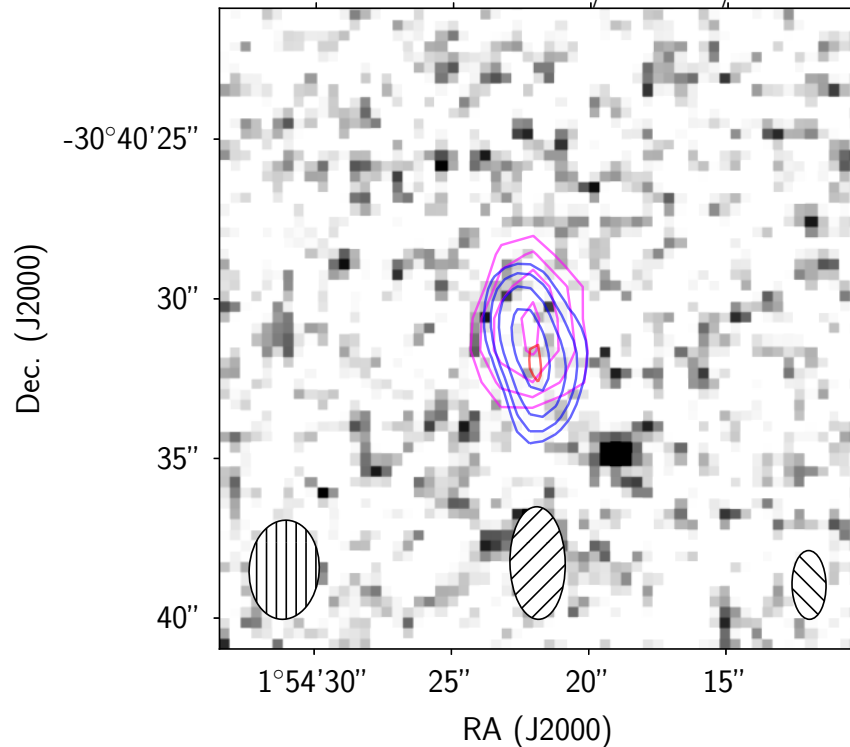
confidence in data reduction and calibration☺

# First Science: Focus on Galaxy Evolution

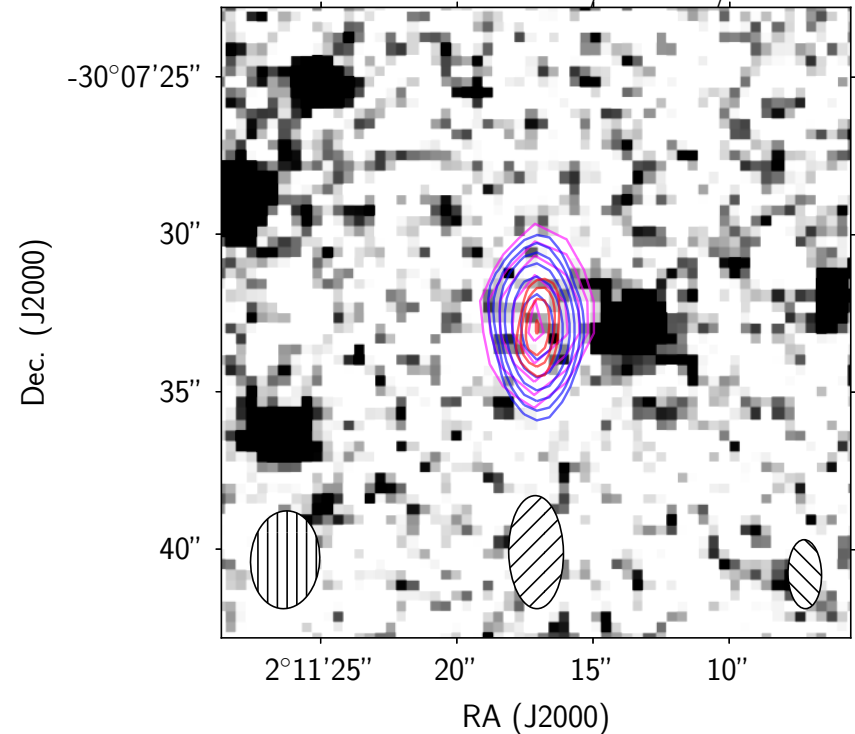
search for counterparts of radio sources selected from the GLEAM survey

Broderick et al. 2022, PASA, in press (astro-ph/2204.08490)

