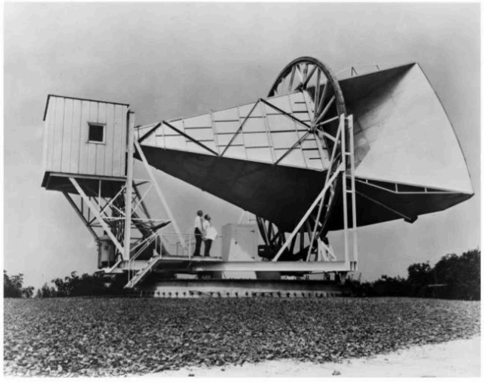
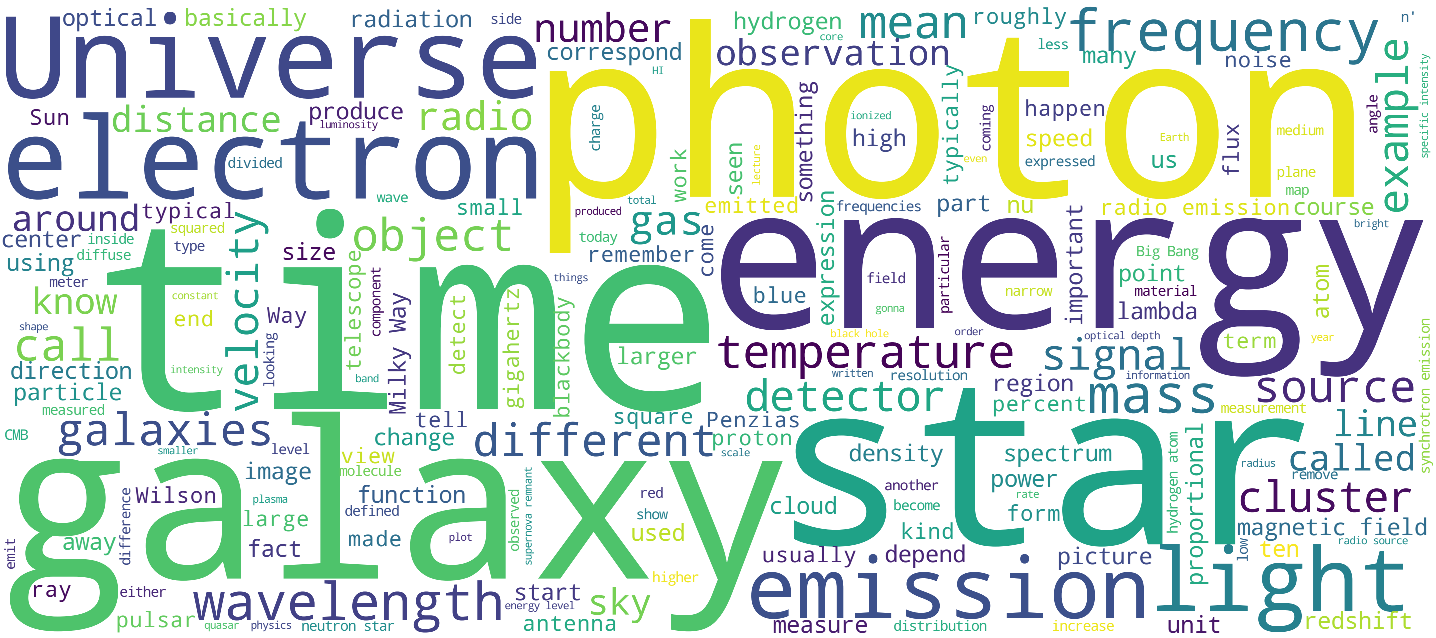
Early history of radio astronomy
Part 2

