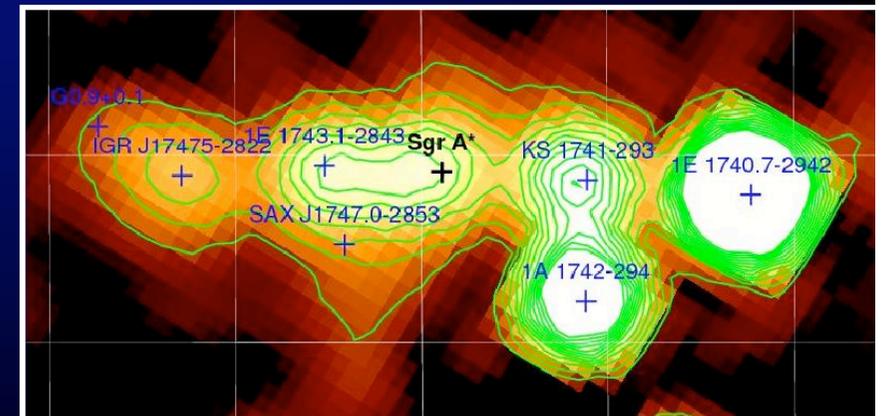
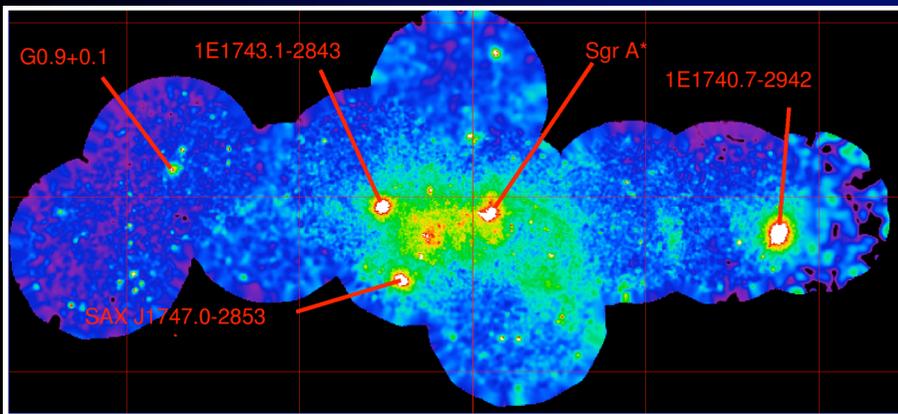


The Glorious Past of Sgr A*

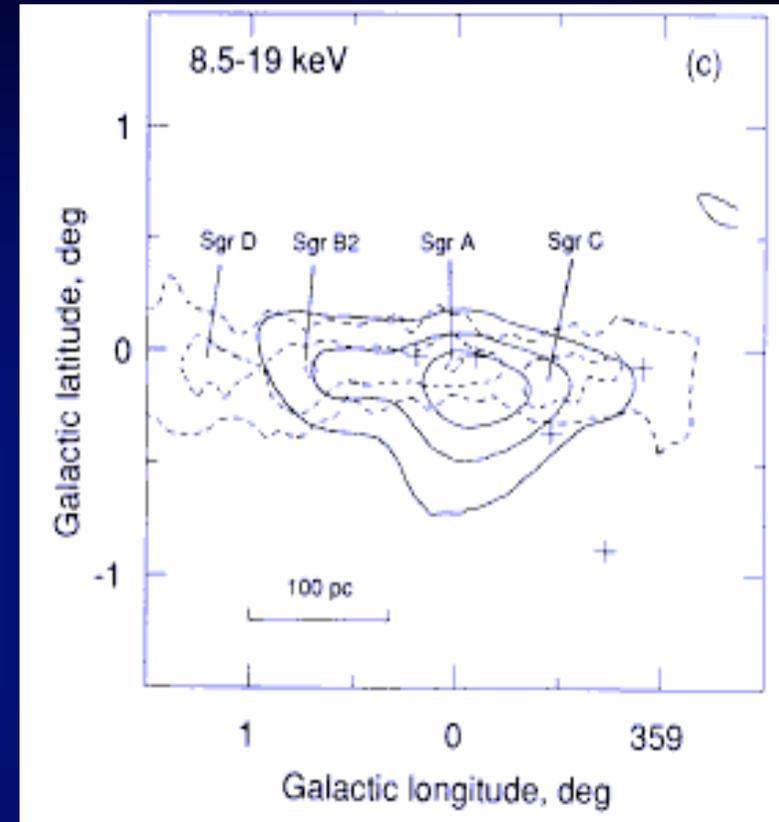
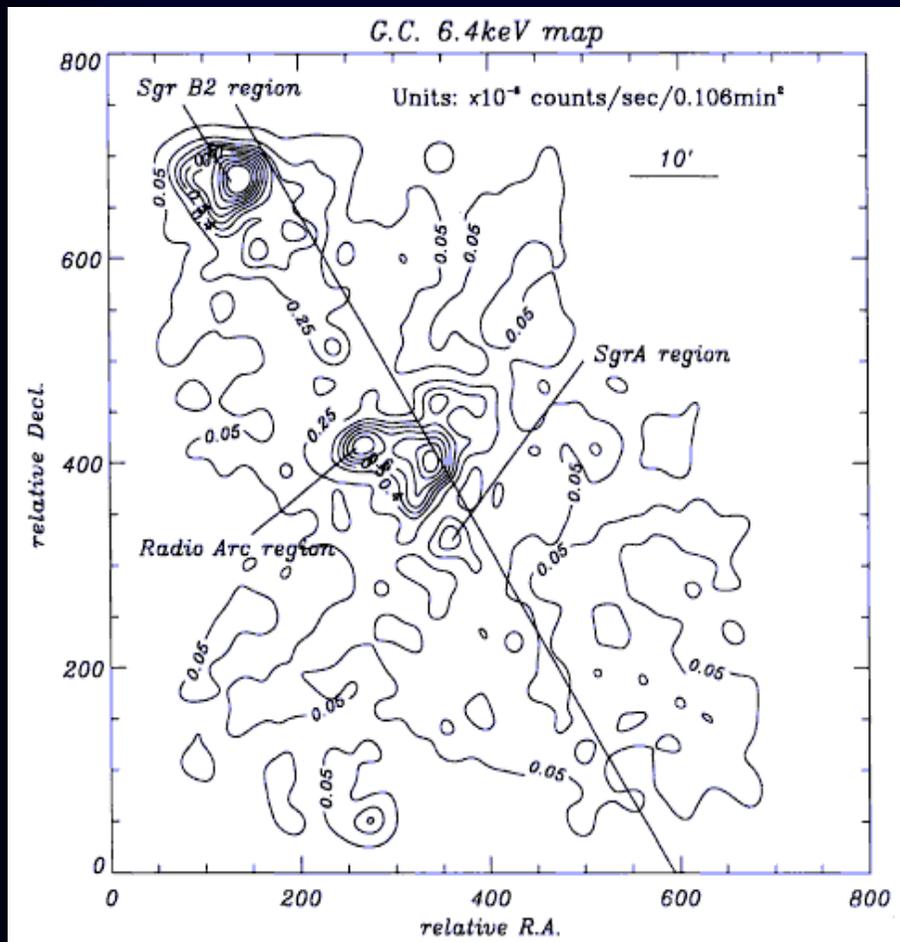
betrayed by molecular cloud emission

Andrea Goldwurm

AstroParticule et Cosmologie – Paris
Service d'Astrophysique / IRFU / CEA – Saclay
France



