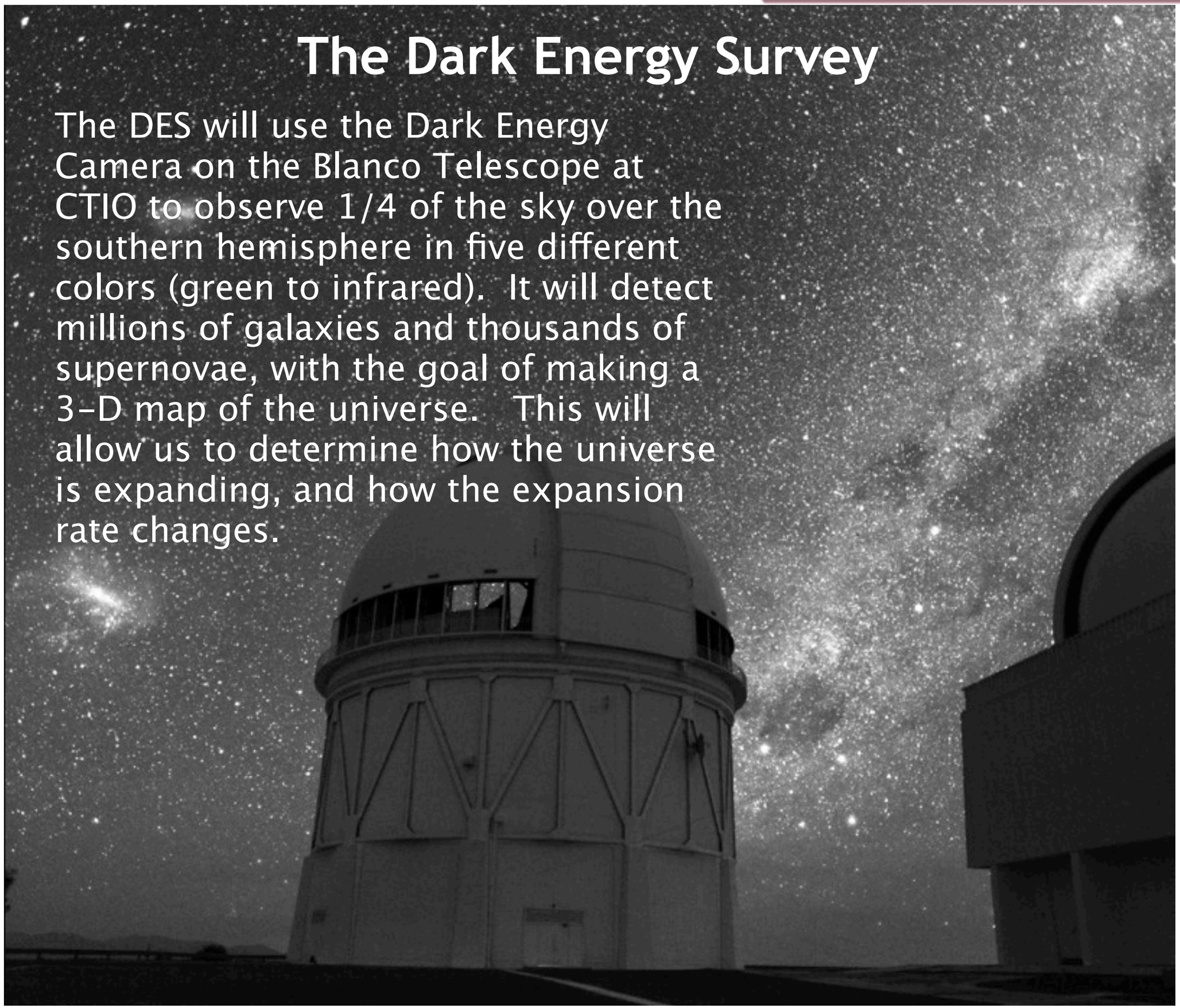
Observing with the Dark Energy Camera (DECam) and its Precursor Camera (PreCam)

Dr. Kyler Kuehn, Ph.D.
Argonne National Laboratory
http://www.hep.anl.gov/des/precam
http://www.hep.anl.gov/kkuehn
http://www.hep.anl.gov/des

