Imaging the sky with the IBIS Compton mode.

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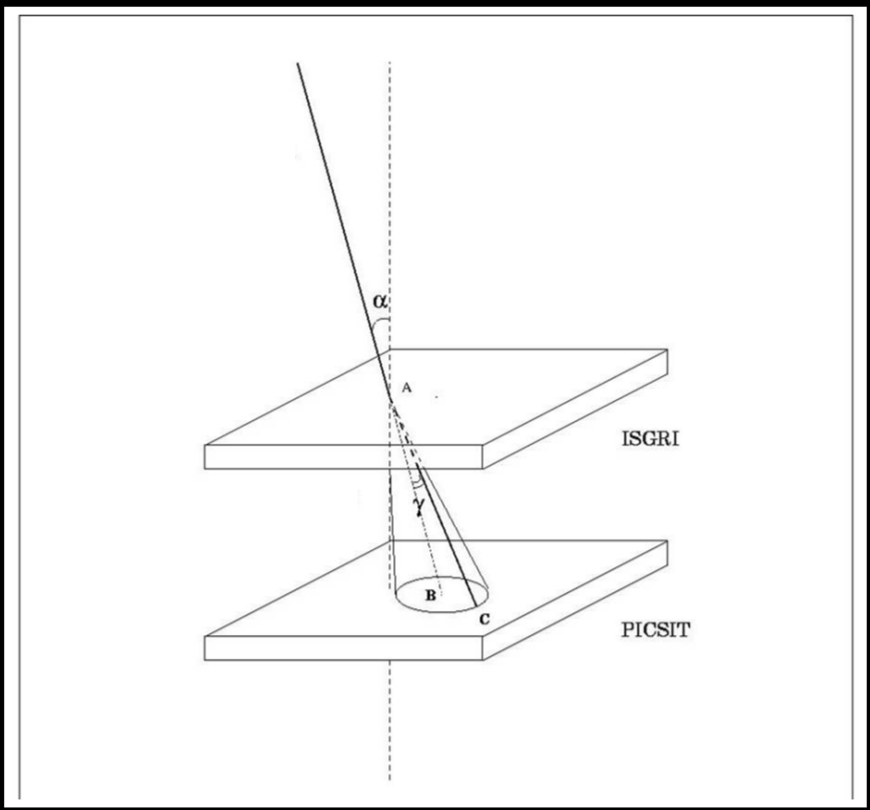
Presentation of the IBIS Compton Mode



The Compton mode uses the temporal coincidence of events both detected on ISGRI and PICSIT.

The coincidence window is about 1.9 ms

Definitions: Compton selection and spurious events

- cos(f) = 1 – $m_e c^2$/ E_{ISGRI} + $m_e c^2$ / (E_{ISGRI} + E_{PICsIT})
- cos(?) = AB.x where AB is along the direction between the two interaction points and x is the telescope axis.

Thus a Compton event can be selected if:

|cos(? -f)| < cos(q_{lim}) with q_{lim} = 19 °

- Spurious events are single events detected in ISGRI and PICSIT during the coincidence window duration, and not due to Compton scattering.

Crab Δφ diagram

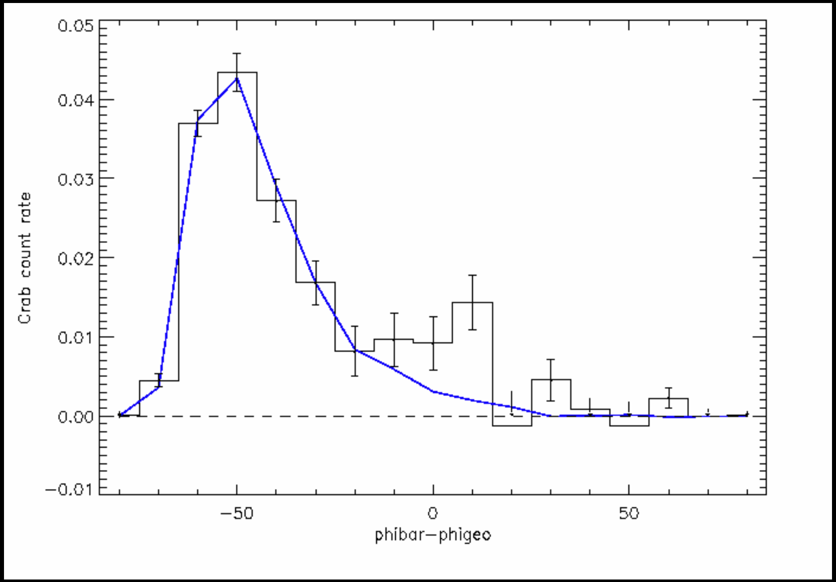
How we proceed ?

