

Science and Technology Facilities Council
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PATT2
Version 02/2013

APPLICATION FOR TELESCOPE TIME (OPTICAL AND INFRARED)

1 TELESCOPE (AAT, UKST, WHT, INT or UKIRT)		WHT	Reference:	Date stamp:
2 SEMESTER		2020B	3 SCIENTIFIC CATEGORY	4
4 COORDINATED PATT PROPOSALS		AAT: <input type="checkbox"/> UKST: <input type="checkbox"/> WHT: <input type="checkbox"/> INT: <input type="checkbox"/> UKIRT: <input type="checkbox"/> JCMT: <input type="checkbox"/> GEMINI: <input type="checkbox"/> LT: <input type="checkbox"/> MERLIN: <input type="checkbox"/>		
5 PRINCIPAL APPLICANT				
Surname: Lintott Title: Prof First name: Chris Post held: Professor of Astrophysics/Citizen Science Lead Address: University of Oxford Department of Astrophysics, Denys Wilkinson Building Keble Road, Oxford, OX1 3RH, UK				
Telephone: 00441865273638		Fax:	Is the applicant a possible observer? Yes	
E-mail: chris.lintott@physics.ox.ac.uk				
6 COLLABORATORS				
Name:		Institute:	Observer?	
Dr Rebecca Smethurst		University of Oxford	Yes	
Mr Tobias Geron		University of Oxford	Yes	
Dr Brooke Simmons		Lancaster University	No	
7 SHORT TITLE OF PROPOSAL (maximum 12 words)				
Are weak bars the progenitors of strong bars?				
8 SUMMARY OF PROPOSED OBSERVATIONS				
We will do great science. Huge.				
9 FOCAL STATION, INSTRUMENT AND DETECTOR				
Focal station:		Instrument:	Detector(s):	Gratings/Filters:
f/11	ISIS	EEV12, RED+	R300B, R316R	
10 OBSERVING TIME REQUESTED THIS SEMESTER				
Time requested this semester		Dark: <input type="text" value="3"/>	Grey: <input type="text"/>	Bright: <input type="text"/>
Minimum useful allocation this semester		Dark: <input type="text" value="3"/>	Grey: <input type="text"/>	Bright: <input type="text"/>
				specify nights or weeks: <input type="text" value="Nights"/>
<i>UKIRT applicants requiring dark time must justify this in section 18</i>				
11 COMPLETE THIS SECTION ONLY IF THIS IS A LONG TERM PROPOSAL				
Total time requested		Dark: <input type="text"/>	Grey: <input type="text"/>	Bright: <input type="text"/>
				specify nights or weeks: <input type="text"/>

12 SCHEDULING INFORMATION

Preferred dates:

Autumn

Impossible dates:

Give justification for impossible dates

Wrong RAs

If observations are to be simultaneous with other telescopes or satellites, give details:

Any other scheduling constraints:

*Include likely clashes with other time applications, constraints on lunar position or quarter, instrument preparation requirements, etc***13 SERVICE OBSERVING**

yes:

no:

maybe:

14 SUPPORT ASTRONOMER REQUESTED AT TELESCOPE

every night:

no:

first night only:

15 LIST OF PRINCIPAL TARGETS

Object(s):

RA(h,m):

Dec(degs):

Mag(type):

Colour:

Exp. Time:

16 LIST ALL SIMILAR/SUPPORTING APPLICATIONS TO ANY PATT OR OTHER TIME ASSIGNMENT COMMITTEE*You must include a brief description of any other applications whose targets or science goals are similar to those requested here*

Telescope/satellite:

Title/Description of programme:

Understanding the role that internal processes play in galaxy evolution is a key goal of modern astrophysics. An increasing body of evidence shows that galaxy growth is mainly dependent on such processes rather than galaxy mergers; ?, for example, have shown that only 27% of star formation is triggered by major or minor mergers. The focus has therefore shifted to trying to determine the dominant mechanisms responsible for galaxy growth and the quenching (or cessation) of star formation. One such process is the funneling of gas from the outskirts of a galaxy by a galactic-scale bar. Bars are thought to remove gas needed for star formation in the outer regions and deposit it in the centre where it either triggers a starburst or is too dynamically hot to be used for future star formation. In either the case, the eventual result is thought to be that the galaxy has a lower star formation rate than before the formation of the bar, moving the galaxy from the blue cloud to the red sequence.

One question that remains unanswered however is whether this only occurs in the strongest of barred galaxies, where the bar is the dominant feature. A large range of bar strengths is seen across the galaxy population with a broad distribution of bar lengths, widths and relative sizes (see Figure). Most previous studies have focussed their efforts on the strong bar population which are easier to select from galaxy surveys since they are brighter and constitute the main feature of the galaxy. In contrast, there are a few studies which then specifically target weaker bars to determine their effects on the galaxy. However, it is not known if weak and strong bars are a dichotomy in the barred galaxy population or a continuous distribution of the same feature with similar effects.

