Galactic compact objects with *eRosita*

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Isolated X-ray emitting neutron stars

Total number of NSs in the Galaxy: $\sim 10^9$

- radio pulsars: ~ 10^3 *(Manchester et al. , 2005)*
- X-ray binaries:~ 10^2 *(Liu et al. 2006, 2007)*

The vast majority of NSs is not observed!

Characterization of NS population:

- using radio pulsars → obs. biases due to unknown distribution of B-filed strength and geometry, uncertain emission mechanism
- using XRBs → obs. biases due to uncertain details of binary evolution scenario(s)

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Characterization of NS population:

Isolated X-ray emitting neutron stars potentially provide an independent way to study the NS population of the Galaxy.

Not strongly affected by magnetic field or binary evolution.

Isolated X-ray emitting neutron stars

- Isolated thermally emitting NSs ("Magnificent Seven"); *F. Haberl, 2007*
- Magnetars (AXP/SGR), 10+4; S. *Mereghetti, 2008*
- Compact Central Objects (CCO) in SNRs, 8; *E.V. Gotthelf & J. P. Halpern, 2007*

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Isolated thermally emitting neutron stars

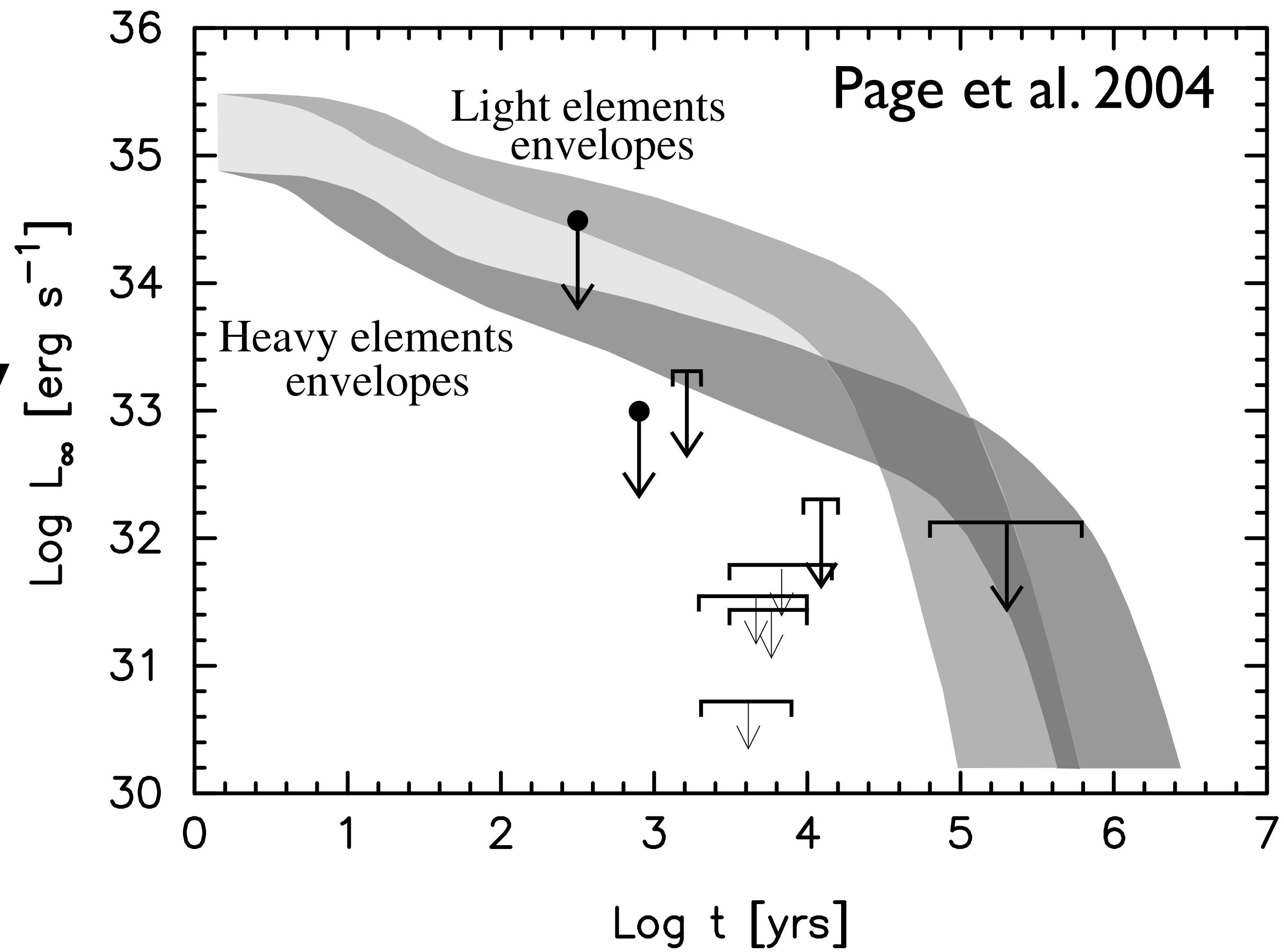
X-ray emission is characterized by BB-continuum with little photo-electric absorption