The Universe At Radio Wavelengths

Frédéric Courbin



C: wikipedia



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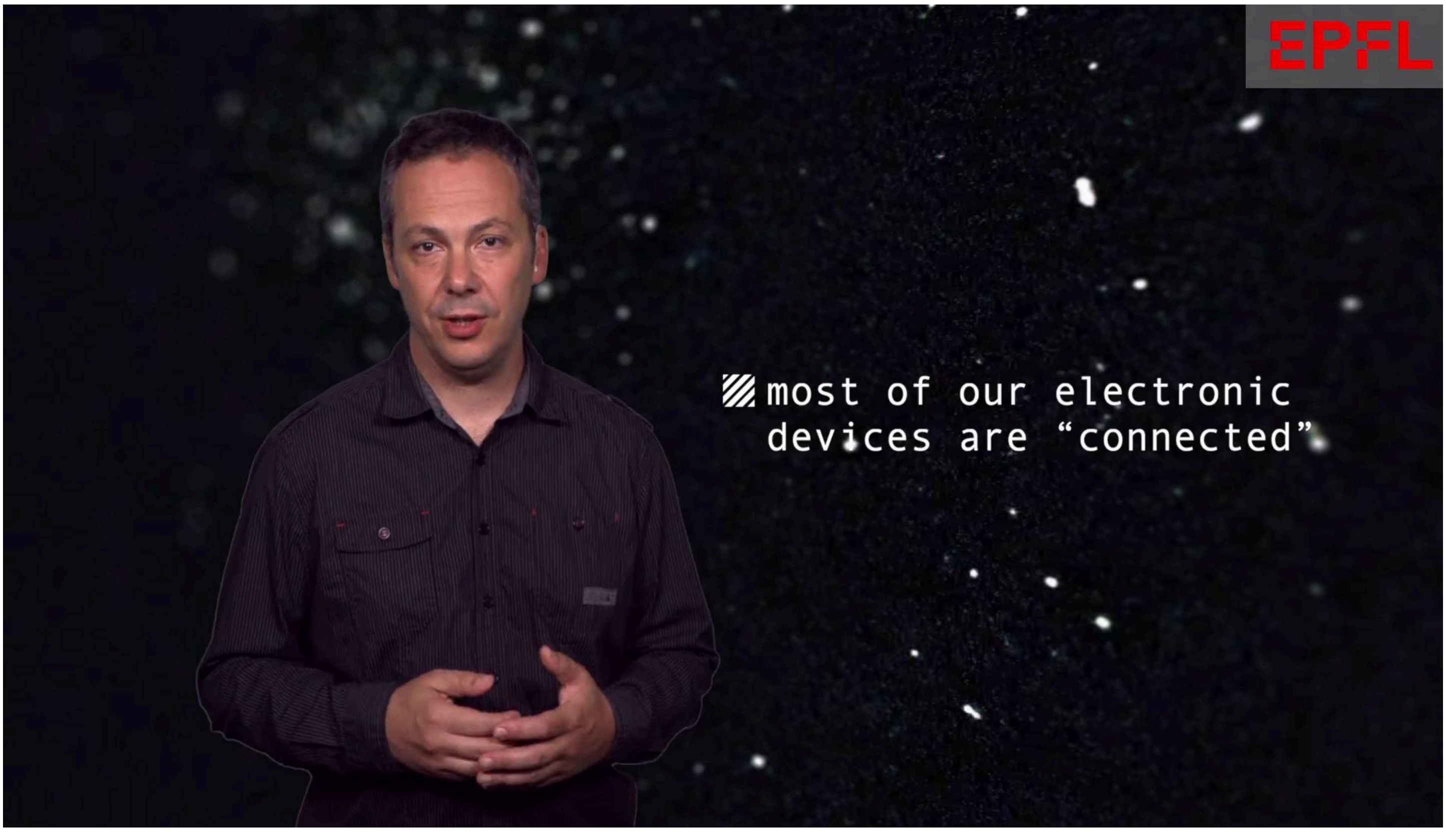
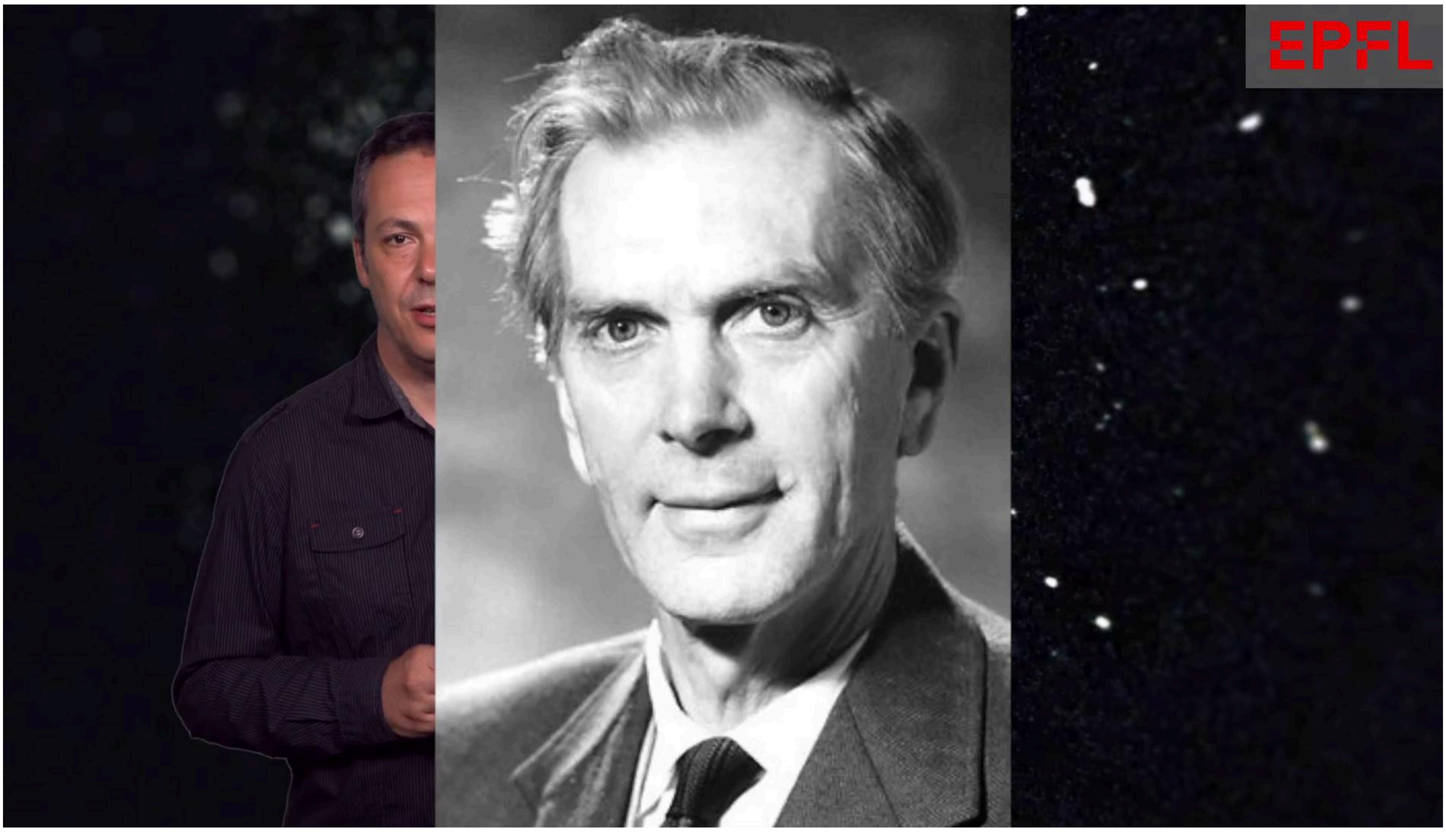


