Britain: Science cuts threaten Jodrell Bank radio telescope

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The Labour government of Prime Mister Gordon Brown is pushing ahead with unprecedented cuts in the UK science budget, with many critical programmes and facilities now threatened. In March, the Science and Technology Facilities Council (STFC) outlined a Programmatic Review listing all the science projects it funds in order of priority.

The review followed the STFC's December 11 budget announcement proposing severe cuts to the budgets of critical physics research and astronomy projects in the UK. The council cited an £80 million shortfall in its £670 million triannual budget as the reason for the cuts.

The report divides scientific projects into High, Medium-High, Medium-Lower and Lower categories. Scientists fear that funding may be withdrawn from those facilities deemed to be "Lower Priority" and some of those listed as "Medium-Lower Priority." Some 18 projects are listed as "Medium-Lower Priority" and a further 25 as "Lower Priority."

Among the many projects described as being of "Lower Priority" are the following:

* MERLIN, e-MERLIN and "Jive"—The Multi-Element Radio Linked Interferometer Network (MERLIN) is an array of radio telescopes centred on the world-famous Lovell telescope at Jodrell Bank in Cheshire and is operated by the nearby University of Manchester. The array is distributed around Britain, with separations of up to 217 km. The project is preparing to complete a full £8 million upgrade to fibre-optic cables, enabling the full use of each dish to be made. The latter is known as e-MERLIN.

* Astrogrid: An open-source project leading worldwide efforts in partnership with established astronomical archives and facilities to establish a Virtual Observatory. The project has already designed much of the infrastructure to enable simultaneous access to most astronomical catalogues, images, spectra and other datasets in a standardised way from anywhere in the world.

* BiSON: The Birmingham Solar Oscillations Network consists of a network of six remote solar observatories monitoring low-degree solar oscillation modes.

* CASU/WFAU: The Cambridge Astronomical Survey Unit (CASU) is part of the Institute of Astronomy, Cambridge University, and is mainly involved in survey astronomy.

* Gemini: The Gemini Observatory consists of two of the largest telescopes in the world, one in Hawaii and one in Chile. Gemini North is both a very advanced and the largest telescope UK astronomers have access to in the northern hemisphere.

* EISCAT: The EISCAT Scientific Association project operates three incoherent scatter radar systems, at 931 MHz, 224 MHz and 500 MHz, in northern Scandinavia. EISCAT monitors and studies the interaction between the Sun and the Earth as revealed by disturbances in the magnetosphere and the ionised parts of the atmosphere. It is these interactions that produce the spectacular aurora known as the Northern Lights.

* UKIRT: The United Kingdom InfraRed telescope is located on Mauna Kea in Hawaii. It is currently carrying out the most extensive survey of the infrared sky ever attempted.

* UKATC: Based at the historic and world-renowned Royal Observatory in Edinburgh, the UK Astronomy Technology Centre is the national centre for astronomical technology. UKATC designs and builds instruments for many of the world's major telescopes.

* ING: The Isaac Newton Group of Telescopes has been listed as a "Medium-Lower" priority. The ING consists of three important telescopes on the island of La Palma in the Canary Islands, Spain.

* Also listed as "Medium-Lower" is the UK Solar System Data Centre (UKSSDC). This is a central archive and data centre facility for Solar System science in the UK, supporting the archives for all the researchers in the UK's solar system scientific community.

Jodrell Bank

Immediately following the publication of the STFC review, there were protests throughout the astronomy and physics communities and among scientists in general. Sir Bernard Lovell, who founded and oversaw the construction of Jodrell Bank and who still works there at the age of 96, said, "We are all astonished. I'm sure some solution will be found. It is the wrong time to close it. The work is of such fundamental importance. It would just not be sensible for them to pull the plug now."

Prominent astronomer Patrick Moore condemned the STFC plans. He said, "If we lose Jodrell Bank, it will be a devastating blow not only to British radio astronomy, but to astronomy all over the world. The amount involved is not very much in the bigger scheme of things. It's about the same amount claimed by Cabinet ministers last year for their expenses."

Robert Massey of the Royal Astronomical Society said, "We are very concerned about these plans—they are a real threat to Jodrell Bank. Jodrell Bank is a world-class facility and to save £2.7 million a year by axing something the UK is so good at is terribly disappointing. And this is only the tip of the iceberg."