Haberl, 2007:

Object	kT eV	Period s	Amplitude %	Optical mag	PM mas/year
RX J0420.0–5022	44	3.45	13	B = 26.6	
RX J0720.4–3125	85-95	8.39	8-15	B = 26.6	97
RX J0806.4–4123	96	11.37	6	B > 24	
RBS 1223[(a)]	86	10.31	18	$m_{50ccd} = 28.6$	
RX J1605.3+3249	96	6.88?	?	B = 27.2	145
RX J1856.5–3754	62	–	<1.3	B = 25.2	332
RBS 1774[(b)]	102	9.44	4	B > 26	

Isolated thermally emitting neutron stars

Population modeling (assuming different cooling scenarios) is difficult as ages are only determined in a few cases *(Kaplan et al. 2007)*.
To test theoretical models one needs sufficient number of sources!



Turner et al., 2010: the number of isolated thermally emitting NSs in RASS/BSC is **7÷50**;
eRoseta should find **240÷1500**!

CCO and Magnetars

- can also be detected in *eRosita* survey.

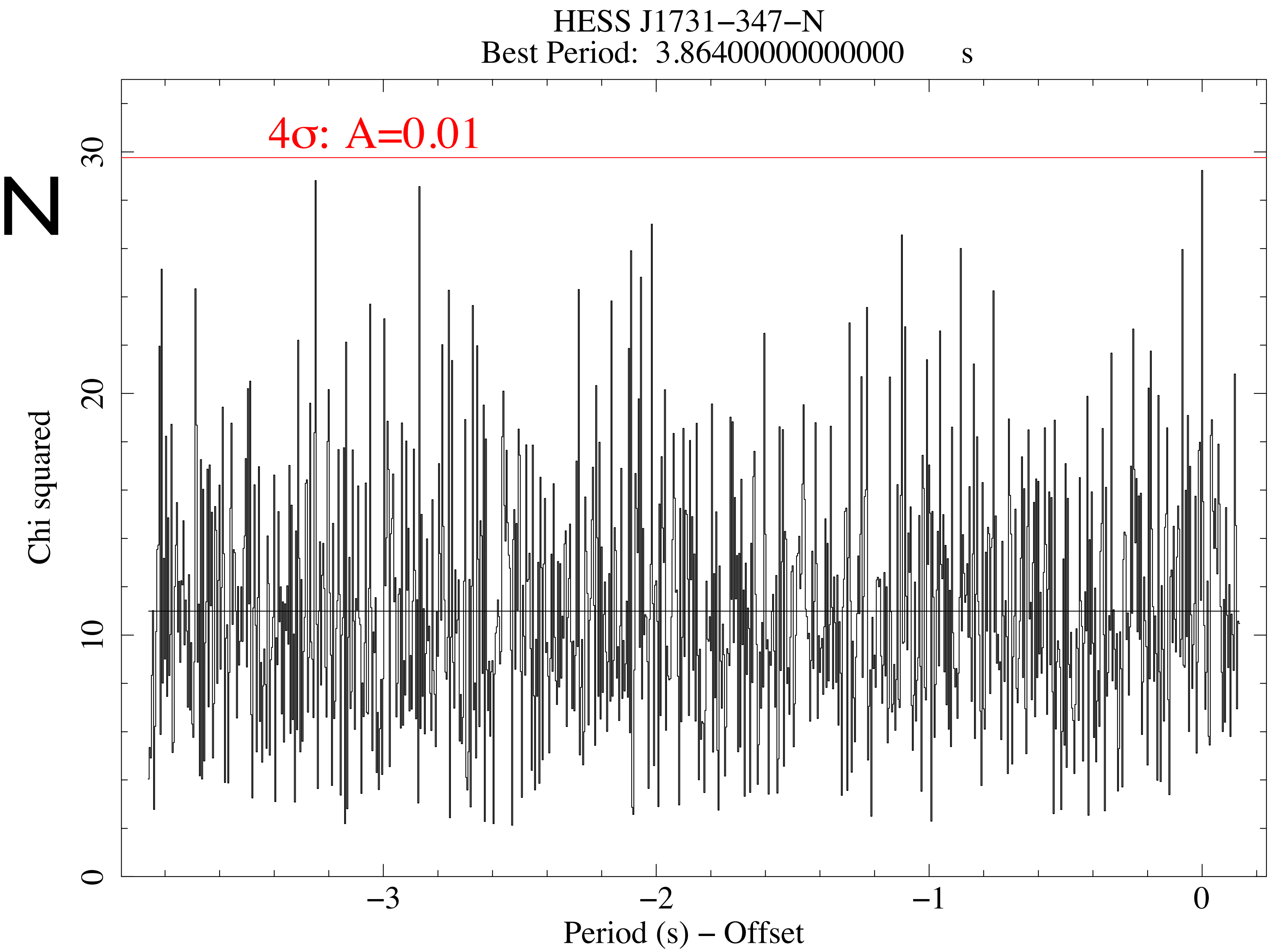
CCO in HESSJ 1731-347,
Pühlhofer, Klochkov, Santangelo, in prep.

