Spectral Mapping of Extended Sources

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"Advanced" Scripting

- Automate running Ciao tools (via `system()` function)

- Import *modules* to obtain additional functionality from compiled code

- S-Lang control structures enable iterative computations

Overview

- Basic process is conceptually very simple:

  – adaptively extract spectra

  – generate responses

  – fit a user-specified model

- Script uses spectrum extraction module written in C
  (minimizes i/o to improve efficiency)

- Developed to map clusters and elliptical galaxies;
  other applications are possible.

- Works with both Chandra and XMM data

Implementation

Input: event file + spectrum model + mapping parameters,

   + background info, response info, initial fit-parameter values

Output: fit-parameter values, confidence limits, plots, spectra

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Two-Pass Algorithm:

1. Adaptively generate list of spectral extraction regions;
   generate responses via system calls.

2. Given region list, extract and fit spectra;
   optionally compute single-parameter confidence limits

Post-processing: Generate FITS images of fit-parameters, with WCS
to support overlays.

Design Features

- Any fit parameter can be mapped.

- Extraction region list can be user-generated;
  need not be a regular grid.

- Minimizing file i/o gives significant speed increase
  (at most, the event file is read twice; PHA file output is optional)

- Optional driver can distribute computations over a
  network of machines (uses PVM=Parallel Virtual Machine).

Hydra A

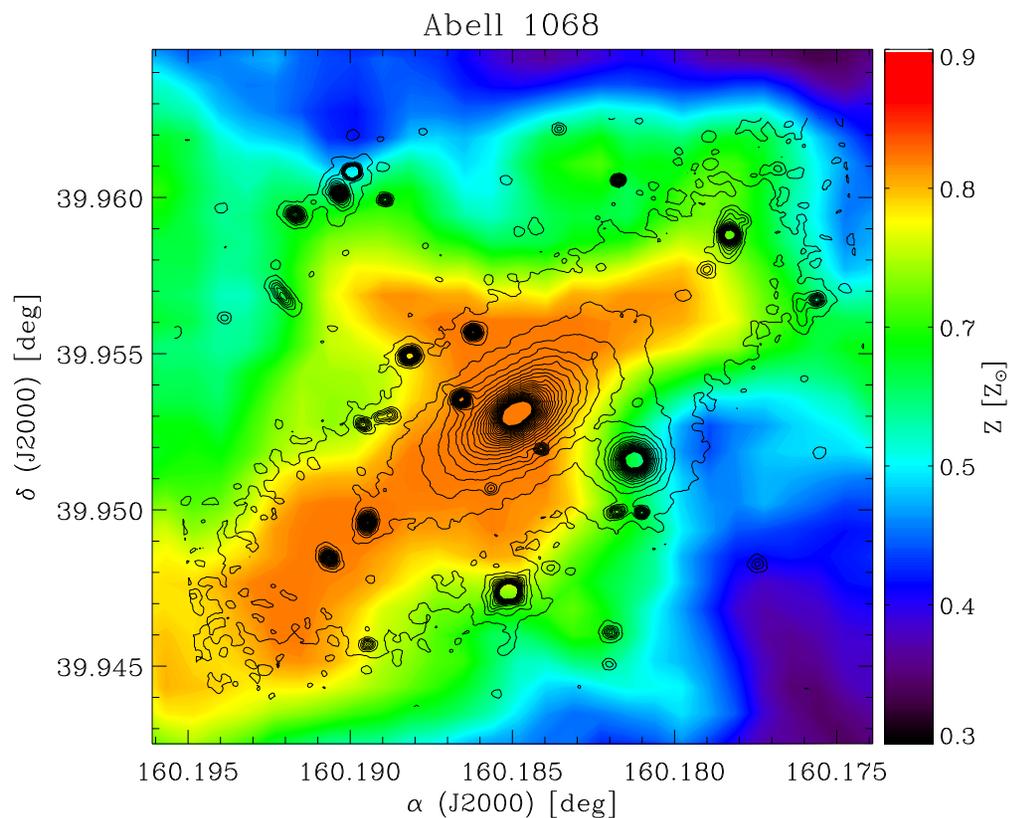T_X + radio contours (Nulsen, et al, 2002, ApJ, 568, 163)

