The photoelectric effect
Photoconduction
Bandgap energies for different materials
Fig. 3.4. A typical CCD dewar. This is the Mark-II Universal dewar originally produced in 1984 at Kitt Peak National Observatory. The dewar held 1.75 liters of liquid nitrogen providing a CCD operating time of approximately 12 hours between fillings. This dewar could be used in up-looking, down-looking, and side-looking orientations. From Brar (1984).
CCD readout

Figure 6.4. Readout method for the entire array. The charges in the pixels of the array are all shifted to the right by one pixel. The charges in the rightmost column are thereby moved into a transfer register and are then read out in the upward direction to a field-effect transistor (FET). This yields an analog signal with amplitude proportional to the charge in the pixel being read out. These analog numbers are converted to digital form with an analog-to-digital converter.
Fig. 3.5. Histogram of a typical bias frame showing the number of pixels vs. each pixel ADU value. The mean bias level offset or pedestal level in this Loral CCD is near 1,017 ADU, and the distribution is very Gaussian in nature with a FWHM value of near 2 ADU. This CCD has a read noise of 10 electrons and a gain of 4.7 e⁻/ADU.
Linearity

SITE#3 chip at LCO
October 1998

Counts / second (normalized)

Counts - Bias
Blooming
Fringing: LRIS-R
Cosmic rays: HST ACS/HRC
\[ V = v_1 + a_0 \]
\[ \text{RMS} = 0.055 \]

just magnitude zeropoint
magnitude zeropoint and airmass term

\[ V = V_{\text{inst}} + c_0 + c_1 X \]

RMS = 0.032
Colour terms

Objects with different spectral shapes have different colour terms.

Arlo’s B filter

your B filter

red star

blue star

wavelength
\[ V = v_{\text{inst}} + c_0 + c_1 X + c_2 (B - V) \]

RMS = 0.021

magnitude zeropoint, airmass and colour terms