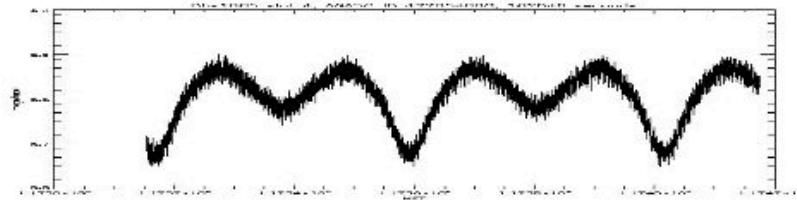
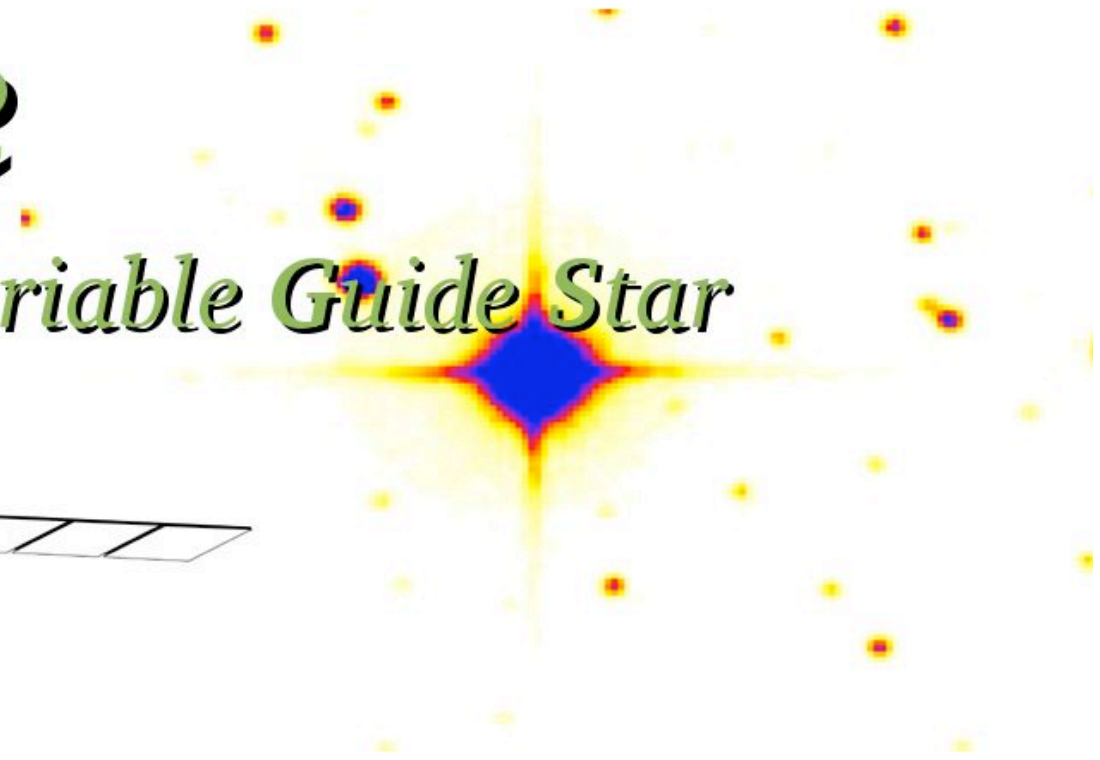
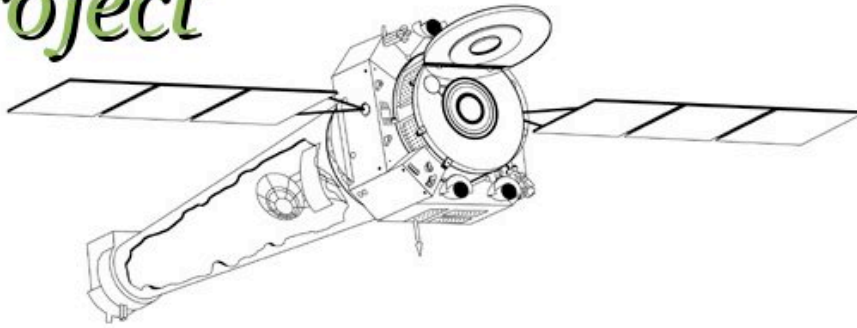


VGuide

The Chandra Variable Guide Star Project



Chandra Variable Guide Star Catalog Team

Joy Nichols, Jennifer Lauer, Doug Morgan, and Beth Sundheim
Harvard-Smithsonian Center for Astrophysics

Eric Martin
Northrop Grumman Space Technology

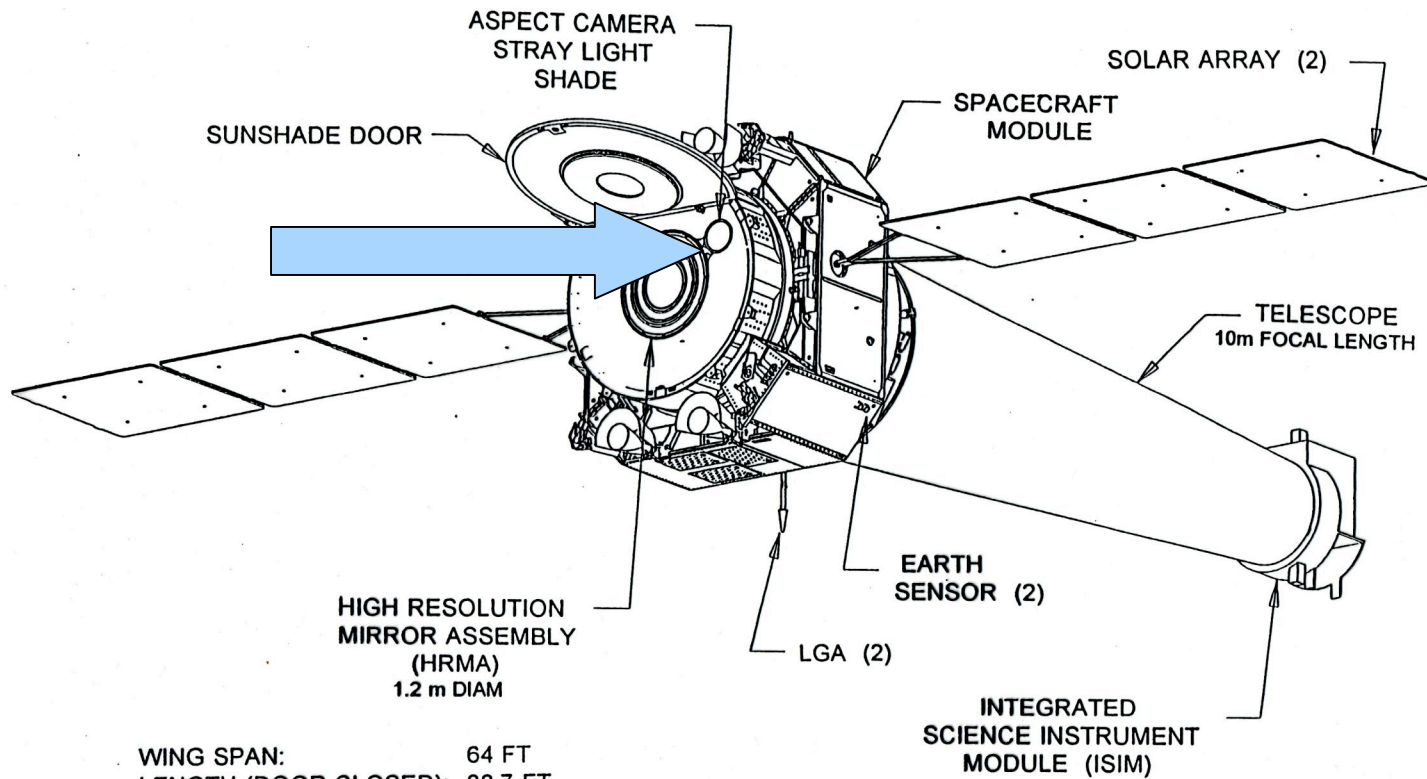
David Huenemoerder
MIT Kalvi Institute for Astrophysics and Space Research

Optically variable stars identified from the light curves of Chandra guide star data

- The Chandra Guide Star Catalog
- Description of the Aspect Camera and Detector
- Method of Identification
- The Chandra Variable Guide Star Catalog
- Examples of detected variable stars
- Collaboration with AAVSO

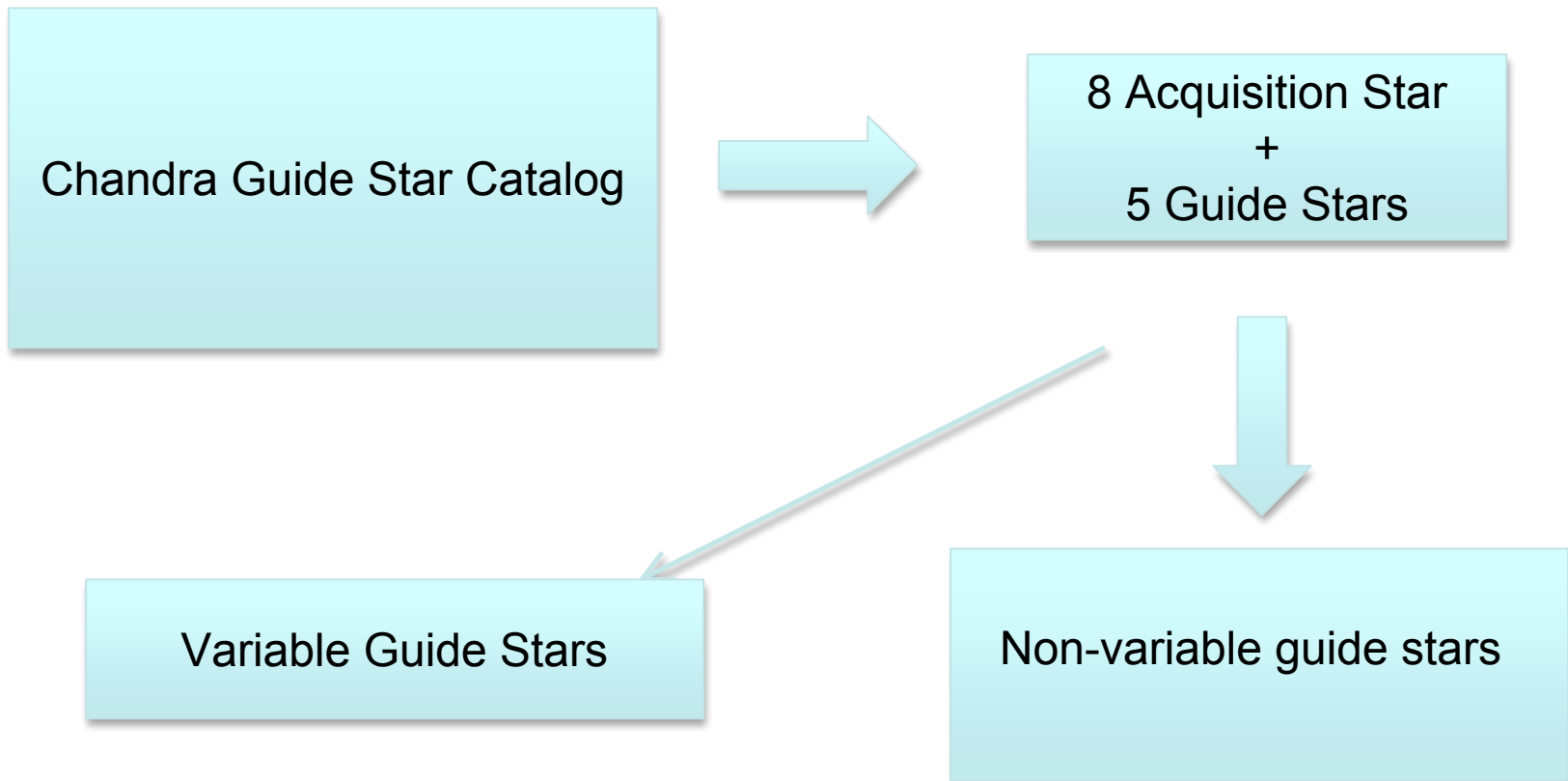
Chandra X-Ray Observatory

AXAF-I DEPLOYED CONFIGURATION



WING SPAN: 64 FT
LENGTH (DOOR CLOSED): 38.7 FT
LENGTH (DOOR OPEN): 45.3 FT
LAUNCH WEIGHT: 12,960 LB
ON-ORBIT WEIGHT: 10,560 LB
EOL POWER: 2,428 W

For each planned observation:



Chandra Guide and Acquisition Star Catalog

- Primary source: Guide Star Catalog (GSC) for Hubble Space Telescope
- Secondary sources: Positions and Proper Motions (PPM) catalog; Tycho Output Catalog (Tycho-1); ACT Reference Catalog; Tycho-2 catalog
- More than 15 million stars with magnitude in 7 to 16 range
- Aspect Camera guide stars rarely fainter than mag 10.6, but occasionally as faint as 11.2
- Aspect Camera effective spectral response much redder than Johnson B or V filters, and includes a much broader range of wavelengths
- Known variables in the Guide and Acquisition Star Catalog are flagged and not used

Characteristics of the Aspect Camera

- 4000-9000 Å sensitivity
- 11.2 cm f/9 Ritchey-Chretien telescope with 990 mm effective focal length
- 1024x1024 CCD; 5 arcsec pixels
- Sampling rate of 2 seconds
- First moment centroid in 8x8 pixel region locates stars
- Photometrically stable for over 8 years
- Maintains pointing accuracy of 0.5 arcsec

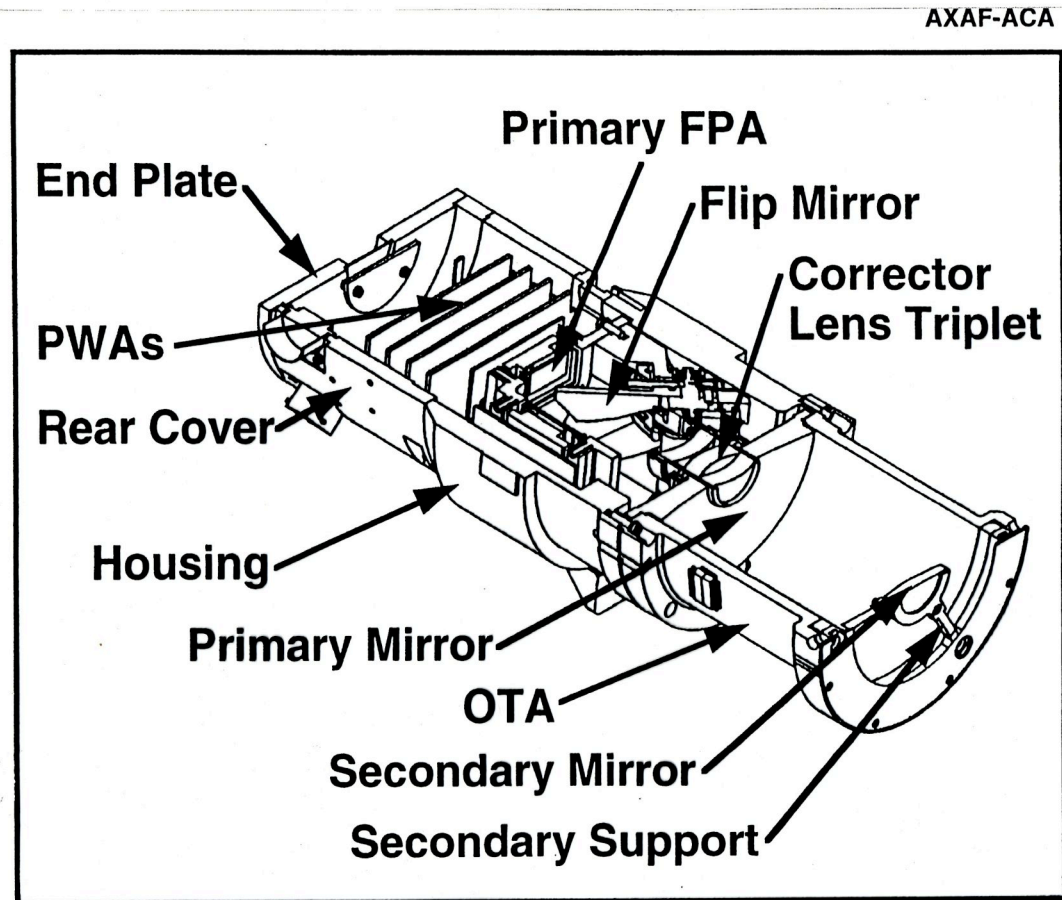
Aspect Camera Assembly (ACA)

- Optics

- Cassegrain telescope, with refractor triplet
- Effective focal length: 990 mm
- Aperture: 110 mm
- 2 focal plane detectors
- Flip mirror mechanism for using redundant focal plane

- Focal Plane

- TK1024 CCD
- 1024 x 1024 pixels
- Pixel size: 24 μm x 24 μm
- Nominal plate scale: 5" / pixel
- Active focal plane cooled between -10 C and -20 C
- 4 electrical quadrants, with individual pre-amp readouts

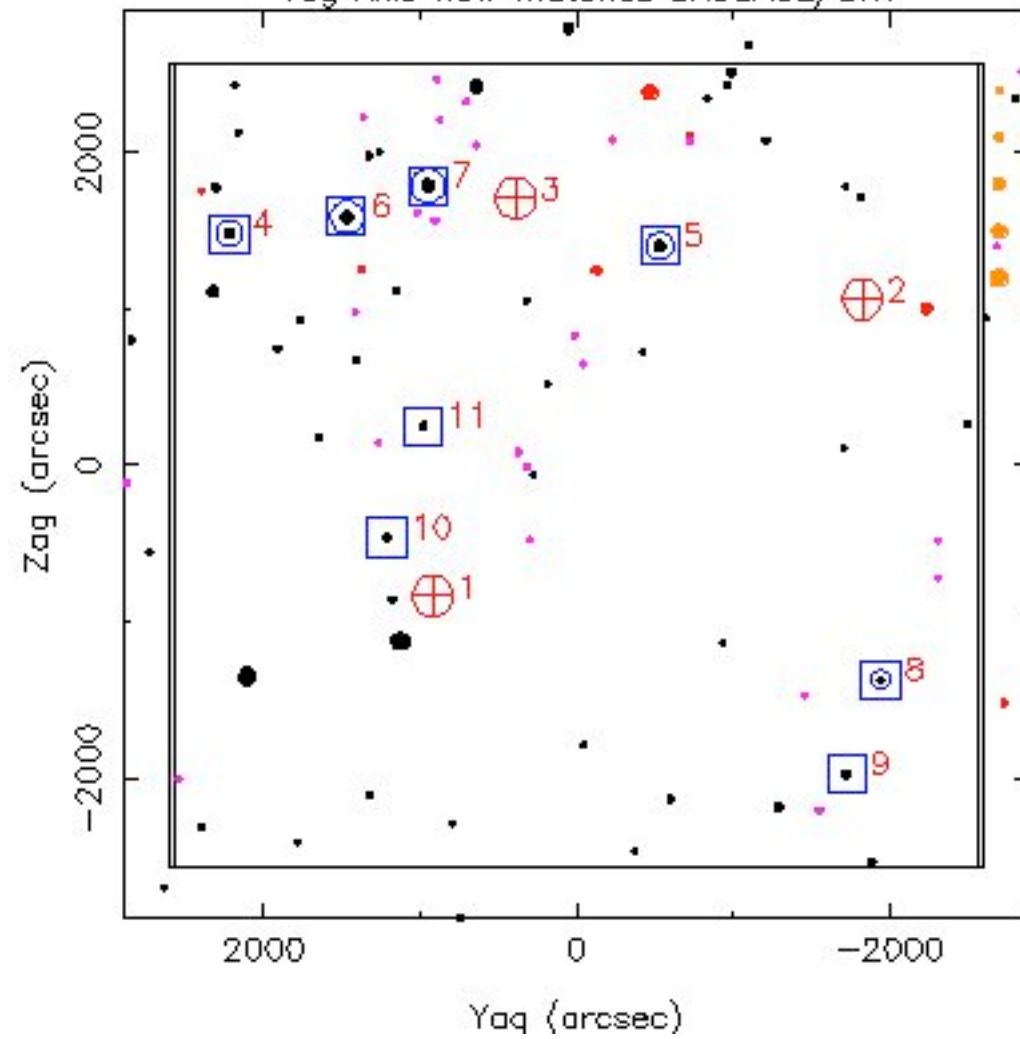


Aspect Camera Acquisition Sequence

- Spacecraft maneuvers to target attitude (using gyros for attitude reference)
- Aspect Camera executes commands to search for and track up to 8 “acquisition” stars, which are used to establish fine attitude at end of maneuver
- Aspect Camera executes commands to find and track “guide” stars (typically 5 guide stars)
- Guide star positions on Aspect Camera CCD, along with gyro data, are used throughout X-ray observation to maintain precise attitude/pointing stability
- Each image is tracked in a 6x6 or 8x8 pixel region on CCD
- Aspect Camera integration time is 1.7 sec

