

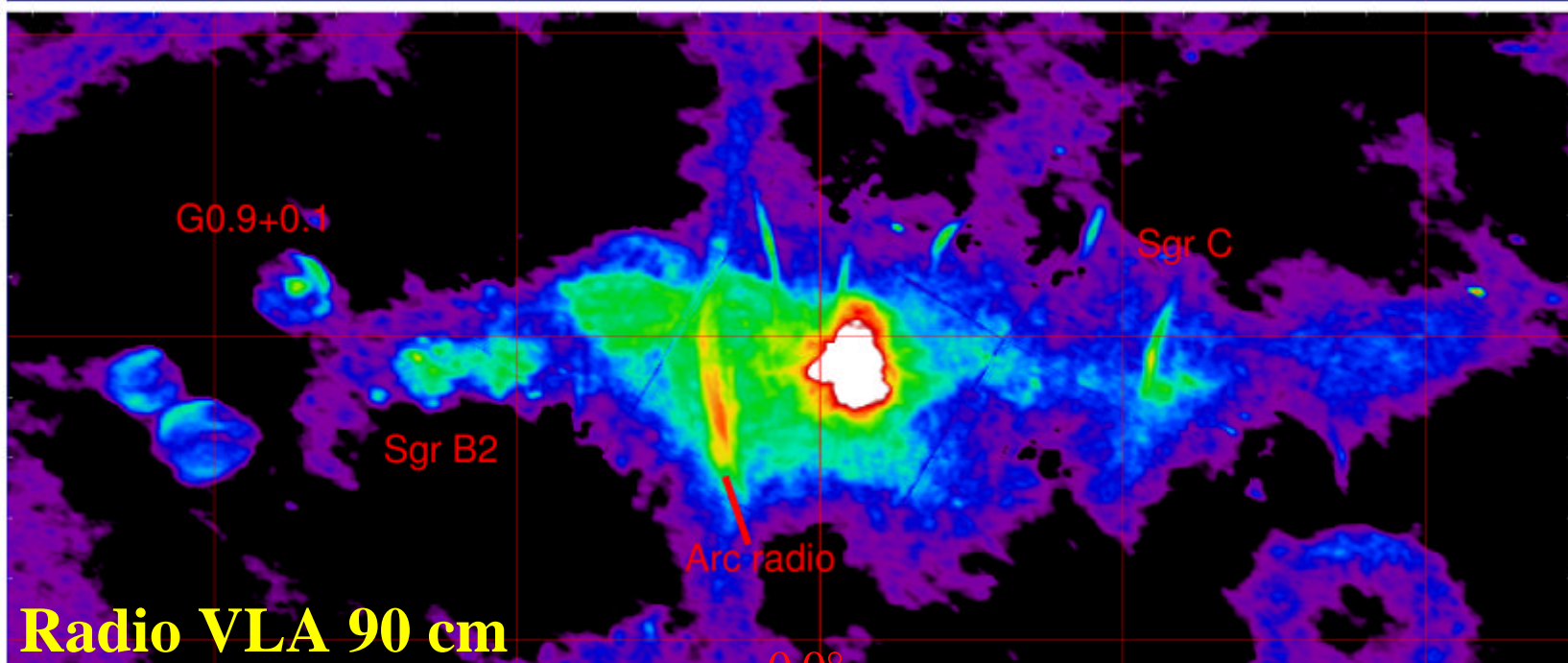
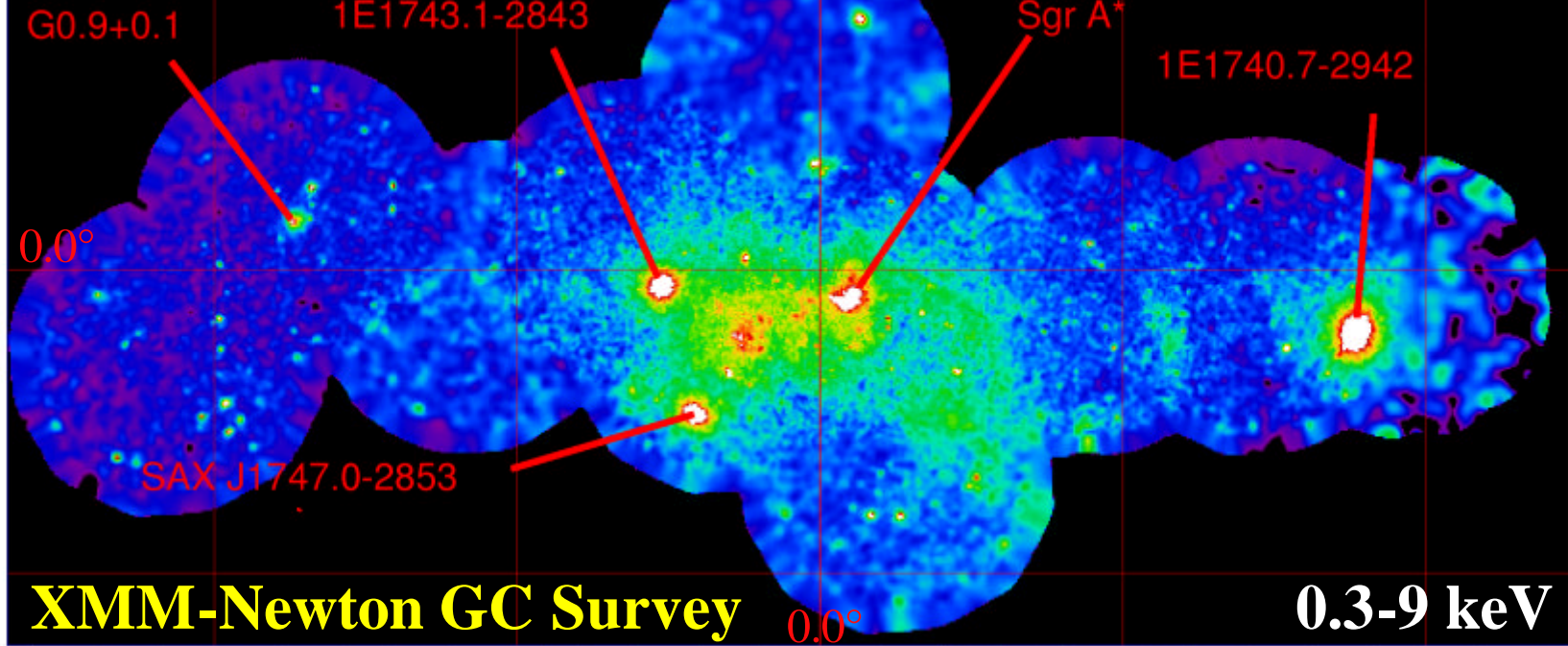
# The **INTEGRAL** View of the Galactic Nuclear Region

(progress report, Jan 2005)

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(Service d'Astrophysique / DAPNIA / CEA - Saclay, France)

et al.



