ACam Instrument Overview.

KMDee July 2009

Introduction

ACAM is a new 8.3 arcmin wide-field imager/spectrograph, which was successfully commissioned in June 2009. It is mounted permanently at a folded-Cassegrain focus of the 4.2-m William Herschel Telescope.

ACAM will be used for a broad range of high-impact science programmes requiring rapid response (e.g. supernovae, gamma-ray bursts), or awkward scheduling (e.g. exoplanet transits), or the use of specialised filters (e.g. narrow-band H_{α} imaging of low-red shift galaxies).

Instrument Structure

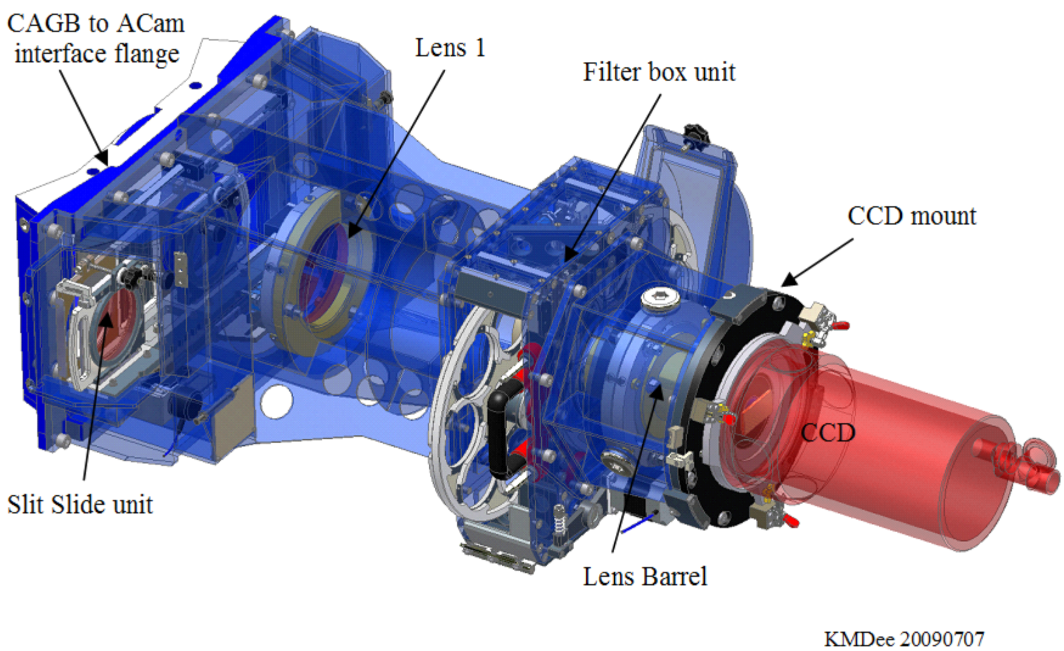

Fig 1. Transparent view of ACam.

Fig 1 shows the instrument layout and displays the main internal components. The light path is from left to right. The blue part is the ACam instrument and the red cylindrical can to the right is a CCD cryostat which is cooled with liquid nitrogen. The instrument together with CCD cryostat mounted is 1.2 metres long and weighs 120 Kg.

From left to right the main components are the slit slide unit, lens 1 mount, filter wheel unit, lens barrel, CCD mount and the CCD cryostat.

