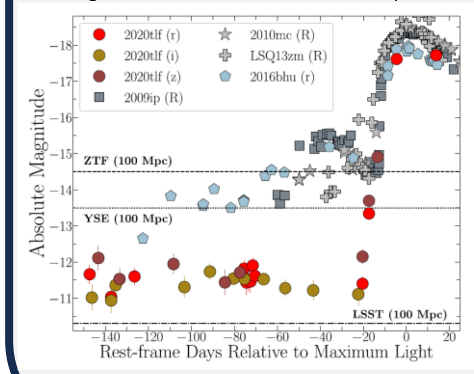
GalRSG:
A long-term monitoring campaign of Galactic Red Supergiants and the quest for SN premonitory signs *(See poster S1.1)*

F.Bocchino, S. Orlando, M. Miceli, O. Petruk, A. Pastrorello, M. Limongi, A. Chieffi, G. Peres

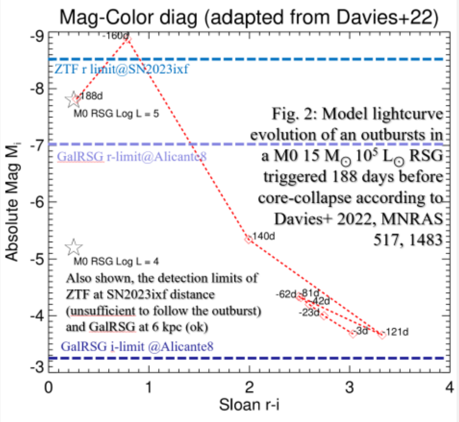
1. Pre-SN outbursts: focus on low-mass RSGs

Fig. 1: from Jacobson-Galan+ 2020, ApJ, 925,15



Growing evidences of flash ionization signatures, i.e. pre-SN mass-loss

BUT LOW-MASS RSGs OUTBURSTS ARE FAINT, WE NEED NEAR TARGETS



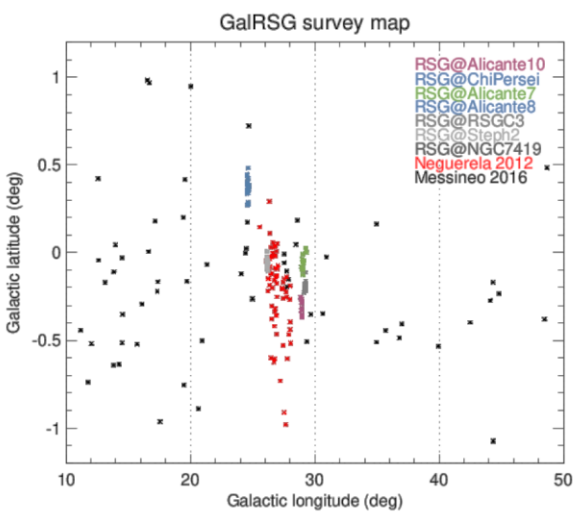
2. The sample of Galactic Red Supergiants

BEFORE

I look for as many **SNe** as possible THEN I maybe detect a **precursor**

HERE COMES GalRSG

I monitor as many 7-15 M$_\odot$ **RSGs** as possible THEN I maybe detect a **SN**

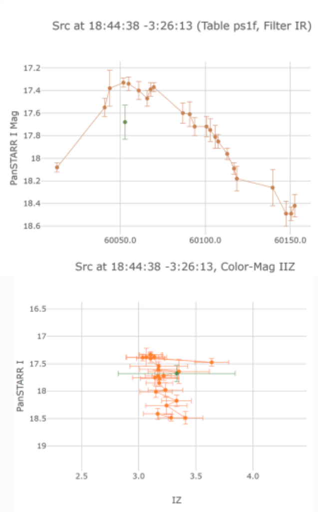


Scutum-Crux massive clusters

They are all at ~ 6 kpc, approx. coeval (~ 15 Myr) and within few deg in the sky

3. The monitoring campaign

- **Higher sensitivity** allows us to target mid/low-L RSGs (i.e. the majority) and their precursors.
- **Multi-band** optical/NIR **homogeneous** coverage
- Short and regular cadence **(<= few days).**
- **No need of large telescopes**. Now using INAF-REM & INAF-VST
- **Duration** => 3 yr
- **Other current surveys either have too-long cadence or lack of iz/NIR colors. LSST baseline survey has too-long cadence**
- **GalRSG lightcurve database has a legacy value**



Search for γ-ray emission from SNRs in the Large Magellanic Cloud: preliminary results of a new cluster analysis at energies above 4 GeV

A.Tramacere, R.Campana, E.Massaro, F.Bocchino, M.Miceli, S.Orlando

See poster S1.2

We applied two cluster search methods (MST and DENCLUE) for detecting photon concentrations in the 15 y Fermi-LAT field of LMC.

Confirm of 9 previous detections and slection of 6 new γ-ray SNR candidates.

