OSA10 energy calibration

two drift laws

ISGRI_RT

ISGRI_PHA

LUT1 uniformity, temperature-dependent per MDU (since OSA 10).

revolution 1401

ISGRI_PI

2D drift correction, tabulated for each rise time

ISGRI_PHA1

ISGRI_PI

ISGRI_PHA2

LUT2 (charge loss)

ISGRI_PI

25 keV

59 keV

ISGRI_ENERGY

Issues with OSA 10 energy calibration

reported by

pointed out by Carlo at IUG 2014

Approach in OSA11

Keep the LUT1 with MDU-dependent temperature correction.

ISGRI_PHA, ISGRI_RT→ISGRI_PHA1, ISGRI_PI

Fit the data of each revolution with time-dependent 2D charge loss model,
Generate LUT2 regularly together with the response

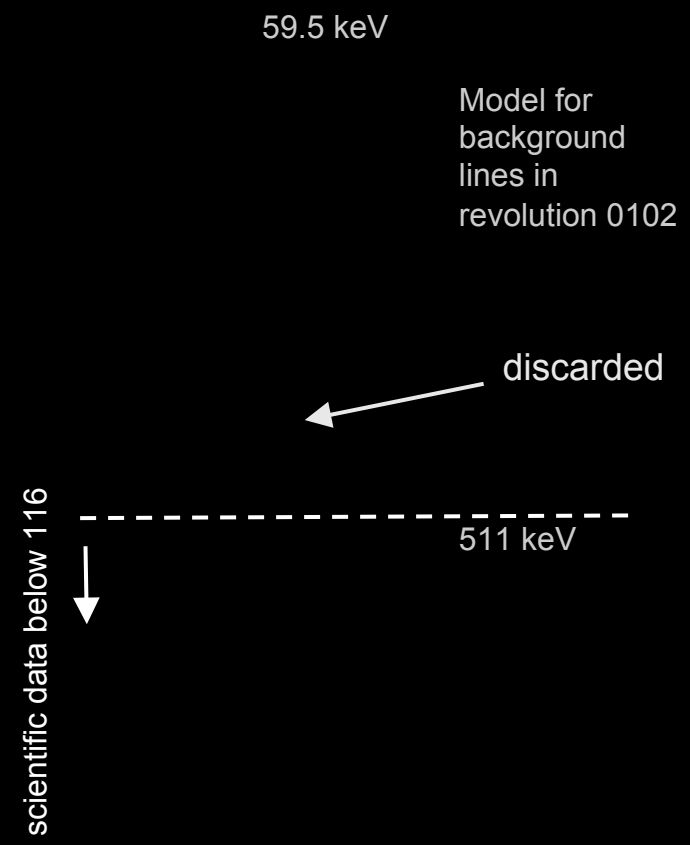
ISGRI_PHA1, ISGRI_PI→ISGRI_ENERGY

Charge loss model

Charge loss model due to limited charge carrier lifetime: 4 parameters fitted in each revolution.