Since it was constructed in 1957, the huge 76.2 metre (250 ft)-wide Jodrell Bank radio telescope dish located in the Cheshire countryside, 20 miles south of Manchester, has become known and loved by millions of people. One letter published in the local newspaper, the *Manchester Evening News*, said, "I can't believe that this is happening. I was inspired to study science myself by visits to Jodrell Bank as a child and I know that a lot of other people had the same experience."

Such is the public affinity with Jodrell Bank that in 2006, it was named the winner in a BBC News online competition to find the UK's greatest "Unsung Landmarks."

For more than 50 years, the Jodrell Bank Observatory, originally known as the Jodrell Bank Experimental Station, has been at the forefront of worldwide radio astronomy. Sir Bernard Lovell had worked on radar in the Second World War and wanted to investigate the phenomena of cosmic rays. He had originally used a 218-ft wire mesh Transit aerial on the same site. Unlike the aerial, the dish could be pointed to any part of the sky to detect radio waves emanating from space. It was built at an estimated cost of £260,000—at least £3 million at today's costs.

Despite the great advances in radio astronomy since 1957, and the building of many other dishes worldwide, the Lovell remains the third-largest steerable radio telescope in the world today. Today, there are four radio telescopes of varying sizes on the site, the main one being the Lovell.

Over the past five decades, Jodrell Bank has made an astounding contribution to science and our understanding of the universe.

Stars, galaxies and other objects in the universe emit different types of radiation—from visible light to invisible X-rays, gamma rays and infrared. Prior to the advent of Jodrell Bank and the radio telescope age, astronomers were only able to view the visible light emitted by stars. Overnight, it revolutionised astronomy, as it was able to detect radio waves from objects at the far reaches of the universe. The Lovell telescope allows these radio waves to bounce off its dish onto an aerial and radio receiver at its centre.

Among its many achievements, it has developed our understanding of the age of the universe and what it is made of. It has led the way in the understanding of quasars, pulsars and supernovae and played a critical part in a number of space missions. Today, it researches various fields in physics and astronomy including gravitational lenses, cosmic microwave background, active galaxies, stellar Physics, solar plasmas, starburst galaxies and supernovae.

On becoming operational in the summer of 1957, it was the only telescope able to track Sputnik 1, the world's first artificial satellite launched into space by the Soviet Union. On October 12, 1957, Jodrell Bank located the satellite.

In 1959, Jodrell Bank received the very first pictures transmitted from the far side of the Moon by the Soviet probe Luna 3.

Jodrell Bank also tracked the NASA probe Pioneer 5 between March 11 and June 12, 1960. It was also used to send commands to the probe, including the one to separate the probe from its carrier rocket and the ones to turn on the more powerful transmitter when the probe was 8 million miles away. It was the only telescope in the world capable of receiving data from Pioneer 5.

Recalling the tumultuous era that marked the beginning of humanity's exploration beyond Earth, Lovell commented in 2003, "Both the Soviets and Americans had the ability to launch payloads into space, but no means of tracking them!"

Another milestone in the history of Jodrell Bank was in February 1966. The telescope tracked the Soviet Union's first unmanned moon lander, Luna 9. It was able to detect the facsimile transmission of photographs from the moon's surface being relayed back to the Soviet Union.

Perhaps the most outstanding moment in the history of Jodrell Bank was when it assisted in tracking the Apollo mission that put man on the moon on July 20, 1969. During the descent of the Eagle lander to the surface of the moon, Jodrell Bank mapped out a plot chart of it based on Doppler Shift measures. This plot showed a very discernable movement that marked the exact moment when the crew assumed manual control of the craft and momentarily changed course in the last seconds before landing. This was because they had seen a potentially hazardous crater that may have jeopardised the mission.

Today, that plot chart can be seen by visitors on the wall of the cafe in the Jodrell Bank Visitor Centre.

Even as recently as 1993, the Lovell Telescope was asked by NASA to help in the search for the lost Mars Observer spacecraft. Although the craft was not detected, the Lovell was the only instrument on Earth with the capability to do so.

Scientific observations carried out by the telescope included using radar to measure the distance to the Moon and to Venus. It has also observed pulsars and discovered various types of pulsars including millisecond pulsars and the first pulsar in a globular cluster.

