

# HST Pointing Improvements

## Some recent Statistics

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# HST Pointing Improvements

## Why Improve HST Pointing & Astrometry?

1. Absolute astrometry increasingly important:
  - multi-mission archives, multi-wavelength campaigns, coordinated observations
  - “Fundamentally important property of HST data” – *STUC, 2002*
2. Improved pointing supports the most efficient COS acquisition scenarios.
3. Well-calibrated FOV entering SM4 simplifies SMOV calibrations & operations.

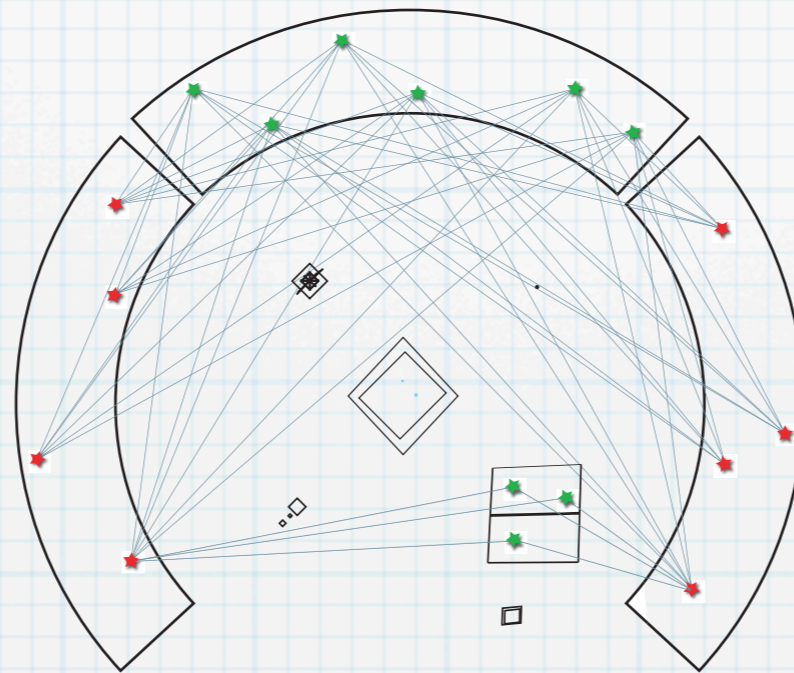
## What Comprised the Initiative?

1. Use of GSC2 in operations since mid-2006 (Cycle 15)
  - Reduces catalog error to 0.25" ( $1\sigma$  absolute) and 0.18" ( $1\sigma$  relative across FOV)
2. Retroactive improvements in HLA astrometry
  - Updated astrometry keywords by identifying GSC2 objects in images. Other methods for archive astrometry improvements being assessed.
3. **SI & FGS alignment calibrations (“focal plane alignment”)**

# Focal Plane Alignment

## Basic Process

- ➔ 1. update FGS magnifications (this linear distortion term continues to trend significantly for many years on-orbit)
- ➔ 2. with  $\sim 20$ mas astrometry stars, use guidestars and astrometer FGS to obtain zero point and rotation of the three FGSs
- ➔ 3. with the resulting current FGS calibrations, determine accurate relative locations of SIs
- ➔ 4. make operational updates to SIAF, FGS matrices, FGS magnifications and related products.



➔ CAL-OTA 11021 and the routine FGS calibration program obtained such data.

- ➔ **New FGS calibrations were made operational on 2008.014 (matrices & magnifications)**
- ➔ SI updates were not made due to the loss of ACS, and small deltas for WFPC2 & NICMOS

# Assessing the Improvement

## Guidestar Separations

Compare guidestar pairs' angular separation based on their GSC coordinates against their separation based on their FGS-observed locations and operational transformation to V2V3.

