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Posters

Poster	Title	Authors	Meeting
https://cloudone.ing.iac.es:8081/sharing/xHPrrF9Lk	Collection of posters shown at the WEAVE inauguration exhibit at the WHT	Various	WEAVE Inauguration - 30th October 2023



INTRODUCTION

In this work we present the coatings of the spectrograph red camera of WEAVE-the new multi-object survey facility for the 4.2m William Herschel Telescope. The initial requirements of WEAVE red camera lenses, with reflectances as low as 0.4% through the wavelength interval from 590 nm to 959 nm at angles of incidence of $18^\circ \pm 17^\circ$ represented a challenge for both design and production.

AR coating AOI specification

A detailed analysis was carried out regarding the AOI specification of the camera coatings. Based in Zemax ray tracing, RAL Space provided histograms of the AOI of different rays at each interface airglass for the spherical camera lenses.

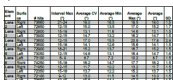


Table 1. Ray tracing over the different surfaces of the spectrometer optics.

Designs

Several designs were developed and the advantages of each were evaluated. The teams of INAOE and CIO collaborated very closely to achieve the best solutions.

Figure 1. Six layer coatings for different substrates

DATA ANALYSIS

The coating evaporations were performed at CIO in the Integrity 30 Denton Vacuum Deposition System. In all the depositions at least a witness samples is included to evaluate the coating quality by measuring afterwards the transmittance of the sample(s).

To be able to calculate the reflectance at other AOI it is indispensable to find the design corresponding to the actual reflectance measured experimentally. A re-optimization through damped least squares of the design is done, using the experimental data as boundary to fit a theoretical model.

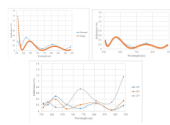


Figure 2: Top left: experimental data and theoretical reflectance, after removing Fresnel reflections from the second surface. Top right: Re-optimized design that fits the experimental data. Bottom: data extrapolation to non-normal AOI.

Repeatability

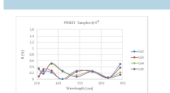


Figure 3 Reflectance obtained in different section num.

Reflectance results for two PBMZY witness samples in two different depositions for the same coating prescription. Samples L62 y L64 were coated in the first run and L63 y L65 in the second one.

FINAL COATINGS

Lens 6 and Lens 7 (PBM2Y)

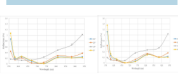


Figure 4. Reflectance obtained for PBMZY Lens 6 and Lens 7, Surface 1.

Lens 4 (PBL1Y)

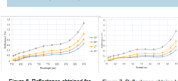


Figure 6. Reflectance obtained for PBL1Y Lens 4, Surface 1.

Lens 8 (SLAL-9)

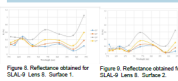


Figure 8. Reflectance obtained for SLAL-Q Lens 8, Surface 1.

CONCLUSIONS

Great amount of R&D has been done in the determination of the most suitable material combination and optimal optical properties of AR coatings for the specific case of WEAVE. The requirements are large AOI and a medium size spectral range. Red Camera coatings are soon to be finished and the Blue Camera along with its AR coatings are under development.

^aInstituto Nacional de Astrofísica, Óptica y Electrónica (Mexico). ^bCentro de Investigaciones en Óptica (Mexico). ^cDepartment of Physics, University of Oxford (UK). ^dSTFC Rutherford Appleton Laboratory (UK). ^eKapteyn Institut, Rijksuniversiteit Groningen (Netherlands). ^fInstituto de Astrofísica de Canarias (Spain). ^gIGEP Observatoire de Paris, CNRS (France). ^hOsservatorio Astronomico di Padova INAF (Italy). ⁱIsaac Newton Group (Spain). ^jtoriz@inao.es

Antireflective coatings for the red camera of WEAVE

Ortiz (INAOE) et al.