Hydra A
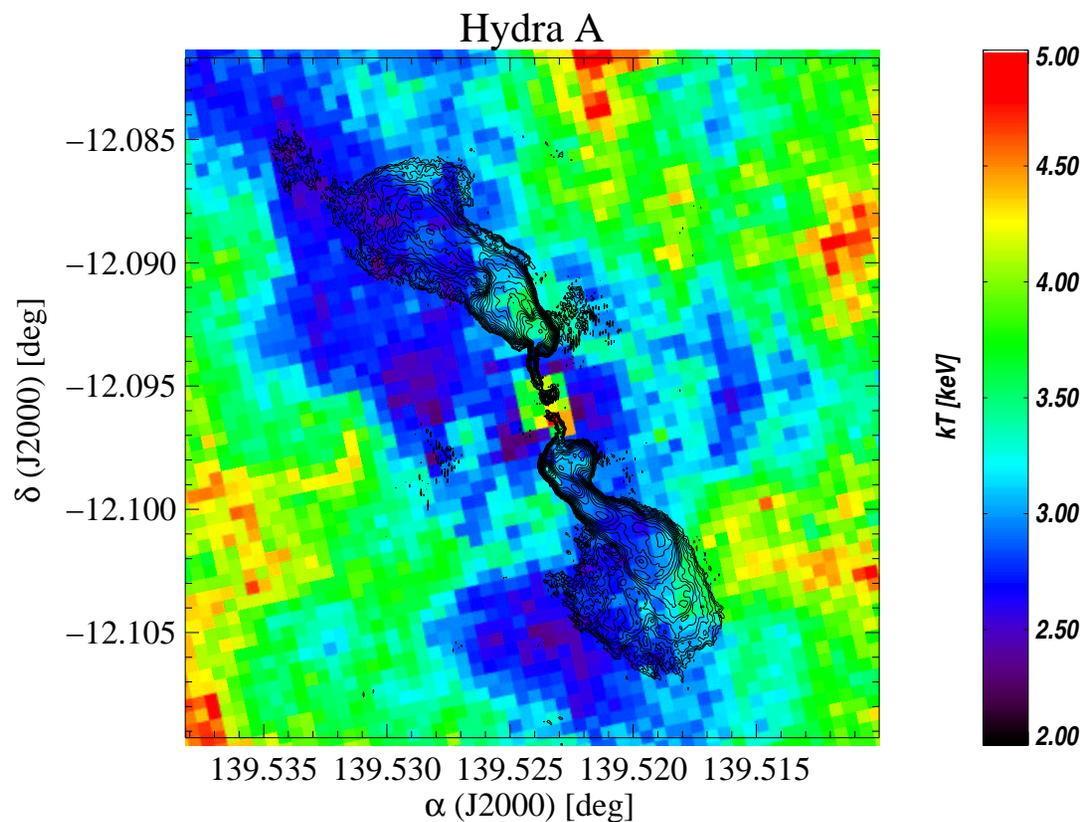
Abell 1068

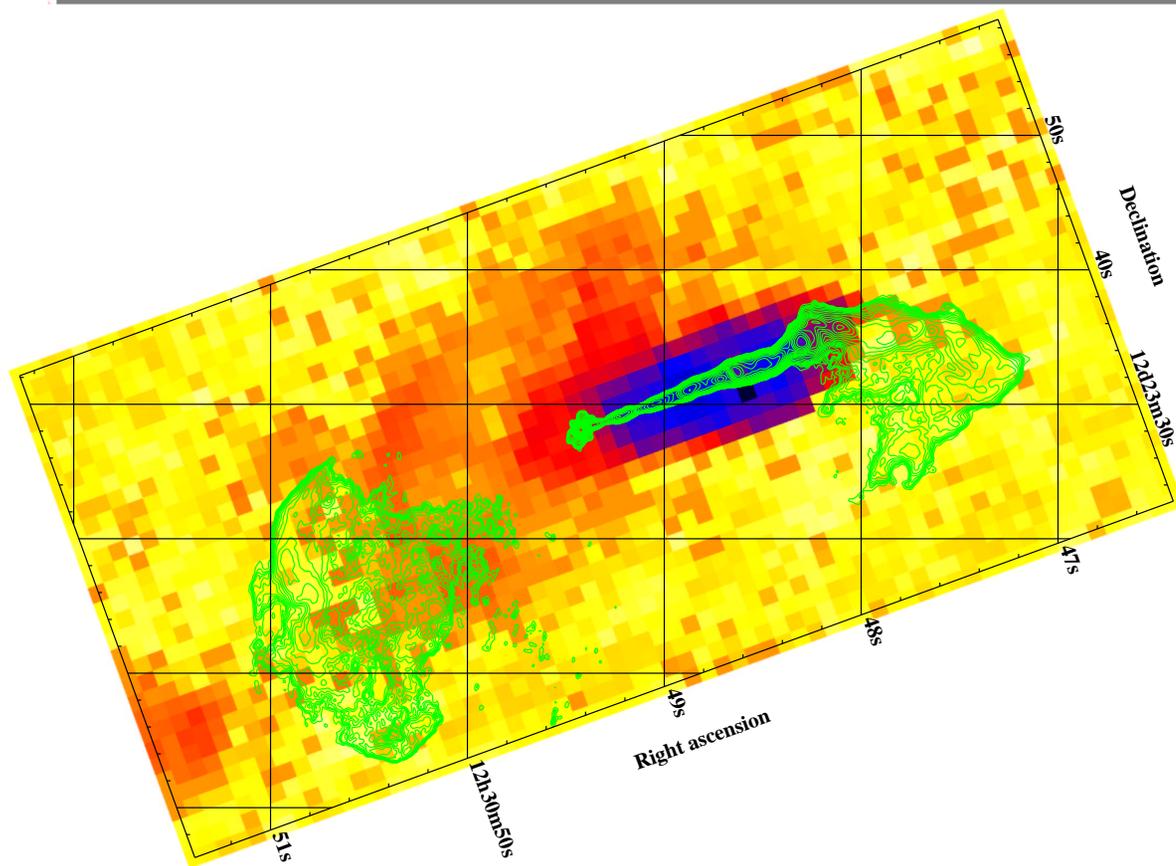X-ray abundance + HST R-band surface brightness

(Wise, McNamara & Murray, 2004, ApJ, in press (astro-ph/0310033)

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M87 Jet

X-ray power-law exponent + radio contours   (Wise, et al. 2004)

Status

- Working prototype, no documentation

- Currently developing support for multi-CCD maps

- Many components are now available to create complex applications

  – histogram module

  – SLgsl module (GNU Scientific Library)

  – XPA module (ds9 interface)

  – PVM module

- Code available on request