

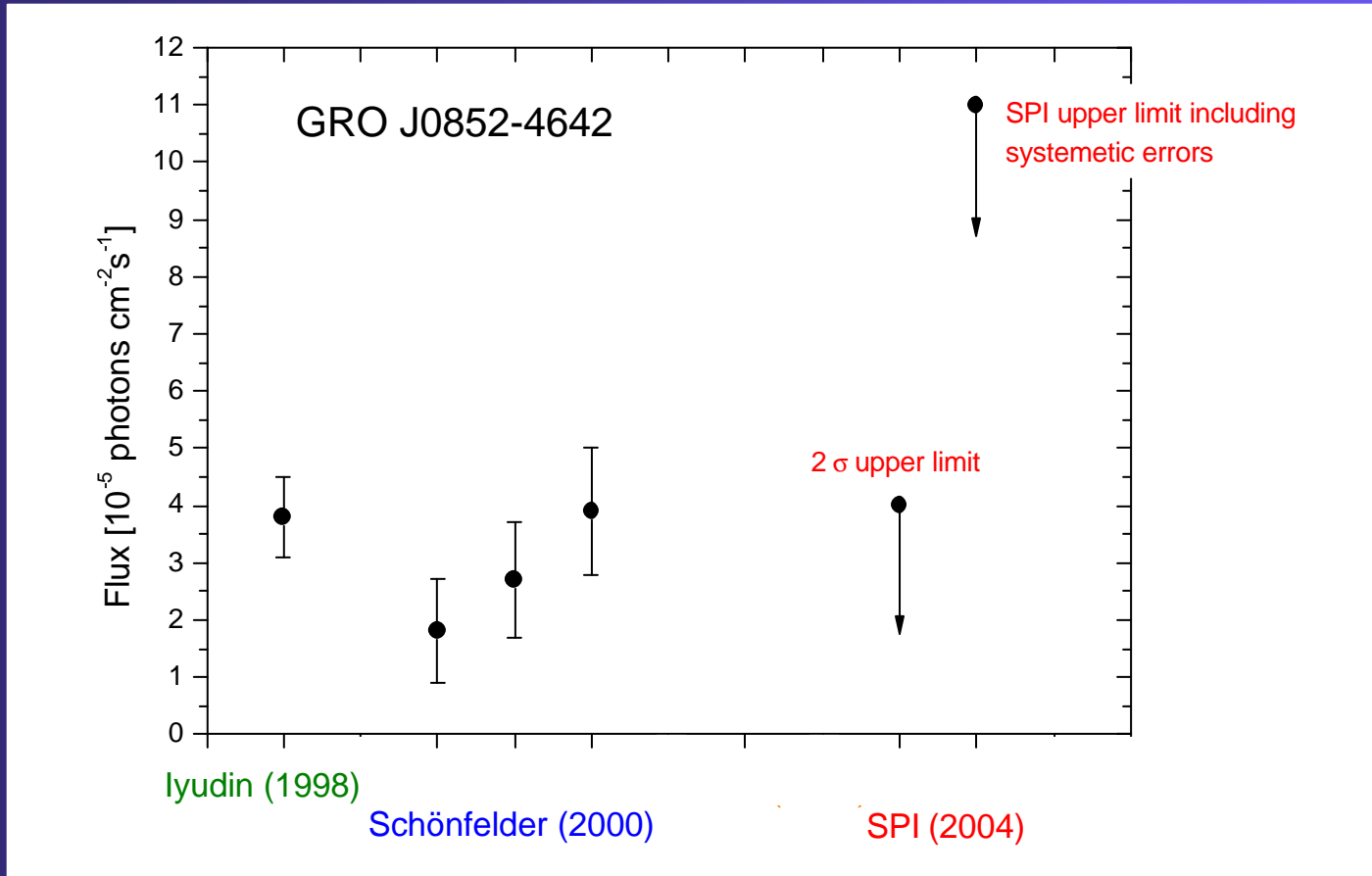


# SPI Search for $^{44}\text{Ti}$ Sources: Vela Junior

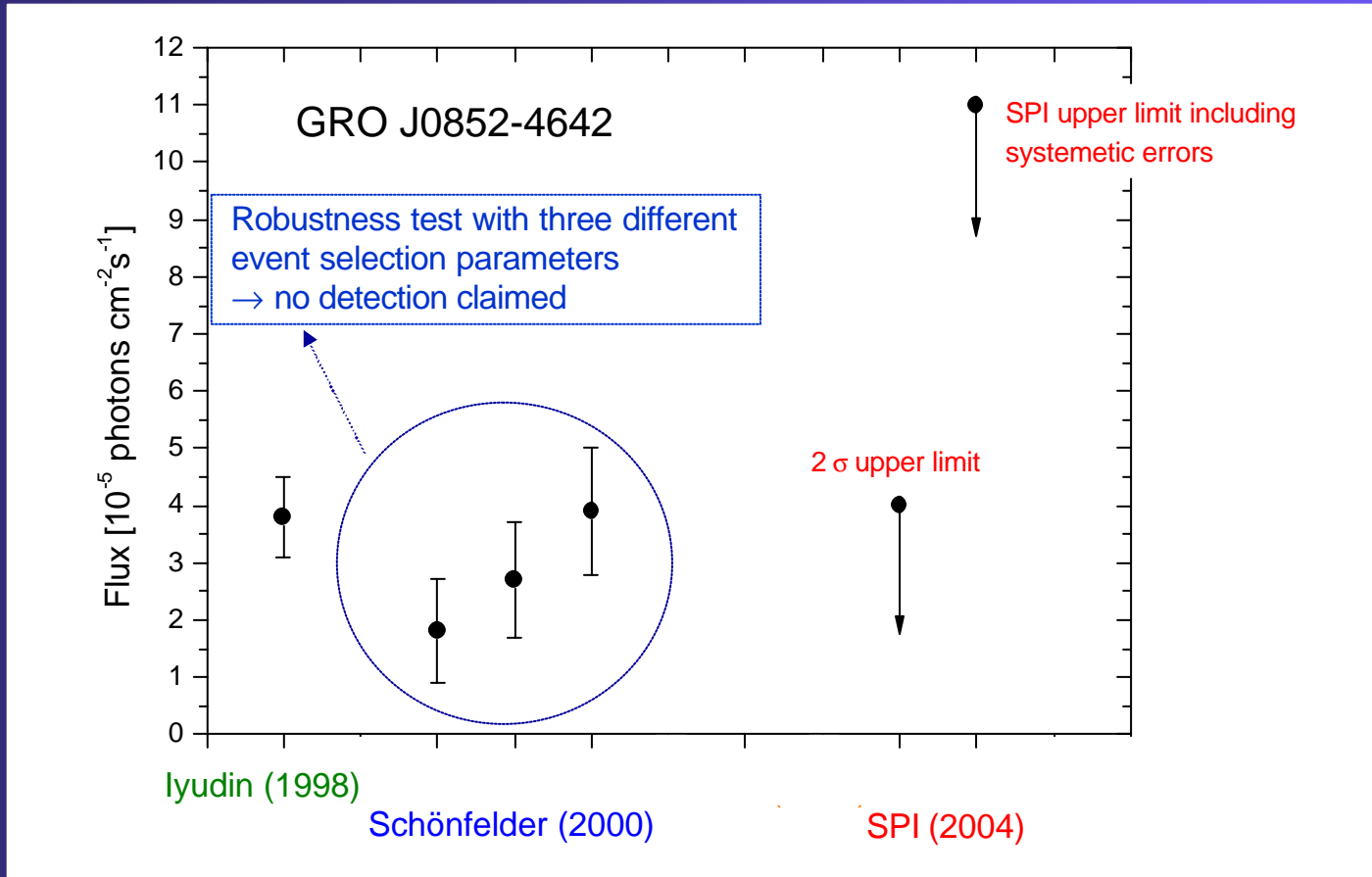
## - Status of Analysis / Outlook

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