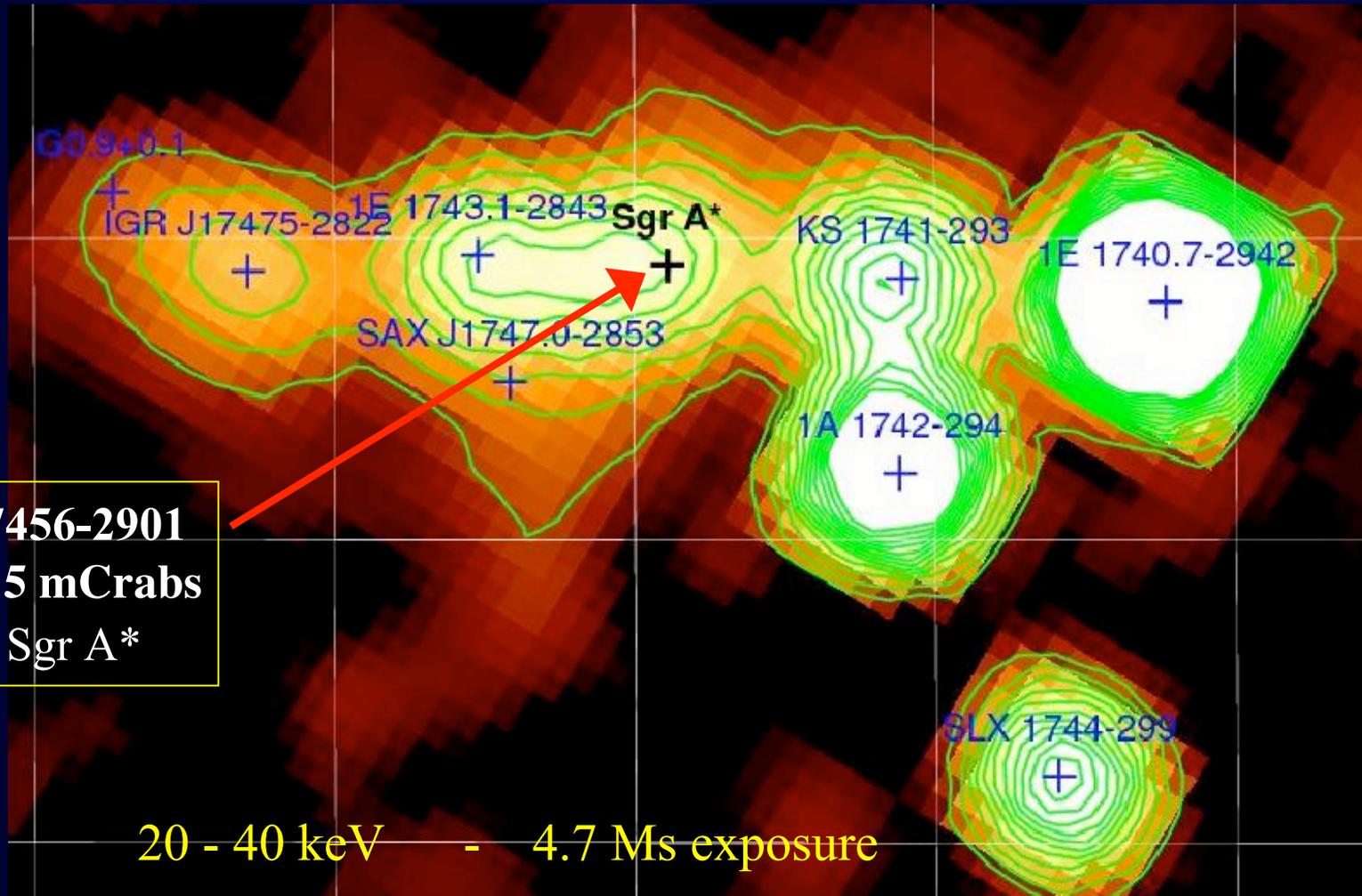
The Iron 6.4 keV Line from GC MCs



- η Clumpy diffuse 6.4 keV line emission of neutral iron coincident with some GMC in particular Sgr B2. Very large EW: 1 - 2 keV. (Koyama et al 96, Murakami et al 01)
- η Fluorescence in the GMC Sgr B2 due to photo-ionisation by hard X-ray (>7.1 keV) emission from an external source (Sunyaev et al 93. Koyama et al 96,)? or rather
- η Low energy (< 0.1-1 MeV) electron impacts on MC, ionize inner shell => 6.4 keV line + hν + structure. Dist. 7 to 10 pc from Sgr A. (V. L. ... X-ray ... 7.1 keV ... 1997)

IBIS / ISGRI IMAGES of the GC

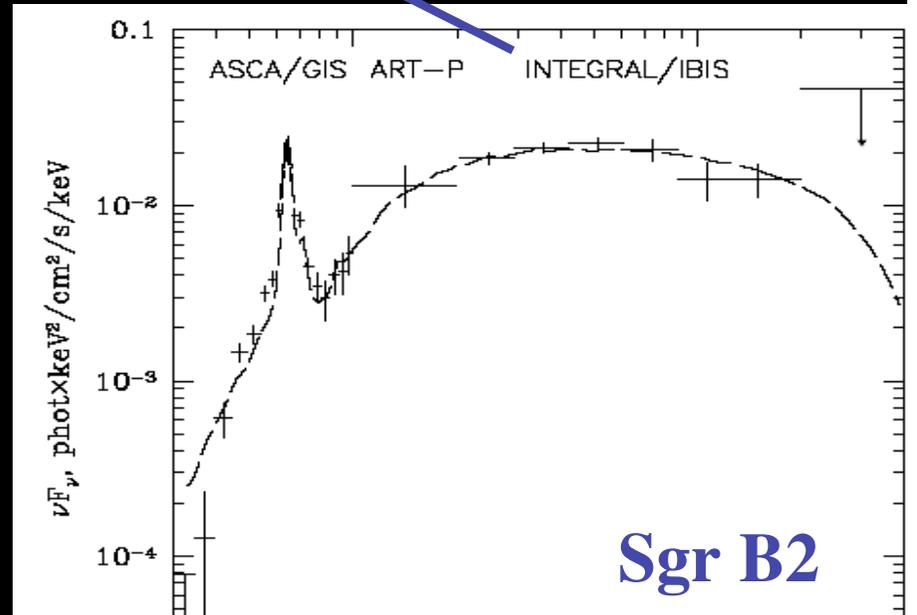
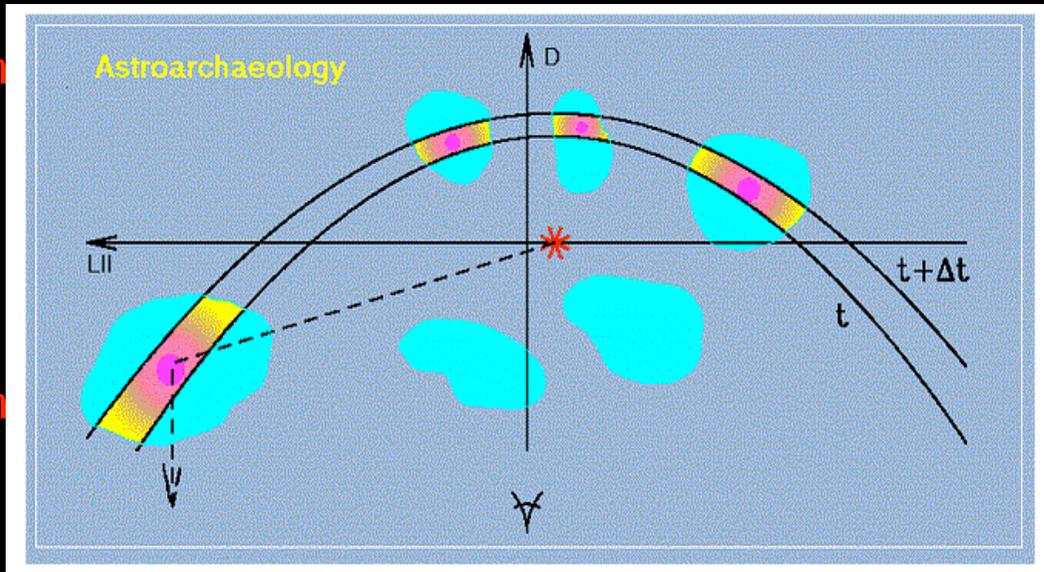
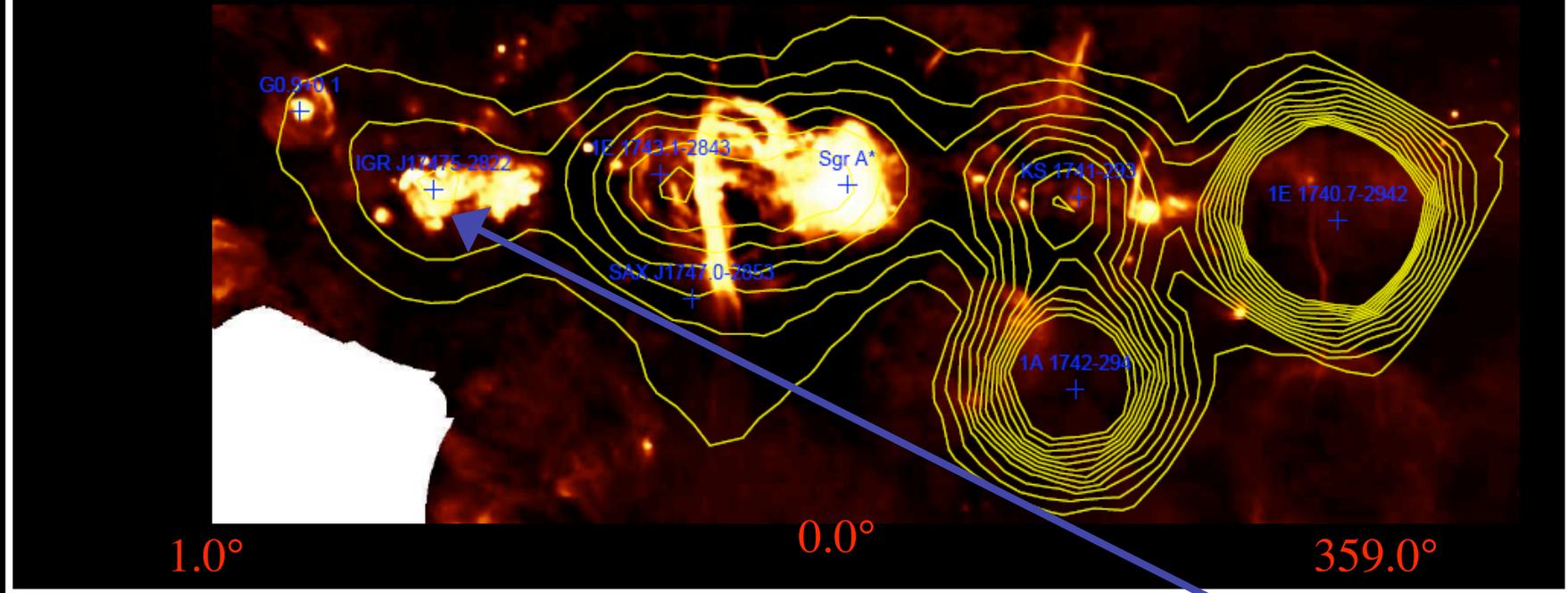
(Belanger et al. 2006)



