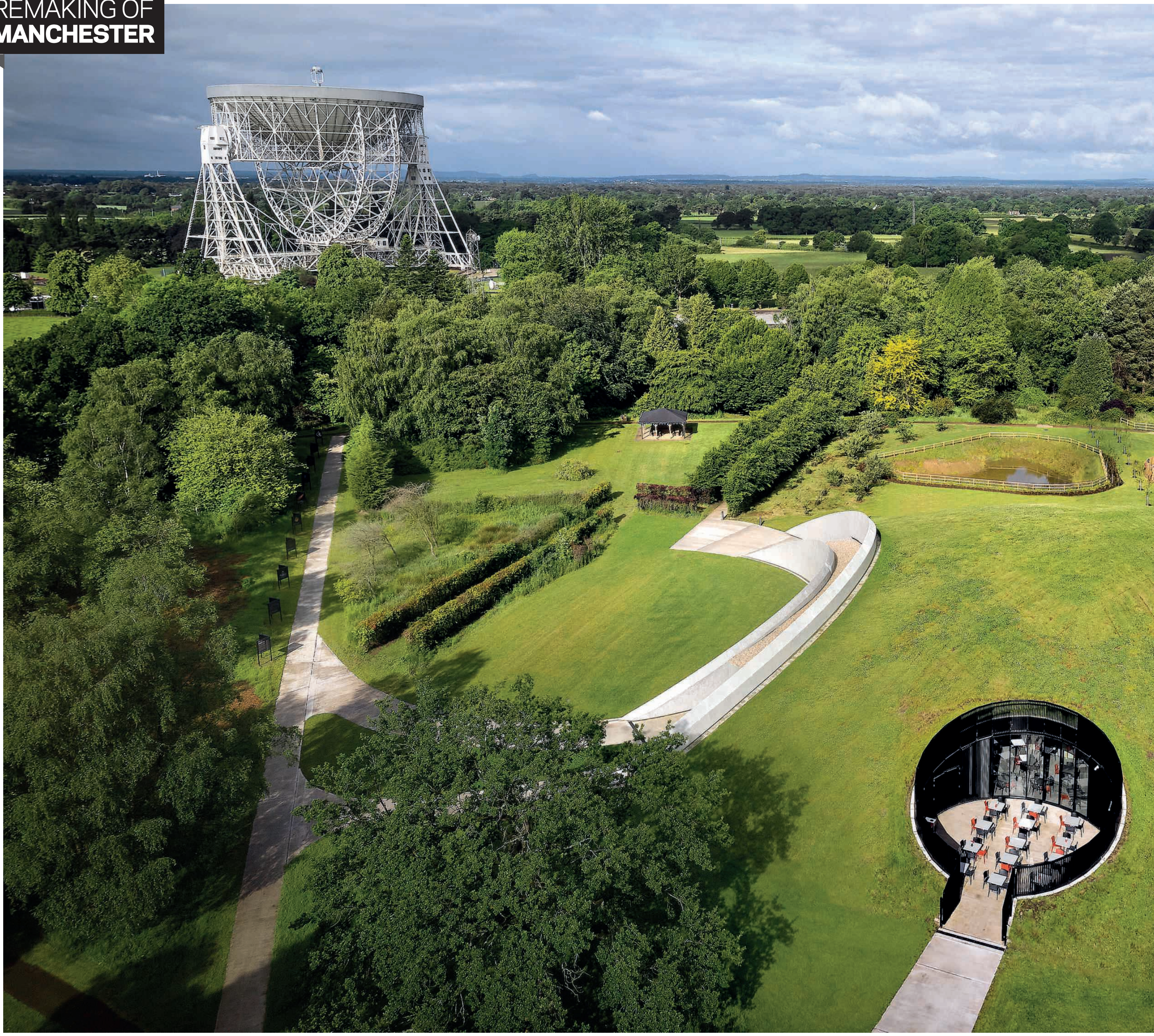
REMAKING OF
**MANCHESTER**



# MEANWHILE, BACK ON PLANET EARTH

First Light Pavilion, a £20.5m visitor centre at Jodrell Bank, takes the form of a grass-topped dome that mirrors the shape and scale of the dish of the famous Lovell telescope. But while the radio telescope searches out the mysteries of the universe, the new centre presented challenges of a far more terrestrial kind. **Thomas Lane** reports

The approach to Jodrell Bank Observatory's new First Light Pavilion is designed to instil a sense of surprise and wonder. Visitors approach two parallel curved concrete walls suggestive of a new moon, along a simple concrete path.

