

DEM Reconstruction with the AIA

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Purpose of This Study

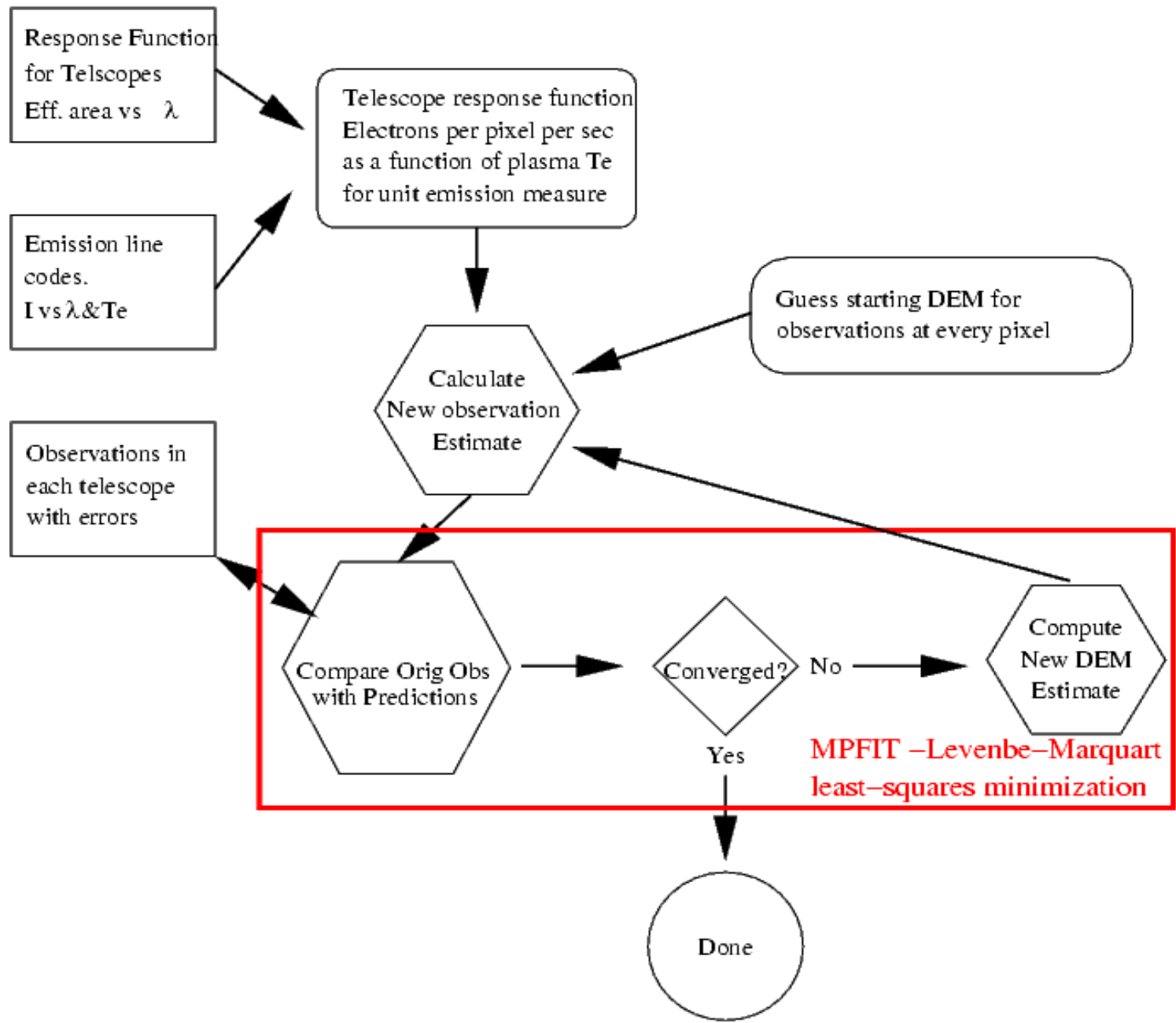
- To examine the quality of T and EM (DEM) reconstruction using normal-incidence EUV multilayers.
- Examine quality of DEM determination with the 7 EUV channels of the SDO/AIA.

Procedure Used

- Know instrument response function for each filter/channel of the instrument.
- Assume an emissivity model (APEC) for the coronal plasma.
- Choose a target DEM and construct instrument detected response. (Equivalent to observed input data, at each pixel.)
- Determine best least-squares fit DEM to observations, via spline-fit Widget (mpfit.pro).