J0007-3040 SHARKS/VLASS/ATCA



J0008-3007 SHARKS/VLASS/ATCA

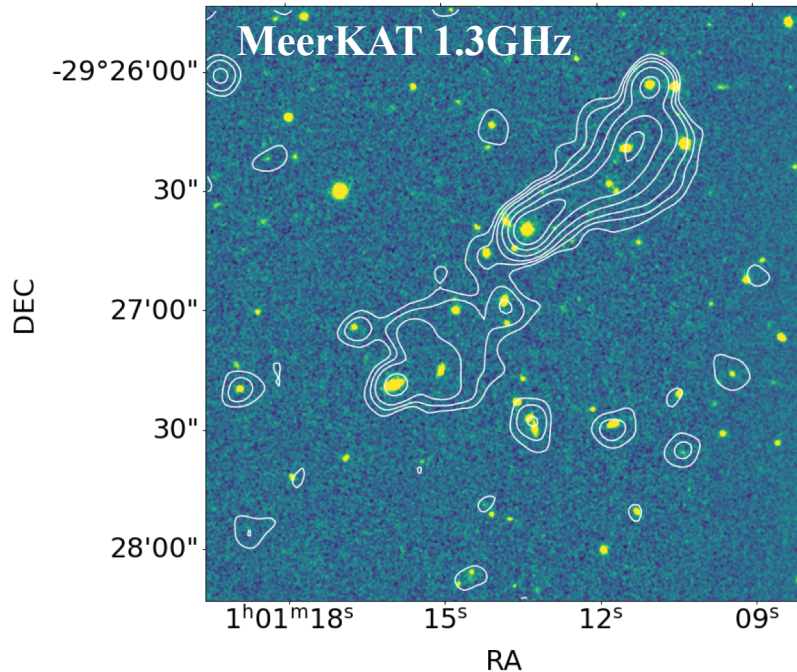


undetected down to  $K_s=22.7\text{mag}$

first publication using SHARKS data☺

# First Science: Focus on Galaxy Evolution

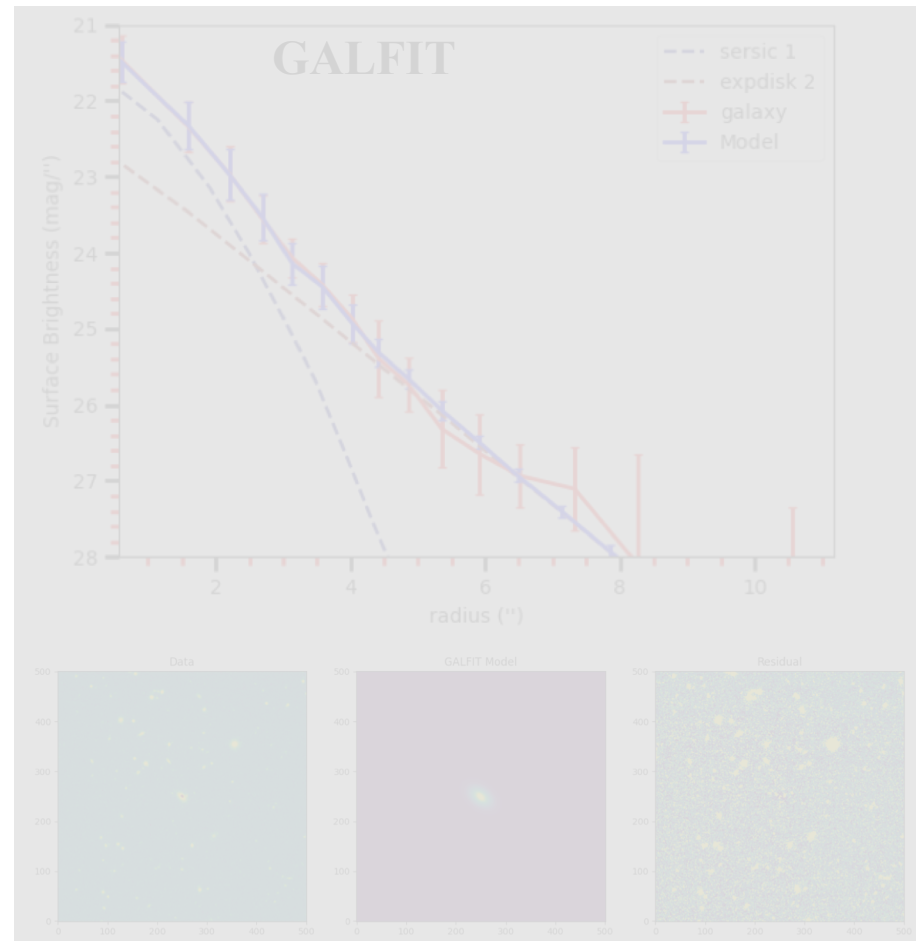
use  $K$ - $z$  relation for radio galaxies