One wall is higher than the other; the lower wall is punctuated by a central vertical slot. Behind the walls is a large mound of earth. What could this be? A sculpture, a garden folly, or a modern take on an ancient burial ground? Continue along the path into the space between the walls and visitors end up inside an entrance hall and go under a large archway into Jodrell Bank's new visitor centre.

The visual approach cues are not random. The external walls are indeed intended to reference celestial bodies which is, after all, what Jodrell Bank is all about.

The observatory is home to four radio telescopes, including the famous Lovell telescope named after Jodrell Bank's founder, Sir Bernard Lovell. These telescopes enable scientists to observe astronomical phenomena deep in space.

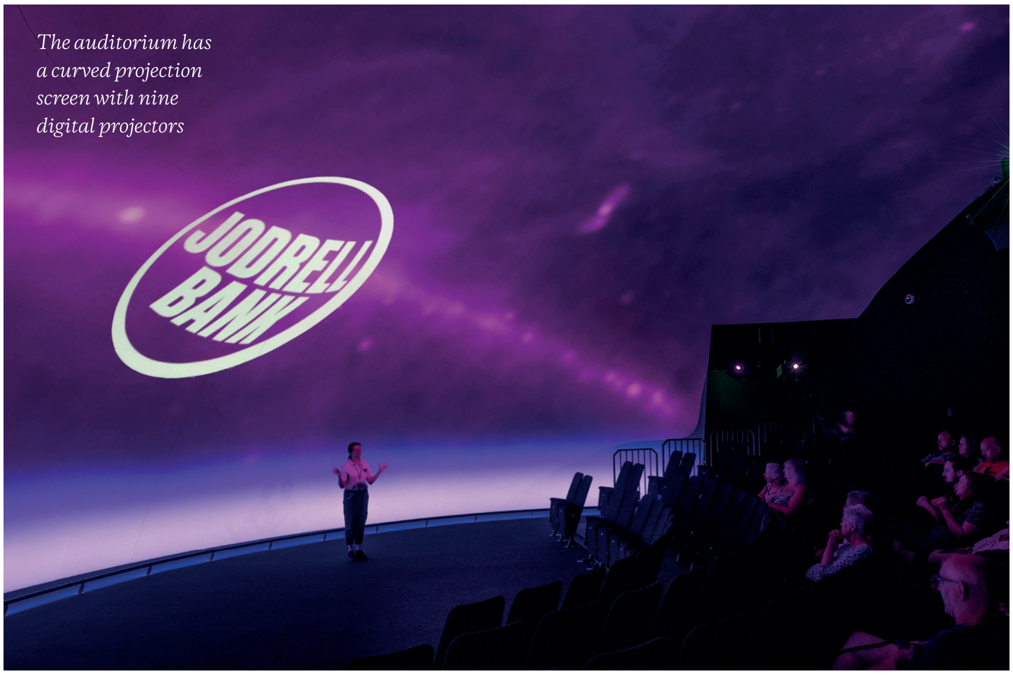
The connection with an ancient burial mound is deliberate as this references sites such as Stonehenge and Newgrange that connect the earth with the celestial. Newgrange is a Stone Age circular mound in County Meath, Ireland, where the passage and chamber are aligned with the rising sun on the morning of the winter solstice. That slot in the outer wall performs the same function: at local astronomical noon on 21 June, the summer solstice, the sun shines though a hole in a brass plate in the slot and lines up exactly with a central marker.

Twenty miles south of Manchester, and part of the city's university, Jodrell Bank receives 180,000 visitors a year. The idea behind the £20.5m visitor centre was to help them better understand radio astronomy and help the observatory appeal to a wider and more diverse audience. The centre includes interactive »

*Left: Jodrell Bank's First Light Pavilion opened in June. Visitor facilities include an exhibition gallery, an immersive projection space and auditorium, and a new education hub and cafe*

*Below: The entrance to the First Light Pavilion is along two parallel curved concrete walls*

HUFTON + CROW




*The auditorium has a curved projection screen with nine digital projectors*

» exhibits showing the work of the observatory and the "space dome", a huge, 270° curved screen where visitors can enjoy a 30-minute film detailing the history of Jodrell Bank which is narrated by Professor Brian Cox.

The earth mound is hiding one of the largest reinforced concrete domes to be built in Europe. What is perhaps less obvious to visitors is that this dome – which is the roof of the building – is exactly the same diameter and height as the dish of the Lovell telescope.