"SPIE Astronomical
Telescopes +
Instrumentation",
Texas, USA, 10-14
June 2018



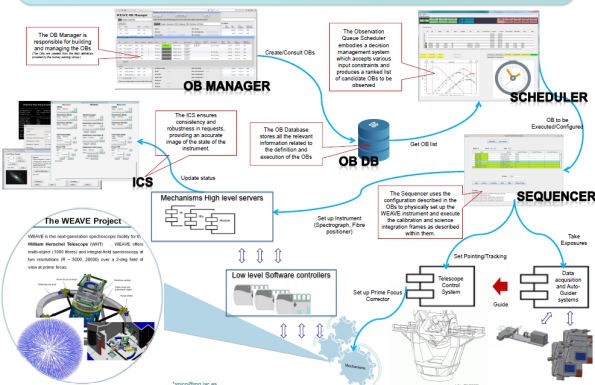
The WEAVE Observatory Control System



Sergio Picó^{1a}, Don Carlos Abrams^{2a}, Chris Benn³, Lilian Domínguez Palmero⁴, Cecilia Farfán⁵, Jose Miguel Delgado⁶, Carlos Martín⁷, Diego Cano⁸, Bernardo Salasnick⁹, Steve Guest¹⁰, Frank Gibbin¹¹, Jure Skvarc¹², Emanuel Gaulton¹³, Gavin Dalton¹⁴, Kevin Middleton¹⁵, Scott Tragger¹⁶, J. Alfonso Aguero¹⁷, Piercarlo Bonifacio¹⁸, Antonella Vallenar¹⁹, Esperanza Carrasco²⁰

¹NASA Newton Group, 28700 Santa Cruz de La Palma, Spain; ²Instituto de Astrofísica de Canarias, 38200 La Laguna, Tenerife, Spain; ³Osservatorio Astronomico di Padova, INAF, Vicolo Osservatorio 3, 35122, Padova, Italy; ⁴UK Space, STFC Rutherford Appleton Laboratory, Harwell Oxford, OX11 0QX, UK; ⁵Dept. of Physics, University of Oxford, Keble Road, Oxford, OX1 3RH, UK; ⁶Kapteyn Institut, Rijksuniversiteit Groningen, Postbus 800, NL-9700 AB Groningen, Netherlands; ⁷IGEP, Observatoire de Paris, Université PSL, CNRS, Place Jussieu, 82195 Meudon, France; ⁸INAOE, La Frontera s/n, Tonantzietla, Puebla, Mexico

The Observatory Control System (OCS) is responsible for providing the software control and feedback framework through which WEAVE will be operated. It is built upon the existing software infrastructure in place at the **William Herschel Telescope**, the Instrument Control System (ICS), adding scheduling and sequencing capabilities. All the information related with a WEAVE observation is grouped in an entity denominated **Observing Block** (OB).

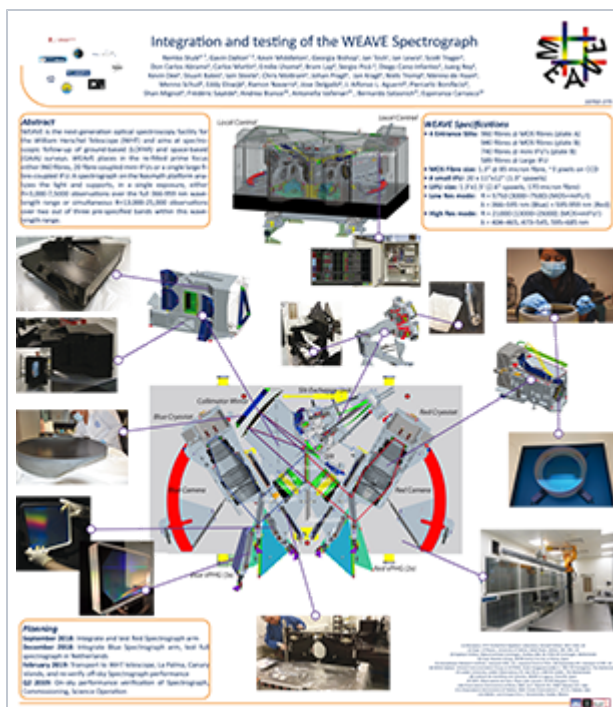


First light: WHT, La Palma, 2019

The WEAVE Observatory Control System

Picó (ING) et al.