Basic Inputs

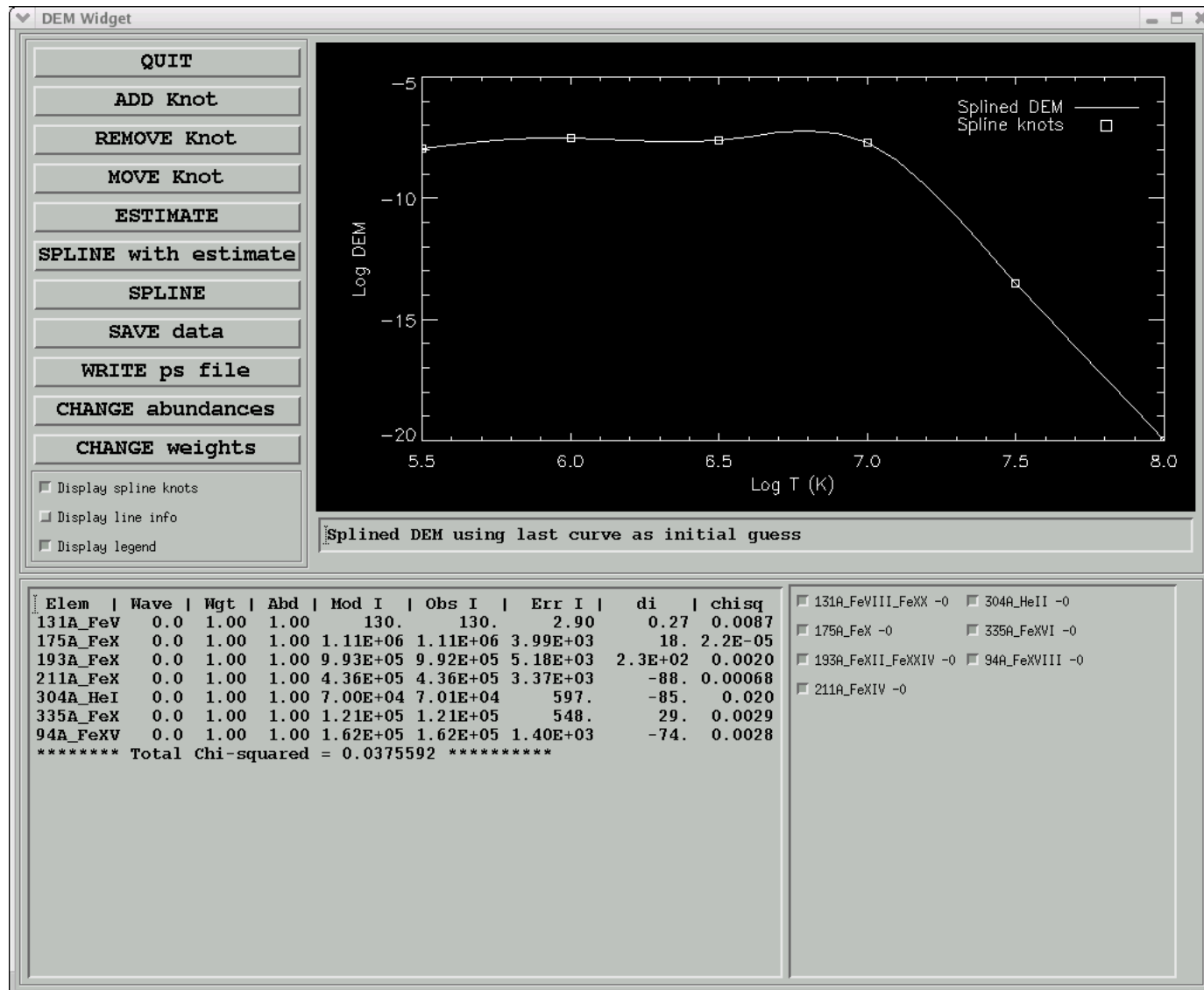
Secondary Products



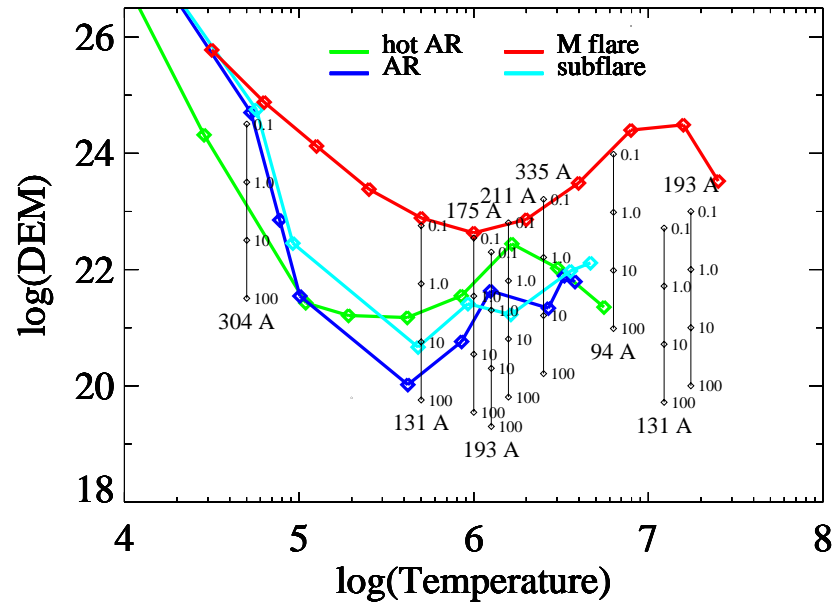
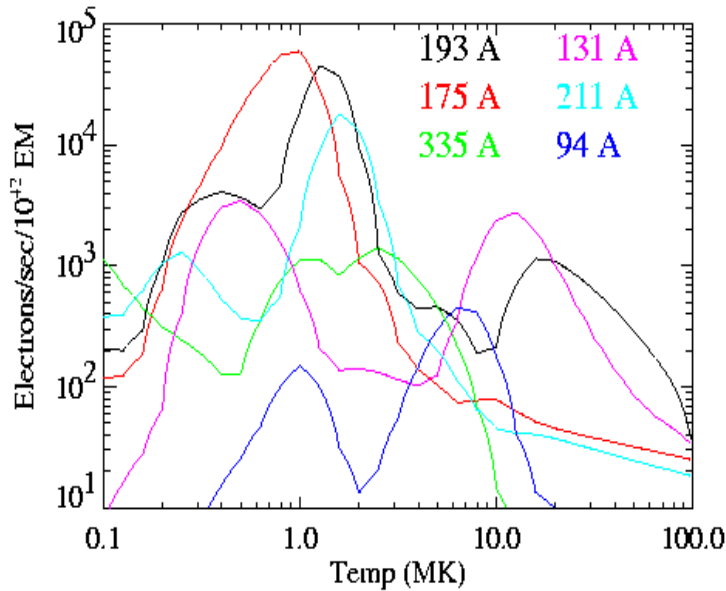
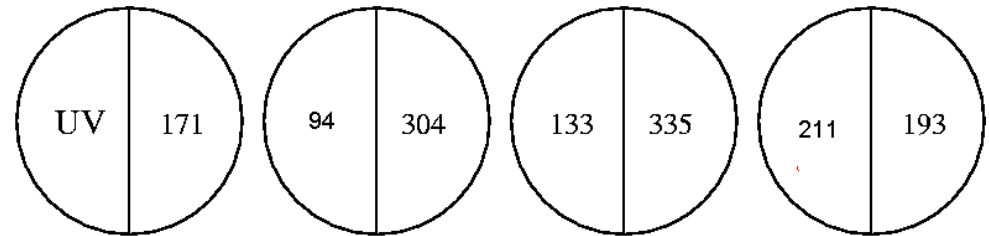
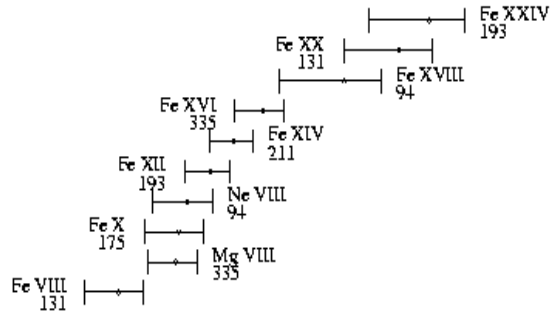
DEM Reconstruction Tests

1. Single-temperature source, range of temperatures.
2. Two-temperature source, range of separations.
3. “Real” coronal DEMs, from coronal holes, quiet corona, active region and flares (small and large).