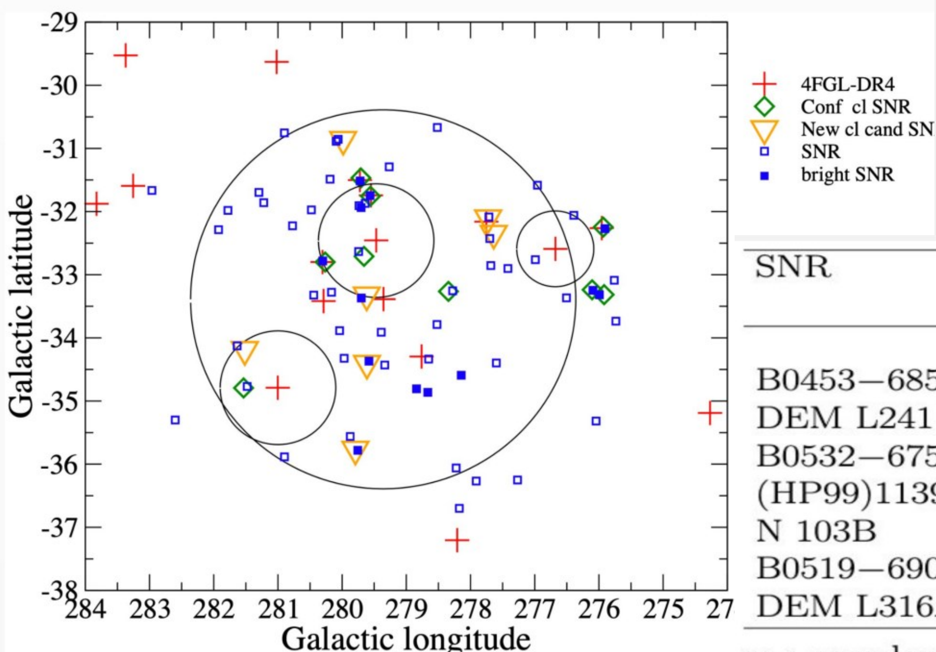
SNR	RANGE GeV	TYPE	D ′	L_X 10^{35} erg s^{-1}	$S_{cls}4$	$S_{cls}10$	Δ ′	MST M	Notes
N 44	>6;10	–	4.3	0.90	4.8	3.3	3.7	28.7	
N1 32D	>6;10	CC	2.1	315.04	6.6	4.6	1.8	57.6	4FGL
N 49B	>6*;10	CC	2.8	38.03	*5.6	*3.9	3.4	20.0	
N 49	>6*;10	CC-SGR	1.4	64.37	*5.6	*3.9	3.5	18.4	
B0528−692	>10		4.5	1.99	4.4	3.5	4.1	58.8	
N 63A	>6;10	CC	1.4	185.68	6.5	4.1	0.4	53.7	4FGL
N 157B	>6;10	CC-PWN	2.0	15.00	18.8	11.6	1.6	577.4	4FGL
B0540−693	>10	CC-PSR	1.2	87.35	8.7	4.8	5.3	35.4	4FGL
N 186D	> 6		1.9	1.09	—	3.7			

* : unresolved cluster at energies lower than 10 GeV

D : SNR diameter

Δ : angular separation

L_X : X-ray luminosity in the band 0.3–8 keV from the Maggi et al. (2016) catalogue



SNR	RANGE GeV	TYPE	D ′	L_X 10^{35} erg s^{-1}	$S_{cls}4$	Δ ′	MST M	Notes
B0453−685	>4	CC	2.0	13.85	3.7	2.0	18.3	m
DEM L241	>4		5.3	3.84	5.2	1.2	56.7	m
B0532−675	>4		4.7	2.48	3.1	5.4	23.5	
(HP99)1139	>4		4.4	1.44	3.1	6.4	17.8	e
N 103B	>4	Ia	0.5	51.70	3.3	2.7	18.8	m
B0519−690	>4	Ia	0.6	34.94	4.2	5.0	26.6	m
DEM L316A	>4	CC?	3.2	1.26	4.7	4.1	21.5	Nf, m

m : angular distance from MST centroid position

e : MST magnitude at energies >6 GeV.

Nf : M value obtained in a field with $b > -31^o$.

Gamma-ray detection of newly discovered Ancora supernova remnant: G288.8–6.3

Christopher Burger-Scheidlin (Dublin Institute for Advanced Studies DIAS)

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Institiúid Ard-Léinn Bhaile Átha Cliath | Dublin Institute for Advanced Studies

