Key words: Photographic plate, photomultiplier, CCD

ESOcast Episode 112: Catching Starlight	
00:00 **New ESOcast intro**	**00:00** **New ESOcast intro**
00:08 **[Visual starts]** Hello and welcome to the ESOcast. Capturing and recording the light from the heavens has always been an essential aspect of astronomy. In this episode, we're going to delve into the history of the sensors that have been used to study the Universe over the centuries.	**00:00** Prof. J in Studio Background: timelapses
00:26 The very first astronomical "detector" was, of course, the unaided human eye. It wasn't until the early 17th century that we started to use a tool to help us see fainter and more distant stars: the telescope. One of the first astronomical uses of the telescope was by Galileo Galilei back in 1609. Amongst many other things, he discovered the four largest moons of Jupiter, which forever changed our view of our place in the Universe. But, in order to record what they saw through the telescope, Galileo and the astronomers that came after him had to make do with pen and paper. They had to draw what they saw.	Prof. J in Studio Background: historical images

01:08 Around 230 years later, in the middle of the 19th century, this dependence on the human eye finally ended. Instead, astronomers started using photographic plates to detect the light from celestial objects. Now these had several advantages. To begin with, photographic plates can be exposed for hours on end, allowing astronomers to detect much fainter objects, than was possible by eye. And, for the first time, astronomers had a faithful image of the night sky, instead of just a sketch.	Prof. J in Studio Background: Celestial images and handling of photographic plates
01:42 But, although a huge improvement over the eye, photographic plates were far from perfect. And so, the quest for greater sensitivity continued…	Night timelapse
01:53 As technology progressed, eventually, electronics entered the picture. Photomultiplier vacuum tubes became available in the 1930s. They convert an incoming photon into an electron, which is then repeatedly multiplied in order to generate an easily measurable electrical current.	Prof. J in Studio with photomultiplier vacuum tube.
02:13 Now photomultipliers had a sensitivity that was about ten times greater than that of photographic plates. But they were cumbersome to use, being essentially, just a single picture camera.	Night timelapses

02:27 However, everything changed with the advent of digital imaging in the 1970s. Charge-coupled devices, or CCDs, are extremely light sensitive semiconductors.	Prof. J in Studio with a CCD
02:39 They consist of a thin layer of silicon divided into millions of tiny squares, each representing a picture element, or pixel. These pixels absorb virtually every incoming photon and produce a corresponding electron. When electronically counted and fed into a computer, the numbers of electrons correspond to the different brightnesses in the different pixels of a digital image, all recorded in a single shot. Scientists and engineers at ESO have helped to push the boundaries of CCD sensitivity and size. Now initially, CCDs were really really small. Over time, they became larger, like this one, and today they can be as large as 9000 by 9000 pixels, that's 81 megapixels in total! And, these huge CCDs can even be mosaicked together to produce cameras with more than a billion pixels.	Animation of CCDs collecting photons and night timelapses Still image of OmegaCAM
03:19 This is not the end of the road of course. As the technology continues to develop, we can look forward to future detectors that will be even better, at catching the faint drizzle of light from the cosmos. This is Dr J, signing off for the ESOcast. Join us again next time for another cosmic adventure.	Prof. J in Studio Nice celestial background or telescope timelapse
00:00 **[Outro]**	*Produced by ESO, the European Southern Observatory.* *Reaching new heights in Astronomy.*