"We came up with the idea that the visitor centre should reflect the legacy of the telescope in some way, so we chose the diameter of the telescope and everything fitted," says Julian Gitsham, principal of architect Hassell, which did the concept design. He explains that the building needed to blend into the landscape as it overlooks a 35-acre arboretum and had to be single-storey to avoid blocking the Lovell telescope's field of view. It also helped that the exhibition designer, Casson Mann, wanted a black box for the interactive displays, so it did not matter if the building was buried.

The dome has a big job to do. It is 76m in diameter and 8m high in the centre, and must bear its own weight plus 300mm of wet soil. Allowances had to be made for the weight of the equipment used to lay the soil, and a tractor lawnmower for maintenance once it was finished – and even the weight of wandering cows, should they escape from a neighbouring field. Yet the dome is just 200mm thick.

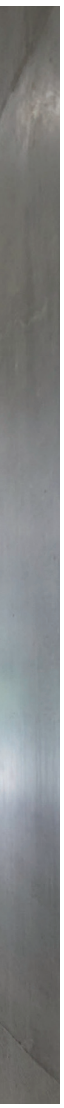
## Structural concept

First Light has been built by Kier, which developed the concept design under a pre-construction services agreement before contracting to build it for a £13m lump sum.

POSITIVE IMAGE PHOTOGRAPHY; HUFTON + CROW; KIER

*Left: The pavilion's entrance was built into a curved concrete wall designed to reflect the arc of the sun*

*Below: The entrance hall – visitors walk under a large archway into Jodrell Bank's new visitor centre*



## A BRIEF HISTORY OF JODRELL BANK

**The reason why Manchester university established Jodrell Bank in the middle of the Cheshire countryside is that Bernard Lovell, the scientist behind the centre, needed a site free from interference from Manchester's electric trams. Lovell wanted to see if radar could be used to study cosmic rays and, having discovered instead that radar was good for detecting meteors, established a research centre on the site. Lovell and a handful of other scientists spent the second half of the 1940s experimenting with old Second World War army equipment and built a radio telescope that detected the Andromeda galaxy, 2.5 million light-years away.**

**Looking further into space required a bigger telescope so the 76m-diameter Lovell telescope was born. As no one had built anything like it before, costs spiralled out of control and at one point the project appeared to be doomed. It was saved by the appearance of the first Russian Sputnik satellite, which was launched by an intercontinental ballistic missile. This brought home the role that Jodrell Bank could play in military defence, and within weeks it was fully operational. It continued this role during the Cold War, acting as Britain's early warning defence system. Since then, it has helped discover quasars, black holes and other astronomical phenomena. Despite being built in 1957, the Lovell telescope remains one of the biggest and most powerful radio telescopes in the world. It is still in use today and continues to play a leading role in extreme physics.**

### PROJECT TEAM

**Concept architect** Hassell
**Executive architect** JMArchitects
**Concept structural engineer** Atelier One
**Executive structural engineer** Roscoe
**M&E engineer** Mott MacDonald
**Exhibition designer** Casson Mann
**QS** Simon Fenton Partnership
**Concept landscape architect** Planit-IE
**Executive landscape architect** DEP Landscape Architecture
**Main contractor** Kier
**Concrete specialist** Mayo Civil Engineering
**M&E specialist** Lorne Stewart

WE CAME UP WITH THE IDEA THAT THE VISITOR CENTRE SHOULD REFLECT THE LEGACY OF THE TELESCOPE IN SOME WAY, SO WE CHOSE THE DIAMETER OF THE TELESCOPE AND EVERYTHING FITTED
**JULIAN GITSHAM, HASSELL**

"The biggest challenge was that we had a very loose structural concept for the concrete dome," explains Andrew Webster, Kier's design manager on the project. "A big focus of the project was how we could make this thin shell dome work and as easy to construct as possible."

Project director Ryan Southern says there were concerns that the proposed design was not buildable. "The structural design was a major risk to us as, from our experience and other structural engineers we went out to, all were concerned that a 200mm-thick dome roof was too thin and surely needed to be 250m, even 300mm," he says.

Why not simply make the concrete shell thicker? "As soon as we started thinking of adding 50mm or 100mm of extra concrete, the cost of the project started going up, and also the self-weight of the concrete started defeating itself," Webster says.

The concept design had been done by structural engineer Atelier One and had also been the subject of a Leeds University research project. Kier engaged its own structural engineer, Roscoe, to go back to first principles to validate Atelier One's design. Roscoe's structural engineer Dan Gent says he was initially sceptical but soon changed his mind.

"When we ran the numbers on the dome, we were pleasantly surprised to find it did work," he says. Webster and Southern then engaged Kier Professional Services to validate the design again, which satisfied Southern. "It had gone through four completely different parties, who all came up with the same answer," he says.