AIA DEM Widget

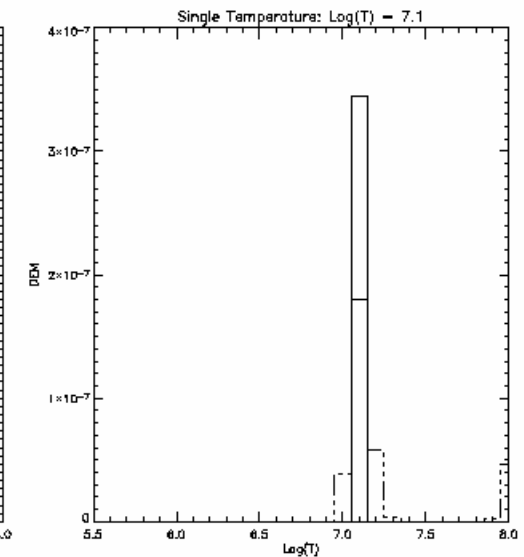
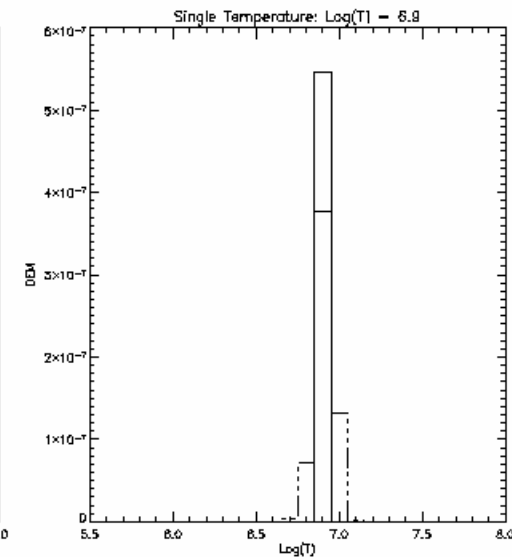
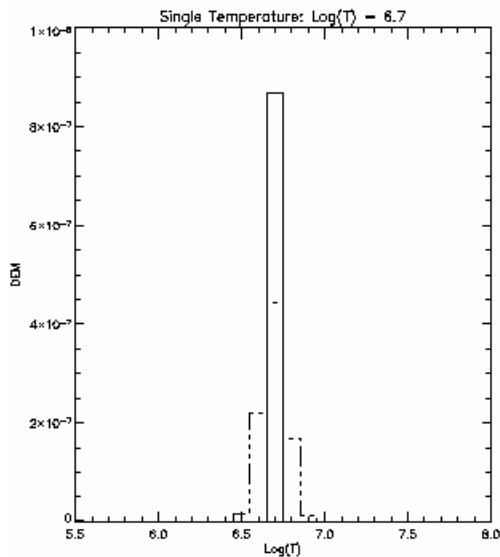
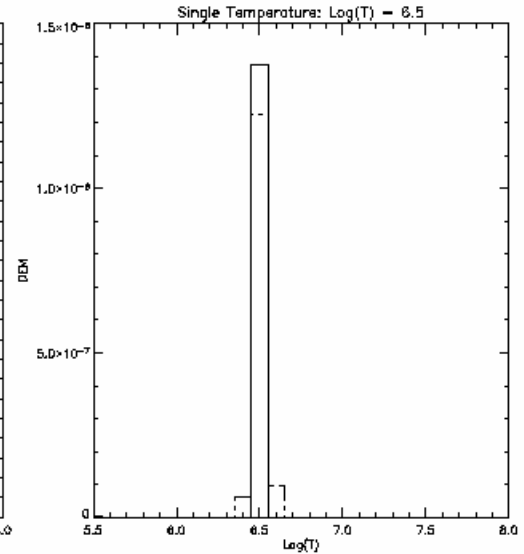
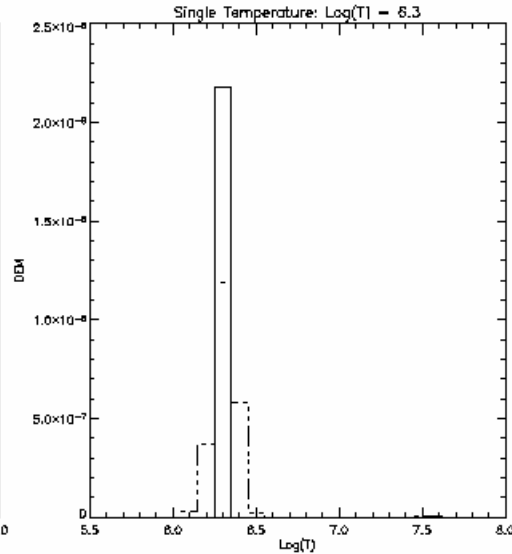
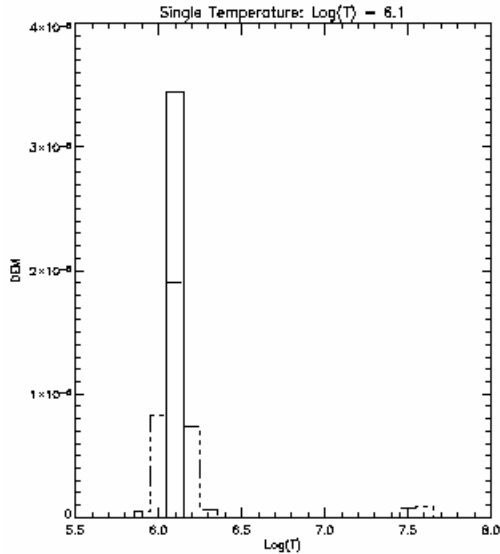