Both classes are associated with SNRs. The SNR population of the Galaxy is going to increase, also using TeV-range (recent discoveries by H.E.S.S., future observations with CTA)

Preliminary analysis of TeV data by H.E.S.S. collaboration

CCO in HESS J1731-347

No pulsations detected by XMM/PN



From simple BB-fit:

$$D_{10\,\mathrm{km}} \simeq 30\,\mathrm{kpc}$$

$$D_{15\,\mathrm{km}} \simeq 45\,\mathrm{kpc}.$$

Distance to SNR:
~3.2 kpc
(Tian et al. 2008)

Modification of the spectrum by NS atmosphere gives lower limit *(V. Suleimanov, priv. comm.)*:

D ~19 kpc !

Wanted!

Several compact object types not discovered yet:

- Isolated accreting NSs (Bondi-Hoyle accretion)

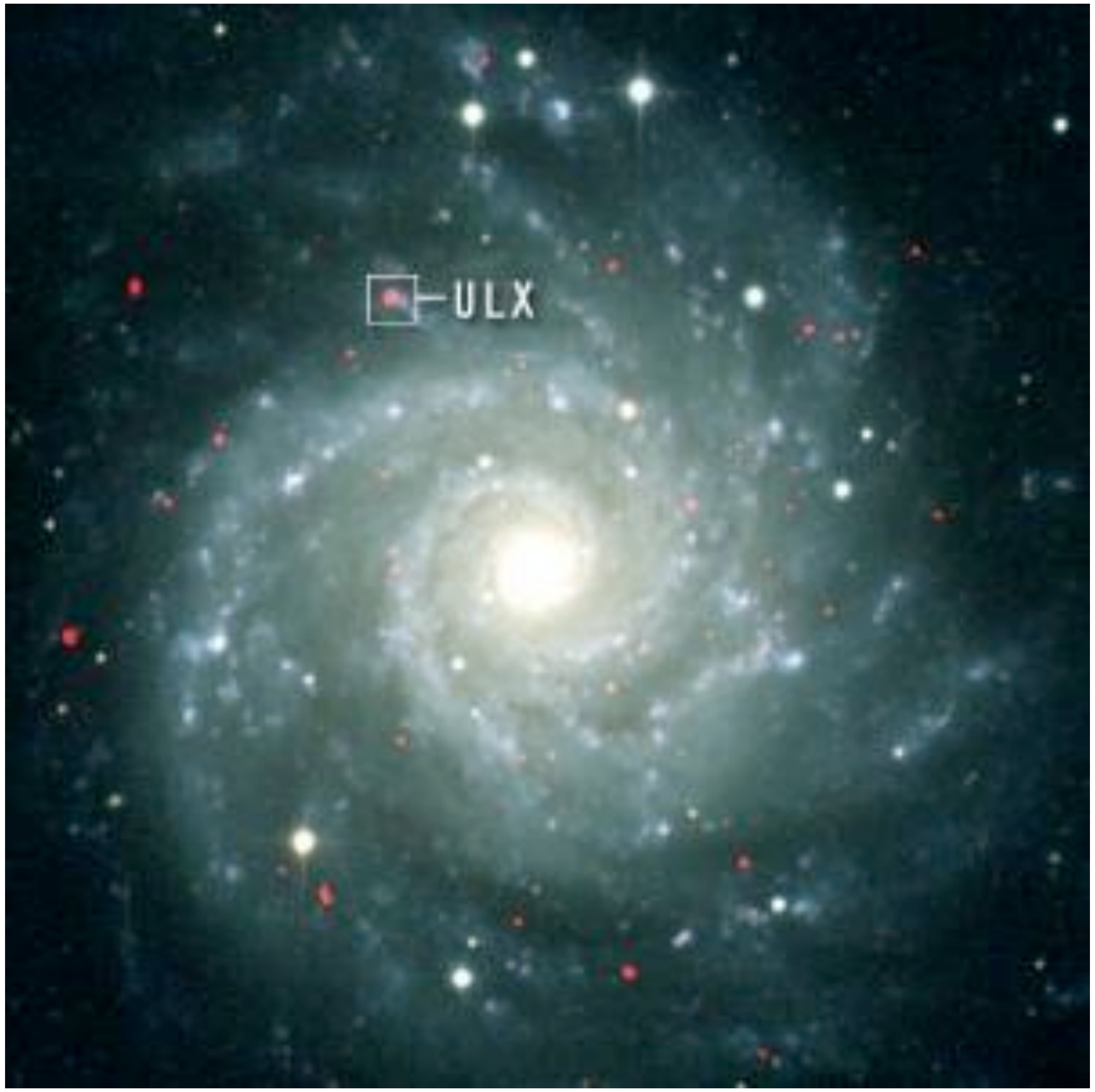
  MHD-simulations show that $\dot{M}$ given by Bondi formula should be reduced by 10^{-3}, consistent with essentially no such sources detected by ROSAT. But *eRosita* might find some!
- Isolated BHs (accretion or some exotic emission)

  probably some unidentified EGRET sources *(Punsly et al. 2000)*
- Isolated NSs on the propeller stage *(Blondin & Popov 2010)*
- Extragalactic magnetars.

Ultraluminous X-ray sources

- sources with $L_{\mathrm{X}} \gtrsim 10^{39}$ erg/s, Eddington luminosity for a $10 M_{\odot}$ black hole (Fabbiano 1989)

If emitting isotropically,
M $\sim 20 \div 10^3 M_{\odot}$
- "Intermediate Mass Black Holes"



Composite X-ray (red)/optical (blue & white) image of the spiral galaxy M74 (Liu et al.)

Ultraluminous X-ray sources

ULXs in star-forming galaxies (SFG) within ~30 Mpc can in principle be resolved with *eRosita:* 30´´ corresponds to ~1/3-1/2 of the linear size of the Galaxy

Prokopenko & Gilfanov (2009) considered:

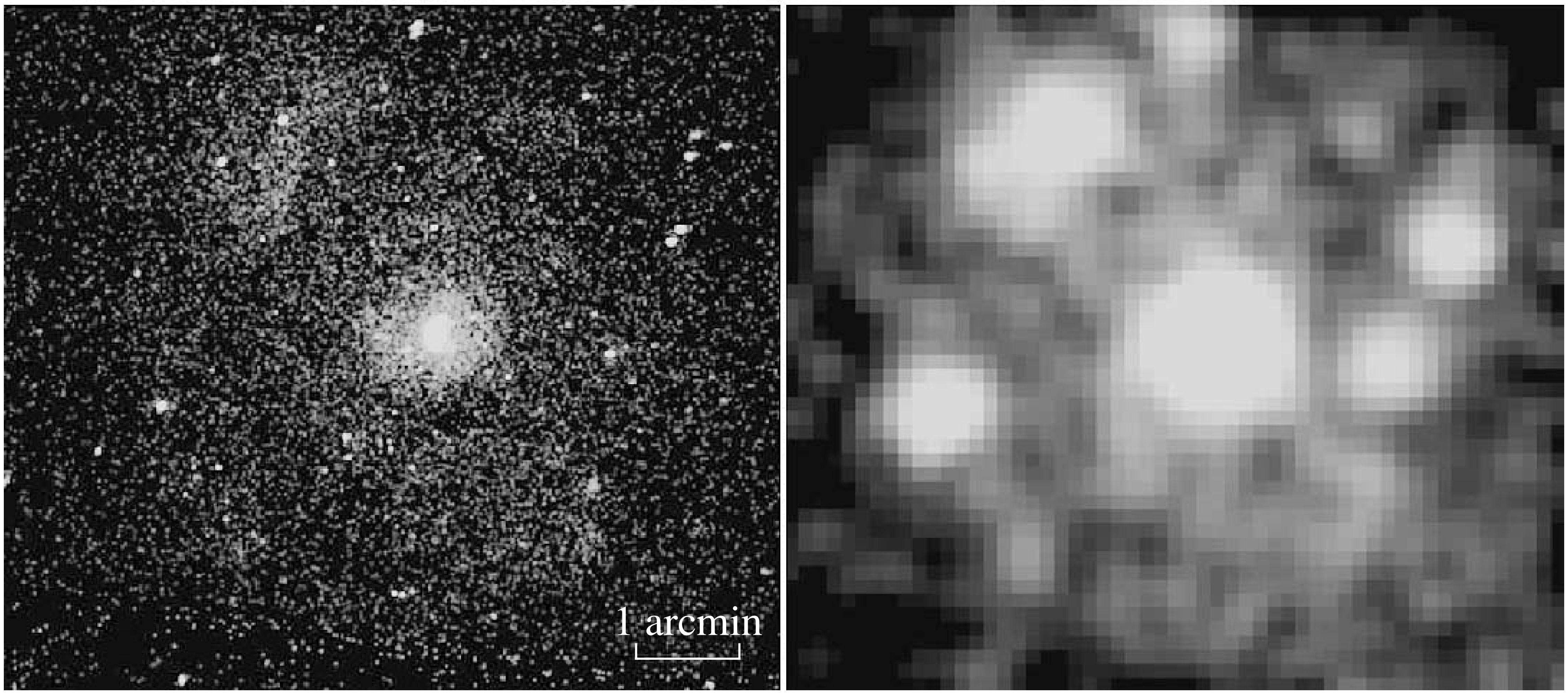
- galaxies within 35 kpc
  $L_{\mathrm{X}} \simeq 10^{39}\,\mathrm{erg\,s^{-1}} \rightarrow F_{\mathrm{X}} \simeq 2\times10^{-14}\,\mathrm{erg\,s^{-1}cm^{-2}}$
- luminosity function of X-ray sources in SFGs for
  $L_{\mathrm{X}} \simeq 10^{39}\,\mathrm{erg\,s^{-1}}$ *(Grimm et al. 2003)*
- distribution of galaxies in star forming rate *(Bell 2003)*

Result: $N_{\mathrm{ULX}} \simeq 85$

Ultraluminous X-ray sources

M 51 (star-forming galaxy at 7.5 kpc)

Chandra eRoseta (simulated)