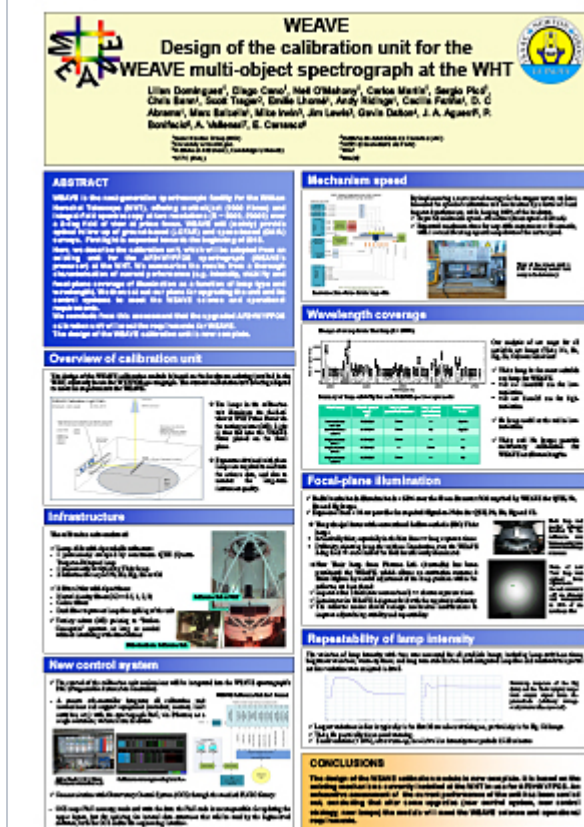
"SPIE Astronomical
Telescopes +
Instrumentation",
Texas, USA, 10-14
June 2018



Integration and testing of the WEAVE Spectrograph

Remko Stuik (NOVA) et al.

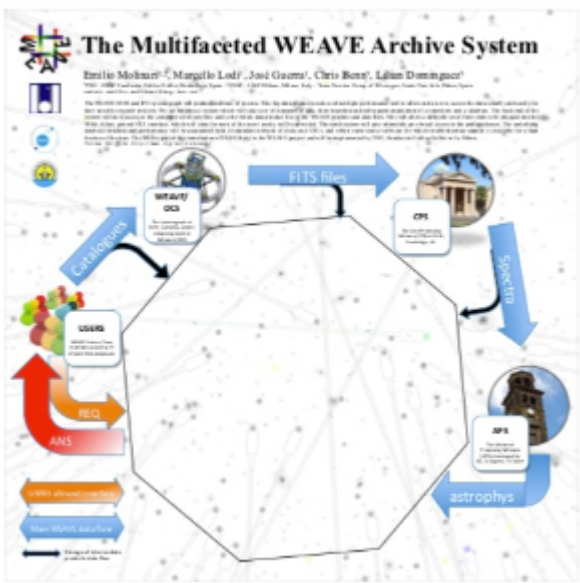
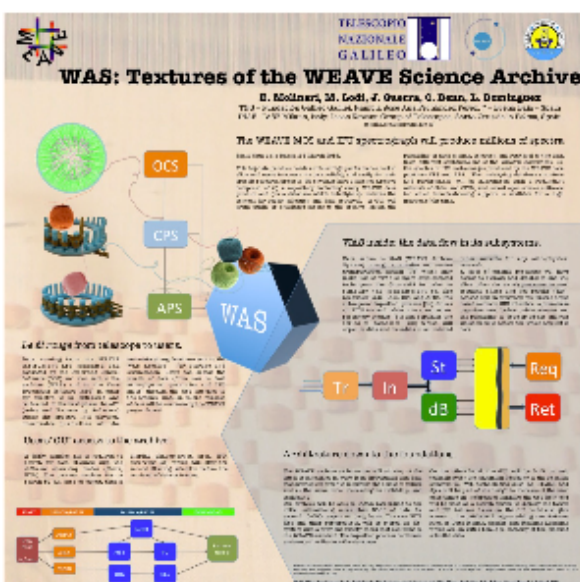
"SPIE Astronomical
Telescopes +
Instrumentation",
Texas, USA, 10-14
June 2018



Design of the calibration unit for the WEAVE multi-object spectrograph at the WHT

Lilian Domínguez (ING) et al.

