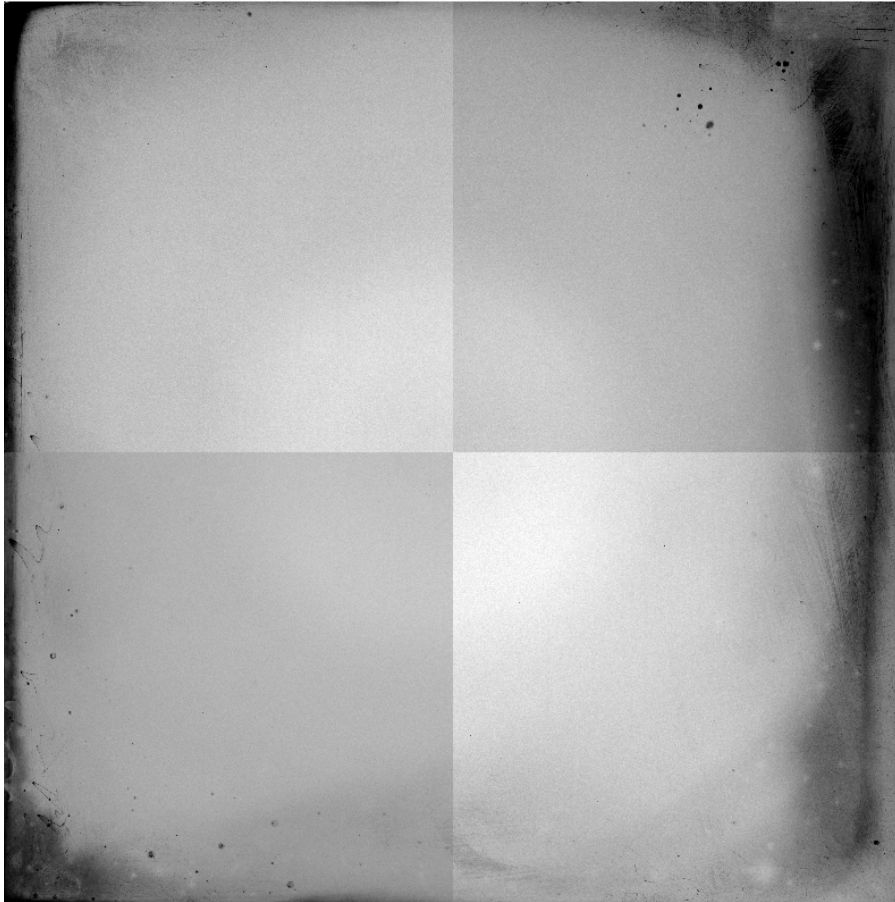
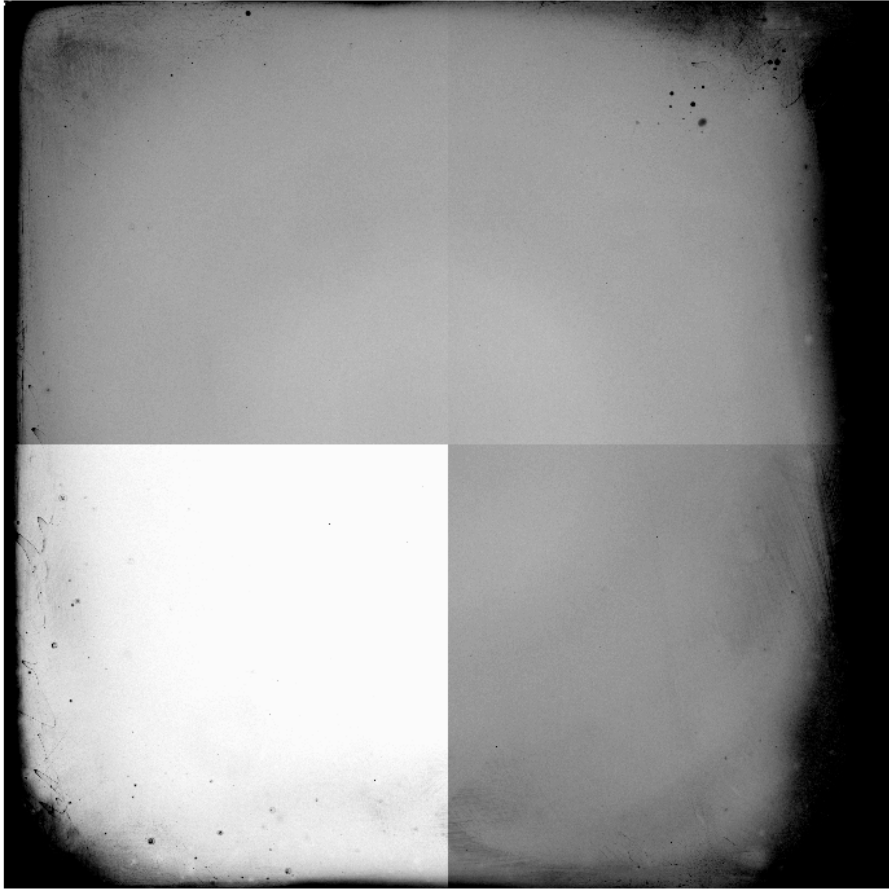