# **INTEGRAL Observations of the Galactic Nuclear Region**

**Core Program Galactic Center Deep Exposure (GCDE) 2003 - 2004**

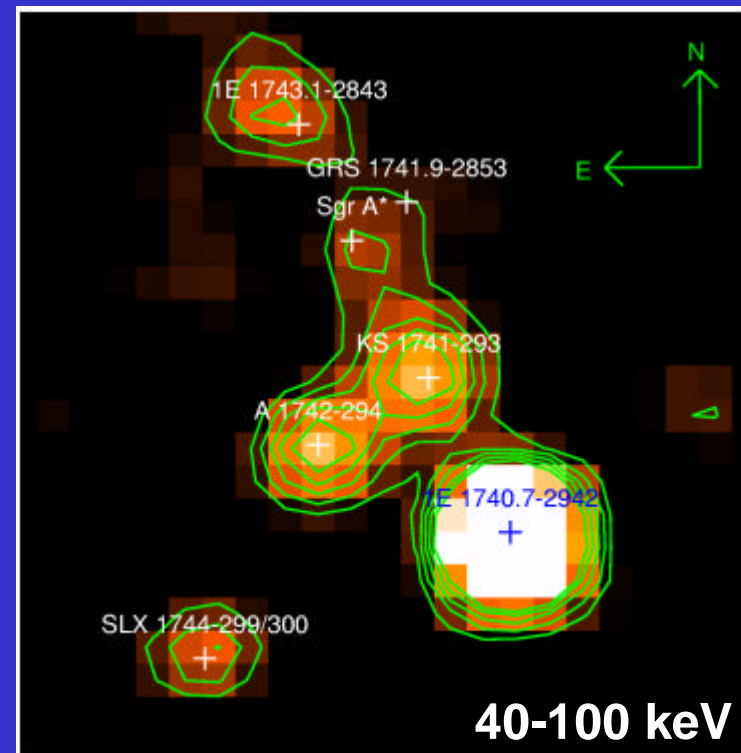
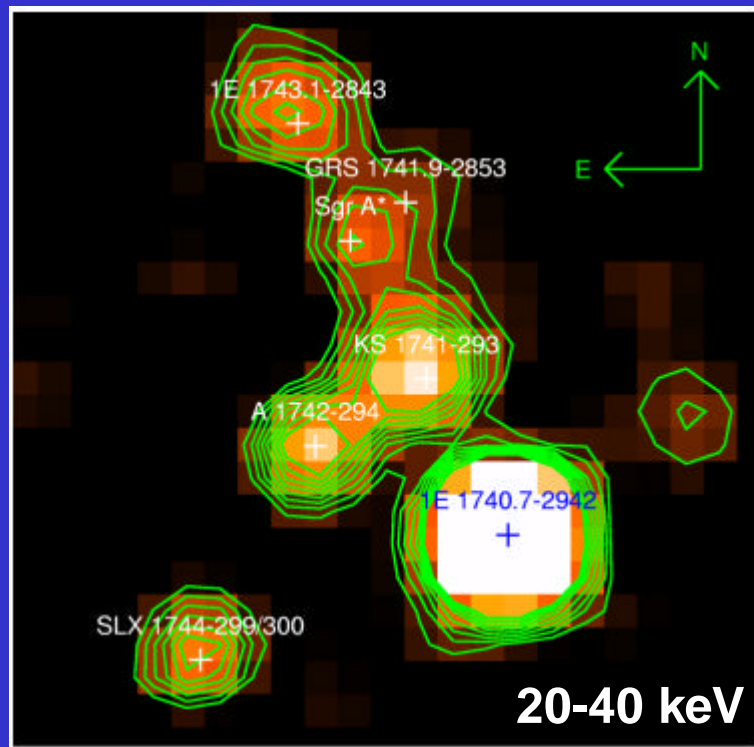
**GO Observation of GC and some Open Program public data (2003)**

**GO Observations in 2004 (~ 600 ks) correlated to the XMM-Newton Large Program on Sgr A\***

**TOTAL Effective Exposure Time on Sgr A\* of » 4 Ms**

- OSA 4.2 processing , Mosaic with pixel spread option.
- Careful selection of ScW (2740). Background correction.
- PSF fit for several sources in the decoded images
- Light curves and spectra from images.

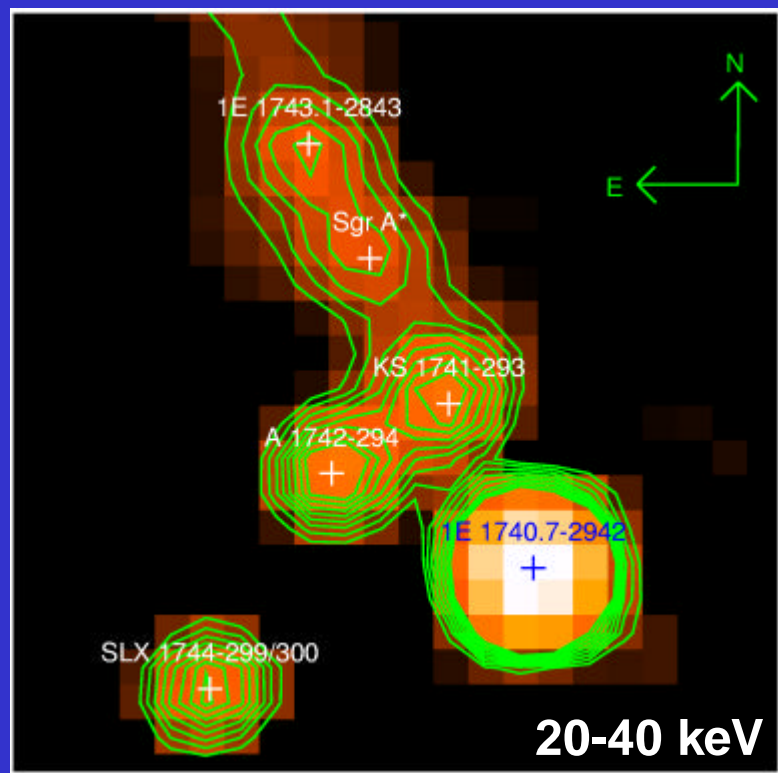
# First INTEGRAL IBIS / ISGRI Images of the G.N.



## Feb - May 2003 Observations (Eff. Exp. $\sim$ 800 ks)

- Six known high-energy sources in the central  $2^\circ \times 2^\circ$  of the Galaxy
- A significant excess (8.7 s) at  $\sim 1'$  from Sgr A\* (4.7 s in 40-100 keV)
- Unidentified INTEGRAL source IGR J 17456-2901, error radius  $\sim 4'$
- Flux :  $\sim 3$ . mCrab, up to 80 keV, possible variability

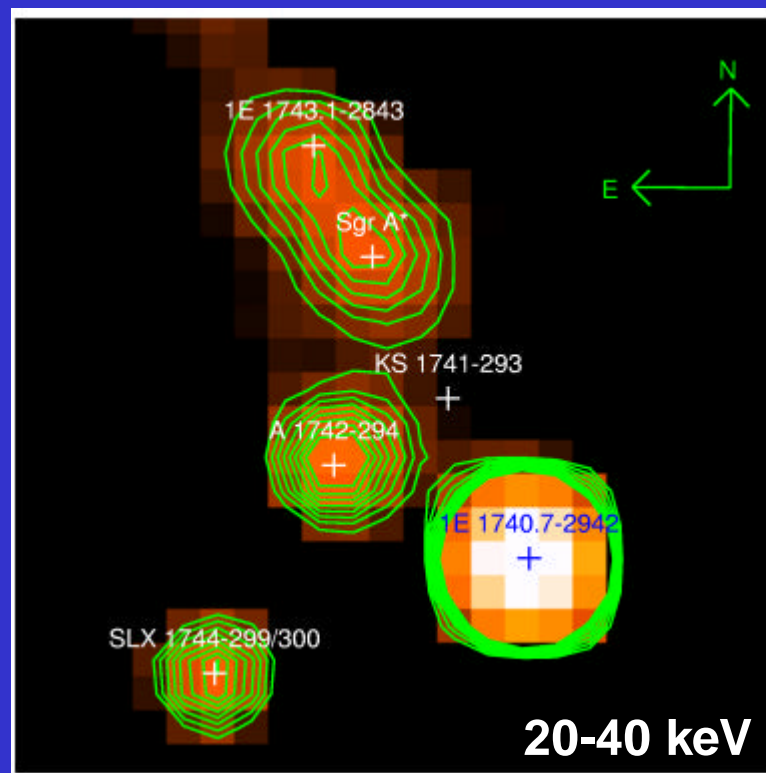
# More Recent Analysis of IBIS/ISGRI Galactic Center Data



GCDE + ToOs Data

(Feb - Oct 2003 – 1.2 Ms)

