



A common question from the Chandra Help Desk: How do you combine or merge observations?

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Why bother?

Just had Cycle 10, so we have plenty of data in the archive. Observations are tiled to cover a larger area, or repeated to go deep (e.g. COSMOS, CDF-S).

Recent scheduling constraints mean that long observations will be split up in order to keep Chandra cool (may get worse).



The Answer?

Treat *each* chip individually within an observation interval (OBI), and treat *each* OBI individually. Perhaps you should also treat each node separately too for good measure...



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Unfortunately this

is not always feasible (e.g. data size);
does not allow some science (e.g. faint sources);
and avoids the issue of alignment of OBIs.



So, why even suggest it?

⇒ we can understand (i.e. calculate) the instrument response
CHIP + SIM_Z + (time,dy,dz,dtheta) from aspect solution
→ DET + (time,ra,dec,roll) from aspect solution
→ SKY

⇒ we avoid GTI issues

```
dmextract "evt2.fits[bin sky=circle(4250,4800,40)]" ...  
EXPOSURE = 66268.6885875010  
dmextract "evt2.fits[ccd_id=6][bin sky=circle(4250,4800,40)]" ...  
EXPOSURE = 66262.4886756865
```



What is available?

CIAO 4 dead area correction for FI chips is now turned on by default (and supported by scripts like `specextract` but ***not*** `merge_all`).

`merge_all` has a long history, works *in general*, need to document issues, does too much?

`reproject_aspect` (`wcs_match`, `wcs_update`), `reproject_events`,
`reproject_image`, `reproject_image_grid`, `dmmerge`

`dmcoords`, `get_sky_limits`, `acis_set_ardlib`



What are the complications?

Bad-pixel files are per OBI, so ARFs and instrument maps (hence exposure maps) should really be made per OBI.

As each chip may have its own set of GTIs, safest way to ensure exposure times are correct is to do the analysis per chip.

The position of the optical bench on which ACIS sits may vary between observations (SIM_Z value), which leads to messages like “omit - SIM_Z values different more than 0.100000” and problems calculating responses for the merged products.



What are the complications?

PSF variations

how do you combine different PSFs?

how do you merge source lists?

correct handling of apertures, e.g. chip edges; bad pixels;
overlapping sources

ACIS background files are non-standard event files, so users may experience “difficulty” when reprojecting these files.

Care must be taken to use the right files, depending on what corrections have been applied (book keeping).



Imaging analysis



reproject_aspect (wcs_update) to match WCS followed by merge_all or manual reduction (reproject_image and reproject_image_grid) to combine event lists, images, and exposure maps.

Spectral analysis



reproject_aspect (wcs_update) to match WCS followed by separate analysis of observations. Anecdotal evidence that results from merged data similar to those from doing it “properly”, but ...