Upgrading the WHT Acquisition TV Cameras

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Despite advances in solid state imaging devices over the last twenty years, the choice of a camera to replace the aging vacuum tube devices on the WHT telescope was not obvious. All ING telescopes originally had Westinghouse (Intensified Secondary Electron Conduction) ISEC TV cameras, which could be used at the standard 25 frame s^{-1} TV rate, had an advantage of photon multiplication within an intensifier stage, and could be made to integrate charge at the photocathode. Being able to integrate for longer than a single TV frame made these cameras attractive in astronomical applications. The integrating facility works by inhibiting the electron beam from a thermionic cathode for an integer number of TV frames before reading off the two dimensional charge pattern with a single raster scan, the image is then held in a digital frame store until refreshed by the next scan but is presented to the observer on a TV monitor as a stationary image during the interscan period. The problem with ISEC cameras is that they can be damaged by over illumination and have poor geometric stability because image distortion is dependent among other factors on the linearity of the camera time-base oscillators. Furthermore these cameras are no longer supported by the manufacturer and obtaining or engineering around obsolete spares was starting to become a problem. Solid-state detectors offer excellent geometric stability are not damaged by over illumination and have a large dynamic range.

An important decision when retrofitting an acquisition camera to a telescope intended to operate with a camera such as the Westinghouse ISEC is whether to replace the reimaging optics and design a system utilising a smaller format imaging device. Small format devices are of course cheaper and several cameras are commercially available, many work at TV frame rates and some have thermoelectric cooling and can integrate for a few tens of seconds. A problem with many of these products is their poor quantum efficiency of the CCDs used and relatively high dark currents, these shortcomings combine to make it difficult to achieve the limiting magnitude of the ISEC cameras $\sim m_V = 20$. A solution adopted at some observatories is to use an intensified CCD camera, generally a MCP ahead of a cooled CCD, but we wanted to avoid this solution partly because of the nuisance of managing the over illumination risk, but also to offer better photometric performance than the ISEC cameras. The performance requirements for future upgrades to ING acquisition cameras had previously been specified in a memo (Rutten and Barker, 1996) and these included features such as on-line bias subtraction, generation of FITS files and a minimum of 8 bit precision over the dynamic range of the detector. These requirements were easier to meet using commercially available cameras aimed at the university observatory market. Several suppliers offer cameras aimed at the university telescope niche but the Micro Luminetics Cryocam offered the possibility of remote PC operation over a single 50 ohm coaxial cable, whilst other contenders typically needed multicore cables of restricted length between the camera and PC. This cable limitation was an important factor in choosing the Cryocam although other observatories like the AAT have chosen to accept the cable restriction and have mounted the controlling PC on the telescope.

The Cryocam model presently operating at the Cassegrain focus of the WHT has a thinned back illuminated 1k square SITe chip with 24µ pixels. Replacing the original camera with a CCD having a similar format meant the acquisition FOV at Cassegrain has been retained and slightly increased in the y-direction, the possibility of interposing a focal reducer to change between a 1.5 arcmin and a 4 arcmin FOV remains along with the original camera filter wheel. The chip is operated at a temperature of 220 K and has a dark current better than 0.2 e^- $pixel^{-1}$ s^{-1} with a QE>80% between 600 to 750 nm. The Cryocam will operate in either fast readout 8 bit 'focus mode' when acquiring bright $\sim m_V = 5-7$ calibrate stars or monitoring the position of a bright source on the ISIS slit or the 'normal mode' with 16 bit precision. Any shutter speed ≥200 ms is available in either mode giving the possibility of confirming the position of faint or extended objects on the ISIS slit without the need to trust a 'blind offset'. The camera is operated by the observer from the control room and the control and display application run on a PC under the Windows 98 operating system. The camera CCD does not operate in the frame transfer mode and requires a mechanical shutter to close during readout and the long term reliability of this component is an area of concern, with bright stars there is a temptation to use the minimum 200 ms integration time and a readout time of less than a second in focus mode implies several thousand shutter operations per hour. The recommendation is that in these circumstances it is preferable to integrate for longer and use a red filter, we have however operated a Cryocam at the Cassegrain focus for both direct and slit viewing since May 2001 and have not experienced any serious problems. The spare camera was recently tested with AF2 to manually guide utilising the recently upgraded coherent guide fibres and we are considering the purchase of enhanced Cryocam software so a Cryocam can be used for autoguiding AF2. ¤

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