Optics Layout

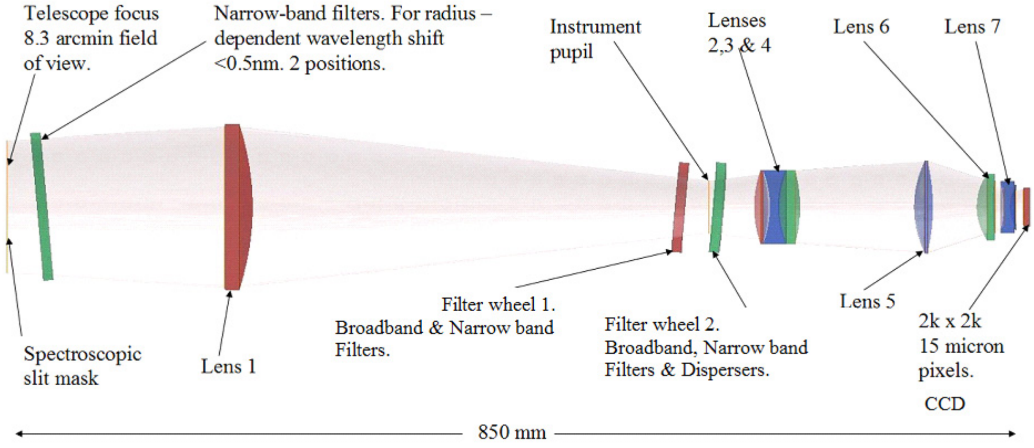

Fig 2. ACam optical layout.

Figure 2 shows the optical components of ACam, the light path runs left to right. The optics in ACam consists of 7 lenses. Also shown are the locations at which filters can be positioned. Lens 1 is mounted on its own, lenses 2 to 6 are mounted in a common lens barrel. Lens 7 is mounted in the CCD cryostat front face and apart from it's optical properties it also acts as a vacuum seal and window for the CCD cryostat.

Slit Slide Unit

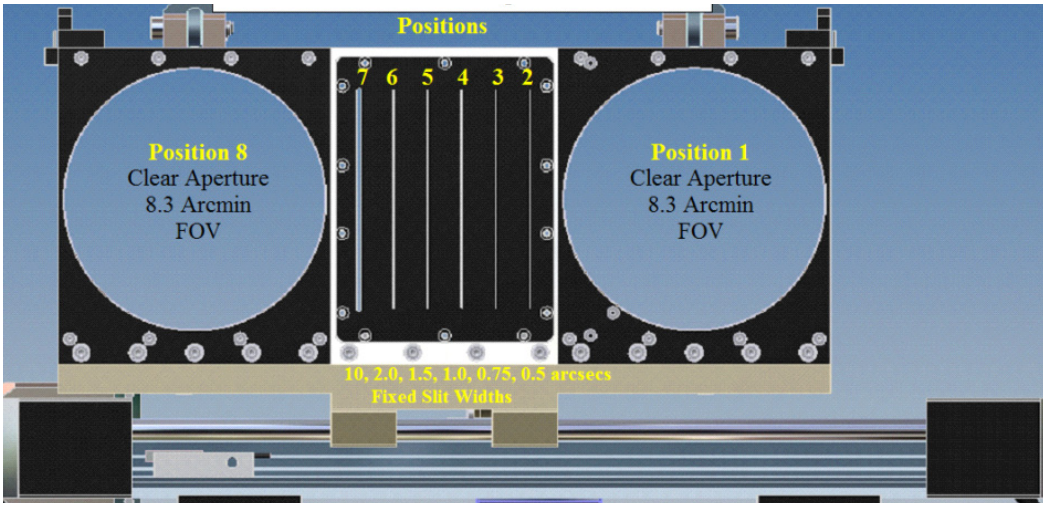

Fig 3. Front view of the slit slide unit

The slit linear slide sits at the telescope's focal plane. The linear slide moves left and right and 8 positions are available. Six of these positions are for slits and 2 positions are clear (Full FOV). Additionally there is a pre-slit mask (see fig 4) that deploys in front of the slits and allows light from the FOV to pass only through the selected slit. The other 2 positions are normally empty and provide a full FOV clear aperture. On the back of the slide, 30 mm behind the two clear apertures there are mounts for filters, allowing observers the option of mounting narrow-band filters (when it's important to minimise any field-radius dependence of central wavelength). These filters can be manually tilted to fine-tune the filter band pass.