Combined IBIS/ISGRI images (20-40 keV) of the central $\sim 2^\circ \times 1.5^\circ$ of the Galaxy from 2174 pointing observations in 2002-2004 (off-*Fermi* 4.7 Ms); contains 0.5 to 75 σ

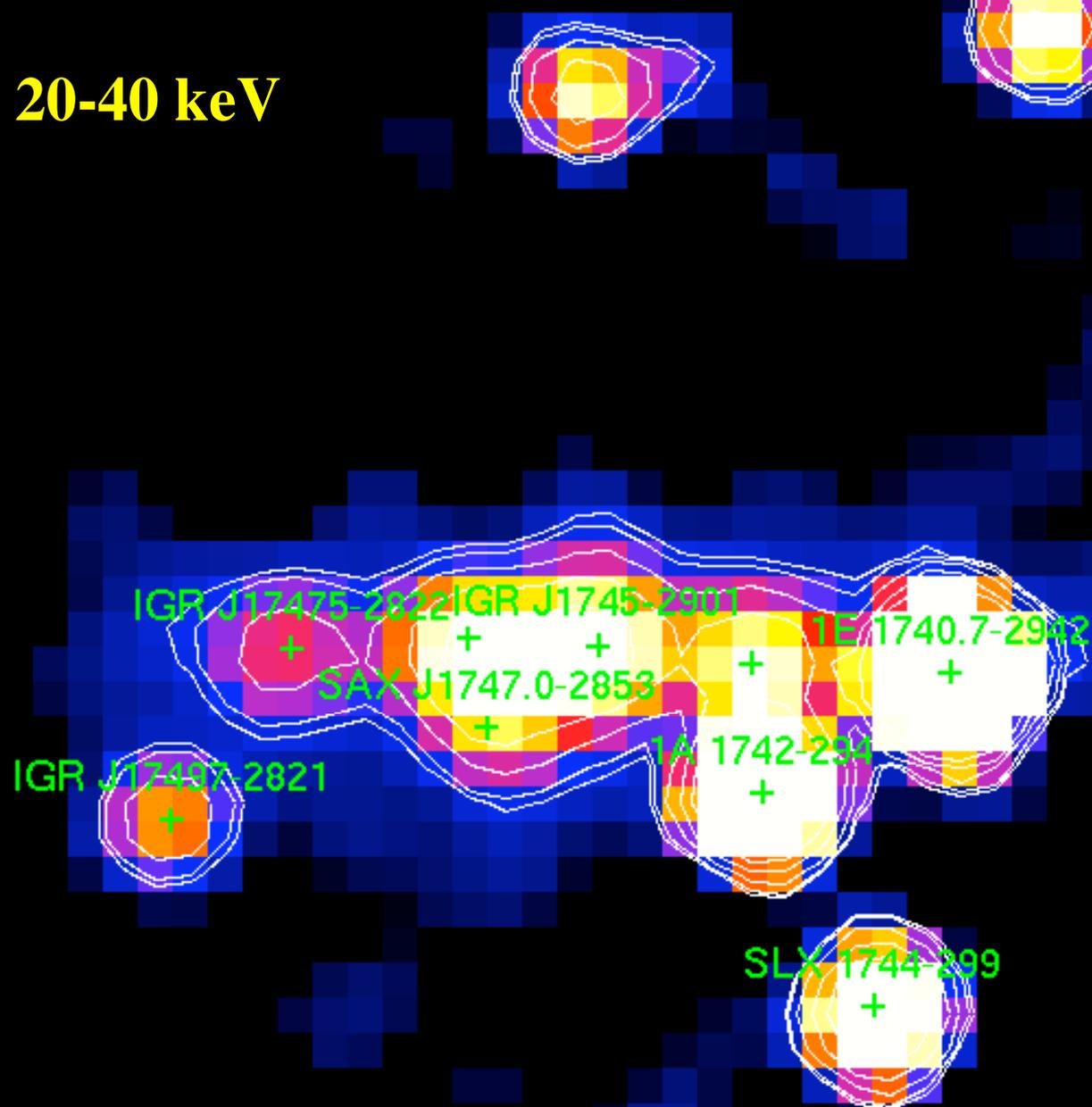
VLA (20cm, col) & INTEGRAL (20-30 keV, contours)

(Belanger et al. 2006)



(Belanger et al. 2006)

IBIS/ISGRI 20-40 keV



8 yr, 20 Mo INTEGRAL GC monitoring

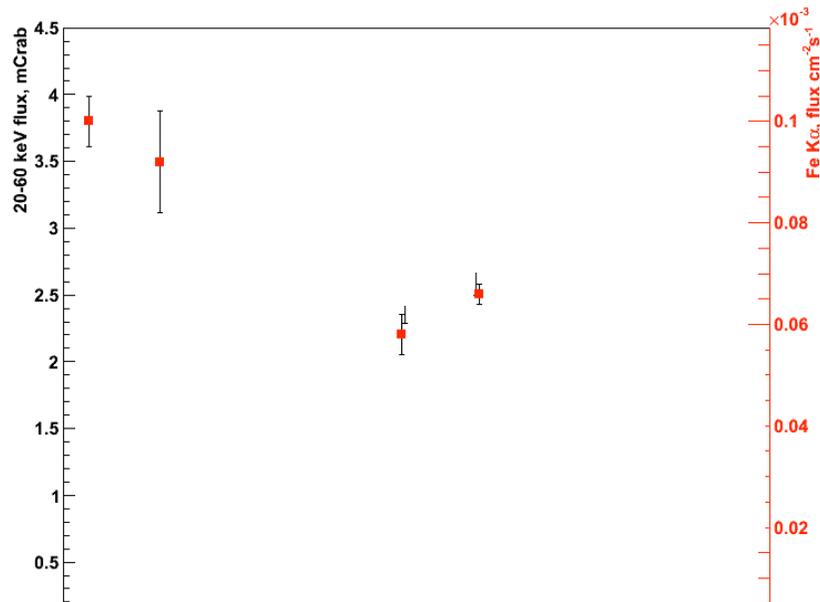
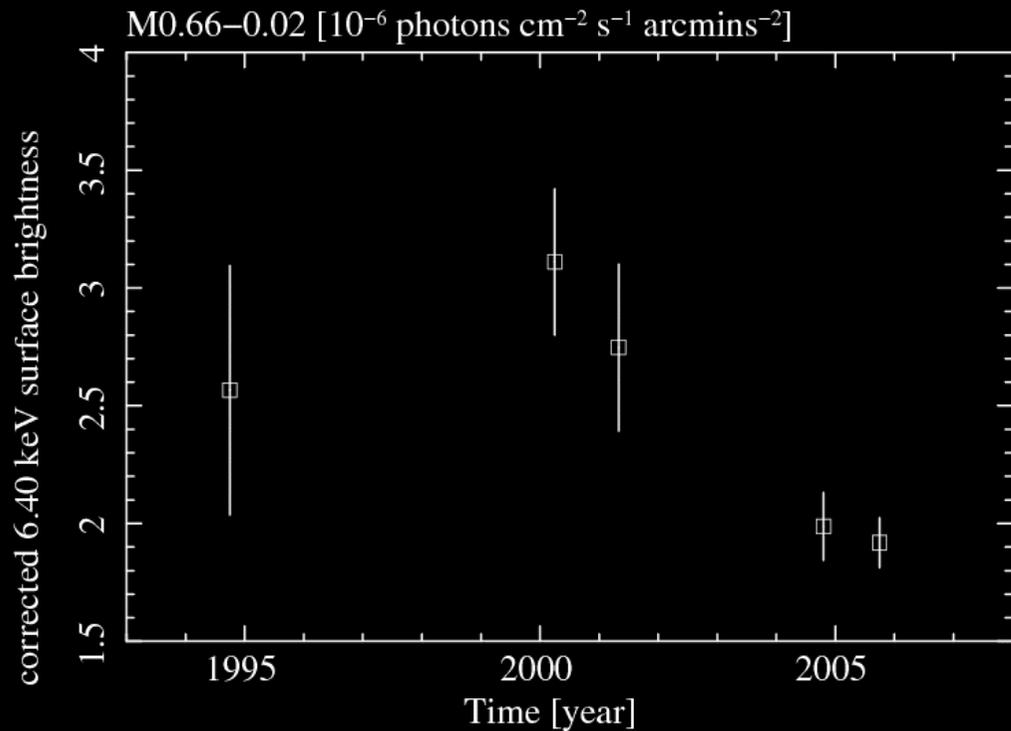
X-ray