Stars at RA=240.768274 Dec=-40.287617 Roll=244.645288

Yag Axis now matches SAUSAGE/SKY

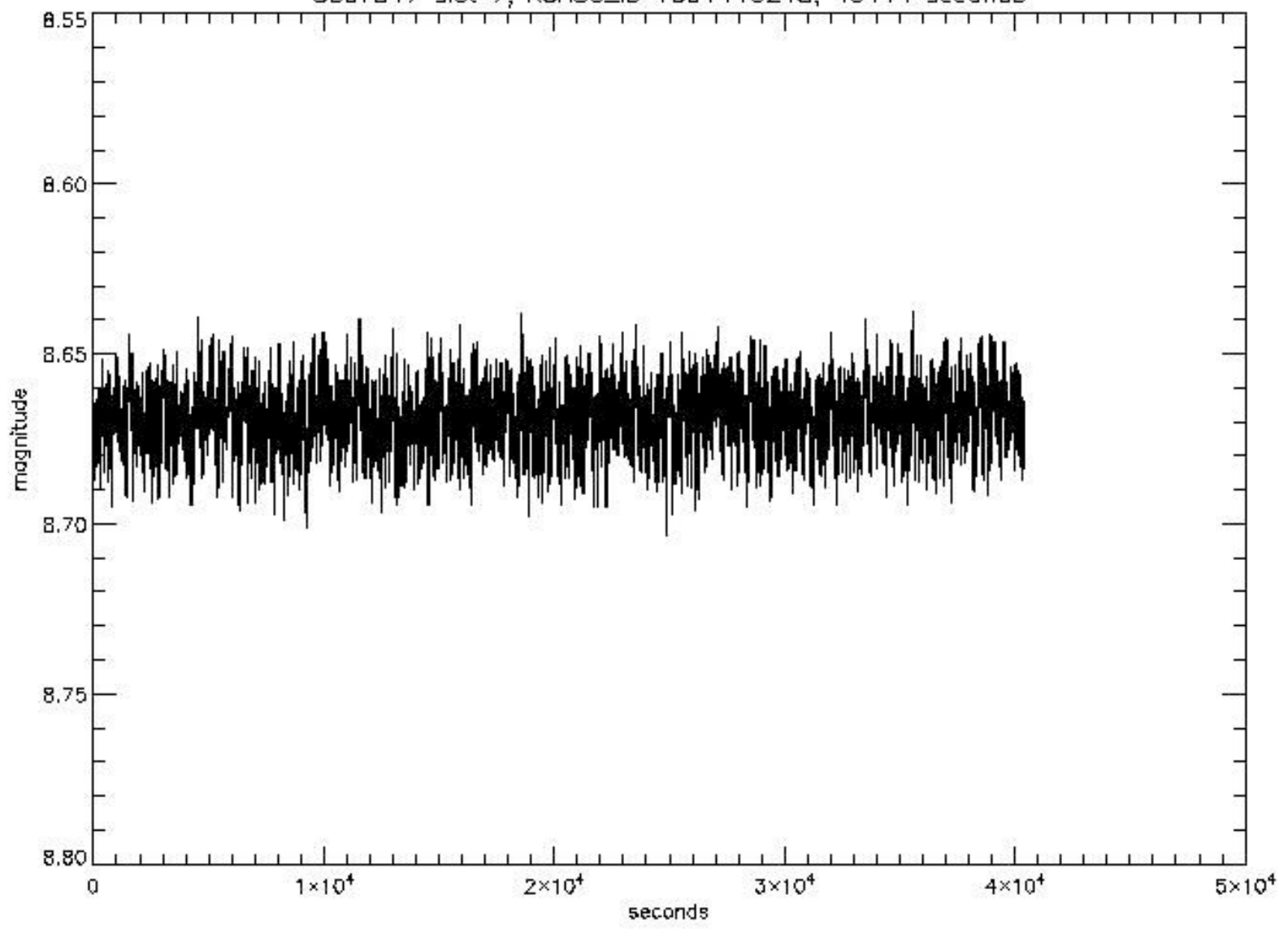


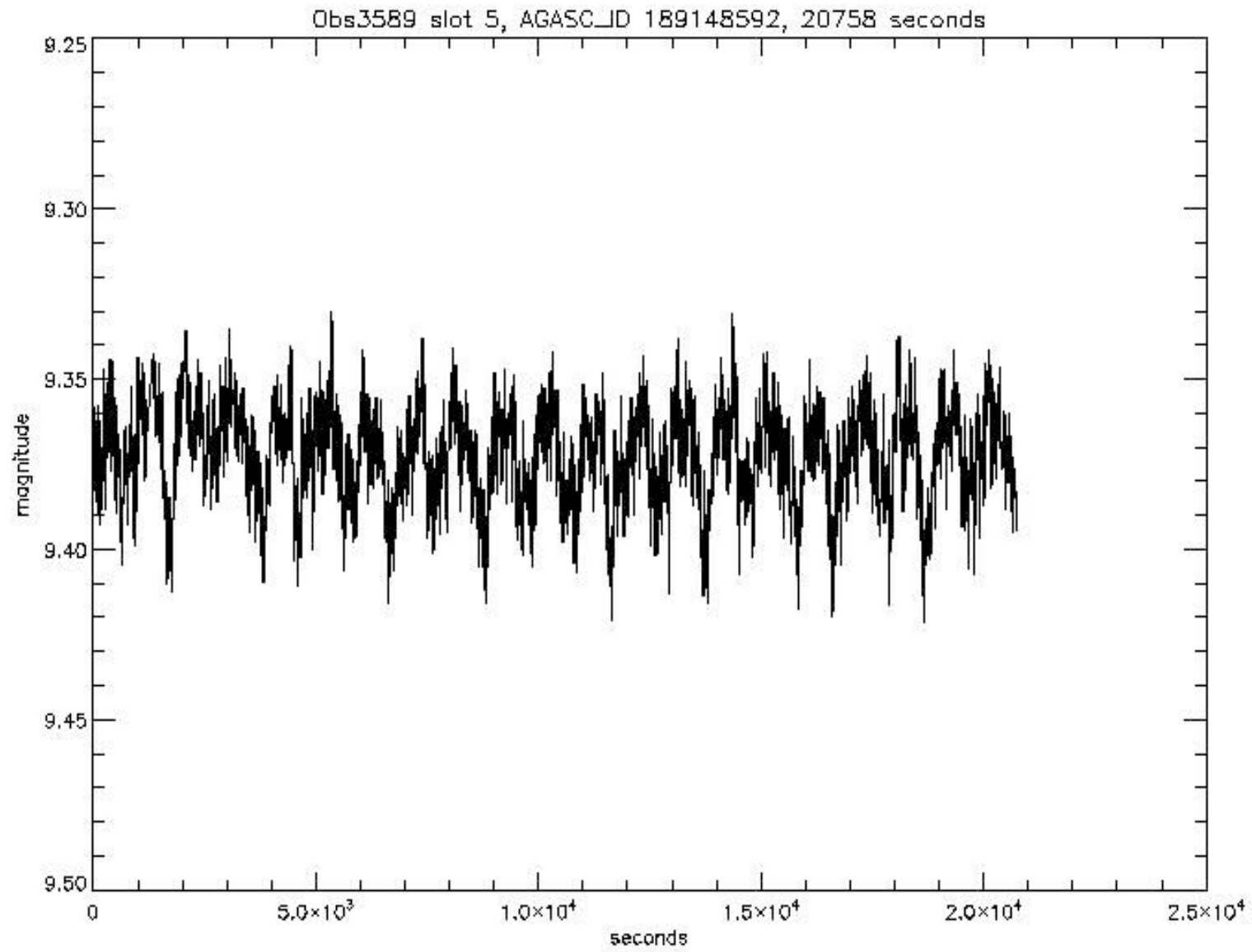
Method of detection of variable stars

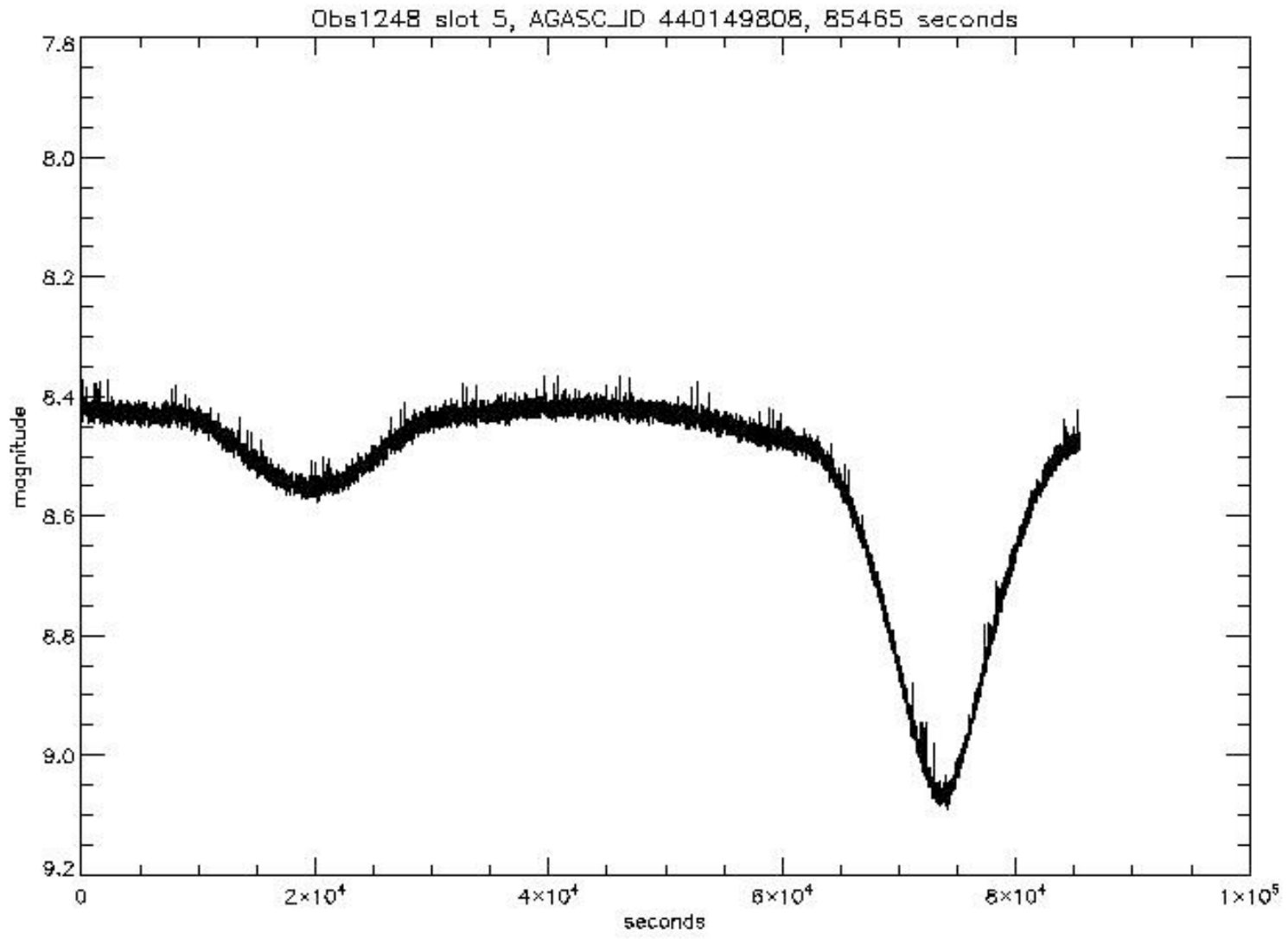
- Visually detected by examining the light curve of each guide star tracked by the Aspect Camera for each Chandra X-ray observation during the Validation and Verification procedure
- This is currently a manual process. Over 55,000 light curves have been examined by the team
- A MySQL database has been prepared that keeps track of each possible variable star identified, Combining information for stars observed more than once, providing a flexible backend for statistics and review

AGASC ID	Star Name	Long Type	Spectrl Type	IR?UV?Xray?	# Obs	Category	GCVS Class	Known?VSX?	Status	Confidence Level	Scrubbed?	Scrub Date	Updated	Rfrnce	Cmmnt	Notes	Plots
133360	HD 224958	Star	F2 (D) ~	Y	29			N	SUSPECT		N		07/11/08		N	Y	Y
797328	V* CF Psc	Variable Star	B8 (D) ~	Y	1			Y	ACCEPTED		N		08/15/08		N	N	Y
1581504	HD 5495	Star	K0	N	2			N	DITHER		N		05/23/06		Y	Y	Y
3147456	HD 8128	High proper-motion Star	A5	Y	2	Pulsating		N	ACCEPTED		N		08/13/08	JSN	Y	Y	Y
3285472	HD 6266	Star	A5	Y	1			N	ACCEPTED		N		05/20/08		N	Y	Y
3805352	HD 10467	Star	A2	Y	1	Pulsating		N	ACCEPTED		N		08/06/08	JSN	Y	Y	Y
6168976	HD 17078	Star	F0	Y	2			N	ACCEPTED		N		08/13/08		Y	Y	Y
6827664	V* DX Cet	Variable Star	A5 (D) ~	Y	1	Pulsating	DSCT	Y	ACCEPTED		N		07/25/08	VSX	N	Y	Y
7212976	HD 18789	Star	A5V	Y	2			N	ACCEPTED		N		03/27/08		Y	Y	Y
9569784	NLTT 12418	High proper-motion Star	G5	Y	1			N	SUSPECT		N		12/26/06		Y	Y	Y