Source of 20 s at  $\approx 52''$  from Sgr A\*

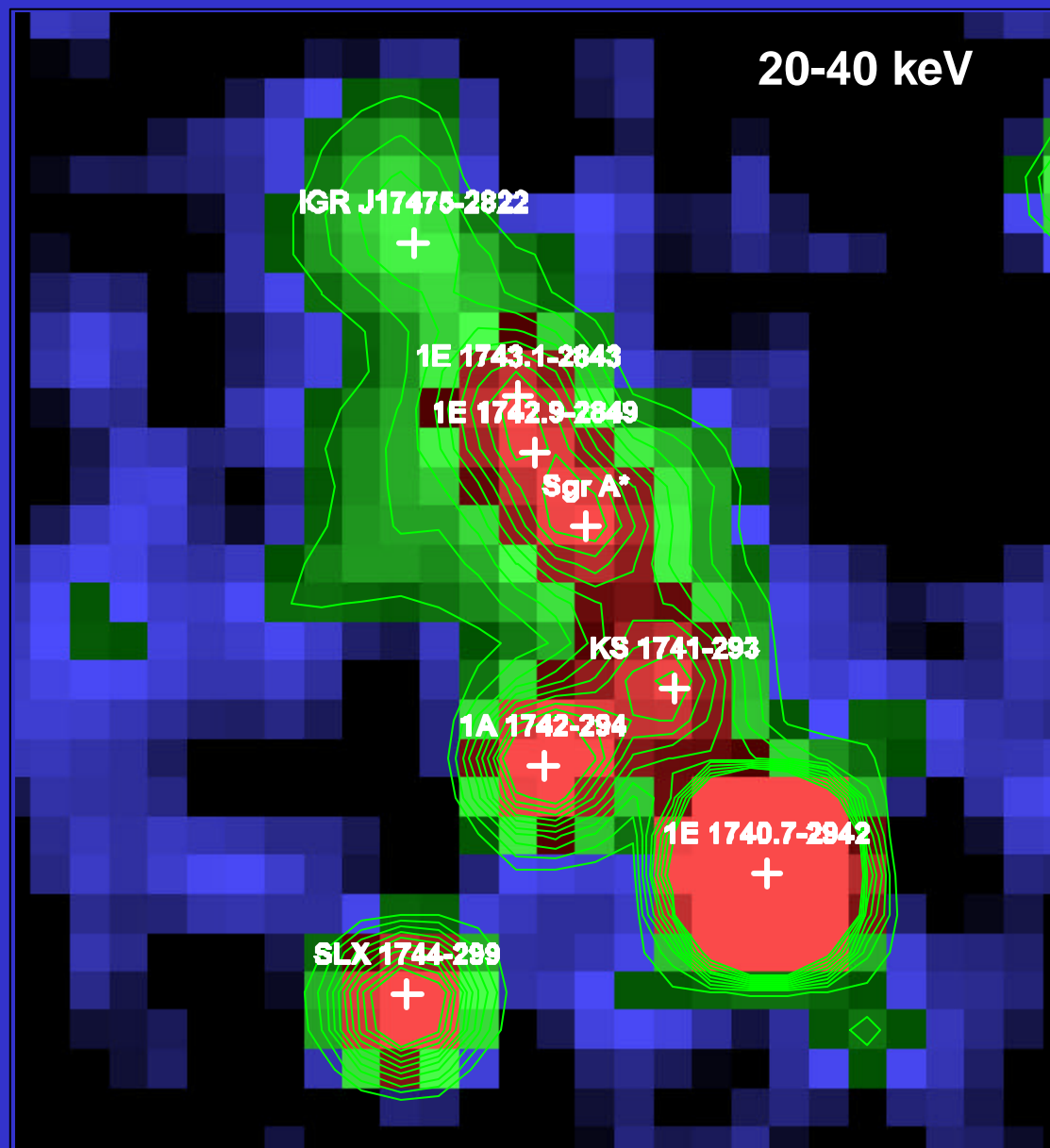


GO Obs Data

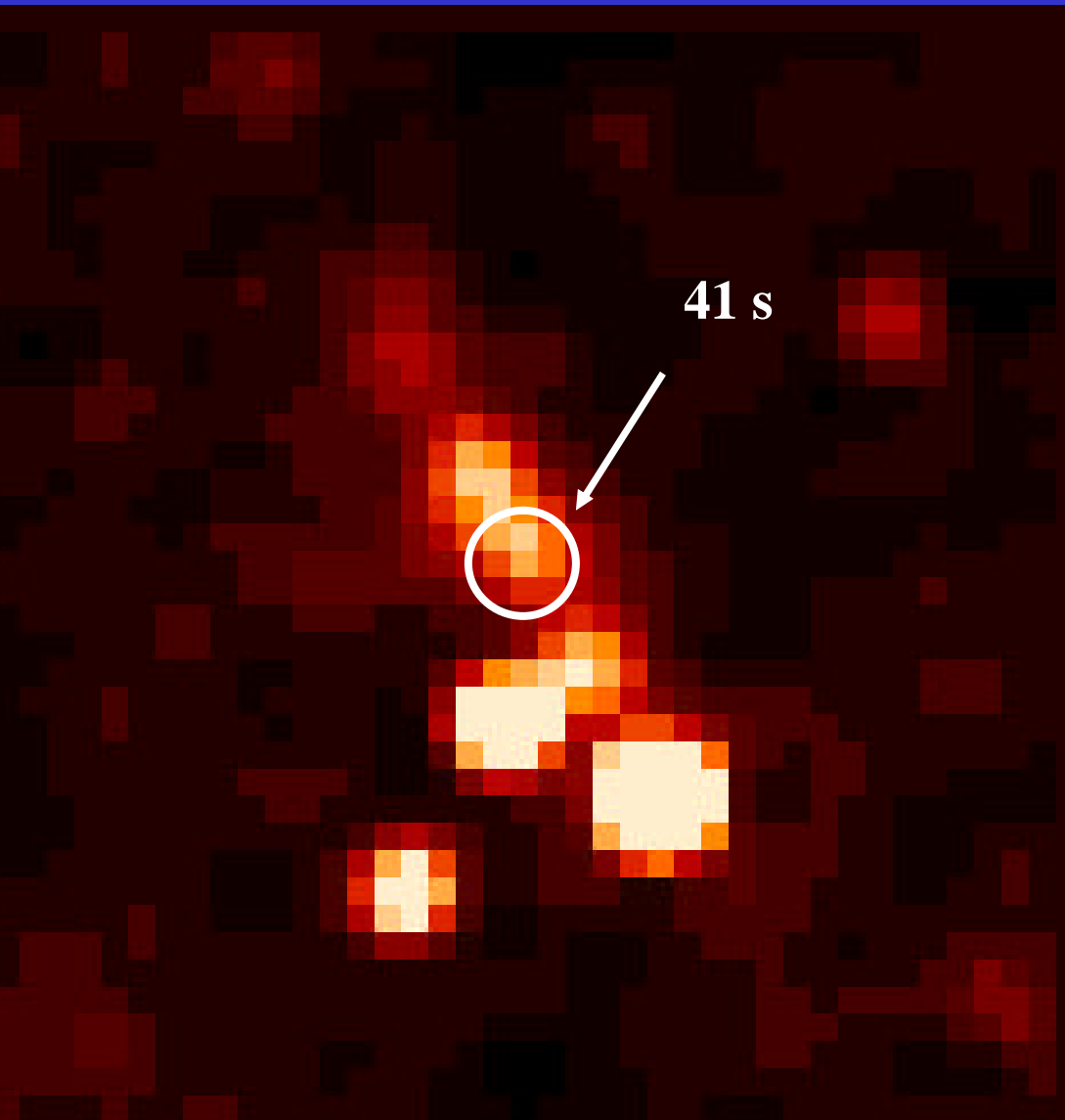
(Sep 2003 – 1 Ms)

Source of 27 s at  $\approx 40''$  from Sgr A\*

# Most Recent Analysis of IBIS/ISGRM GC Images



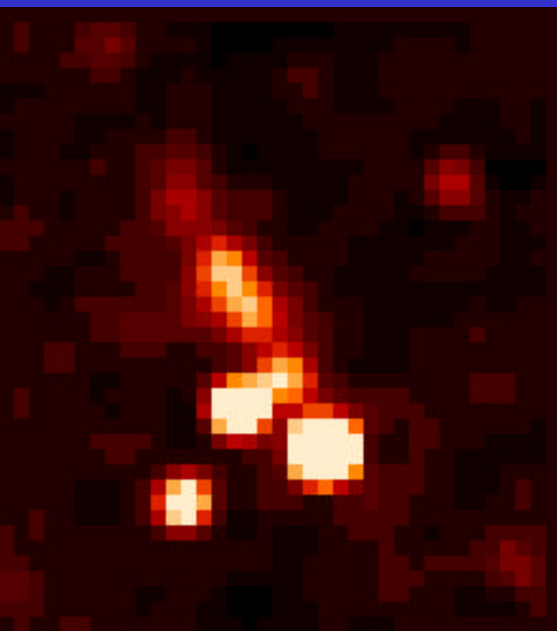
# Most Recent Analysis of IBIS/ISGRI GC Images



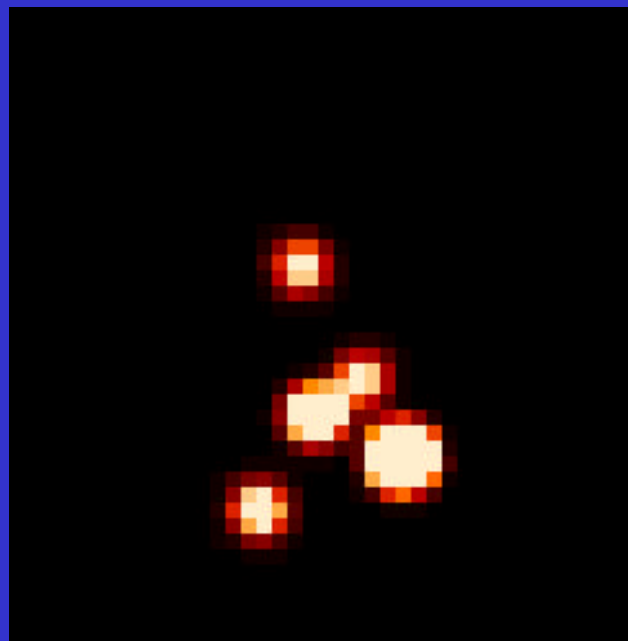
- Eff. Exposure @GC  
~ 4 Ms
- IGR J 17456-2901 at  
~ 41 s, at  $< 1'$  from  
Sgr A\*
- Error radius ~  $1'$
- Confused region
- Multiple source fit  
analysis.