- Compute for each event the Δφ value.
- Fill ISGRI detector map with events in a given Δφ bin.
- Deconvolve this shadowgram and compute the Crab count rate.
- Do the same for the spurious events file.
- Compare the Crab count rate for true and spurious data in a given Δφ range.

Crab Δφ diagram (450 – 650 keV)

Rev. 102-103-170 (130 000 s)

Crab count rate (cts/s)



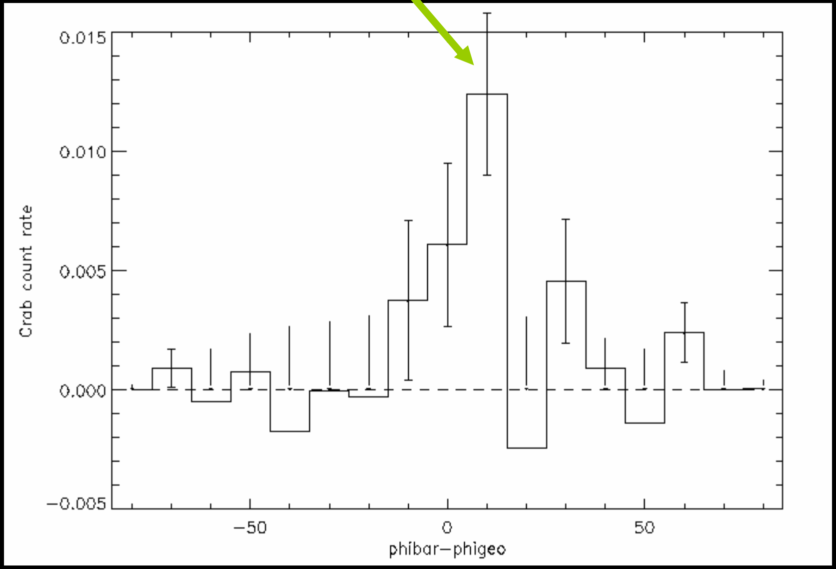
Δφ

Black : all events

Blue : spurious events

After spurious events removal

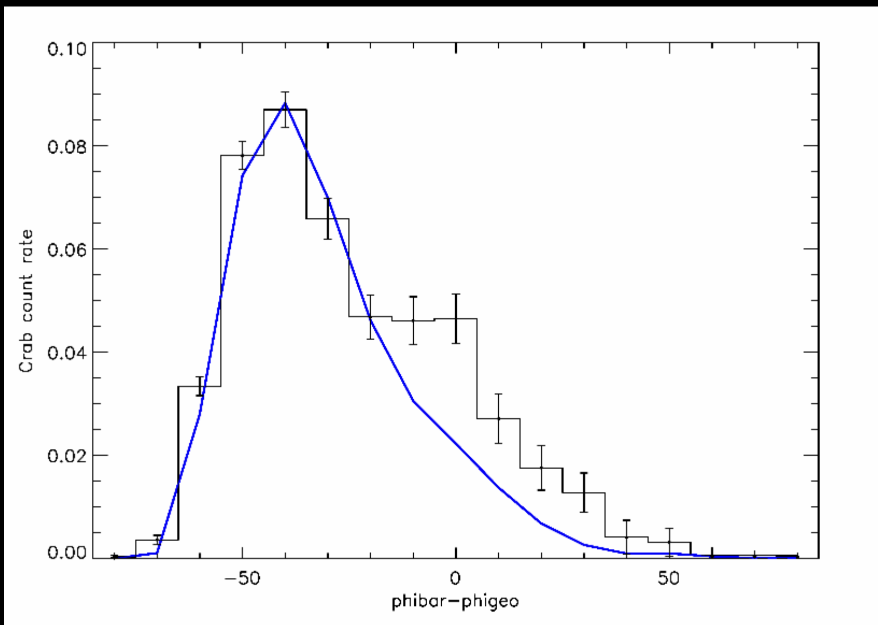
Crab: 0.022 cts/s



Crab Δφ diagram (300 – 450 keV)

Rev. 102-103-170 (130 000 s)

Crab count rate (cts/s)