AIA: High Spatial and Spectral Resolution

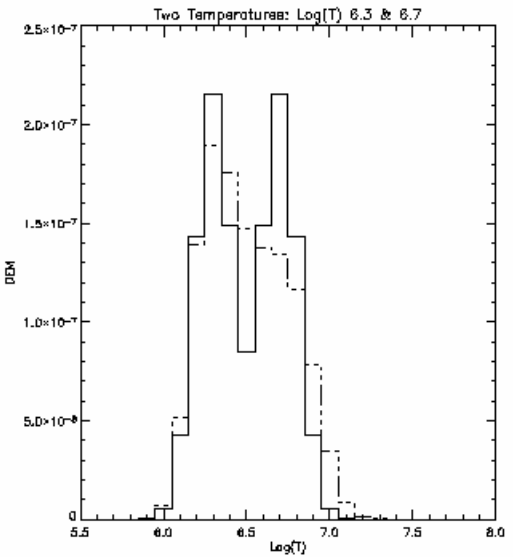
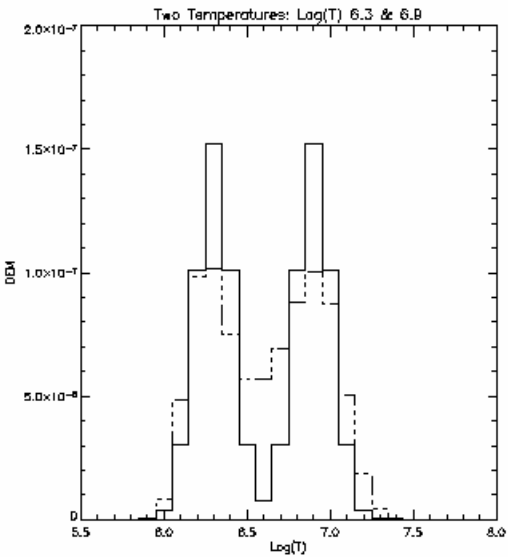
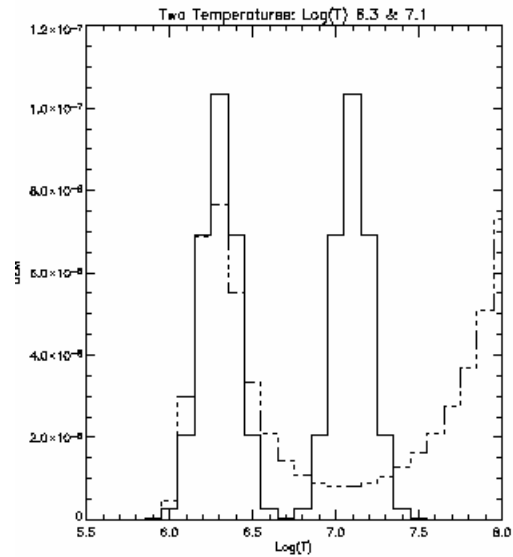
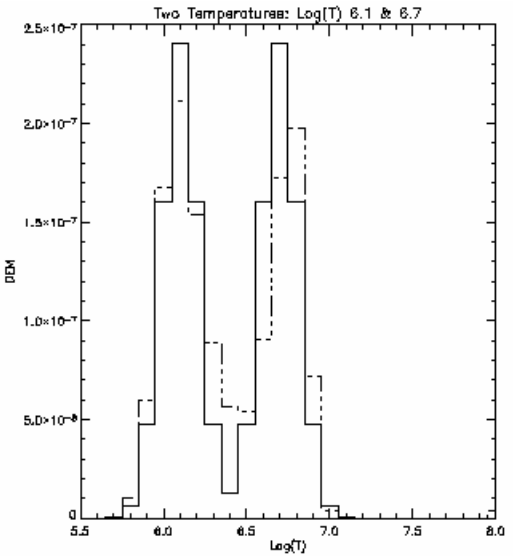
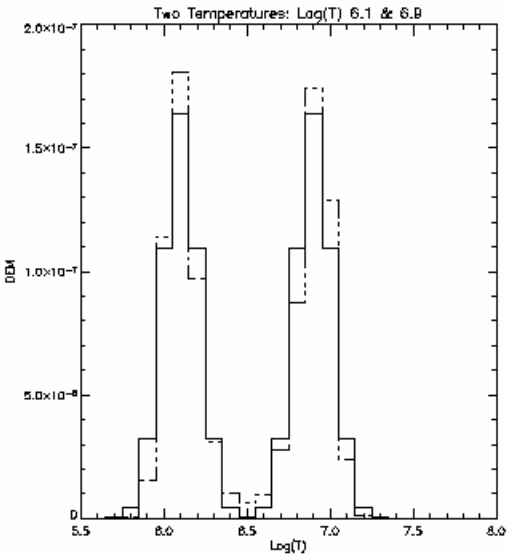
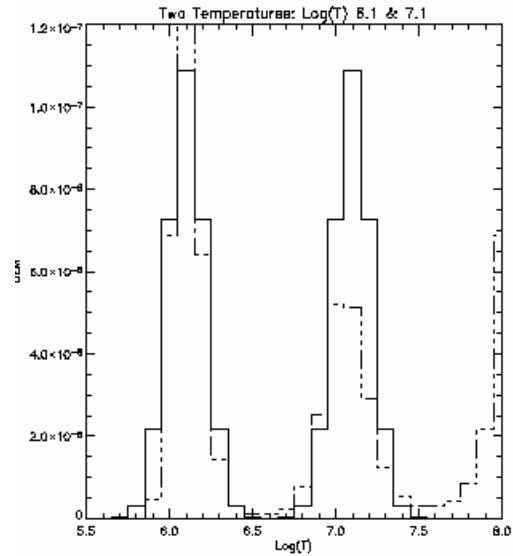


T-range: 0.5-22MK + T_{\min} + WL

AIA Single-T DEMs

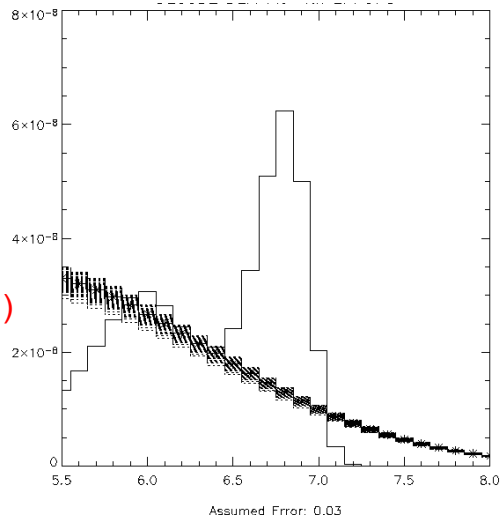


AIA 2-T DEMs

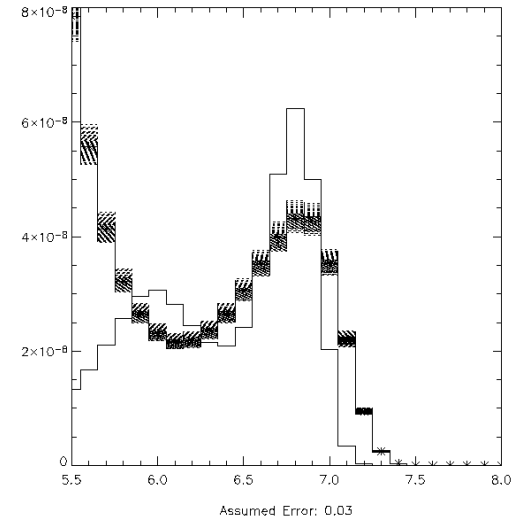


AIA AR DEMs

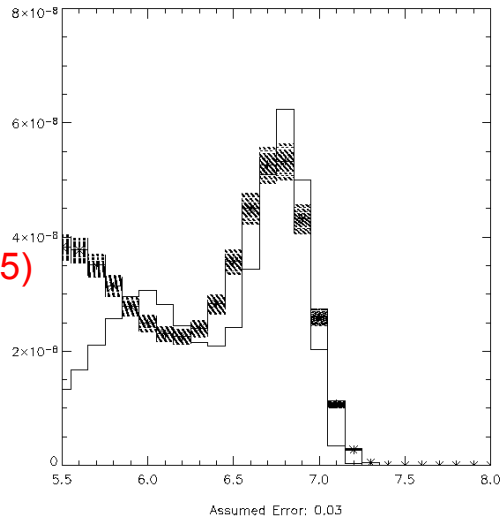
4 channels
(131,175,193,211)



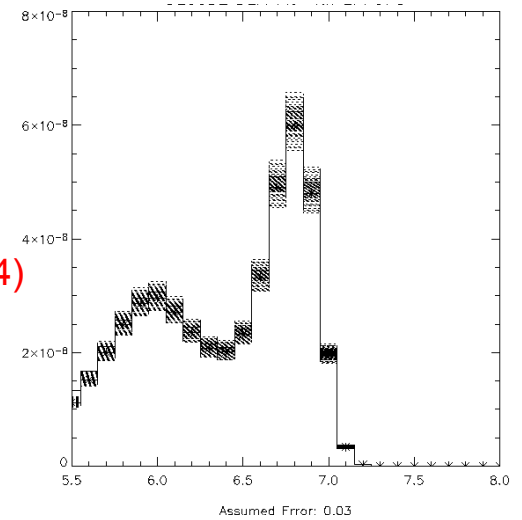
5 channels
(previous 4+94)