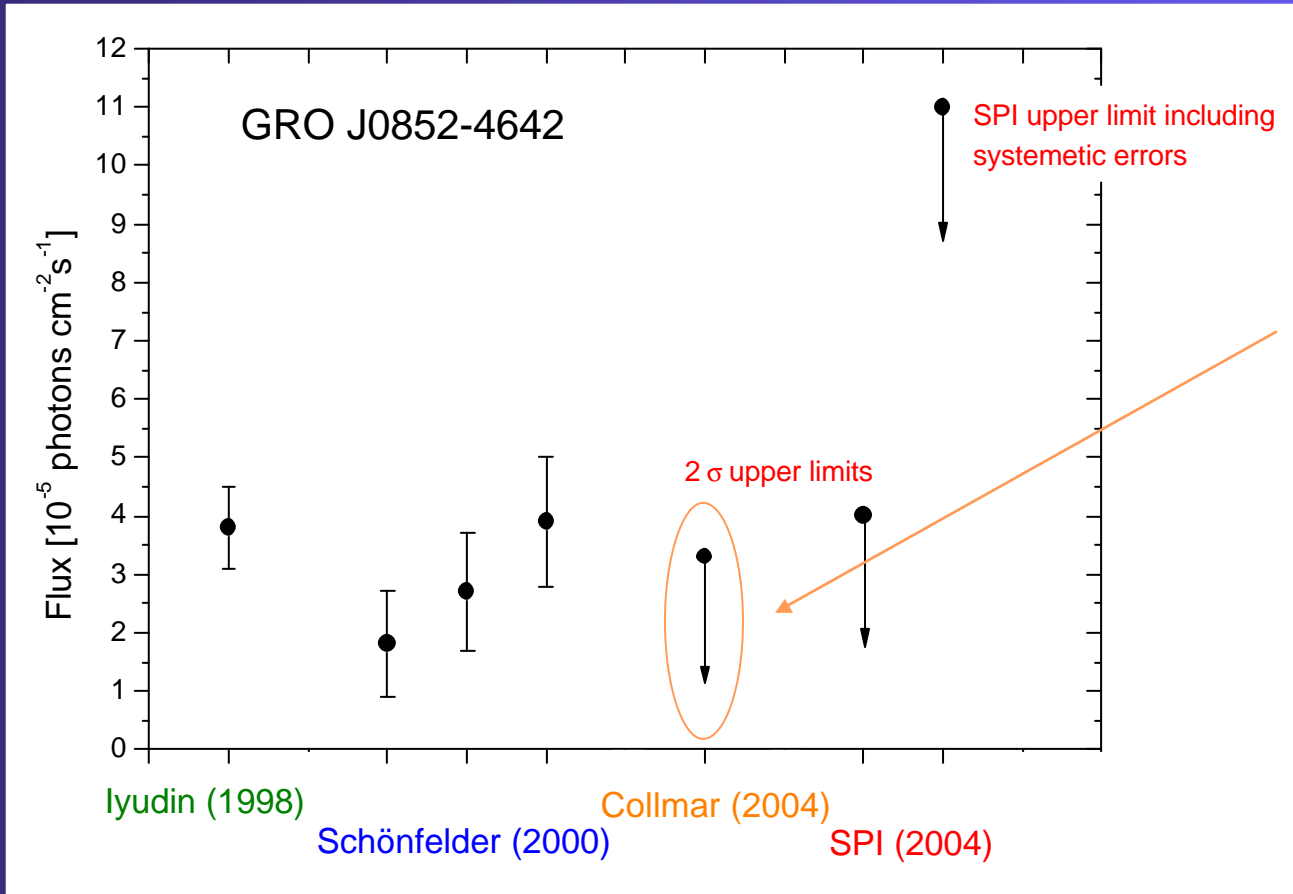


- ◆ Results summarized IWS5 in proceedings report:
  - “Search for  $^{44}\text{Ti}$  gamma-ray line emission from GRO J0852-4642 with INTEGRAL/SPI” – A. von Kienlin et al.



