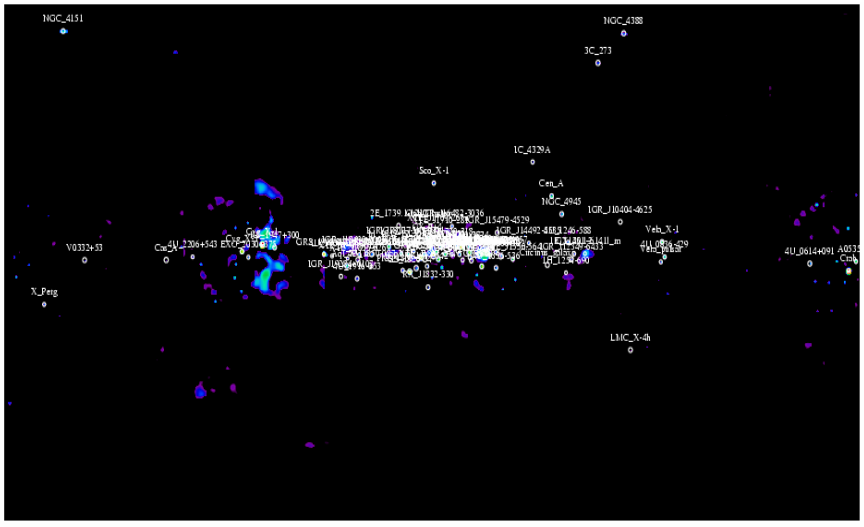
SOURCES SEARCH WITH SPIROS

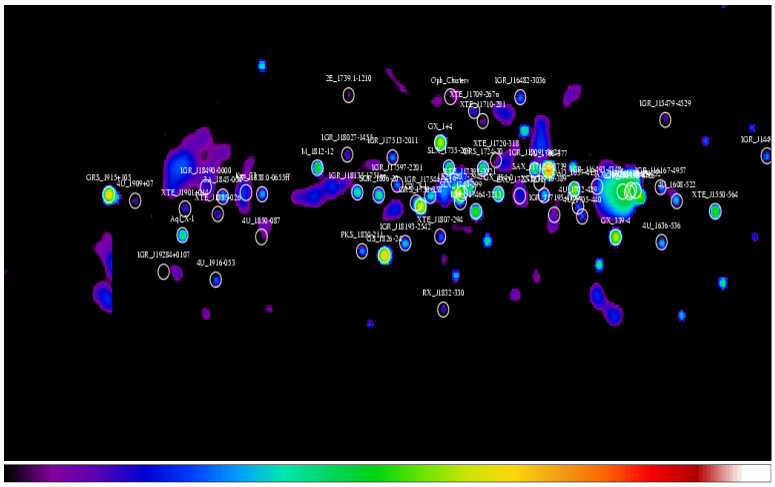
- **Start from previous catalogue**
- **Divide the sky in small area :**
  - 12 regions of size Δl=60 x Δb=180 centered at l=180, 150, …,-150
  - Keep the central Δl=30 x Δb=180
  - Run Spiros and search for new sources
  - Eliminate strong variables sources from the data using TIME_MODEL_FIT (Bouchet et al., 2005)
- **Analysis of each area of Δl=30 x Δb=180**
  - Sources catalogue
- **Image of the sources of the Galaxy by combining these area**

