



INTEGRAL's view on AXPs and binaries in the Cassiopeia region

Peter den Hartog

Lucien Kuiper, Wim Hermsen & Jacco Vink

SRON - Netherlands Institute for Space Research
Utrecht, The Netherlands

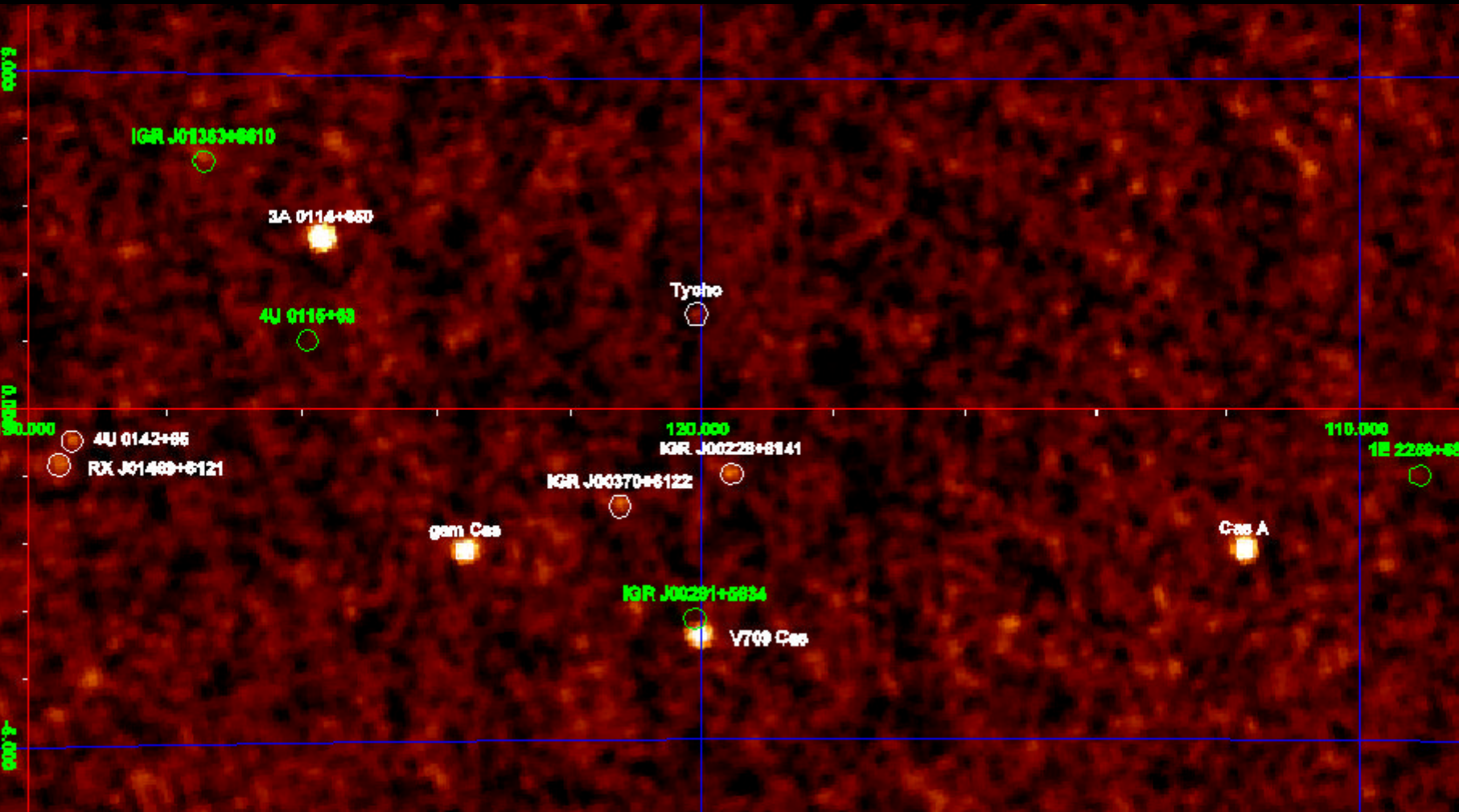
Cassiopeia region: (future) observations

