



Astronomy & Teaching Programs at UCT

Prof. Renée C. Kraan-Korteweg

Astronomy Department (UCT)

Co-Director Astrophysics, Cosmology and Gravity Centre (ACGC)

• Astronomy Departmental Profile

- Developments (mostly since 2005)
- Foundation of ACGC 2009

• Teaching Programmes at UCT

- Undergraduate Programme
- Postgraduate
 - pure research MSc (2yrs)
 - research PhD (3yrs)

• **NASSP Honours & MSc**

-> Dominant contribution to growth of postgraduate students

Peter Dunsby & Patricia Whitelock



The Astronomy Department at UCT

Academic Staff



Prof. R.C. Kraan-Korteweg
(Head of Department)



Prof Tom Jarrett
(Professor)
SARCHI Chair
(from June 2012)



Prof. C. Carignan
(Professor)
SKA SARCHI Chair



A/Prof. P.A. Woudt
(Associate Professor)



Dr. K. van der Heyden
(Senior Lecturer)



Dr. Sarah Blyth
(Lecturer)
SKA Position



Dr. Vanessa McBride
(Lecturer)
Joint SAAO/UCT position



Prof. P.A. Whitelock
(Visiting Professor)
Joint SAAO/UCT Position



Prof R Fender
(SKA Visiting Professor)



Em. Dist. Prof. B. Warner
(Emeritus Professor)
Senior Scholar

Emeritus and honorary staff at the Astronomy Department



Hon. Prof. M.W. Feast
(Honorary Professor)



Dr. Ian Stewart
(Honorary Research Associate)

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Honorary researchers associated with the Astronomy Department



Prof. P.K.S. Dunsby
(Honorary academic member)
NASSP Director



Hon. Prof. P.A. Charles
(Honorary Professor)
University of Southampton



Hon. Prof. W.J.G de Block
(Honorary Professor)
ASTRON, NL



Hon. Prof. T. Williams
(Honorary Professor)
Director SAAO

Administrative staff:

- 2 admin officer/senior secretary
- 1 IT officer (Linux)
- 2 NASSP admin positions (IT, general)



The Astronomy Department at UCT

Postdoctoral fellows at the Astronomy Department



Dr. Garry Angus
ACGC Postdoctoral Fellow



Dr. Richard Armstrong
SKA Postdoctoral Fellow



Dr. Kelley Hess
SARChI Postdoctoral Fellow



Dr. Danielle Lucero
SARChI Postdoctoral Fellow



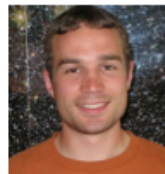
Dr. Natasha Maddox
SKA Postdoctoral Fellow



Dr. David Puglielli
SARChI Postdoctoral Fellow



Dr. Valerio Ribeiro
SKA Postdoctoral Fellow



Dr. Matthew Schurch
UCT Postdoctoral Fellow



Dr. Roger Deane
SKA Postdoctoral Fellow



Dr. Maciej Bilicki
SARChI Postdoctoral Fellow



Dr. Ed Elson
NRF/MWL Postdoctoral Fellow



Dr. Mickaël Coriat
SKA Postdoctoral Fellow

1-2 more to join in 2013; 1-2 will move on



The Astronomy Department at UCT

Postgraduate students (16 PhD + 19 MSc)

PhD students in Astronomy



Paul Kotze
PhD student
at SAAO/UCT



Virai Parekh
PhD student
at UCT



Tom Mutabazi
PhD student
at UCT



Zolile Mguda
PhD student
at UCT



Rudi Kuhn
PhD student
at SAAO/UCT



Andry Rajoelimanana
PhD student
at SAAO/UCT



Bradley Frank
PhD student
at UCT



Roger Ianjamasimanana
PhD student
at UCT



Thuso Simon
PhD student
at UCT



Rojovola Zara-Nomena
Randriamanakoto
PhD student
at SAAO/UCT



John Egan
PhD student
at UCT



Moses Mogotsi
PhD student
at UCT



Sally Macfarlane
PhD student
at Nijmegen/UCT
(EMA SAPIENT)



Deanne de Bude
PhD student
at Nijmegen/UCT
(EMA SAPIENT)



Laure Catala
PhD student
at UCT/SAAO



Mpati Ramatsaku
PhD student
at Groningen/ASTRON/UCT
(Joint PhD)