50-100 keV IMAGE



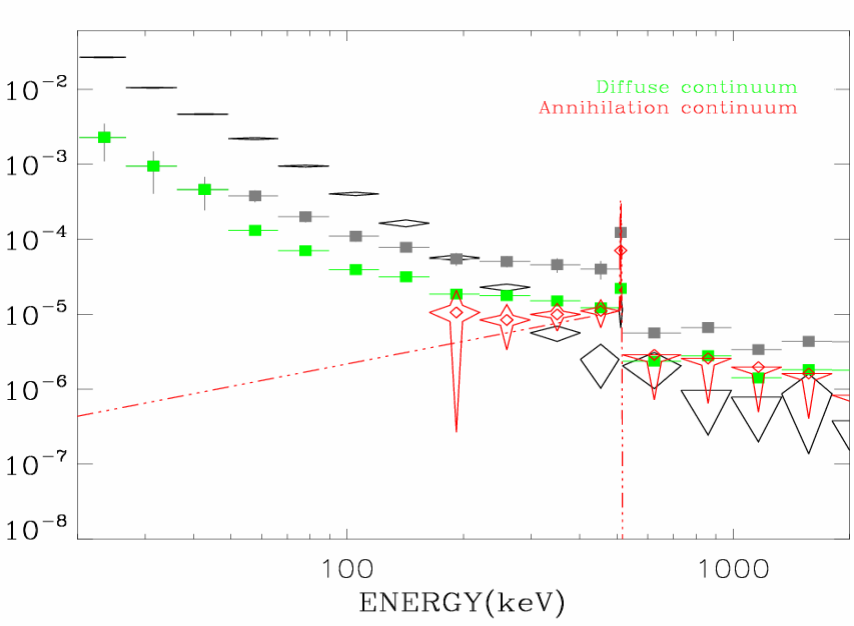
- Log scale with threshold at 3 σ
- Remarks : Sources variability not taken into account properly for Cyg X-1 and Crab with A0535

ZOOM ON CENTRAL RADIAN



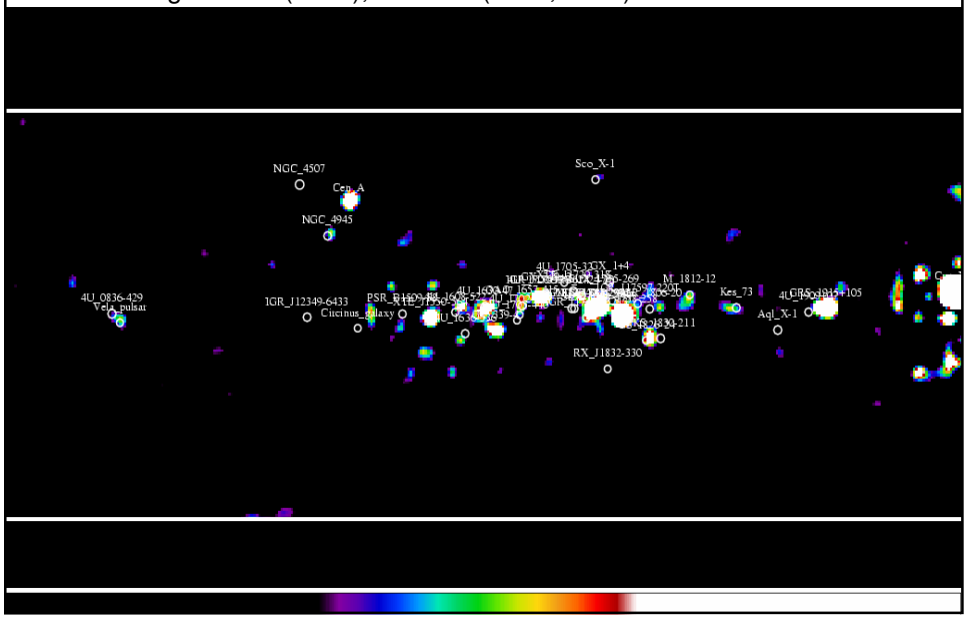
- Log scale with threshold at 3 σ

Sources contribution to total emission

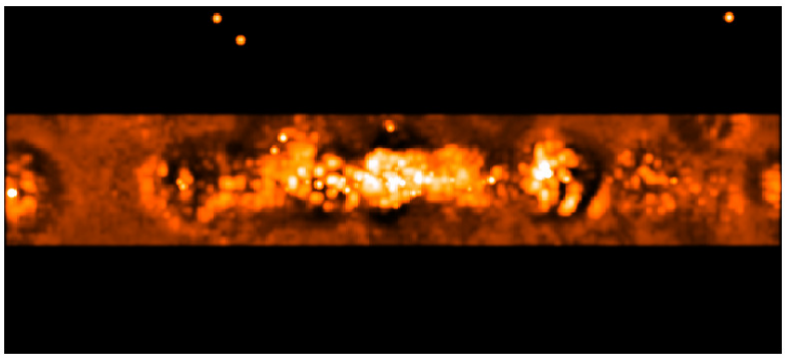


100-300 keV MAXIMUM ENTROPY IMAGING

- Skilling & Brian (1984), Bouchet (1992, 2000)