In 1979, it inaugurated the field of the study of "gravitational lenses" as its radio observation led to the discovery of the first such lenses. Gravitational lenses had first been predicted by Albert Einstein in his theory of General Relativity at the turn of the last century. Einstein conjectured that instead of light from a source travelling in a straight line (in three dimensions), it is actually bent by the presence of a massive body. This allows the observer to see the object that is further away and would not actually be detected without the presence of the large object.

Further discoveries in this field were made in 1998 with the joint Jodrell Bank/NASA detection of a special type of gravitational lensing known as Einstein Rings.

In September 2006, Jodrell Bank announced that following three years of observing a double pulsar with three of its telescopes, the attending results showed that the general theory of relativity is accurate to 99.5 percent.

Last but not least, the telescope also plays an important role in the search for extraterrestrial life.

Jodrell Bank's latest groundbreaking research

Jodrell Bank/MERLIN has recently been instrumental once again in another monumental scientific breakthrough. On April 2, the team at MERLIN in collaboration with a network of scientists in the US announced the discovery of the youngest planet ever detected.

The planet is still in the process of formation and is known as a "protoplanet." The gas planet and its surrounding mix of rocky particles and dust is thought to be just a few hundred years old and orbits around the star HL Tau. The parent star itself is very young and is estimated to be less than 100,000 years old. It lies in the direction of the constellation of Taurus at a distance of 520 light years. Our own Sun, in comparison, is 4,600 million years old.

The discovery reveals a new planetary system in the process of formation. The evolving planet is a gas giant, some 14 times the size of our Jupiter. Prior to its discovery, the previous youngest planet was confirmed to be 10 million years old.

The HL Tau star region was initially imaged by the Very Large Array (VLA) of radio telescopes in the US at emission wavelengths. These were specifically chosen to detect rocky particles about the size of pebbles. Scientists hoped that the presence of such tiny rocky material would reveal that they were beginning to clump together to form planets. MERLIN, including Jodrell Bank, was able to study the same system at longer wavelengths. These observations confirmed the emissions were from rocks and not from other sources such as hot gas.

Dr. Anita Richards, one of two scientists at Jodrell Bank who analysed the data, said, "The new object, designated HL Tau b, is the youngest planetary object ever seen and is just one percent as old as the young planet found in orbit around the star TW Hydrae that made the news last year. HL Tau b gives a unique view of how planets take shape, because the VLA image also shows the parent disk material from which it formed."

Jodrell Bank's future is bound up with the e-MERLIN project, which is currently being finalised. It is due to be operational in late 2008 or early 2009 at a total cost of £8 million.

It has also been selected as the headquarters of a larger international project—the Square Kilometre Array. This proposes to connect dozens of radio dishes at a remote facility to be built either in South Africa or Australia at a cost of about £1 billion. This project is not intended to be fully operational until 2020, meaning that Jodrell Bank is reliant on the continuation of the e-MERLIN project.

The upgrade of Jodrell Bank associated with e-MERLIN will increase the resolution and sensitivity of the system by 30 times. This would result in the telescope being able to observe a much wider range of objects in the universe. The scrapping of e-MERLIN would result in no new science being achieved from the £8 million investment and the possible closure of Jodrell Bank altogether.

Phil Diamond, the director of the observatory, said, “It means there is a threat to the whole facility. We are coming to the end of the £8 million MERLIN upgrade, which when it comes on stream, will make us one of the most powerful telescopes on the planet, so it is unbelievable.”

The cuts being proposed by the STFC have been aptly described as “scientific vandalism.”

For several generations, Jodrell Bank has been a powerful symbol representing scientific achievement and progress. For many school children, including this writer, seeing the giant telescope up close as a child left an indelible memory. Tens of thousands of people still visit Jodrell Bank each year and marvel at the structure and what it represents historically. Lectures are regularly held there that continue to play an important role in the dissemination of the latest developments in the fields of radio astronomy and physics.

Precisely due to the great advances in scientific understanding and discoveries, in which it played a major role, today Jodrell Bank and the other projects threatened in the STFC review are ever more critical in both enhancing and promoting scientific enquiry. The slashing of the science budget is bound up with a general onslaught being carried out by a government whose policies are based on facilitating the requirements of big business. The pursuit of science and knowledge is being sacrificed to the narrower and more immediate demands of corporations for returns on their investments.

A web site www.savejodrellbank.org.uk has been set up by students at the University of Manchester in response to the threat.