Mosaicked image in 20-30 keV band. Background structure correction.

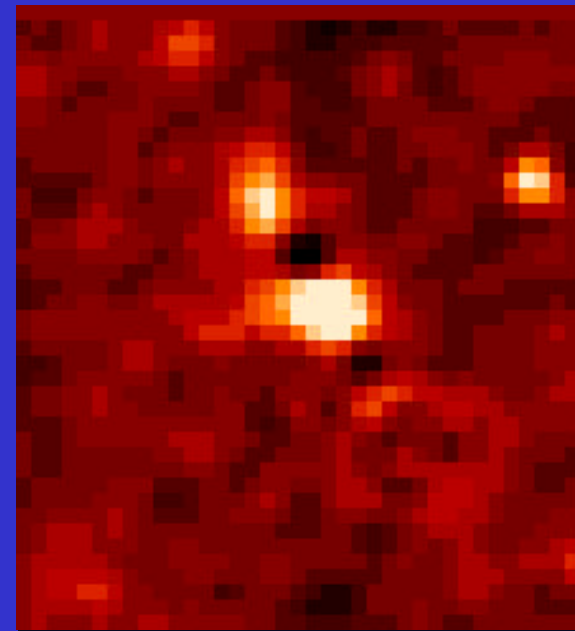
# Fitting the Decoded images with the Point-Spread Function



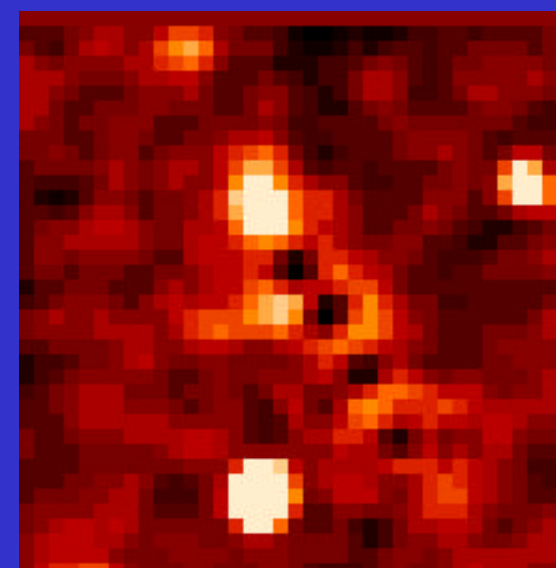
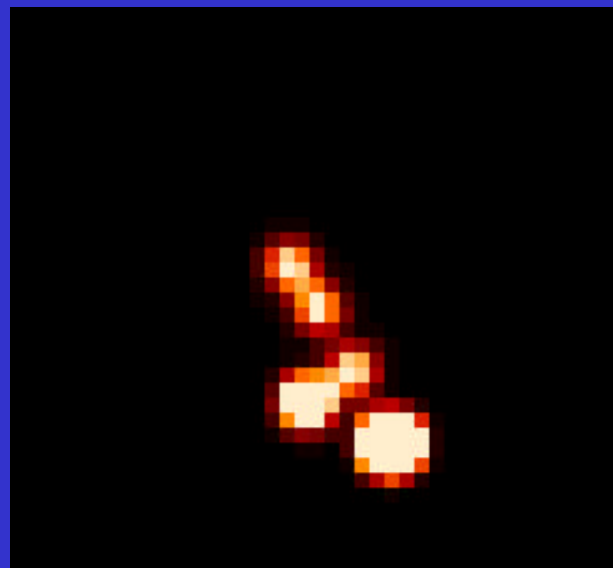
**IMAGE MOSAIC**



**FITTED MODEL**



**RESIDUES**





# Fitted positions of IGR J1745.6-2901 (20-40 keV)

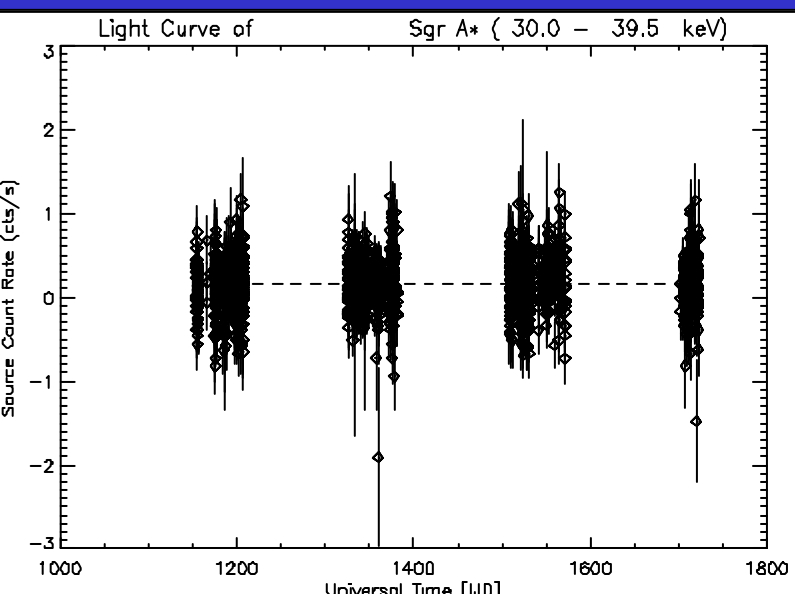
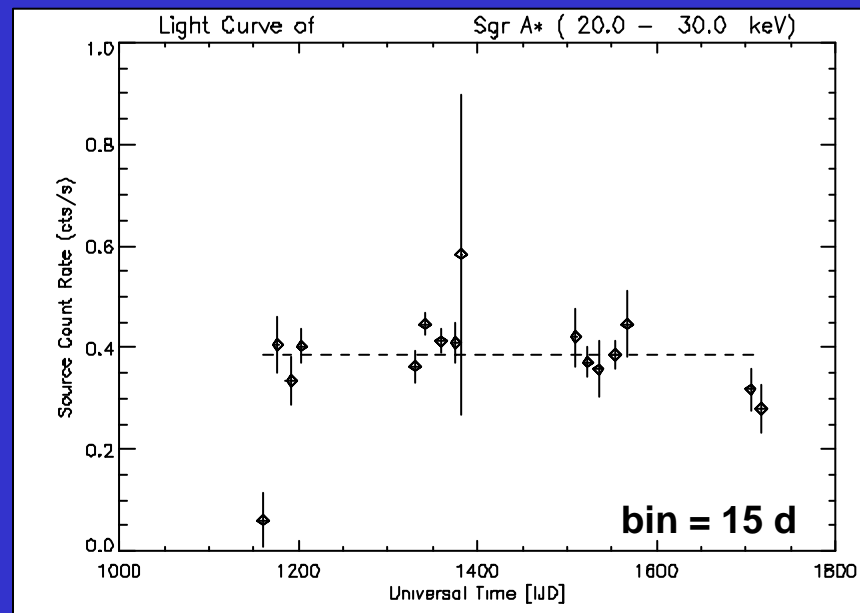
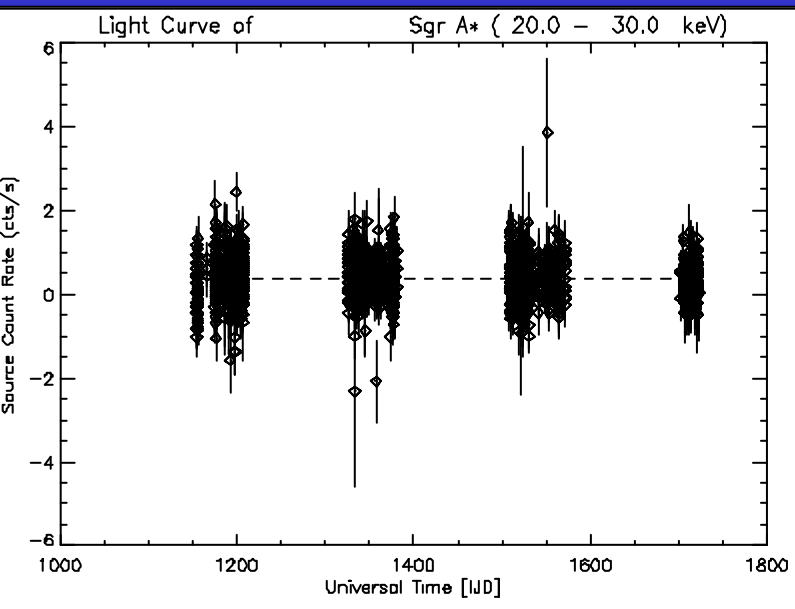
GCDE + ToO spring 2003			2003-2004 Data, recent analysis			
	20 – 40 keV		(20-30 keV)			
	S/N	Offset	S/N	Offset	Err. Rad.	
E 1740	70	19"	258	17" 0.28'	0.27'	
A 1742	15	3"	106	42" 0.70'	0.42'	
SLX 1744			71	89" 1.48'	0.55'	
KS 1741			49	34" 0.56'	0.71'	
E 1743	9	234"	46	141" 2.34'	0.74'	
<b>Sgr A*</b>	<b>8</b>	<b>52" (^)</b>	<b>41</b>	<b>56" 0.96'</b>	<b>0.81'</b>	
<b>AX J1745</b>	<b>8</b>	<b>36" (^)</b>	<b>41</b>	<b>140" 2.33'</b>	<b>0.81'</b>	

