Promote AGASC 1.6 for use with OFLS 10.3 and SAUSAGE

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Summary

- **Seek approval to promote AGASC 1.6 for operational use with OFLS 10.3 and SAUSAGE**
- **AGASC 1.6 corrects a calibration error in AGASC 1.5. For red stars the predicted magnitudes are up to 0.5 mags too bright**
- **New version also has improved star magnitude uncertainties which account for stellar spectral variation**
- **Only the MAG_ACA and MAG_ACA_ERR columns have been updated. All other values are identical and files retain the same length and same number of header blocks.**

Presentation:

- **Background**
- **Calibration**
- **Creation of AGASC 1.6**
- **Validation**

Background

- **AGASC 1.5 uses observed V and B-V color to predict star magnitude in the ACA bandpass, which is fairly red**

- **Predicted magnitude can have significant uncertainty because of variations in stellar spectra**

- **AGASC 1.5 was calibrated in May 2001 using 1939 observed Tycho-1 stars to update MAG_ACA and MAG_ACA_ERR**
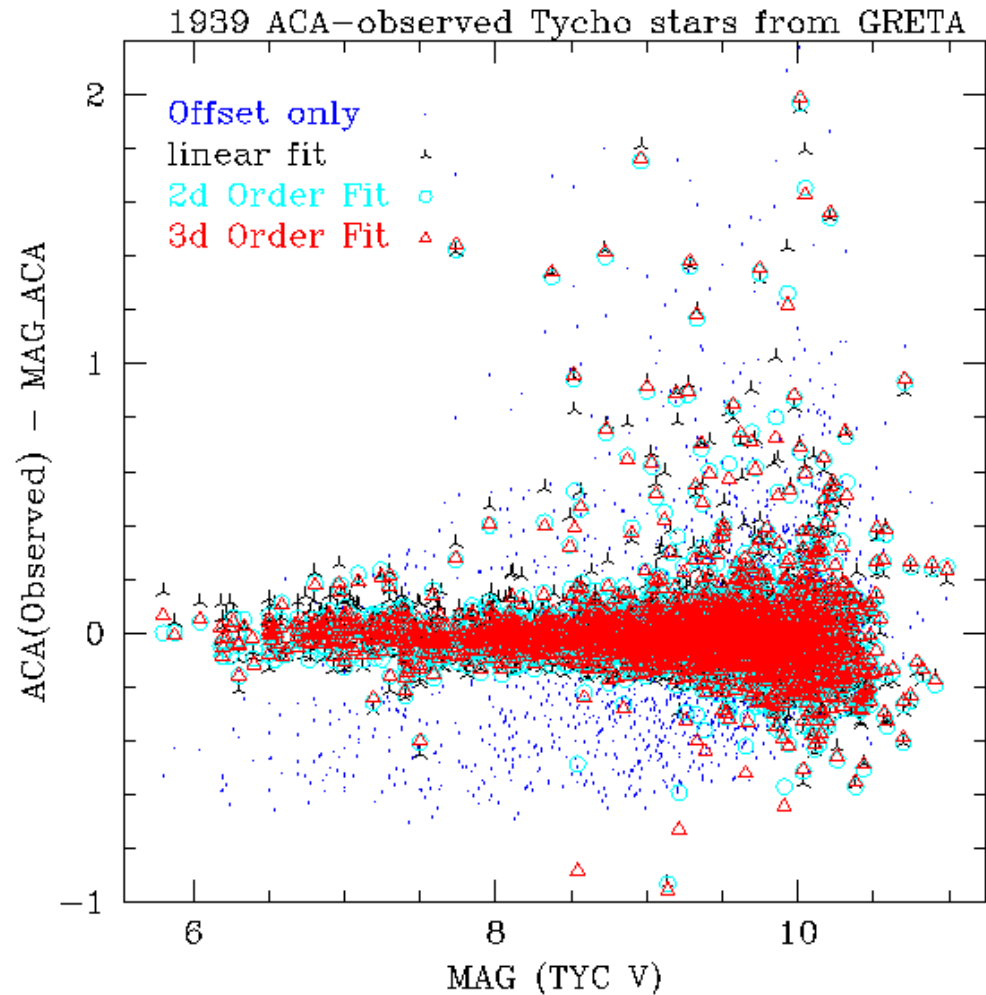
- **Derived a third order polynomial fit**

   $$\text{MAG\_ACA} = V + C_0 + C_1*(B-V) + C_2*(B-V)^2 + C_3*(B-V)^3$$

Apparently a good fit, but...