O-1: ~1.5 Ms	Cas A & Tycho	PI : Vink & Decourche
O-2: ~1.5 Ms	Cas A & Tycho	PI : Vink & Decourche
O-2: ~0.2 Ms	4U 0115+63	PI : Santangelo
O-2: ~0.3 Ms	IGR J00291+5934	PI : Falanga
O-3: ~2.5 Ms	Cas A & Tycho	PI : Vink & Decourche
O-3: ~1.0 Ms	AXP 4U0142+614	PI : Kuiper

Currently ~1.6 Ms from AO-1 and AO-2 is used.

total exposure Cassiopeia region after AO-3 : > 7 Ms

Cassiopeia region (20-50 keV)



Revs 141-148, 161-162; ~1.6-~0.8 Ms

Cassiopeia region: observed sources

7 known sources

3A 0114+650

RX J01469+6121

γ Cas

V709 Cas

Cas A*

Tycho**

3A 2206+543

3 'new' sources > 10 keV

AXP 4U 0142+614

(den Hartog et al 2004 Atel 293)

IGR J00370+6122

(den Hartog et al 2004 Atel 281)

IGR J00234+6141

(den Hartog et al 2005 Atel 394)

presented by J. Vink

den Hartog et al. 2005 (in prep)

* presented by M. Renaud

Cassiopeia region: Binaries

I GR J00370+6122	Sg HMXB	~ 40 keV	Γ ~2.1
I GR J00234+6141	??	~ 40 keV	Γ ~2.0
3A 0114+650	Be HMXB	~100 keV (60)	Γ ~2.9
RX J01469+6121	Be HMXB	~ 40 keV (30)	Γ ~2.4
γ Cas	Be HMXB	~ 50 keV (40)	Γ ~3.5
3A 2206+543	Be HMXB	~100 keV (60)	Γ ~2.3
V709 Cas	Intm Polar	~ 80 keV (70)	Γ ~2.8

1GR J00370+6122: New Supergiant X-ray Binary

~11 σ in Rev 0147
(20-60 keV) 4.5 mCrab

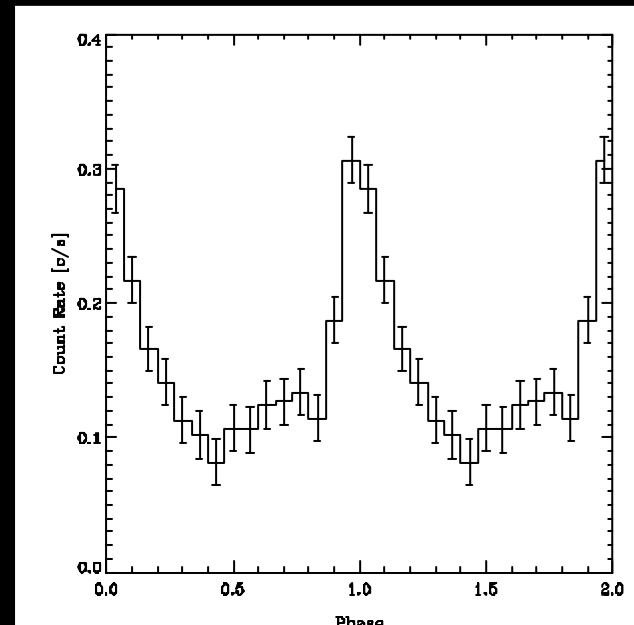
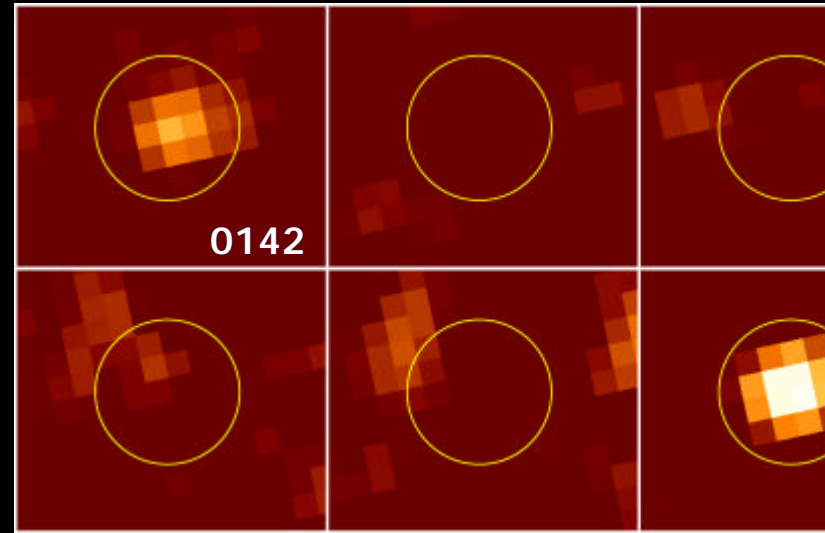
~5 σ in Rev 0142