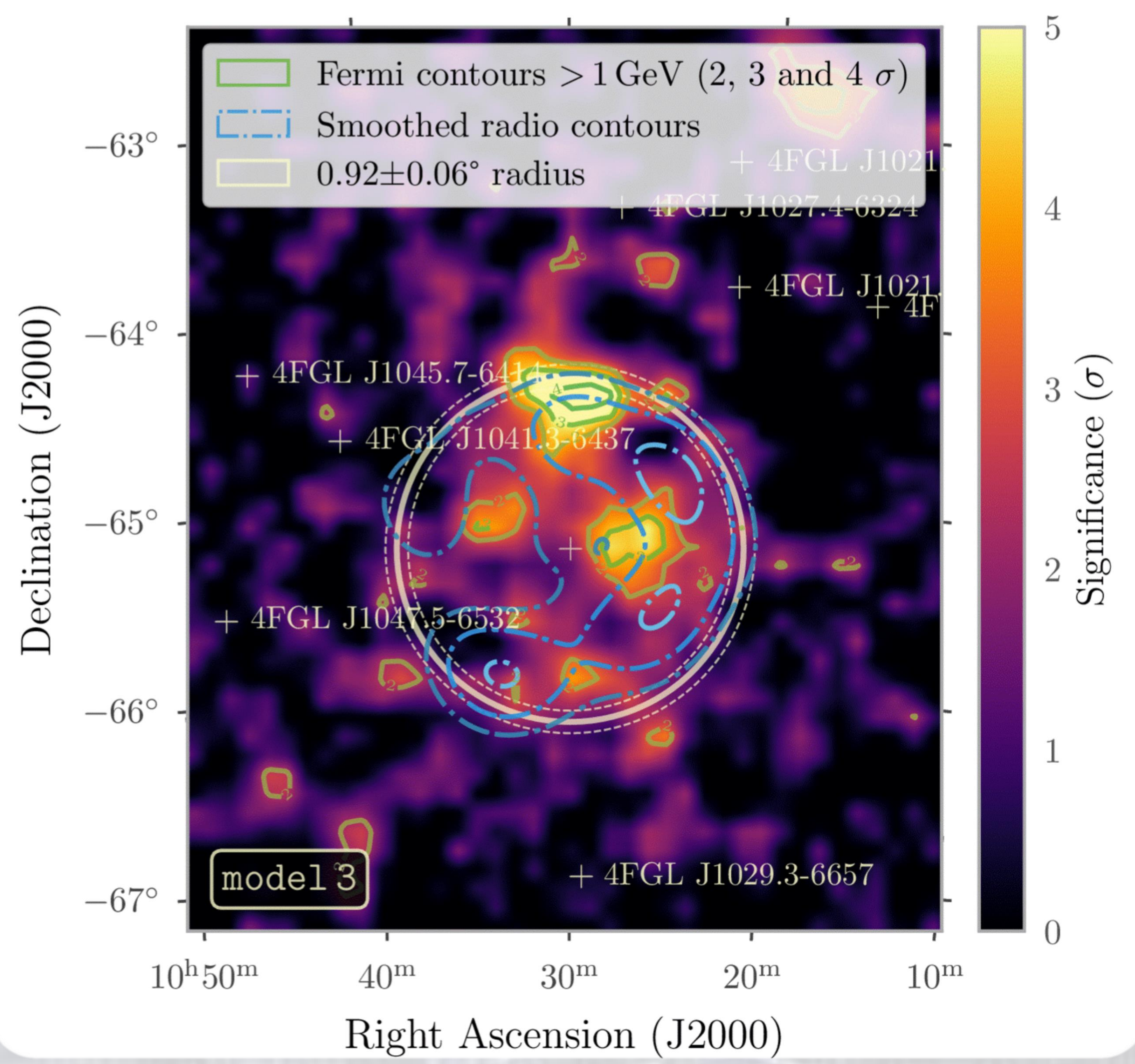
UCD DUBLIN

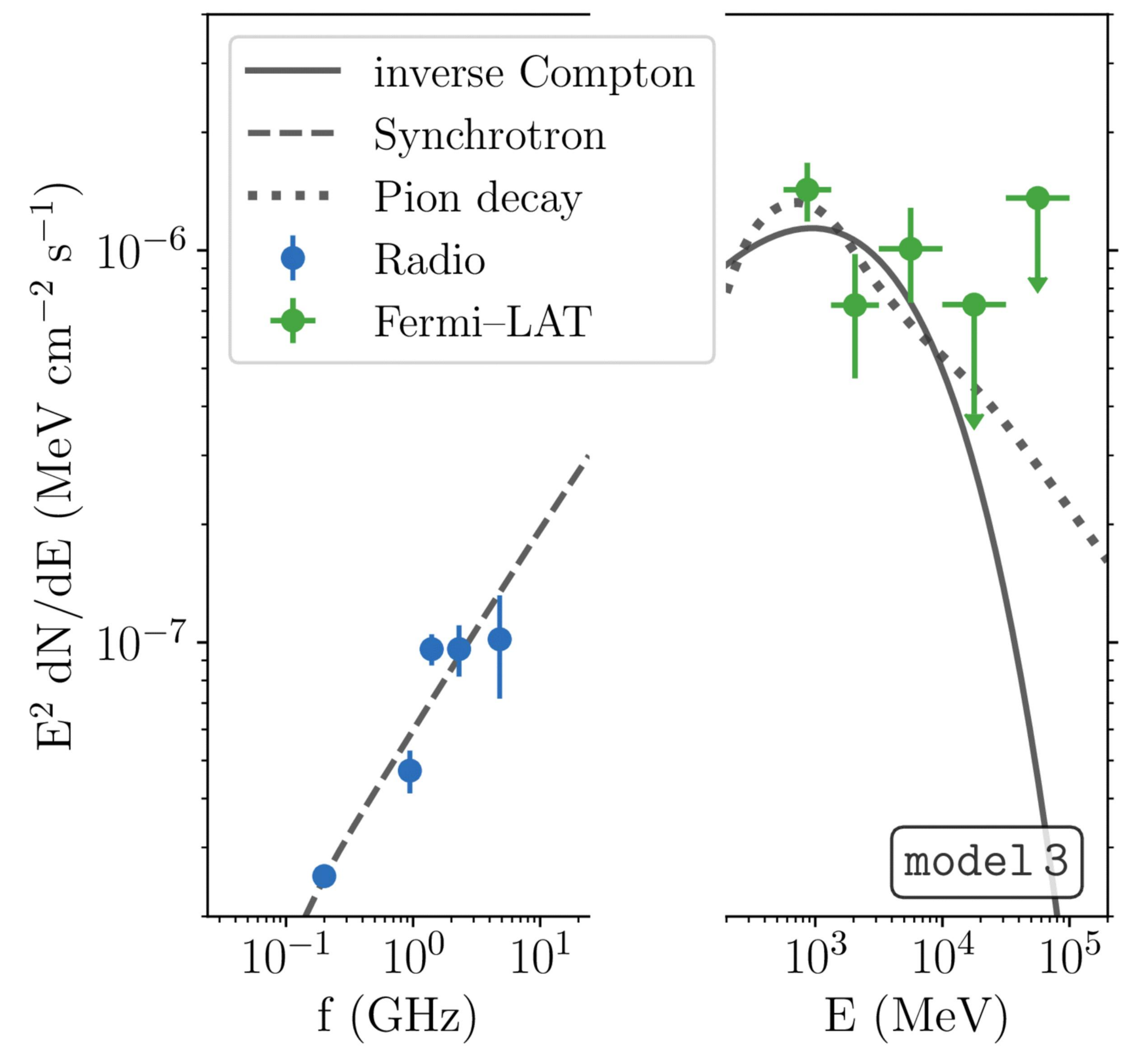
***Ancora SNR*.**

- Recently discovered at high Galactic latitude using observations with ASKAP (Filipović et al. 2024)
- Fermi-LAT detection of extended emission with up to 8.8 σ using a Disk/PL model (energy flux of $(4.80 \pm 0.91) \times 10^{-6}$ MeV cm^{-2} s^{-1})
- Spectrum up to 5 GeV, hotspots above 1 GeV, s=2.3 ± 0.11

- One of only seven objects at high Galactic latitude detected with Fermi-LAT
- Study of this new population of remnants in such unperturbed environments can provide insight into the evolution and properties of SNRs

CBS et al. 2024: A&A, 684, A150 (arXiv:2310.14431)