Lemont High School
February 22, 2012

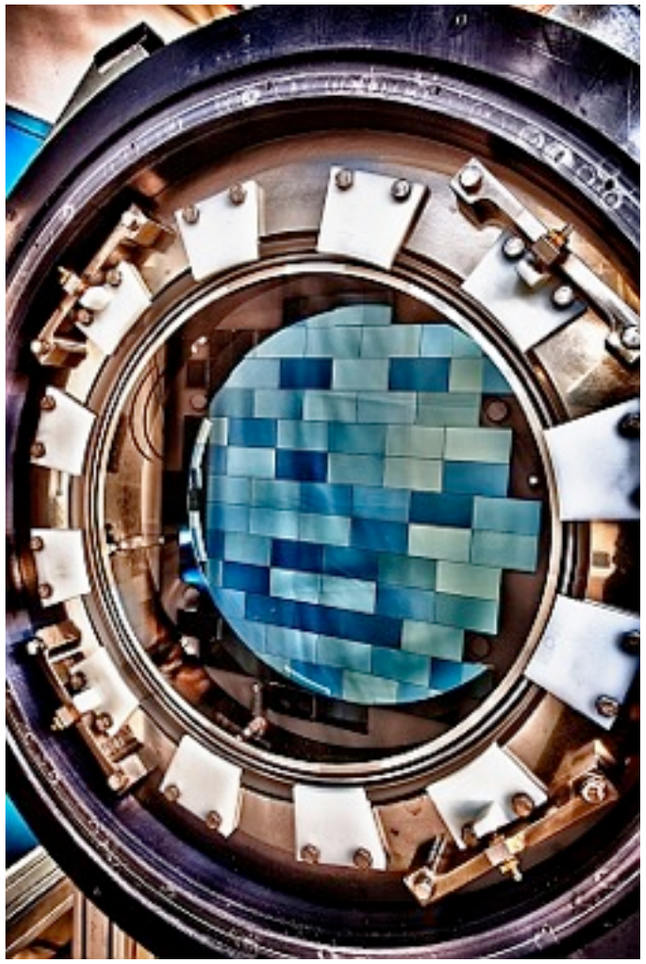
The Dark Energy Survey

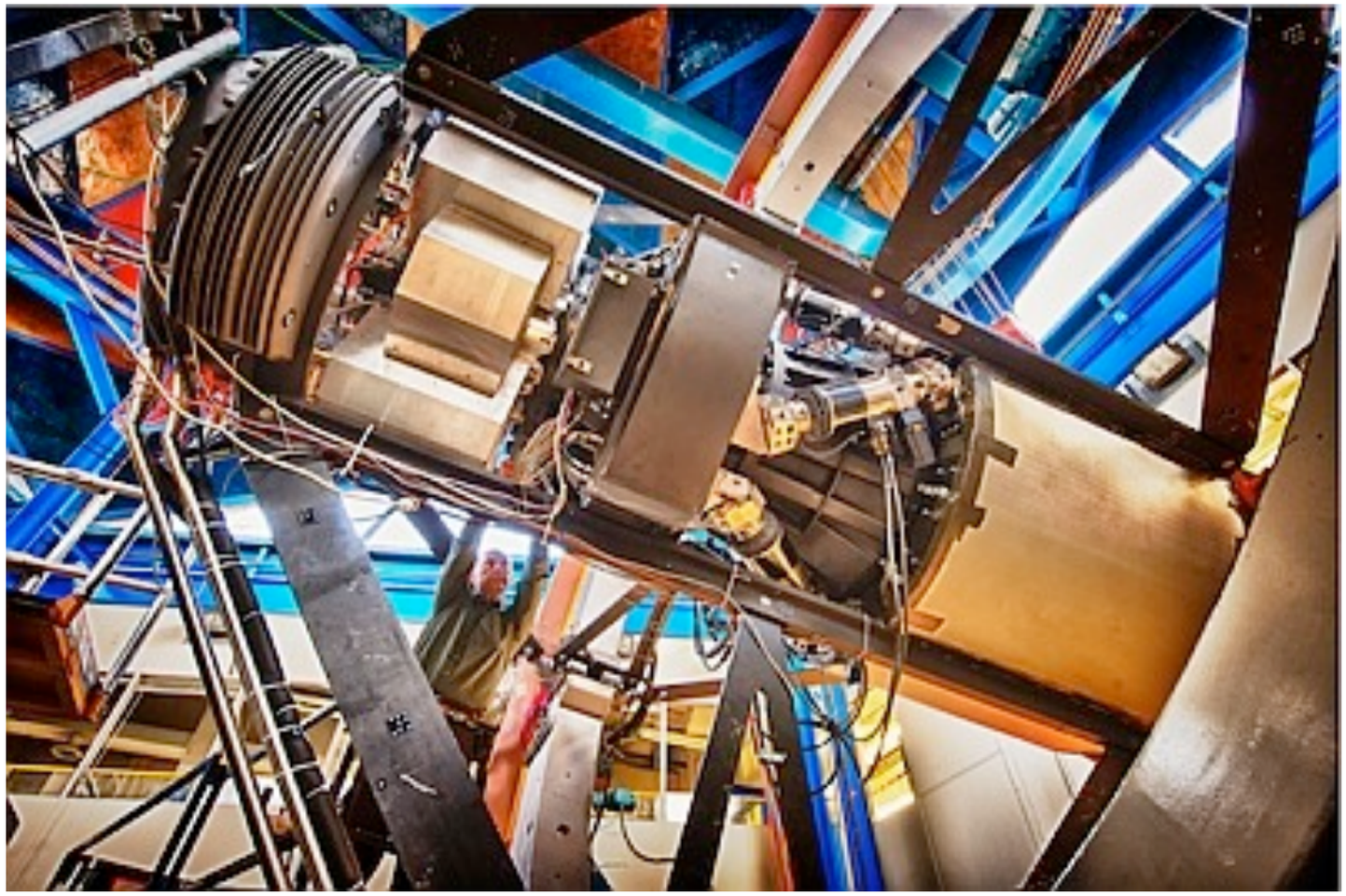
The DES will use the Dark Energy Camera on the Blanco Telescope at CTIO to observe 1/4 of the sky over the southern hemisphere in five different colors (green to infrared). It will detect millions of galaxies and thousands of supernovae, with the goal of making a 3-D map of the universe. This will allow us to determine how the universe is expanding, and how the expansion rate changes.



The Dark Energy Camera

DECam is a 570 Megapixel camera consisting of 62 extremely red-sensitive CCDs. DECam is currently undergoing testing and installation at the Blanco Telescope prior to Dark Energy Survey observations.