Obs7517 slot 7, AGASC_ID 1091446248, 40444 seconds

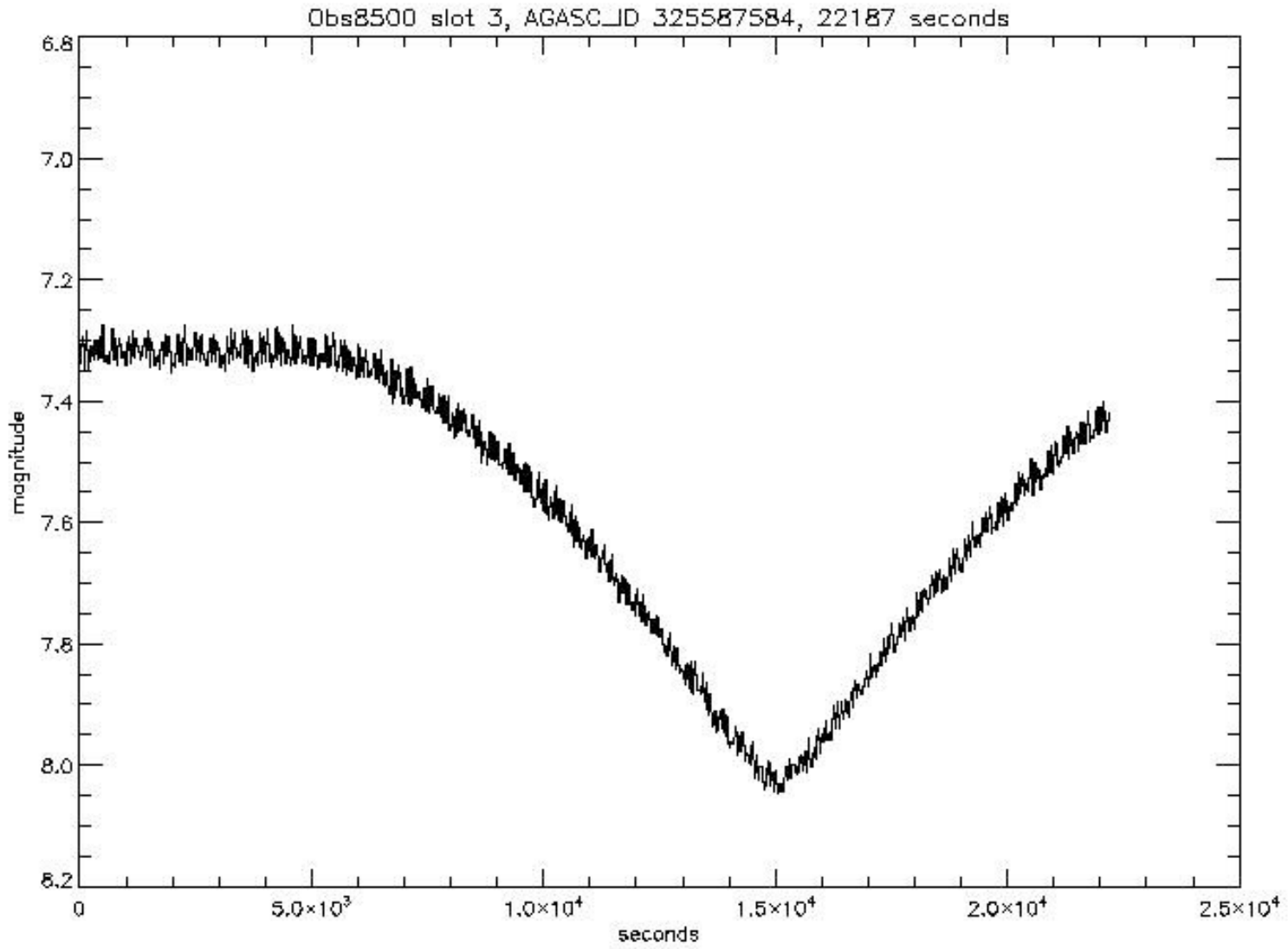


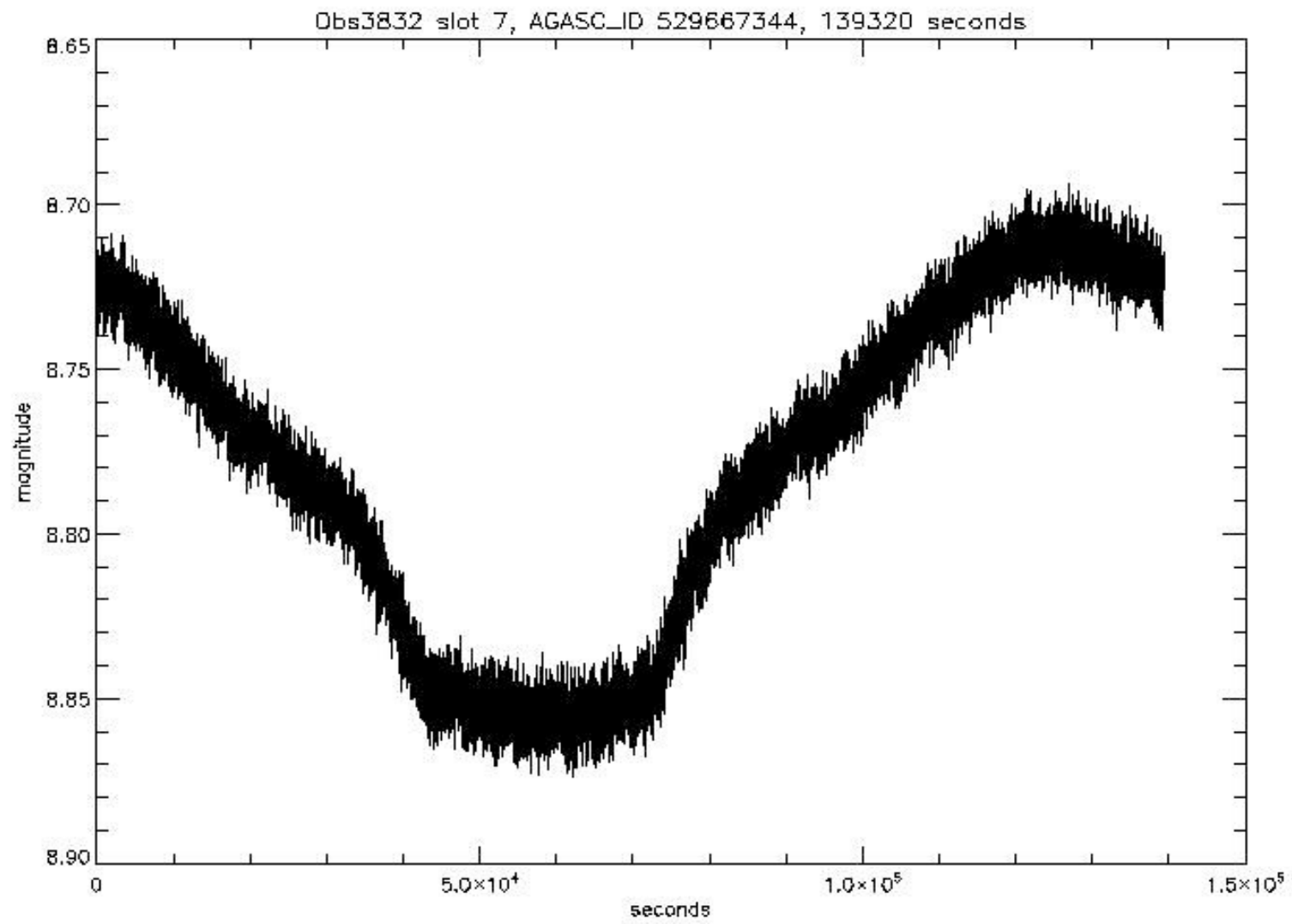




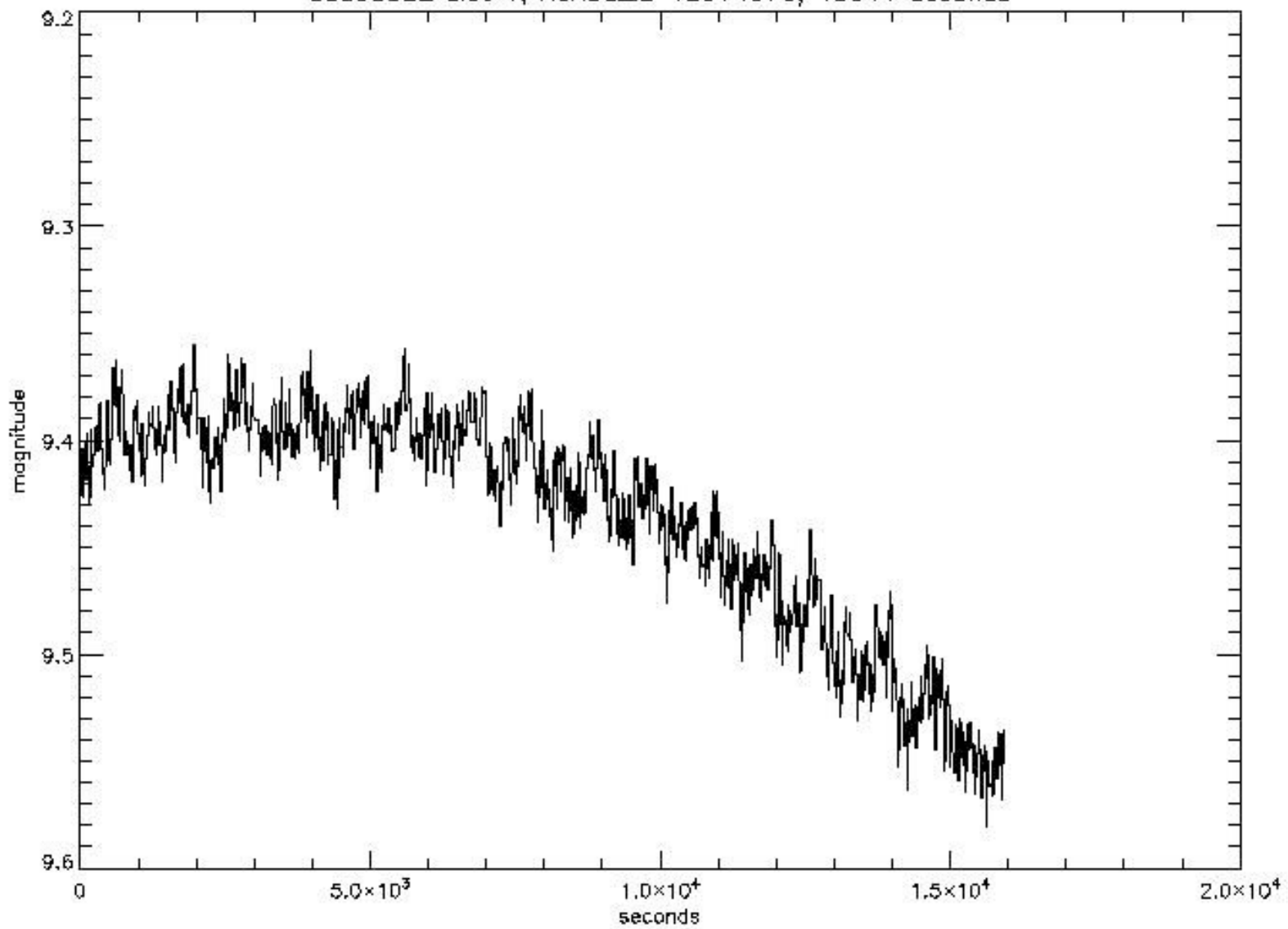
The Chandra Variable Guide Star Catalog

- Light curves of over 900 stars for time periods ranging from 20 min. to 2 days
- Ancillary data extracted from SIMBAD
- Flags for UV, X-ray and IR sources
- Variable classification, if known
- Web interface
- Total unique guide stars observed = about 37,000
- Total variable stars detected=696 (+216 possibly variable)
- Total previously unknown variable stars =485