$K=19.4(AB)$ ,  $z = 1.1$

Yifan Ding & Dave Clements  
*Imperial College*

structural parameters of AGN host galaxies selected through GAMA spec

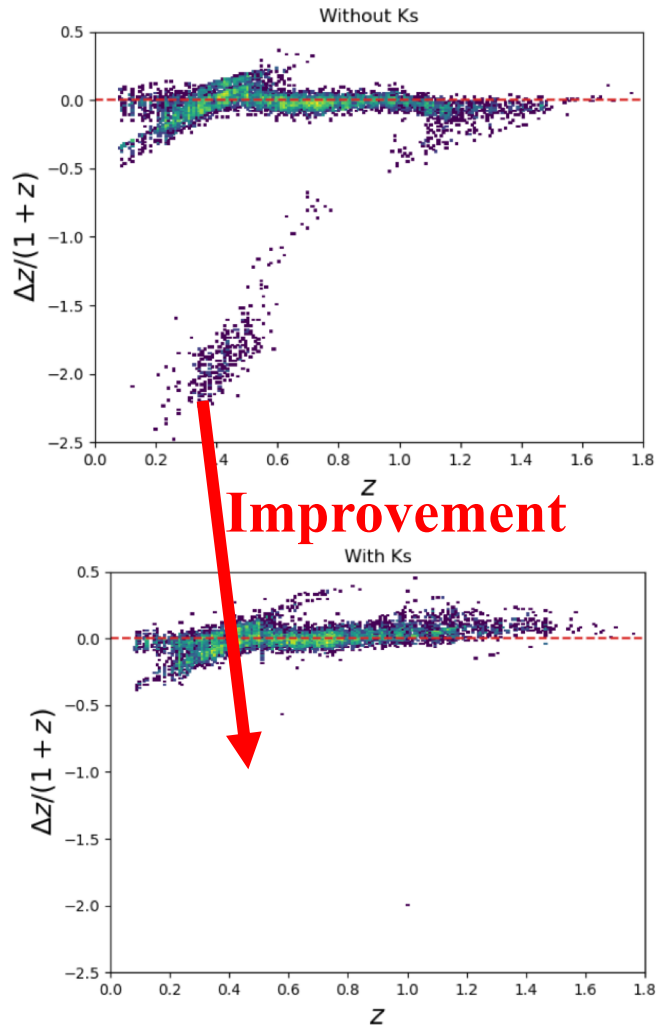


see next talk by Emmanuel Ríos-López, IAC



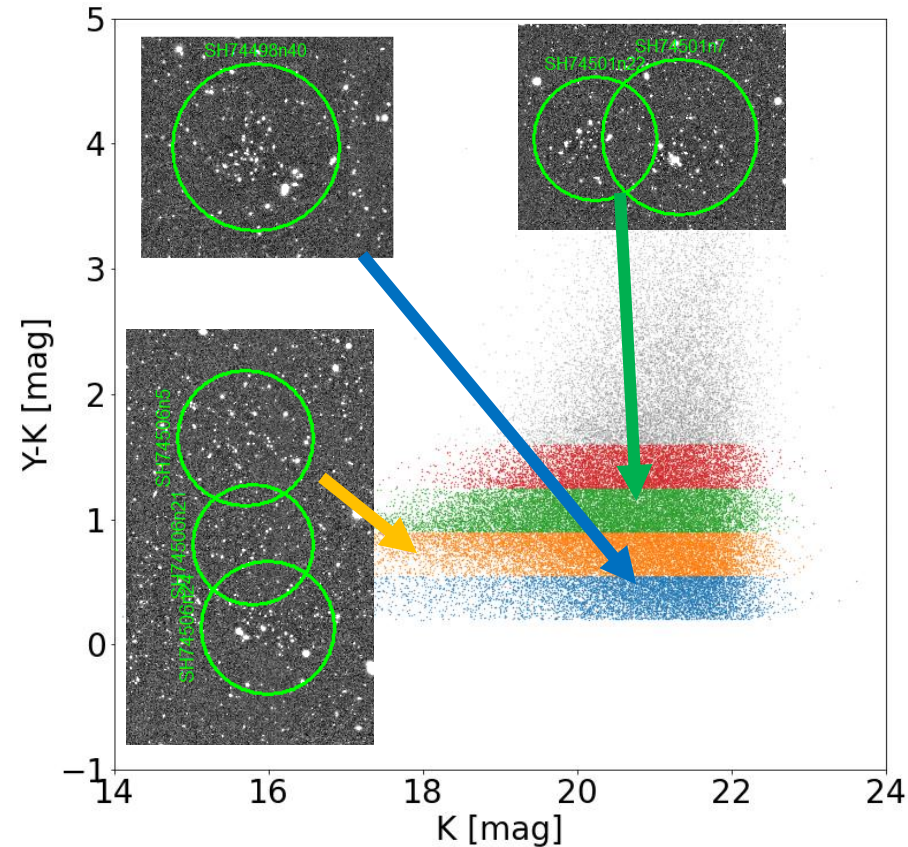
# First Science: Focus on Galaxy Evolution

photo- $z$ 's (SED fitting & ML)



Victor Bonjean & Nataliya Ramos-Chernenko, *IAC*

search for galaxy overdensities



Color selection of red sequence +  
Friends-of-Friends algorithm

Giuliano Lorenzon &  
Giulia Rodighiero  
*U Padova*

# Conclusion & Outlook



- **300 sq. degree  $K_s$ -band down to 22.7mag (AB)**
- **first data release on 31 January 2022**
- **dedicated data reduction to reveal low-surface brightness emission**
- **ESO Messenger article published recently**
- **SHARKS-DR2 planned for 2023**
- **Euclid will observe major part of the SHARKS fields >250 sq. deg.**

<http://research.iac.es/proyecto/sharks/pages/en/home.php>