Assuming presence of GRS 1741.9-2853

Still Compatible with Sgr A\*

Not anymore compatible with the ASCA transient AX J 17456-2901

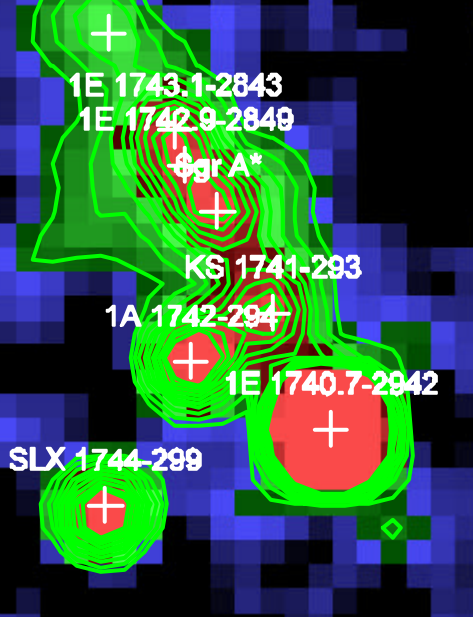
# Light Curves of IGR J1745.6-2901 (all data)



- No clear variability from this source
- Previous flare detection not confirmed

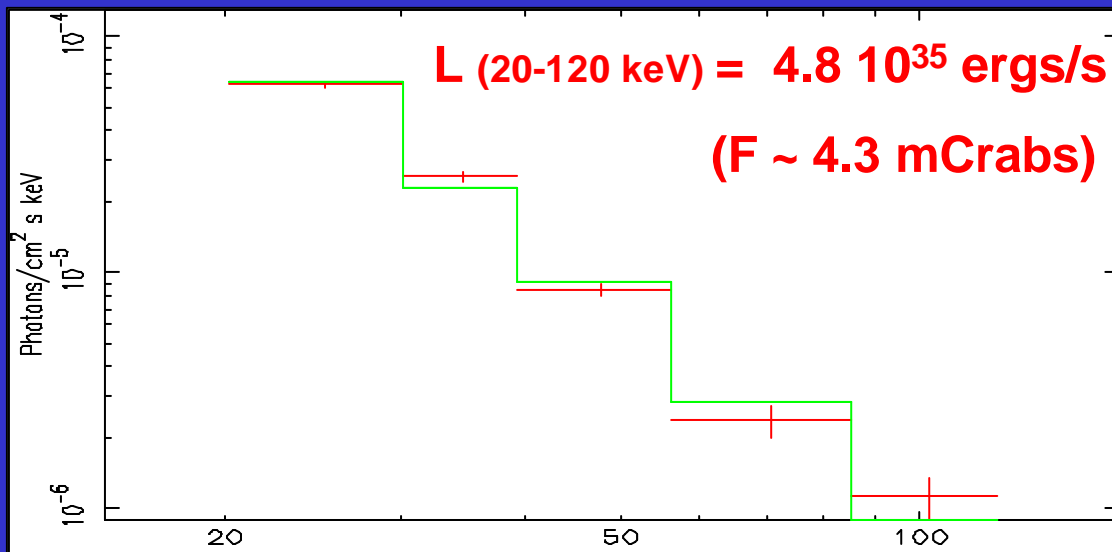
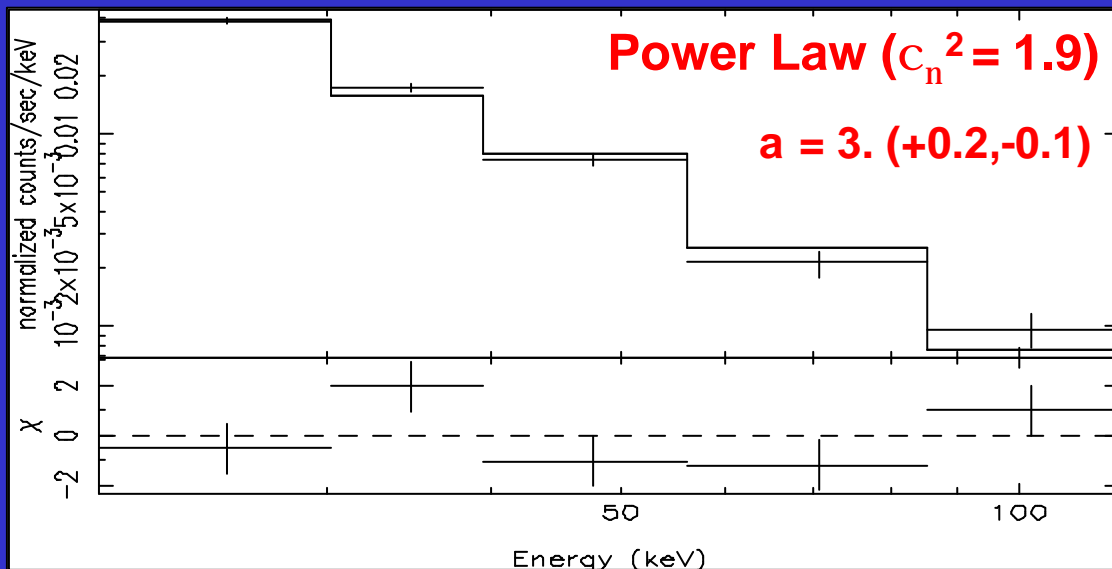
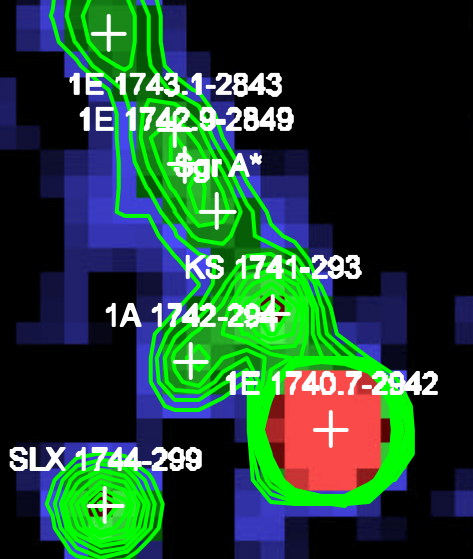
# Spectrum

