Report of ISM/SNR WG meeting

- Report on DE-RU WG chairs meeting at IKI in November 2018 (MF)
- Report on ISM: PV proposal "Cha-III molecular cloud" + XMM AO17 (MF)
- Discussion on role/calibration of background
- WG membership
- EC requests
- Discussion on WG projects in context of PV/eRASS1 ("early science")
- Presentation on SNR candidate simulations (WB)

WG administrative issues

- Report on first joint DE-RU WG chairs meeting at MPE in November 2018: change of RU PV target policy: now "shadowing" the DE subjects instead of "all-in"
- Review of WG Wiki page(s)

Home Page of the eRosita SNR, Diffuse emission Working Group

- Members
- Presentations
- Science Projects
- Meetings
- Collaborations

- Review of WG members list
- EC requests (EC to be listed on WG or on Consortium level?)
- Discussion on WG projects in context of PV/eRASS1 ("early science")
- Report on status of PV proposal and associated observations

Members of the SNRs, diffuse emission WG

WG Chairs: Werner Becker, Michael Freyberg, Manami Sasaki

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Science Projects

The ISM is a highly dynamic structure, consisting of various phases, from cold and high-density star-forming clumps, over molecular and atomic clouds, photoionised regions, up to tenuous and hot plasma with temperatures of 10^5 - 10^7 K, from which X-ray emission is observed. The X-ray emission is partly in the form of a diffuse component, and partly in the form of individual sources, which may cover substantial fractions of the sky.

Stellar outputs in the form of, e.g., radiation and stellar winds of massive stars, supernova explosions, and jets and flares from accreting binaries are responsible for the injection of energy and matter into the interstellar medium. X-ray observations allow us to to constrain the mixing of the stellar ejecta with interstellar gas and the impact of the expanding shocks on the ambient ISM and thus provide an important diagnostic tool for the physics of the ISM.

Title	**Lead**	**Details**	**PhD Project**
Milky Way			
3-D structure of the X-ray emission and properties of the Local Interstellar Medium	M. Freyberg, M. Sasaki	Details	Y
3-D galactic structure of soft diffuse X-ray emission (0.2-2 keV) beyond the LHB	M. Freyberg, M. Sasaki	Details	-
Study of the Orion-Eridanus superbubble	M. Freyberg, M. Sasaki	Details	-
Properties of the Milky Way halo	M. Freyberg	Details	-
Large nearby SNRs	M. Sasaki, W. Becker	Details	Y
Search for SNRs in the Milky Way	W. Becker, M. Sasaki	Details	Y
Nonthermal SNRs in the Milky Way	G. Pühlhofer, W. Becker, M. Sasaki	Details	Y
Cosmic ray acceleration around star clusters	M. Sasaki	Details	Y
Fermi bubbles	A. Strong	Details	-
Galactic ridge emission	J. Schmitt	Details	Y
Dust scattering halos	P. Predehl, A. Santangelo	Details	-

Nearby galaxies			
SNRs and Bubbles in the Magellanic Clouds	F. Haberl, M. Sasaki, W. Becker	Details	Y
Hot interstellar medium in galaxies	M. Sasaki, F. Haberl	Details	Y
Time critical			
SNe in the Milky Way and in the Magellanic Clouds	W. Becker, M. Sasaki, F. Haberl	Details	-

PV Observation

Title	Proposer	Target	Duration
Utilizing the new window to carbon-line astrophysics of the Local Interstellar Medium	Chamaeleon Dark Cloud III	60ks	M. Freyberg

CAASTRO collaboration

Title	Proposers	Collaborators	Details
Supernova remnants, superbubbles, and the global structure of the interstellar medium in the Magellanic Clouds	M. Sasaki, F. Haberl, J. Kerp	L. Staveley-Smith, M. Filipovic, B. Koribalski, S. Points	Details

Abstract:

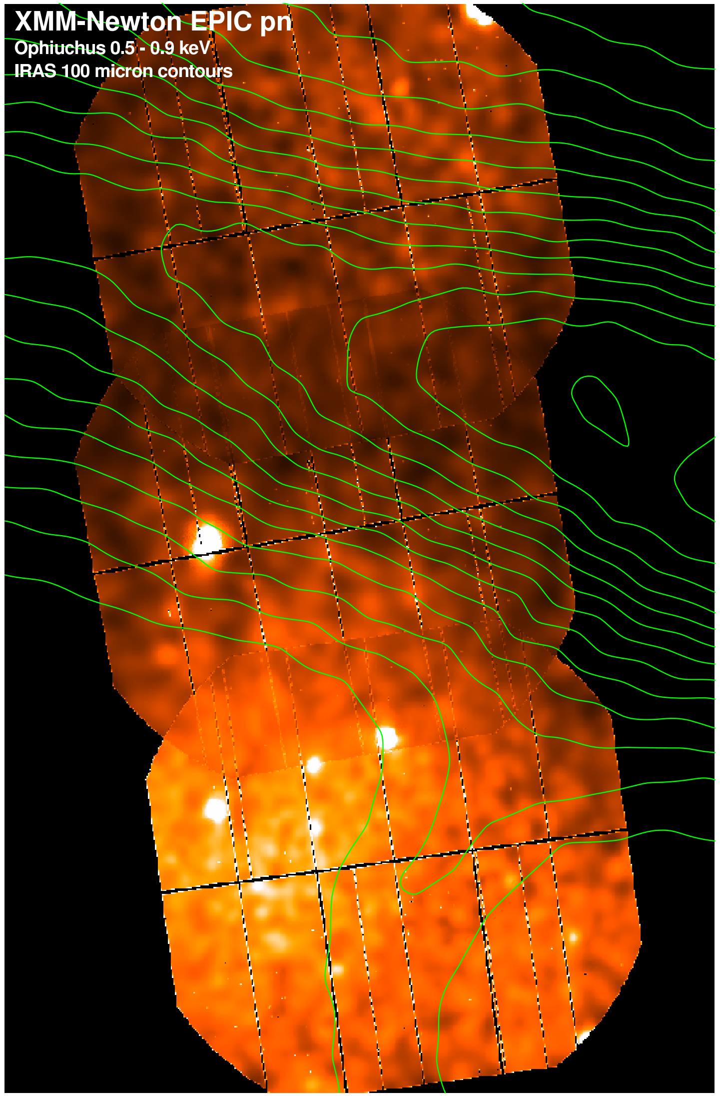
We aim to detect diffuse emission from the Local Interstellar Medium (Local Hot Bubble) in the direction of the darkest regions of the sky (X-ray shadowing) and produce X-ray spectra towards these characteristic locations. For each location we aim to isolate local thermal from distant thermal (and any non-thermal) emission, determine temperature components of the thermal emission, and via line ratios conclude on the origin of the thermal emission (i.e., plasma state). We propose to observe two fields for 60 ks each (out of a list of 6 targets in decreasing priority, to be selected on visibility). The proposed observation will make use of the uniqueness of eROSITA, and will illustrate the performance of the instruments.

