Instrumentation Plans for the Anglo-Australian Observatory

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Abstract

Plans for future instrumentation for the Anglo-Australian Telescope are described. Current projects for the AAT include the IRIS-2 infrared camera and spectrometer, and a new controller system to be used with the IR detector and CCDs. The Six Degree Field (6dF) fibre spectroscopy system is being developed for the Schmidt telescope, following on from the successful development of 2dF for the AAT. A design study is now underway for a new advanced spectrograph (ATLAS) based on the use of volume phase holographic (VPH) gratings.

Key words: AAO; Telescopes; Instrumentation

1 Introduction

The main instrument projects for the AAO are summarized in Table 1. It can be seen that the emphasis is on wide field instruments appropriate for survey type observing. This is an appropriate role for the AAT in the era of 8–10-m class telescopes. However, the AAO also aims in its instrumentation program to develop innovative ideas which may subsequently be used for larger telescopes. For example our successful development of 2dF has led to AAO getting the contract to develop a fibre positioner for the ESO/VLT.

Table 1
New AAO Instrumentation

Instrument	Field	Range	Resolution	Date
2dF	2°	0.35–0.9μm	600–5000	Now
IRIS-2	7.7 min	1-2.4μm	Broadband	07/00
			1500–3000	
PFU/WFI	33 min	0.35–1.0μm	Broadband	12/99
6dF	6°	0.35–0.9μm	500–2000	09/00
ATLAS	24 min	0.37–1.1μm	1500–10000	?

2 Fibre Spectroscopy

The two degree field (2dF) project has been the main instrument project at the AAO until recently. 2dF is a multi-fibre spectrograph enabling observations of 400 objects over a two degree field on the sky. It mounts at the AAT prime focus. The instrument now meets all its major deign goals, providing configuration of 400 fibres in under an hour, and achieving a high level of reliability. The 2dF is being used for a major galaxy redshift survey which will eventually cover 250,000 galaxies (Colless 1999a, Colless 1999b). By July 1999 redshifts of 49636 galaxies had been measured.

A new fibre spectroscopy system is now being developed to operate over a six degree field (6dF) on the Schmidt telescope. 6dF will have 150 fibres positioned by an r,θ positioning robot. It will be used for projects such as a redshift survey of galaxies found by the DENIS and 2MASS infrared surveys.

3 IRIS-2

IRIS-2 is a near infrared imager and spectrograph for the AAT based on a 1024$\times$1024 Rockwell HgCdTe array. The optical system is a fully transmitting collimator/camera which reimages the f/8 focus of the AAT onto the array at f/2.2 giving a 7.7 minute field with 0.45 arcsec pixels. The instrument can also be used with the f/15 or f/36 secondaries to achieve smaller pixel sizes. Grisms can be placed in the collimated beam to obtain spectroscopy with resolution of $\sim$2000. A number of upgrade options are possible including a multi-object capability, polarimetry, and an upgrade to a 2048$\times$2048 array.

In conjunction with the IRIS-2 project the AAO is developing a new array controller which will be used initially with the IR array, but also for CCD systems. The new controller will provide high readout speeds and support for multiple readout devices. The data acquisition software will run on VxWorks and Solaris systems in the DRAMA environment and will allow the phasing out of our VAX/ADAM systems.

4 Prime Focus Upgrade / Wide Field Imager

The upgrade of the prime focus imaging facility at the AAT will provide automated filter changing and shutter at the prime focus and is designed for use with the Wide Field Imager (WFI) being developed by the Research School of Astronomy and Astrophysics at ANU. The WFI will use an 8K×8K mosaic array using 8 CCDs made by MIT Lincoln Labs. On the AAT this will give a 33 minute field with 0.248 arc second pixels. The WFI will be shared between the AAT and the ANU 1-m telescope on the Siding Spring observatory site.

5 VPH Gratings and ATLAS

Volume Phase Holographic (VPH) gratings (Barden 1998) are constructed by introducing modulations of refractive index into a layer of dichromated gelatin mounted on a glass substrate. VPH gratings offer very high efficiencies (∼90% at peak compared with ∼60% for a conventional surface grating). Because of the significant thickness of the grating, the peak efficiency is obtained in directions obeying the Bragg condition (effectively specular reflection from the refractive index modulations). This has the consequence that the wavelength of peak efficiency of a grating can be changed by tilting the grating, something which is not possible with a surface grating which has a fixed blaze angle. However to take advantage of this capability a spectrograph must be designed with the ability to change the angle between collimator and camera.