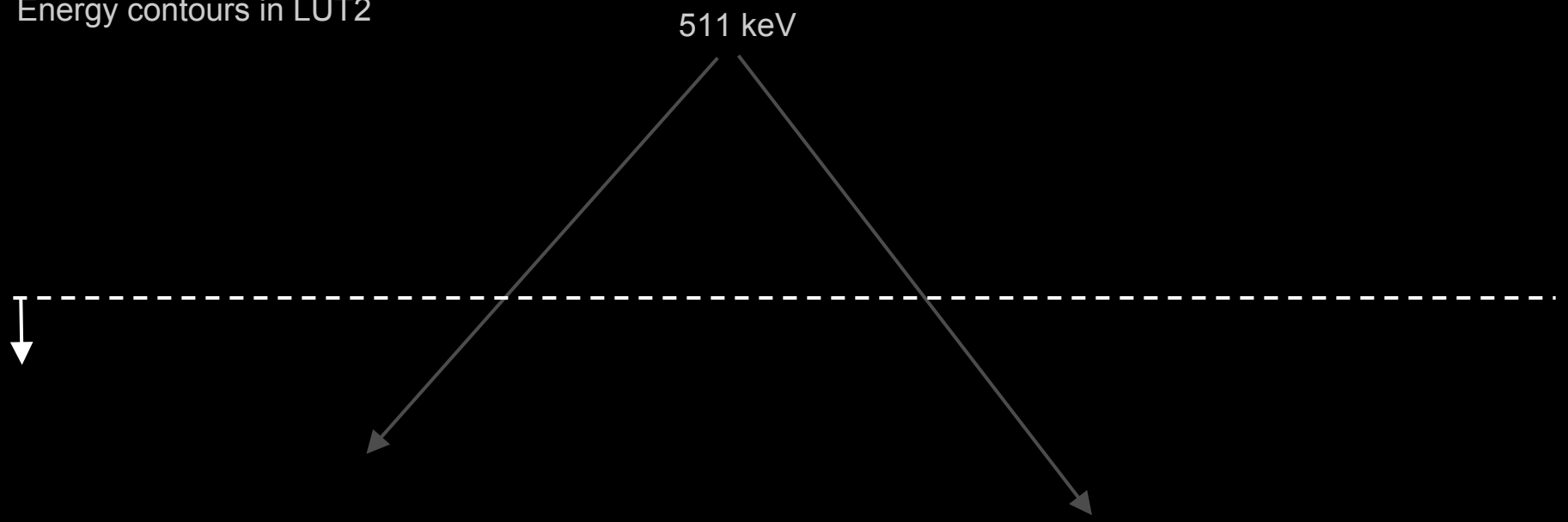
Ballistic losses model related to low charge carrier mobility: Fitted to ground calibration. In S1 data range set by 2 fixed parameters.

Model of electronics: charge to PH conversion with resolution, fixed for each rise time - pulse height pair. Many (~15) parameters are selected.
Offset and width are fitted in a revolution, to account for possible incompleteness of the model.