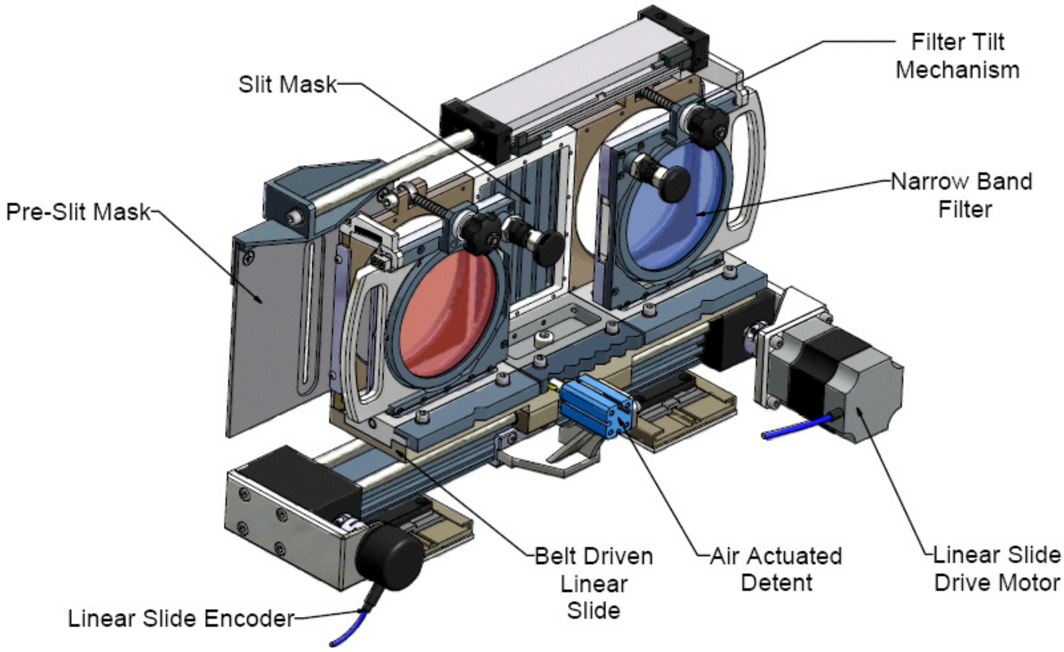

Fig 4. Back view of slit slide unit

An air-operated detent mechanism accurately and repeatably holds the linear slide in place. The linear slide is a continuous belt drive, minimising the overall width of the slide for the given range of travel. The drive system has been designed with backlash in it to allow the detent mechanism to complete final positioning.

<u>Lens 1 Holder.</u>

Lens holder 1 supports the field lens which is made from N-BAK2 and is 140 mm diameter. The field-lens assembly (fig. 5) is fully adjustable for alignment (tilt, centring and piston), which relaxes manufacturing tolerances for the main instrument structure. The lens barrel (fig 10) has the same mounting arrangement and adjusting system.