In this project we propose to observe a mass-matched sample of strong and weak bars along with a control sample of no bars in order to characterise the effects of bars and the impact of strong and weak bars. We will use the ISIS spectrograph on the WHT to obtain spectra along and perpendicular to the bar for each target (unbarred galaxies will have the slit aligned along the major and minor axes). The flexibility provided by the choice in gratings makes ISIS the ideal instrument to achieve our science goals. In particular, resolving the emission lines in each target across a large range of wavelengths will allow us to determine the gas kinematics along and perpendicular to the bar. We aim to test whether there is a significant inflow of gas along the bar, compared to outside the bar (and the control sample of unbarred galaxies) and therefore whether bars are indeed a significant driver of galaxy evolution. Complementary to this we will test whether there is a significant difference in the gas kinematics of strong and weak bars in order to determine if weak bars are a separate phenomenon to strong bars or part of a continuous distribution. Do weak bars drive gas to the centre of a galaxy at the same or different rates to strong bars?

The simultaneous observation of both the blue and red side of the spectrum with IDIS will also allow us to determine the star formation rates within and outside the bar using $H\alpha$ on the red side, and $Dn4000\text{\AA}$ [OIII] on the blue side. These resolved star formation rates will be crucial to determining if the bar is indeed responsible for any change in the star formation rate in these galaxies. Once again we will also test the differences between the resolved star formation rates of strong and weak bars to determine whether both types of structures are able to quench the star formation in a galaxy.

We aim to publish two papers as a result of these observations: (1) determining the gas kinematics for each of our targets to determine which structures (if any) are inflowing gas to the centres and (2) constraining the star formation rates inside and outside of the bar to determine whether either strong or weak bars are directly responsible for quenching galaxies.

17 SCIENTIFIC JUSTIFICATION

Continuation page for AAT, WHT and UKIRT proposals for 8 or more nights, and for all long-term and coordinated proposals

18 TECHNICAL INFORMATION (I)

Give details of the technical feasibility of the proposal (S/N,etc) AND any non-standard technical requirements

PARAGRAPH FROM TOBIAS ABOUT SAMPLE SELECTION.

The ISIS spectrograph on the WHT is ideal for observing this sample as it allows the simultaneous observation of the red and blue sides of the spectrum in combination with the flexibility of the gratings available. This allows us to optimise the wavelength range targeted against the spectral resolution in order to maximise the science output. We therefore propose to target the $H\alpha$ emission line in each of our sources with the R316B grating on the RED+ detector, with simultaneous observations of the $D_n 4000\text{\AA}$ break- $H\beta$ -[OIII] region using the R300B on the EEV12 detector. Probing these regions of the spectrum specifically will allow us to observe a maximum number of emission lines to derive precise gas kinematics whilst also allowing for an accurate determination of the resolved star formation rate in and outside the bar.

In order to derive an accurate measure of the gas inflow rates in our targets, we need to be able to determine the gas kinematics. We will utilise the tried and tested PPXF spectral fitting code (?) to derive the velocity of the gas along the bar for each of our targets. To do this we require a high signal-to-noise ratio (SNR) to ensure that each of the emission lines in the sample are well resolved. To achieve a $SNR = 10$ for each of our targets we calculated an exposure time given the quantum efficiency of the detectors at the redshifted wavelength of $H\alpha$ and assuming negligible sky background on dark sky nights with respect to the read noise of the EEV12 and RED+ detectors. Given these requirements the total on source time is ??? minutes, assuming a seeing of 1" and optimal airmass conditions. The minimum (maximum) exposure time for a single source is ?? (??) minutes.

Using this information combined with the overhead estimates from the ISIS Total Observing Time Estimator and assuming an average weather downtime of ??% in ??, we calculate that we can observe all 30 targets in ?? nights of dark skies in ?? of the 2020 semester.