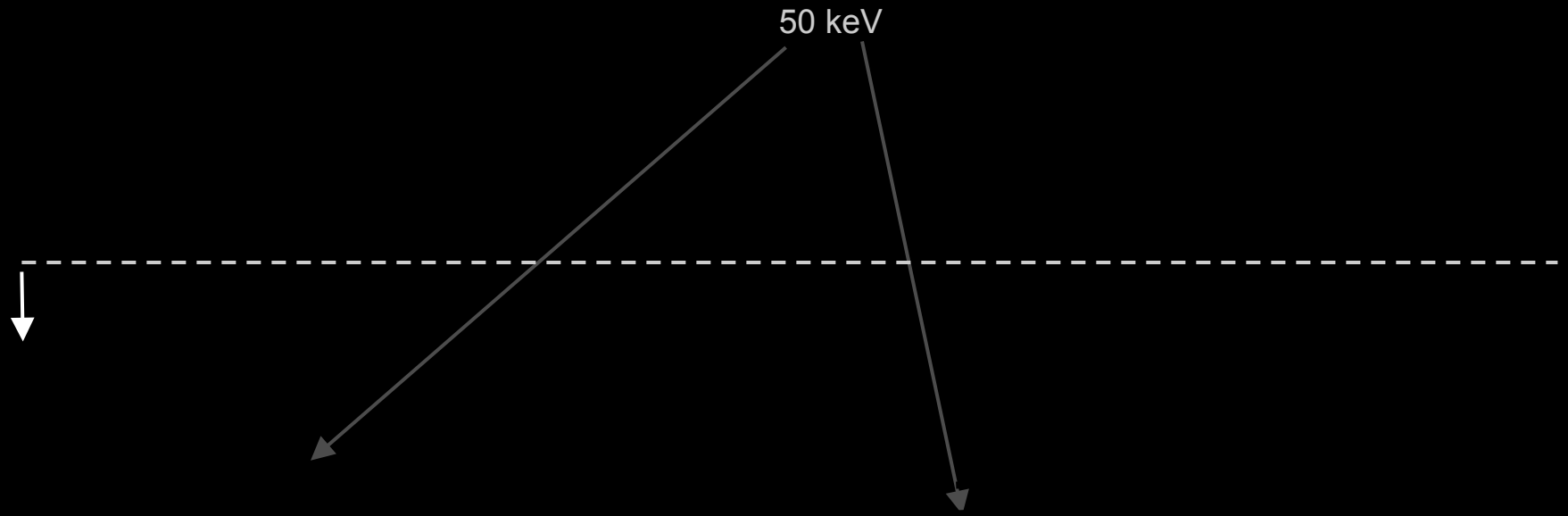
Model of LUT2 evolution

Energy contours in LUT2



Model of LUT2 evolution

Energy contours in LUT2, focus on low energy



Effect of overlapping energy tracks

After discarding rise time, resolution of reconstructed energy is a combination of resolutions at different rise times, and depends on the rise time used.
Limiting rise time also reduces efficiency.

reconstructed energy

RT 16-50

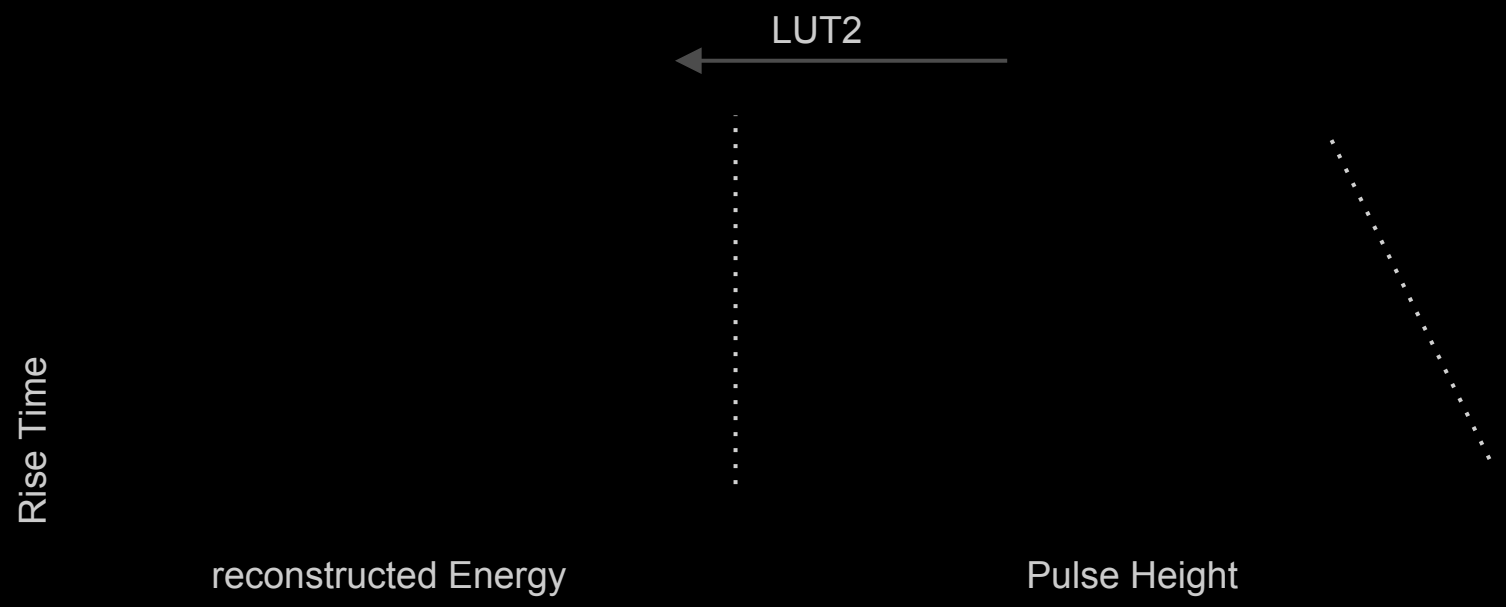
RT 16-116

RT 16-256

(not used in scientific data)