Coincident with
1RXS J003709.6+612131

Optical counterpart
BD +60 73 (B supergiant)

RXTE-ASM folded light curve
shows 15.665 d orbital period

Improved RXTE observation to
search for possible X-ray Pulsar



IGR J00234+6141 another new HMXB (?)

8.0 σ , 1.2 mCrab, 20-30 keV

3.8 σ , 0.8 mCrab, 30-40 keV

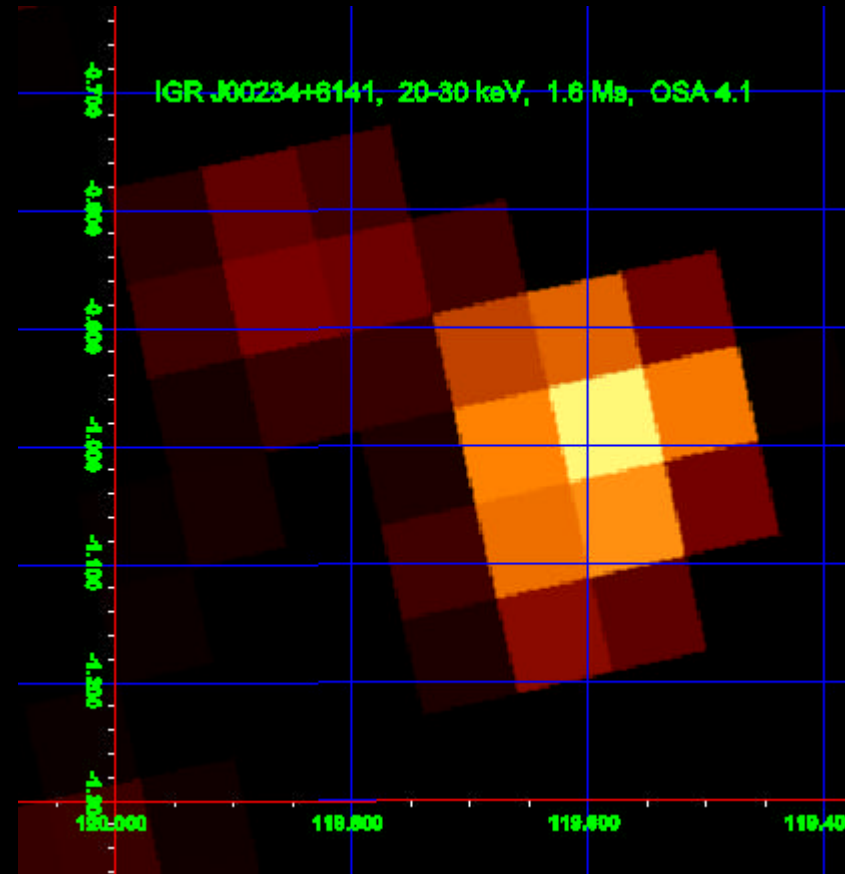
Net exposure of 1.6 Ms

Coincident with
1RXS J002258.3+614111

No optical counterpart yet

Weak detection with RXTE-
ASM, but no modulation

More details under study...



