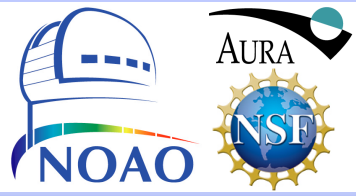


Sipping from the firehose:

Why we need not fear the LSST alert stream

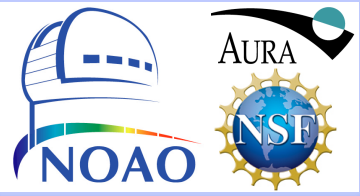
S.T. Ridgway, T. Matheson, A. Saha

NOAO



The LSST Alert Stream

- An alert will be issued for every target that exhibits a different brightness when observed than in an archival reference image
- New alerts will be issued, irrespective of how many alerts have been issued on a target in the past.



Alert Peak Rate

- Peak rate per visit will probably occur for Baade's Window
- Peak sustained rate will probably occur for survey of extended area in the galactic bulge



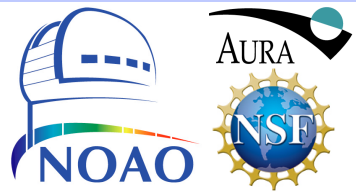
Determining the Peak Rate

- What is the surface density of stars?
- What is the frequency of variability?
- Multiply
- Discussed in detail: <http://arxiv.org/abs/1409.3265>