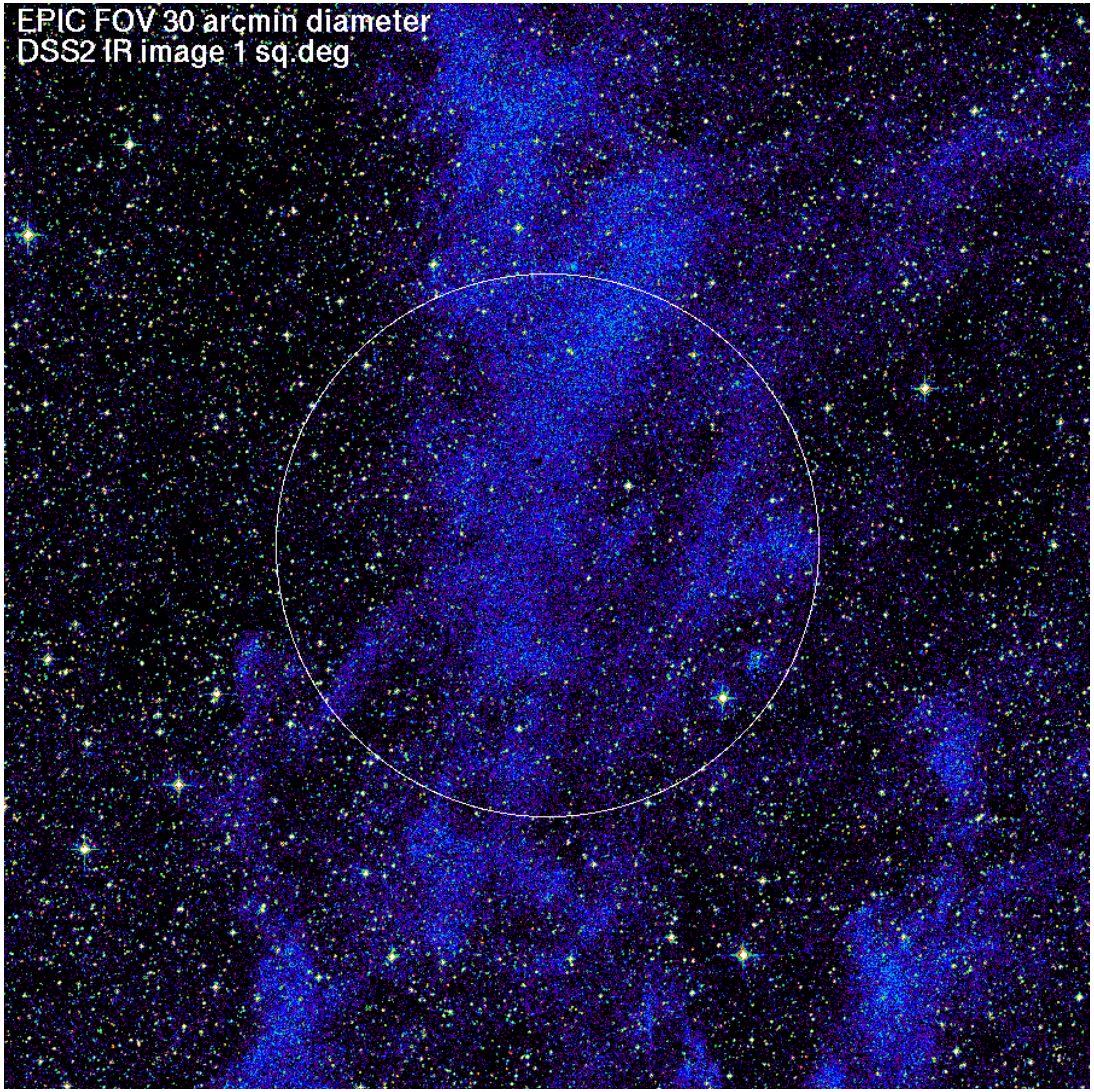
1 Scientific justification, main scientific goals:

We aim to detect diffuse emission in the direction of the darkest regions of the sky, and produce X-ray spectra towards these characteristic locations. For each location we aim to isolate local thermal from distant thermal (and any non-thermal) emission, determine temperature components of the thermal emission, and via line ratios conclude on the origin of the thermal emission (i.e., plasma state).