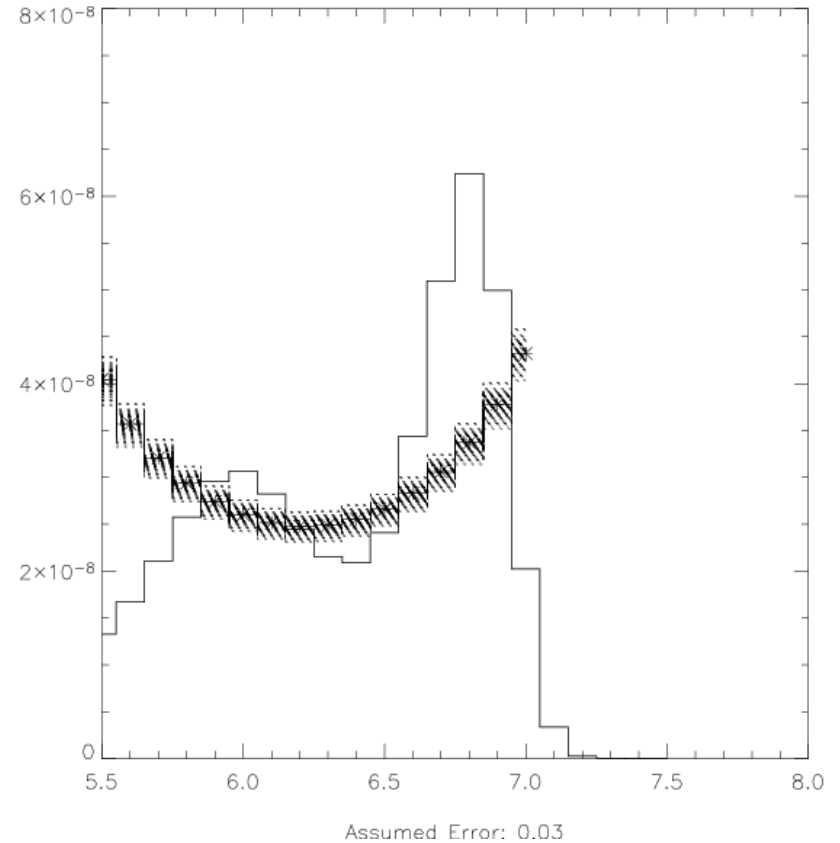
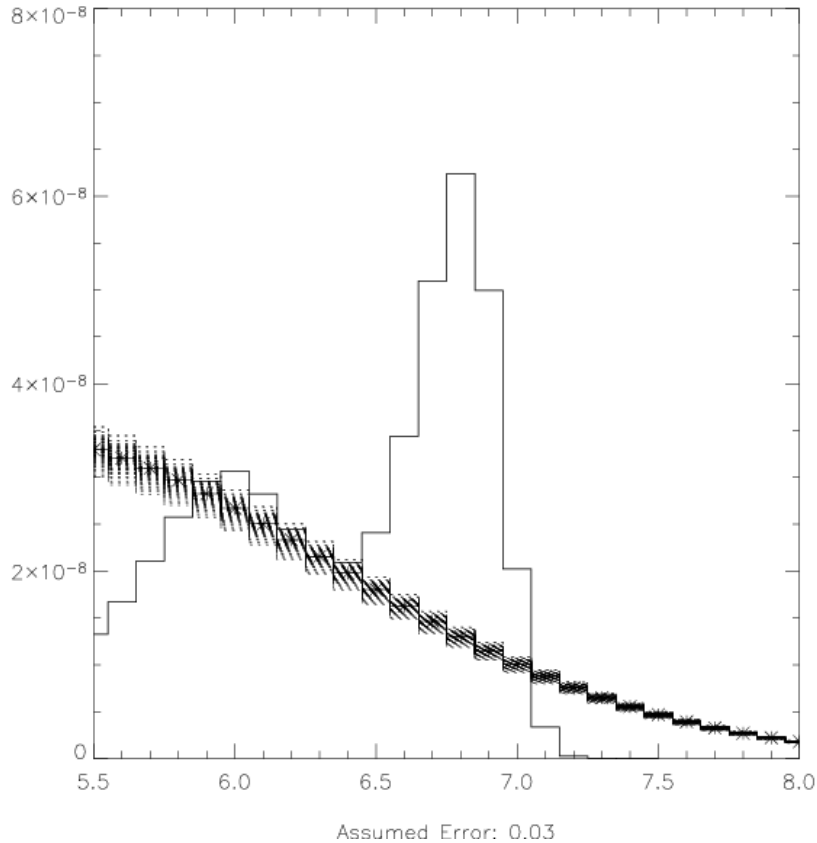
6 channels
(previous 5+335)



7 channels
(previous 6+304)

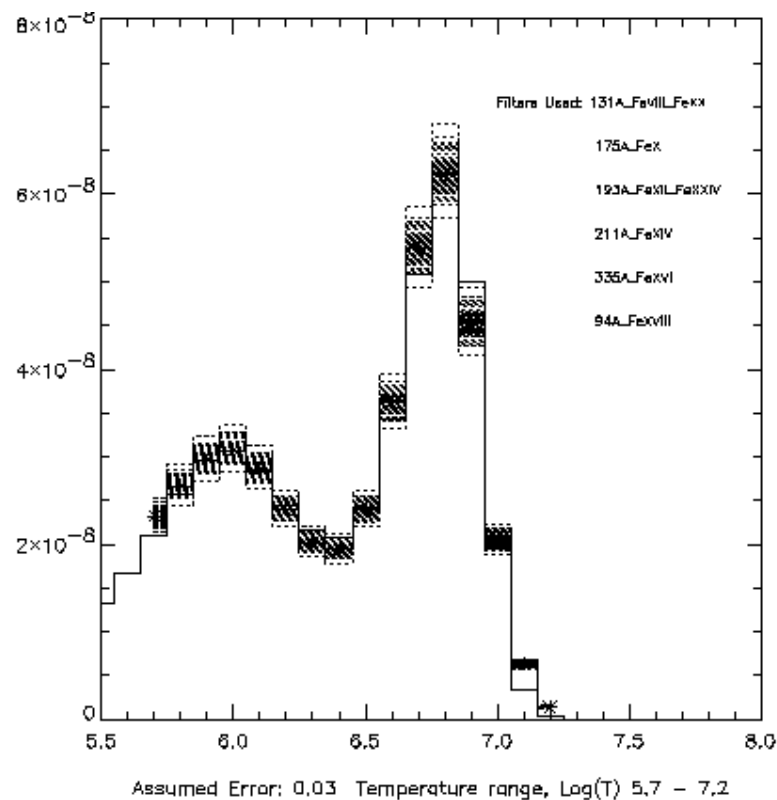
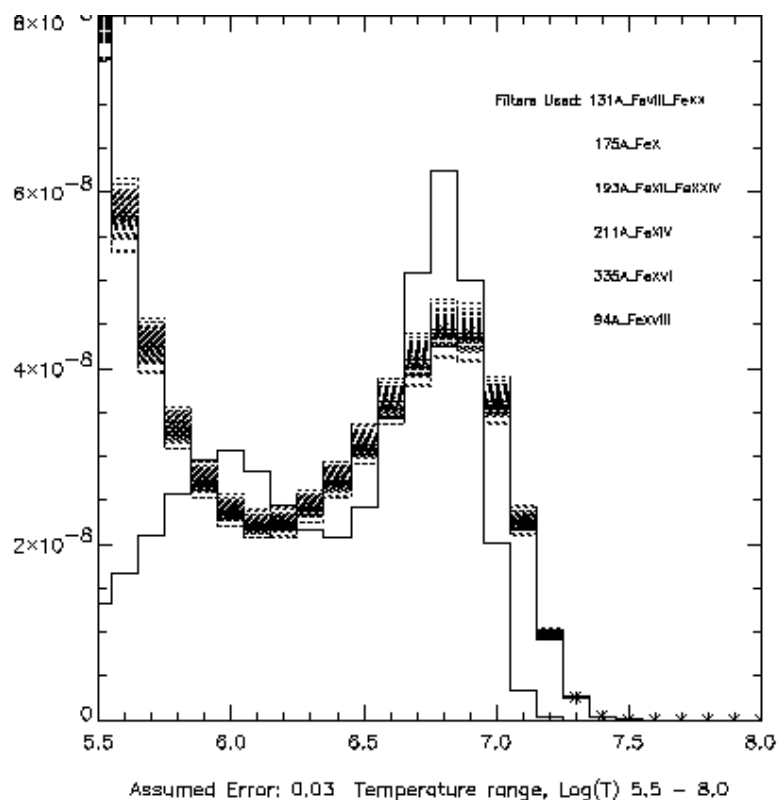