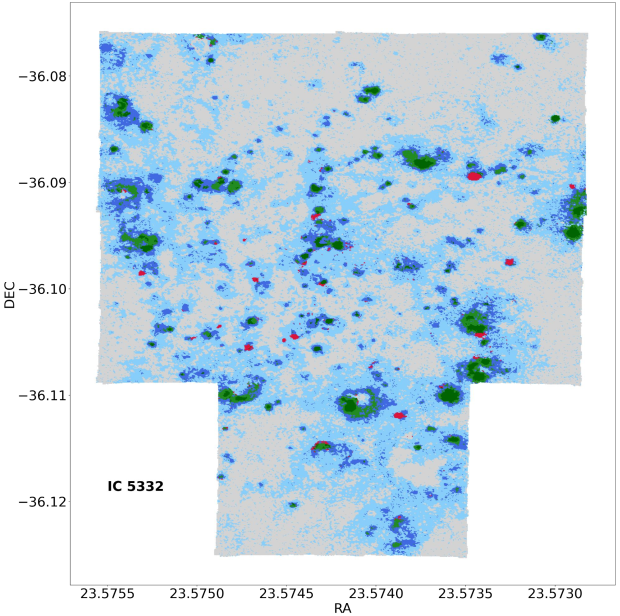


Source name	Extension (deg)	Energy flux (MeV cm^{-2} s^{-1}) 1 GeV–1 TeV	Photon spectral index –	Reference
Ancora SNR/G288.8–6.3	0.92	$(3.29 \pm 0.78) \times 10^{-6(\perp)}$	$2.31 \pm 0.11^{(\perp)}$	This work
G150+4.5	1.5	$5.20 \times 10^{-5(*)}$	$1.62 \pm 0.04_{stat} \pm 0.22_{sys}{}^{(\dagger)}$	Devin et al. (2020)
G17.8+16.7/ FHES J1723.5–0501	0.73	$(1.38 \pm 0.26) \times 10^{-5(\triangledown)}$	$1.83 \pm 0.02_{stat} \pm 0.05_{sys}$ $1.97 \pm 0.08_{stat} \pm 0.06_{sys}$	Araya et al. (2022) Ackermann et al. (2018)
G296.5+10.0/FHES J1208.7–5229	0.7	$8.17 \times 10^{-6(**)}$ $(1.13 \pm 0.24) \times 10^{-5(\triangledown)}$	1.85 ± 0.13 $1.81 \pm 0.09_{stat} \pm 0.05_{sys}$	Araya (2013) Ackermann et al. (2018)
SN 1006/G327.6+14.6	0.1	$(3.63 \pm 1.62) \times 10^{-6(\dagger\dagger)}$	1.57 ± 0.11	Condon et al. (2017)
Calvera SNR/G118.4+37.0	0.53	$3.06 \times 10^{-6(\triangledown\triangledown)}$	$1.66 \pm 0.10_{stat} \pm 0.03_{sys}$	Araya (2023)
G166+4.3	~0.3	$2.87 \times 10^{-6(**)}$	2.7 ± 0.1	Araya (2013)

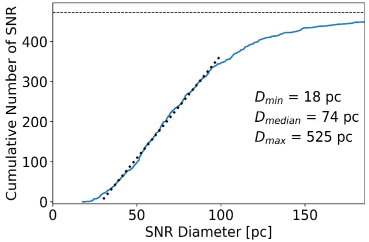
Supernova remnant catalog in the PHANGS survey

Asier Castrillo

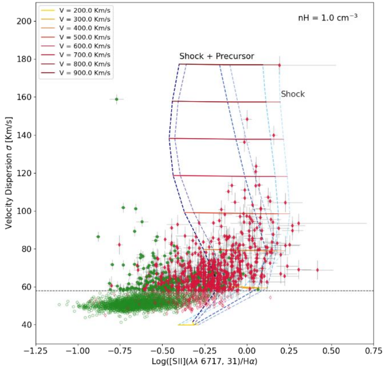
Unsupervised machine learning algorithm



483 SNR

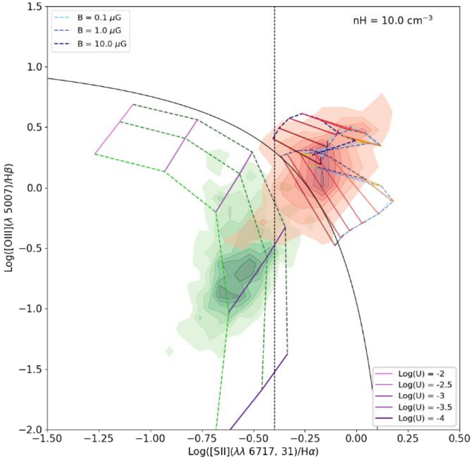


Size distribution

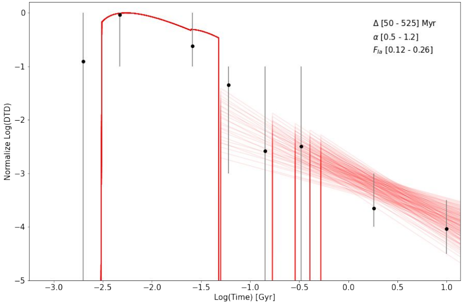


Kinematic analysis

Diagnostic Diagrams



Delay time distribution of SNR



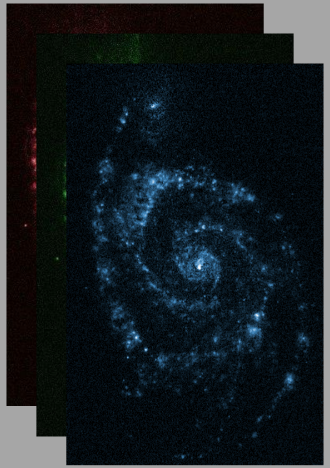
Supernova Remnants III
An Odyssey in Space after Stellar Death
9-15 June 2024, Chania, Crete, Greece

Characterization of M51's supernova remnants with SITELLE

CRAQ Comprendre l'Univers

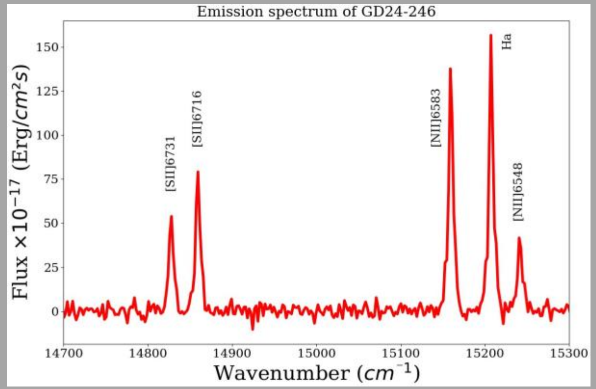
Université Laval

Detection and spectroscopy with SITELLE



Detection of 283 candidates

Confirmation and analysis of 83 SNRs + 20 new



Confirmation criteria :