*Pro:* large number statistics

*Con:* doesn't tell you what's happening at the SI

## Target coordinates obtained from science data

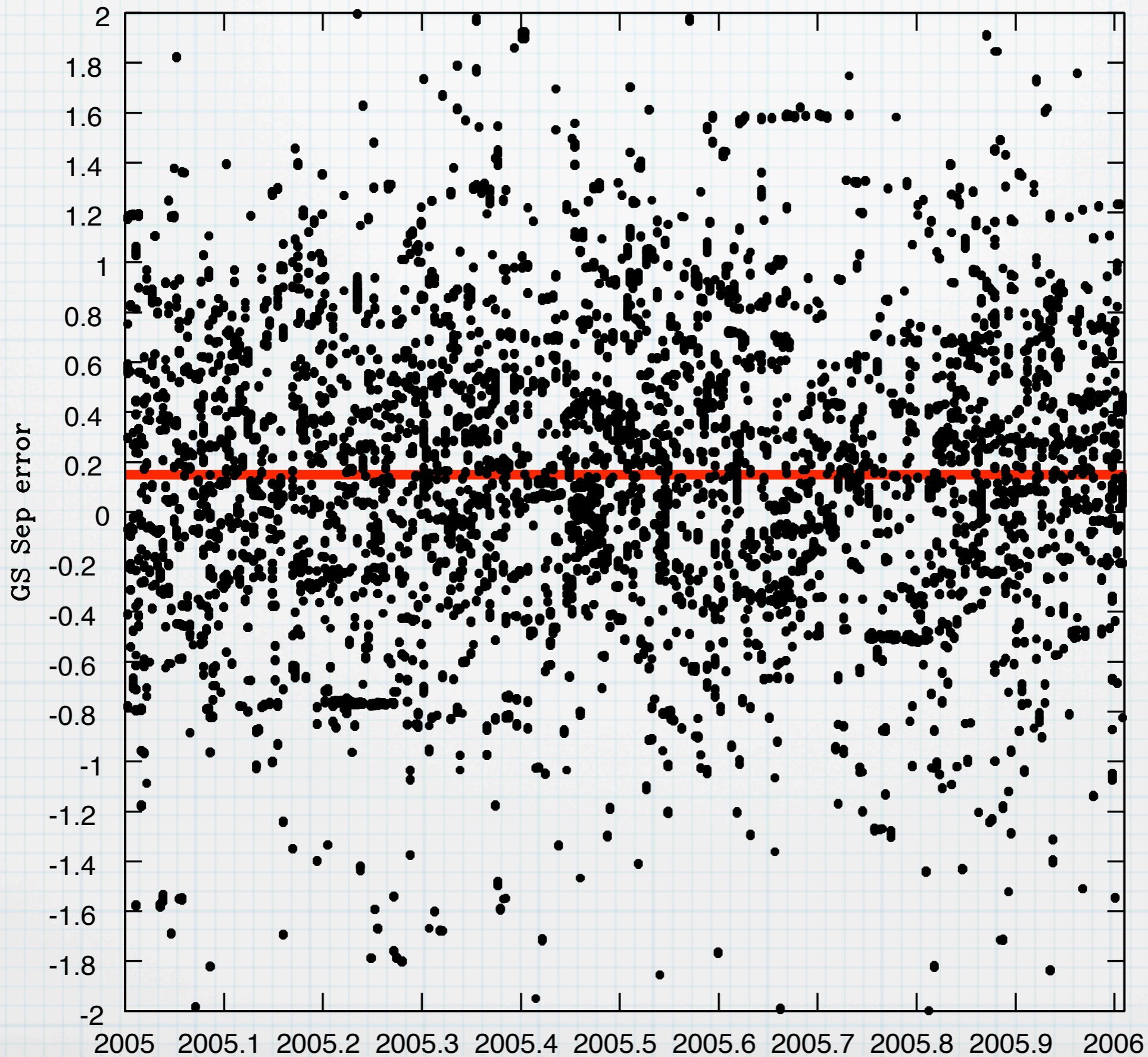
For centroidable astrometric targets, determine from the science data headers the RA & Dec and compare against their astrometric coordinates