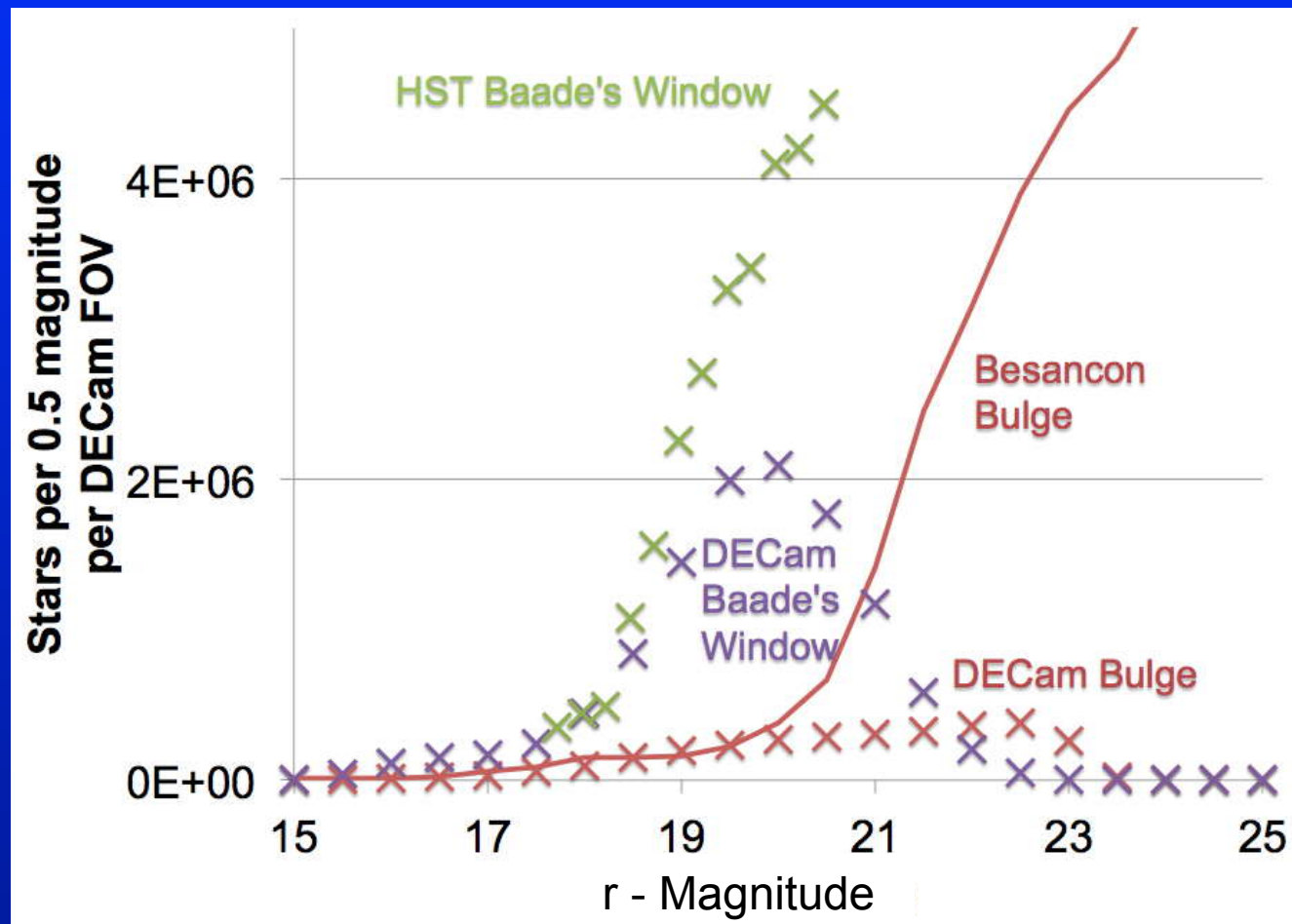


Surface Density of Stars

- Use Besancon galactic model (Robin et al., A&A 409, 523)
- Check validity in galactic bulge DECam images