## Contamination History of the KeplerCam CCD

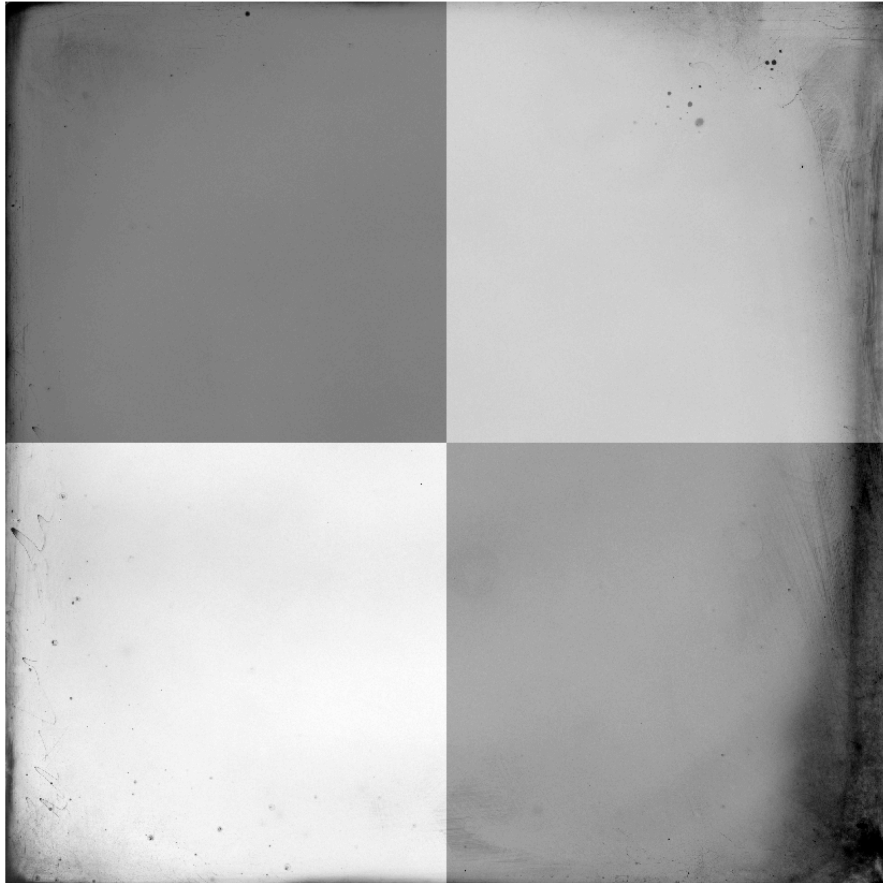
There are spots of an unknown substance on the CCD flatfield exposures that date back to the earliest flatfield exposures from 2005, when KeplerCam came online. The majority of them are on AMP 1 (top right section) and AMP 4 (bottom left section) of the CCD. More of these spots appeared during the 2012 shutdown, which took place between July 15, 2012 and September 1, 2012. Below is a timeline of flatfield exposures from throughout KeplerCam's operation.