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# Comparison COMPTEL - SPI



New analysis of COMPTEL data by W. Collmar (2004) for 2<sup>nd</sup> COMPTEL source catalogue

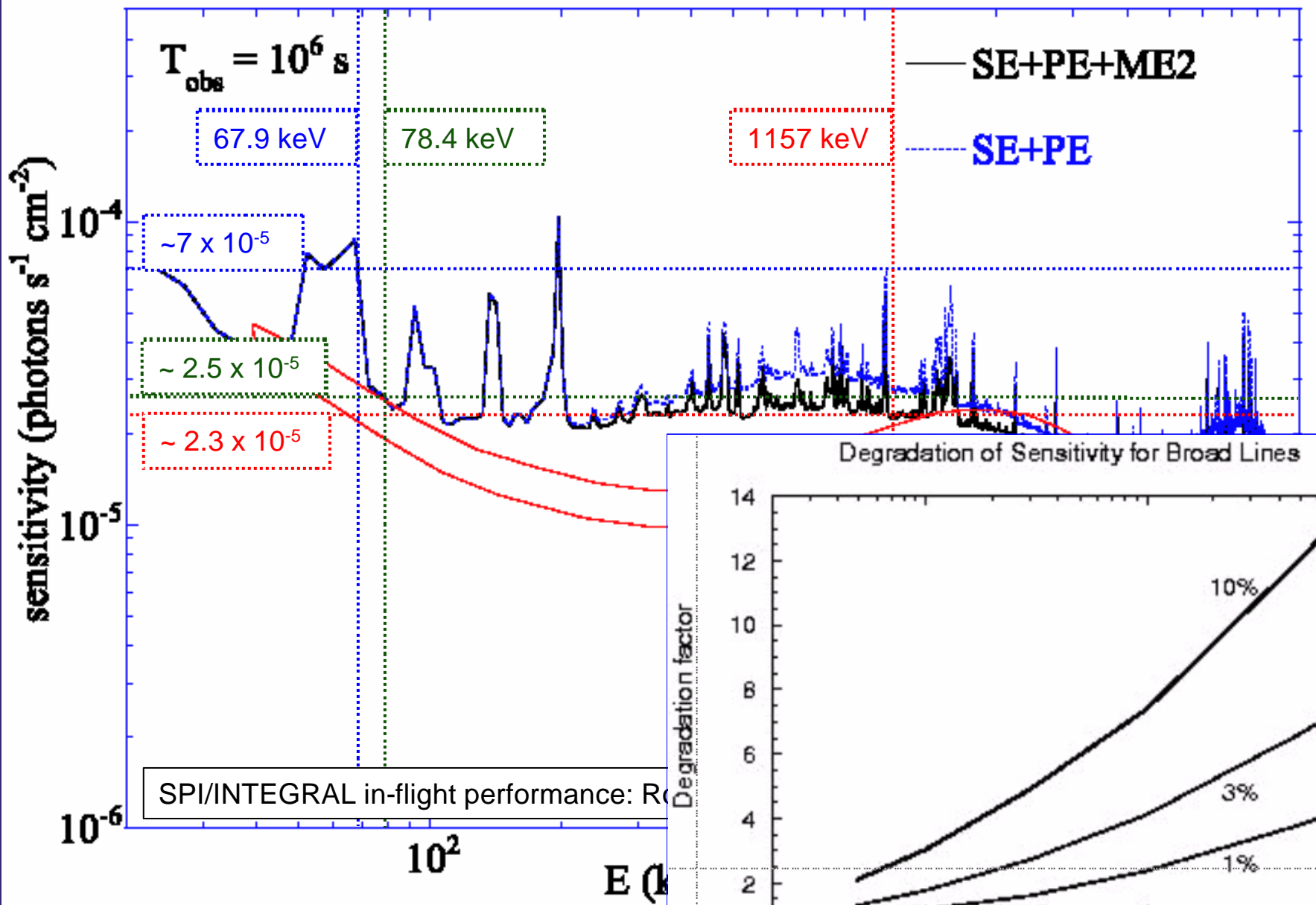
# Data selection & processing (SPI)

- ◆ AO-1 core program observations of the Vela region
  - June / July 2003: during 8 orbits
  - November / December 2003: during 5 orbits
- ◆ Caveats
  - Strong solar activity during both observation periods
    - ▶ Exclusion of these data
  - Failure of germanium detector 2 of SPI :
    - ▶ 06. December 2003, beginning of orbit 140
- ◆ First analysis: 1.2 Ms effective exposure
- ◆ ISDC standard processing of SPI data
  - Four energy ranges in 20 - 110 keV interval, 0.5 keV bins
  - Single events (SE) only
  - Standard ISDC energy calibration