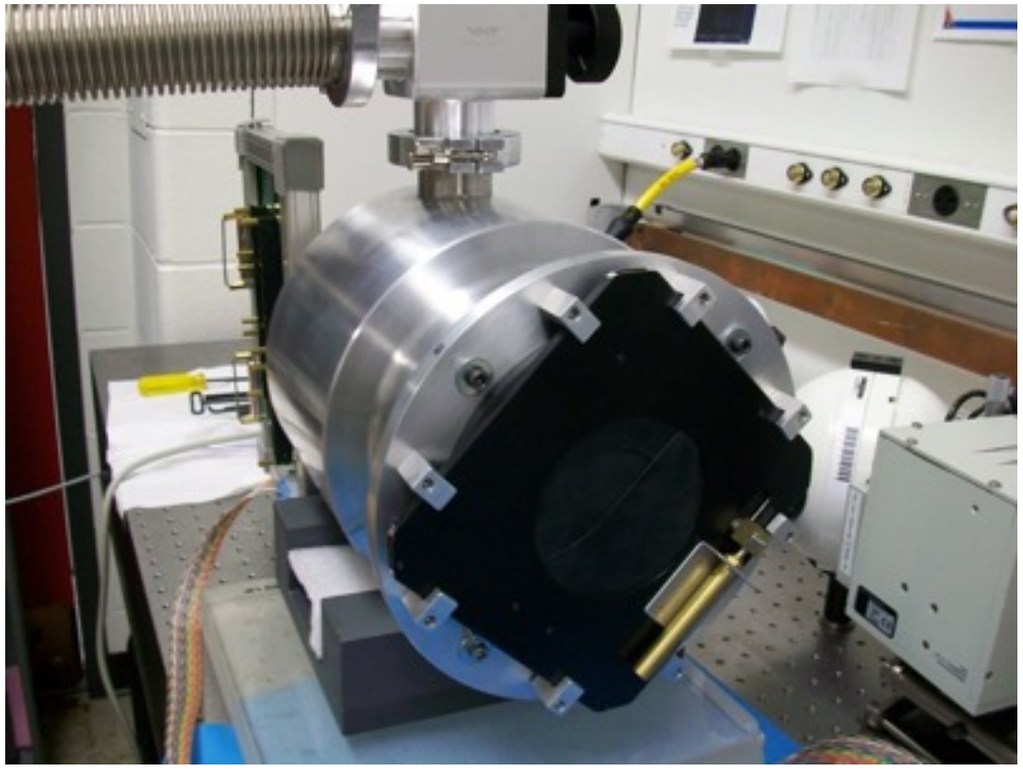
To be able to accurately measure faint astronomical objects with the Survey starting late this year, we need to have “standard” stars:
objects of known brightness, spread out across the Southern Hemisphere, so we can make comparison measurements anywhere we look in the sky.

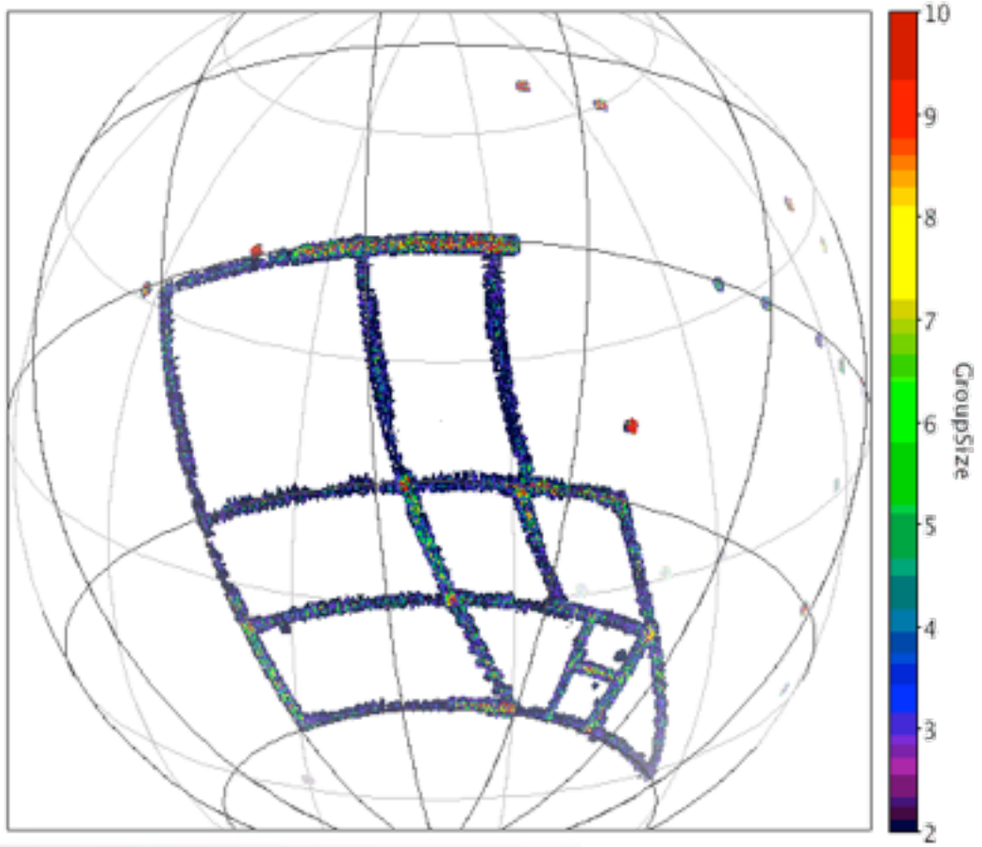
PreCam, the Precursor to the Dark Energy Camera

PreCam is a scaled down version of the DECam built at Argonne National Laboratory using the same digital camera technology as DECam. This let us test all of the computer programs that run the camera, as well as a lot of the electronics and other parts.