Anomalous X-ray Pulsars

X-ray power greater than rotational-energy loss

- ❑ 6 established, 2 candidates
- ❑ Young characteristic ages ($\tau \sim 10\text{-}100$ kyr)
- ❑ Periods in range 5 – 12 s
- ❑ Large \dot{P} s $\sim 10^{-11}$ s s^{-1}
- ❑ X-ray luminosities in range 10^{34} – 10^{36} erg s^{-1}
- ❑ **Spectra soft**: $kT_{\text{BB}} \sim 0.35$ – 0.6 keV + $\Gamma \sim 2$ – 4
- ❑ Steady spin-down like radio pulsars

- ❑ **Magnetars, dipole spin-down B fields 10^{14} – 10^{15} G**

Anomalous X-ray Pulsars (> 10 keV)

□ 4U 0142+614

(den Hartog et al. 2004),
(den Hartog et al. 2005 in prep),
(Kuiper et al. 2005 in prep)

□ 1RXS J170849-400910

(Revnivtsev et al. 2004),
(Kuiper et al. 2005 in prep)

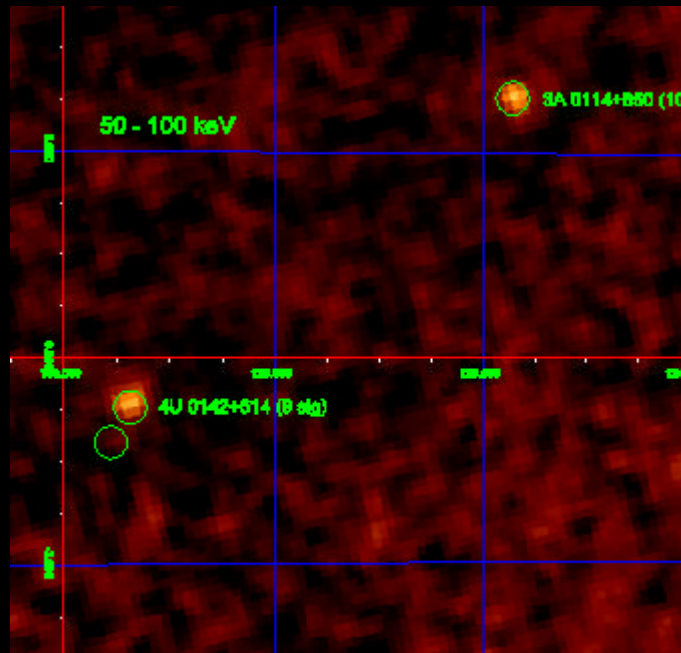
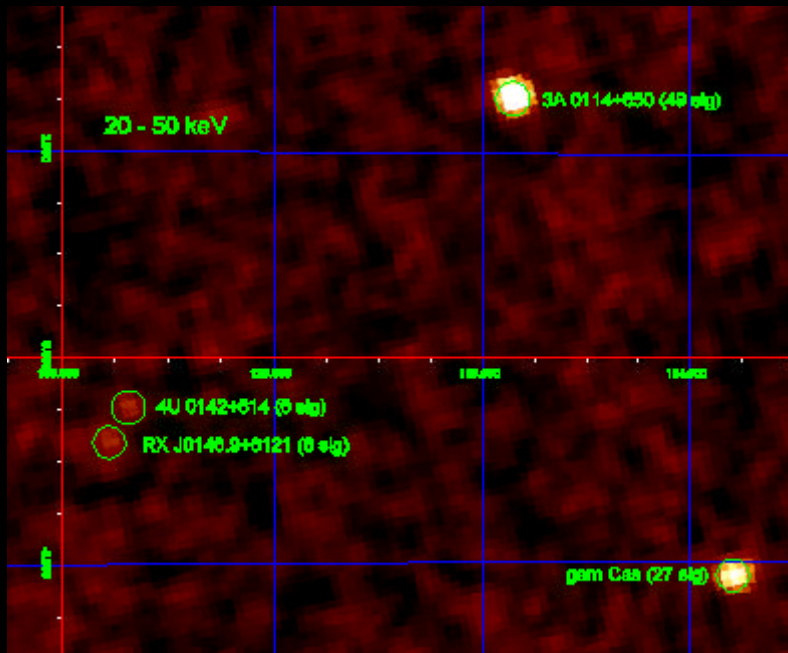
□ 1E 1841-045