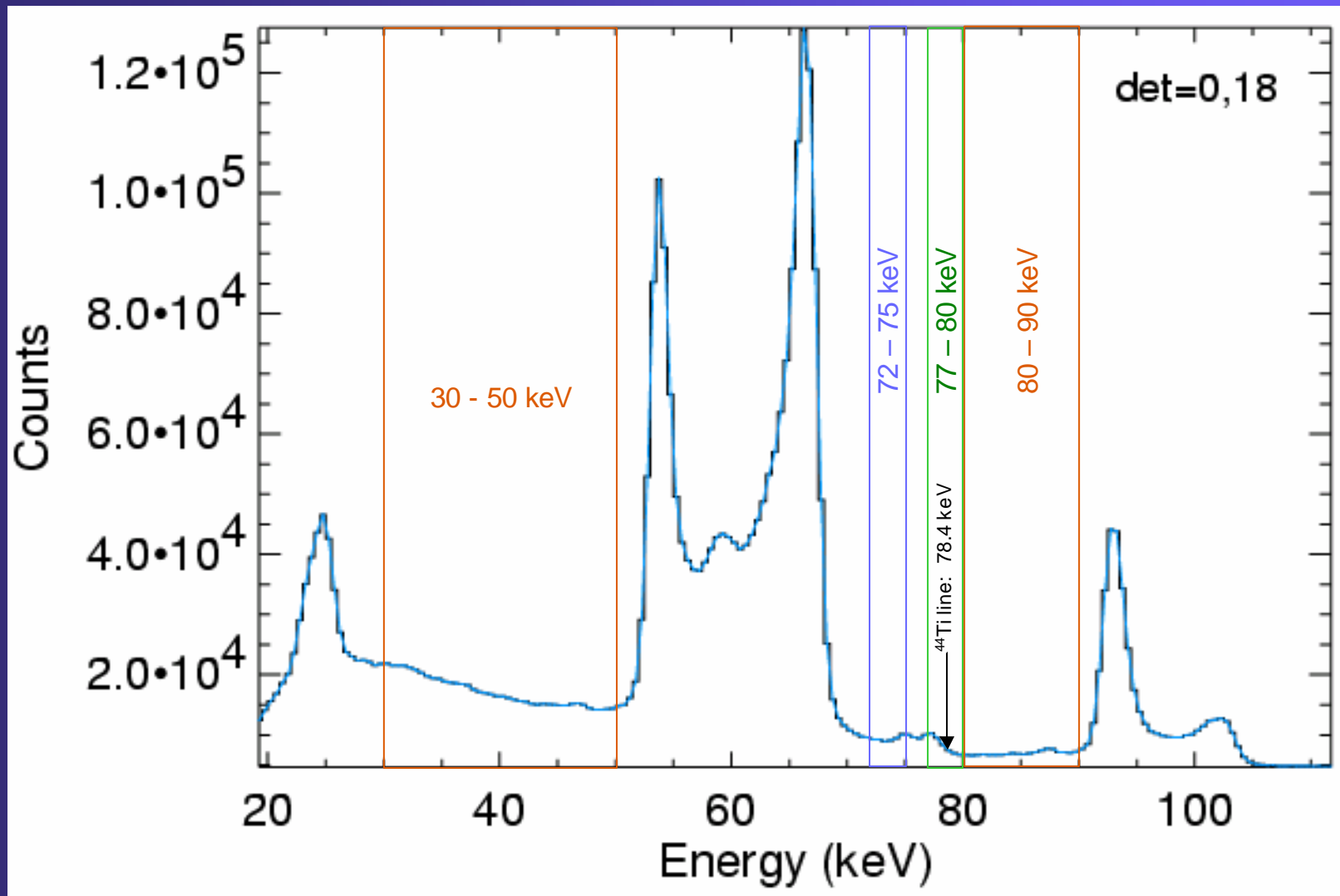
# Imaging analysis with *spiros*

- ◆ Technique: “Iterative Removal of Sources (IROS)”  
[Skinner & Connell, A&A 411, L123 (2003)]
- ◆ Model of sky determined by *spiros*:
  - List of source positions and fluxes
  - One background value for each detector/energy band
    - ▶ Final solution includes 19 background coefficients
- ◆ Background-time dependence taken from Germanium saturated event
- ◆ Alternative approach : Mean Count Modulation (MCM) method
  - Adopts averaging detector count-rates as background model
  - Spectra and Images are calculated by using count-rate deviations about each mean value per pointing
- ◆ Test of *spiros* performance: [P. Dubath et al., MNRAS (2005)]

# Narrow line sensitivity of SPI



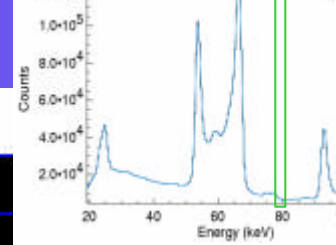
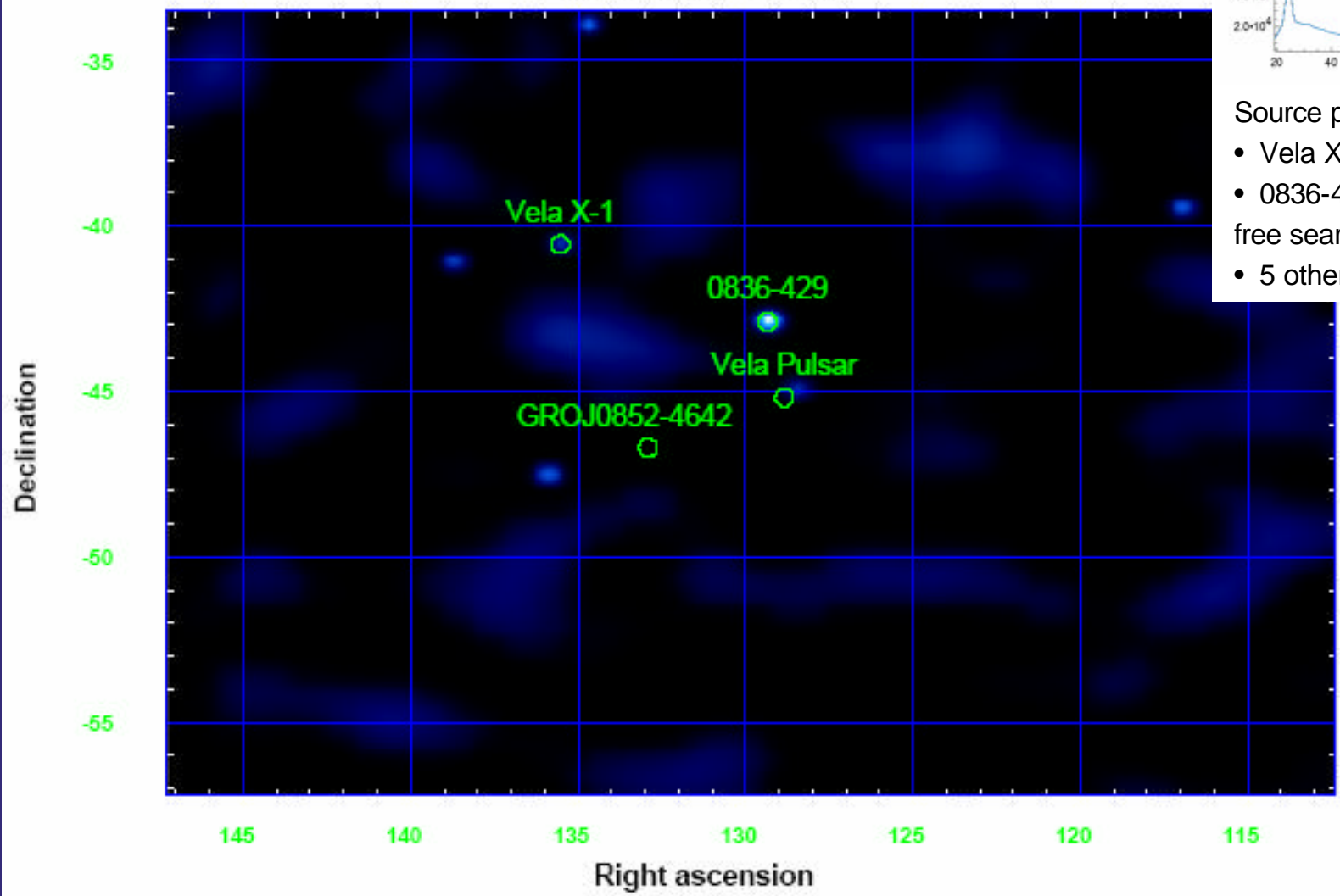
# Germanium detector spectrum: 20 – 110 keV





