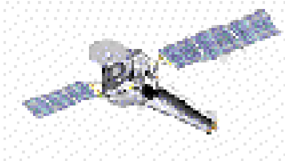

Better Mousetraps: CIAO High Spatial/Spectral Resolution Imaging

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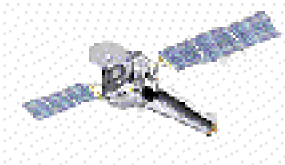
- multi-scale and multi-dimensional analysis tools
  - **Chandra is the *ONLY* high-angular (sub-arcsecond) resolution X-ray telescope in a foreseable future**
  - **It is *natural* that one of the leading threads for *CIAO* 3+ development should be high-angular resolution analysis**

==> our goal is to reach the full potential of the *unique spatial* resolution capabilities of HRMA and the instruments: < 0.5"



Existing Building Blocks include:

- **tools for obtaining *unprecedented* aspect accuracy**
- **tools for calibrating and correcting instrumental effects**
- **tools to simulate accurate Chandra PSFs (*ChaRT/MARX*)**

Future Building Blocks include:

- ***ChaRT* upgrades**
- **Multi-scale deconvolution with error maps**
- **Aspect improvement/maintenance**
- **ACIS sub-pixel resolution**
- **HRC position reconstruction errors correction**
- **better detect and smoothing**

ChaRT Upgrades

- **adjust limits (eg. exp, # sources); improve error detection**
- **ChaRT/MARX interface (web page and s/w upgrade)**
- **aspect simulation in SAOsac**
- **FITS image file input (possibly with var. spectra)**
- **set of precomputed spectra**
- **interface with Sherpa**

Multi-Scale Deconvolution

- **EMC2 (Expectation through Markov Chain Monte Carlo)**

-- > multi-scale deconvolution tool using ChaRT/MARX PSFs.

- **performs on low count statistics data**
- **the product of the deconvolution include error/significance maps.**
- **can be extended to work with *spatially* and *spectrally* variable, "uncertain" PSFs**

Aspect Improvement/Maintenance

- **mitigate the effects of the increase in warm pixels**

--> Currently effective aspect reconctruction blurring of PSF: sigma ~0.07" . Aspect is degrading because of increase of warm pixels (could increase RMS uncertainty ~50%)

ACIS sub-pixel resolution

- **apply Sub-pixel Event Repositioning (SER) techniques to improve spatial resolution**

--> SER techniques: the impact position of events can be refined, based on the distribution of charge among affected CCD pixels; 20% -50% improvement (Penn State, RIT)

HRC PSF blur correction

- **correct PSF blur caused by dithering over residual errors in the event detector position reconstruction.**

--> Size of the blur depends on how the dither pattern samples detector space typically 3-4 HRC pixels (0.4-0.5 arcsec)

Detect

- **SExtractor**
- **Bayesian Blocks 2D and 3D Detect**

--> Better statistics, better PSF info

Smoothing

- **adaptive smoothing tools**

-->updating and improving csmooth and implementing multi-scale analysis

Some references:

ChaRT
(http://asc-bak.cfa.harvard.edu/chart/ ; and references)

Aspect:
(see http://cxc.harvard.edu/cal/ASPECT/image_recon/report.html)

HRC blur
(see http://cxc.harvard.edu/contrib/juda/memos/hrc_blur/hrc_blur.html) (M. Juda)

SER
Li, Kastner at al. “Refining Chandra/ACIS Subpixel Event Repositioning Using a Back-side Illuminated CCD Model”, astro-ph/0211509 (and references)