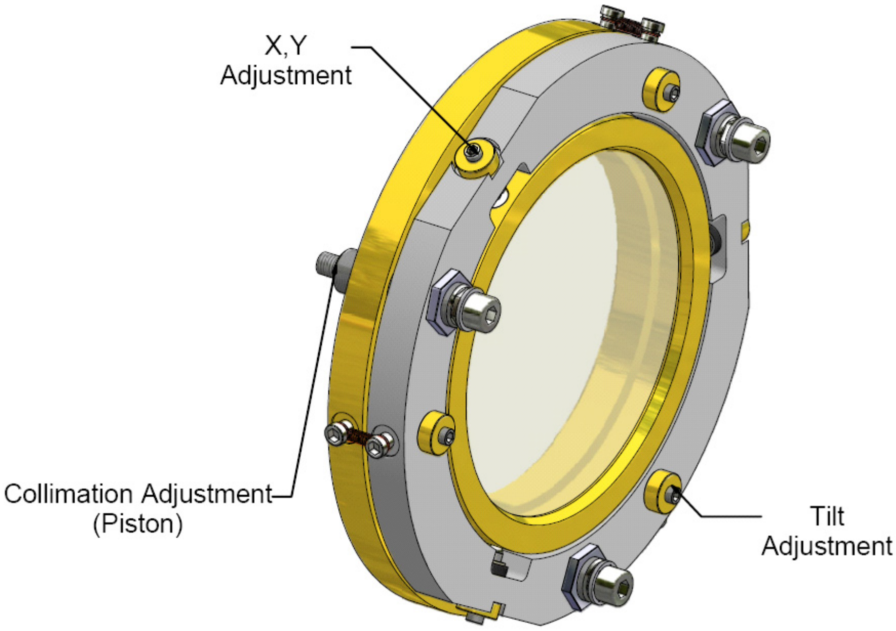

Fig 5. Lens 1 Holder Assembly

Filter Box unit

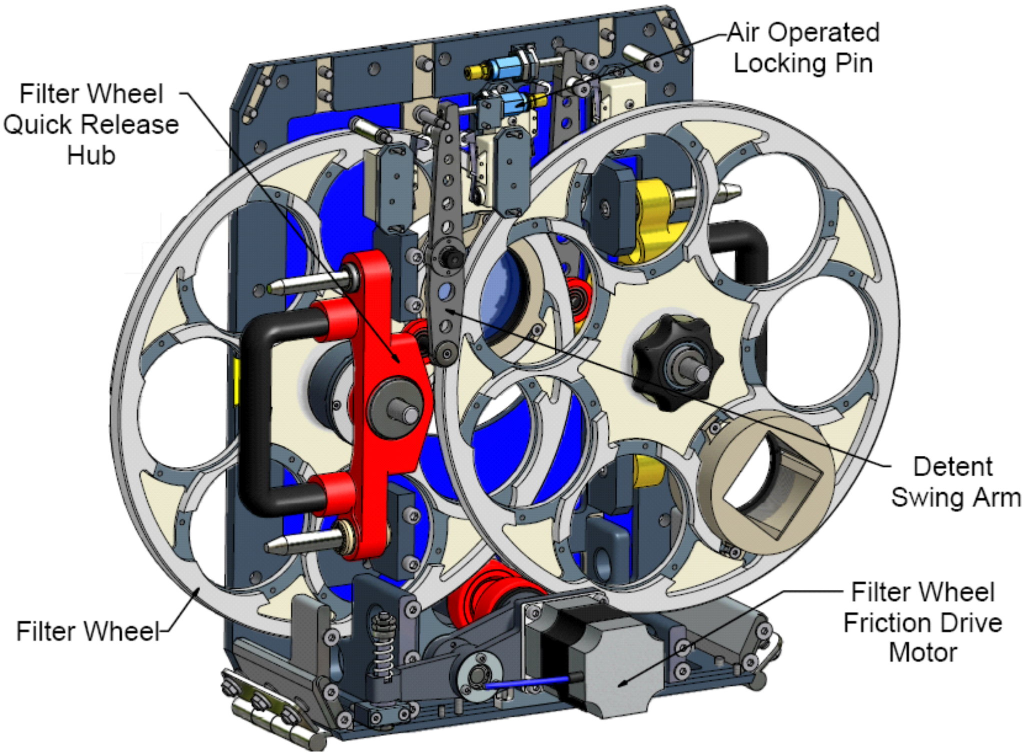

Fig 6. Inside View of the Filter Box Unit

The filter box houses two wheels, a shutter and associated mechanisms. The two wheels rotate to enable different filters or dispersing elements to be placed in the optical light path. The first filter wheel (filter wheel 1) has 7 positions in the standard set up which can house 6 filters leaving 1 clear aperture. The second filter wheel (filter wheel 2) closest to the CCD sits at the pupil plane. This also has 7 positions available one of which is left clear another one houses the dispersing element for spectroscopy and the remaining 5 positions can be used for filters up to 76 mm diameter.