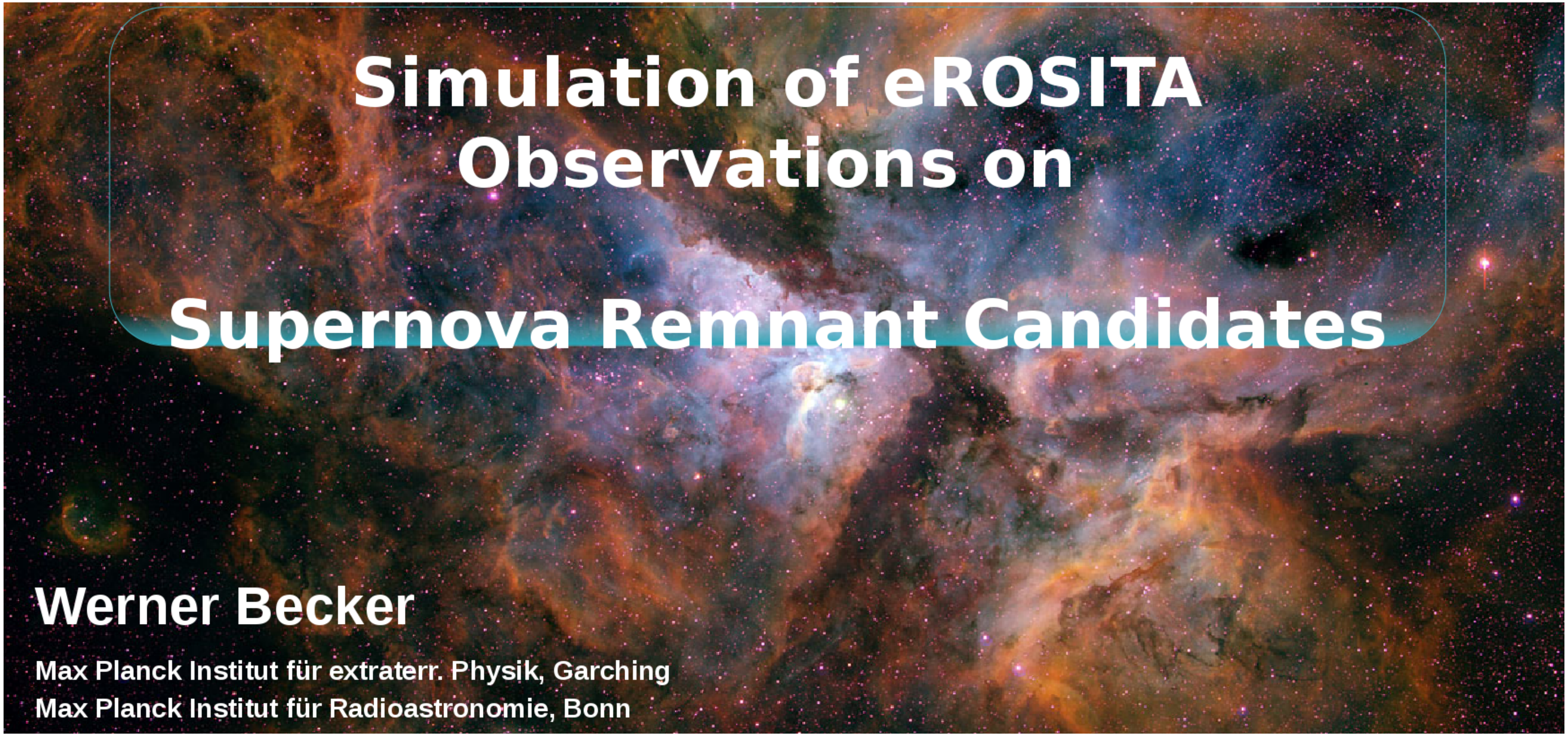
Target	RA	Dec	[ks]	comment
Cha III	12 52 54	-79 52 18	60	no star forming activity in cloud
Ophiuchus	16 40 48	-24 12 00	60	large contrast
Barnard 68	17 22 43	-23 48 05	60	very dense
MBM 20	04 35 46	-14 37 48	60	
MBM 12	02 56 05	+19 28 35	60	
MBM 16	03 20 00	+11 14 00	60	

The undisturbed local interstellar medium towards a really dark cloud (Cha-III) → XMM-AO17





Left: merged image of three XMM-Newton EPIC-pn observations of the Ophiuchus molecular cloud in the $0.5 - 0.9\,\text{keV}$ band with IRAS $100\,\mu\text{m}$ contours, it casts a strong shadow onto the X-ray background (Freyberg 2004).
Right: XMM-Newton EPIC field in AO17 overlayed on DSS2 IR image, scheduled for 25 March 2019, for 100 ks, 3533_0824720101


Simulation of eROSITA
Observations on
Supernova Remnant Candidates
Werner Becker
Max Planck Institut für extraterr. Physik, Garching
Max Planck Institut für Radioastronomie, Bonn

Scientific Background

- We observe in galaxies like the Milky Way 1 supernova explosion per ≈ 30 to 50 years.
- The radio lifetime of a supernova remnant, on average, is about 60,000 years (Frail et al., 1994). The X-ray lifetime is about twice that long.
- At any given time, there should be 1200 to 2000 SNRs in our Galaxy observable e.g. in the radio and X-ray bands
- However, there are less than 300 confirmed radio SNRs in the Milky Way at this moment!