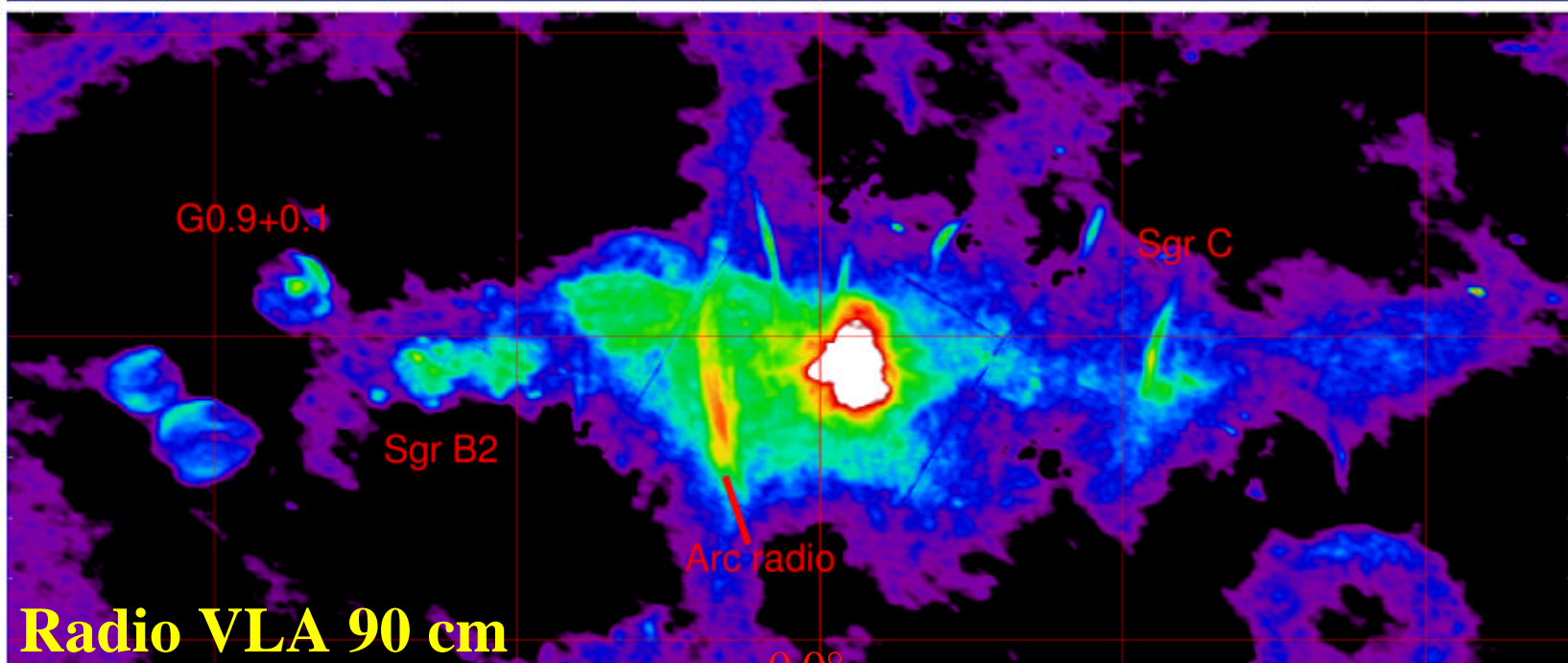
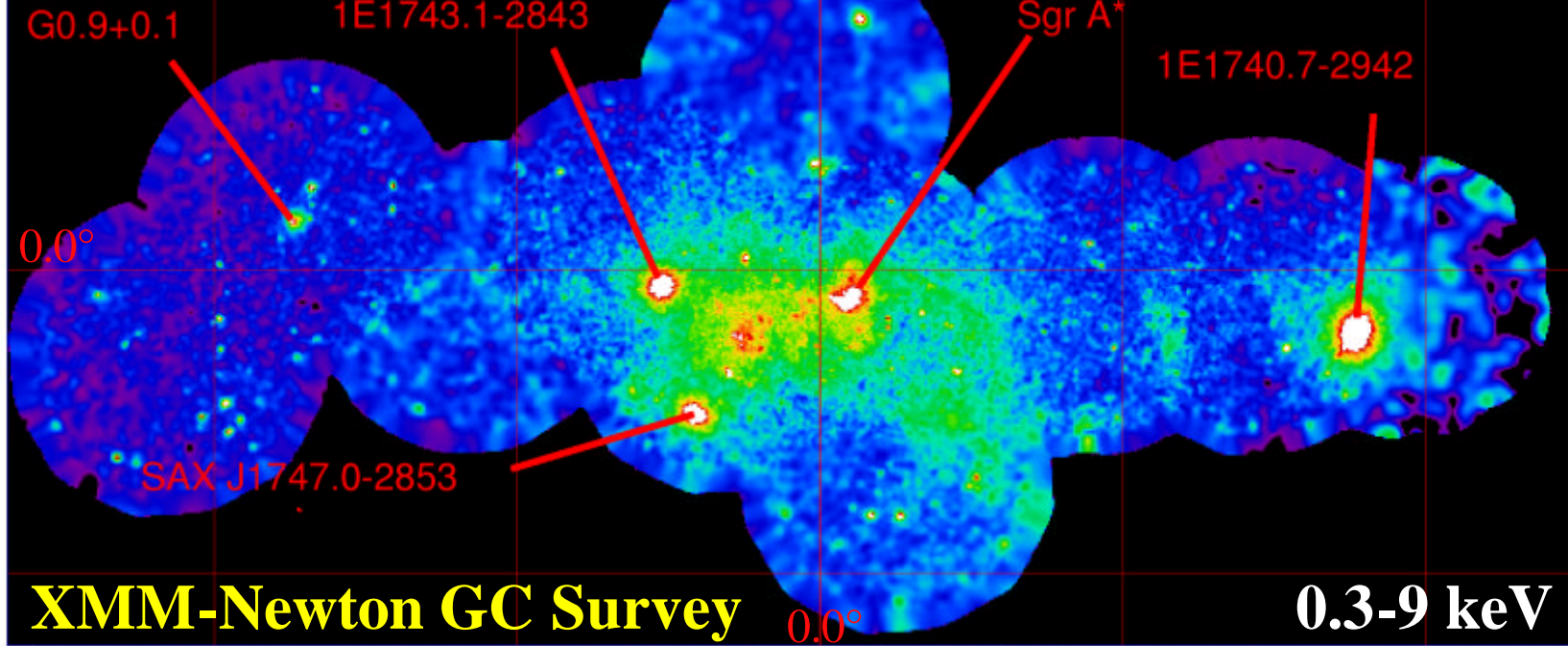
IGR J17475-2822