"SPIE Astronomical
Telescopes +
Instrumentation",
Edinburgh, UK, 26 June
- 1 July 2016

 The Multifaceted WEAVE Archive System Enrico Molinari¹, Margale Lod², José Guzmán³, Chris Raux⁴, Lluís Dominguez⁵ ¹INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ²INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ³INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ⁴INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ⁵INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy The WEAVE archive is a multi-faceted system that provides a wide range of services to the astronomical community. It is designed to be a central hub for the storage and distribution of astronomical data, and to provide a variety of tools and services for the analysis and visualization of this data. The archive is organized into several layers, each with its own set of services and tools. The top layer is the FITS Files layer, which provides access to the raw data. The next layer is the Catalogues layer, which provides access to the data in a structured format. The third layer is the Visualisation layer, which provides access to the data in a graphical format. The bottom layer is the Analysis layer, which provides access to the data in a processed format. The archive is also integrated with a variety of external services, including the VizieR service for data access and the SIMBAD service for object identification.	The Multifaceted WEAVE Archive System	Molinari (INAF) et al.	EWASS, Tenerife, June 2015
 WAS: Textures of the WEAVE Science Archive Enrico Molinari¹, Margale Lod², José Guzmán³, Chris Raux⁴, Lluís Dominguez⁵ ¹INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ²INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ³INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ⁴INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy; ⁵INAF - Osservatorio Astronomico di Brera, 20121 Milano, Italy The WAS (WEAVE Science Archive) is a multi-faceted system that provides a wide range of services to the astronomical community. It is designed to be a central hub for the storage and distribution of astronomical data, and to provide a variety of tools and services for the analysis and visualization of this data. The archive is organized into several layers, each with its own set of services and tools. The top layer is the FITS Files layer, which provides access to the raw data. The next layer is the Catalogues layer, which provides access to the data in a structured format. The third layer is the Visualisation layer, which provides access to the data in a graphical format. The bottom layer is the Analysis layer, which provides access to the data in a processed format. The archive is also integrated with a variety of external services, including the VizieR service for data access and the SIMBAD service for object identification.	WAS: Texture of the WEAVE Science Archive	Molinari (INAF) et al.	"Multi-Object Spectroscopy in the Next Decade: Big Questions, Large Surveys and Wide Fields" La Palma, March 2015



WEAVE

The Mechanical Design for the WEAVE Prime Focus Corrector System



Don Carlos Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (JMU), Chris Evans (ATC, Edinburgh)

Introduction

The WEAVE Prime Focus Corrector will be mounted onto the telescope structure and will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph.

Optical Layout

The WEAVE Prime Focus Corrector is a complex optical system. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph.

Mechanical Layout

The WEAVE Prime Focus Corrector is a complex mechanical system. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph.

Summary

The WEAVE Prime Focus Corrector is a complex optical and mechanical system. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph.

WEAVE Design, Construction and Exploitation

WEAVE is a new wide-field multi-object spectrograph for the William Herschel Telescope. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph. It will be responsible for correcting the light path from the telescope to the spectrograph.

WEAVE The Mechanical Design for the WEAVE Prime Focus Corrector System

Don Carlos (ING) et al.

"SPIE Astronomical Telescopes + Instrumentation 2014", Montréal, Quebec, Canada, 22-27 June 2014



WEAVE

A New Wide-Field Multi-Object Spectrograph for the William Herschel Telescope



Marc Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (JMU), Chris Evans (ATC, Edinburgh)

Science

- Milky Way archaeology**
Follow-up of ESA's GAIA mission.
- Structure & dynamics**
radial velocities
10° stars 17 < V < 20
2 km/s accuracy
- Accretion history**
abundances in streams
5°10' metal-poor thick-disk and halo stars 17 < V < 18
- Star-formation density evolution**
Spectroscopy of LOFAR complete census ~1000 sources per deg²
- Lyman-alpha emitters**
10° emitters in 10 deg²
- Galaxy evolution**
- Cosmology**
Galaxy redshift surveys
- Nature of dark energy**
Baryonic Acoustic Oscillations
Radial-Space distortions 10° spectra over 10° deg² redshifts z=0-1.4