[SII]:Hα > 0.4

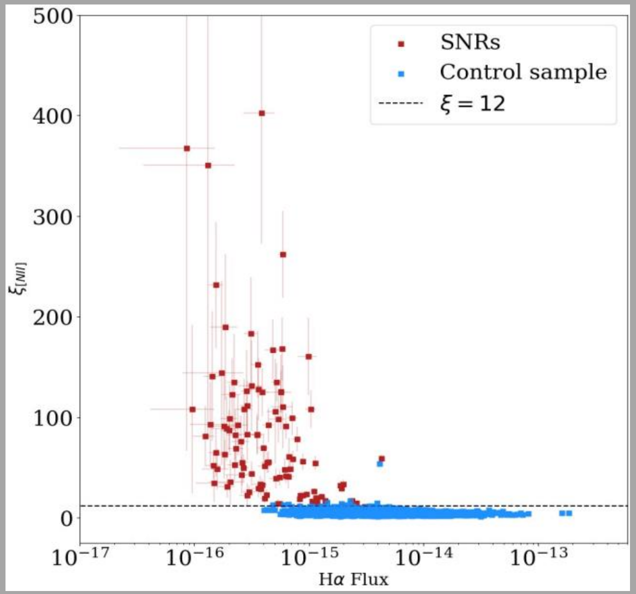
σ > 30 km/s

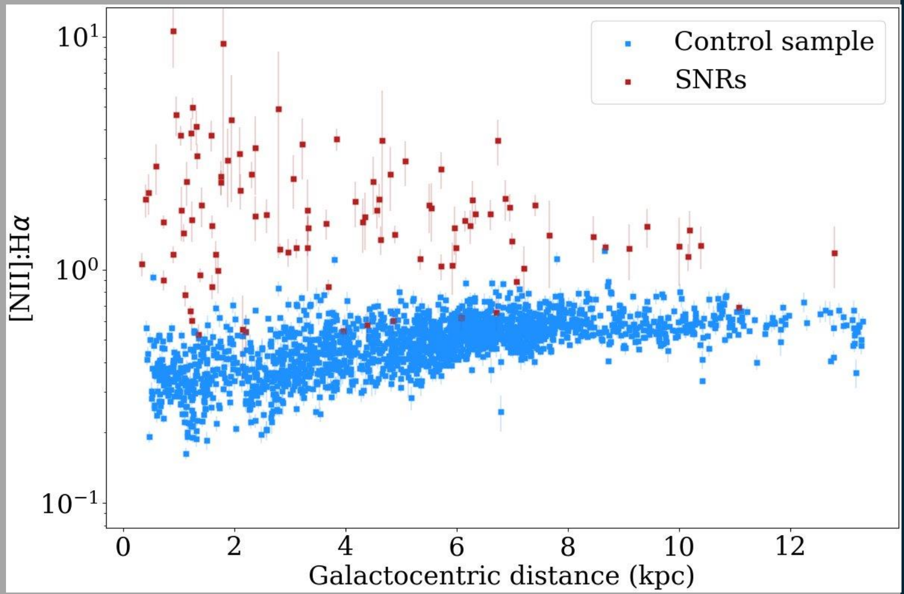
Population analysis :

ξ = [SII]:Hα ×σ

Metallicity gradient

Multi component fit





Billy Gamache
June 2024
Supervised by Laurent Drissen and Carmelle Robert

Supernova Remnants : An odyssey after stellar death

Galactic SNR catalogues: since 1984

Dave Green: dag9@cam.ac.uk
University of Cambridge

https://www.mrao.cam.ac.uk/surveys/snrs

New version later this year. What has changed since the first version.

1. **The number of SNRs has more than doubled:**
   (145 in 1984 version, now 310 entries)

   ⟶ this is good!

2. **Many more distances are available:**
   (so no longer dependant on '$\Sigma - D$' relation, which is not reliable)

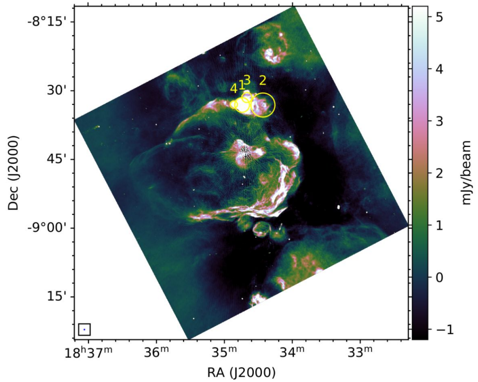
   ⟶ this is good!

3. **Selection effects are still a big problem for statistical studies:**
   (faint SNR are missing, especially towards $l = 0°$ and $b = 0°$;
   young but distant (i.e. small angular size) SNRs are missing;
   many possible/probable remnants still need clarification)

   ⟶ this is not good!

