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High frame rate and low noise CMOS WaveFront imager for E-ELT Adaptative Optics

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The European Southern observatory's extremely Large Telescope (E-ELT) will allow the search for exoplanets, drastically advance astrophysical knowledge (super-massive black holes or the nature and distribution of the dark matter for instance) and to study far distant galaxies. This telescope uses sophisticated Adaptive Optics systems and the laser/Natural guide star WaveFront imager is a very critical component of this system. The WaveFront imager is composed of 800x800 pixels of 24µm2. It is to used detect multiple sub-images from the guide star in a way that allows the centroid of each sub-image to be accurately found. Both natural and laser guide stars produce a very low signal on the detector. This requires the detector to be low read noise (<3e-), low lag (<2e- at 100e- charge capacity), highly linear at low signals, to have a very high QE (> 90%) and to operate at -10oC. This detector also needs to operate at high frame rate of 700 frames per second to enable the monitoring of rapid atmospheric fluctuations. All these requirements makes the design of this imager very challenging. To achieve this performance a CMOS back illuminated technology has been selected for this imager.

This presentation will focus of the design details of this CMOS WaveFront imager. The architecture and the column ADC approach to reach low noise at high frame rate will be discussed. The lag and QE performance versus temperature will be presented. Finally, the design of the Peltier package challenges will be discussed.

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