Science Requirements

- 2 deg field of view
- WFS (multiplex 1000, IFU, mini-IFU front ends)
- Spectroscopic resolution: R = 5000 (280 - 950nm) for velocities, R = 20000 (480 - 880nm) for element abundances, Throughput > 20%

Instrument Concept

- Fibre module**
Design based on AAT's successful 2IFU. This computer simulation shows the complexity of seating 820 fibres in the required positions in the focal plane.
- New prime-focus corrector**
Enlarged field of view 2 deg (currently 40 arcmin)
- Spectrograph (on Nasmyth enclosure)**
2-arm concept
VPH dispersers
R = 5000, R = 20000
- New top-end ring**
Model of new exchangeable top-end ring (with new corrector + fibre module) being craned into position.

WEAVE Design, Construction and Exploitation

WEAVE is being designed and built by a European consortium led by the ING partner countries. The preliminary design phase is expected to end in 2012, and science observations should start in 2013. The total cost of design and construction, including the new prime focus corrector for the WHOT, is €12M.

It is expected that a large fraction of 600T time will be devoted to surveys with WEAVE. Surveys spanning a large range in apparent magnitude can be carried out via coordinated observation of the large FOV/multiplex offered by WEAVE, and the greater depth of observations with GTC, SDSS, WISE and others.

WEAVE, a new wide-field multi-object spectrograph for the William Herschel Telescope

Marc Balcells, Chris Benn, Don Abrams (ING), Gavin Dalton (Oxford/RAL), Scott Trager (Groningen), David Carter (Liverpool-John Moores), Chris Evans (UKATC)

UK-Germany National Astronomy Meeting NAM2012, Manchester, 27-30 March 2012.

WEAVE
A New Wide-Field Multi-Object Spectrograph
for the William Herschel Telescope

Marc Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (LJMU), Chris Evans (ATC, Edinburgh)

Structure & dynamics:
radial velocities
10 stars $1'' \times 4'' \times 20''$
2 km/s accuracy

Accretion history:
abundances in streams
5-10'' metal-poor disk-disk
and halo stars $17'' \times 1'' \times 18''$

Star-formation density evolution
Spectroscopy of LCOAR
complete census: ~1500
sources per deg²

Lyman-alpha emitters
10'' emitters in 10 deg²

Milky Way archaeology
Follow-up of ESA's GAIA mission.

Science

Galaxy evolution

Cosmology
Galaxy redshift surveys

Nature of dark energy:
Baryonic Acoustic Oscillations
Radial-Space distortions 10'' spectra over
10'' deg² redshifts $z=0.5-1.4$

Nearly thin galaxy disks
dark luminous matter
Disk vertical velocity dispersion
Mass-to-light ratio
Born-disk dynamics

Science Requirements
2 deg field of view
MOS (multiplex 1000), IFU, mini-IFU front ends.
Spectroscopic resolution:
R = 5000 (380 - 900nm) for velocities,
R = 20000 (450 - 900nm) for element abundances.
Throughput > 30%.

Fibre module
Design based on AAT's successful
2IFU. This computer simulation
shows the complexity of seating
500 fibres to the required
positions in the focal plane.

New prime-focus corrector
Enlarged field of view 2 deg
(currently 40 arcmin)

Instrument Concept

Spectrograph
(on Nasmyth enclosure)
2-arm concept
VPH dispersers
R = 5000, R = 20000

New top-end ring
Model of new exchangeable top-end
ring (with new corrector + fibre
module) being craned into position.

For further information:
<http://www.ing.iac.es/weave/>

WEAVE Design, Construction and Exploitation

WEAVE is being designed and built by a European consortium led by the ING partner countries. The primary design issues is required at the end of 2012 and science observations should start in 2017. The total cost of design and construction, including the new prime focus corrector for the WHT, is €120M.

It is expected that a large fraction of 400T time will be devoted to surveys with WEAVE. Surveys spanning a large range in apparent magnitude can be carried out as coordinated experiments of the large PPM multiplex offered by WEAVE, and the greater depth of observations with GTC, GEMINI, WISE and WISE/WISE.