1939 ACA-observed Tycho stars from GRETA

Offset only
linear fit
2d Order Fit
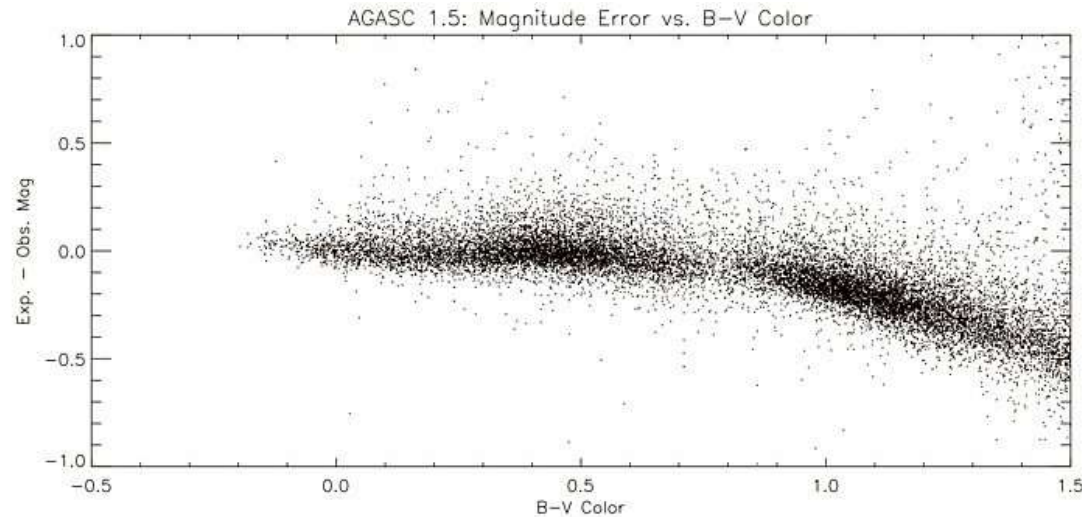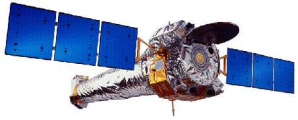3d Order Fit

ACA(Observed) − MAG_ACA

MAG (TYC V)