Monitoring of Sgr B

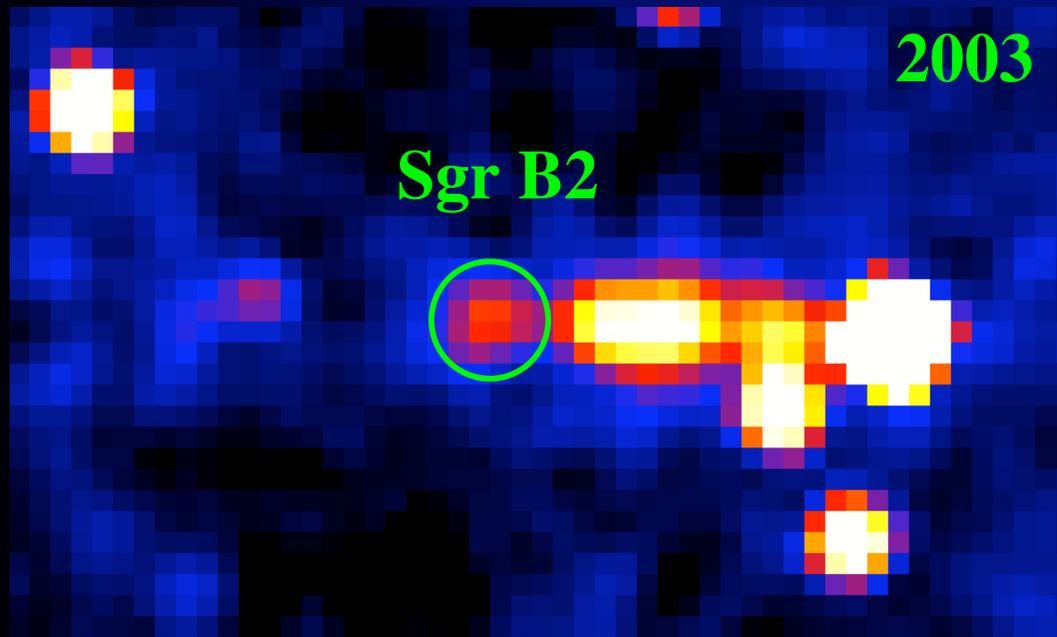
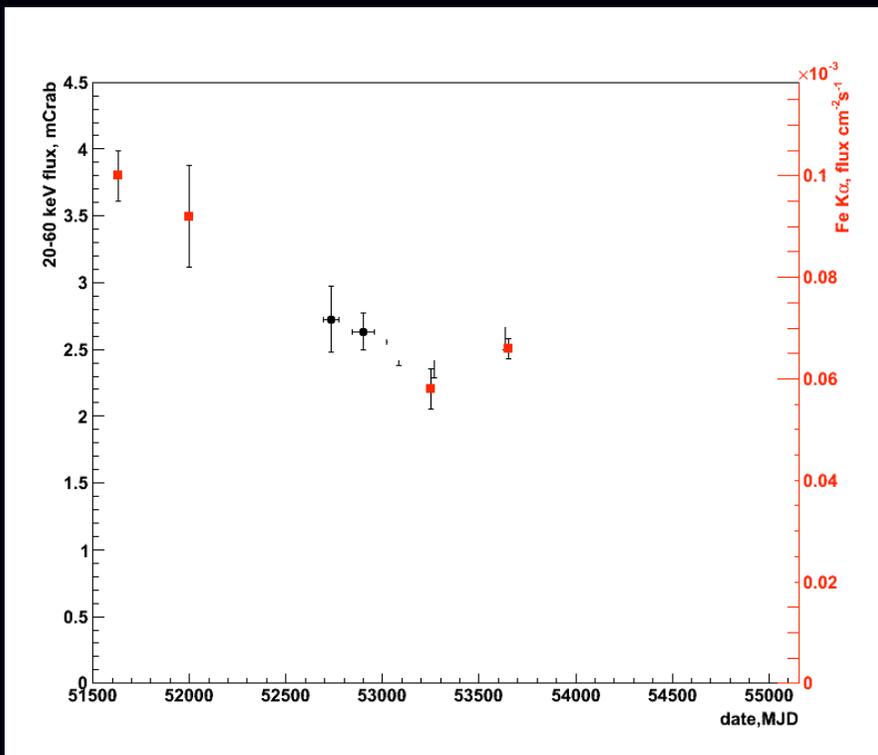
η Detection of significant decrease of Sgr B2 Iron line emission between 2001 and 2005 from Chandra – XMM – Suzaku data
(Koyama et al 06 07 08, Inoui et al 07)

η However measurements taken with different instruments

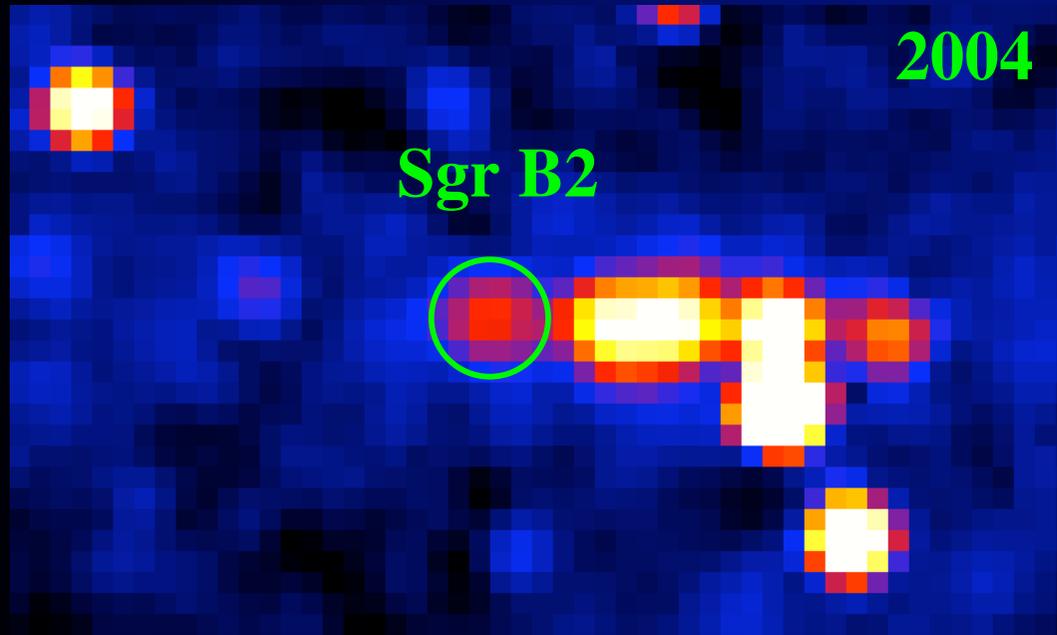
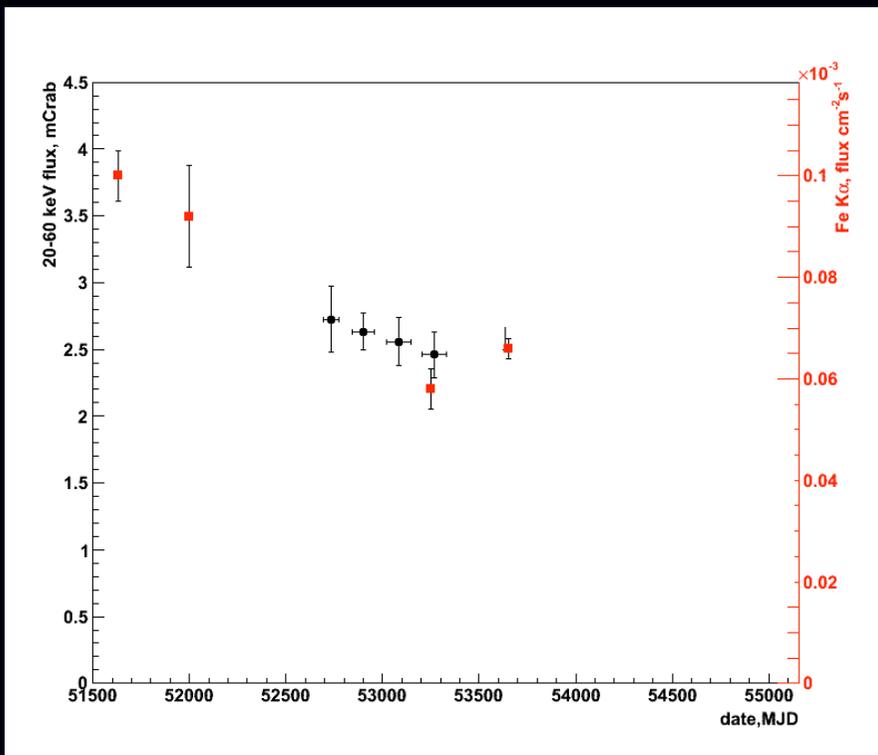
η Similar variation in hard X-rays ?
Only INTEGRAL has sensitivity and angular resolution and long obs. baseline to observe the effect.