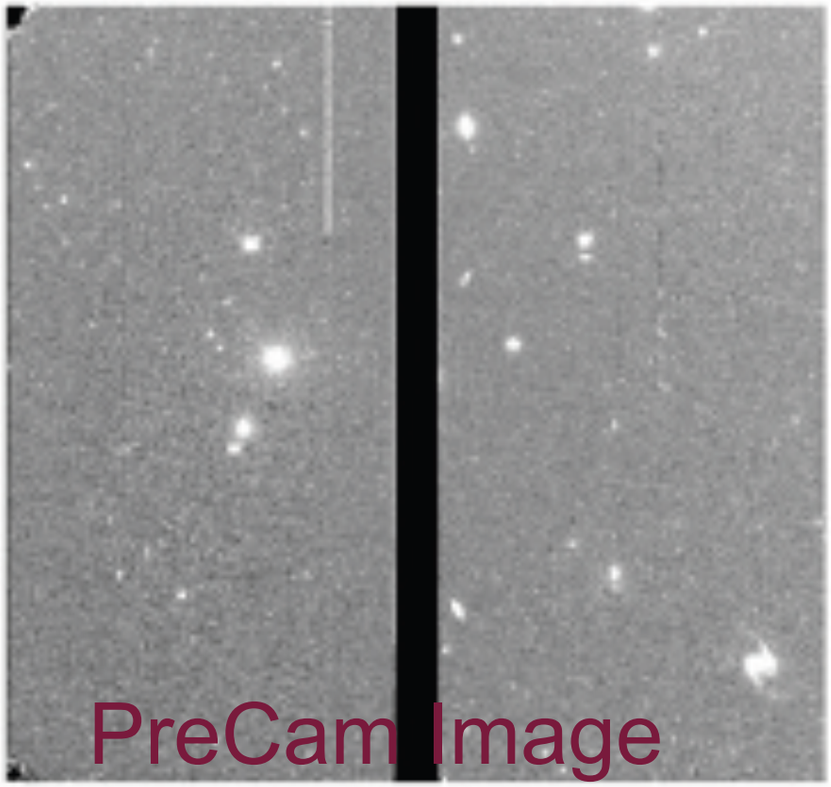
PreCam was designed and constructed in less than one year, and we started observing with it in September 2010. It gave us the opportunity to observe a grid of southern hemisphere standard stars for the DES (especially in the infrared, where there are not many known standard stars).

And we will have a the catalog of standard stars ready before the Dark Energy Survey begins!

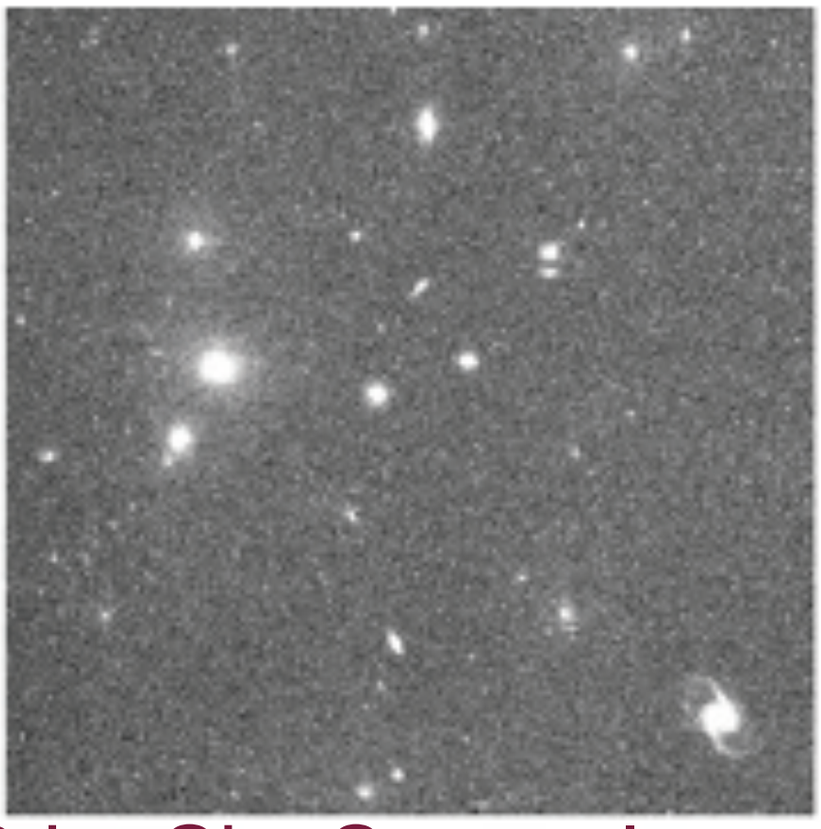




PreCam: Installation, Testing, and First Observations



PreCam Image



Prior Sky Survey Image

How to Observe with PreCam

- Point telescope to zenith to make sure positioning is accurate. If we can see a star, this also lets us know the temperature of the camera is right. The electronics are so sensitive that we have to keep the camera at -100ºC or the heat will cause random motion of particles in the camera to overwhelm the light from the stars!
- Focus telescope to make sure objects are not fuzzy. This also tests whether the dome, the shutter, and other parts work properly.
- Use the computer interface to point to your first standard star.
- Observe the star in all five colors.
- Go to the next star; repeat.
- Go to the next star...this could get boring, so we have a computer program called the Observing Tactician (ObsTac), so observers don't have to "babysit" the computer. Instead they can monitor the telescope, look at the data as it arrives, or do other important tasks.