Studying SNRs and their environment with high-resolution radio spectral index maps

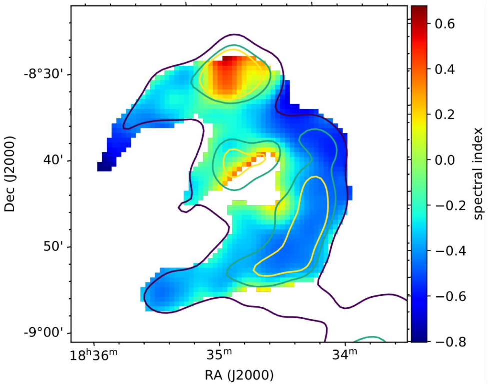
Adriano Ingallinera, INAF (poster S1.8)



SARAO MeerKAT Galactic Plane survey at 1.3 GHz

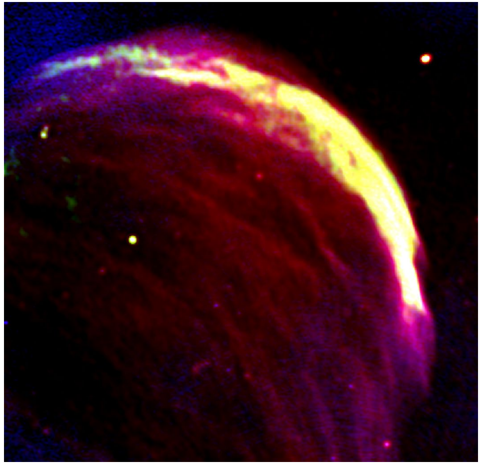
Characterization of SNRs (see Sara Loru's talk)

MWA-MeerKAT spectral index maps



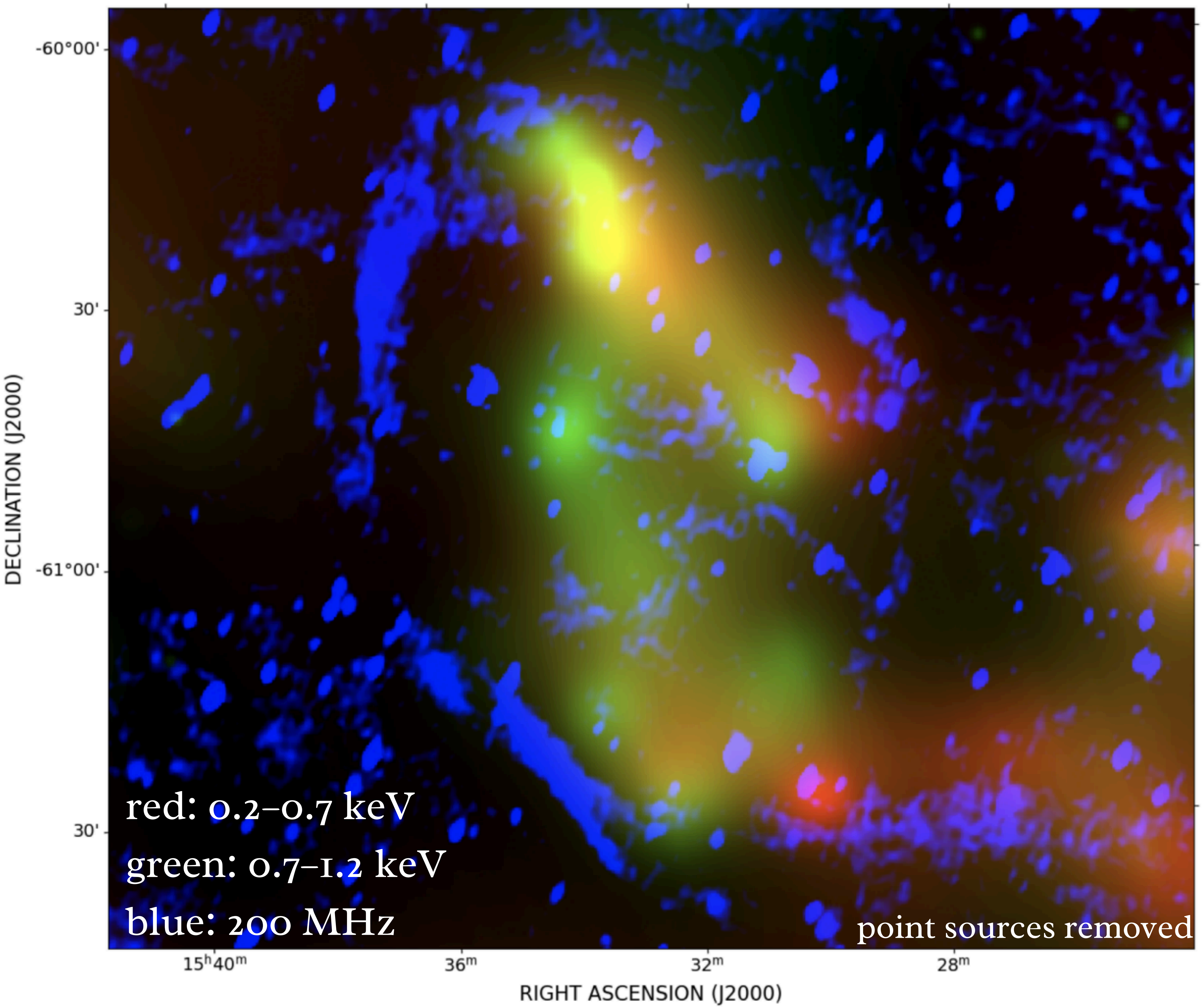
Data reprocessing to build in-band spectral index maps

Using *S*-band observations for a wider frequency range



A. Khokhriakova, S. Mantovanini,
W. Becker, N. Hurley-Walker,
G. E. Anderson, and L. Nicastro

SNR G321.3-3.9 observed with **multi-band radio** data and **SRG/eROSITA**



Disentangling the evolutionary paths of Supernova Remnants: observational evidence of (non) multi-wavelength emission