Research MSc students in Astronomy



Getachew Mekonnen
NASSP MSc student
at UCT/SAAO



Hannes Breytenbach
NASSP MSc student
at UCT



Rocco Coppejans
NASSP MSc student
at UCT/SAAO



Zwidofhelangani Khangale
NASSP MSc student
at UCT



Osupeng Moralo
NASSP MSc student
at UCT/SAAO



Rajin Ramphul
NASSP MSc student
at UCT/SAAO



Toky Randriamampandry
NASSP MSc student
at UCT



Iniyar Natarajan
MSc student
at UCT



Priscilla Chauke
NASSP MSc student
at UCT



Enrico Kotze
NASSP MSc student
at UCT/SAAO



Rajeev Manick
NASSP MSc student
at UCT/SAAO



Itumeleng Monageng
NASSP MSc student
at UCT



Mokhine Motsoaledi
NASSP MSc student
at UCT



Elizabeth Naluminsa
NASSP MSc student
at UCT/SAAO



Riona Ramraj
NASSP MSc student
at UCT/SAAO



Khaled Said
NASSP MSc student
at UCT

Research Students Co-supervision



Scott Badenhorst
MSc Computer Science student
at UCT



Daniel Wood
MSc Computer Science student
at UCT



Richard Baxter
MSc Computer Science student
at UCT

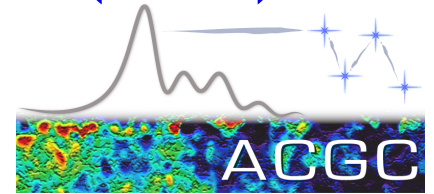
→ Enormous increase only possible
- due to national PG program (NASSP)
- increase in SV capacity

Note: about 1/3 have main SV at SAAO

Formation of Research Centre at UCT

Astrophysics, Cosmology and Gravity Centre (ACGC)

<http://www.acgc.uct.ac.za>



- **Established in 2009:** Combination of
 - Dept. of Astronomy
 - Cosmology/Gravity group of Dept. of Math & Applied Mathematics
- 20 Staff, ~20 Postdocs, ~50 postgraduate students (MSc / PhD)
- **Research focus:** Stellar Astrophysics (compact binaries), Extragalactic Astronomy (distance scale, large-scale structures, galaxy dynamics, DM) Cosmology (DE, modified gravity, inhomogeneous cosmology)
- *Strong development in radio astronomy* (4 survey PIs on MeerKAT)
 - LADUMA (ultra-deep HI survey)
 - MIGHTEE (ultra-deep continuum survey)
 - ThunderKAT (radio transients)
 - Mhongoose (deep highly resolved HI in nearby galaxies)

Core Members of the ACGC (UCT)

(20 acad. staff; ~22 postdocs; ~50 postgrad students)

Academic staff (10):

- **Renée C. Kraan-Korteweg**
- Claude Carignan (SKA-SARChI Chair)
- Tom Jarrett SARChI Chair
- Patrick A. Woudt
- Vanessa McBride (joint SAAO/UCT)
- Kurt van der Heyden
- Sarah L. Blyth (SA SKA funded)
- Patricia Whitelock (joint SAAO/UCT)
- Brian Warner (Sen.Scholar/Em.Dist. Prof)
- Michael Feast (Honorary Professor)
- Rob Fender (Visiting Prof / Southampton)

Affiliated Honorary Professors:

- Erwin de Blok (former SARChI Chair)
- Phil A Charles (former Director SAAO)
- Ted Williams (incoming SAAO director)

Postdoctoral fellows (12)

Postgraduate students:

35 (16 PhD, 19 MSc) students (2013)

Academic staff (9):

- **Peter Dunsby**
- Chris Clarkson
- Charles Hellaby
- Jeff Murugan
- Bob Osano
- Deon Solomons
- Amanda Weltman
- George Ellis (Sen.Scholar/Em.Dist. Prof)

Postdoctoral Fellows (9)

Postgraduate students:

14 (7 PhD + 7 MSc) students in 2013

Research areas of the ACGC

- galaxy evolution and transformation
- extragalactic large-scale structures, distance scale and cosmic flow fields
- neutral hydrogen (HI) and dark matter content of nearby galaxies
- Galactic structure
- high-speed stellar photometry and spectroscopy of variable stars (CV' s)
- stellar pulsations
- history of astronomy

observational cosmology

- **dark energy & Chamaleon DE**
- **modified gravity**
- **inhomogeneous cosmology**
- **string theory and cosmology**
- **early universe physics**
- **modelling inhomogeneity**
- **gravitational wave physics**

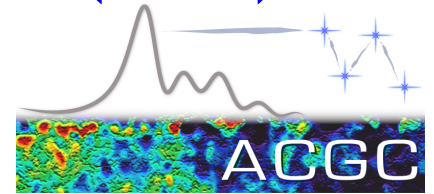
ACGC mini workshops



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The undergraduate astronomy curriculum at UCT

Traditionally: BSc in Physics
specialization at postgraduate levels

Astrophysics major (1995-2000)
Failed, too few students

Reinstated the astrophysics major in 2006 in response
to the changing astronomical landscape (new world-class
facilities)



The Astronomy Department at UCT

A - Undergraduate teaching:

- **Astrophysics major (since 2006)**

- AST1001F : An Introduction to Astronomy (open to all students; 70 → 130 students)
- AST2002S: An Introduction to Modern Astrophysics (between 20 → 45 students)
 - **current introduction of AST2003 additional Obs & Technology course**
- AST3002F: Stellar Astrophysics (typically 6-10 students)
- AST3003S: Galactic & Extragalactic Ast; Cosmology (typically 4-8 students)

- **New Astronomy-Technology stream (offered since 2009)**

- with exchange of some phys and math courses for engineering courses

Since launch

- Yearly increase in enrollment of the Astrophysics major
- Large increase in fraction of black African students in Astrophysics
- Growing influx into postgraduate programme (**NASSP Hons; MSc**)

Sutherland Field Trip

2nd year students
- overnight trip

3rd year students
- 4 nights photometry (1st semester)
- 4 nights spectroscopy (2nd semester)





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AST Major:

Student Numbers

	AST1000F	AST2002S	AST3002F	AST3003S
2006	61	16	9	6
2007	65	14	4	3
2008	125	26	0	0
2009	115	29	6	4
2010	148	33	11	8
2011	129	41	6	5

Registered students →

SB014-APH & MAPH		1 st year students		2 nd year students		3 rd year students	
2006 (13)		4		2		7	
Male	Female	3 (75%)	1 (25%)	-	2 (100%)	5 (71%)	2 (29%)
White	Black	3 (75%)	1 (25%)	2 (100%)	-	7 (100%)	-
2007 (19)		10		6		3	
Male	Female	10(100%)	0	4 (67%)	2 (33%)	1 (33%)	2 (67%)
White	Black	6 (60%)	4 (40%)	4 (67%)	2 (33%)	3 (100%)	-
2008 (30)		19		11		-	
Male	Female	10 (53%)	9 (47%)	10 (91%)	1 (9%)	-	-
White	Black	5 (26%)	14 (74%)	6 (55%)	5 (45%)	-	-
2009 (42)		24		14		4	
Male	Female	16 (66%)	9 (38%)	8 (57%)	6 (43%)	3 (75%)	1 (25%)
White	Black	5 (21%)	19 (79%)	3 (21%)	11 (79%)	3 (75%)	1 (25%)
2010 (43)		24		13		6	
Male	Female	n/a	n/a	8 (62%)	5 (38%)	n/a	n/a
White	Black	8 (33%)	14 (58%)	2 (15%)	11 (85%)	2 (33%)	4 (67%)
2011 (49)		23		21		5	
Male	Female	11 (48%)	12 (52%)	12 (57%)	9 (43%)	3 (60%)	2 (40%)
White	Black	5 (22%)	18 (78%)	4 (19%)	17 (81%)	3 (60%)	2 (40%)

←AST-majors/spec

Astrophysics Major

- Within new BSc framework of Science Faculty
- And in accordance to recommendation from Review Comm (UCT's Inst Planning Dept) *To better prepare SA'n black students for senior AST undergrad course*
- → Curriculum review workshop of AST Dept (UCT Phys, MATH, CHED, CET)

→ Introduce a practical 2nd yr half course (AST2003H)

- *general fundamentals of (astronomical techniques, instrumentation, solid foundation of statistics, hands-on statistical data analysis)*
- *40% of course will be field-work based*
- *new optical/NIR and radio facilities on campus for students*

→ Change current 2nd year course AST2002F → AST2002H

- *slight adaption of course-content to make it less dense*
- *change it to a half course*

→ Is well suited for both 3yr and 4yr option

Phased Experimental Demonstrator (PED)

- 4 element interferometer
- Donated by KAT team at the end of 2011
- SAAO agreed to continue hosting it.



