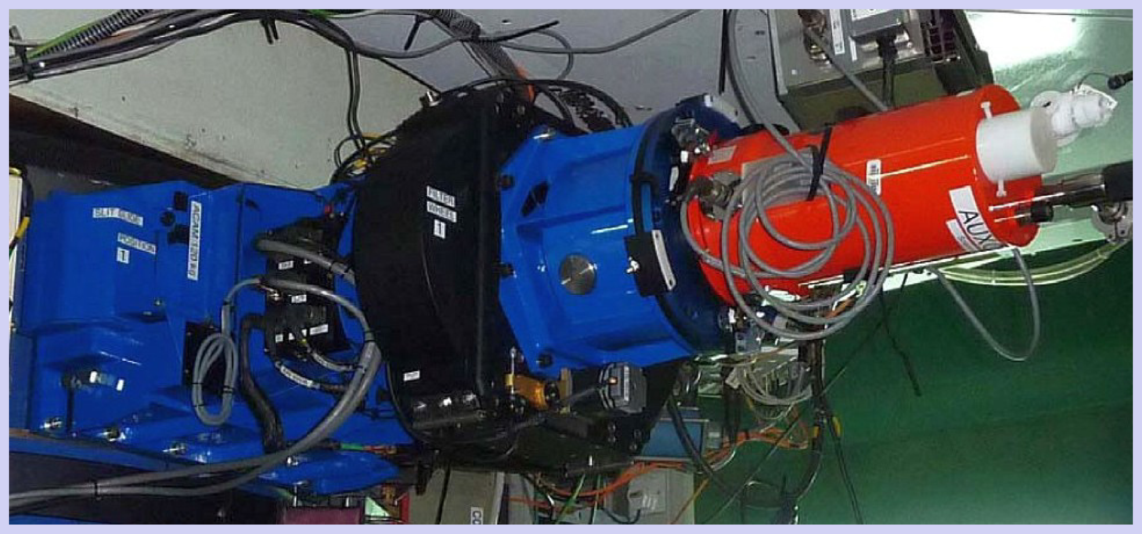
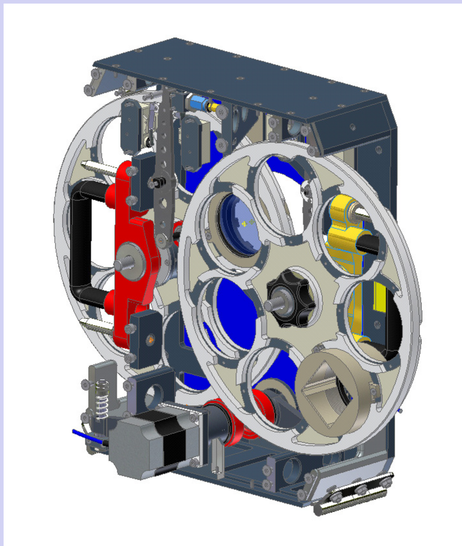
ACAM - A New Imager / Spectrograph at the William Herschel Telescope

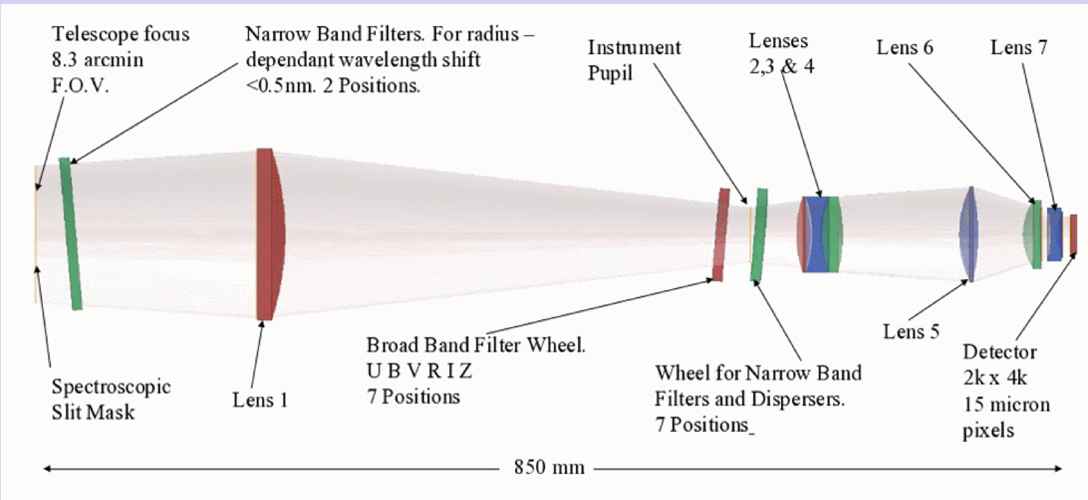
Chris Benn[a], Kevin Dee[b], Tibor Agòcs[c], Lilian Domínguez[a]

