Fully differential signal path for the ZTF mosaic

Roger Smith and Stephen Kaye
California Institute of Technology

The Zwicky Transient Facility is a 4x4 mosaic of 6K*6K CCDs under construction for the 1.2m Palomar Oschin Schmidt Telescope, to survey 80 square degrees per minute at 1 arcsec per pixel.

**PROS OF DIFFERENTIAL**
- Video cross talk reduced → negligible?
- Less susceptible to interference.
- These become common mode errors which are rejected:
  - Bias noise
  - Ground differentials
  - Reset feedthrough
  - Clock feedthrough
  - Clamp control signal feedthrough.
  - AC coupler drift
  → clamp once per line.

**CONS**
- CCD noise is incurred twice.
- CCD output power is doubled.

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Life size →

To keep beam obstruction below 23%, readout electronics must be mounted outside the telescope.

Sixty four video channels must be transmitted over >1 m of cable at 1 MHz to meet the 10 second read time requirement.

True differential outputs of e2v 231-C6 CCD are amplified and transmitted differentially to a differential input ADC performing digital CDS.

The goal is to get close to \( 7e^- = \sqrt{2} \times \text{“typical noise”} \) quoted for single channel operation and to eliminate the need for crosstalk correction.

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### AD8066:
- Output swing to 50mV of rail for \( I_o = 30 \) mA
- GBW = 146MHz
- \( e_n = 7 \) nV/\( \sqrt{Hz} \)
- \( I_o = \pm 1 \) pA
- \( P_o = 132 \) mW per ch
- Conductively cooled via ground and supply planes

### ADG601:
- \( I_o = \pm 10 \) pA
- \( R_{cm} = 2.5 \) ohm

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**Differential preamp is located in vacuum at warm end of CCD flex cable. Drives balanced strip-line implemented in vacuum interface board**

Black level clamping at AC coupler:
- Active during vertical transfer only
- Can close reference side switch to convert to single sided CCD output (lower noise) while preserving differential transmission.
- Close both switches for shorted input noise test.
- Close signal switch only to check reference side.

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**Vacuum Interface Board**
- 1/8” thick PCB carries preamps
- Trapped between two O-rings in side wall and back cover.
- Signals routed on internal layers.
- Outer layers are isolated, in contact with case: conduct heat from preamps.
- Eliminates hermetic connectors.
- COTS cables connect directly to edges: all custom wiring in PCB.