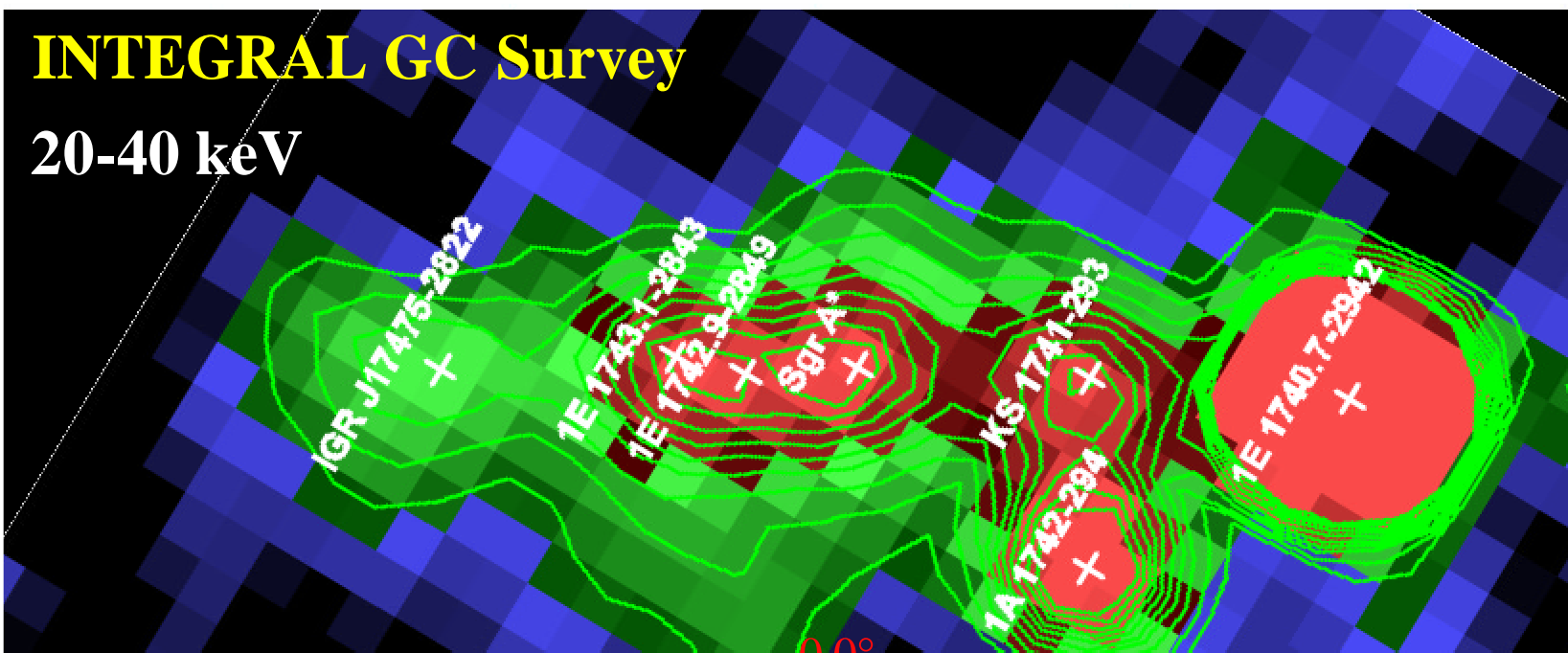
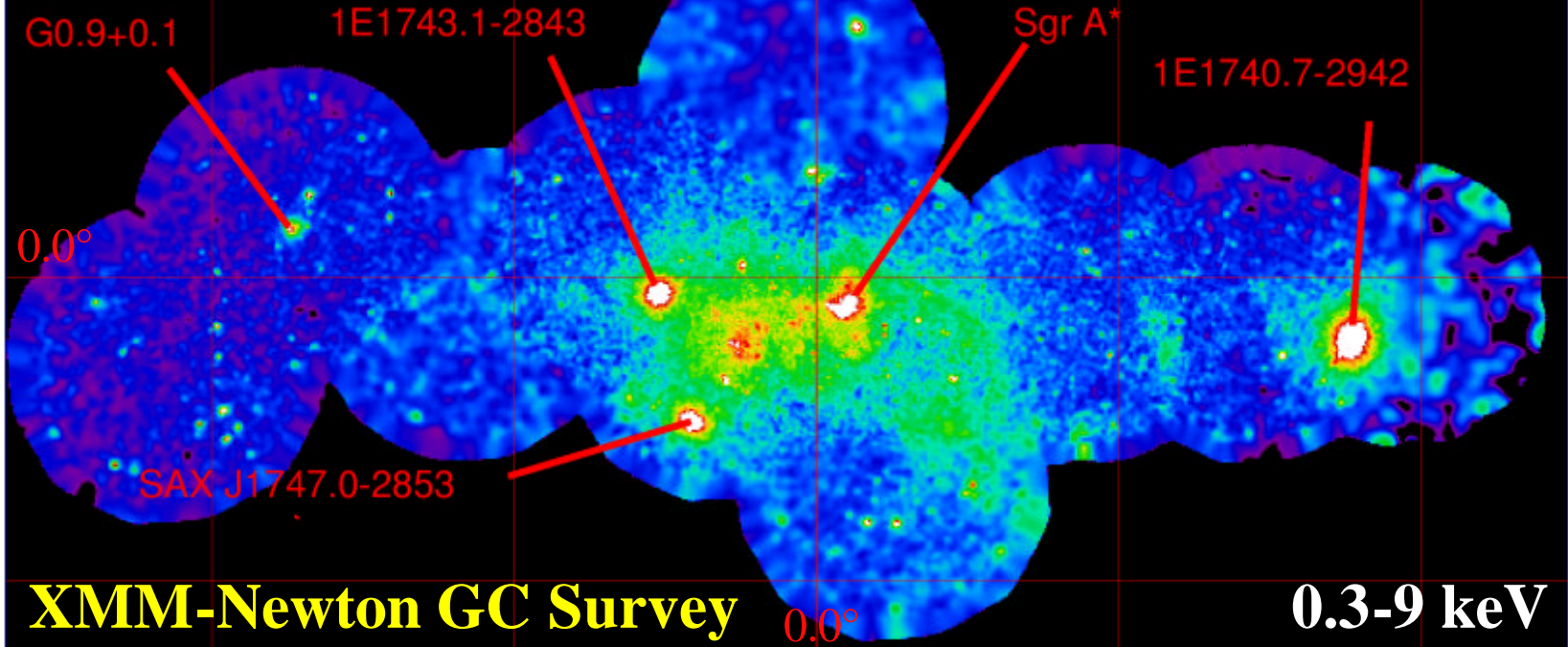


40-60 keV

IGR J17475-2822



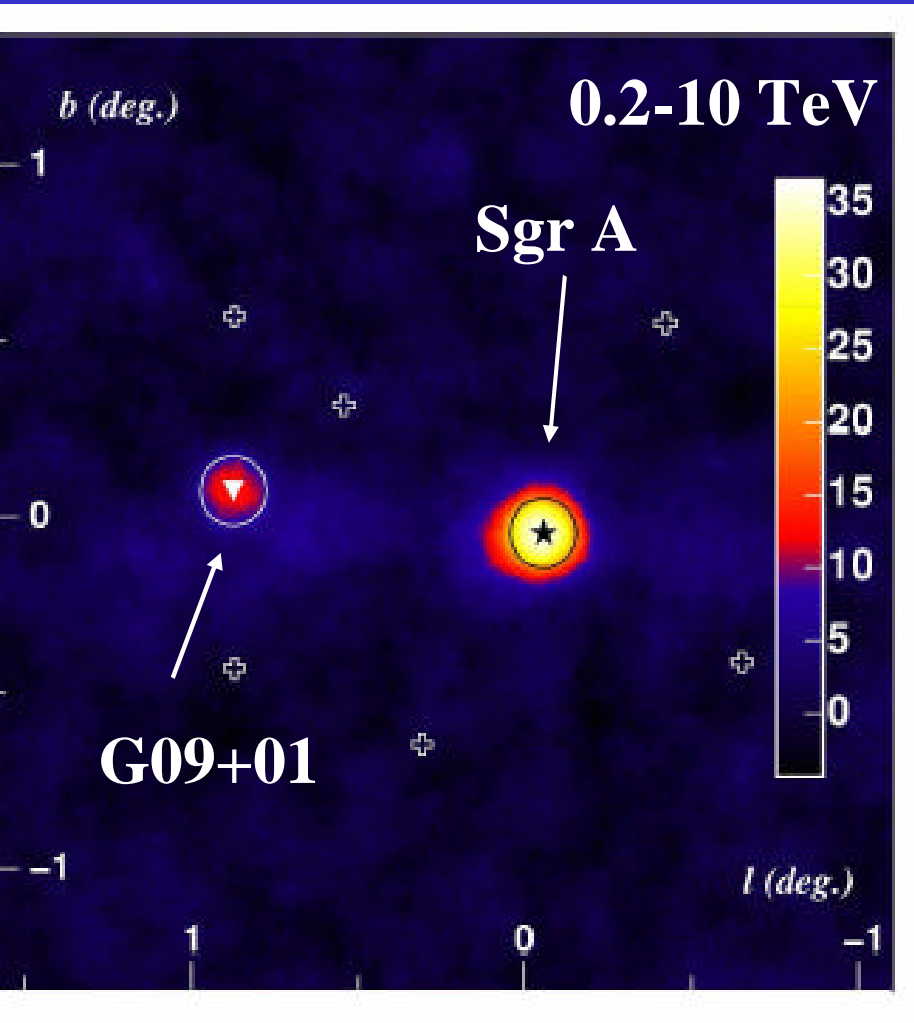




# Nature of the INTEGRAL source in Sgr A region

- The INTEGRAL source is not compatible with known high energy ( $> 10$  keV) sources of the region (GRS 1743-290, GRS 1741.9-2853, etc.)
- It is not associated to some non-thermal structures of the region (Radio Arc, Radio/X NTF) proposed as possible HE sources.
- It cannot be explained by simple extrapolation of the (point/diffuse) X-ray emission within 10' from Sgr A\* as measured by XMM & Chandra.
- Several Chandra or XMM-Newton transient sources were observed in the IGR error box but they are weak and soft. Detailed study using 2004 coordinated XMM obs. is in progress.
- The hard ASCA transient AX1745.6-2901 (at  $\sim 1.3'$  from Sgr A\*) does not seem compatible with IGR source. XMM data also show it was not bright in 2004.
- Detection of a TeV source in the region with HESS centered on Sgr A indicate presence of particle acceleration. Relation with IGR source ?