Optical Teaching Observatory

- Currently being installed; Jan 2013 (roof of the department)
- multi-band imaging & spectroscopy



UCT teaching telescope on roof of RW James building

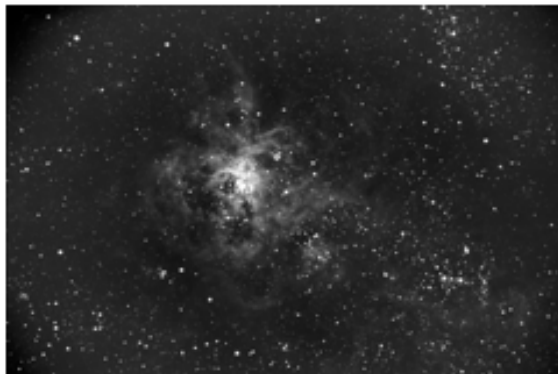
First emission line image of the Tarantula Nebula using the UCT teaching telescope



First emission line image of the Tarantula Nebula, taken on 23/01/2013, using the UCT teaching telescope. The Tarantula Nebula (also known as 30 Doradus, or NGC 2070) is an H II region in the Large Magellanic Cloud (LMC). It was originally thought to be a star, but in 1751 Nicolas Louis de Lacaille recognized its nebular nature. The image was fully reduced by Luc Turbide from the Université de Montréal. It consists of 10 x 5 minutes exposures in the H α and the OIII interference filters, added together. The gas in this region is ionized by the bright and massive OB stars in the Doradus region.

[Read more](#)

"First Light" from the new teaching telescope



First light image of 30 Doradus taken on January 20, 2013 with the UCT teaching telescope. This is a raw image (22 x 30 seconds exposures with the L filter, automatic off-axis guiding and adaptive optics) with no calibration (flat field, bias, dark frames) taken in very strong wind conditions. Despite the wind, the image quality is quite good over the whole field of view. The image is binned 4 x 4, so ~ 3.0 arcsec/pixel for a field $\sim 37' \times 25'$. The CCD detector is Peltier and water cooled at ~ -20 C. The filters available are the broadband LRGB set and UBVRi set, plus H α and OIII interference filters. The C14 (35.5 cm) optical

tube is combined with a focal reducer, which changes the focal ratio from F/12.6 to F/7.3, which still yields a pixel of 0.725 arcsec with no binning. The telescope is installed on a Paramount MX mount and is equipped with an instrument rotator and an automatic focuser. Still to be commissioned is the self-guided spectrograph, which will yield resolution from 9 to 1 Angstroms/pixel.

Astrophysics Major

Table 2: The proposed Astrophysics curriculum in a 3-year stream.

1 st year	2 nd year	3 rd year
AST1000F <i>Introduction to Astronomy</i>	AST2002H Astrophysics	AST3002F Stellar Astrophysics
PHY1004W Matter & Interactions	AST2003H Astronomical Techniques	AST3003S Galactic & Extragalactic Astrophysics
MAM1000W Mathematics 1000	PHY2014F Waves & Electromagnetism	
	PHY2015S Classical & Quantum Mechanics	
	MAM2000W Mathematics 2000	

Astrophysics Major

Table 3: The proposed Astrophysics curriculum in a 4-year stream.

1 st year	2 nd year	3 rd year	4 th year
AST1000F Introduction to Astronomy	AST2003H Astronomical Techniques	AST2002H Astrophysics	AST3002F Stellar Astrophysics
PHY1023H Principles of Physics A	PHY1004W Matters & Interactions	PHY2014F Waves & Electromagnetism	AST3003S Galactic & Extragalactic Astrophysics
MAM1005H Mathematics 1005	MAM1006H Mathematics 1006	PHY2015S Classical & Quantum Mechanics	
		MAM2000W Mathematics 2000	