(Molkov et al. 2004),
(Kuiper, Hermsen & Mendez 2004)

□ 1E 2259+586

(Kuiper et al. 2005 in prep)

More in following presentation



P 4U 0142+614

8.7 s

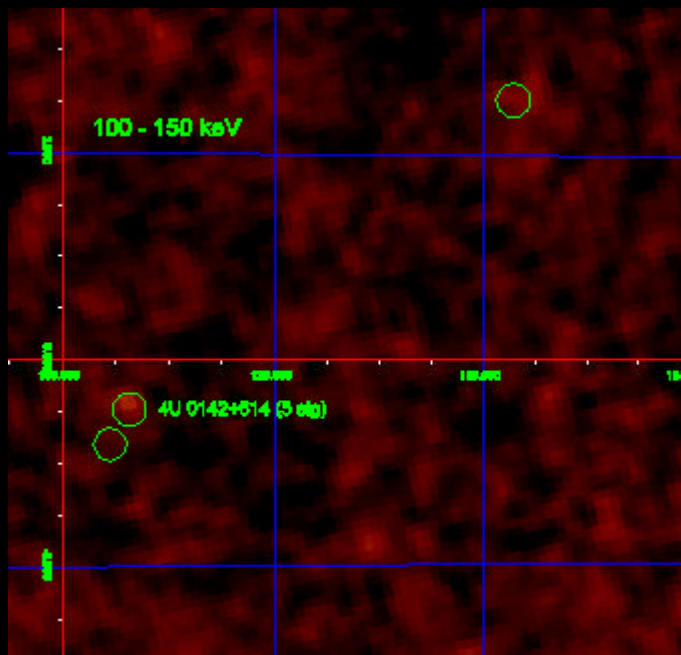
$0.2 \cdot 10^{-11} \text{ ss}^{-1}$

69 kyr

$1.3 \cdot 10^{14} \text{ G}$

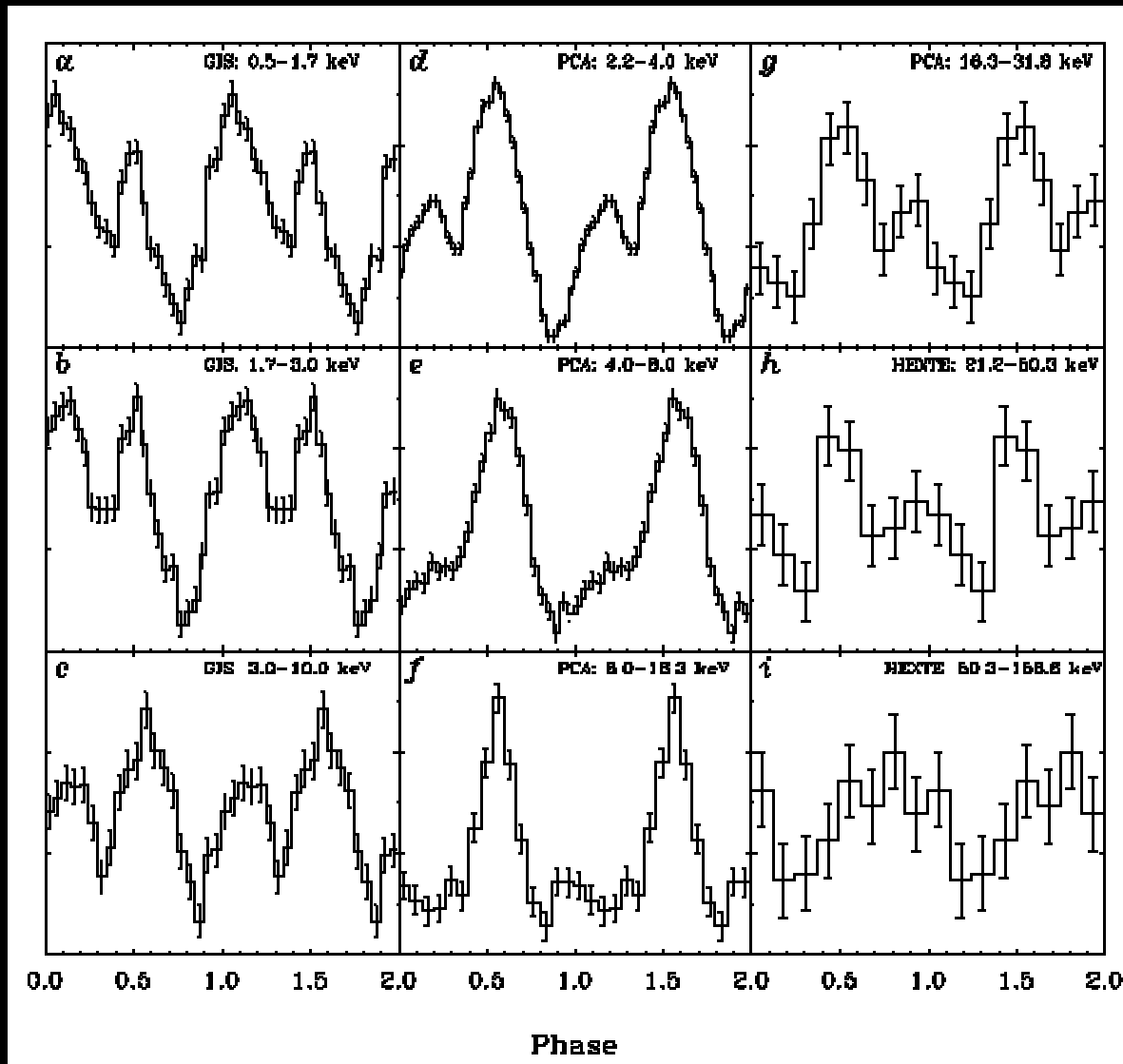
3 kpc

able rotator



AXP 4U 0142+614

pulse profile as function of Energy