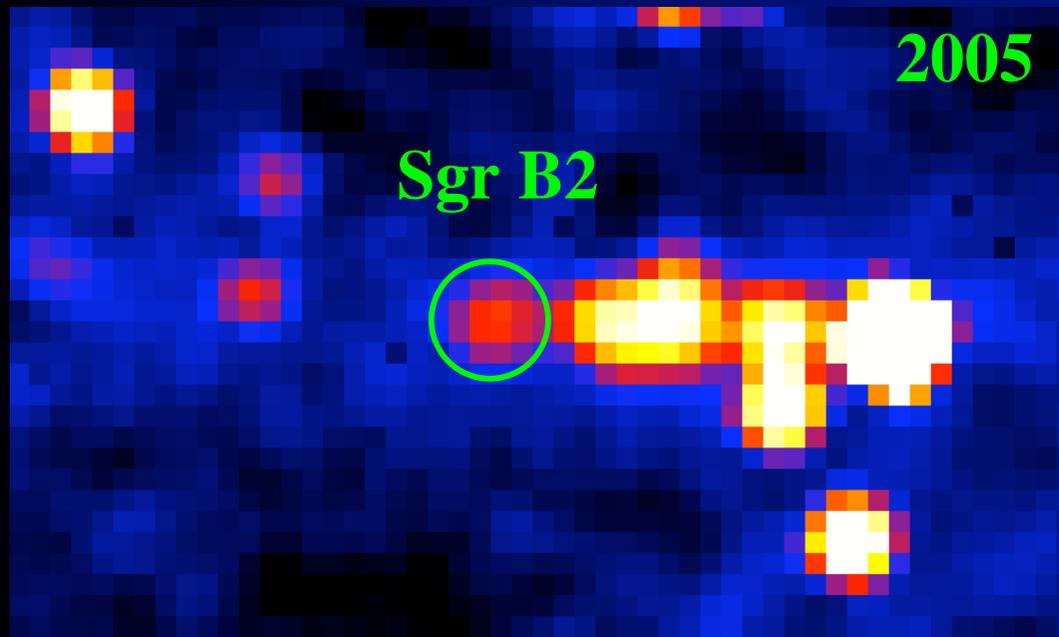
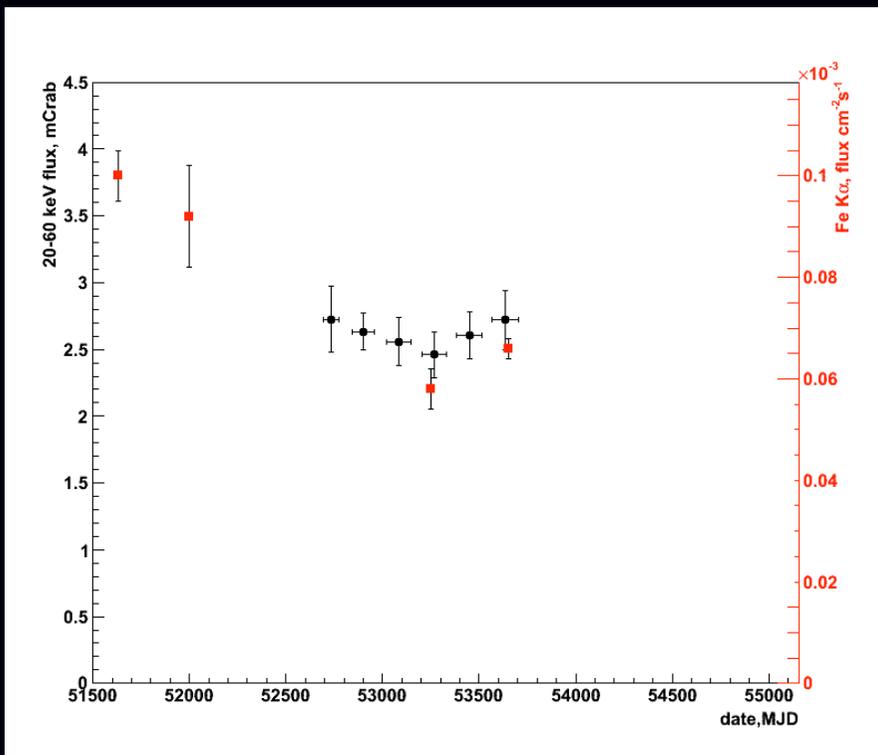
INTEGRAL Monitoring of Sgr B



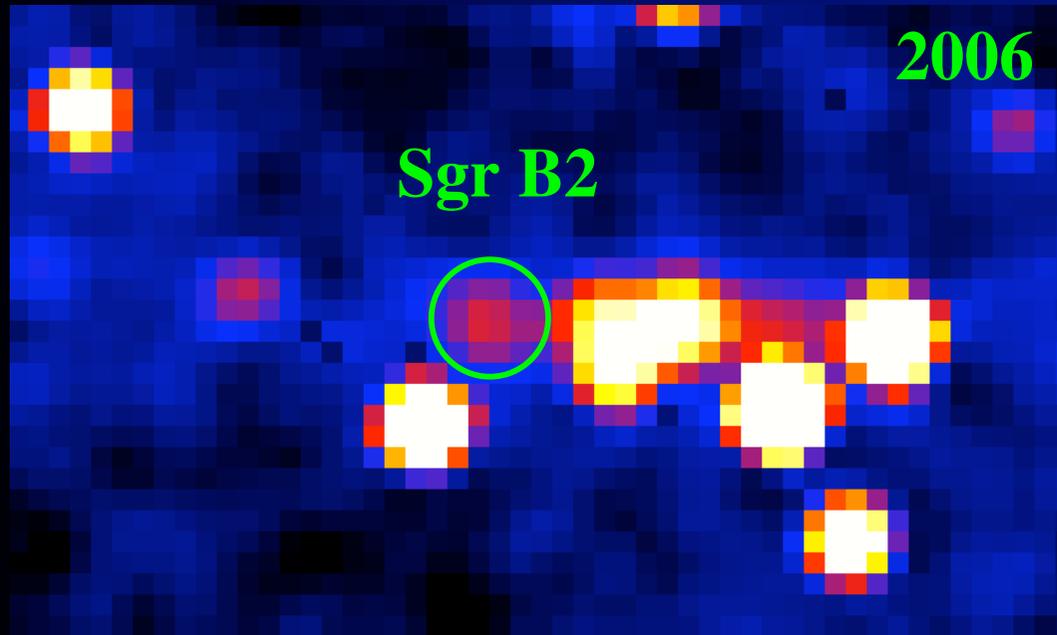
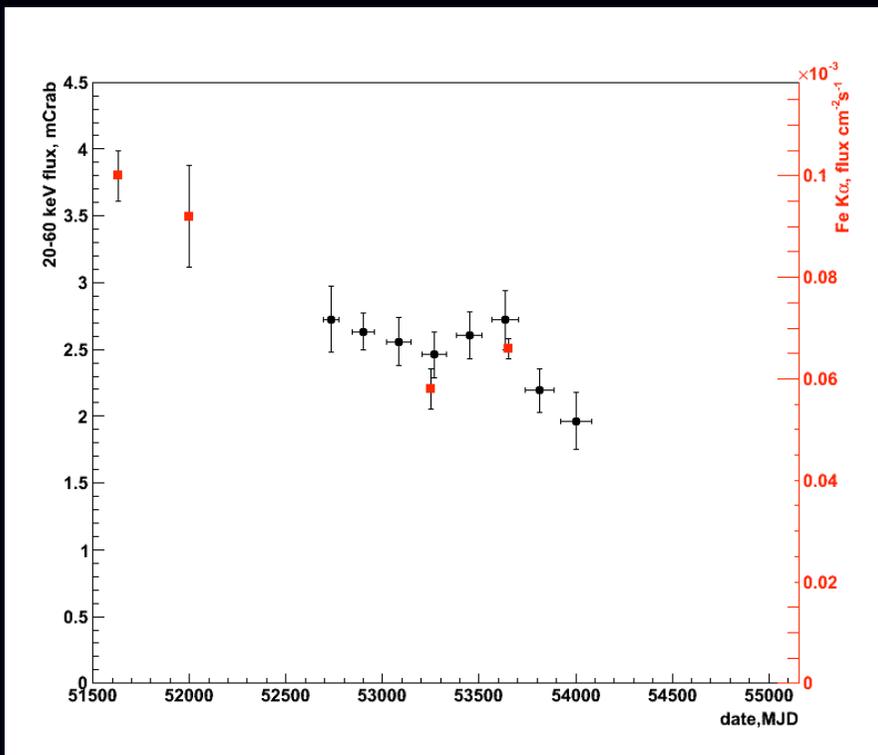
INTEGRAL Monitoring of Sgr B