*Pro:* measures exactly what you want to check

*Con:* more labor intensive and not possible/feasible in most cases

# Guidestar Separations

Guide Star Pair Fit Error during 2005 GSC1 Ops



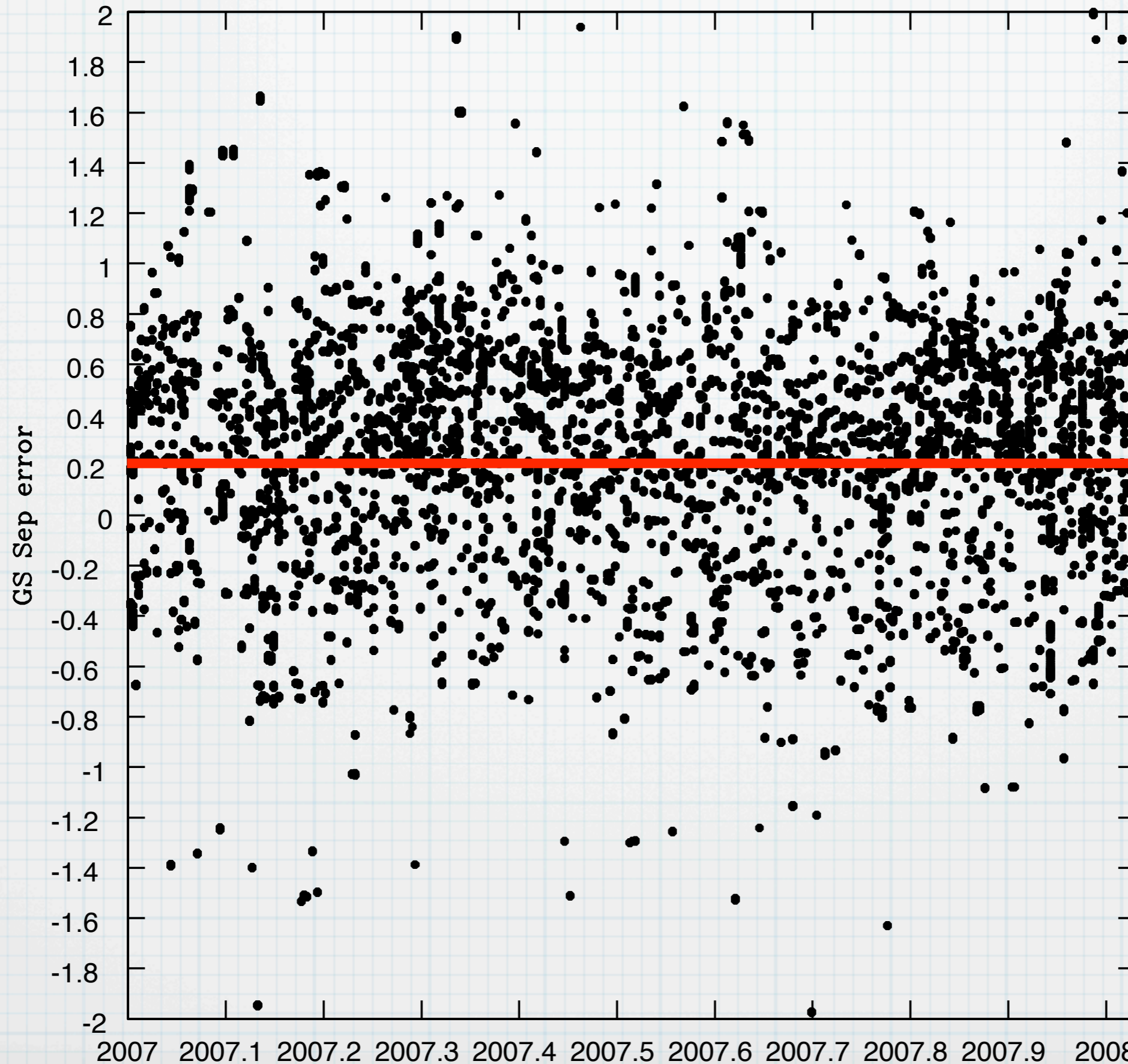
Number of GS pairs  
**32177**

Mean Separation Error  