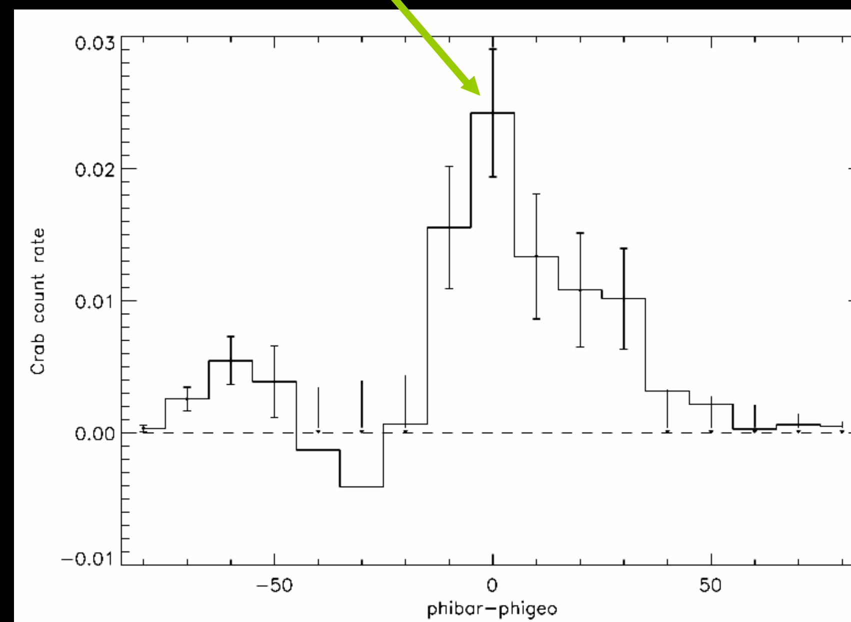
Δφ

Black : all events

Blue : spurious events

After spurious events removal

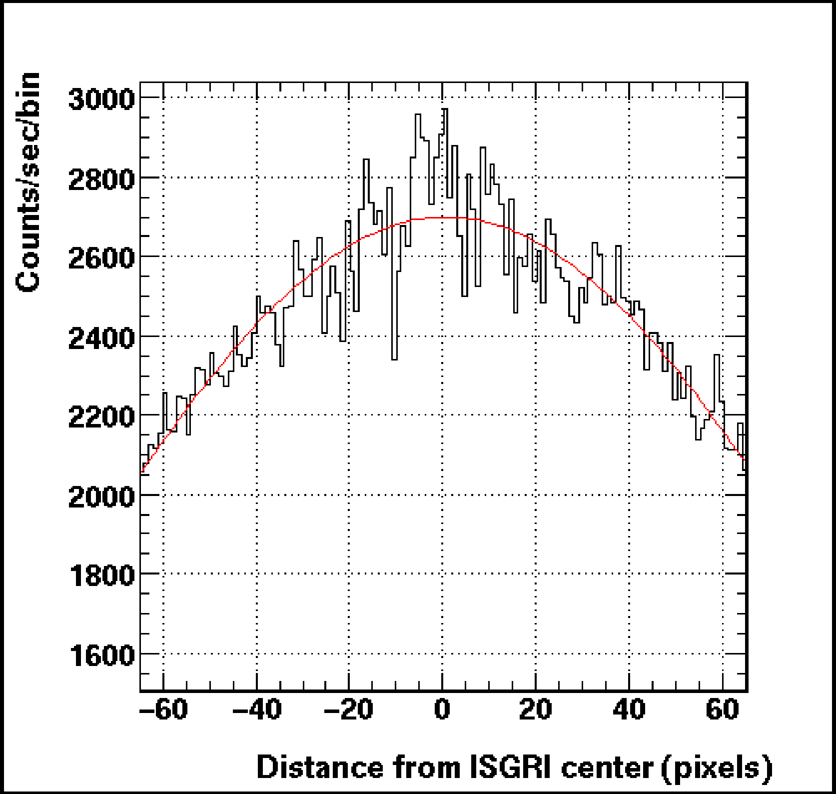
Crab: 0.053 cts/s

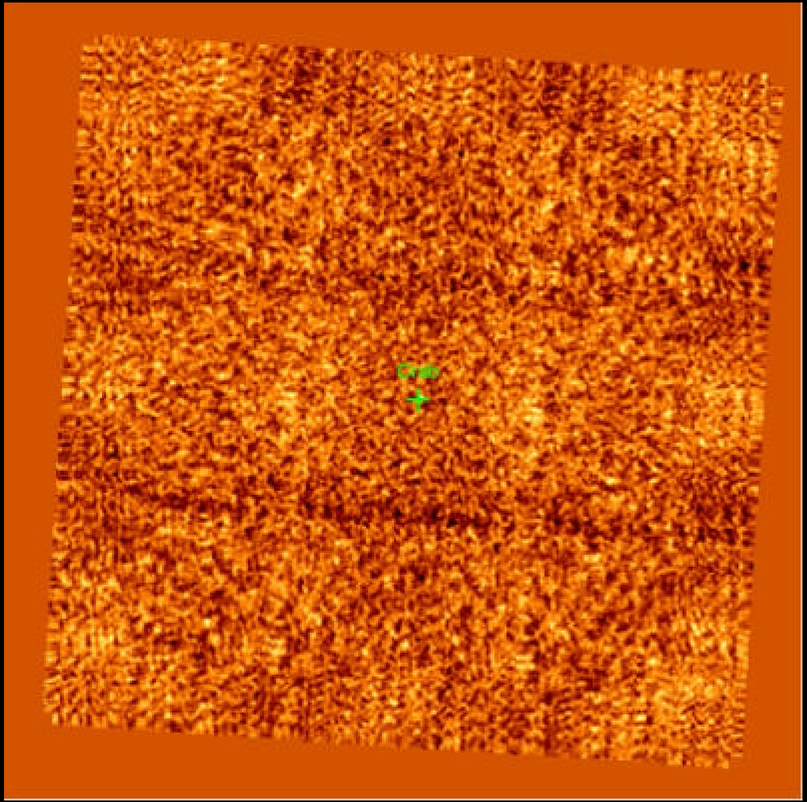


Imaging the sky…

- ISGRI shadowgram of Compton events are used to make images of the sky.
- Spurious events must be substracted to avoid false detections.
- Images can be made between 200 keV and 5 MeV.
- Uniformity correction has to be applied.

Uniformity correction





Compton shadowgram not uniform!

A correction (gaussian fit) must be applied.

Spurious correction

- Correction = (ISGRI shadowgram) × α

R_0 = Count rate of ISGRI events in coincidences with PICSIT single.