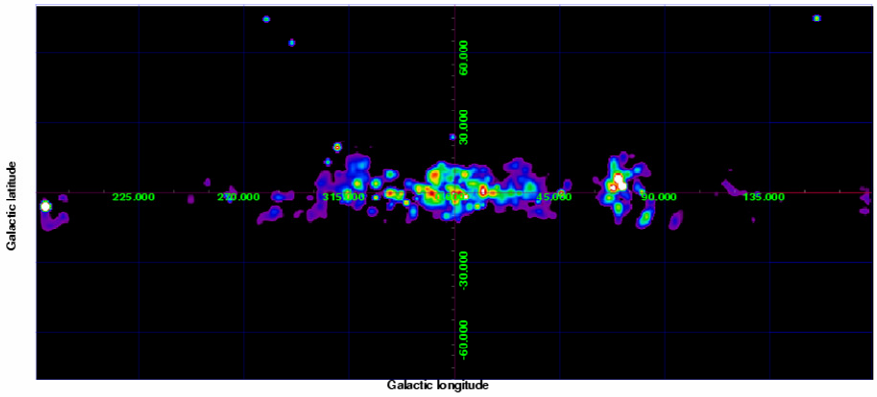


100-300 keV MEM with "differenciation" between source and diffuse pixels

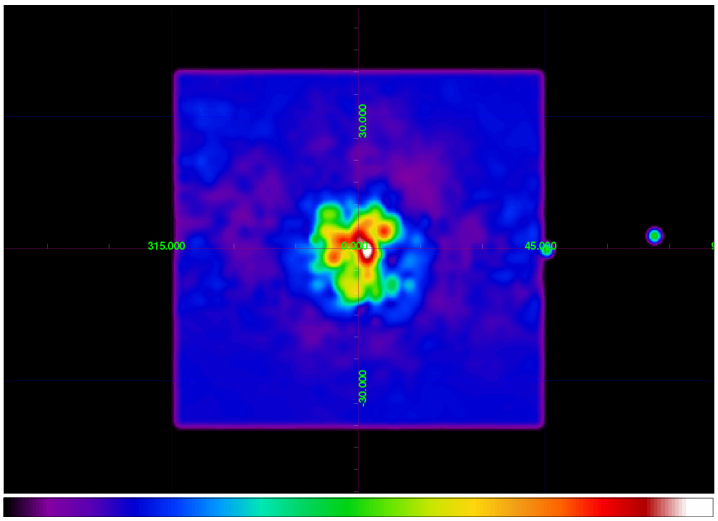


- Log scale

100-300 keV MEM with “differenciation” between source and diffuse pixels

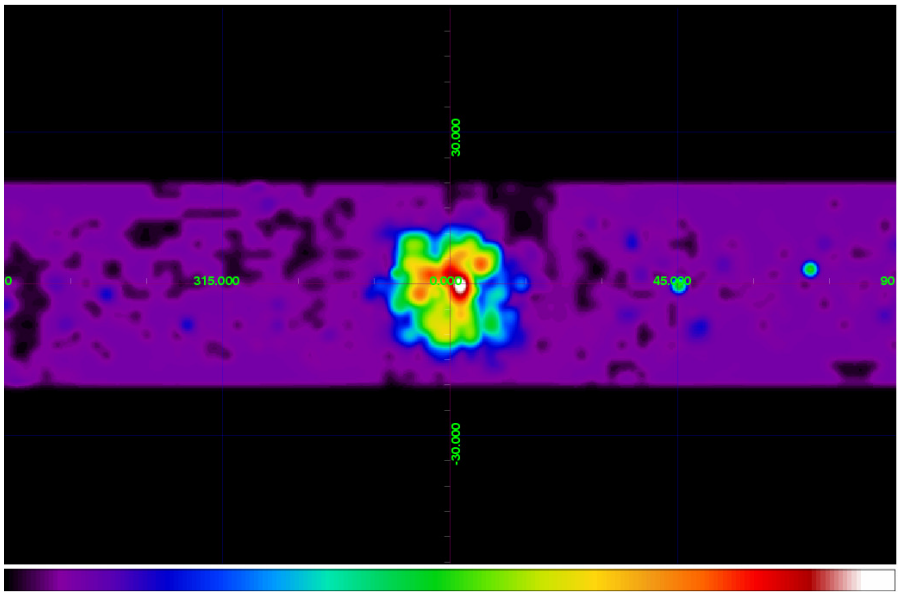


Maximum Entropy 511 keV

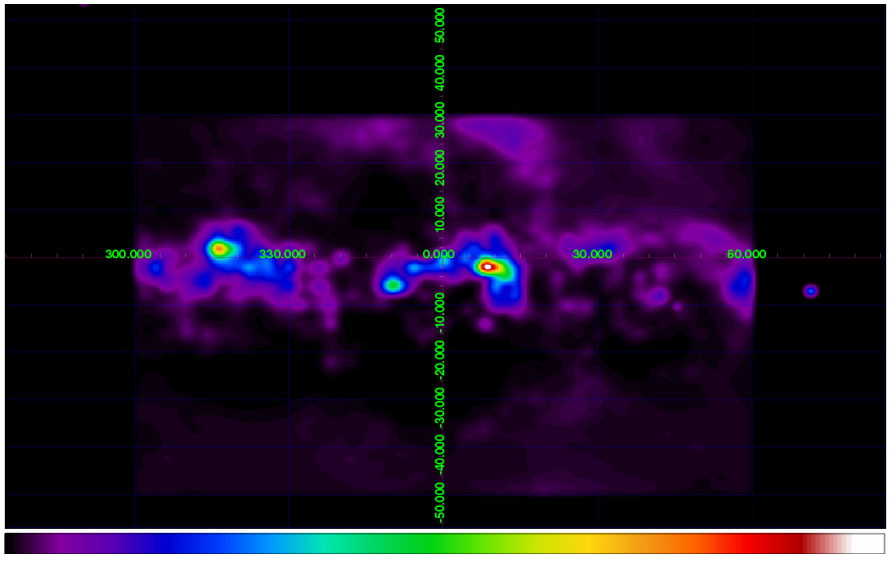


- Log scale from 0 to max image

511 keV IMAGE(2)



516-1300 keV IMAGE



Maximum entropy Mathematical Background

$$S(O,m) = \sum_{j=1}^{N} O_j - m_j - O_j \log \frac{O_j}{m_j}$$

$$C(O) = \chi^2(O) = {}^t(d - RO)[\sigma^{-2}](d - RO)$$

$$L(O,m) = \alpha S(O,m) - C(O)$$

$$S(x) = S_0 + \sum_{\mu=1}^{3} S_\mu x_\mu - \frac{1}{2}\sum_{\mu=1}^{3} x_\mu^2$$

$$C(x) = C_0 + \sum_{\mu=1}^{3} C_\mu x_\mu + \frac{1}{2}\sum_{\mu=1}^{3} G_\mu x_\mu^2$$

$$O^{(n+1)} = O^{(n)} + \delta O$$

Skilling & Brian, 1984

$$\delta O = X_1 E_1 + X_2 E_2 + X_3 E_3$$