Background

- **Early in 2004 it was observed that for red stars (B-V > 0.5) there was an increasing discrepancy between the predicted and observed ACA magnitudes (using 25937 acquisition stars)**
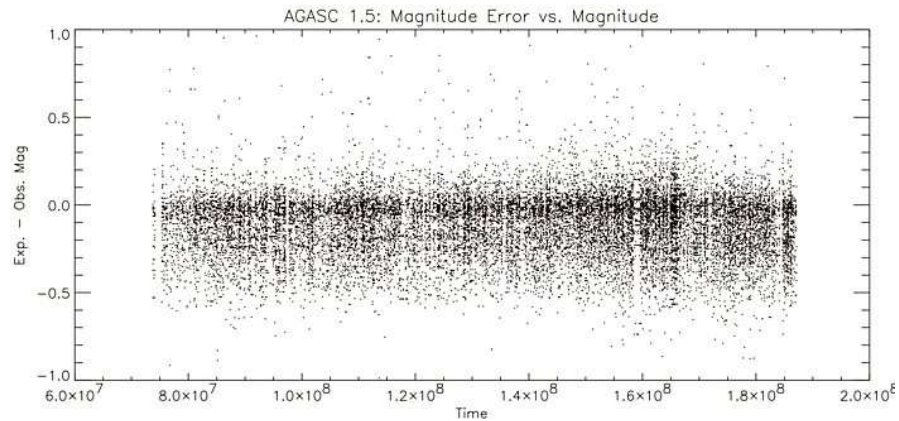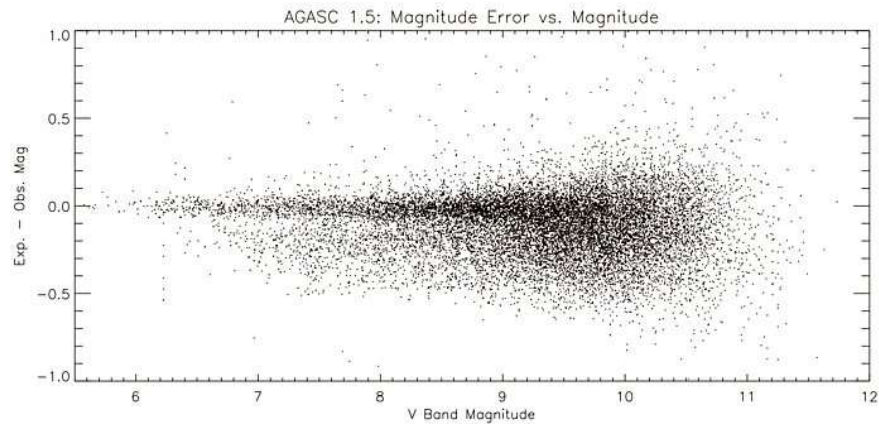

AGASC 1.5: Magnitude Error vs. B-V Color

Background

- **There is no strong magnitude or temporal dependence**

AGASC 1.5: Magnitude Error vs. Magnitude

AGASC 1.5: Magnitude Error vs. Magnitude

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Background

- **The discrepancy between predicted and observed magnitudes was eventually traced to a "accounting" error in program used to generated AGASC 1.5:**

    - **The usual Johnson B-V color is related to the Tycho B_T-V_T color by B-V = 0.85 * (B_T-V_T)**

    - **In the process of generating AGASC 1.5 that correction factor got applied in twice in different places**

- **The star selection and acquisition working group came to a consensus that a fix was needed and that the cleanest legacy solution was to correct the AGASC**

Calibration

- **Using a substantially larger database of observed stars (~26000 vs. 2000), we generated a new best-fit curve to relate MAG_ACA and Tycho-2 magnitudes B_T and V_T.**

- **Recalibration only applies to stars with Tycho-2 colors (>99.8% of candidate guide/acquisition stars)**

- **With larger database we could fit over a wider color range**

- **A spline fit was used instead of a polynomial fit, giving a better fit over the wide range**

- **MAG_ACA_ERR was recalculated to account for intrinsic uncertainty related to dispersion in stellar spectra**

$$\sigma^2_{mag\_aca} = \sigma^2_v + \sigma^2_{(b-v)} [d\,MAG\_ACA\,/d(B\text{-}V)]^2 + \sigma^2_{aca\_resp}$$

- **ACA response term calculated so mean MAG_ACA_ERR matches observed RMS in each color bin**