[a]Isaac Newton Group, La Palma, Spain; [b]Engineering & Project Solutions Ltd, Warrington, UK; [c]ASTRON, NL

ACAM is a highly-versatile wide-field imager/spectrograph, mounted permanently at a folded-Cassegrain focus of the 4.2-m William Herschel Telescope. The field of view in imaging mode is 8.3 arcmin. In spectroscopic mode, the resolution is R ~ 600 in the red. ACAM is ideal for programmes requiring high throughput (up to twice that of ISIS), unusual (e.g. custom) filters, rapid response (e.g. supernovae) or observations over several nights (e.g. exoplanet transits). During the first two years of operation ACAM has proved popular with observers, and has been used for imaging or spectroscopy of a broad range of objects from comets and exoplanets to supernovae and gamma-ray bursts.







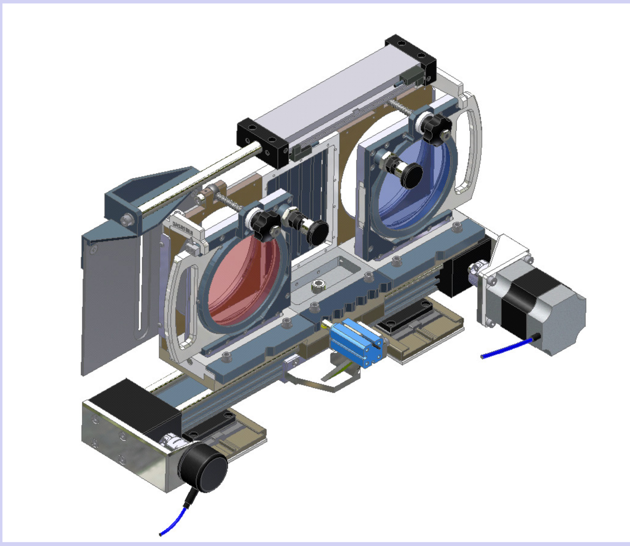


Fig. 1. ACAM is mounted at a folded-Cassegrain f/11 focus of the WHT (top left). The black central section houses the filter wheels (shown top right). The 7-lens optical train (bottom left) is designed to deliver excellent (i.e. << seeing) image quality across the whole 8.3-arcmin field of view, at wavelengths 350 – 950 nm. For robustness, and ease of alignment, lenses 2 to 6 (Fig. 1) are mounted in one lens barrel. Lens 7 is the (optically-active) CCD window.

ACAM can be switched from imaging to spectroscopy mode in about 30 seconds, by (1) rotating into the near-pupil beam a 400 lines/mm VPH, housed in one of the filter wheels, and (2) sliding one of six fixed-width slits to the centre of the focal plane.

The focal-plane slit slide (bottom right) can also be used to mount narrow-band filters. This is sometimes used when imaging extended objects through narrow-band filters, to avoid the small radius-dependent wavelength shift which occurs when a filter is mounted in the near-pupil wheels.

Fig. 2. Commissioning images of M51 and of the moon. ACAM has a circular field of view, diameter 8.3 arcmin. Two factors limited the choice of field of view: (1) the rapid rise with increasing radius, of the cost and complexity of an optical design delivering good panchromatic PSFs at all radii; and (2) the need to minimise vignetting of the (off-axis) patrol field of the Cassegrain autoguider. At a scale of 0.25 arcsec/pixel (chosen to sample adequately the best La Palma seeing), an 8.3-arcmin field of view is accommodated by the central 2k x 2k pixels of a low-fringing EEV CCD. (M51 image by Pablo Rodriguez and Andrew Cardwell).

Fig. 3. The ACAM commissioning team celebrating first light, 9 June 2009. From left to right: Carlos Martin, Craige Bevil, Tibor Agocs, Kevin Dee, Chris Benn, Andrew Cardwell, Pablo Rodriguez, Don Abrams.

Fig. 4. ACAM images taken near the moon suffer from scattered moonlight (above left). A 'Chinese lantern' of plate baffles was installed in the WHT's below-Nasmyth turret in November 2011 (above right, before and after installation), and has reduced the intensity of the scattered light by ~ 70%. Investigations continue.

