

PERTH OBSERVATORY 2004-2005

Program Leader: Dr James Biggs

ASTRONOMICAL RESEARCH (a core function) ANNUAL REPORT

Team members – (details are provided under each SPP, below)

Context

This core function involves the utilisation of research facilities and capitalises on its isolated location. Most of its projects are long-term worldwide collaborations. It aligns with Corporate Priority 12.

Aim

To provide astronomical research in the following areas:

- Monitoring brightness changes in stars, comets, gravitational lensing events and other celestial bodies, and participate in their further study.
- Determining positions of minor bodies (asteroids and comets) and targets of opportunity and forwarding these to the International Astronomical Union for publication and dissemination.
- Searching for extra-galactic supernovae in low-redshift spiral galaxies.
- Testing the suitability of appropriate Western Australian sites for astronomical observations.

This program directly addresses the State Government's 'Innovate WA' Policy objective of '*strengthen and improve the educational and research capacity of the state*', and with a recommendation in the Final Report of the (Australian) Innovation Summit Implementation Group; Innovation: Unlocking the Future (2000), '*Publicly funded basic research plays an important role in supplying much of the knowledge, skills and new ideas critical to a competitive and innovative economy.*'

Summary of progress and main findings

Progress in individual projects is detailed below for each SPP. Observatory staff published 3 papers in refereed international journals and another 4 in minor publications (poster papers, abstracts etc). 100% of referred papers submitted were published (100% in 03/04).

Management implications

- There is ongoing external demand for scientific collaborations that exploit the Observatory's isolated location.
- Continued government support of the Observatory's scientific activity provides substantial evidence that it is serious in its endeavours to attract to the state the SKA, the world's largest radio telescope.

The details for each SPP are discussed below.

Variable star observations

SPP # 98/0009

Team members

J Biggs (0.01), P Birch (0.1), R Martin (0.01), A Verveer (0.02), A Williams (0.01), J Pearse (0.02), R Tonello (0.03), G Lowe (0.03); Total (0.23).

Context

This SPP involves a long-term worldwide collaboration involving the study of variable stars. It aligns with Corporate Priority 12.

Aim

- To monitor the brightness of variable stars. This will lead to an increased knowledge of the structure and processes within stars.

Summary of progress and main findings

- No observations were made in 2004/2005, as there were no suitable targets bright enough for our instruments.
- One refereed paper was published in April 2005 concerning the roAp star HR 1217.

Future direction(s)

Participation in international variable star monitoring programs will continue as time and resources permit, with the milestone remaining 'the successful observations and reduction of data for publication'. No target stars have been announced for 2005/2006

Imaging and spectrophotometry of comets

SPP # 98/0010

Team members

J Biggs (0.01), P Birch (0.1), R Martin (0.01), A Verveer (0.02), A Williams (0.01), J Pearse (0.02), R Tonello (0.03), G Lowe (0.03); Total (0.23).

Context

This SPP involves a long-term collaboration with US astronomers in the study of comets. It aligns with Corporate Priority 12.

Aim

- To monitor cometary brightness changes in specific wavelength bands.
- To observe comets over a wide range of heliocentric distances both pre-perihelion and post-perihelion.
- To image the coma and tail(s) for specific structural features. This will facilitate a comparison between the various cometary families and build a database of cometary properties.

Summary of progress and main findings

- Cometary observations were made on 6 nights in November and December 2004 on 49P/Comet Arend-Rigaux as part of nucleus rotation studies.
- An astronomer from Lowell Observatory worked with Perth Observatory staff in February 2005 processing data taken over the previous 30 years as part of an ongoing collaboration between the two institutions.
- Observations made in May 2005 with the Perth / Lowell 61cm reflector of 9P/Comet Tempel1 were used to fine tune the settings for observations being made with the Deep Impact mission.

Future direction(s)

- Further observations will be made of Comet 9P (Tempel1) during 2005 in the lead up to the Deep Impact Mission culmination in mid 2005.
- Commissioning of an automated focuser for the PLAT in 2005 should facilitate an increased number of observations.

Imaging and CCD photometry of transient and variable sources

SPP # 98/0011

Team members

J Biggs (0.04), P Birch (0.01), R Martin (0.01), A Verveer (0.02), A Williams (0.01), J Pearse (0.02), G Lowe (0.03), R Tonello (0.03); Total (0.17).

Context

Suitable targets are imaged and processed as appropriate. It aligns with Corporate Priority 12.

Aim

To image newly discovered celestial objects and/or poorly known variable sources, so as to increase knowledge of Solar System objects, discover new Solar System objects, and increase knowledge of the structure and processes within stars.

Summary of progress and main findings

Possible transient changes to the star SS2883 were monitored in a student project.

Future direction(s)

Suitable targets will be observed as time and resources permit. Future observations will be conducted using the 35-cm Real Astronomy Experience (RAE) telescope. The University of California (Berkeley) and the Lawrence Hall of Science loaned the telescope, its ancillary equipment and software.

Astrometry of minor planets, comets and targets of opportunity

SPP # 98/ 0012

Team members

J Biggs (0.20), P Birch (0.01), R Martin (0.01), A Verveer (0.02), A Williams (0.01), J Pearse (0.02), G Lowe (0.24), R Tonello (0.24); Total (0.75).

Context

This SPP involves a long-term worldwide collaboration to track and discover asteroids and comets. Targets of opportunity are also observed as appropriate. It aligns with Corporate Priority 12.