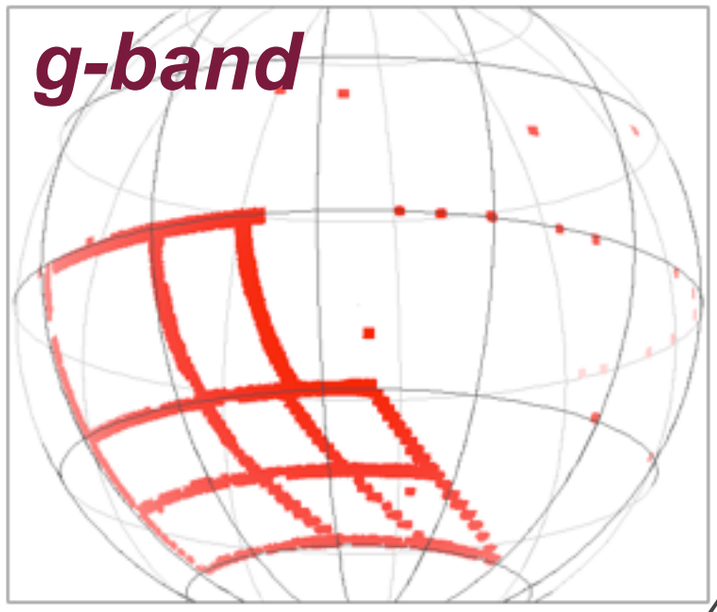
Image ID	Type	Dur	Filter	RA	Dec
3218	object	51	r	53.12	-27.81
3219		51	r	52.23	-28.81
3220		51	r	52.23	-28.31
3221		51	r	52.23	-27.81
3222		51	r	52.23	-27.31
3223		51	r	52.23	-26.81
3224		51	r	52.67	-28.81
3225		51	r	52.67	-28.31
3226		51	r	52.67	-27.81
3227		51	r	52.67	-27.31
3228		51	r	52.67	-26.81
3229		51	r	53.12	-28.81
3230		51	r	53.12	-28.31
3231		51	r	53.12	-27.31
3232		51	r	53.12	-26.81
3233		51	r	53.56	-28.81
3234		51	r	53.56	-28.31
3235		51	r	53.56	-27.81
3236		51	r	53.56	-27.31
3237		51	r	53.56	-26.81
3238		51	r	54.00	-28.81
3239		51	r	54.00	-28.31

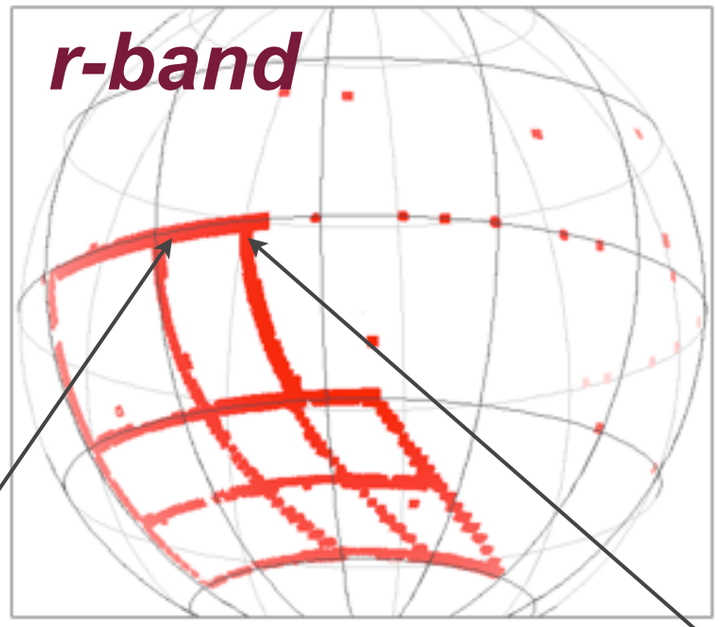
Standard * Field: CDFS, airmass=1.42, focus=7200

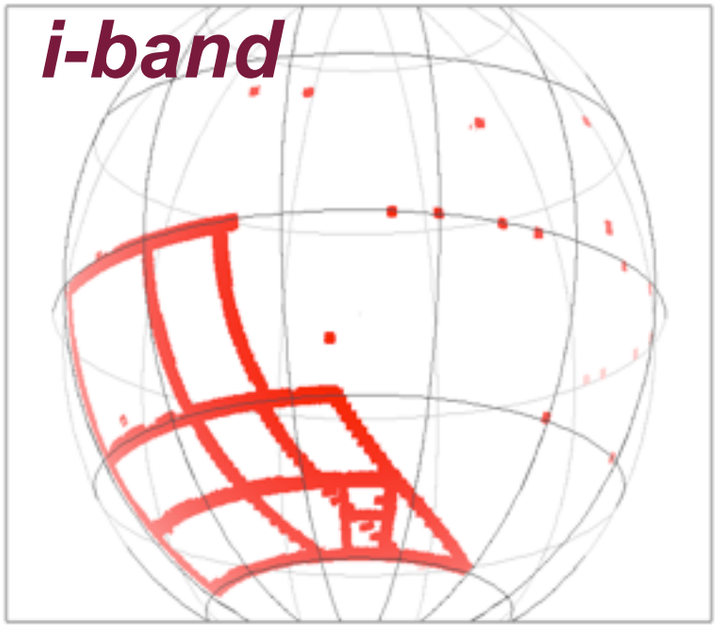
Image ID	Type	Dur	Filter
3268-3269	object	36	g
3270-3271		51	r
3272-3273		65	i
3274-3275		162	z
3276-3277		73	y