# SPIROS image of Vela region: 77 – 80 keV

Vela region 77 - 80 keV

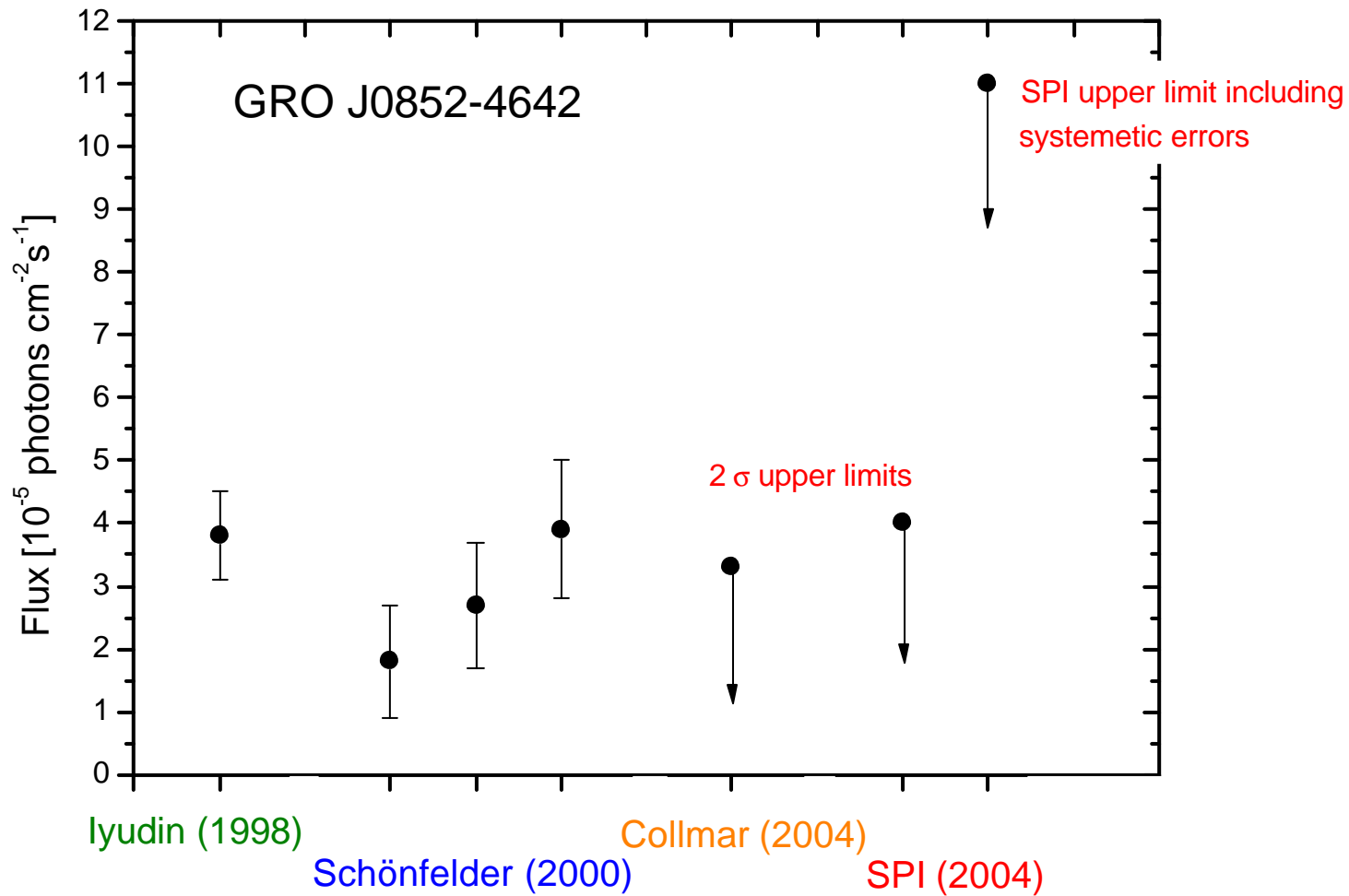


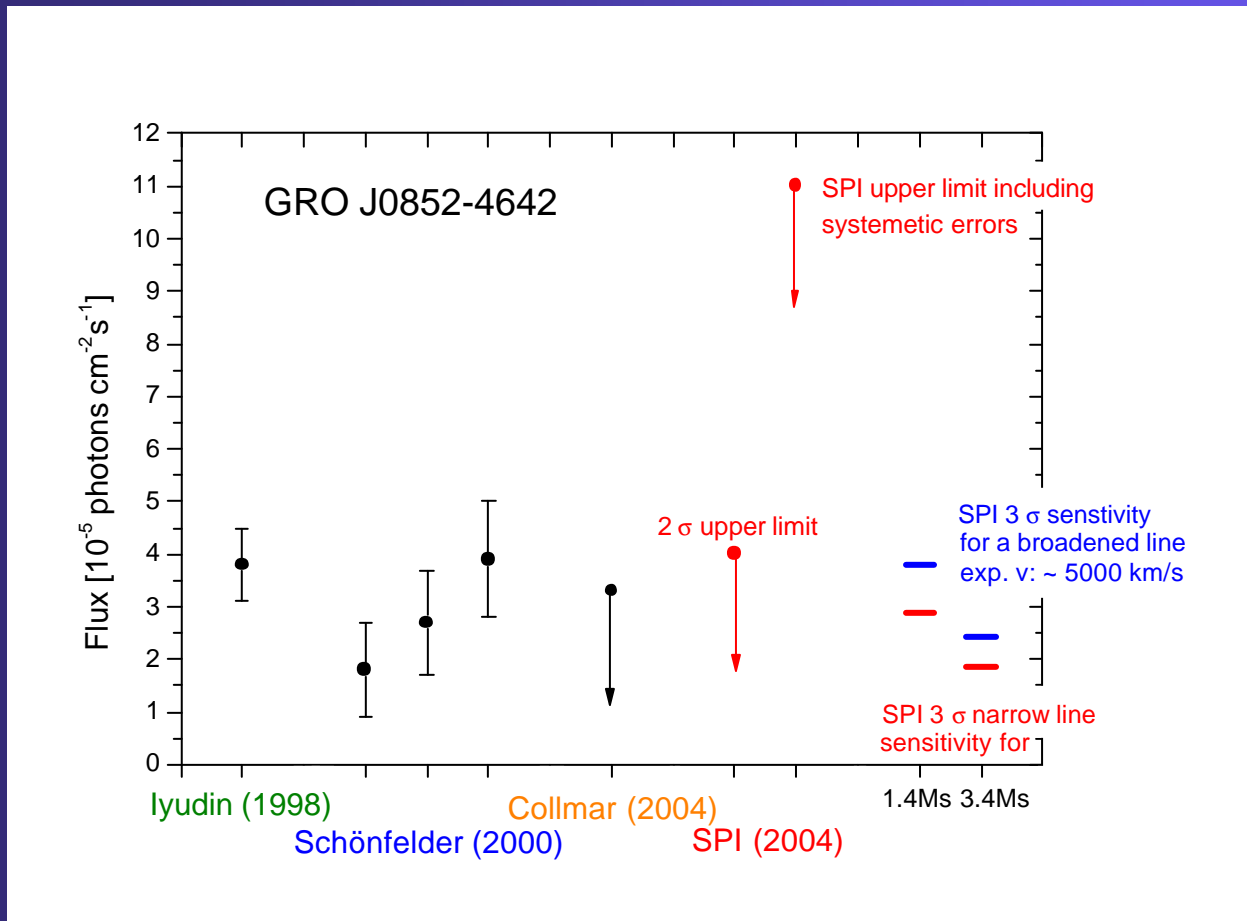
- Source position fixed
- Vela X-1
  - 0836-429
- free search for
- 5 other sources

# Vela region source fluxes extracted by SPIROS

Source	Flux [ $10^{-4}$ ph/ (cm <sup>2</sup> s)]			
E - range	continuum	line	<sup>44</sup> Ti line	continuum
	30 – 50 keV	72 – 75 keV	77 – 80 keV	80 – 90 keV
Vela X-1	$145.5 \pm 0.7$	$0.6 \pm 0.2$	$0.4 \pm 0.2$	$1.4 \pm 0.3$
0836-429	$46.4 \pm 0.7$	$1.3 \pm 0.2$	$1.2 \pm 0.2$	$1.5 \pm 0.3$