The first job after casting the slab was to build two circular, parallel walls to support the dome and create a series of perimeter spaces around the central exhibition and auditorium spaces. There is also a wall separating the exhibition and the auditorium space.

Southern describes this separating wall as one of the biggest challenges. "Everything on this project was curved, and this wall wasn't even a consistent curve as the radius varied," he says. "From the setting-out point of view, it was very challenging."

Kier used the Efco shuttering system for the curved walls, as this features linked metal shutters that can be adjusted to create the required radius. An inner metal facing sheet ensures curves are round rather than faceted and ensures a good finish.

The entrance walls, which curve away from the dome-supporting walls, were also built. The intersection between the entrance and »

» dome support walls provides a bifurcating double arch where people enter the building.

The big challenge was realising the dome. “The original intent was to use laser-cut foam formwork which completely blew the budget out of the window,” explains Webster. Southern says Kier got concrete specialist Mayo Civils involved very early on to work out an economical way of doing it. Mayo proposed using timber formwork and built a mock-up in its workshop to prove it could be done.

Titan support tables, which are usually used for constructing flat slabs, were used to form a base for the timber formwork. The tables were set out in three levels, stepping up towards the centre of the dome. Timber trusses, with a curved top section, were made in the workshop and assembled on site.

There was one truss per degree, per level, making up 360 to form a complete circle. With three levels that adds up to a total of 1,080 for the whole project. Marine ply, 18mm thick, was fixed over the trusses to form the dome shuttering.

The next job was placing the steel reinforcement. Gent says a lot of work was done on the rebar design to ensure this performed structurally yet could be easily placed by the site teams.

“We ended up detailing a lot of the bars as straight bars even though it all curved, as the guys were able to offer these round to the correct radius,” he explains. “As you get closer to the crown you can’t bend the bars on site, so those were pre-bent to the correct radius.”

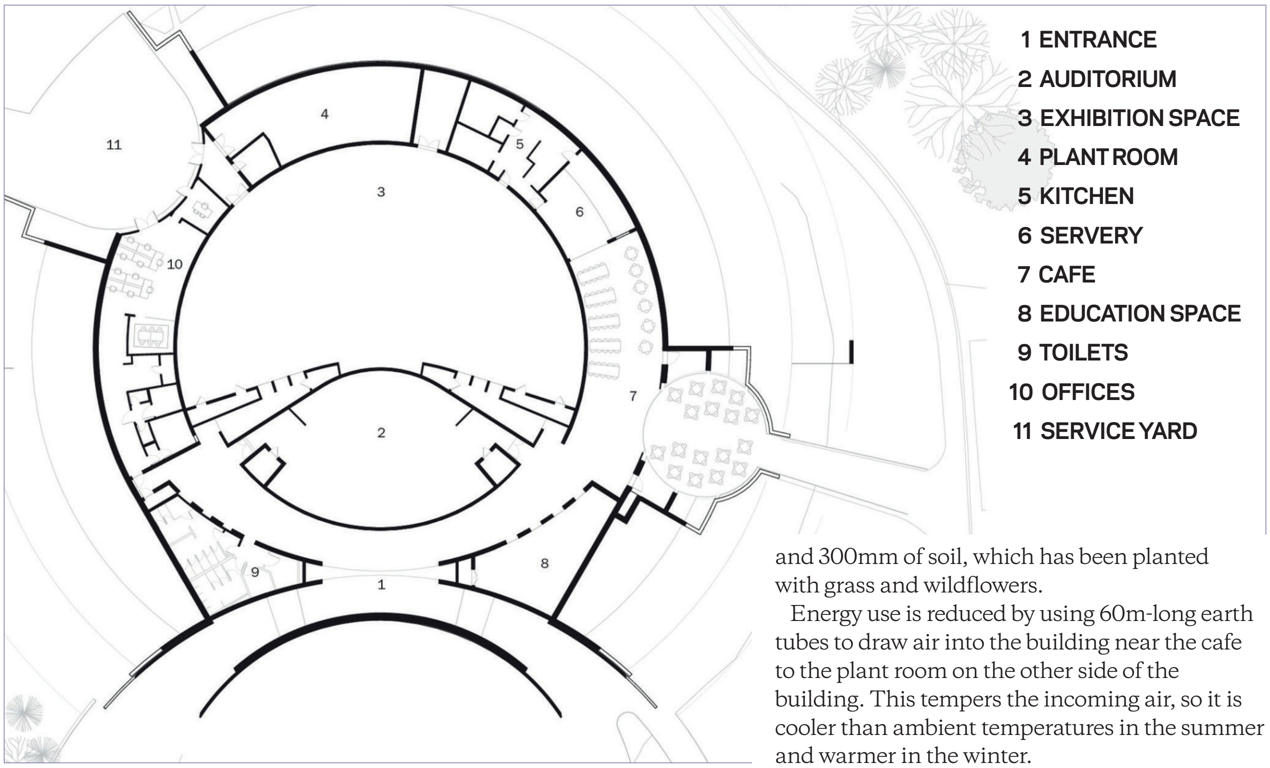
The bars radiate out from the centre of the dome towards the edges, and there are also bars running in circles around the dome. Gent adds that he had to ensure the bars did not get too congested in areas of high stress.