Aim

- To measure the position of minor bodies, so as to determine their orbits. This is of fundamental interest in itself in order to determine the origin, history and fate of each object. Also, knowledge of an object's position facilitates other specialized types of observation (and these not need be restricted to the visible part of the electromagnetic spectrum).
- To measure the position of targets of opportunity such as supernovae in order to confirm their existence as well as facilitate follow-up observations with other instruments.

Summary of progress and main findings

- In 2004/2005*, a total of 57 (43 asteroid and 14 comet) minor body positions were published - a system upgrade curtailed activity in this project
- This project was transferred to the 35-cm Real Astronomy Experience (RAE) telescope. The University of California (Berkeley) and the Lawrence Hall of Science loaned the telescope, its ancillary equipment and software.
- The RAE telescope is a fully operational Internet telescope and can be operated from around the world. Though this telescope will be shared with others, observing will be more efficient and fainter objects can be imaged.

Future direction(s)

Monitoring of NEOs will continue with the milestone an increased number of published positions. Further integration of telescope and camera control onto 1 PC will be progressed. Also, the search of the Earth's Lagrangian points for asteroids will be continued.

*As at 3 May 2005.

Monitoring gravitational microlenses

SPP # 98/0013

Team members

J Biggs (0.01), P Birch (0.01), R Martin (0.25), A Verveer (0.03), A Williams (0.30), J Pearse (0.03), G Lowe (0.03), R Tonello (0.03); Total (0.69).

Context

This SPP involves a worldwide collaboration that uses the gravitational microlensing effect to gain information about our galaxy, its stars and their planetary companions. It aligns with Corporate Priority 12.

Aim

- * To use precise light curve measurements in order to characterize the statistics and kinematics of Galactic microlensing events.
- * To detect extra-solar planets.
- * To gather information on the stellar population in and around the Galactic Bulge.

This is achieved through an international collaboration - PLANET - with 32 members affiliated with 18 institutions in 10 countries. Access to telescopes in Perth, South Africa, the Canary Islands, Chile, Hawaii and Tasmania (ranging from 0.6m to 2m) allows 24-hour monitoring during the bulge season (May - August).

Summary of progress and main findings

- * The Perth-Lowell Automated Telescope is used in fully automated mode, with PLANET members anywhere in the world able to adjust target selection and sample rates (based on real-time data reduction and automatic modelling), via an online 'homebase' control system. Perth observatory is the only telescope in the collaboration with this facility - most other telescopes require an observer to be present all night, every night.
- * The telescope was used to contribute to the data gathering during the previous PLANET observing season, as well as staff contributing to the data reductions. Perth Observatory staff constructed the web pages and homebase control system for the PLANET site.
- * Two refereed papers and one other were published.

Future direction(s)

The June-August 2004 bulge season included many prime events, papers on some have already been published and some are in preparation. The 2005 bulge season has already seen a couple of outstanding events, and a paper on one is currently in preparation already. A commercial automated focuser for the PLAT has been purchased, and is awaiting some work to fit it to the telescope - this should result in a large improvement in the data quality and number of useful images taken.

Supernova search

SPP # 98/0014

Team members

J Biggs (0.01), P Birch (0.01), R Martin (0.3), A Verveer (0.02), A Williams (0.25), J Pearse (0.02), G Lowe (0.03), R Tonello (0.03); Total (0.67).

Context

This SPP involves a long-term study of supernovae - an endpoint in stellar evolution. It aligns with Corporate Priority 12.

Aim

- To contribute to the broader study of supernovae by employing methodical search techniques to detect supernovae at early stages of their evolution.
- To make an independent determination of the supernovae rates within late spiral galaxies.
- To do additional research on the supernovae found. For example collect photometric light curves of supernovae discovered by Perth Automated Supernova Search.

The Perth Automated Supernova Search is a search for extra-galactic supernovae in low redshift spiral galaxies. The search uses the 61-cm Perth Lowell Automated Telescope (PLAT) at the Perth Observatory.

Summary of progress and main findings

- Three new supernovae were discovered during the 2004/2005-year, and another 2 new supernovae were detected, but just after discovery by other astronomers.
- Three minor publications were produced.
- Mathematical modelling of SN 2004S is complete and a paper is in preparation.
- A good set of VRI light curves for SN 2005AE

Future direction(s)

Paper concerning SN 2004S will be submitted for publication and assessment of the datum for SN 2005AE will be made. A commercial focus unit has been purchased and will be used to automatically focus for the PLAT. Development of the software to control the focuser and the mounting of the unit on the telescope should be finished this year.

Astronomical evaluation of sites in WA for observation

SPP# 00/0006

Team members

J Biggs (0.02), P Birch (0.01), R Martin (0.06), A Verveer (0.02), A Williams (0.01), J Pearse (0.02), G Lowe (0.01), R Tonello (0.01); Total (0.16).

Context

This SPP involves evaluation of various sites regarding their suitability for astronomical observations. It aligns with Corporate Priority 12.

Aim

Testing appropriate Western Australian sites regarding their suitability for astronomical observations. This will provide information necessary for the planning of future facilities.

Summary of progress and main findings

- An observation run over several nights was undertaken at a remote site.
- These data have been analysed in a manner consistent with earlier data.

Future direction(s)

This site evaluation project will result in a paper detailing the preliminary results of conditions for optical astronomy observing in WA. Also, observations at other sites will be conducted as resources allow.