Prokopenko & Gilfanov 2009

ART-XC

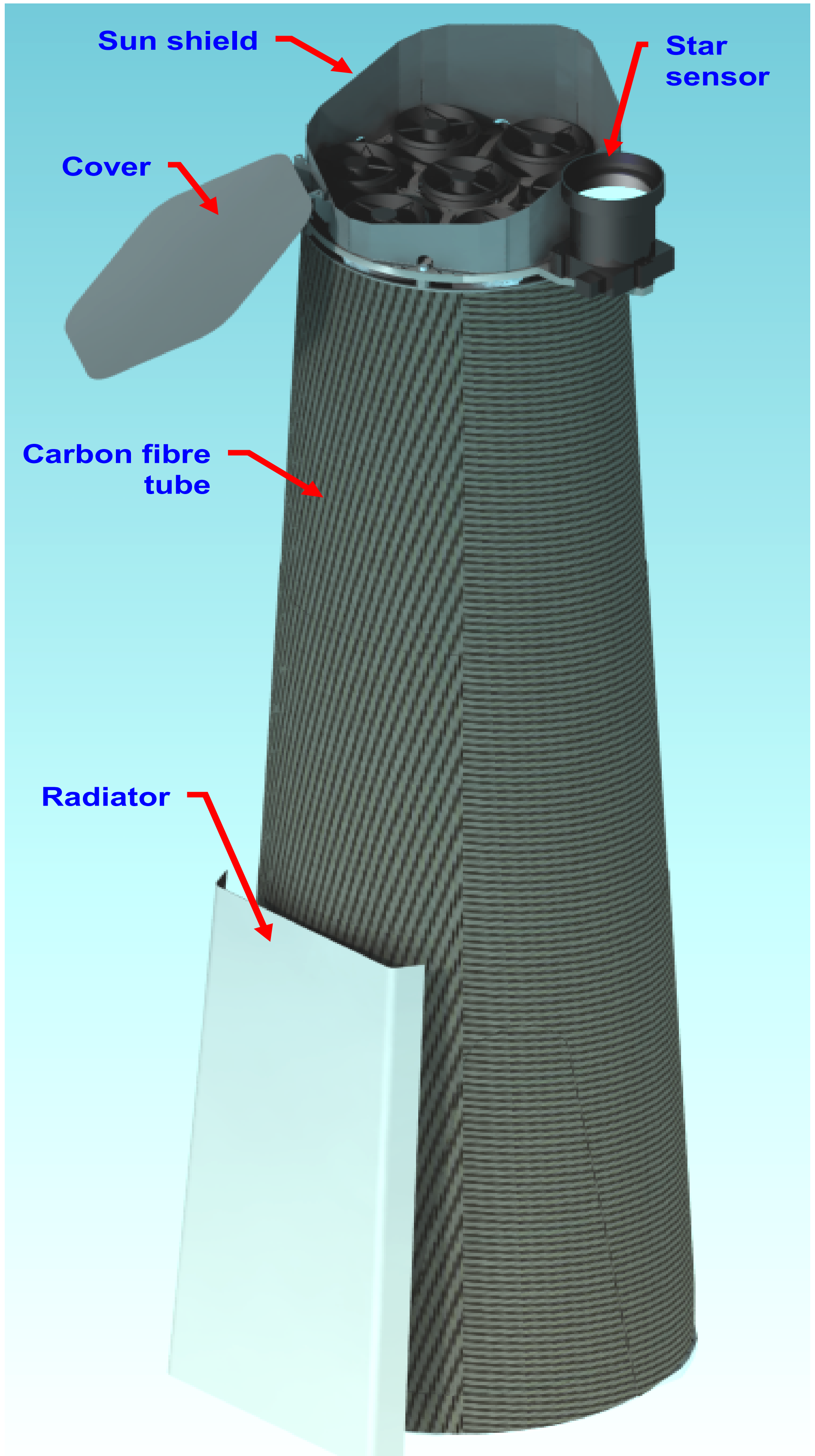


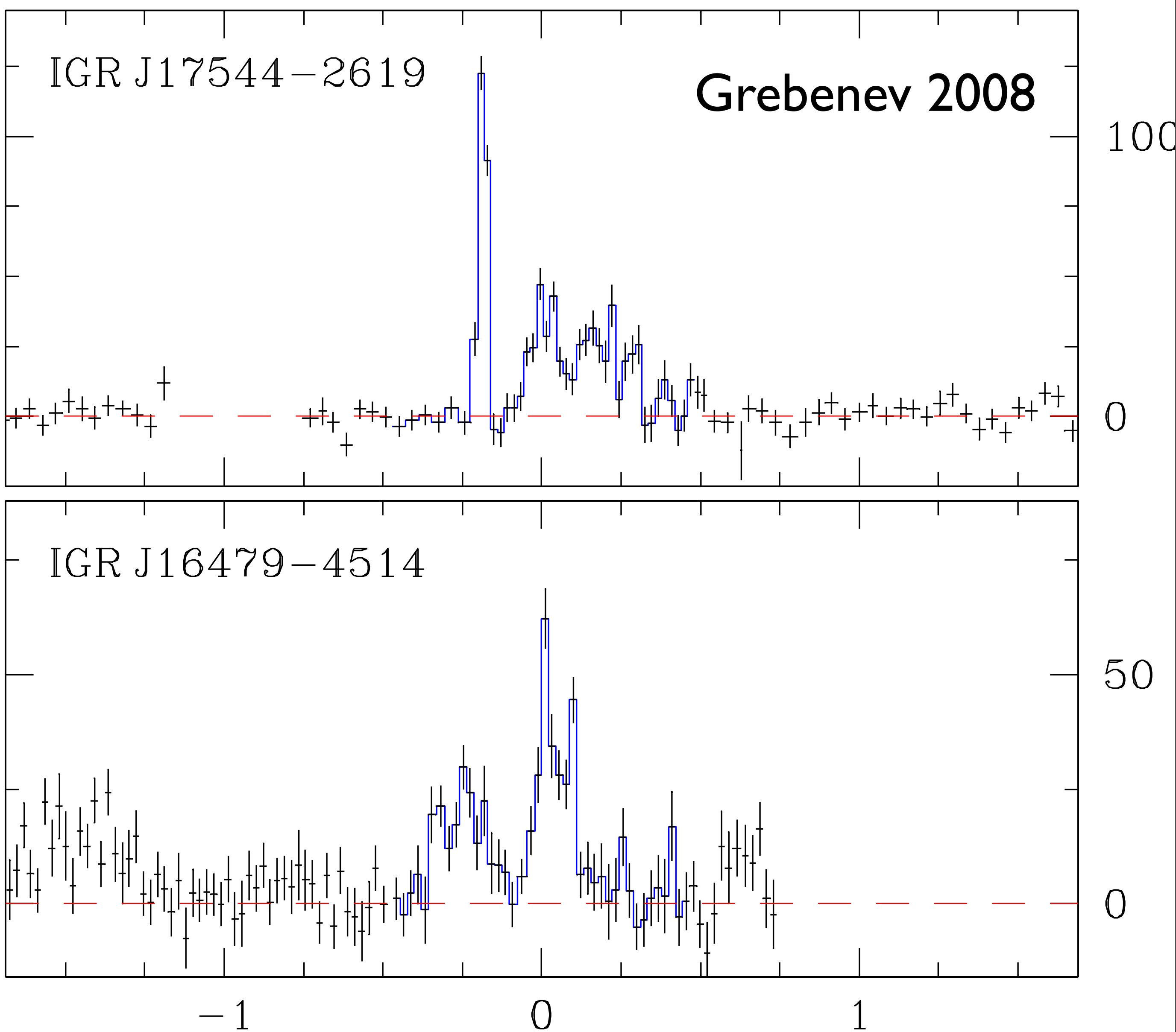
Table 2. Basic parameters of the ART-XC instrument

number of mirror systems	7
number of nested mirror shells	28
mirror shells and coating materials	Nickel and Iridium
focal length	2700 mm
FOV	∅32′
angular resolution	<1′
effective area for pointed observations	510 cm^2 at 7 keV
Grasp for survey	45 deg^2 cm^2 at 7 keV
detector type	DSSD CdTe
size	25.6 × 25.6 mm^2
number of strips	64 × 64
Strip pitch	0.4 mm
Energy range	6 – 30 keV
Energy resolution	10% at 14 keV
Time resolution	1 ms
Working temperature	-40° C
Total weight of instrument	350 kg
Power consumption	300 W

ART-XC

- Heavily obscured galactic XRB/SFXT discovered with INTEGRAL (see e. g. Chaty 2008 for a review)

  Before INTEGRAL only a few HMXBs were known to have a supergiant OB-companion. After launch of Spectrum-GR the population of obscured XRB/SFXT might grow significantly



- Study of broad band spectra of galactic XRBs (CRSFs!), AXPs, SGRs; cross-calibration with MAXI all-sky monitor