- **Details:** `http://cxc.harvard.edu/mta/ASPECT/agasc1p6cal/`
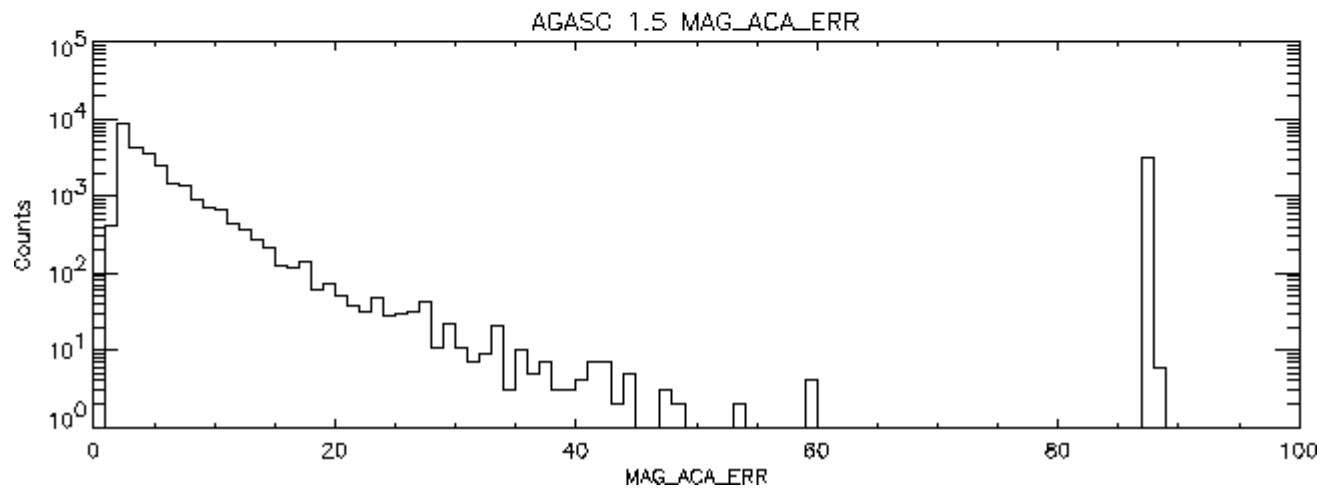