Brightness Distribution Functions*



Solid curve – Besancon model star counts

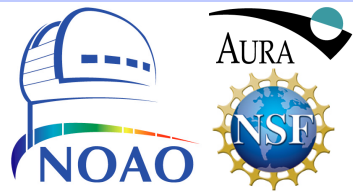
Symbols (X) – Observed star counts

* DECcam minisurvey and Holtzman et al. HST program

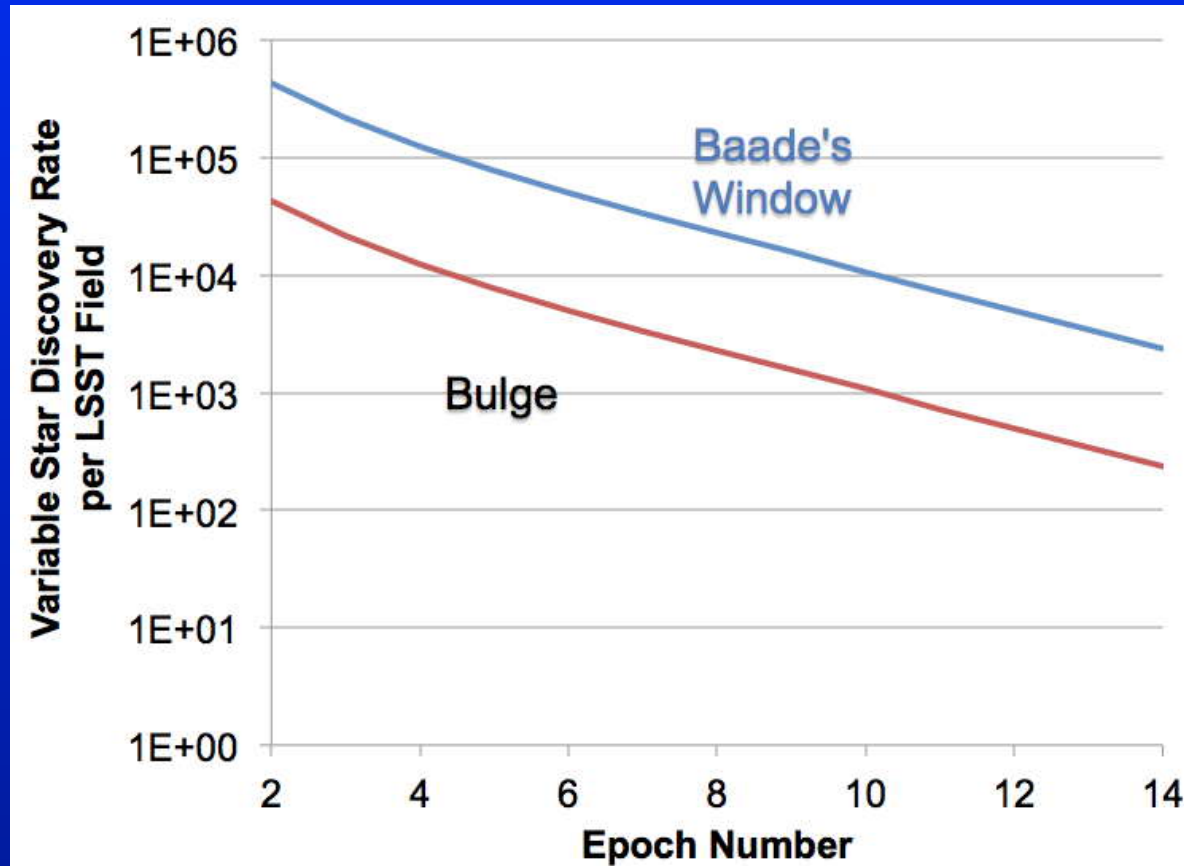


Frequency of Variability

- Use Kepler survey to calibrate Variability Probability Frequency distributions
- Check by comparison to number of variables found in bulge DECam mini-survey
 - The detected variability fraction is $\sim 10X$ lower than predicted by our model
- Apply model to predict variable discovery rates