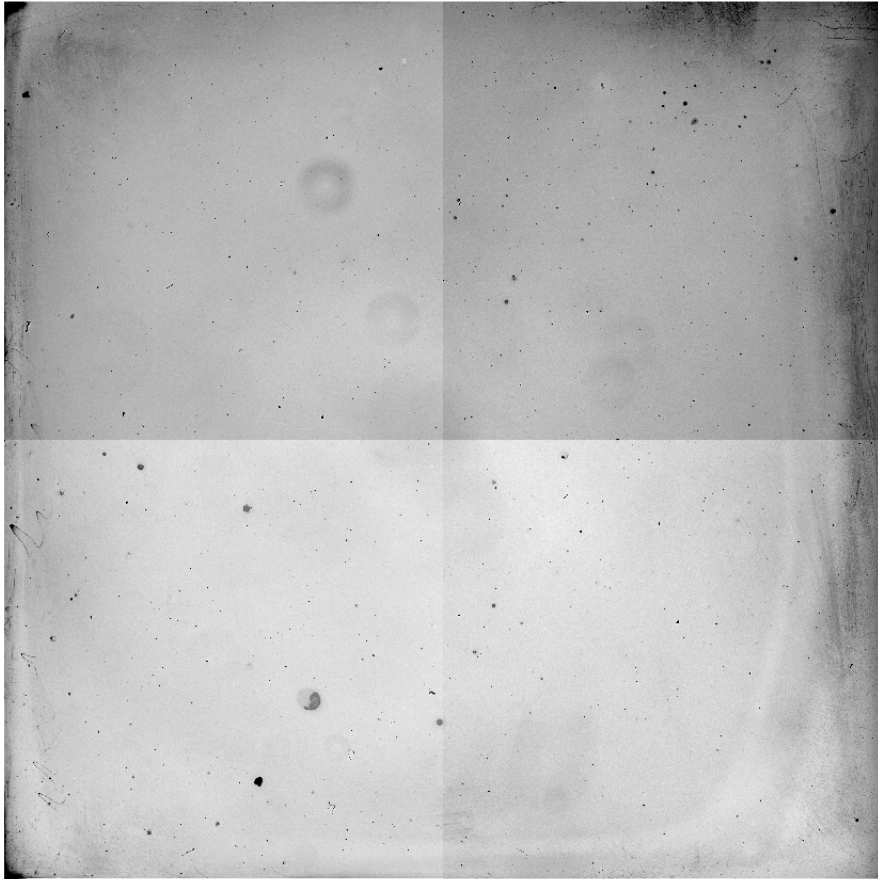
August 17, 2005. This is the very first exposure, and the spots are there.



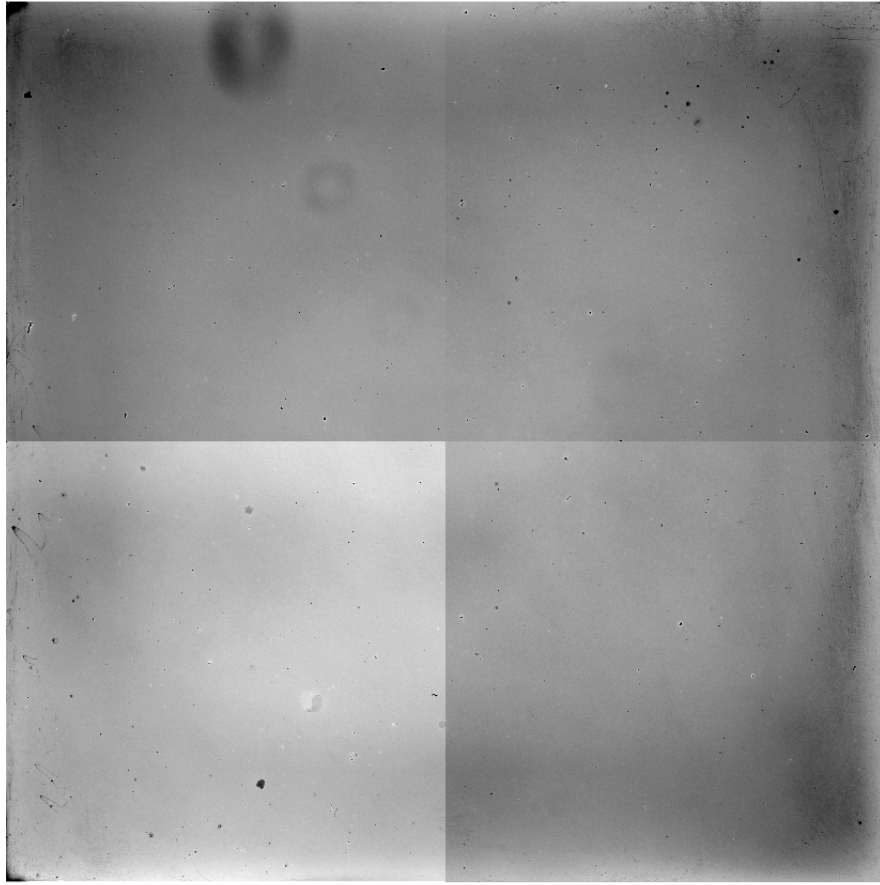
August 17, 2007.