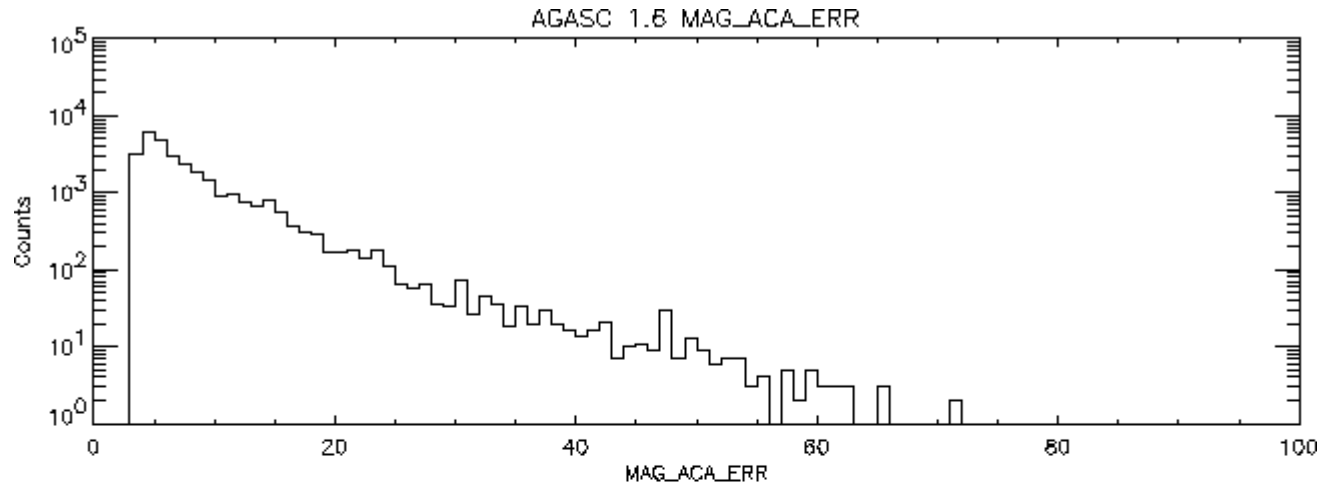
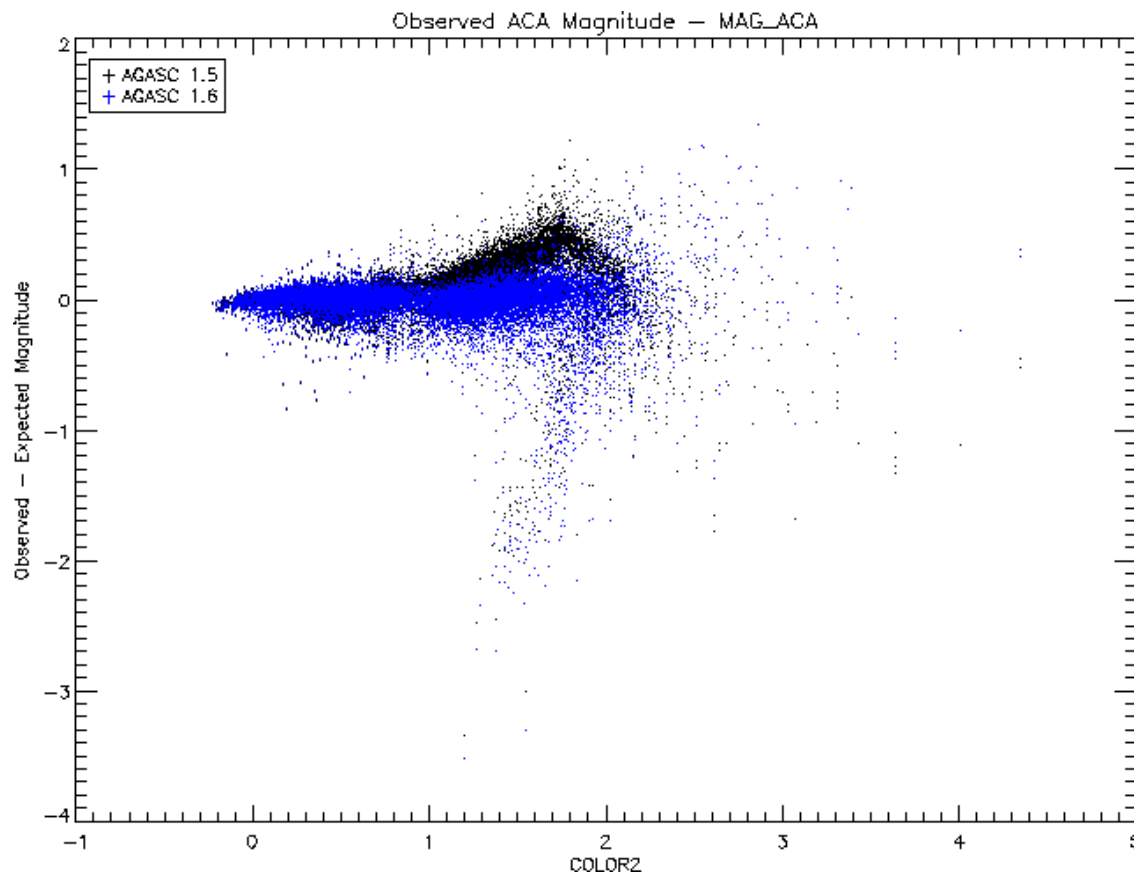Spline