WEAVE, a new wide-field multi-object spectrograph for the William Herschel Telescope

Marc Balcells, Chris Benn, Don Abrams (ING), Gavin Dalton (Oxford/RAL), Scott Trager (Groningen), David Carter (Liverpool-John Moores), Chris Evans (UKATC)

Science with the optical-infrared telescopes at CAHA and ORM in the coming decade, Madrid, 22-23 March 2012.

Conceptual design of a two-degree field corrector and ADC for prime focus at the 4.2m WHT

Will O'Mahoney, David Agocs, Chris Benn, Marc Balcells, Don Carlos Abrams

Don Carlos Abrams, David Agocs, Chris Benn, Marc Balcells, Will O'Mahoney, 2011

David Agocs, Will O'Mahoney, David Agocs, Chris Benn, Marc Balcells, Don Carlos Abrams

We present a conceptual design for a new refractive corrector for the prime focus of the 4.2m William Herschel Telescope, optimized to allow wide field multi-object spectroscopy. The proposed design incorporates a counter-relating corrected doublet pair acting as a two-degree field corrector (MOS). It satisfies the remaining requirement that the FWHM is no larger than 0.5 arcsec (0.5 arcsec) over a wavelength range of 350 - 900 nm, with a 10 degree FOV. This version of the design has reduced the number of glass types previously published (Agocs, 2010), and enables an extended secondary observation, as well as allowing the use of light and dark glass fibers in the image plane. This is achieved by concentrating the image plane to be by four and five telescopes to only as close as possible to the camera.

Figure 1: Schematic of the proposed design. The design shows a doublet pair acting as a two-degree field corrector (MOS). It satisfies the remaining requirement that the FWHM is no larger than 0.5 arcsec (0.5 arcsec) over a wavelength range of 350 - 900 nm, with a 10 degree FOV. This version of the design has reduced the number of glass types previously published (Agocs, 2010), and enables an extended secondary observation, as well as allowing the use of light and dark glass fibers in the image plane. This is achieved by concentrating the image plane to be by four and five telescopes to only as close as possible to the camera.

Figure 2: Performance of the proposed design. The design shows a doublet pair acting as a two-degree field corrector (MOS). It satisfies the remaining requirement that the FWHM is no larger than 0.5 arcsec (0.5 arcsec) over a wavelength range of 350 - 900 nm, with a 10 degree FOV. This version of the design has reduced the number of glass types previously published (Agocs, 2010), and enables an extended secondary observation, as well as allowing the use of light and dark glass fibers in the image plane. This is achieved by concentrating the image plane to be by four and five telescopes to only as close as possible to the camera.

CONCLUSIONS

We have presented the conceptual design of a two-degree field corrector for the 4.2m WHT. The design is optimized to allow wide field multi-object spectroscopy. It satisfies the remaining requirement that the FWHM is no larger than 0.5 arcsec (0.5 arcsec) over a wavelength range of 350 - 900 nm, with a 10 degree FOV. This version of the design has reduced the number of glass types previously published (Agocs, 2010), and enables an extended secondary observation, as well as allowing the use of light and dark glass fibers in the image plane. This is achieved by concentrating the image plane to be by four and five telescopes to only as close as possible to the camera.

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Conceptual design of a two-degree field corrector and ADC for prime focus at the 4.2 m WHT

N. O'Mahoney, T. Agocs, D. Cano Infantes, C. Benn, M. Balcells, D. Carlos Abrams

Fourth Science with the GTC Meeting. Santa Cruz de La Palma, 16-18 November 2011.

WEAVE
A New Wide-Field Multi-Object Spectrograph
for the William Herschel Telescope

Marc Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (LJMU), Chris Evans (ATC, Edinburgh)

Structure Dynamics:
radial velocities
10° area $17 \times 17 \times 33$
3 km/s accuracy

Accretion history:
abundances in streams
8°10' metal-poor thick-disk
and halo stars $17 \times 17 \times 18$

Star formation density evolution:
Spectroscopy of LOPAR
complete census: ~1000
sources per deg²

Lyman-alpha emitters:
10° area 17×17 deg²

Science

Milky Way archaeology:
Follow-up of ESA's GAIA mission.