I. Leonidaki [1,2], A. Zezas [1, 2], K. Anastasopoulou [3], M. Kopsacheili [4] and P. Boumis [5]

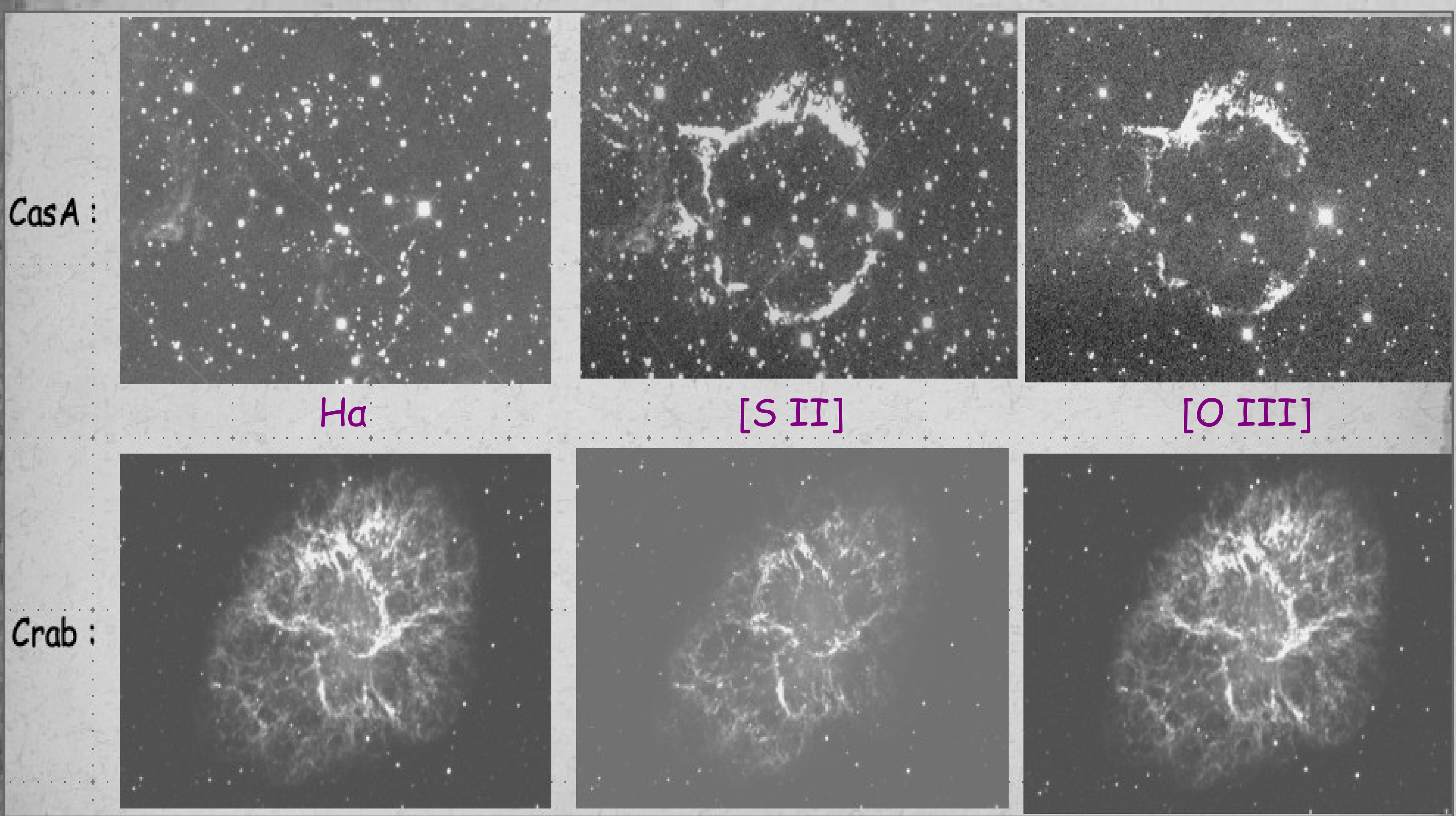
MOTIVATION

- Provide ***for the first time*** an observational framework for understanding the evolution of SNRs based on the Galactic SNR ***population***
- Investigate **SNR evolution** through multi-wavelength emission as a function of age and environment
- Test **theoretical models**.