April 30, 2010.

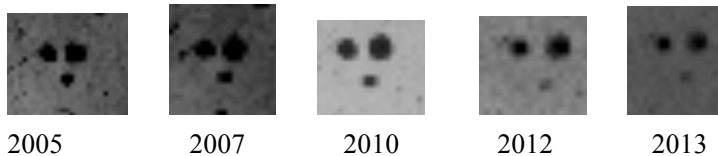


September 1, 2012. This is the first exposure after the 2012 shutdown. Note the numerous new spots that have appeared, which did not exist before the shutdown.



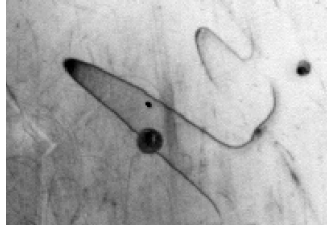
July 31, 2013. This is the most current exposure at the time of writing.

It appears that the spots get fainter over time. A good example is the cluster of three spots in the top right corner (AMP 1). Here is a time lapse of them from 2005 to 2013.

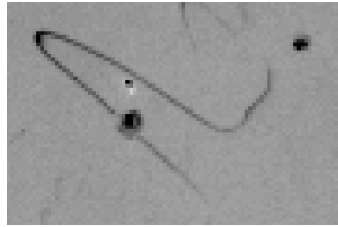


Qualitatively, the spots look like they are fading around the edges and look lighter overall. Quantitatively, in the 2005 image there is a 40% decrease in ADU inside all three spots compared to the surrounding area, from about 9,000 to 5,500. In the most recent exposure from 2013, there is only a 20% decrease in ADU inside the top two spots, from about 10,500 to 8,000-9,000. In the bottom spot, ADU decreases only 5-10%, from 10,500 to 9500-10,000, since smaller spots evaporate faster. This information suggests that the spots have gradually faded over time.

Here is another example.



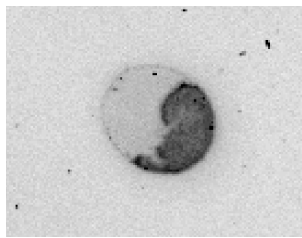
2005



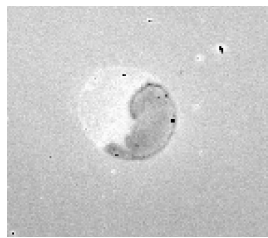
2013

This is a wave-shaped spot in the bottom left corner (AMP 4). In 2005, ADU decreased 35% from 10,000 to 6,500 in the dark "crest" region of the wave. In 2013, ADU decreased 30% from 12,500 to 9,000 in that region. The wave has also thinned significantly.

Third and last example.



2012 (right after shutdown)



2013 (most recent exposure at time of writing)

This is a spot that appeared after the 2012 shutdown and bears an eerie resemblance to the yin/yang symbol. In 2012, ADU in the dark region of the spot decreased 10% from 18,500 to 16,500 counts. In 2013, ADU decreased less than 5% from 13,600 to 13,100 counts. So, the new spots from 2012 are also fading. Strangely, ADU in the light region of the 2013 spot actually *increases* from 13,600 to as high as 14,000.

A visual inspection of the CCD showed that the spots are dull and not shiny, and that apart from them there are no other signs of contamination.

Report prepared by Xuelong Mu, August 15, 2013.