Narrowband With Reduction in T-Range Used for Reconstruction



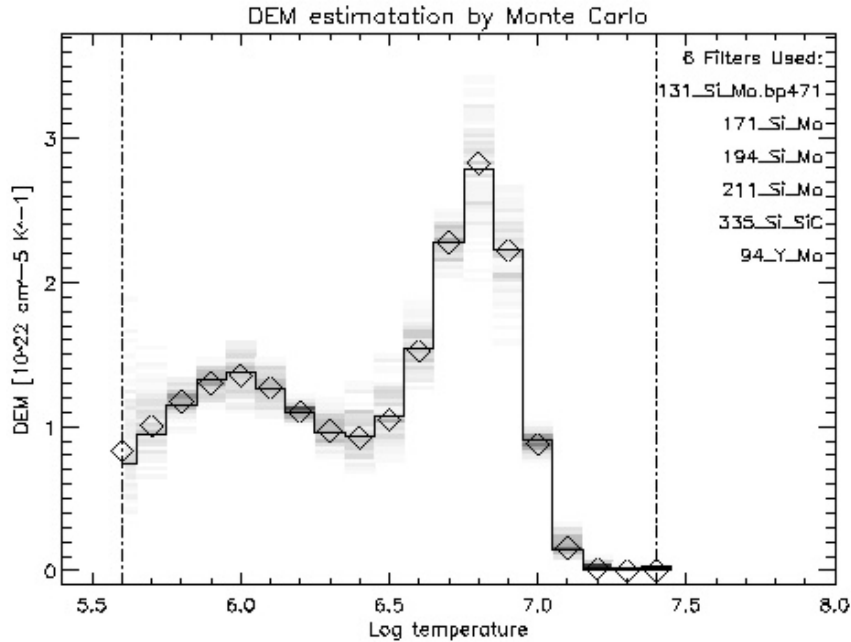
4-channel (Fe VIII,X,XII,XIV) fits, full T-range (left) vs. restricted T-range (right)

Narrowband With Reduction in T-Range Used for Reconstruction

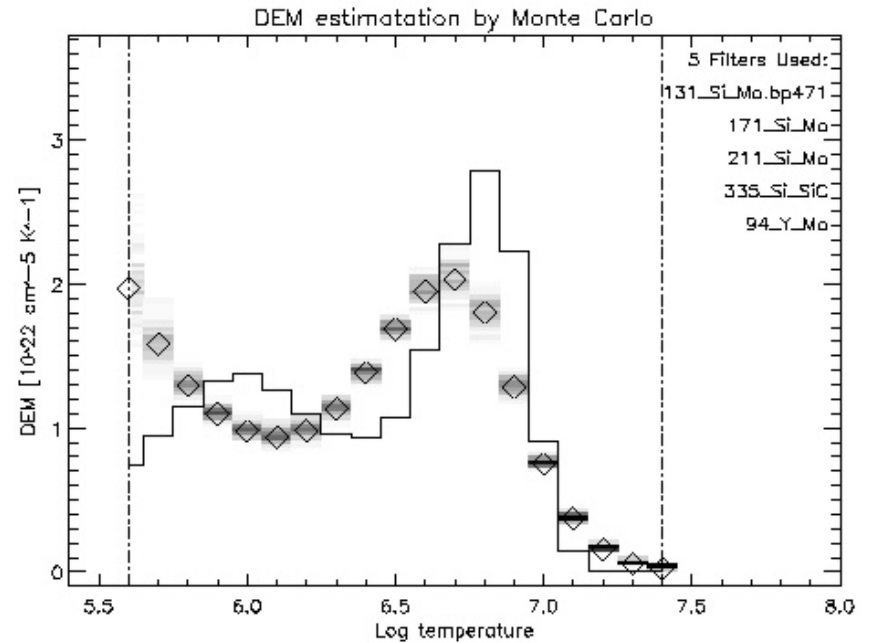


6-channel (Fe VIII,X,XII,XIV,XVI,XVIII) fits, full T-range (left) vs. restricted T-range (right)