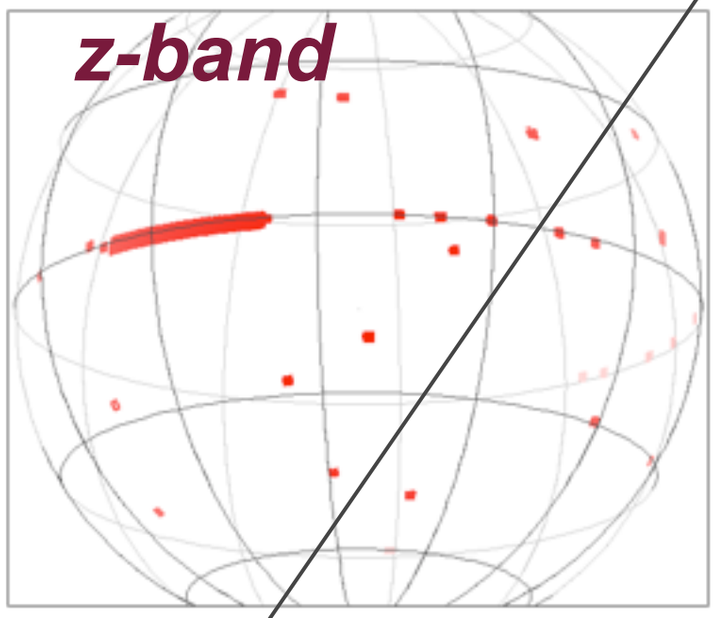
Backup Slides

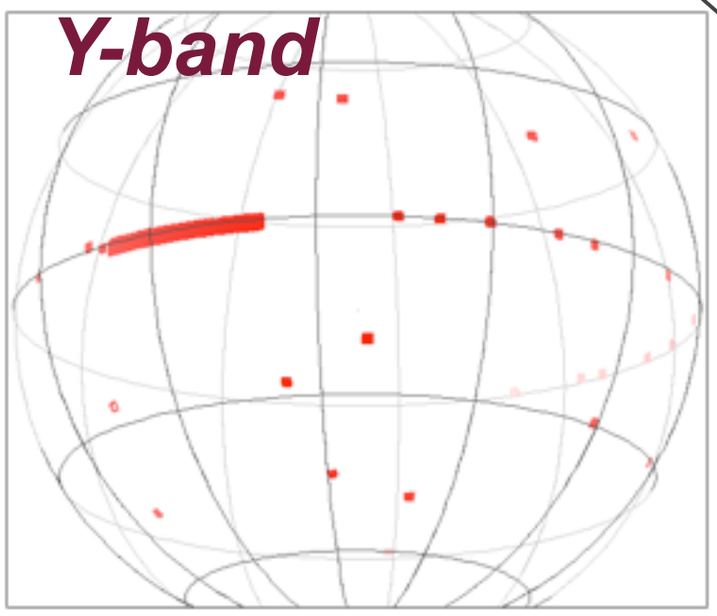
PreCam Coverage Maps

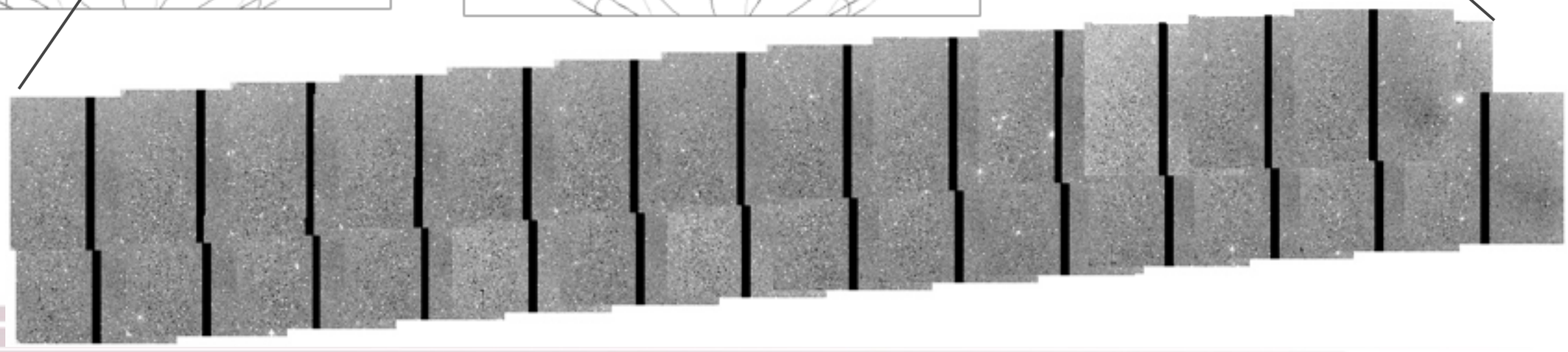




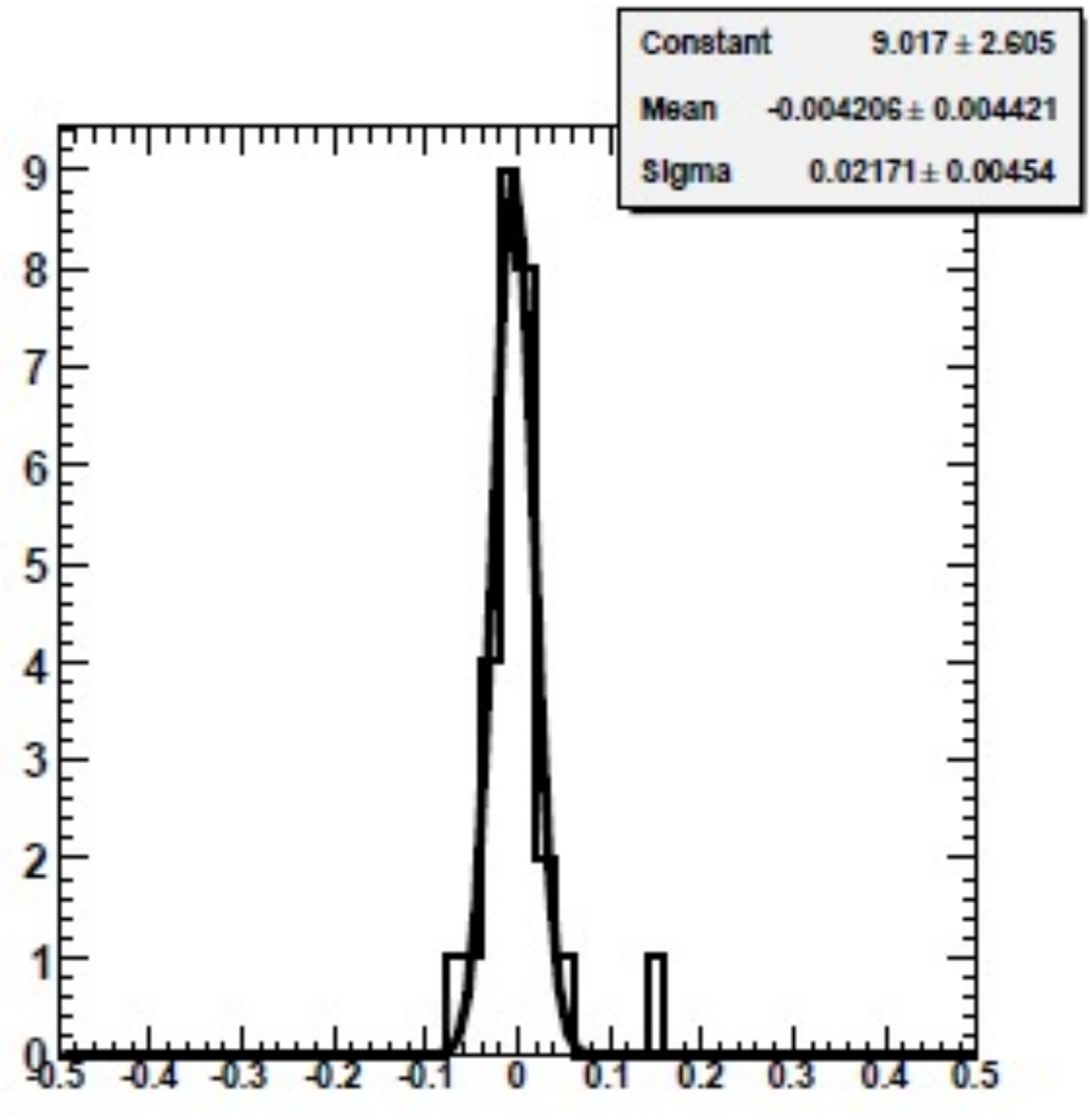