R_1 = Count rate of ISGRI events in coincidences with PICSIT multiple.

$$R_0 = \frac{(2\Delta T - dT)R_{CDTE}R_{PIS}}{1+(2\Delta T - dT)(R_{CDTE}+R_{PIS})}$$

$$R_1 = \frac{(2\Delta T - dT)R_{CDTE}R_{PIM}}{1+(2\Delta T - dT)(R_{CDTE}+R_{PIM})}$$

$$R_{CDTE} = R_{ISGRI} + R_0 + R_1$$

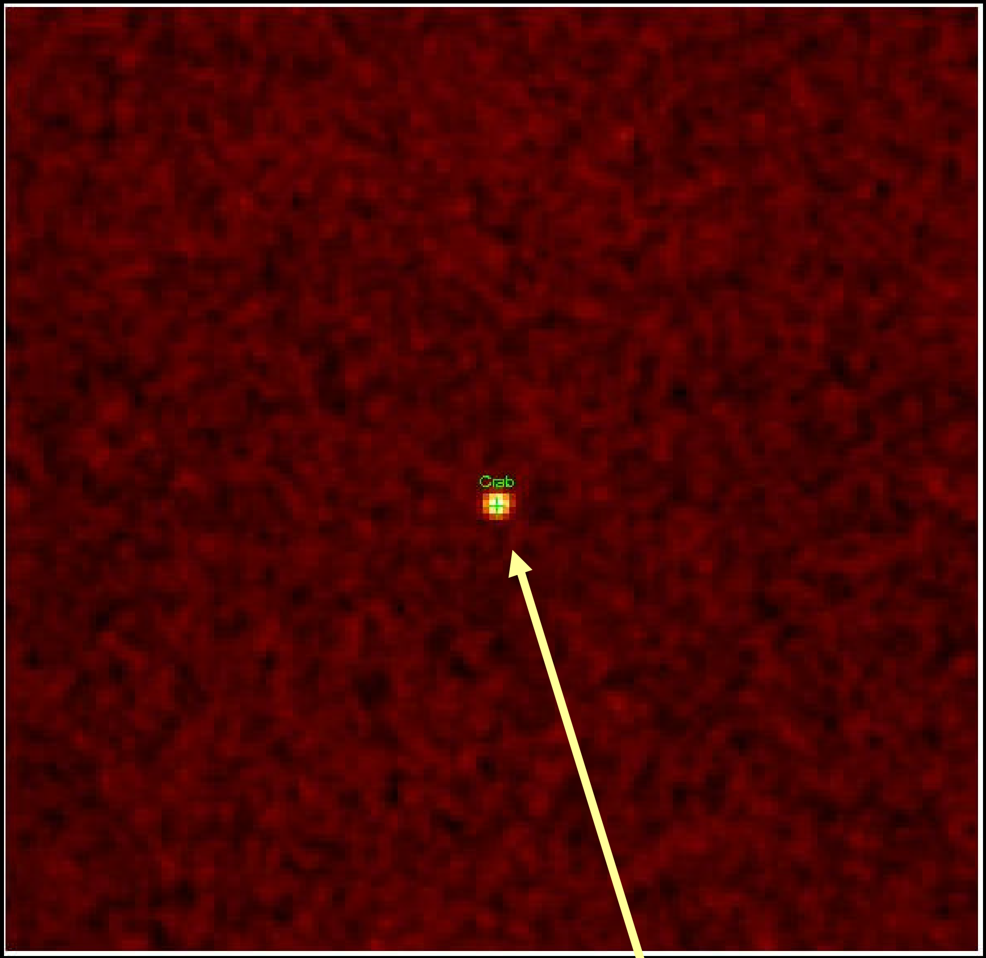
$$a = \frac{R_0}{R_{CDTE} - R_0 - R_1}$$

(Segreto et al. 2003)

α = 2.83% (Rev 39 ΔT = 5.3µs)

α = 1.04% (Rev 102 ΔT = 1.9µs)

Crab SN ratio



Crab pulsar (200 - 250 keV)

SN ratio:

200-250 keV: 20.1 s

250-300 keV: 10.7 s

300-400 keV: 7.2 s

400-500 keV: 4.7 s

Time = 500 ks

Conclusion and perspectives

- Crab detections from 200 keV to 500 keV
- SN ratio has to be improved by RiseTime selection and background map substraction.
- This imaging software will be delivered with OSA 5.
- On board selection effects on the SN ratio.