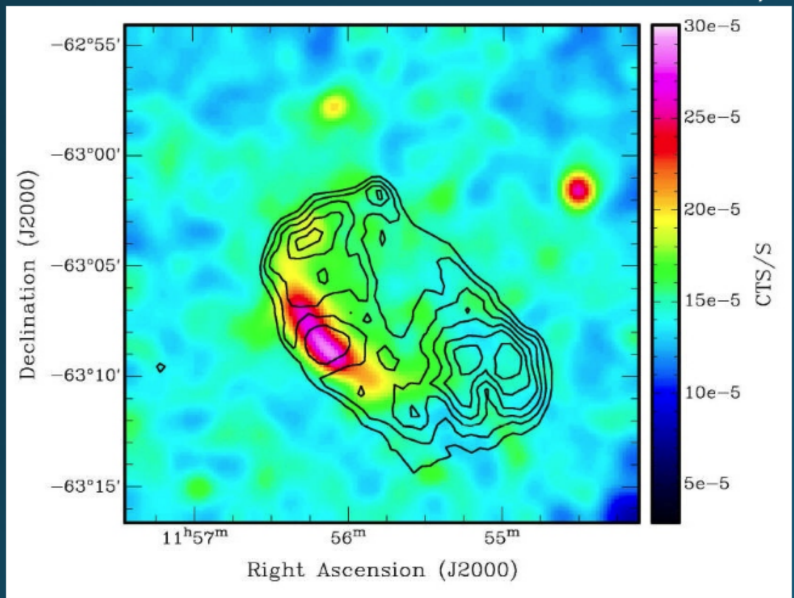
Scientific Background

- This large discrepancy between observed and expected SNRs is mainly caused by a strong bias towards bright resolved objects in observations towards the inner Galaxy.
- In typical radio continuum surveys, we miss the compact, presumably very young SNRs, because they are either confused by other nearby objects or mistaken for extragalactic sources.
- We also miss low surface brightness SNRs, because they are below the sensitivity limit of the survey or they are confused by other nearby objects.

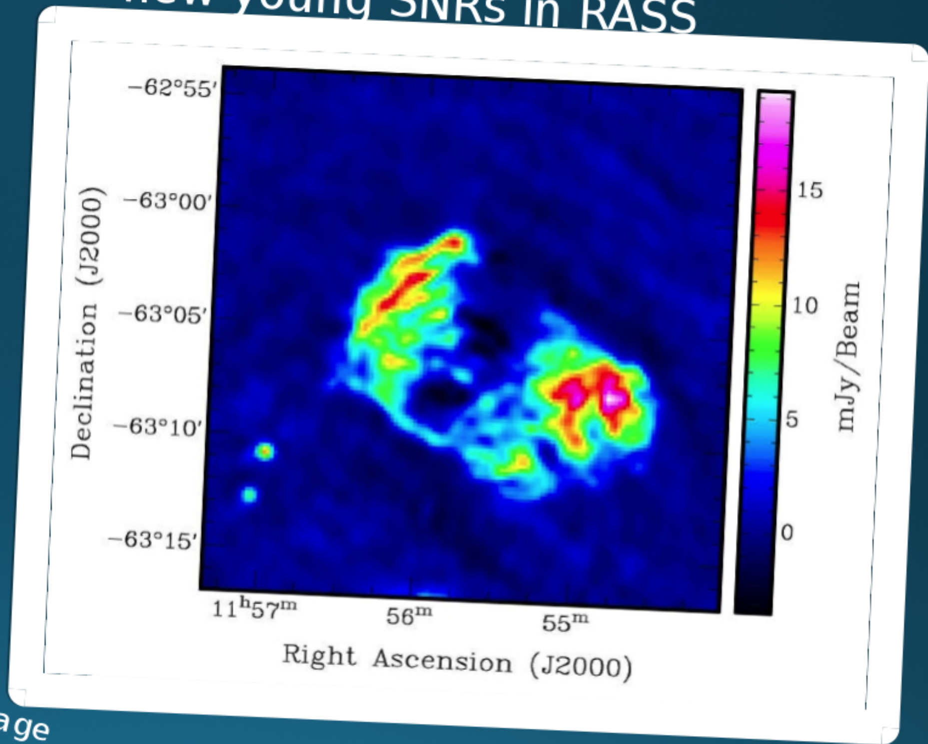
Scientific Background: SNR candidates in RASS: G296.7-0.9

Prinz & Becker 2013

ROSAT RASS image + MOST (contour lines)



new young SNRs in RASS



ATCA (20 cm) image

Test case: SIXTE simulations of RCW 103:

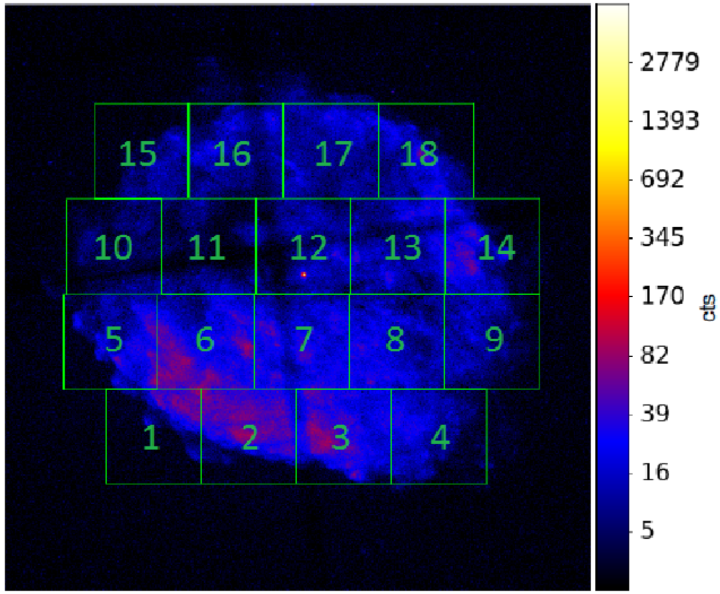
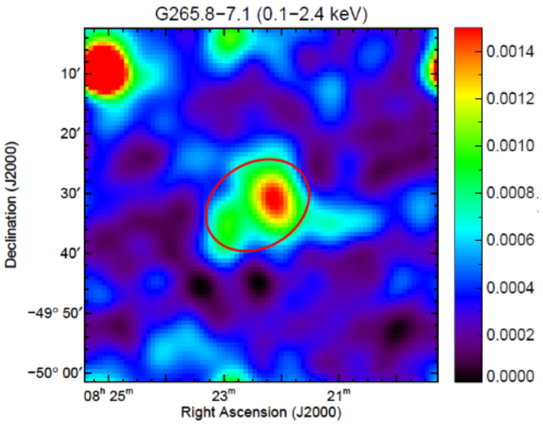


Figure 5.4: Source regions of the SNR RCW 103 after subdividing the entire remnant, which yielded fits with $\chi^2_{red} < 2$ for the fits of the extracted spectra.

SIXTE simulations of SNR candidates

RASS data



eROSITA / SIXTE

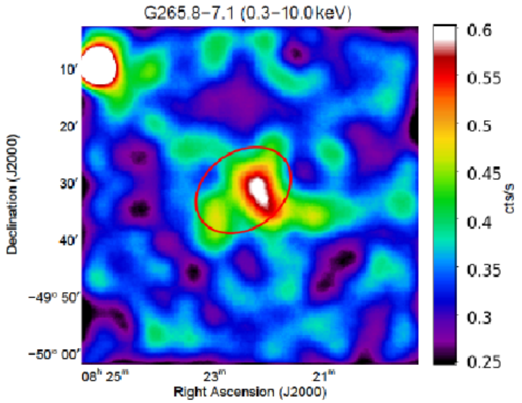


Figure 6.1: Simulated eROSITA image of the SNR candidate G265.7-7.1 without considering the already known bright sources in the 1RXS catalogue. The spectrum of the candidate was used for the whole image field.

eROSITA / SIXTE

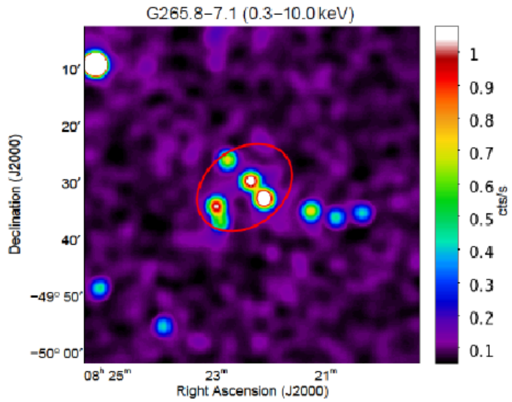


Figure 6.3: Simulated eROSITA image of the SNR candidate G265.7-7.1 while considering the already known bright sources in the 1RXS catalogue. The powerlaw spectra of the bright sources were taken from the 1RXS catalogue, the generated spectrum of the SNR candidate was used for the remaining image field without bright sources.

Conclusions:

- It is difficult to impossible to realistically simulate faint extended source with SIXTE without having very detailed input spectra and images…
- Results of the SIXTE SNR candidate simulations:
  - Spectrum of SNR candidate for whole image:

    → flatter topography of the simulated fields (worse for larger image fields)

    → no remarkable SNR structure in simulated images
  - Spectrum of SNR candidate and from sources of 1RXS (where available):

    → Sources from 1RXS dominate, extended source gets subdivided in multiple point-like bright sources → simulation shows dominant point-like sources and no extended structure


Thank you for your attention!