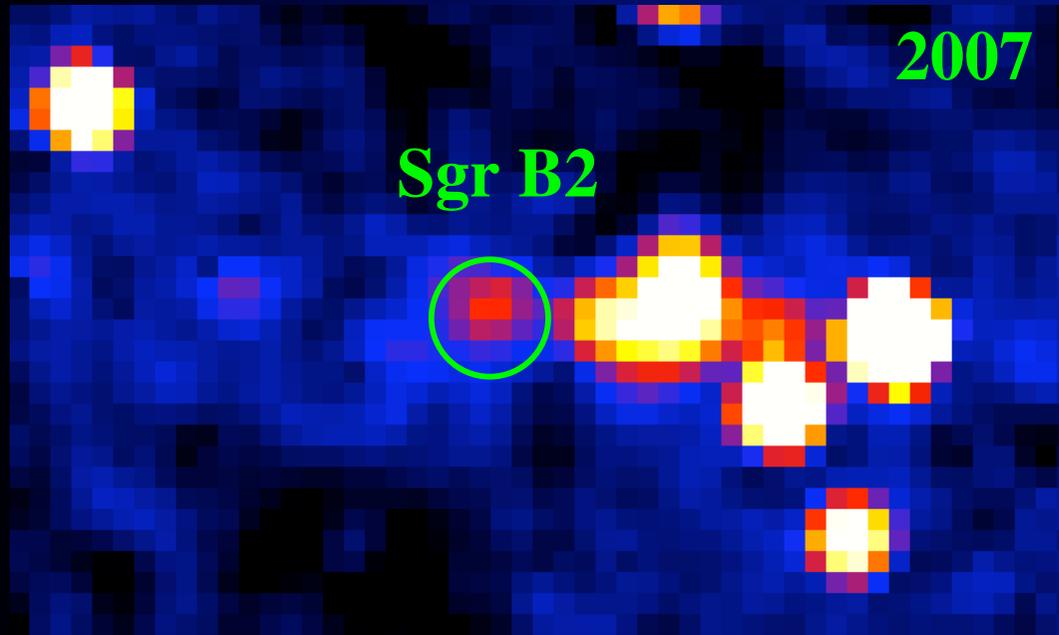
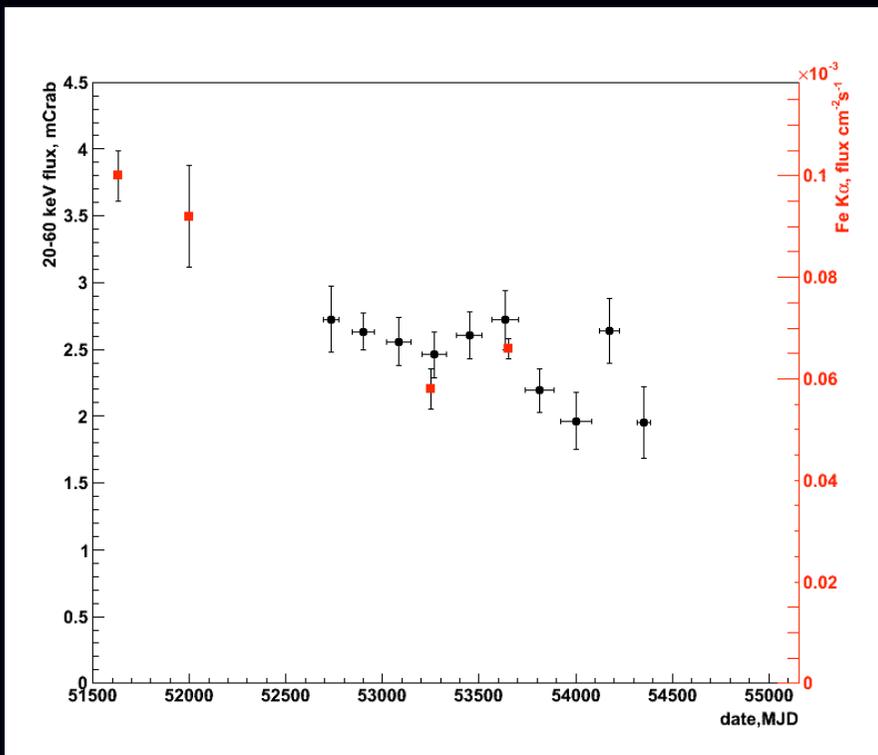
INTEGRAL Monitoring of Sgr B



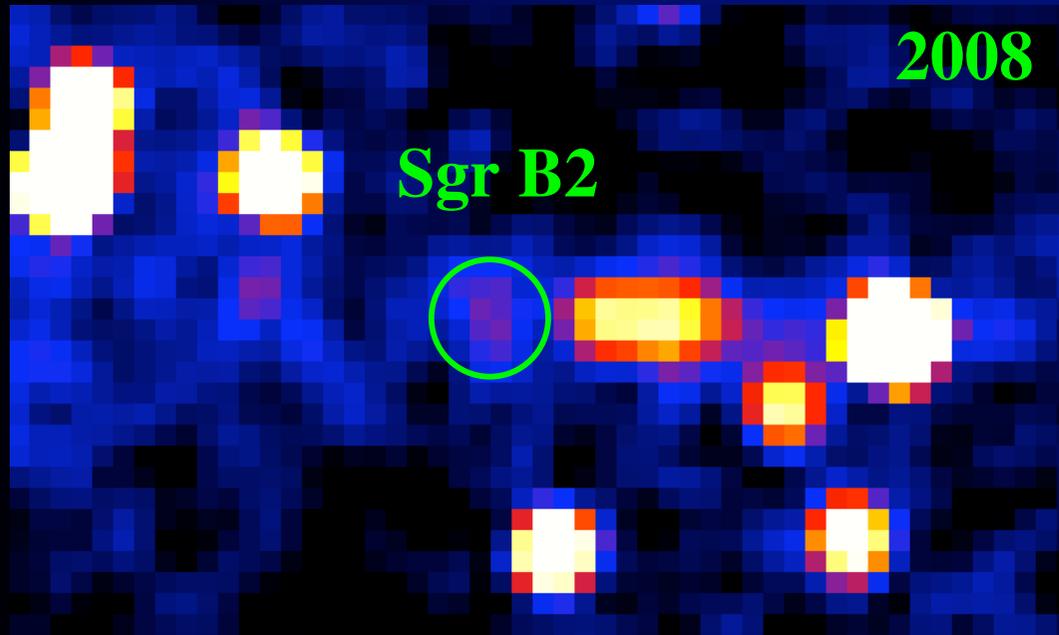
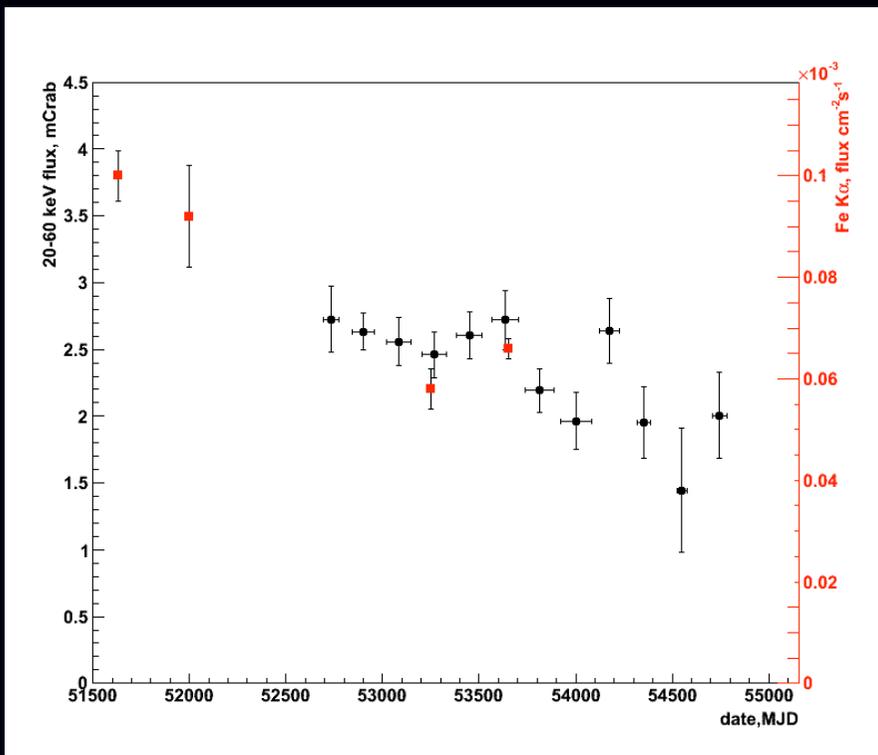
INTEGRAL Monitoring of Sgr B