18 TECHNICAL INFORMATION (II)

References and Figures

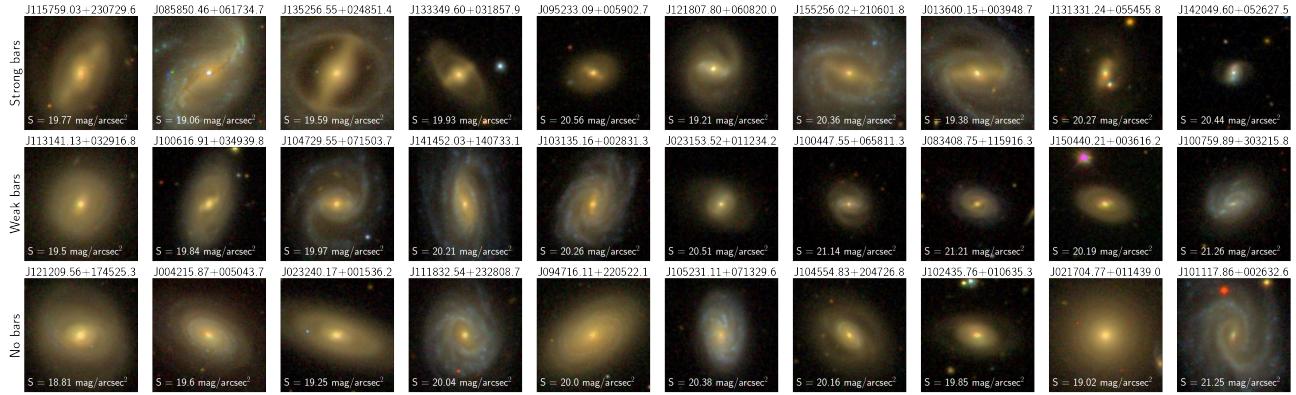


Figure 1: Mosaic of SDSS postage stamps of sample. Strong bars (top), weak bars (middle) and no bars (bottom) with surface brightness shown.

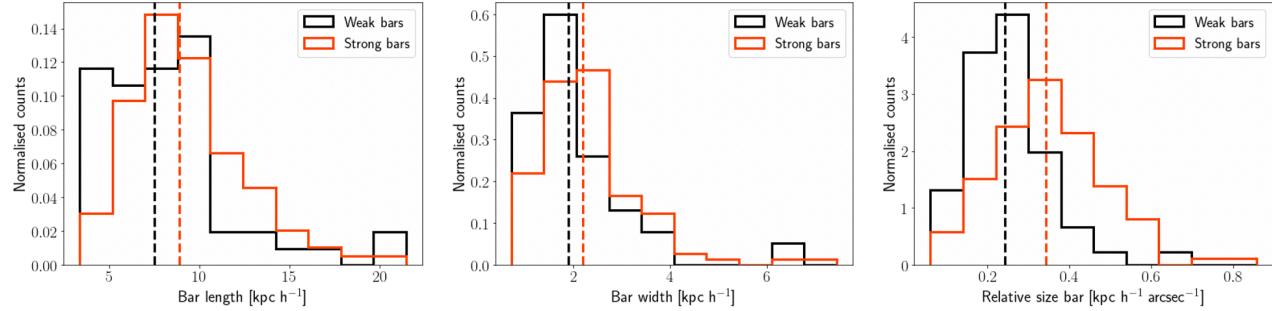


Figure 2: Histograms showing bar properties.

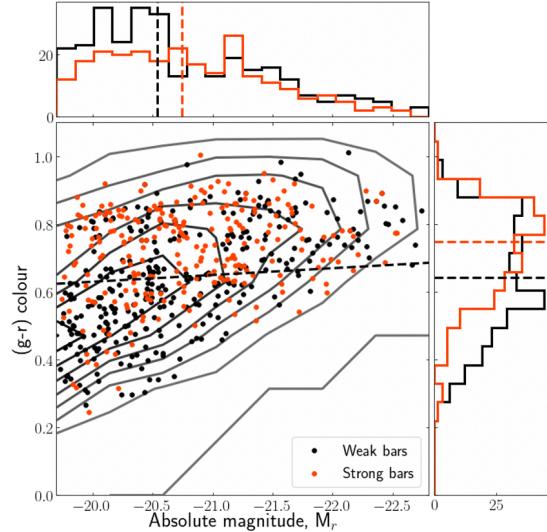


Figure 3: Colour magnitude diagram suggesting strong and weak bars are separate populations, with strong bars causing quenching.

19 SUMMARY OF BACKUP PROGRAMME FOR POOR OBSERVING CONDITIONS*If instrumentation or setup differs from main programme, give full details***20 RELATED PATT APPLICATIONS OVER THE LAST FOUR SEMESTERS (including unsuccessful applications)**

PATT reference: Award: Clear nights: Comments:

21 PUBLICATIONS BASED ON PATT TIME PUBLISHED DURING THE LAST FOUR SEMESTERS (maximum 6)**22 EXPERIENCE OF INTENDED OBSERVERS WHO HAVE NOT PREVIOUSLY USED THIS TELESCOPE****23 COMPLETE IF THE OBSERVATIONS ARE PRIMARILY FOR A STUDENT RESEARCH TRAINING PROGRAMME**

Name of student:

Project title:

24 COMPLETE IF THE OBSERVATIONS ARE ASSOCIATED WITH A CURRENT STFC RESEARCH GRANT

Name of principal investigator:

Grant title:

Grant number:

25 NON-STANDARD TRAVEL AND SUBSISTENCE REQUIREMENTS (UK observers only)

Justify requests for travel and subsistence for more than one person:

Details of any other expenditure (eg freight, remote observing):