GROJ0852-4642	-	-	$0.0 \pm 0.2$	-
Vela Pulsar	-	-	$0.4 \pm 0.2$	$1.9 \pm 0.3$
“Spurious” sources	up to $16 \pm 0.7$	up to $0.6 \pm 0.2$	up to $0.7 \pm 0.2$	up to $1.1 \pm 0.3$

# Comparison COMPTEL - SPI





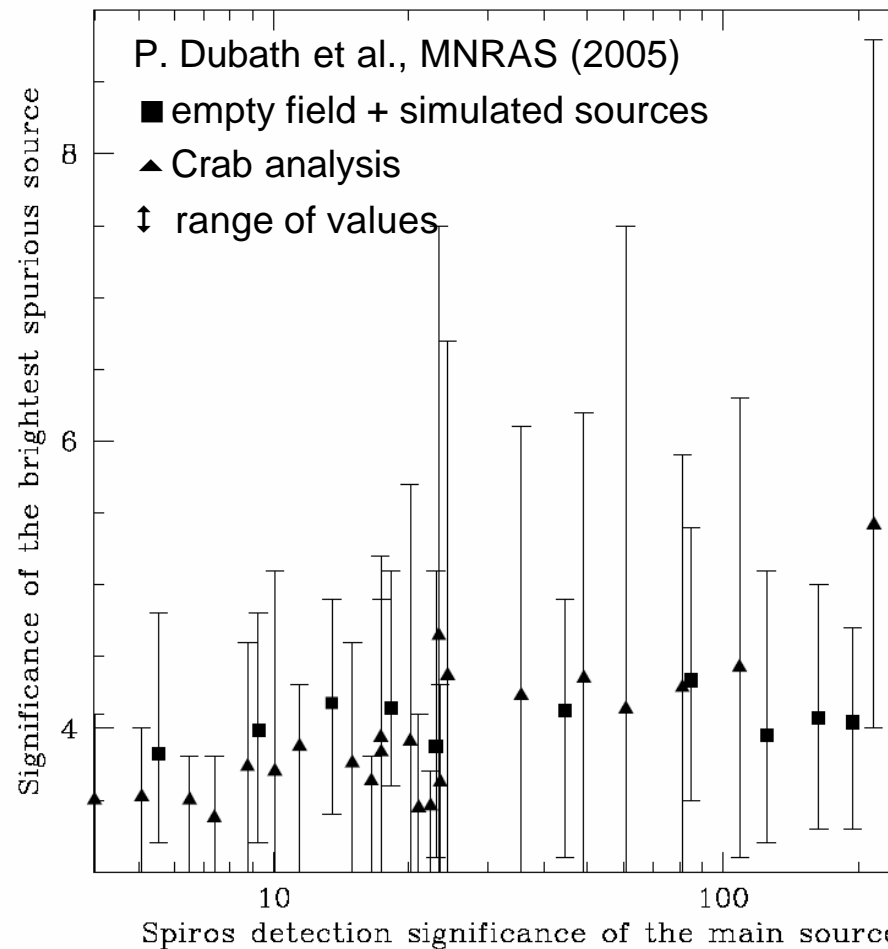
- ◆ Reobservation of the Vela Region during AO-3 - 2 Ms ?? – Proposals by:
  - S. Schanne et al.: “Deep survey of the Vela region for nucleosynthesis studies through  $^{26}\text{Al}$ ,  $^{60}\text{Fe}$  and  $e^+e^-$  annihilation lines”
  - A. von Kienlin et al.: “The Nature of SNR RX J0852-4622 / GROJ0852-4642”