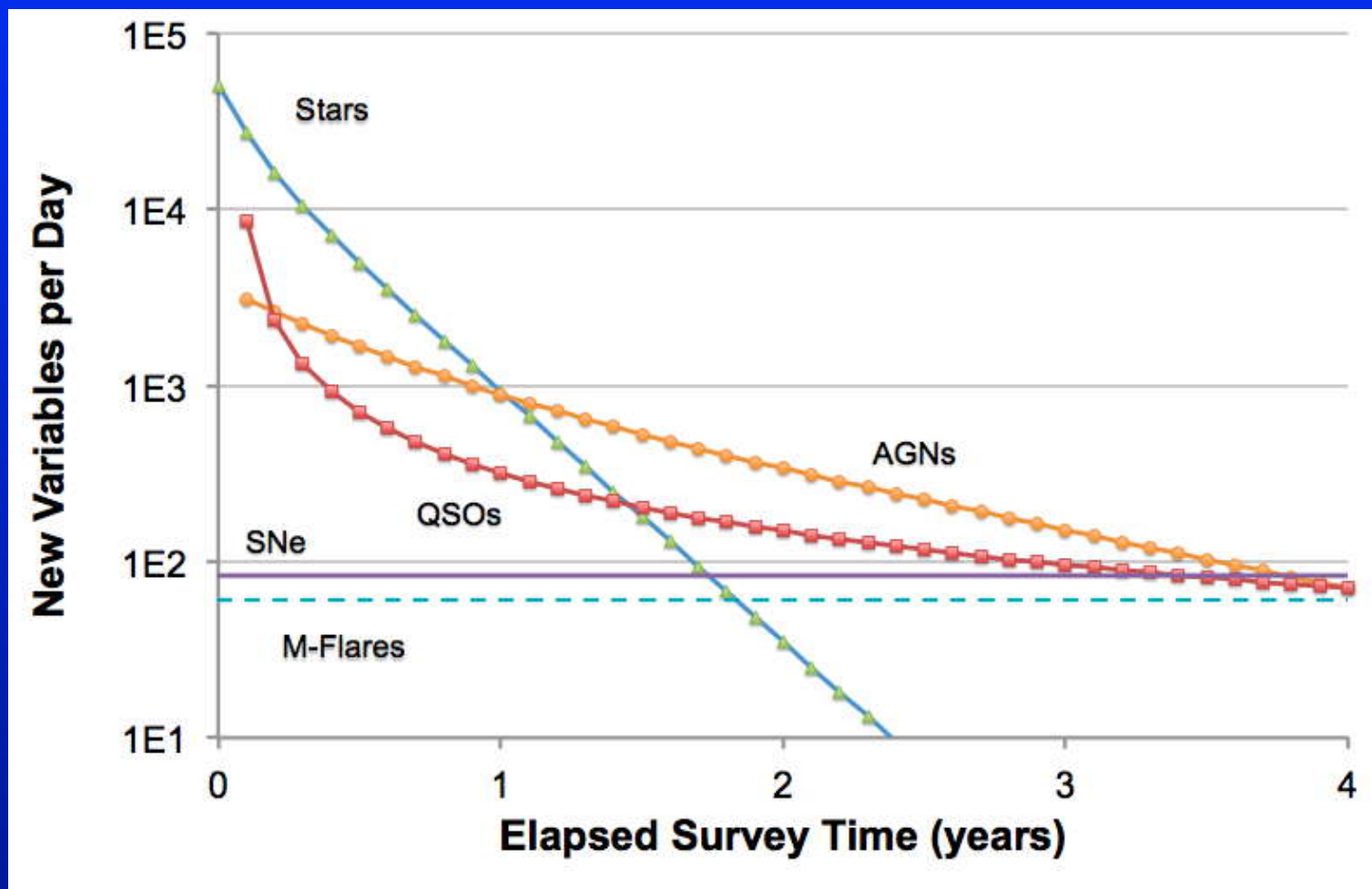


Peak Variable Star Discovery Rates per LSST field





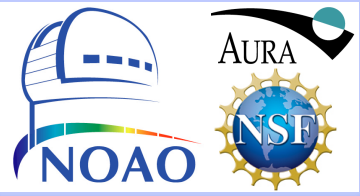
LSST Daily Discovery Rates – Variables of All Types





Variable Discovery Rates After 3 survey years

Galactic stars	~few/nt
AGN	120/nt
QSO	100/nt
SNe	1140/nt



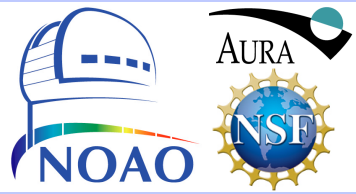
Blank Field Alerts

- Any of the variable types can generate blank field alerts
- Blank field alerts from most stars, QSOs and AGNS can be detected with forced photometry on previous imagery.
- After one year, the overwhelming majority of these blank field events will appear in the one-year stacked catalog.
- New SNe will always benefit from forced photometry, especially of recent images.
- There will always be a small number of non-SNe blank field events that need forced photometry to support alert processing (brokering).



Why We Need Not Fear the LSST Alert Stream

- After one year of operation, the first catalog will already include characterization of most variable objects.
- The alert rate on new discoveries will drop quickly to ~few X 1000 per night.
- Alert brokering must take full advantage of prior knowledge about the ~99% of alerts on targets which have been previously brokered.