SCIENCE WITH ACAM

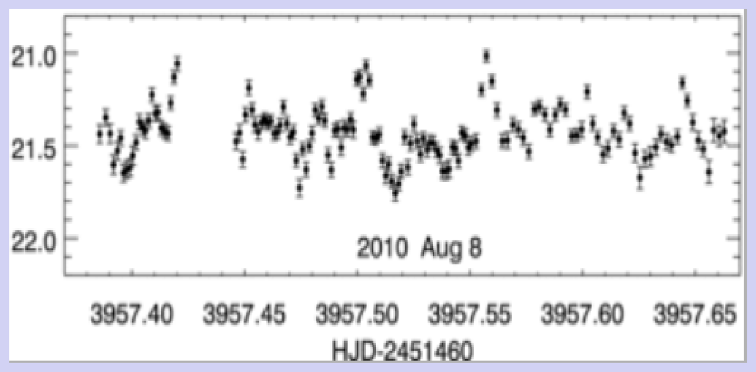


Fig. 5. ACAM photometry of the X-ray transient (and black-hole candidate) XTE J1859+226. The short integration time (120 sec) resolves flickering activity which had previously hindered measurement of the true orbital period. The measured period of 6.6 hours, combined with radial-velocity data from GTC/OSIRIS, implies the presence of a 5-solar-mass black hole, constraining the mass distribution of compact objects in our galaxy, and models for the evolution of massive stars.

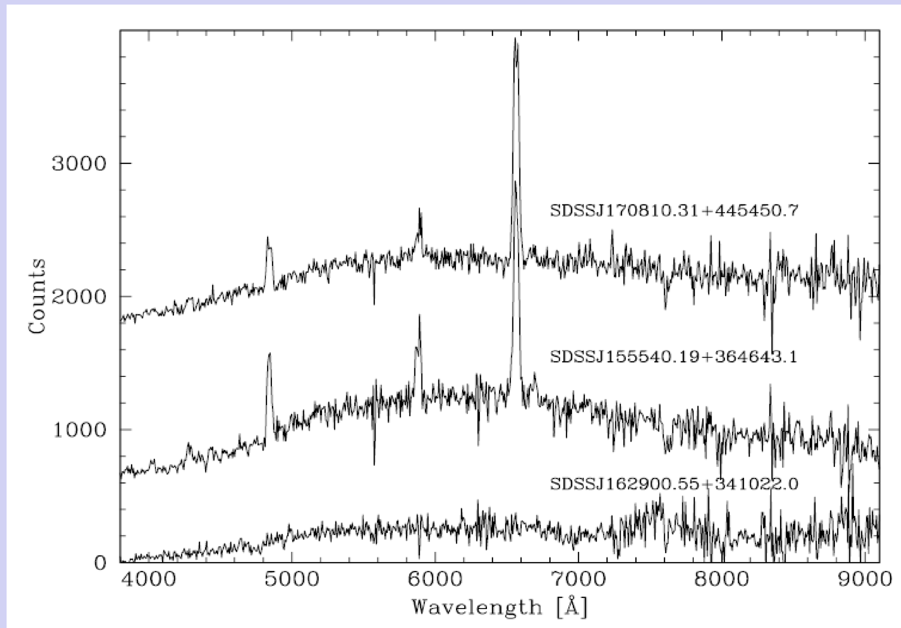


Fig. 6. A sample of candidate dwarf novae was obtained by cross-matching the SDSS and GALEX catalogues (Wils et al, 2010, MNRAS, 402, 436). The above ACAM spectra confirm three of these objects as dwarf novae, and in conjunction with further spectra from GEMINI/GMOS, suggest the existence of a population of intrinsically-faint novae with rare outbursts.

ACAM was designed to exploit the large field of view available at the WHT Cassegrain focus, and to provide a versatile, permanently-available instrument which is expected, for many years to come, to be a useful complement to more specialised instrumentation on larger telescopes (e.g. GTC).

ACAM is a popular instrument on the WHT, particularly for service observations, and for targets of opportunity, and currently accounts for ~10% of the WHT papers published in refereed journals.

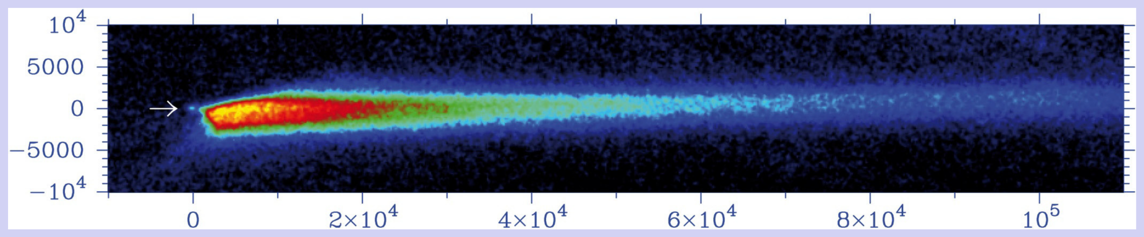


Fig. 7. Comet P/2010 A2 is the closest main-belt comet (activated asteroid) so far discovered. Images obtained with ACAM (above) and GTC/OSIRIS show the asteroidal nucleus detached from the dust tail. The brightness distribution implies that the tail comprises 0.3% the mass of the nucleus, released over a period ~ 8 months (Moreno et al, 2010, ApJ, L718).

http://www.ing.iac.es/Astronomy/instruments/ACAM crb@ing.iac.es kevin.dee@engpro.co.uk tibor@ing.iac.es ldp@ing.iac.es