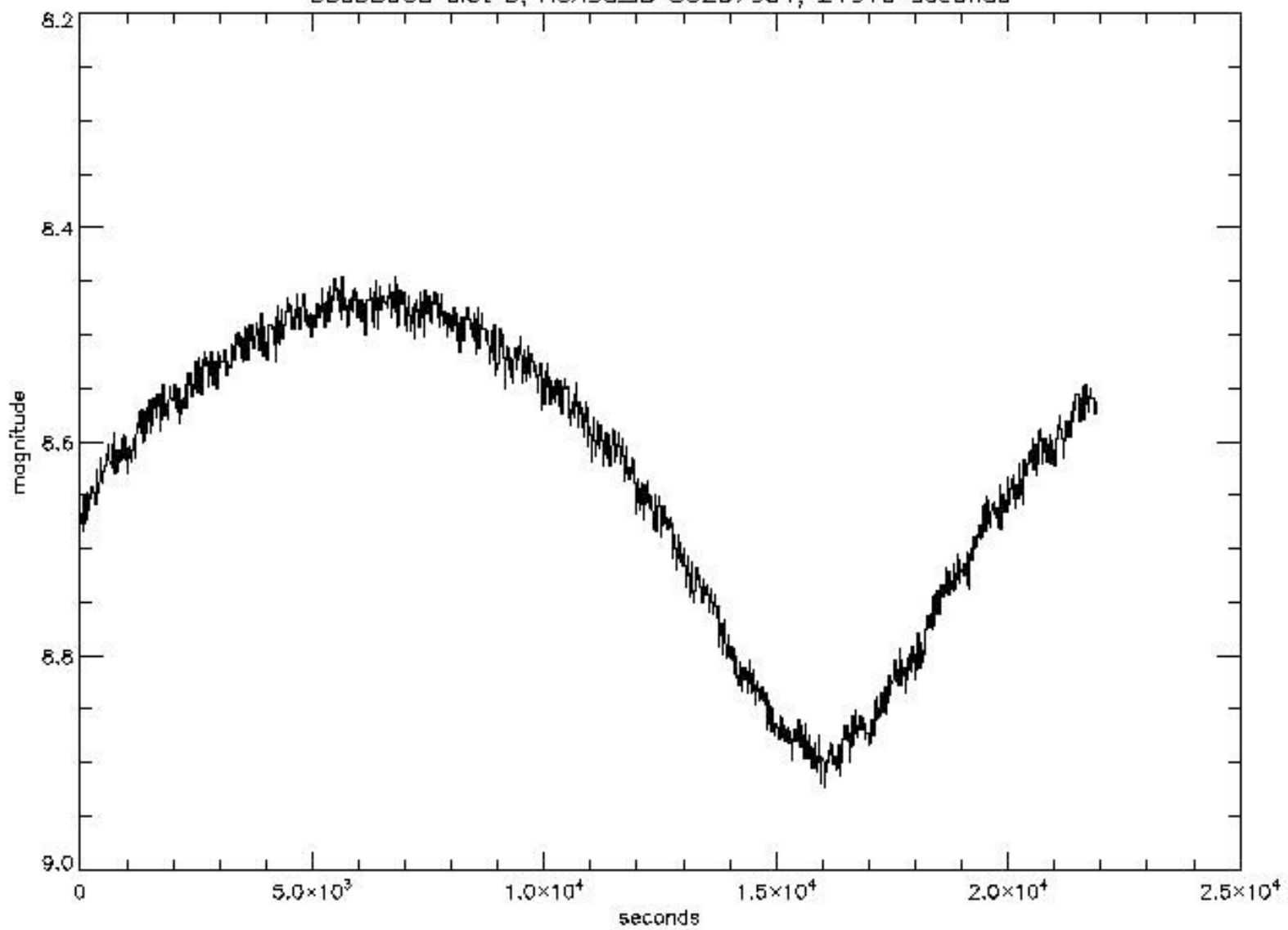




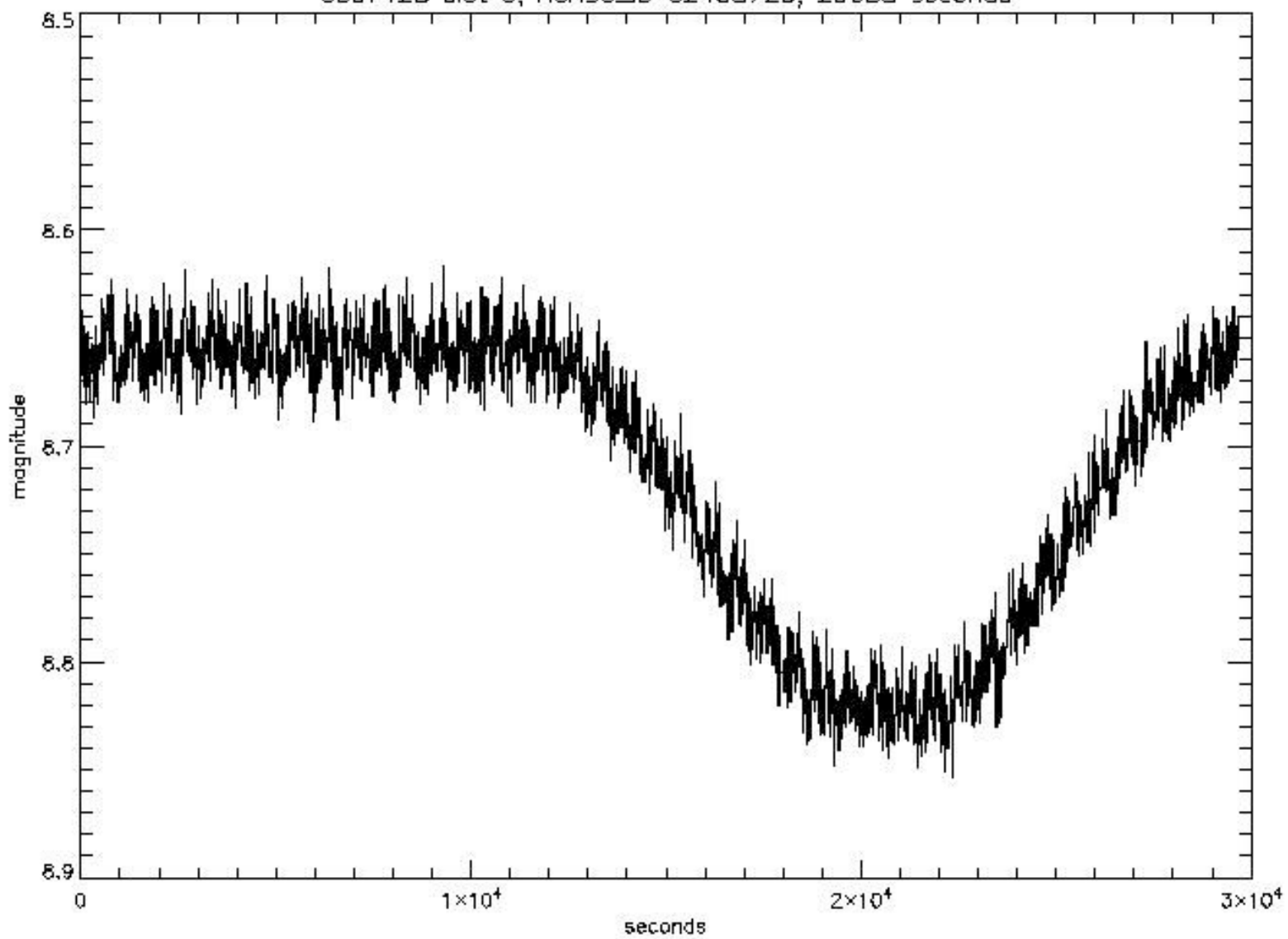
Obs60582 slot 1, AGASC_JD 18614976, 15941 seconds



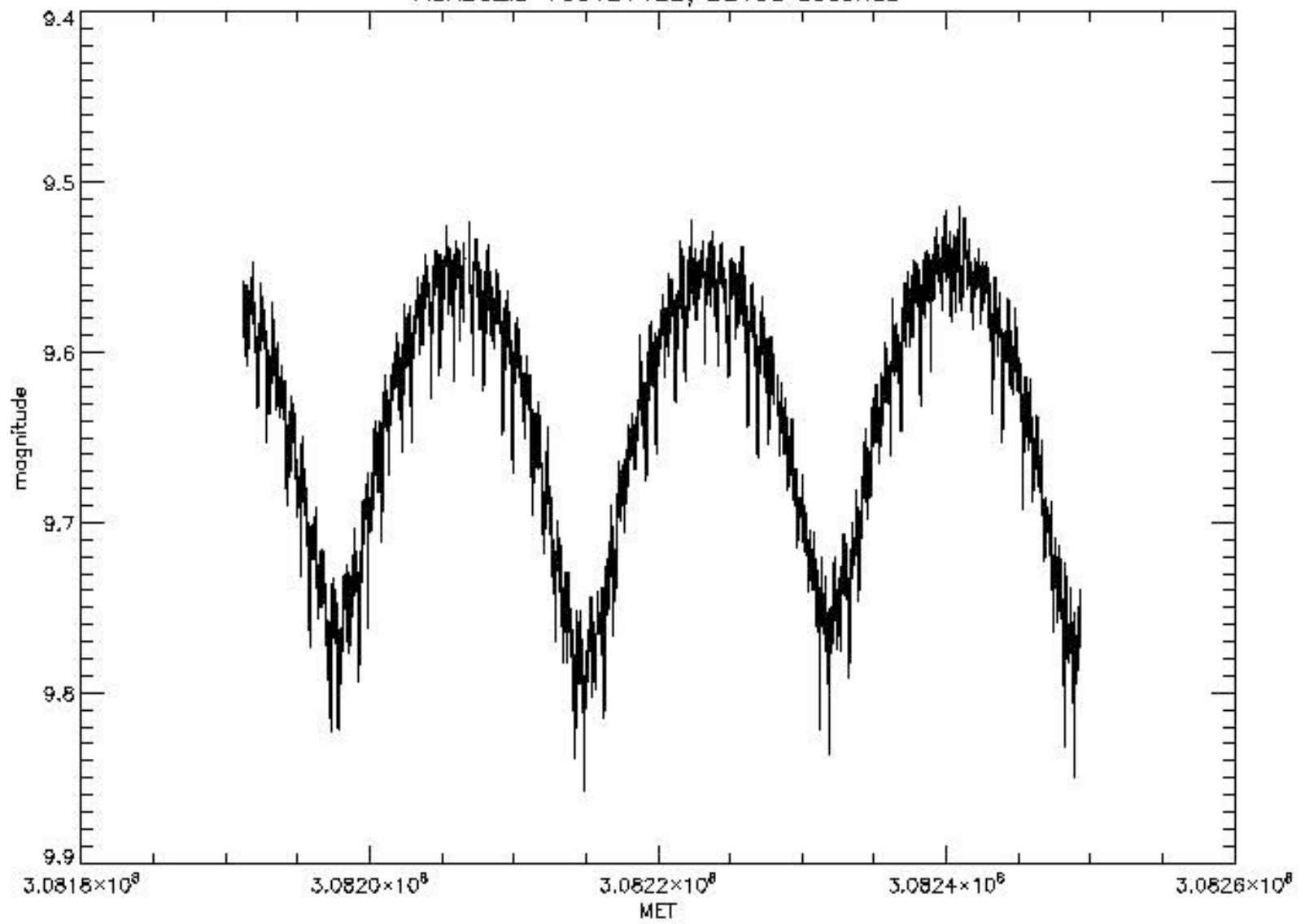
Obs58905 slot 3, AGASC_ID 50207904, 21919 seconds



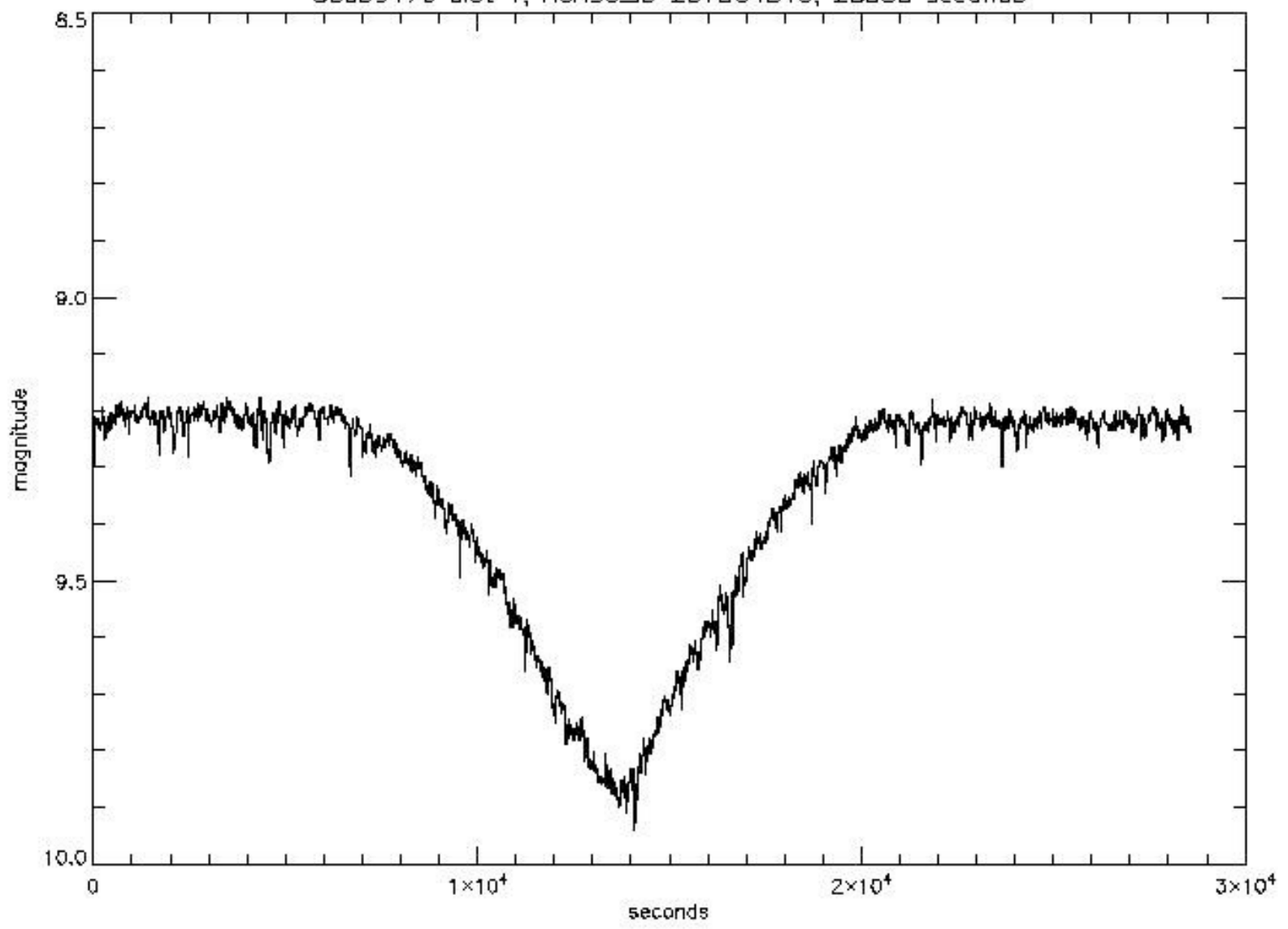
Obs7428 slot 6, AGASC_ID 62408720, 29688 seconds