A VPH grating has recently been used successfully on the AAT as part of an upgrade to the Low Dispersion Survey Spectrograph (LDSS). The LDSS++ upgrade replaced the standard grism with a VPH grism, uses an MIT Lincoln Labs deep depletion CCD with very good red response, and introduces an observing mode in which telescope nodding is synchronized with CCD charge shuffling to provide excellent sky subtraction. These upgrades result in a very efficient red spectrograph which has been successfully used for projects such as a redshift survey in the Hubble deep field south.

The AAO has now begun a detailed design study for a new spectrograph based on VPH gratings to replace the existing RGO spectrograph as well as

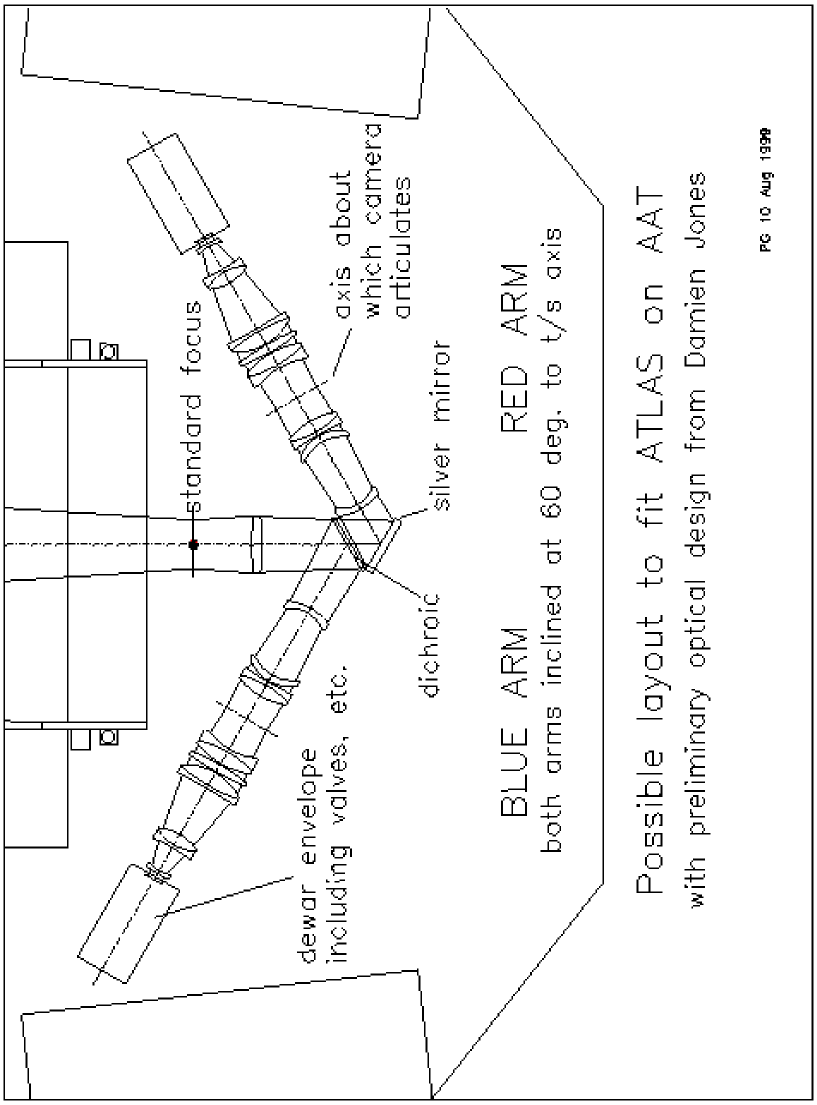

Fig. 1. Schematic showing the ATLAS design

LDSS. The instrument is known as ATLAS (AAO Tunable Littrow Articulated Spectrograph).

The ATLAS concept consists of transmitting collimators and cameras with a 150mm collimated beam size. The instrument will cover a field of 24 arc minutes using an f/2.2 camera and a 4K×4K CCD. The camera is articulated so that it can accomodate collimator-grating-camera angles from 0° (straight though position for Taurus mode or direct imaging) up to 90° or more for high dispersion gratings. Resolutions from 1 500 to 10 000 can be achieved using a 1.5 arc second slit and possibly as high as 18 000 using an Integral Field Unit. The instrument will be a dual beam system using a dichroic to separate blue and red arms, each of which will have its own collimator/camera system. The wide field combined with high efficiency will allow ATLAS to be used effectively as a multi-object spectrograph in a similar mode to that used with LDSS++.

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