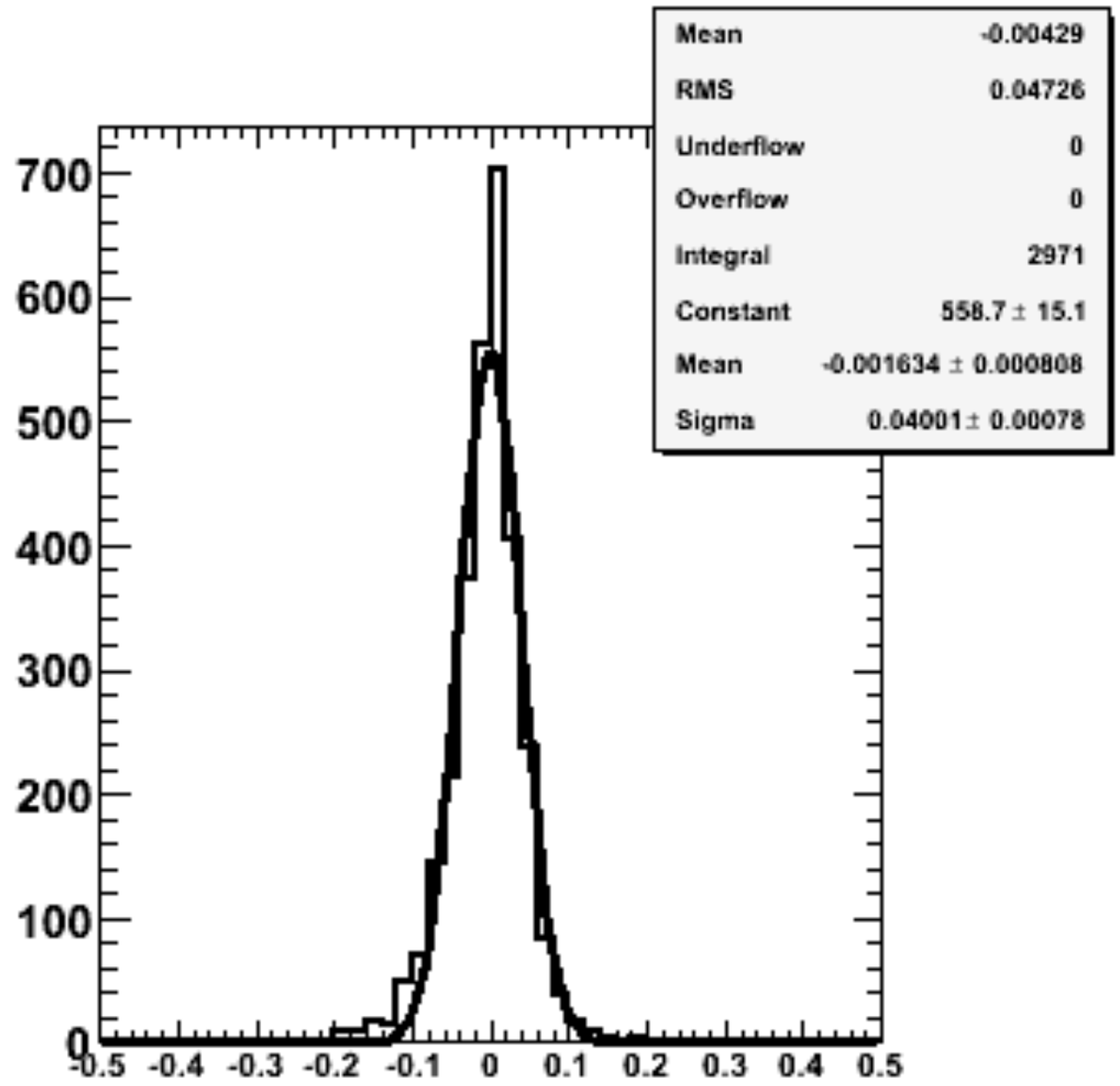




Preliminary Results I: Stellar Photometry



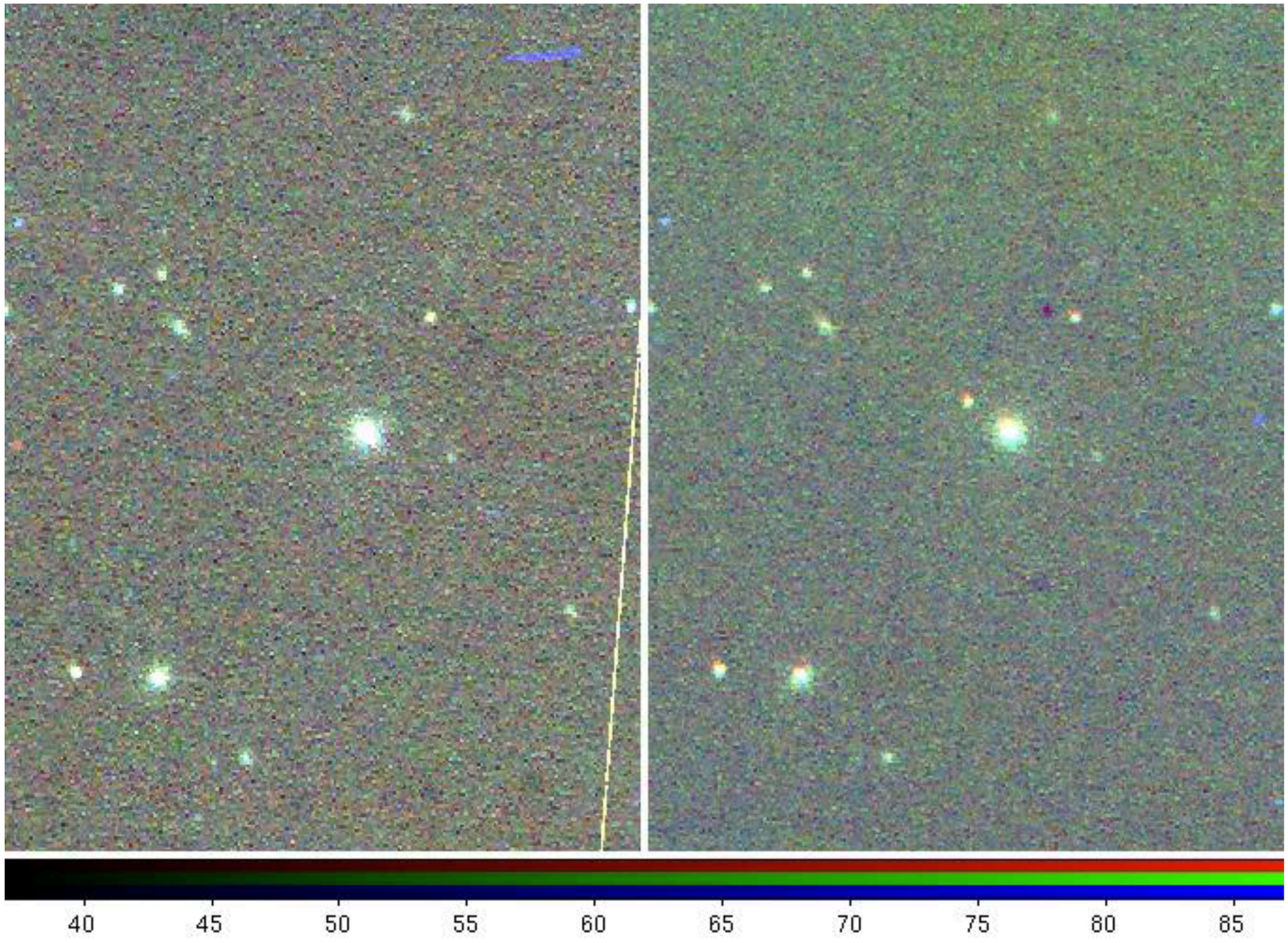
PreCam z - USNO z Bright



PreCam r - SDSS r

Preliminary Single-Image Photometric Accuracy:
4.0% (SDSS r,i); 3.2% (SDSS z); or 2.2% (USNO z, mag<14)

Beyond Calibrations Science: the Case of SN 2010lr



Sprectroscopically Confirmed SNIa with host galaxy 2MASX J00023401-3044061 at z ~ 0.062 (Djorgovski et al., Prieto et al.)