Kuiper, Hermsen & den Hartog AA in prep

AXP 4U 0142+614 spectrum

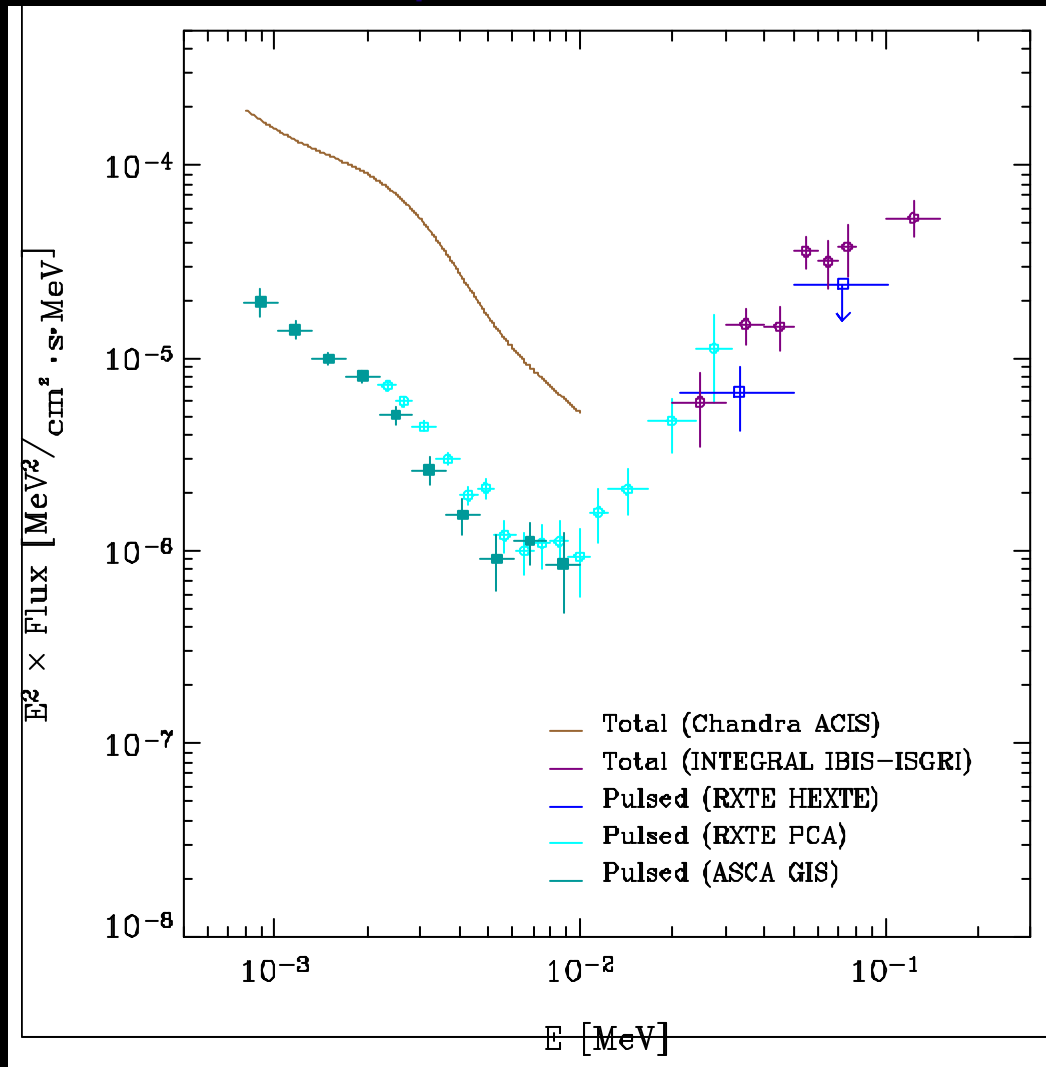
<10 keV

ed fraction:
0% - ~20%

al (DC + pulsed):

3.4 (+ kT_{BB})

el et al 2002)



>10 keV

Pulsed fraction:
~80% - ~100%

Total (DC? + pulsed)

$\Gamma \sim 0.5$

Pulsed-fraction increase as function of energy

Outlook: After AO-3 (~7 Ms)

gaining more statistics.

scenarios:

Spectra up to higher energies, time variability, phase-resolved spectroscopy

CKPs:

For 4U 0142+614 creating the spectrum up to **high energies**. Determine the **break/bend** in the spectrum to tie to Comptel energy range.

Timing to study **pulsed fraction** as function of energy and **pulse-shape changes**.

Hopefully the **detection** of 1E 2259+58



Thank you for your attention

Contact: Hartog@sron.nl