Galaxy evolution:
Nearby blue galaxy disks
dark-matter mass ratios
Dark vertical velocity dispersion
Mass-to-light ratio
near-disk dynamics

Cosmology:
Galaxy redshift surveys

Summary:
WEAVE is a new multi-object spectrograph (1000 fibres, 2-day field) planned for the 4.2-m William Herschel Telescope on La Palma. First light is expected in 2015.

Nature of dark energy:
Baryonic Acoustic Oscillations
Redshift-space distortions 10° spectra over 10° area 17×17 deg²
Redshifts $z=0.5-1.4$

Science Requirements:
2 day field of view
1000 channels (1000) fibres, 1000 fibres each
Spectroscopic resolution
 $R = 5000$ (1000) channels for velocities
 $R = 20000$ (1000) channels for absorption measurements
Throughput = 10%

Fibre module:
Design based on AAT's successful 3AP. This computer simulation shows the complexity of viewing 100 fibres in the required positions in the focal plane.

New prime-focus corrector:
Extended field of view 2 deg (currently 0.5 deg).

Instrument Concept:

Spectrograph (in Nasmyth enclosure):
2-arm concept
VPH dispersers
 $R = 5000$, $R = 20000$

New top-end ring:
Model of new exchangeable top-end ring (with new corrector + fibre module) being created into position.

For further information:
<http://wwwing.lsc.es/weave/>

WEAVE Design, Construction and Exploitation

WEAVE is being developed and built by a European consortium led by the ING system location. The primary design studies is expected at the end of 2011, and science observations should start in 2012. The core set of design and construction, including the new prime-focus corrector for the WHT, is £10M.

It is expected that a large fraction of WEAVE data will be obtained in synergy with LSST. Science opening a large range in research opportunities for the core set of instruments. The large 10°-wide-field allows by multi-object and the greater depth of observations with GTC, GEMINI, ALMA and other facilities.

Partners: ING, RAL, ATC, LAMOST, NAO, ASTROCON, etc.

WEAVE A New Wide-Field Multi-Object Spectrograph for the William Herschel Telescope"

M. Balcells, C. Benn, D. Abrams, G. Dalton, S. Trager, D. Carter, C. Evans

Fourth Science with the GTC Meeting, Santa Cruz de La Palma, 16-18 November 2011.

WEAVE
A New Wide-Field Multi-Object Spectrograph
for the William Herschel Telescope

Marc Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (LJMU), Chris Evans (ATC, Edinburgh)

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Galaxy redshift surveys

Summary:
WEAVE is a new multi-object spectrograph (1000 fibres, 2-day field) planned for the 4.2-m William Herschel Telescope on La Palma. First light is expected in 2015.

Nature of dark energy:
Baryonic Acoustic Oscillations
Redshift-space distortions 10° spectra over 10° area 17×17 deg²
Redshifts $z=0.5-1.4$

Science requirements for WEAVE:
2 day field of view
1000 channels (1000) fibres, 1000 fibres each
Spectroscopic resolution
 $R = 5000$ (1000) channels for velocities
 $R = 20000$ (1000) channels for absorption measurements
Throughput = 10%

Fibre module:
Design based on AAT's successful 3AP. This computer simulation shows the complexity of viewing 100 fibres in the required positions in the focal plane.

New prime-focus corrector:
Extended field of view 2 deg (currently 1 deg).

Instrument Concept:

Spectrograph (in Nasmyth enclosure):
2-arm concept
VPH dispersers
 $R = 5000$, $R = 20000$

New top-end ring:
Model of new exchangeable top-end ring (with new corrector + fibre module) being created into position.

For further information:
<http://wwwing.lsc.es/weave/>

The WEAVE Consortium

A pan-European consortium has been established to promote the development of WEAVE. The total cost of the project, including the new prime-focus corrector for the WHT, is estimated to be €10M.

Partners: ING, RAL, ATC, LAMOST, NAO, ASTROCON, etc.

WEAVE A New Wide-Field Multi-Object Spectrograph for the William Herschel Telescope"

Marc Balcells (ING), Chris Benn (ING), Don Abrams (ING), Gavin Dalton (Oxford / RAL), Scott Trager (Groningen), Dave Carter (LJMU), Chris Evans (ATC, Edinburgh)

NAM 2011, April 2011.