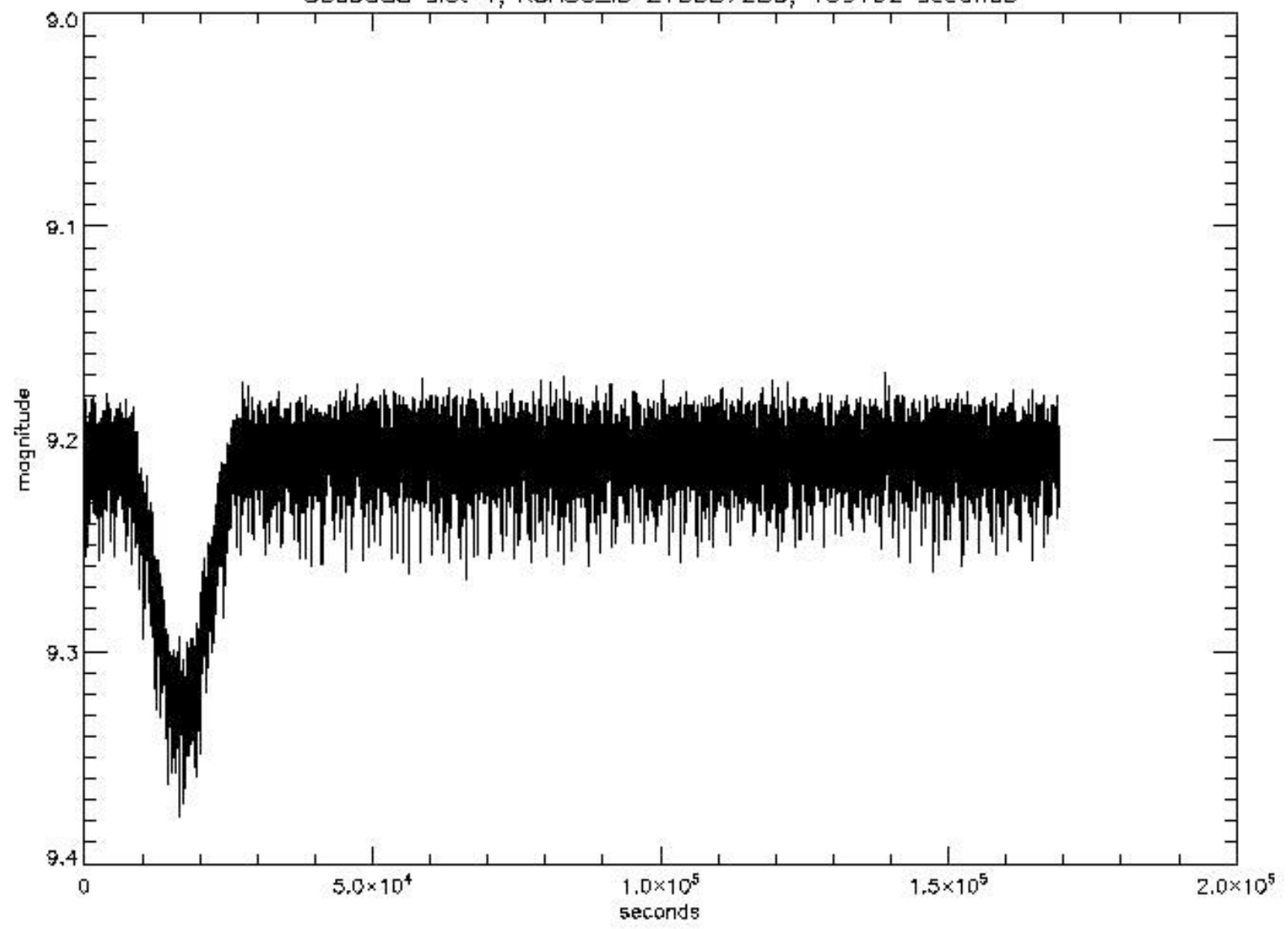
AGASC_ID 160181128, 58103 seconds



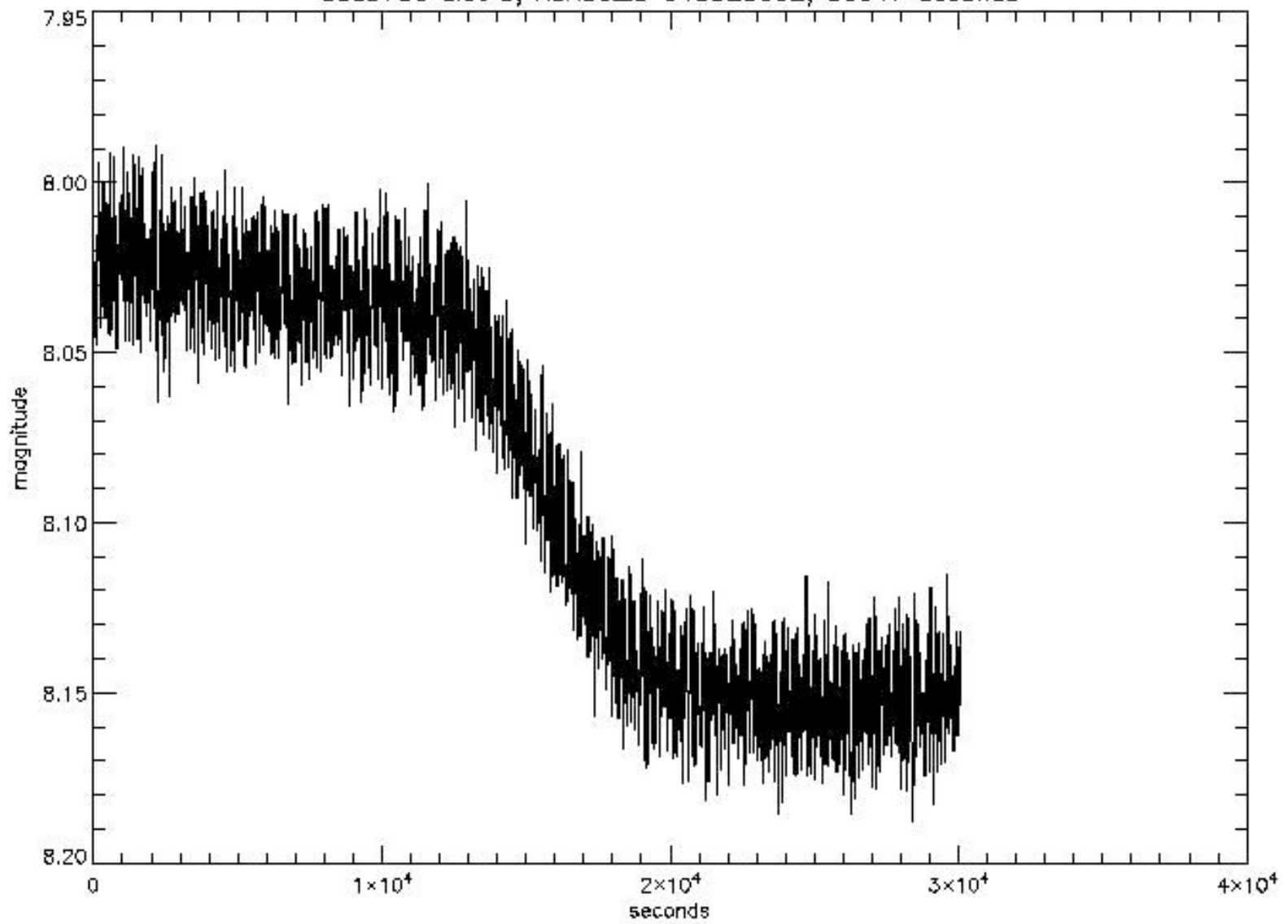
Obs59176 slot 1, AGASC_JD 257304840, 28558 seconds



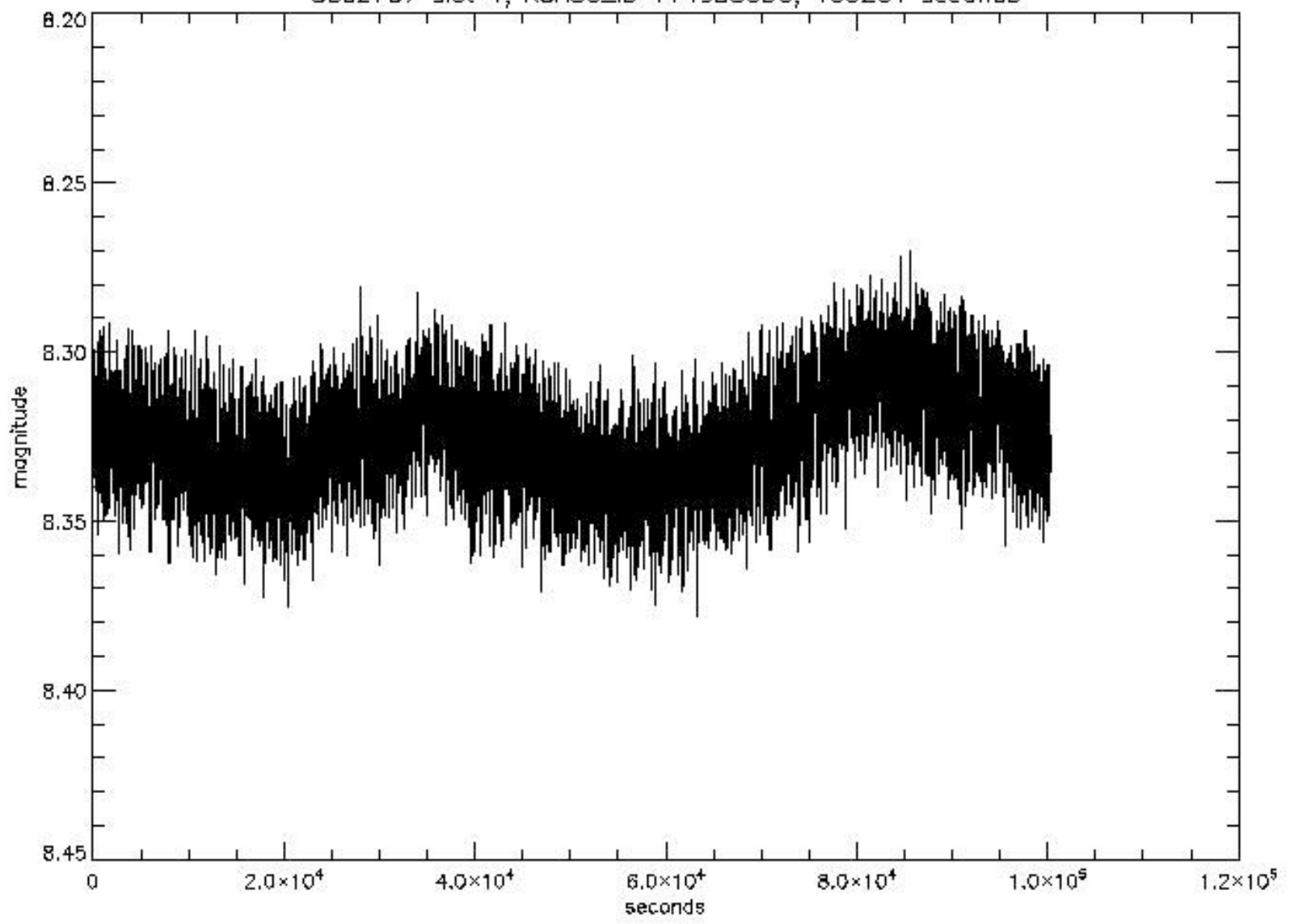
Obs9088 slot 4, AGASC_ID 213387280, 169192 seconds