# SPIROS detection of spurious sources

- ◆ P. Dubath et al.: “Performance of SPI point source data analysis”
  - Spurious sources appear at random locations in the plane of the sky
  - ➔ Significance of the spurious (second) detected by SPIROS as a function of the detection significance of the main source

- ◆ Spurious sources:
  - Probably noise statistical fluctuations in the image
  - SPIROS errors are too optimistic for low detection significances
  - Indication of the noise level
  - Detection significance  $< 10 \sigma$ :
    - ▶ extreme care should be taken in the analysis



# New analysis of COMPTEL data (2004)

⇒ for 2<sup>nd</sup> COMPTEL source catalogue by Werner Collmar (MPE)

◆ All sky data until 2<sup>nd</sup> reboot (1991 - 1997)

◆ Common fit on all data

- of extragalactic background model (G. Weidenpointer)
- of galactic background model (A. Strong)
  - ▶ HI + CO
  - ▶ Inverse Compton
- of all known continuum COMPTEL sources
  - ▶ (Crab, Cyg X-1, Cen A,...)
- Of sources of interest → Cas A, GRO J0852-4642

◆ Standard COMPTEL selections

◆ <sup>44</sup>Ti energy window: 1.06 – 1.28 MeV

◆ Results:

Cas A:	$(2.6 \pm 0.7) \times 10^{-5}$ ph/cm <sup>2</sup> /s	$\sigma$ : 3.7
GRO J0852-4642:	$(1.7 \pm 0.8) \times 10^{-5}$ ph/cm <sup>2</sup> /s	$\sigma$ : 2.1 (no detection)
	2 $\sigma$ upper limit: $3.3 \times 10^{-5}$ ph/cm <sup>2</sup> /s	

⇒ For further information please ask Werner Collmar ([wec@mpe.mpg.de](mailto:wec@mpe.mpg.de))

# Robustness Test

- ◆ V. Schönfelder et al. (2000) in Proc. 5<sup>th</sup> Compton Symposium
  - Different background modelling techniques
  - Different event-selection criteria

- ◆ Reassessment of Significances for

- Cas A:

detection is robust against different analysis approaches

- ▶  $(3.4 \pm 0.8) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 4.3
    - ▶  $(3.5 \pm 0.9) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 3.9
    - ▶  $(4.0 \pm 1.0) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 4.0

- Vela junior:

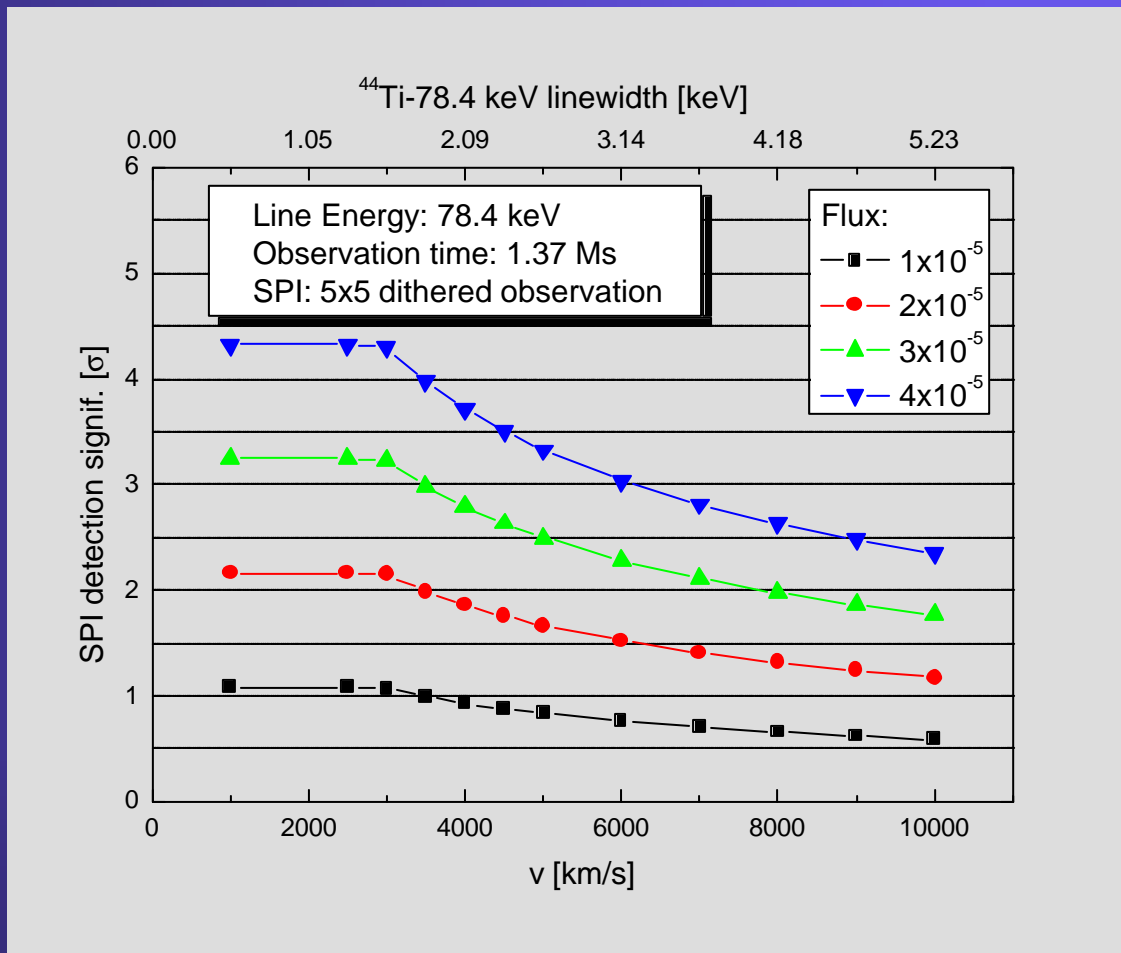
1157 MeV line detection is sensitive to analysis method applied