Fit with Characterized ACA response errors
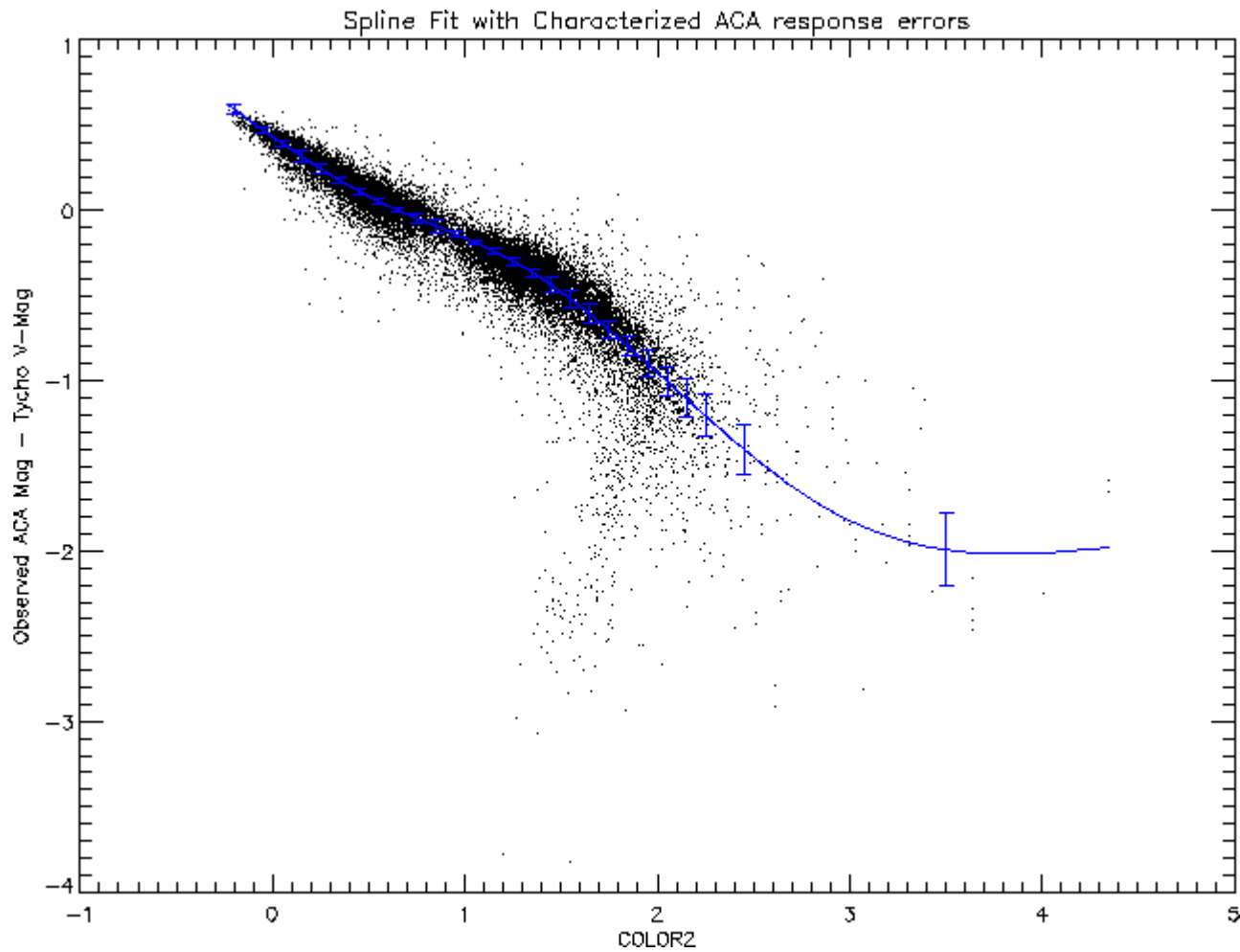
Calibration

