

# Centre for Astrophysics and Supercomputing

## Overview

The Centre for Astrophysics and Supercomputing (CAS) is dedicated to inspiring a fascination in the universe through research and education.

One of the most rapidly growing research institutions in its area in Australia, the centre has built an international reputation for research excellence. We operate a significant supercomputing facility and a virtual reality theatre; we have direct access to the world's largest optical and infrared telescopes – the 10 metre Keck telescopes in Hawaii; and we concentrate on problems in astrophysics that benefit from these resources. The centre delivers a strong public outreach and education program, and unique internet-based education initiatives.

Our radical approach of broadening our funding base through a combination of traditional research grants, commercial work, online teaching and university support, has led to spectacular growth since the centre's formation in 1998.

## Our research focus

The centre's research spans the entire electromagnetic spectrum, covering observational, theoretical and computational astronomy. Priority research areas include galaxy evolution and cosmology, globular clusters, pulsars, star and planet formation, radio astronomy instrumentation simulations and astronomy visualisation.

A strong theoretical group uses the centre's supercomputer to produce world-class simulations, including simulating entire universes, exploring the nature of dark matter, and simulating star and planetary disk formation.

We are successful in attracting external research funding and in 2010 secured just under A\$3 million in competitive grants.

## Facilities

The centre regularly secures time on the most advanced telescopes around the world, such as the Hubble Space Telescope, the Parkes Telescope and the Very Large Telescope in Chile. In 2008 the centre signed a landmark agreement with the California Institute of Technology (Caltech) that put Swinburne in the unique position of being the only Australian university to have guaranteed access to the 10 metre Keck telescopes.

The centre manages the supercomputing needs of Swinburne and is committed to providing an international-standard computing facility based on the latest technology, thus enabling Swinburne staff and students to meet their research goals while maintaining Swinburne as a premier supercomputing site. From 2011 this facility will include gSTAR, a GPU-based supercomputer offering in excess of 100 Tflops of performance. gSTAR will operate as a national facility and Swinburne astronomers will have full access.

CAS also has a virtual reality theatre, which supports its public outreach and school education programs with 3D technology.

## Industry involvement

The centre has commercialised its intellectual property through the creation of a number of products. Using the latest in 3D virtual reality projection techniques and animation, these products help the centre inspire a fascination in the universe. The centre's 3D movies are sold to visitor centres and museums around the world.

The skills developed in producing these products enable the centre to undertake consultancies to industry and universities for the creation of 3D animations. Stereo HD filming is a growing area of expertise, producing spectacular results.

## Collaborations

CAS has wide-ranging collaborations in Australia and internationally. The centre is a member of the ARC Centre of Excellence for All-sky Astrophysics (CAASTRO). We have close ties with the CSIRO Astronomy and Space Science division (CASS), particularly in the area of new technology radio telescopes such as ASKAP and SKA. We also work with the Australian Astronomical Observatory, as well as having collaborators at most of the major universities in Australia. Internationally, the centre has links with Caltech, through our Keck collaborative agreement, and our researchers collaborate with astronomers in the United States and Europe.

## Recent projects

The centre's recent research projects include:

**Theoretical Astrophysical Observatory** – an online tool to build artificial universes from different cosmological simulations, and galaxy formation models to explore and interpret galaxy survey observations

**Massive Black Holes in Dense Star Clusters** – an investigation into the metamorphosis of dense star clusters (containing millions of stars) into massive black holes at the centres of galaxies, using the world's largest optical telescopes and one of the nation's fastest supercomputers

**Study the Astrophysics of Globular Clusters in Extragalactic Systems (SAGES) project** – the centre is taking a leading role in this project, which combines HST and Subaru imaging with Keck spectra to better understand globular cluster systems

**Building Planets** – a project to explore the first dust grains that formed in our solar system and survey the dust content of planet-forming disks in the solar neighbourhood

**SKA Radio Telescope** – CAS astronomers are working towards the next generation radio telescopes in the area of large-scale galaxy survey science, visualisation and data processing.

## Education

The centre hosts a large number of postgraduate students who are undertaking a Doctor of Philosophy (PhD) degree, as well as operating one of the largest online astronomy education programs, Swinburne Astronomy Online. In addition, the centre provides education to school students and the general public via presentations and movies in virtual reality theatres in Australia and internationally.

## Contact us

Swinburne University of Technology  
Hawthorn, Melbourne, Australia

### Key contact

Professor Warrick Couch  
Director, Centre for Astrophysics and  
Supercomputing  
Telephone: +61 3 9214 4712  
Email: [wcouch@swin.edu.au](mailto:wcouch@swin.edu.au)

### Further information

Telephone: +61 3 9214 5569  
Facsimile: +61 3 9214 8797  
Email: [contact@astro.swin.edu.au](mailto:contact@astro.swin.edu.au)  
[www.swinburne.edu.au/astronomy](http://www.swinburne.edu.au/astronomy)

CRICOS provider code 00111D

The information in this flyer was correct at the time of printing (November 2011).

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SP1316d-21-1111