- ▶  $(1.8 \pm 0.9) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 2.0
      - ▶  $(2.7 \pm 1.0) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 2.7
      - ▶  $(3.9 \pm 1.1) \times 10^{-5}$  ph/cm<sup>2</sup>/s  $\sigma$ : 3.5
- } no detection claimed !



# Expected detection significance for Vela Junior

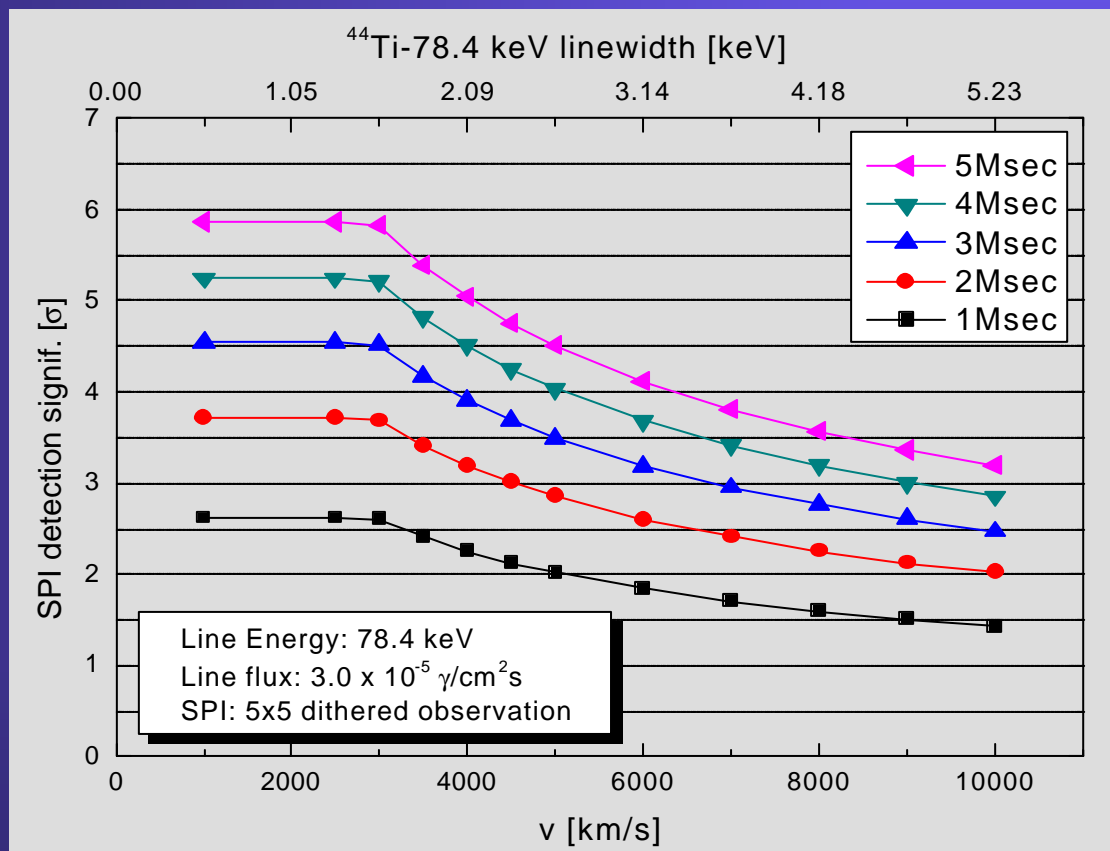
- ◆ Dependence of detection significance on
  - Source flux:  $1 \times 10^{-5}$  to  $4 \times 10^{-5}$
  - Expansion velocity of SNR / 78.4 keV line width



# AO-3 proposal

## ◆ “The Nature of SNR RX J0852-4622 / GRO J0852-4642 ”

- PI: A. von Kienlin; Co-Is: SPI + IBIS team members (3 Ms)
- Approved by TAC with grade C
- Amalgamation with S. Schannes (grade A) proposal possible: 2 Ms



# Outlook: Search for $^{44}\text{Ti}$ sources

- ◆ Present: Reanalysis of AO-1 data of Vela region
  - Different background methods
  - Consideration of the variability of Vela X-1
  - Comparison of *spiros* and *spidiffit* results
- ◆ Analysis of SPI Cas-A data
  - as soon as all AO-1 and AO-2 data are public
  - confirmation of results of J. Vink
- ◆ Search for new  $^{44}\text{Ti}$  sources in the GCDE with SPI
- ◆ Waiting for AO-3 data of the Vela region
  - Further observations (2 Ms)?
  - Amalgamation of proposals?