Filter wheel 1 can be exchanged with a non standard wheel for special setups which can accommodate 3 filters up to 125 mm diameter or 4 up to 106 mm diameter. See fig 7

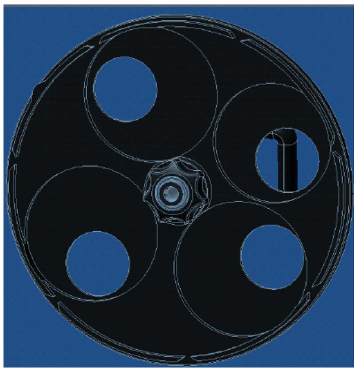

Fig 7. Non standard filter wheel

The whole filter wheel assembly can be removed and placed on the bench by the removal of the central bolt. See fig 8.

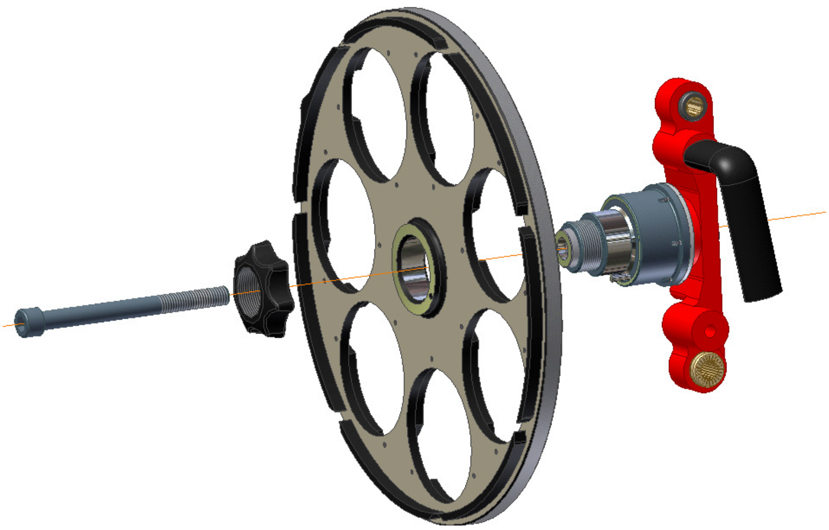

Fig 8. Exploded view of filter wheel assembly.

A friction drive provides rotation and accurate repeatable positioning is achieved through the use of a swing arm detent mechanisms and a air operated locking pin. See fig 6.

A Prontor shutter sits just after filter wheel 2 in the filter box back plate. The shutter is a Prontor Magnetic E/64 with a clear aperture of 64 mm diameter. The shutter electronics have been completely removed. Operation of the shutter has modified to work with pneumatics

Fig 9. Prontor Shutter

Lens Barrel

The lens barrel contains lenses 2 to 6 and is mounted and adjusted in the instrument in the same way as lens 1 holder. In light path order (running left to right in fig 10) the material of each lens is CaF2(L2), N-BAK1(L3), CaF2(L4), S-FPL53(L5), S-LAL7(L6) the biggest diameter lens in the barrel is (L5) 78 mm.

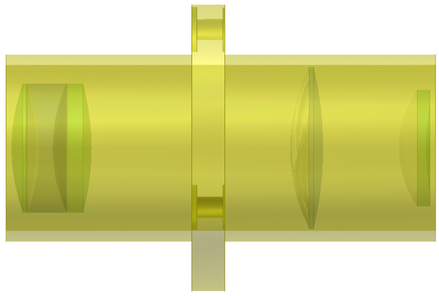

Fig 10. Transparent view of lens barrel

CCD Cryostat Mount

ACam incorporates a standard ING CCD cryostat mount. The CDD is located in place by kinematic mounts and over centre toggle clamps. Although this infers that the CCD can be removed and alignment be maintained it is preferred that the CCD is not removed unless it is unavoidable. The ACam CCD can not be used on any other instrument as the cryostat window has optical power (all other cryostats at ING have a plane flat glass window) and is aligned accurately on axis and for tilt and piston. The mount also includes a sprung loaded baffle to provide a light tight seal with the front face of the CCD cryostat.