Calibration

– **Compare deviations (1.5 vs. 1.6) using actual AGASC 1.6**

Creation of AGASC 1.6

- **The new files for AGASC 1.6 were created using an IDL script**
  - **Read in each file**
  - **Update the MAG_ACA and MAG_ACA_ERR columns for stars with Tycho-2 colors**
  - **Update header comments for version 1.6**
- **Documentation**
  - **Added AGASC 1.6 entry to main SOT MP AGASC page and supplied links to Aspect web pages with detailed description of calibration and testing**
  - **Updated standard COMMENTS.TXT**
 - **Put all code and auxilliary data files in a single directory with associated documentation**

Validation

- **Unit level comparison of AGASC 1.5 to 1.6**
  http://cxc.harvard.edu/mta/ASPECT/agasc1p6testing/

- **CXCDS (Aspect pipeline, MP tools, starcheck, archive)**

- **Flight ops**

  – **OFLS 10.3 load product generation**

  – **SAUSAGE**

  – **OFLS 10.3 AD&SC**

- **Working promotion plan containing detailed test results at**
  http://jeeves.cfa.harvard.edu/Murk/Chandra/PromotionPlan

Validation: Unit level

- **Unit level comparison of AGASC 1.5 to 1.6**
  (`http://cxc.harvard.edu/mta/ASPECT/agasc1p6testing/`)
  - **Color vs. Mag scatter plot**
  - **Color vs. Mag_err scatter plot**
  - **Mag and Mag_err distributions**
  - **Detailed comparison of catalogs generated by SAUSAGE**
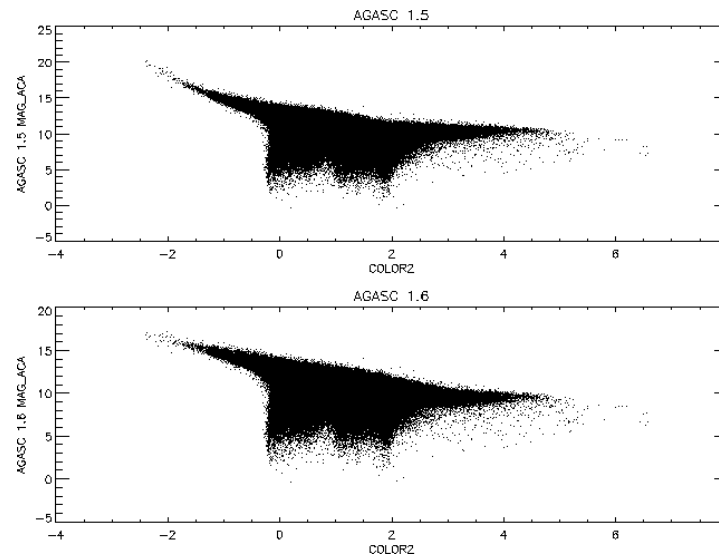
Validation: CXCDS

- **CXCDS Aspect pipeline**
  - **Ran aspect pipeline for eight obsids (standard regression test cases) and confirmed no unexpected errors or outputs and only expected changes in guide star output file**
- **Mission planning tools**
  - **Confirmed correct operation of mp_sfe, mp_get_agasc_id and mp_get_agasc**
- **Starcheck**
  - **Ran starcheck on three FOT test loads and confirmed no errors or unexpected results**
- **SOE file ingest**
  - **Ingested SOE file from one FOT test load using beta archive server and confirmed correct ingest**

Validation: Flight Ops

- **OFLS 10.3 and SAUSAGE**
  - **AGASC 1.6 installed on SGI/OFLS3 server and NetApp for SAUSAGE access**
  - **Built three weekly loads and performed full ACA review. (One load specifically chosen to have many red stars)**
  - **Some differences in selected stars noted, as expected**
  - **No problems in overall star selection**
- **OFLS AD&SC testing (W. Davis)**
  - **Confirmed AGASC 1.6 can be read using W.Davis' PC tool `startest`**
  - **Ran AD&SC with 14 attitudes with different star densities**
  - **Results identical for identified stars and attitude solutions**
- **Similar testing will be done with the Linux OFLS 11 at which time we will seek FDB approval for promotion on this platform**
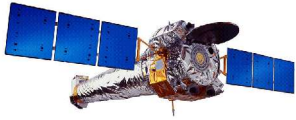
Promotion

- **Once approved actual deployment will include coordinated events, done at a convenient time between load builds**

- **ClearDDTS actions:**

  - **Install Release 4 of Star Catalog AGASC 1.6 on OFLS1 in Working State**

  - **Make Star Catalog AGASC 1.6 Operational (Baseline)**

- **Change star catalog pointer for SAUSAGE**

- **New DS patch release to change pointers to AGASC 1.6, which is already installed on DS. Precise coordination not required**

- **After time of no less than 3 months, remove AGASC 1.5**

Conclusion

- **AGASC 1.6 will improve reliability of star acquisition and guiding**
    - **More accurate predicted star magnitudes**
    - **More realistic assessment of magnitude uncertainties**
- **Testing shows that there are no radical changes and there will be no impact on the ability to find stars in specific fields**
- **Important for the legacy of Chandra to have the star catalog correct**