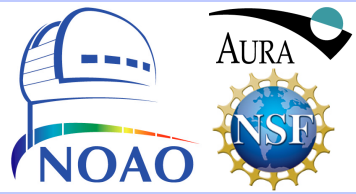
Predicted Number of LSST Variables

Galactic stars	5E6
AGN	3E6
QSO	5E6
SNe	3E5

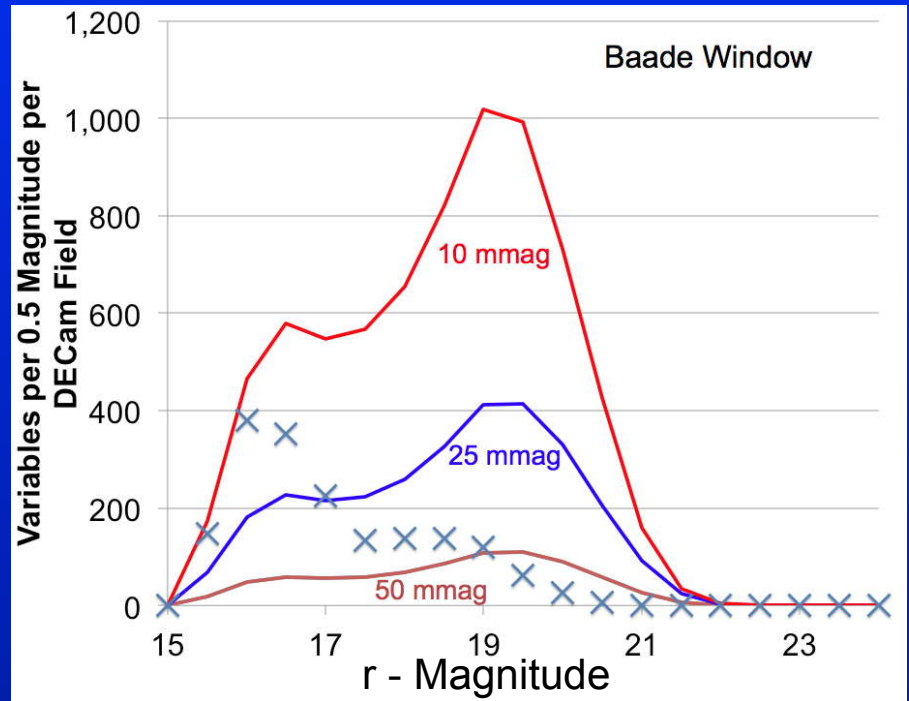
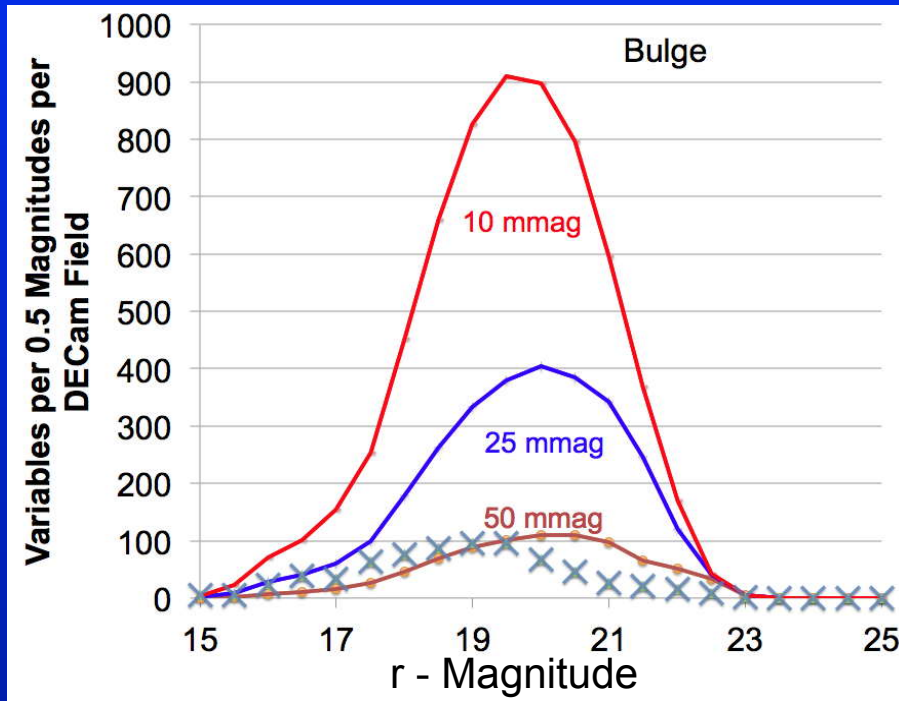
- Assuming 20,000 square degrees, and 10 year survey.



Backup



Observed vs Predicted Variable Numbers – Baade's Window



Solid curves – predicted variable star densities based on observed star counts, for DECcam with several assumed sensitivity cutoffs
Symbol X – observed variable star densities