AR Reconstruction – 6 vs. 5 Channels

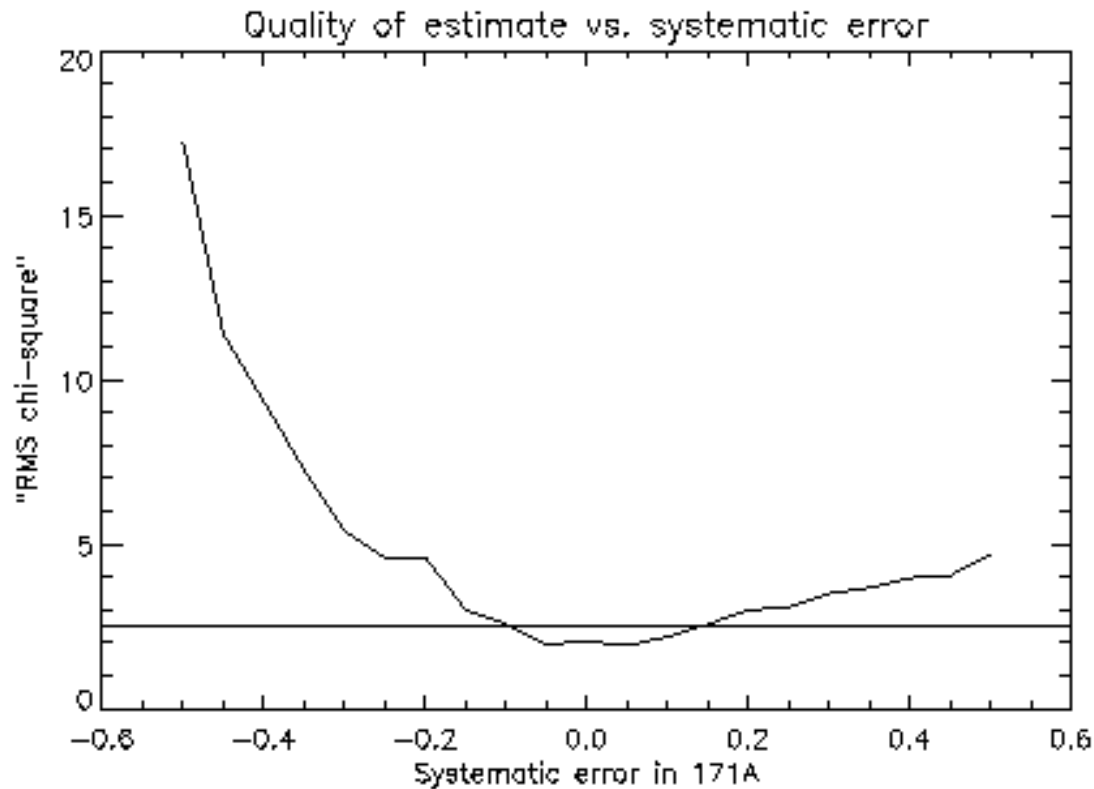


6 Filters Used



5 Filters Used

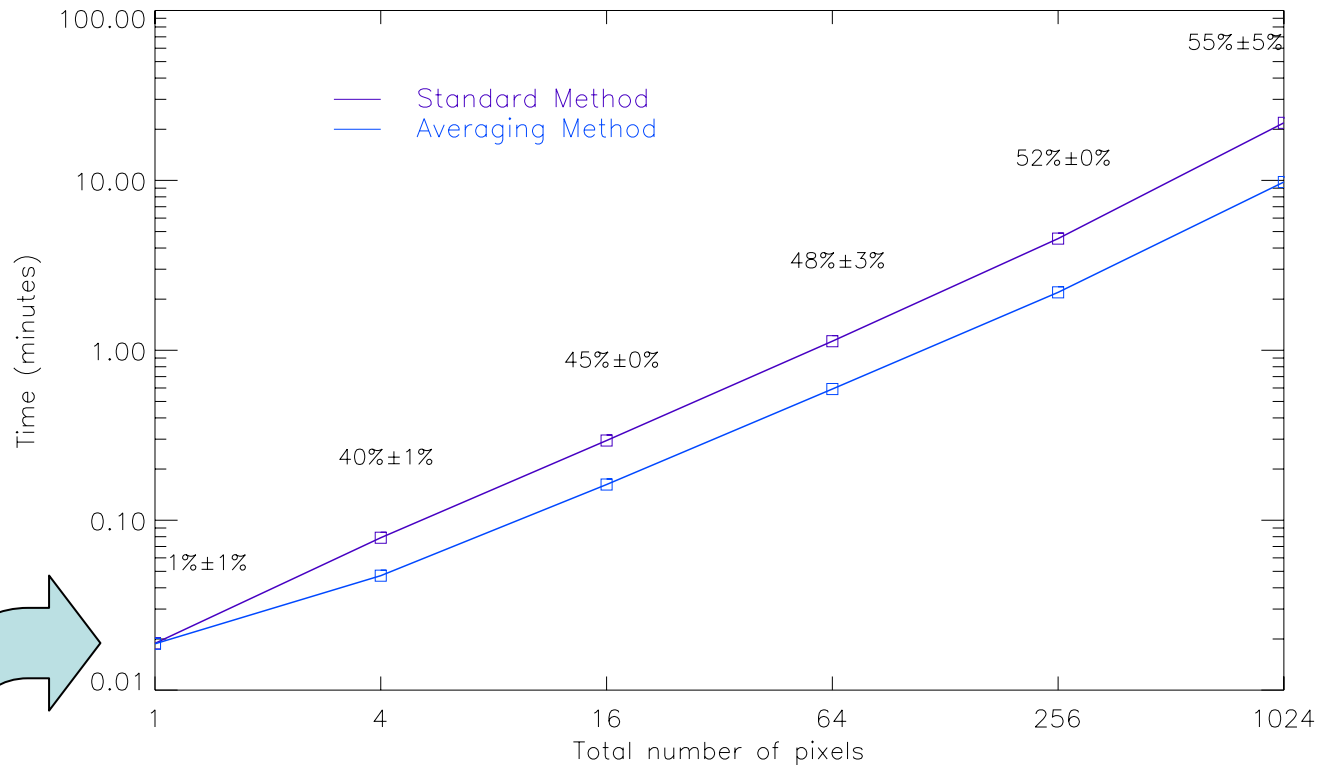
Sensitivity to Calibration Errors



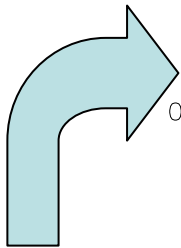
10% systematic error (e.g. calibration) leads to 1σ increase in RMS χ^2