**+0.14 arcseconds**

1 sigma scatter  
**0.73 arcseconds**

# Guidestar Separations

Guide Star Pair Fit Error during 2007 GSC2 Ops



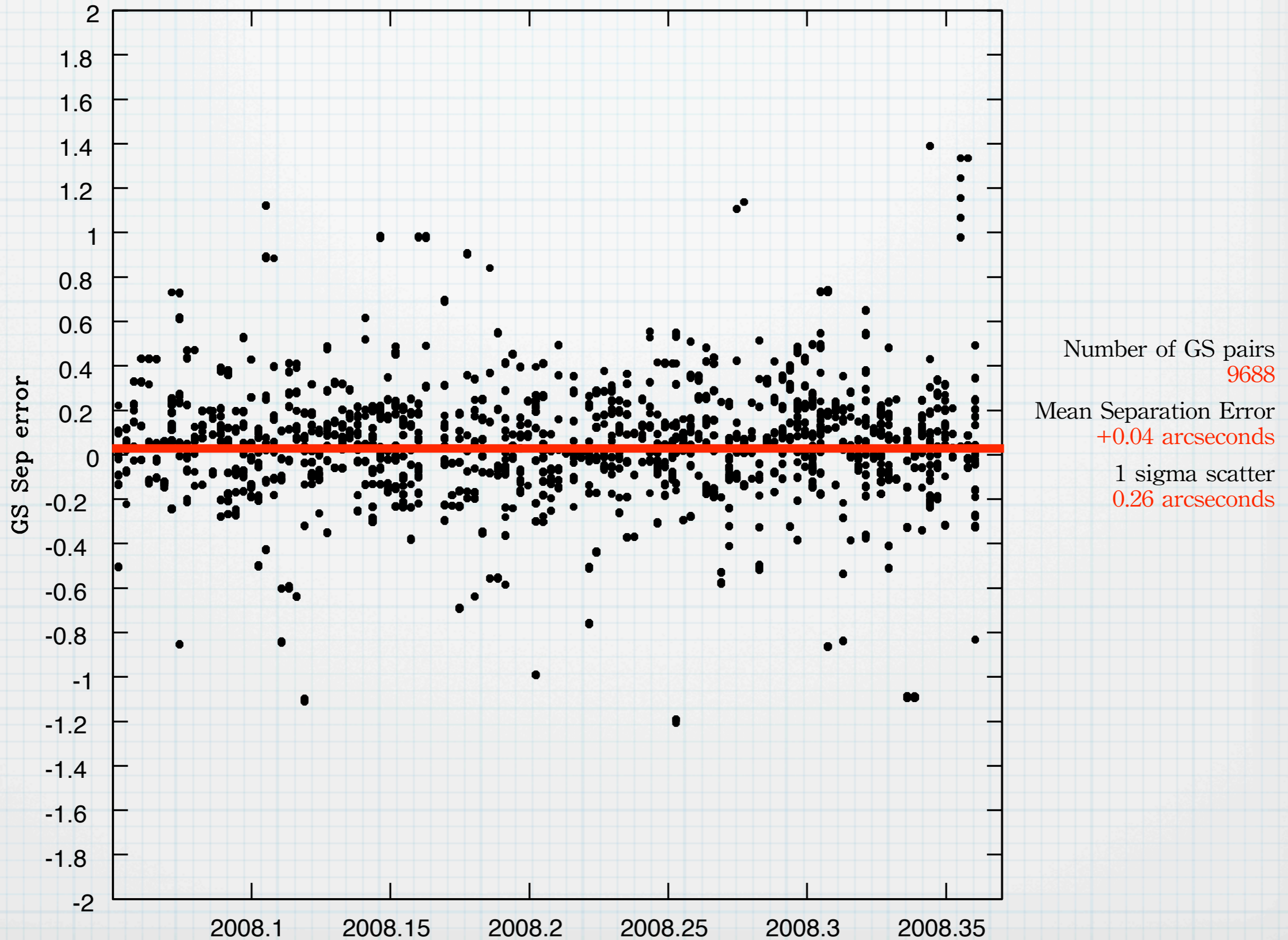
Number of GS pairs  
**23749**

Mean Separation Error  
**+0.22 arcseconds**

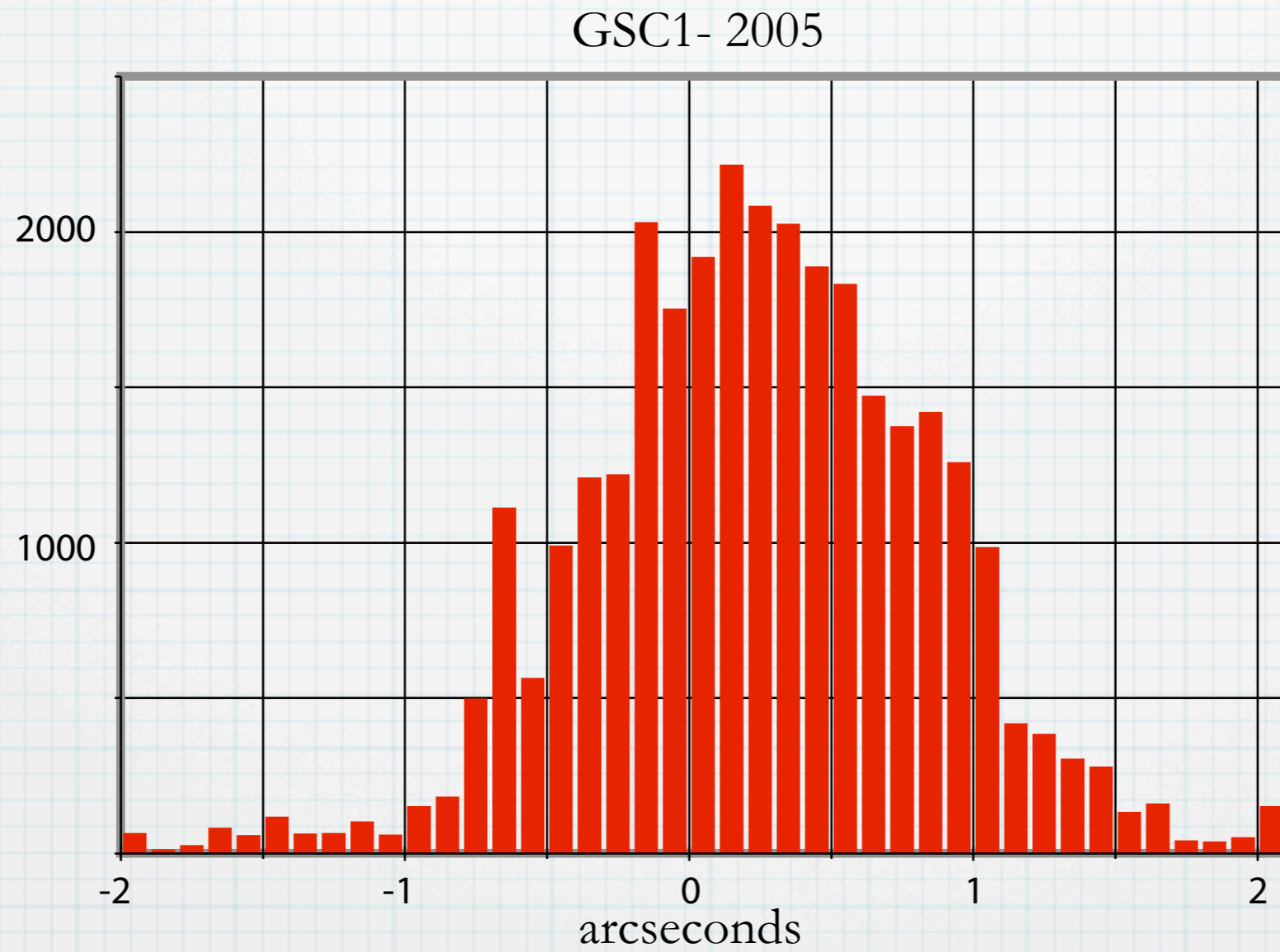
1 sigma scatter  
