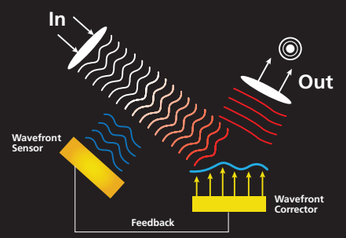
Astronomy Technology

AT DAO

Technology in support of science

Discoveries in astronomy have been driven by dramatic developments in photonics, electronics, and computing power.

NRC is contributing to this innovation by designing, developing and constructing, with support from industry, high performance instruments that allow optical and radio telescopes to analyze the faint light or weak radio signals they gather.



Optical Astronomy – Adaptive Optics

Even as larger mirrors on a telescope let us capture more light to give us deeper glimpses into Space, the Earth's atmosphere can blur those images. This distorts the light of a celestial body into a "twinkle" that limits the potential of our observations. Adaptive optics (AO) addresses this problem, providing much sharper images to the data-capturing instruments on the telescope.

The Herzberg Astronomy and Astrophysics Research Centre is internationally renowned for its expertise in AO systems, which are considered the heart of any large modern telescope. These systems use the light from a star to analyze atmospheric distortions, sending signals 1,000 times per second to a small "rubber" mirror to correct them. Corrected light is then used to produce images almost as sharp as if the telescope was positioned in space.

Radio Astronomy – Low Noise Amplifiers

The need to amplify and measure extremely weak radio emissions from astronomical objects drives the development of sensitive, low noise amplifiers at the heart of radio astronomy receiver systems. NRC is a world leader in ultra-low-noise amplifier technology being used in international observatories such as the Atacama Large Millimetre Array (ALMA) in Chile and the Square Kilometre Array (SKA) in South Africa and Australia.

SCIENTIFIC

Data Services

Canadian Astronomy Data Centre (CADC)

The Canadian astronomy community surveys large areas of the sky to create huge, statistically powerful samples of stars, galaxies and quasars. Storing and processing such massive amounts of unique data requires state-of-the-art computing infrastructure and expertise, which is provided by the CADC.

Located at DAO, this web-based Virtual Observatory houses some of the world's most important astronomical data collections, including those from the Canada-France-Hawaii Telescope, the James Clerk Maxwell Telescope and the Hubble Space Telescope. The CADC also provides open access to a century's worth of historically significant observations from the Plaskett Telescope. Among the largest and most powerful science data management centres in the world, the CADC delivers over a petabyte (1 million gigabytes!) of astronomical data to science users each year.

Specializing in pioneering data products and services that advance many important science goals, the CADC is one of the first astronomy data centres in the world to make the transition from "data host" to integrated systems provider. In recent years the CADC has helped safely guide the first close spacecraft encounter with Pluto and enabled the discovery of supermassive black holes that reveal secrets of the origin of the universe.

Contact

5071 W Saanich Road
Victoria, BC
V9E 2E7
Tel.: 250-363-0001

info@nrc-cnrc.gc.ca
www.nrc-cnrc.gc.ca/herzberg

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WELCOME TO THE

Dominion Astrophysical Observatory

The Dominion Astrophysical Observatory (DAO) is operated by Canada's National Research Council (NRC), the country's premier research organization. Located on Observatory Hill adjacent to Victoria, British Columbia, DAO sits high on the Saanich Peninsula and offers a clear view of the skies above citylights. The location helps minimize the interference of light pollution or "sky glow."

The Herzberg Astronomy and Astrophysics Research Centre manages Canada's participation in some of the world's most important optical and radio astronomy observatories, facilitating access for the Canadian astronomy community. We also work with industry in the design and development of the innovative technology these observatories use to advance our understanding of the universe.

National Research Council Canada | Conseil national de recherches Canada

Canada

WHAT IS

Optical Astronomy?

Astronomy originated in the study of the night sky's visible light, part of the electromagnetic spectrum. Optical astronomy focuses on light visible to the human eye, which is just one part of the electromagnetic spectrum. Visible light is made up of wavelengths approximately 400 nanometres in length (visible as the colour purple) to 700 nanometres (visible as the colour red). A single human hair is 80,000 nanometres thick!