Incident energy

OSA11 reconstruction



revolution 0102

OSA11 vs OSA10

OSA11

OSA10

Rise Time

20 keV 60 keV 511 keV 20 keV 60 keV 511 keV

reconstructed Energy (logarithmic scale)

revolution 0102

OSA11 vs OSA10

OSA11

OSA10

Rise Time

20 keV

60 keV

511 keV

20 keV

60 keV

511 keV

reconstructed Energy (logarithmic scale)

revolution 1401

Effect on the background spectra

behavior at low threshold is somewhat different, compensated by appropriate correction

0102

1401

for most of the mission low rise time spectra above 30 keV are not affected
drift law of OSA10 is not valid for late revolutions

Spectra of 1A 0535+262

Source spectra: Crab

Wave structure in 70-100 keV range is gone.

For Crab, about 50% decrease of count rate above 100 keV.

Remaining difference between model and prediction will be dealt with by better treatment of LE threshold

ph/s/keV

data to model ratio

broken powerlaw, only normalization fitted to OSA11, break at 100 keV, LE slope 2.1 (SPI), HE slope 2.21 (all-mission fit ISGRI). Revolution 839 of Crab calibration

Source spectra: weaker sources

Red : OSA 11

excess at 100 keV was mildly significant, but strongly affected slope!
spectrum of a magnetar provided Lin Lin, 2 Ms observations.

Evolution of the background lines

Line positions fitted in the OSA11 background spectra, averaged over one month. Unstable fit removed.

Final Crab evolution

Remaining issues

Simulated response does not correctly predict counts in 50-100 keV range. This is connected to the structure between absorption edges and the ARF peak.

Increase of the resolution at early time is compatible with assumptions that the resolution is non-evolving in PH-RT plane.
But at later time, the resolution is broader.

Orbital evolution of energy calibration, decrease of gain during the revolution, or after IREM crash. The evolution is connected to IBIS standby, perhaps long-term polarization of detectors.

Changes in OSA11

software

ibis_isgr_energy: disable drift correction (very small change)

ii_shadow_build: to compute LE efficiency, will read current gain information from LUT2, read resolution from current RMF

IC tree

LUT2, ARF, RMF every month. delivered together, produced at first by Paris, later at ISDC. Extrapolations will work for limited time, has to be reproduced regularly

ISGRI imaging activities

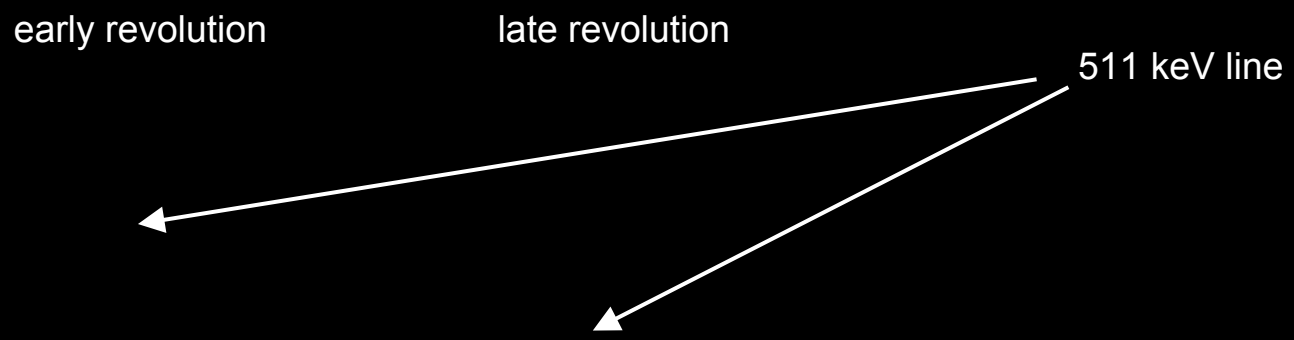
On-going studies

- Point Source Localization Accuracy (PSLA) improvement.
- Improving ghost buster by taking into account bolts into the mask.
- Influence of pixels thickness.
- Uniformity maps.
- Background estimates.

Thank you !

backup slides

backup slides: polarization drift



width