$$E_1 = \frac{O.\nabla S}{\|\nabla S\|},\ E_2 = \frac{O.\nabla C}{\|\nabla C\|},\ \|\nabla S\| = \sqrt{\left(\sum_{i=1}^{N} O_i \left(\frac{\partial S}{\partial O_i}\right)\right)}$$

$$E_3 = O.(\nabla\nabla C)\left[\frac{O.\nabla S}{\|\nabla S\|} - \frac{O.\nabla C}{\|\nabla C\|}\right]$$

O : sky image to be reconstructed

m : sky a-priori model

R : response matrix

d : data

$[\sigma^{-2}]$: diagonal matrix whose diagonal elements are the inverse of the data variance i.e $1/\sigma_i^2$

Multiscale maximum entropy

- Starck & Pantin, 1996

$$O(x,y) = c_{n_p}(x,y) + \sum_{j=1}^{n_p} w_j(x,y)$$

$$S_{ms}(O) = \frac{1}{\sigma_I} \sum_{\text{scales}\, j} \sum_{\text{pixels}} A(j,x,y)\sigma_j (w_j(x,y) - m_j$$

$$-|w_j(x,y)| \ln \frac{|w_j(x,y)|}{m_j}) \qquad (19)$$

$$A(j,x,y) = 1 - M(j,x,y)$$

$$M(j,x,y) = \begin{cases} 1 & \text{if } w_j(x,y) \geq k\sigma_j \\ 0 & \text{if } w_j(x,y) < k\sigma_j \end{cases}$$