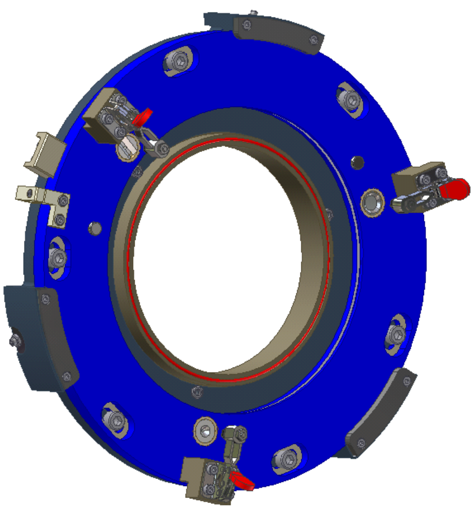

Fig 11. CCD Cryostat Mounting Ring

CCD & Cryostat

The CCD made by E2V is a Deep Depletion type with additional fringe suppression and an AR coating peaking at 900nm Chip type CCD44-82-1-D23. The detector size is 4k x 2k pixels of which only the central 2kx2k is used for ACam. Pixel size is 15 microns.

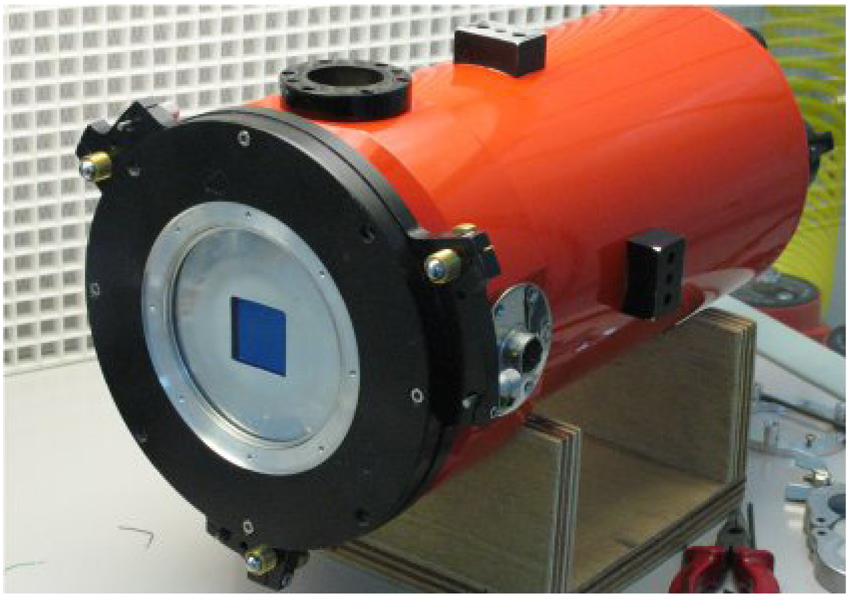

Fig 12. Photo of the ACam CCD and cryostat

The CCD cryostat houses the detector which is under vacuum and cooled with liquid nitrogen. The front face of the CCD cryostat houses lens 7 (fused silica) which also acts a vacuum window. Alignment (tilt & piston) of the CCD detector is achieved using the capstans.

Instrument Control.

All ACam mechanisms can be controlled in engineering (low level) from the PLC and from the telescope observing system (high level).

Low-level control is provided by an Allen Bradley PLC (Programmable Logic Controller). The high-level control software for the control server and the user interface is written in Java and Tcl/Tk respectively.

Kevin Dee 12 July 2009