“If we have too many bars overlapping in the same location, we can’t get the concrete in,” he says. A special circular crown was made for the dome centre where all the bars converge; these were welded in place.

Another concern was cracking as the concrete hydrates and shrinks. “What you don’t want is a roof even with hairline cracks that is about to be buried under wet soil,” Gent says, adding that careful detailing of the rebar took care of this problem.

The final issue was concrete slumping off the roof under gravity, so expanded metal mesh baffles were installed at regular intervals to stop this happening. Gent reckons that when it came to the pour these probably were not necessary.

*Left and top: The main structure of the First Light Pavilion is an insitu concrete dome which was then buried beneath earth and seeded to appear as a “hill” in the arboretum of the observatory. The dome was cast in one go, starting by the entrance to the south. The pour took 10 hours*




*Above right: Site plan*

*Left: Created by exhibition designers Casson Mann, the First Light exhibition tells the Jodrell Bank story. Archive materials, including audio, film, diaries, letters, plans and photographs, are brought together in digital displays and projections*

THE ORIGINAL INTENT WAS TO USE LASER-CUT FOAM FORMWORK WHICH COMPLETELY BLEW THE BUDGET OUT OF THE WINDOW
**ANDREW WEBSTER, KIER**

## Casting the dome

The dome was cast in one go. "Once you start, you can't stop – otherwise the whole thing has to be demolished and started again," Southern says. The weather had to be perfect, not raining as this would ruin the finish or too hot as the concrete would set too quickly. A four-week window was identified as a good time for the pour, with an ideal day coming after just one week.

The job needed two shifts of workers as it was going to take longer than one working day. Two concrete pumps were needed for the pour with a back-up plan put in place in case of problems. This was just as well.

"One of the pumps broke down in the first half-hour so we had a fourth pump that we had already secured brought to site and we had another one on standby," Southern explains. "In total we paid for five concrete pumps just in case of problems."

The pour started at 6am by the entrance to the south, with the team working over the full diameter of the dome in strips three to four metres wide towards the north side. The pour took over 10 hours and used 381m$^3$ of concrete.

The client wanted a belt-and-braces approach to waterproofing, given that the structure would be buried under 2,000 tonnes of soil. There are two lines of defence: the dome structure was formed from waterproof concrete and has been finished with a Bauder green roof system which includes a waterproof membrane with a 25-year guarantee. And 180mm of high-performance PIR insulation was laid over the membrane and the roof finished off with a water-retention system and 300mm of soil, which has been planted with grass and wildflowers.

Energy use is reduced by using 60m-long earth tubes to draw air into the building near the cafe to the plant room on the other side of the building. This tempers the incoming air, so it is cooler than ambient temperatures in the summer and warmer in the winter.

Heating and cooling are provided by an air-source heat pump. Setting out the services inside the building presented the team with another challenge, as everything is on a curve and the services must look neat and tidy as they are exposed.

Internally, the soffit was sprayed with an acoustic deadening material and specialist audiovisual equipment installed. The main exhibition area is filled with a variety of Jodrell Bank highlights, including how it was used to track Russian Sputnik satellites and the race between Russia and the US to land the first man on the moon.

A nice touch is a further link between First Light and the Lovell telescope which is provided by the curved projection screens in the exhibition space. These are old white steel panels from the Lovell telescope which were recently replaced because of corrosion. The corroded areas are visible and add a touch of character.

Next door, the auditorium is fitted with a huge, curved immersive screen extending from both sides and over the audience's heads. This showcases how Jodrell Bank was established and some of the discoveries it has made.

First Light opened in June and is proving popular with visitors. Amy Bishop, the head of marketing, says it is attracting a more diverse audience and that they are staying longer than previously. Many of these visitors are children, particularly now the school holidays are under way. With any luck the new centre will help to inspire a sense of the mysteries of the universe and prompt some of them to follow in the footsteps of Sir Bernard Lovell.

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