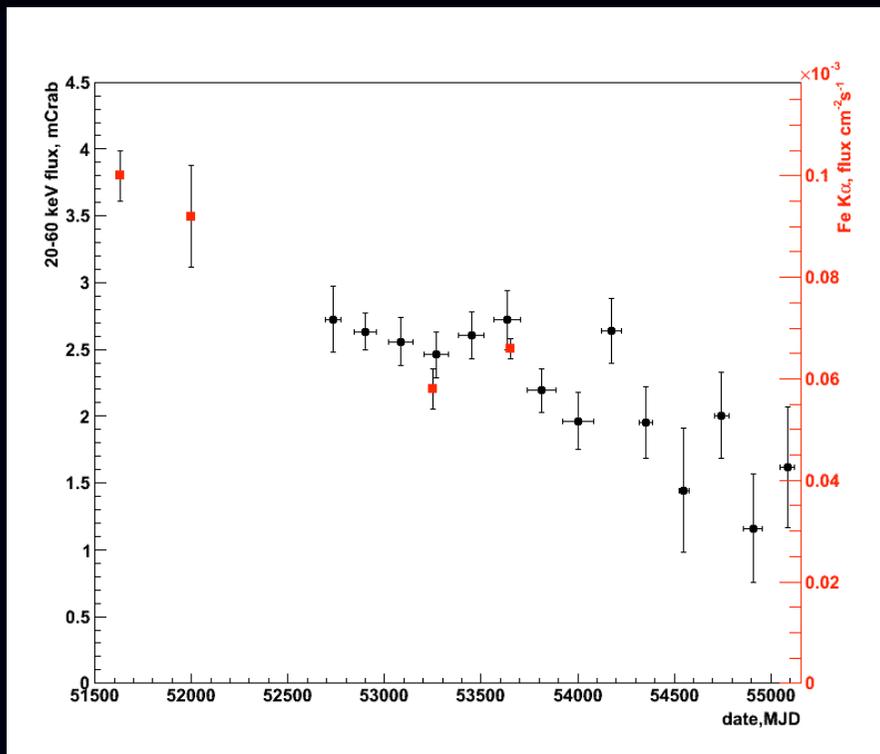
INTEGRAL Monitoring of Sgr B



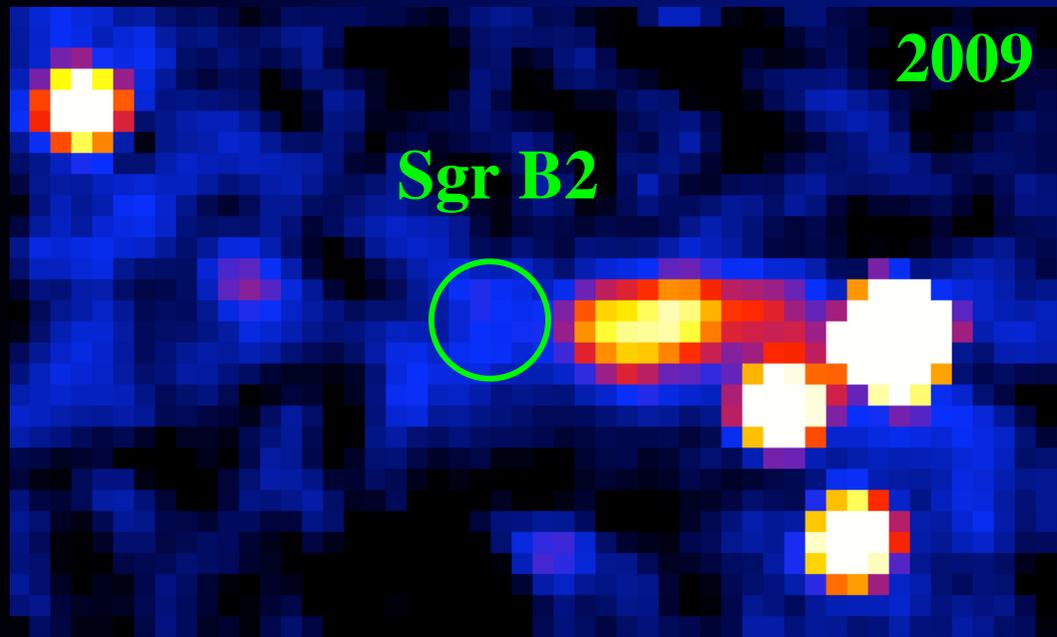
INTEGRAL Monitoring of Sgr B



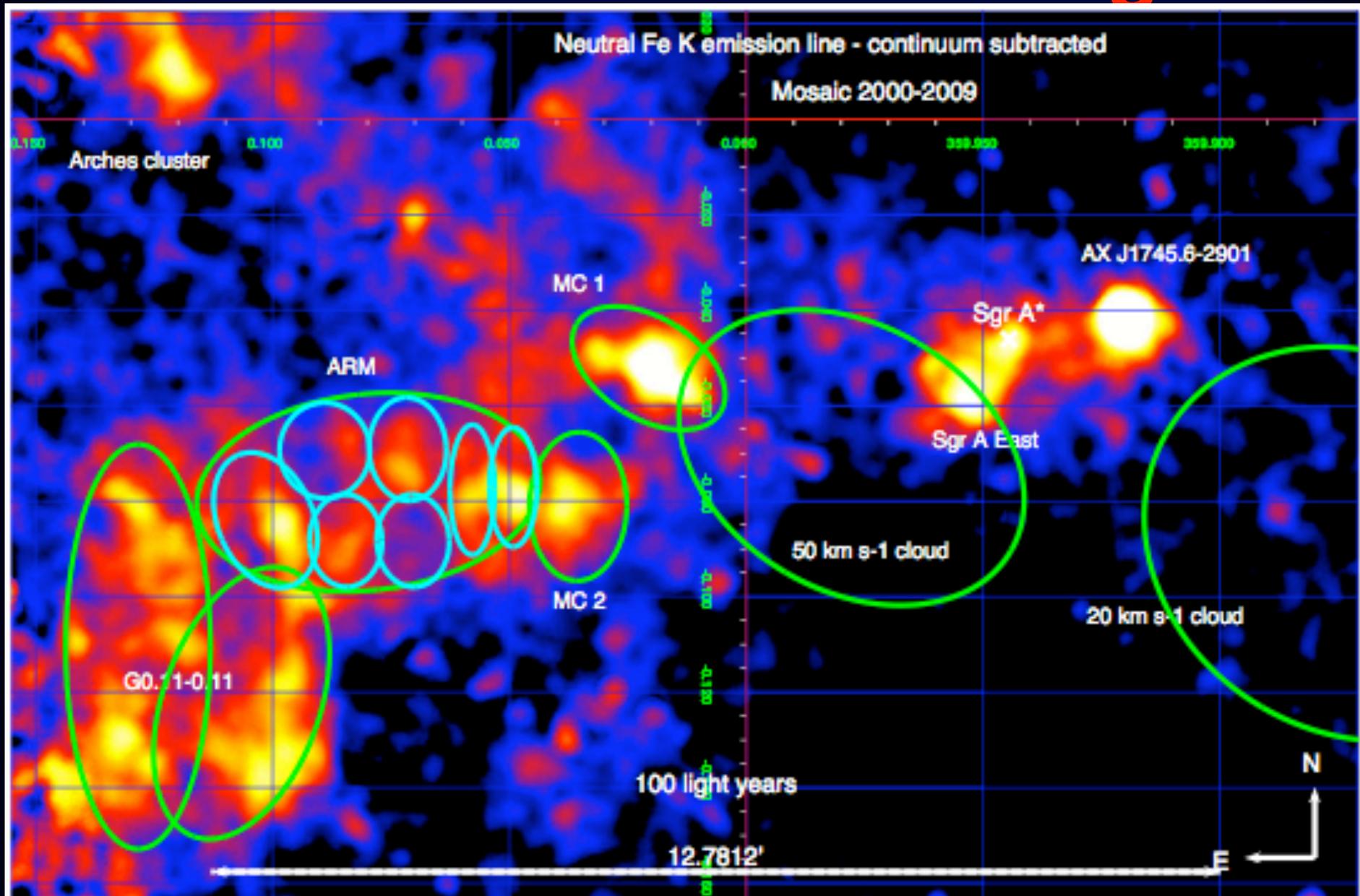
INTEGRAL Monitoring of Sgr B



- η Detection of significant decrease of Sgr B2 Integral source over 7 yr
- η Variation up to 40 %, compatible with the reported 6.4 keV decrease
- η Time of variation \sim cloud core size
- η Consistent with hypothesis of reflection of hard X-ray emission: we witness the end of an outburst of an external illuminating source
- η Sign of a past activity of Sgr A*: outburst of 10^{39} erg/s that ended \sim 100 yrs ago (new location of Sgr B2) (Terrier et al. 2008, 2010 submit)