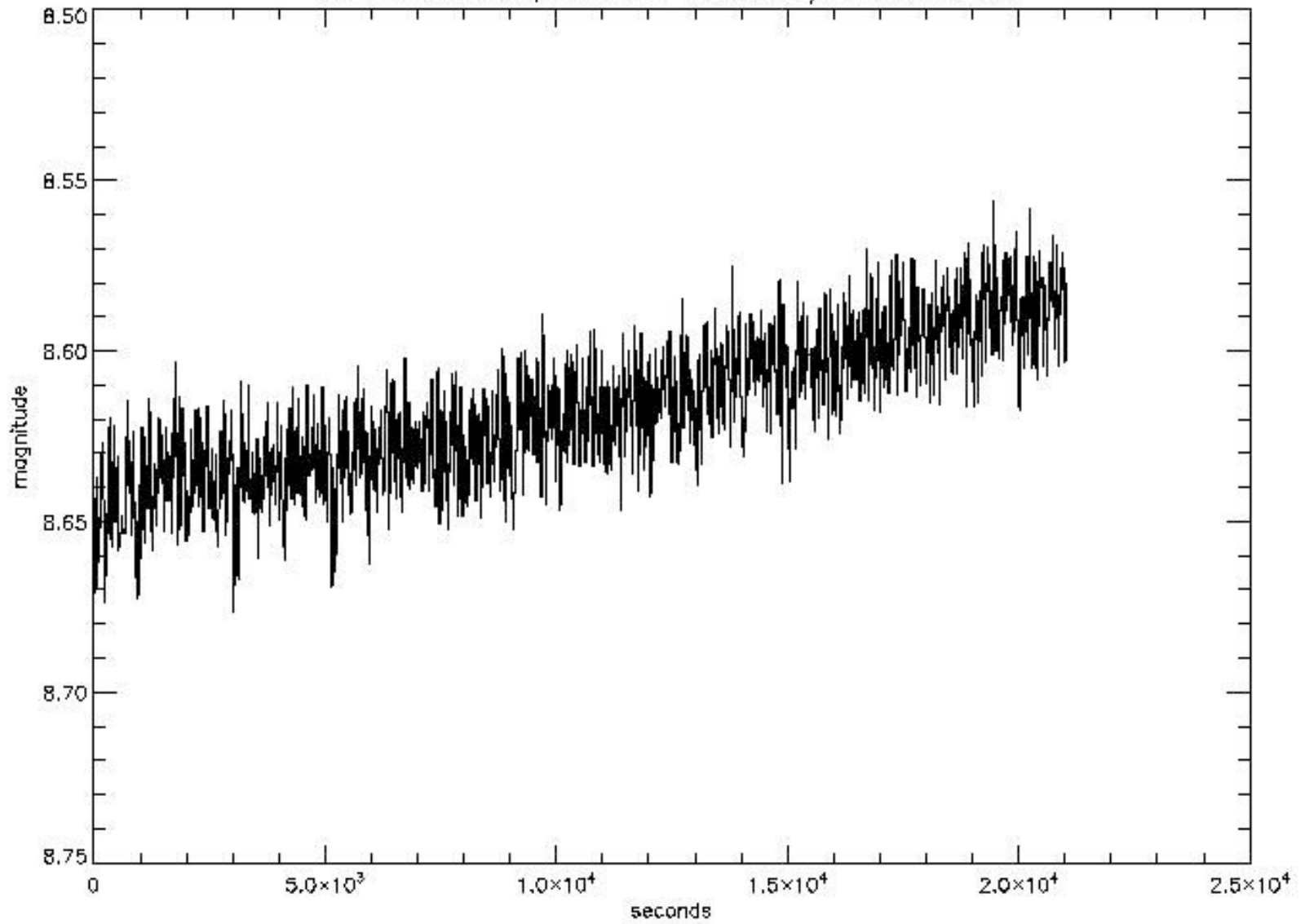
Obs5730 slot 3, AGASC_JD 943325992, 30047 seconds



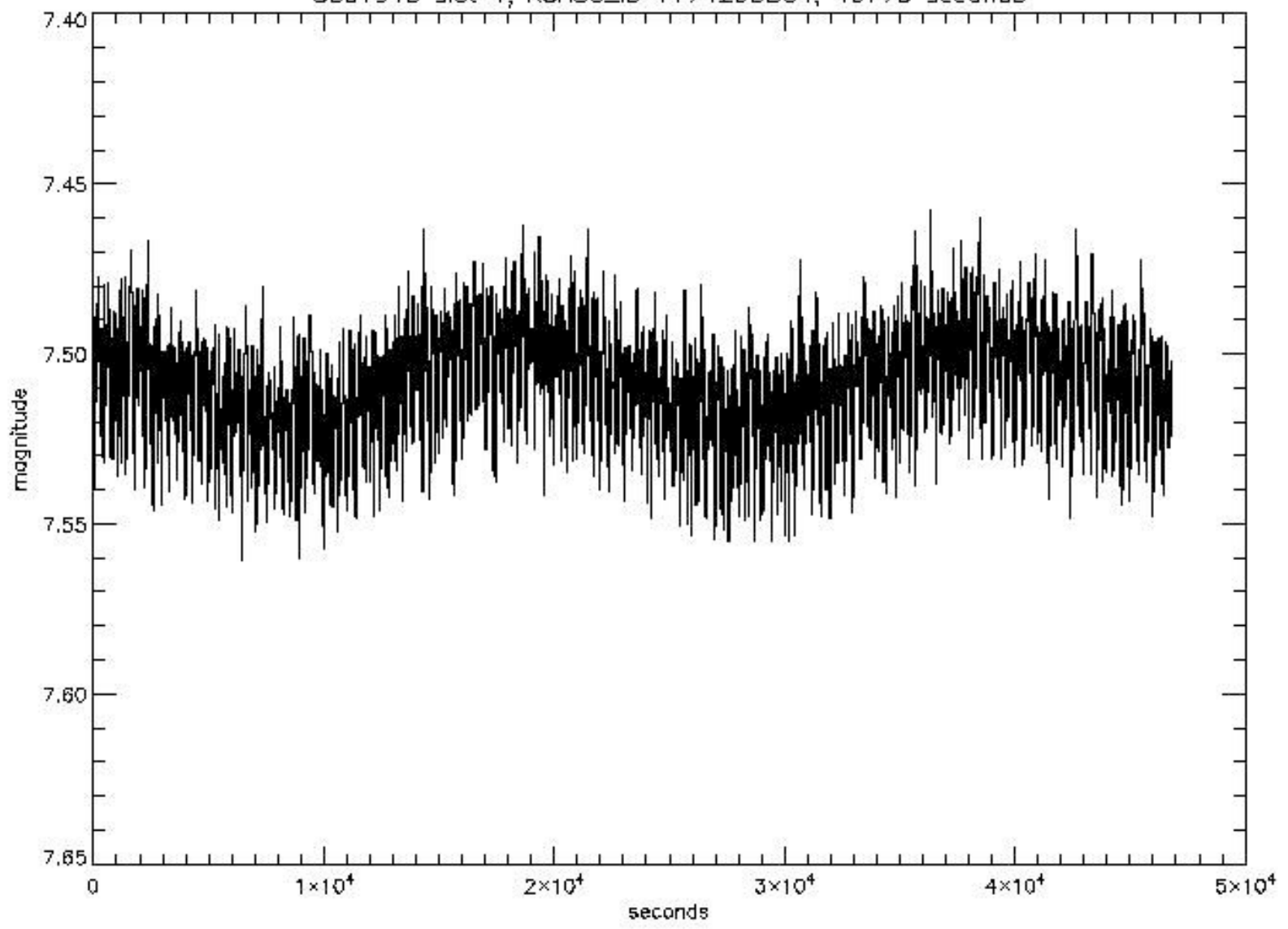
Obs2707 slot 4, AGASC_ID 114955056, 100261 seconds

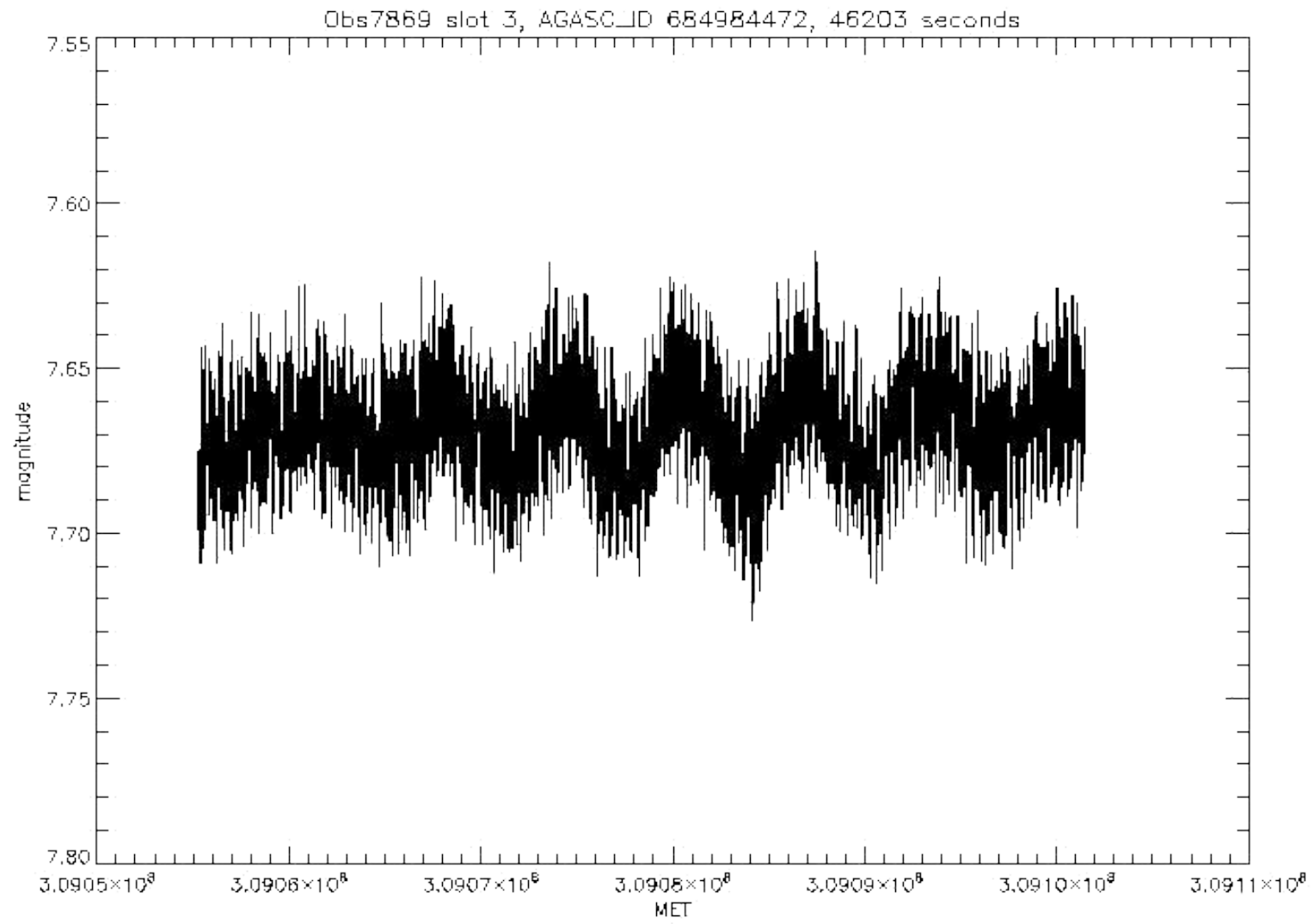


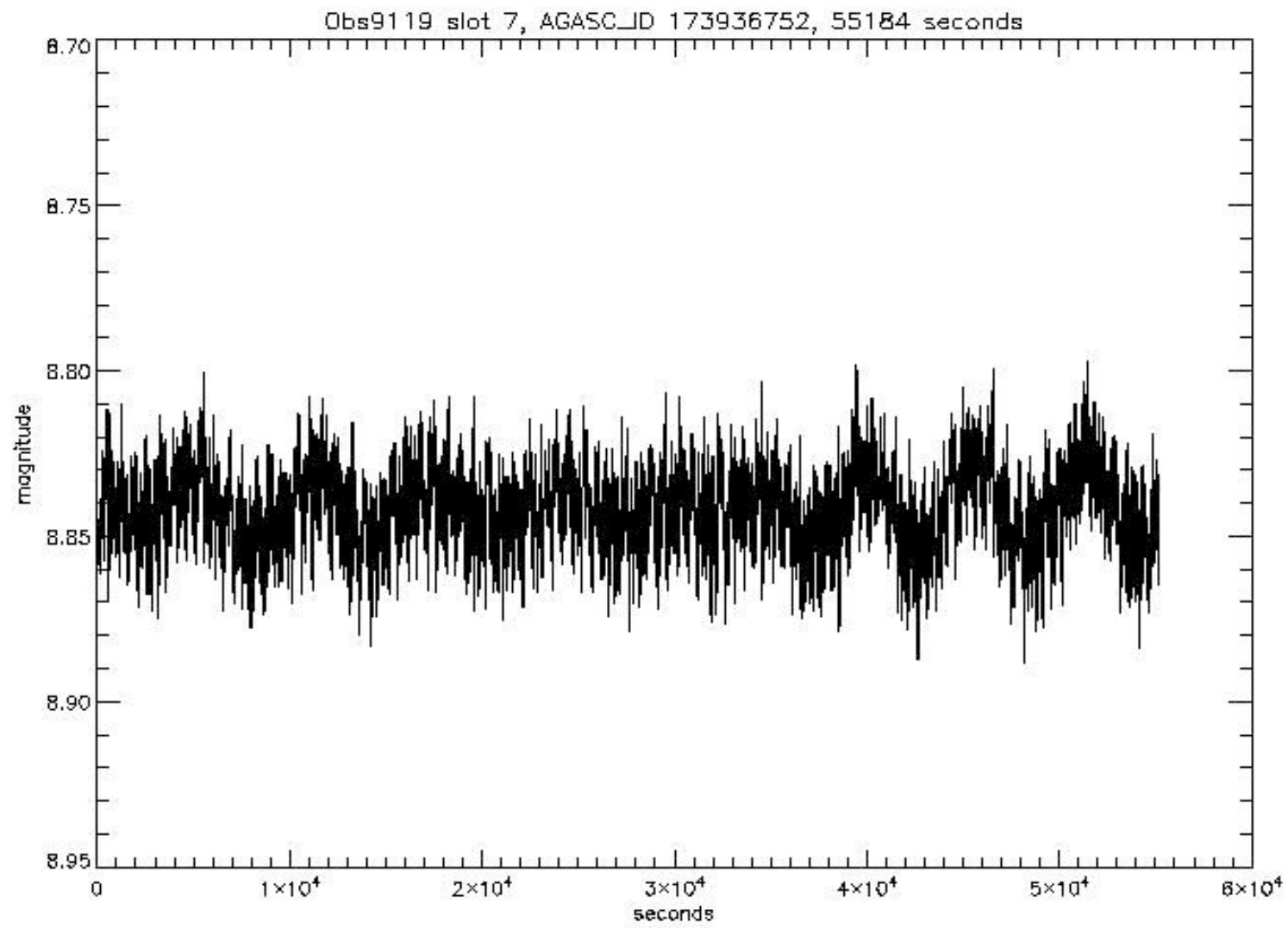
Obs61499 slot 4, AGASC_ID 78388696, 21023 seconds