An optical telescope gathers and focuses light to create an image. It lets astronomers study infrared light, which consists of wavelengths between 1,000 and 10,000 nanometres. The telescopes receive very faint light signals and use large, super smooth mirrors to collect this light. Basically, the larger a telescope's mirror, the fainter – and possibly more distant – the astronomical object that can be studied.

The history of optical astronomy has seen the construction of ever larger telescopes. From Galileo's first tiny 4-centimetre telescope lens and then the 1.8-metre mirror in Canada's pioneering Plaskett Telescope, today a massive 30 metre mirror has been designed for the Thirty Meter Telescope (TMT) in Hawaii. NRC engineers at DAO are currently building and testing components for TMT.

Pioneering

FACILITIES

Plaskett Telescope

This 1.8-metre telescope performs both direct optical imaging and spectroscopy to spread the light of a star out into its rainbow-like "spectrum" of colours by a prism or equivalent. This lets us determine the temperature of the star, the abundance of some of the various elements in its atmosphere, and the radial velocity (speed) at which the star is moving towards or away from us.

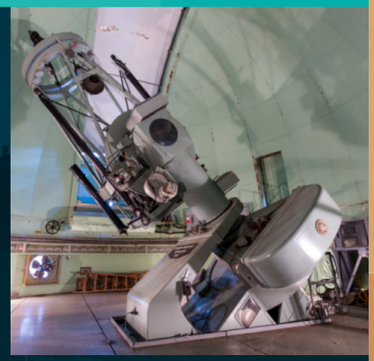
Ongoing upgrades, including a new mirror, have made the Plaskett Telescope 10,000 times more sensitive than when it was built in 1918. Images and spectra are now recorded using ultra-sensitive detectors similar to those in digital cameras rather than being captured on photographic plates. These innovations give the telescope power its creators could only imagine.

Access and Use

DAO hosts long-term observing programs with long blocks of uninterrupted observing time and trains next-generation astronomers and engineers to strengthen Canada's science and technology leadership.

1.2-metre Telescope

The 1.2-metre telescope is equipped exclusively for high-resolution optical spectroscopy. By spreading star light out more than the Plaskett, astronomers can make higher resolution measurements of the patterns produced by various elements. This data allows astronomers to measure rare elements, such as uranium, in the spectra of some stars.



Built in 1961, this telescope has been extensively modified and upgraded to internationally-competitive standards. Although a fairly small telescope by today's standards, the McKellar is still used regularly because of its highly efficient spectrograph and ability to support projects requiring many hours of telescope time.

Canada's Offshore

TELESCOPES

In the 1970s, mirror technology advanced so much that 4-metre telescopes became possible. Canada and other leading science nations realized that expensive telescopes of this nature required collaboration at a global scale.

The international partnership that led to the development of the Canada-France-Hawaii Telescope ushered in a new era of innovation and discovery that put Canada on the map as a world leader in astronomy.

Thirty Meter Telescope (TMT)

As astronomy's next generation observatory, TMT is unprecedented in size, technology, and discovery potential.

Canada's greatest contribution to TMT is the Narrow Field Infrared Adaptive Optics System (NFIRAOS), which is being designed and built at DAO and forms the heart of the telescope. Upon completion, NFIRAOS will be the most advanced AO system in the world used for astronomy, letting TMT tease out starlight passing through a planet's atmosphere to detect its very elements.

Canada-France-Hawaii Telescope (CFHT)

The CFHT, which began operation in 1979, is located on the summit ridge of Maunakea, a 4,200-metre dormant volcano on the Big Island of Hawaii. CFHT is a world-class, 3.6-metre optical/infrared telescope.

DAO contributed to its design and construction and has since helped build some of its most powerful instruments.

Gemini

The Gemini Observatory hosts two 8.1-metre telescopes, one located on Maunakea and the other in the foothills of the Andes near La Serena, Chile. While more than twice as large as CFHT's mirror, Gemini's mirrors are only 20 cm thick. DAO constructed two of the instruments in use by Gemini, as well as the advanced adaptive optics system.