**0.49 arcseconds**

# Guidestar Separations

Guide Star Pair Fit Error since 2008.014 realignment

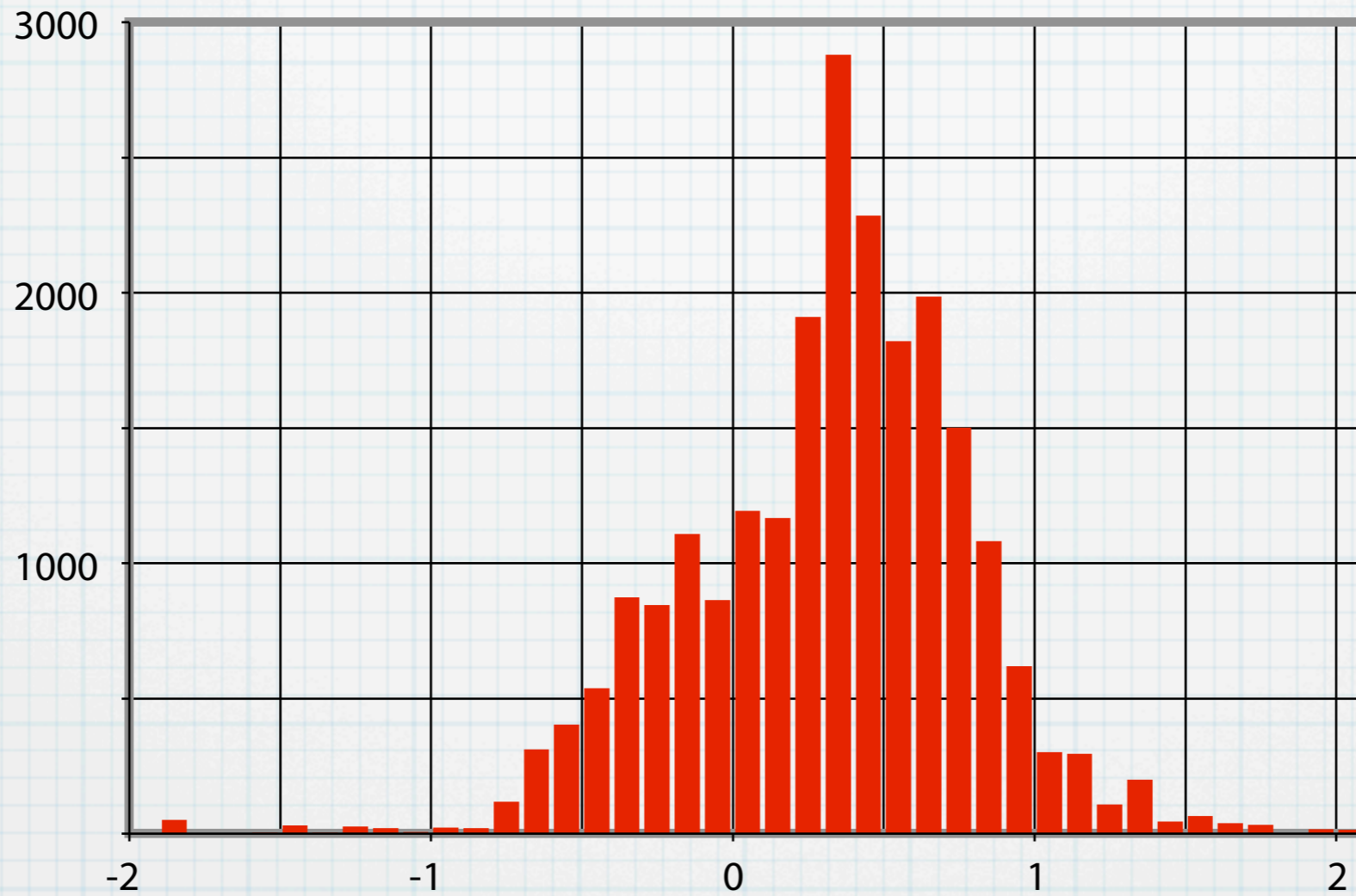


# Guidestar Separations



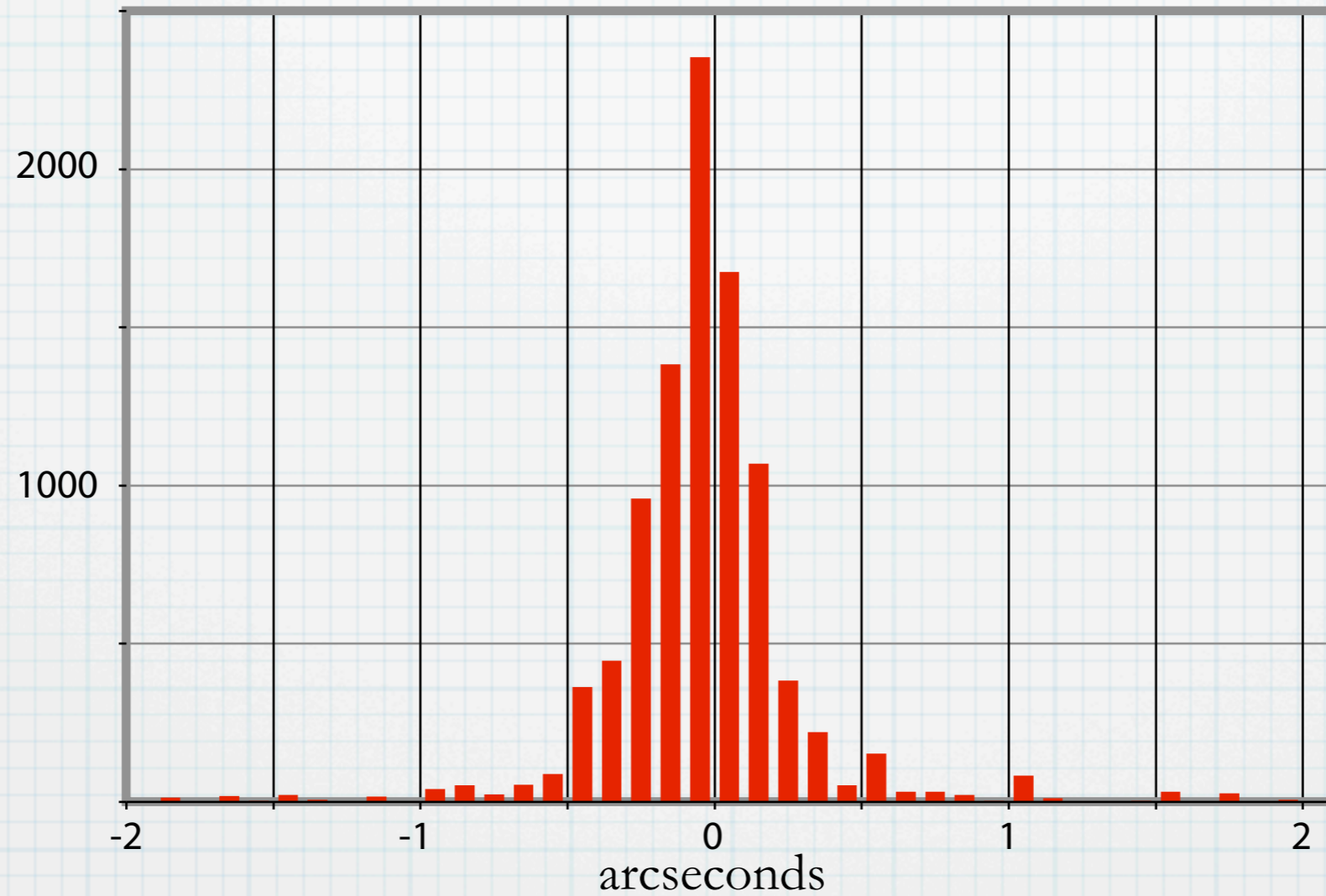
# Guidestar Separations

GSC2 Operations - 2007

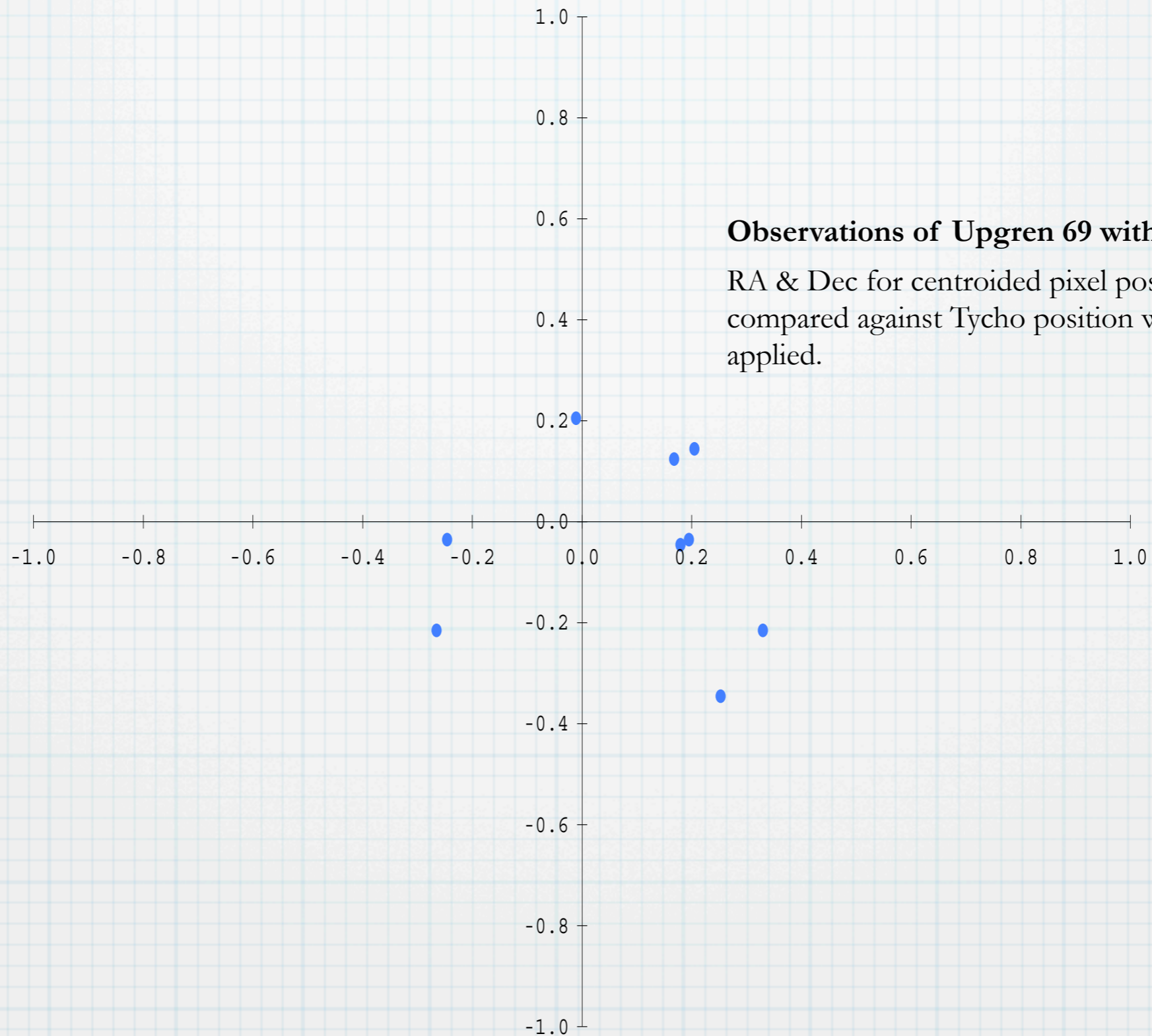


# Guidestar Separations

GSC2 & New Calibrations, 2008 days 14 - present



# Target Coordinates Spot Check



# Cycle 17 Onward

## Maintain pointing and astrometry close to the GSC2-catalog limited value of $\sim 0.2$ arcseconds

### Align new SIs & FGSs

Newly flown instruments trend the most. Keep new FGS from acting as dominant guider during Cycle 17.

### Only use dedicated HST time when necessary

- Track COS & STIS missed distances. From the stored slew amount to center a target with the on-board acq, we will obtain a large number of “missed distances” indicating pointing performance. These data were amassed with STIS for a number of years in early 2000 and facilitated FGS alignment in 2002.
- Guidestar pair statistics, sorted by FGS, gives information to facilitate alignment.
- All-sky UCAC3 (early 2009) can allow accurate SI alignment to be accomplished without dedicated observations.