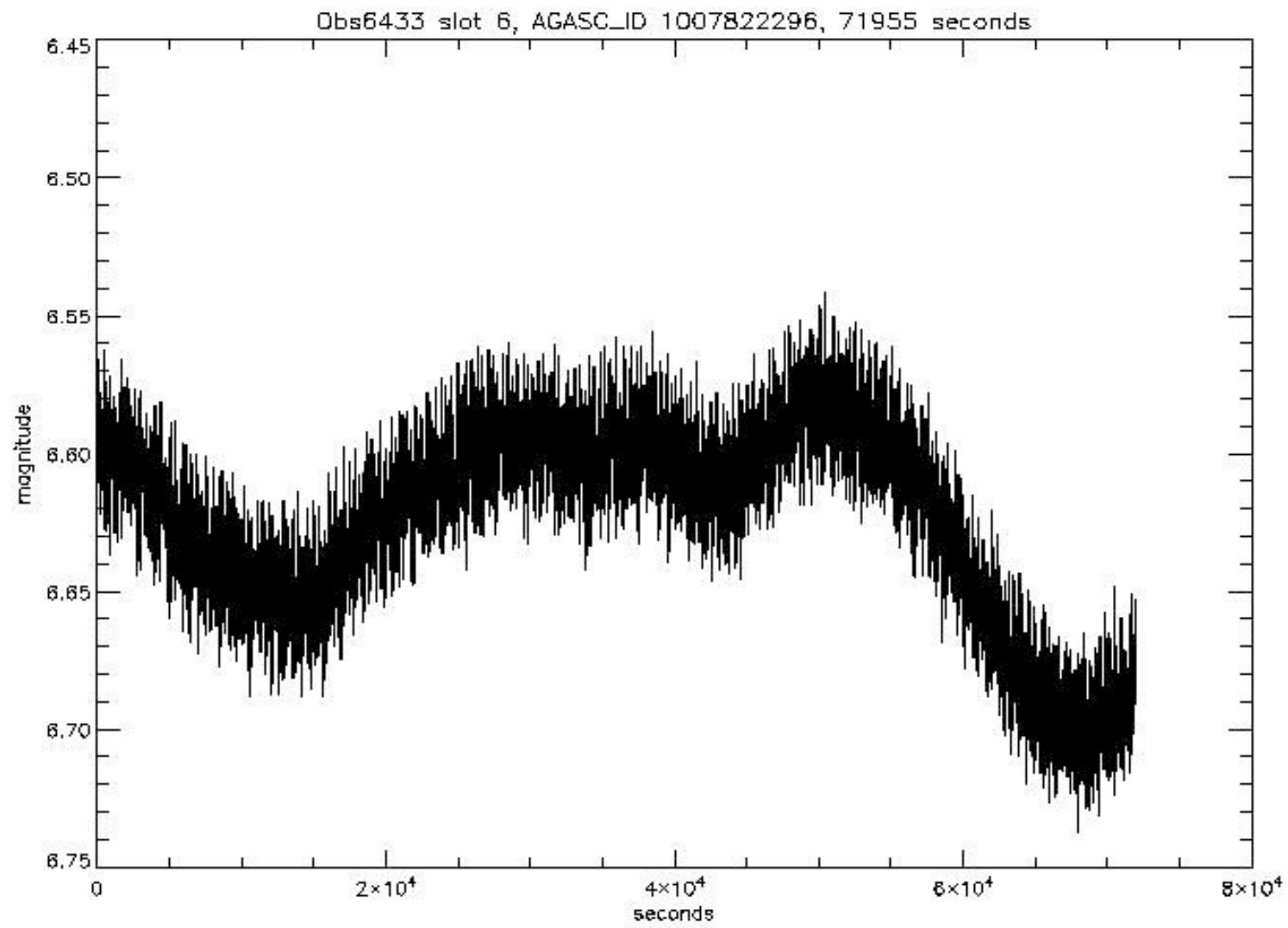


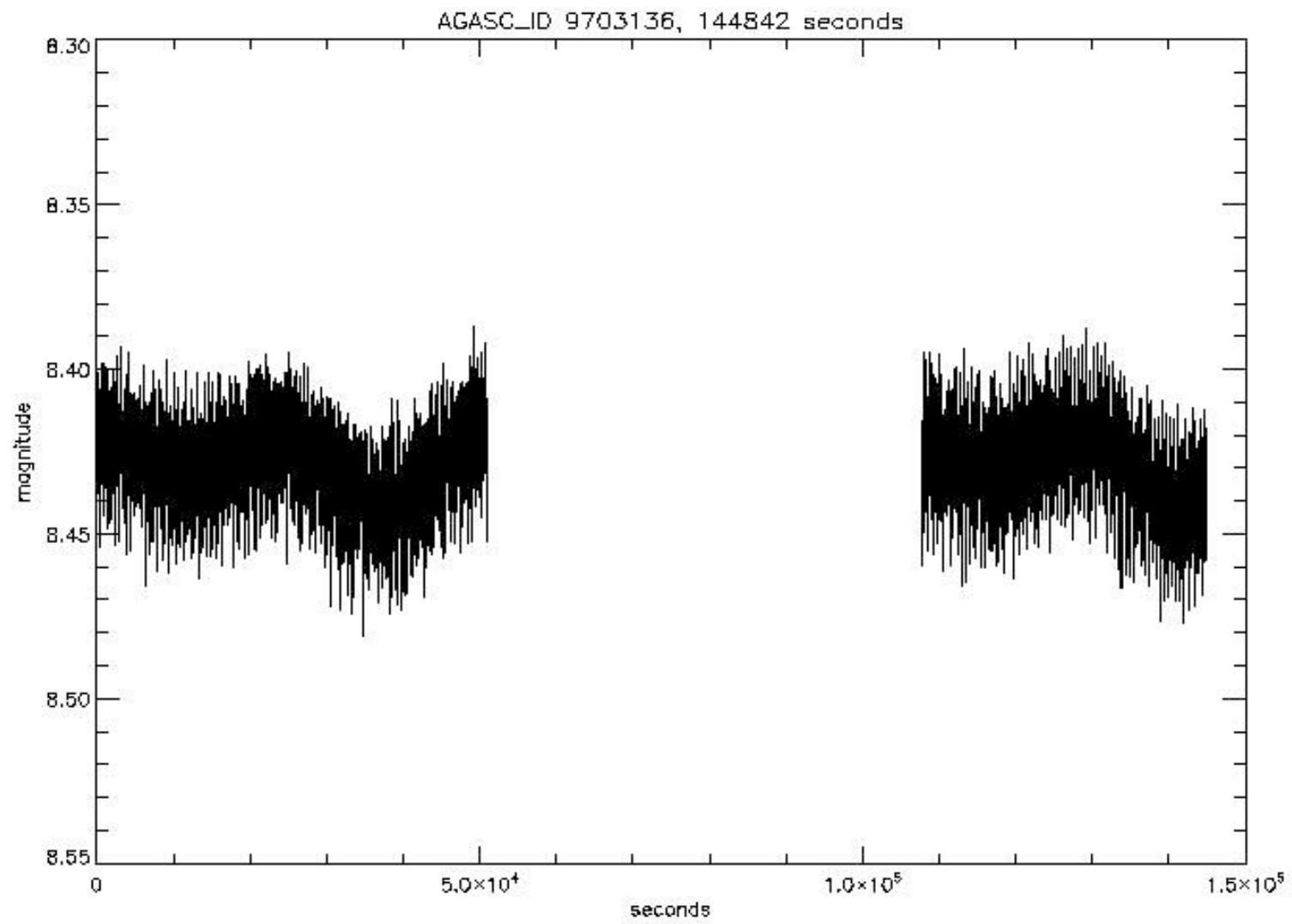
Obs1943 slot 4, AGASC_ID 1174293864, 46779 seconds



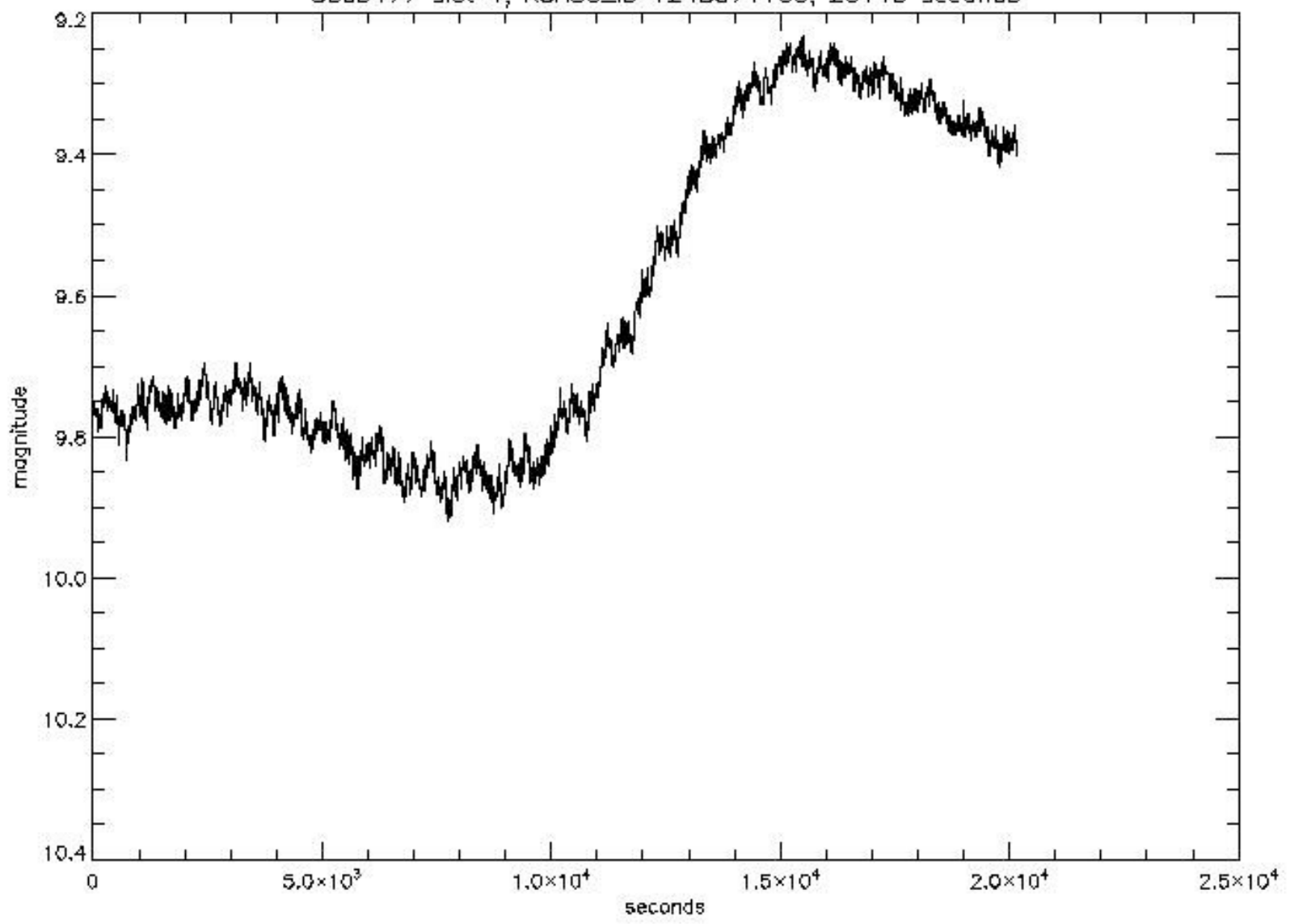








Obs3477 slot 4, AGASC_ID 1248071160, 20143 seconds



Variable stars by spectral class

