Charge Transfer
Inefficiency in the
Continuous Clocking
Mode

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Facts about CC mode

- Row to row clocking time: 2.85 ms (vs. 40 microsec for TE mode).
- This means CTI is due to a different population of traps.
- By default, all ASCA Grade 7 (G7) events are not telemetered.
- There are instrument modes that telemeter all grades but flight grade 255 (all 9 pixels lit).
ECS data: cenpix vs uppix

- External cal source data
- Note 5 bright lines.
Constructing CC mode trapmaps

- Fit slope, intercept, endpoint
- Endpoint gives max trap density
- Assume integrated trap density linear vs chipy, and zero at readout
- Slope gives charge trailing fraction
- Only for F1 chips (so far)
Single-column fitting

- Allows trapmap to fix column-to-column variations
However, comma...

- Need chipy. For bright sources, HETG observations, etc. this comes from RA_TARG and DEC_TARG (user-supplied target coords)
Resolving chipy coord

- For HETG observations (ciao 4.1+), `tg_resolve_events` estimates chipy coord of each event after order sorting.
- We will use this in data processing.
Data prep: Uses existing CIAO tools
- Remove existing CTI correction: a_p_e
- Get chipy coords from target coords: tg_r_e
- Hack header to mock-up TE mode: dmhedit
- Apply cc-mode CTI correction, gain, etc.: a_p_e
- Grating processing as usual.
Testing: HETG obs of HER X-1

- obsid 1702: HETG/CC mode
- Data prepared as above
- Raw order-sorting plots (PHA times the distance in detx pixels from the zero order image)
- Extract spectra for 32-column slices, and fit
Faux Order-sorting plot

- $\text{PHA}^*(\text{detx-detx}_0)$, log stretch
- Note gain “features” esp. $\text{SO}_3$
Order-sorting plot, linear stretch

- Same plot, linear stretch
- Gain map can fix most of this
Fit to PHA spectra

- Fit to $x \approx 176$ slice on S4, MEG & HEG 1st order
- black: TE; green: no chippy correction; red: this work
Fit params vs energy

- Fitted vs nominal energy; colors as before
- Red curve more consistent, HEG vs MEG
Fit params vs energy

- excess line width, colors as above.
- CC mode trap map often much better than TE
Caveat emptor

- Can’t use this on diffuse sources (e.g. external cal source)
- Further calibration using HETG and LETG sources at various SIM-Z
- QE effects: rescuing rejected grades if telemetered (see Norbert Shultz)
- Further work needed on response with this trapmap
Conclusions

- We have a trapmap suitable for use with CC mode data for bright, isolated sky sources.
- It can be applied with existing ciao4.1 tools.
- Still need a gain map (and tgain?)
- Lines often narrower than with TE trapmap.
- Response, if desired, could be created by reducing the width of the TE mode scatter matrix.