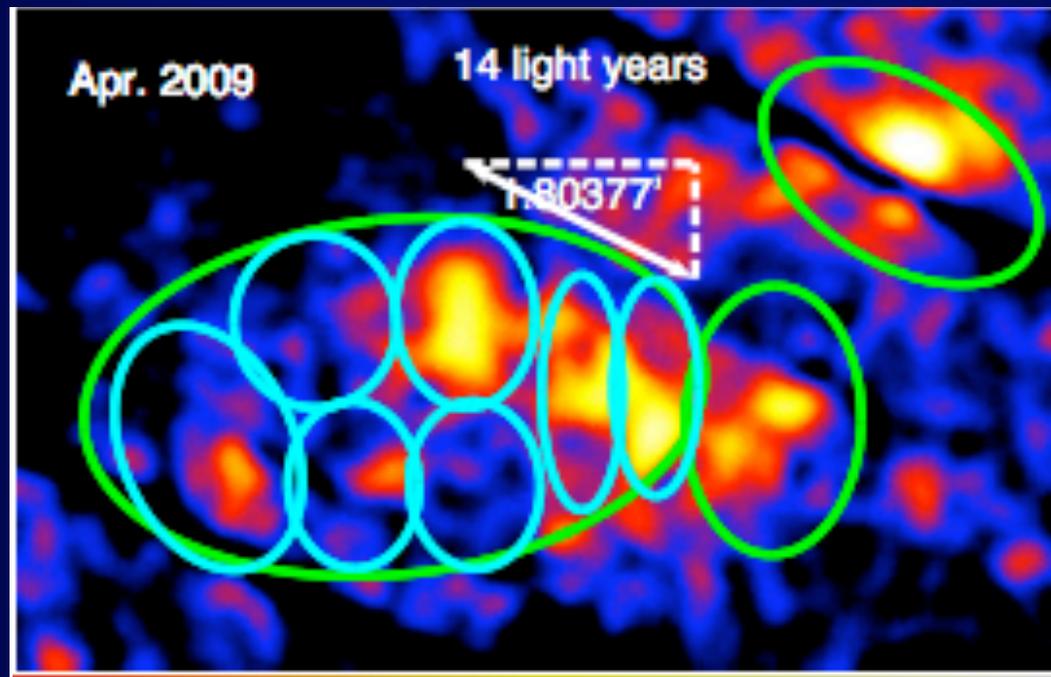


XMM monitoring of the 6.4 keV line emission of MC around Sgr A*



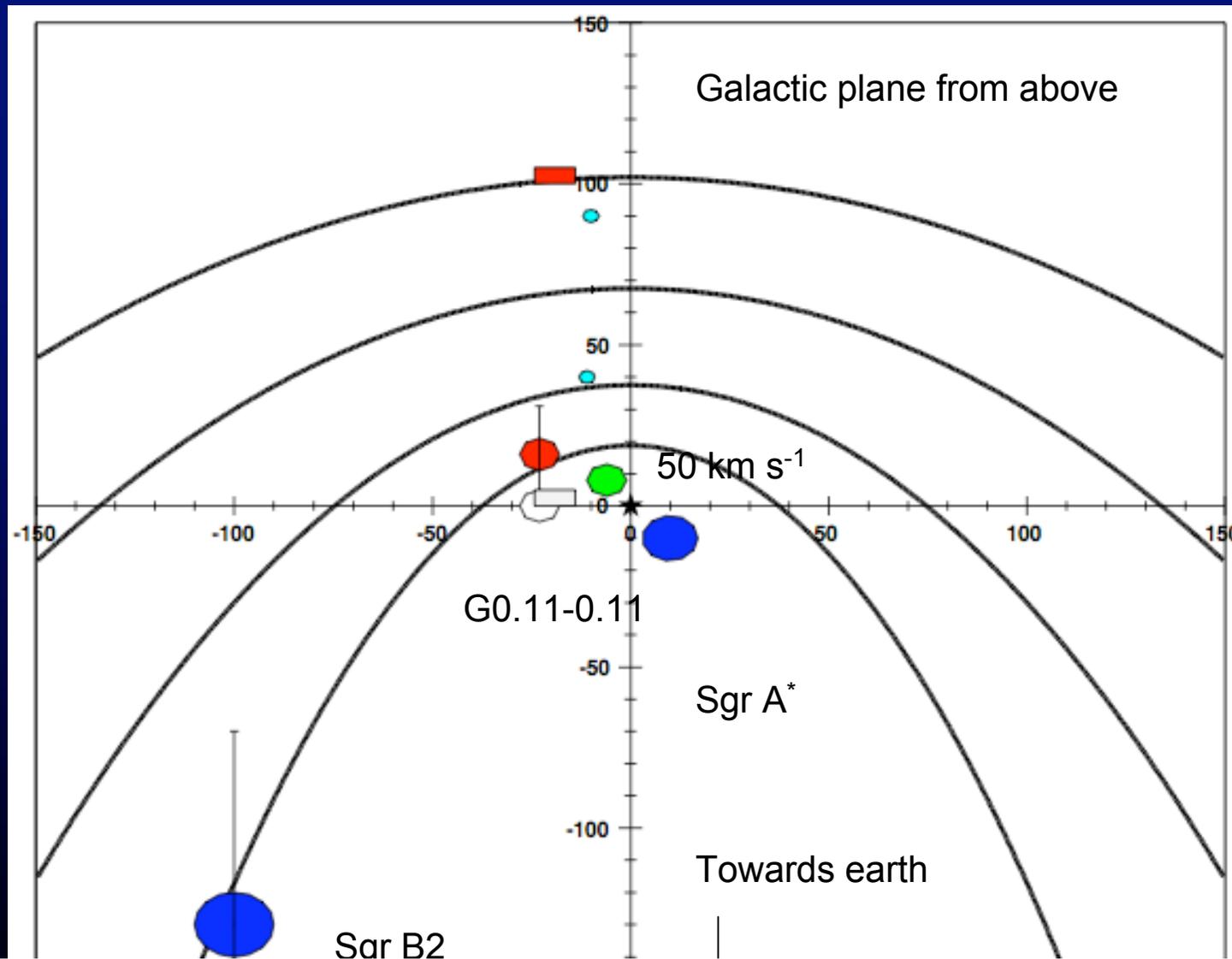
(Ponti et al. 2010)

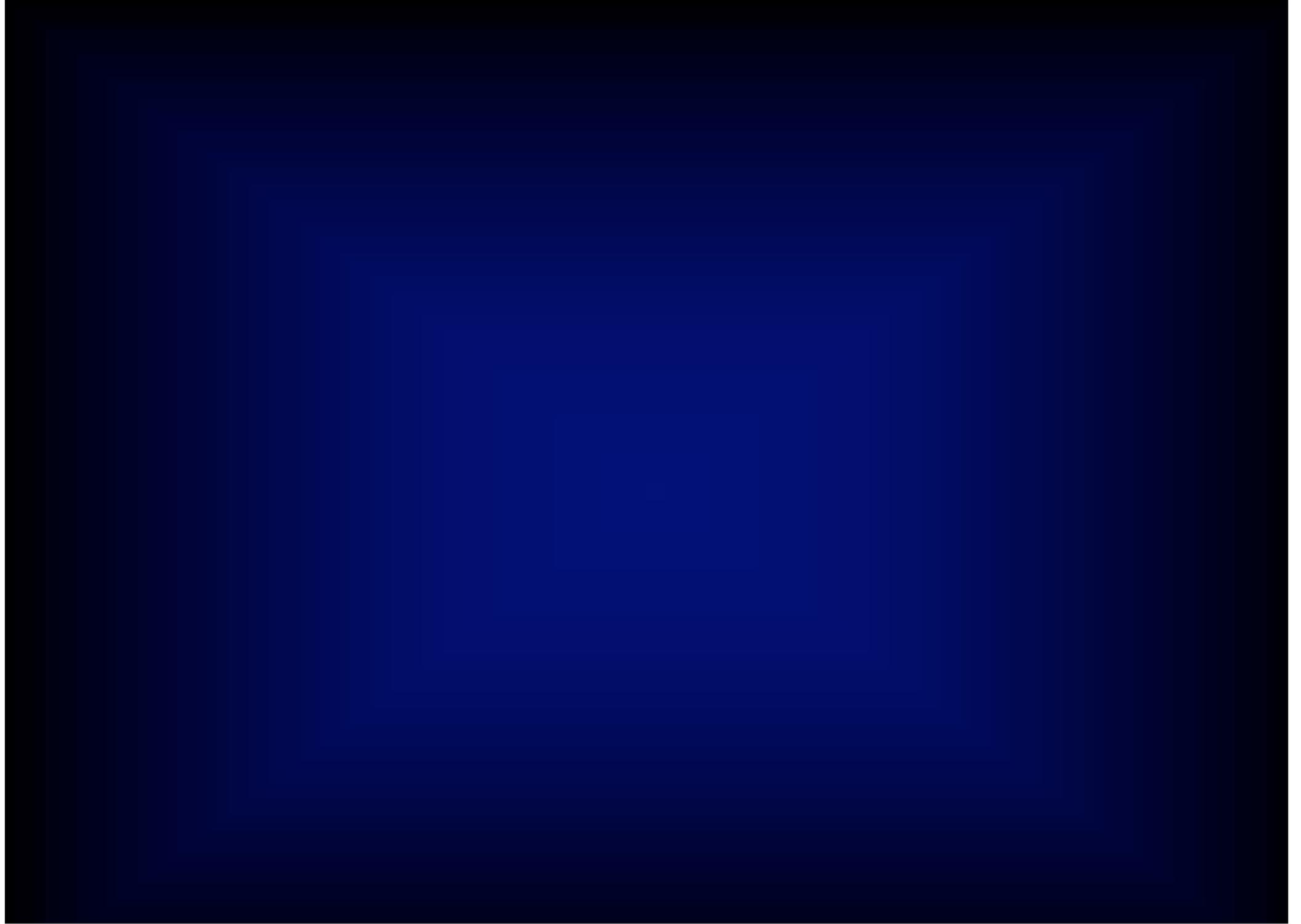
Detection of a superluminal Echo



Sgr B2

Can one single past outburst of Sgr A* explain all what we see?







9th INTEGRAL Workshop and 10th Anniversary in Paris

- η Week around the 17th October 2012
(10th anniversary of launch)
- η Several possible auditorium (~ 250
seats) already contacted (e.g. BNF,
Palais Congres, UNESCO, ..)
- η Close to ESA & CNES head-
quarters
- η Local support: APC & CEA Saclay
- η Preparation in progress ...