DEM Processing Takes Time

Computation Time for DEM Reconstruction:
Standard vs. Averaging Methods

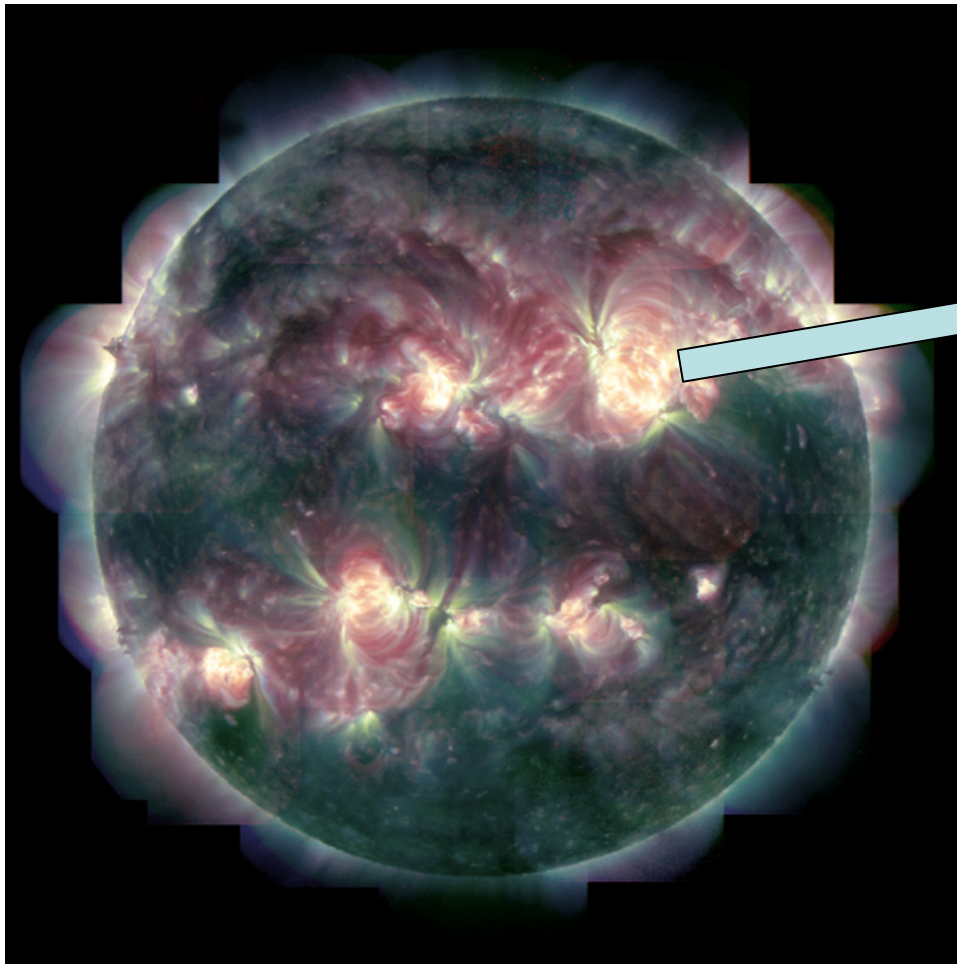


Percentages demonstrate savings in computation time

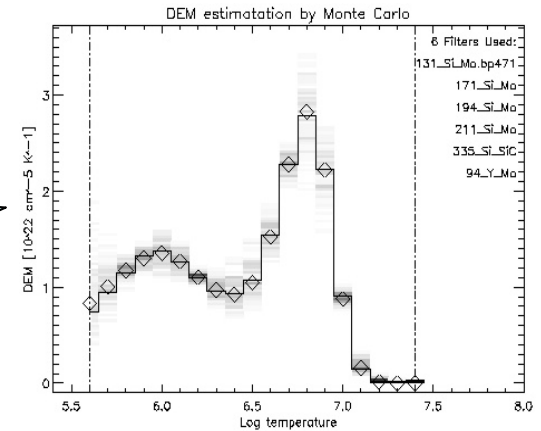


Currently using IDL.
Will try C++ or Fortran
for faster results

Viewing the DEM Calculations



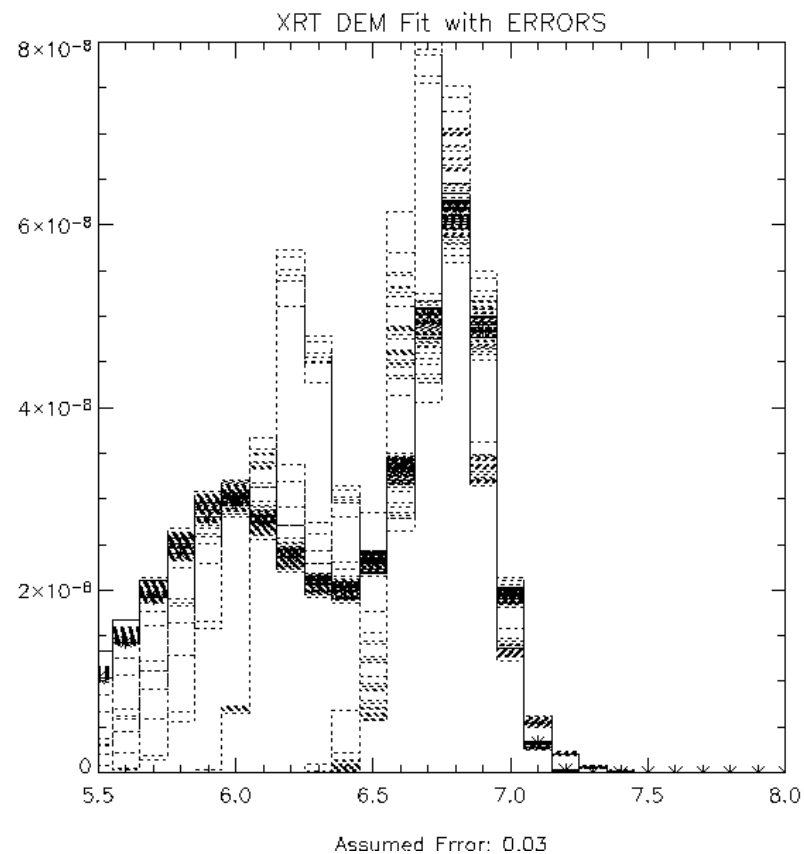
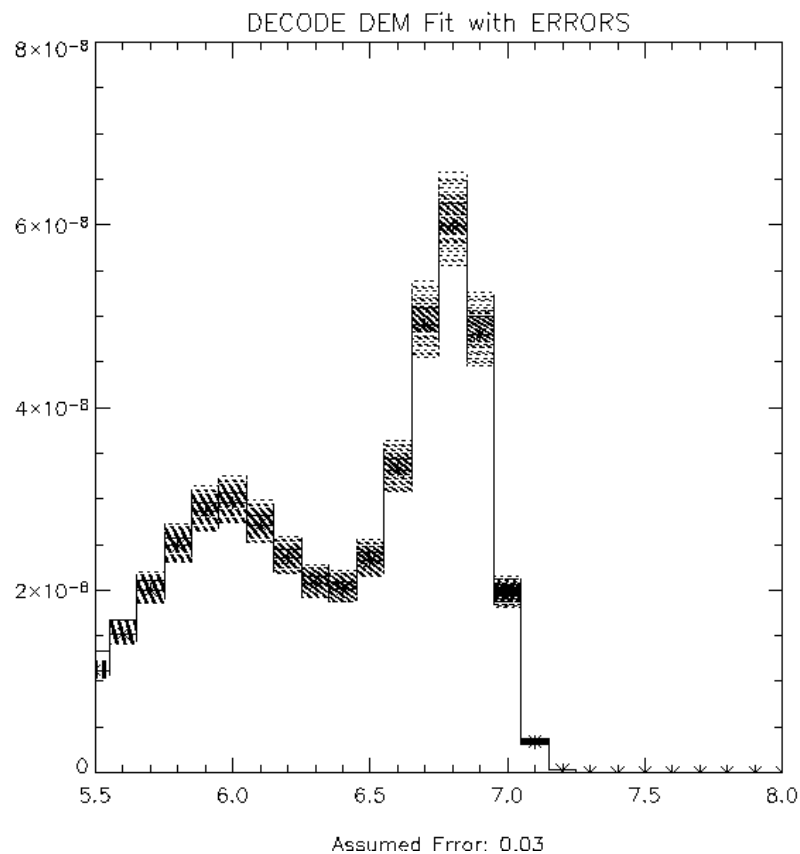
Color-coded DEM Image



DEM at each pixel in image

Or: Display 2-D full disk views of slices in narrow T ranges.

NI vs. GI Sensitivity to Observational Errors



Narrowband (left) vs. Broadband (right): 7 channels, 3% statistics, full T-range, Monte Carlo 100 cases each

Summary

- Narrowband EUV telescopes can provide high quality T & EM diagnostics.
- Requires broad T coverage, with many (*at least 6*) independent channels.
- NI multilayer diagnostics are stable to 10% noise and/or errors, and accurate if 6 or more channels are used.
- Major source of uncertainty is (work in progress) errors in the atomic physics.
- Need method for specifying T-range to be used.
- Need to improve the speed of the DEM reconstruction calculation.