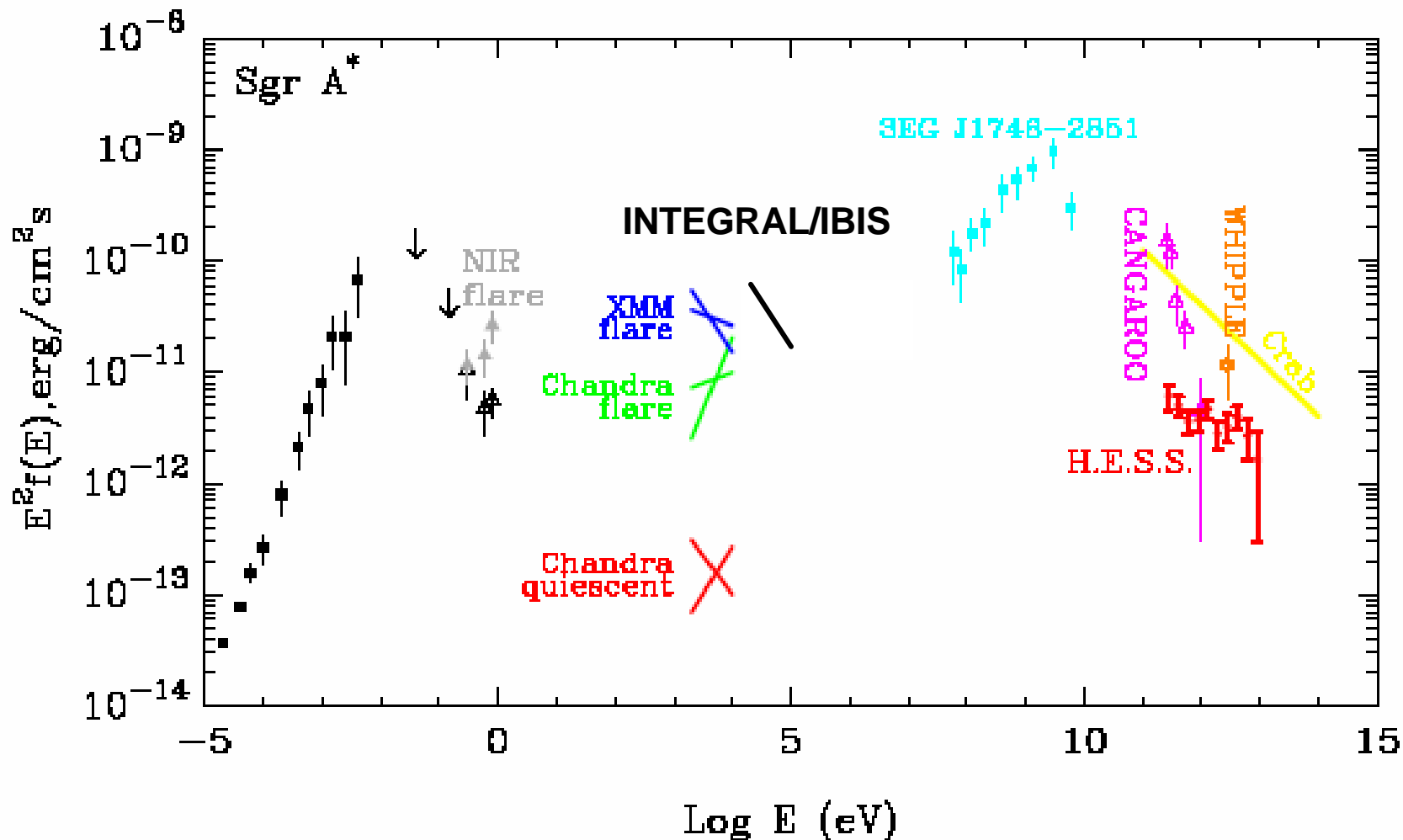
# HESS Observations of the GC



- GC TeV source at the Sgr A position
- G0.9+0.1 composite shell - PWN SNR

Aharonian et al., 2005

# Sgr A\* Broad Band Spectrum



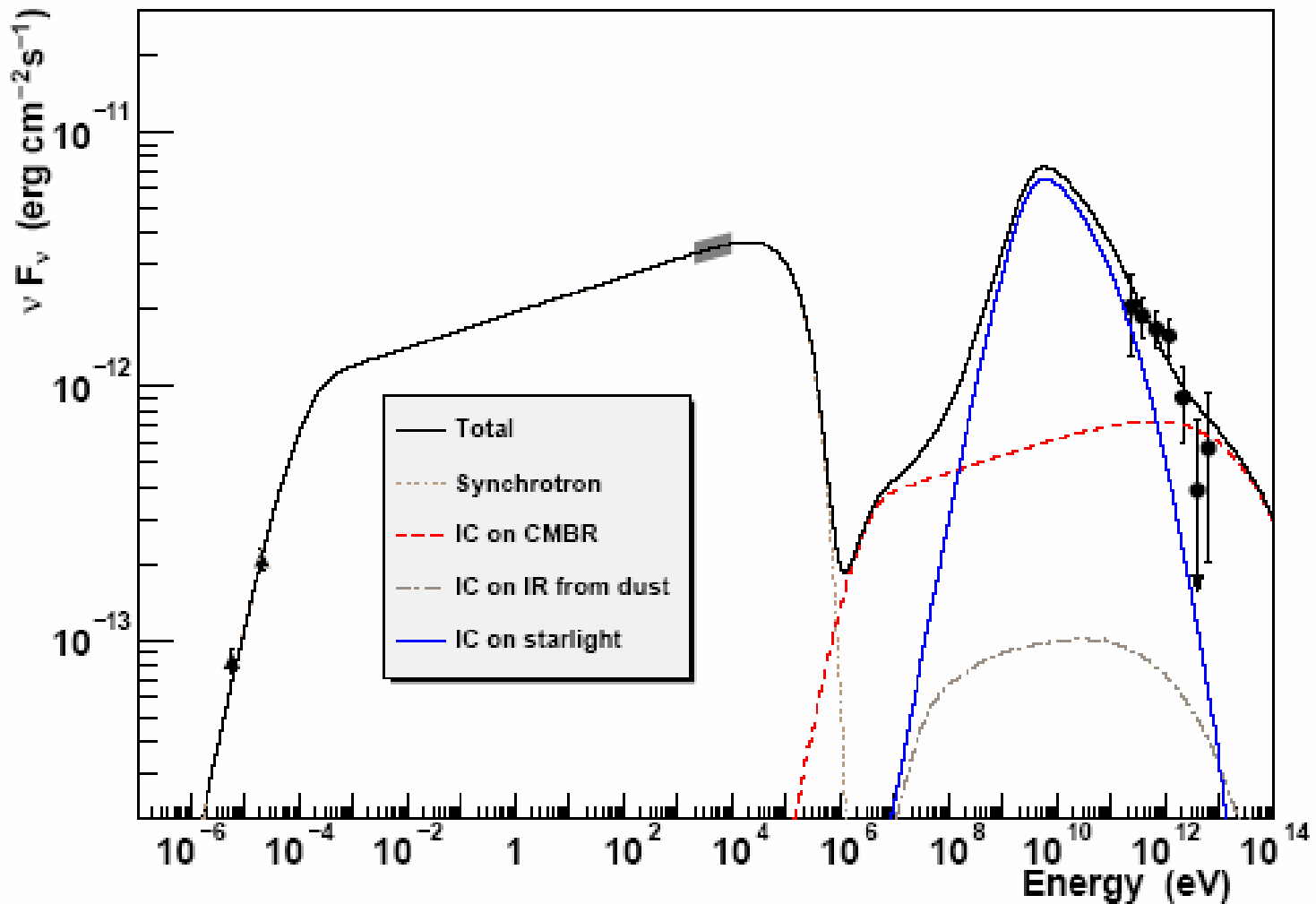
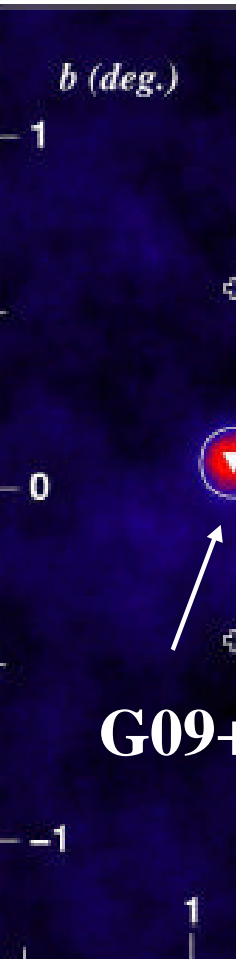


# Work in progress on INTEGRAL data of GC

- Detailed comparison with simultaneous XMM-Newton observations (contribution of X-ray diffuse emission and the X-ray transients)
- Sgr A\* was seen to flare up in X-rays during XMM observations, not clear simultaneous variation of the INTEGRAL source was observed (but .... work still in progress).
- Analysis of JEM X data. JEM X images up to now do not show any significant source at the Sgr A position.
- Evaluate different hypothesis on the possible contributions to the observed 20-120 keV flux (Sgr A\*, Sgr A East, diffuse non-thermal component, etc.)



# HESS Observations of the GC



# If IGR J1745.6-2901 is associated to Sgr A\*