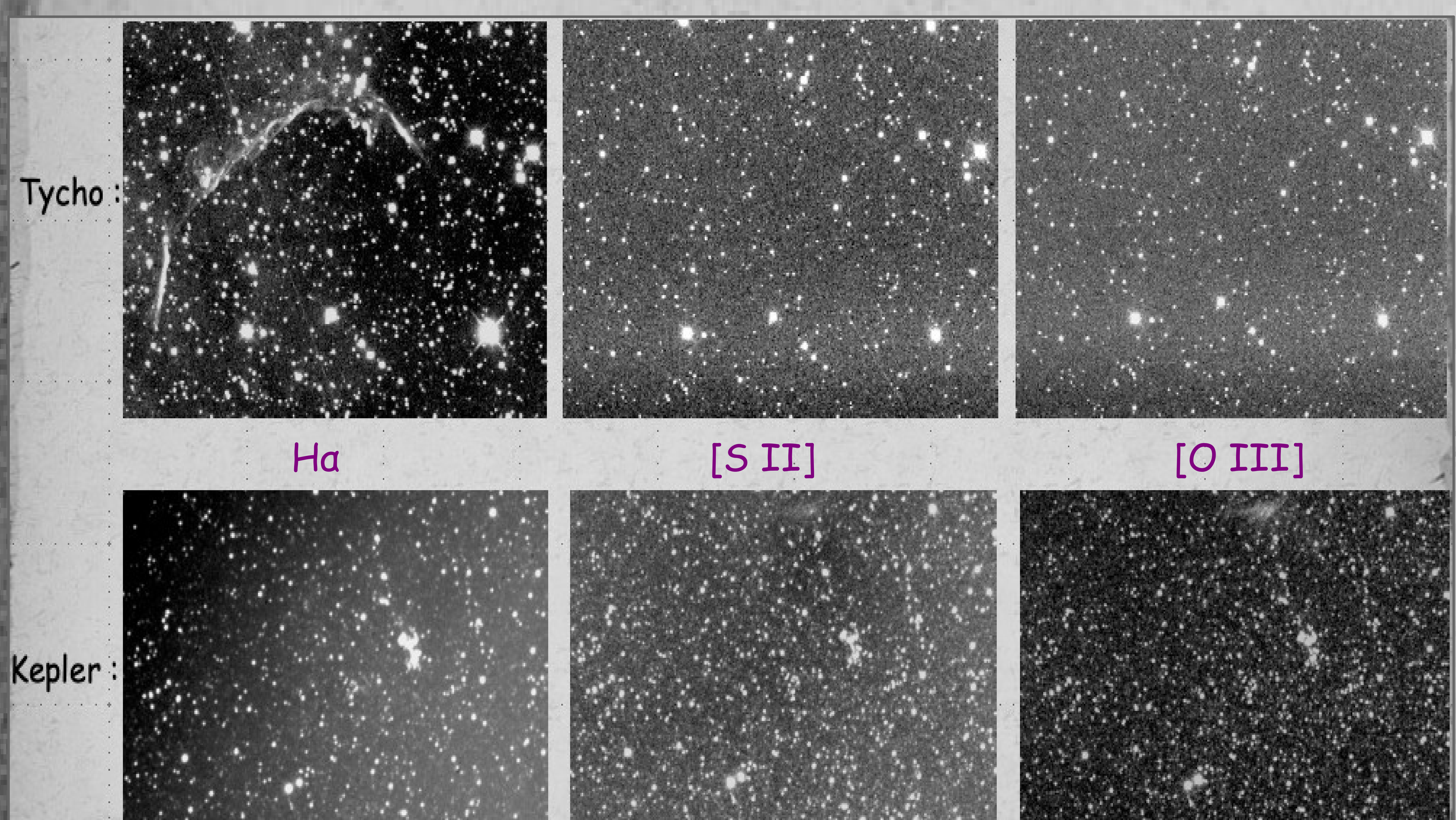
OBJECTIVE

Optical coverage of all Galactic SNRs in narrow-band filters of SNRs' interest (i.e. Hα, [S II], [O III], Hβ) since despite the wealth of data, only ~35% of Galactic SNRs had been observed in the optical band so far.

The presented sample is the first of a series dealing with the optical study of X-ray emitting, Galactic SNRs (29 objects)



	Age (yrs)	log(Hα)	log[SII]	[SII]/Hα	Lx (0.3-10.0 keV)
CasA:	316-352	-17.07±18.57	-17.93±20.16	0.14 ±2x10^5	2.79e+37
Kepler:	417	-17.66±20.23	-18.07±19.89	0.39±4x10^5	1.53e+36
Tycho:	449	-14.67±18.04	-15.63±19.58	0.11±0.0	1.37e+36
3C58 :	830	-17.00±19.68	-17.86±19.86	0.14±0.0	3.30e+34
Crab :	967	-	-	-	1.37e+37



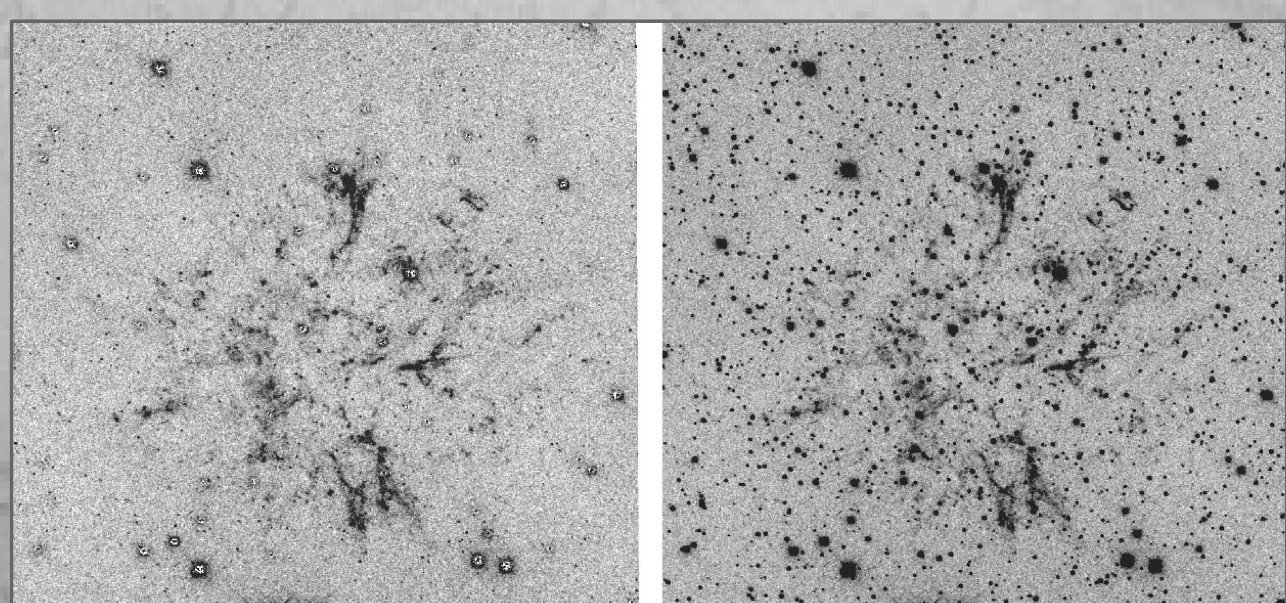
RESULTS

(Leonidaki et al., submitted)

- Integrated Hα, [S II], [O III] fluxes.
- Only 5/29 of the X-ray emitting SNR sample emit in the optical

Tycho, Kepler → Type Ia
CasA → Type IIb
3C58, Crab → Plerionic

Type Ia, Type IIb → Binary systems / massive progenitors
↓
Dense stellar winds and/or wind-driven bubbles modify/transform substantially the CSM
↓
Possible explanation of optical emission in young SNRs (?)



Hα image of 3C58 (G130.7+3.1)

A systematic meta-analysis of physical parameters of Galactic supernova remnants

I. Chousein-Basia, A. Zezas, M. Kopsacheili, I. Leonidaki

What did we do?

Collection and analysis of electron density, shock velocity, and age data from published studies for 63 Galactic SNRs.

Why?

No systematic analysis on the properties of Galactic SNRs.

What methods did we use?

A personalized data homogenization technique, i.e. Monte Carlo sampling, to handle and utilize uncertain data.

Here's what we found…

- **Intra-object statistics**
  - For 34 objects, information on individual regions (Fig. 1).
- **Population statistics**
  - Shock velocity and electron density distribution (Figs. 2, 3).
- **SNR evolution**
  - Clear anticorrelation between velocity and age and weak correlation between velocity and density, in agreement with models of SNR evolution (Figs. 4, 5).
  - Age is the driving factor of shock velocity for optically emitting SNRs.