Improving the sensitivity and resolution of radio observations cannot rely solely on the construction of ever larger radio dishes.

Notes

Summary

0m 05s

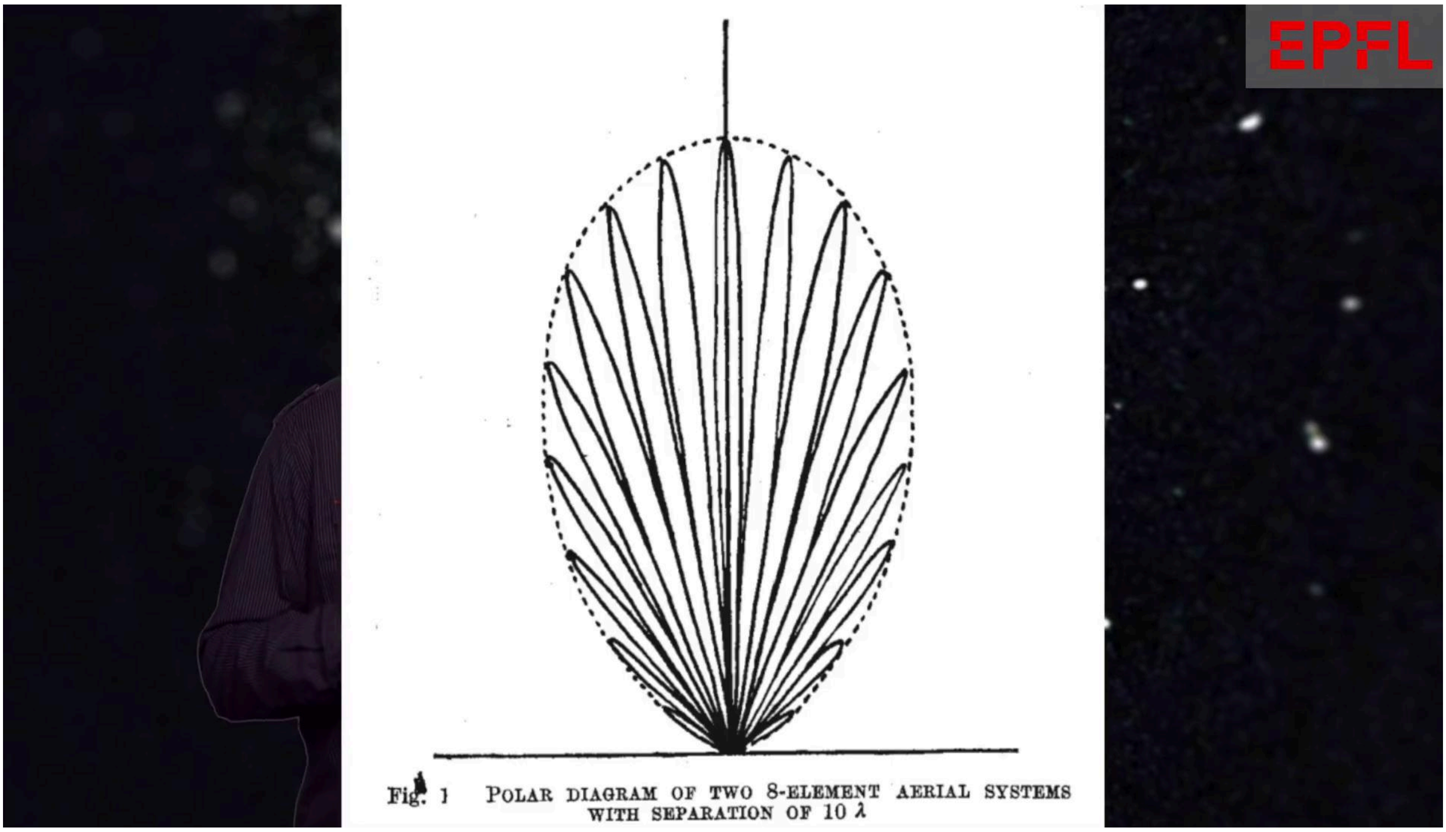


In fact, the largest radio dish in the 40s had 72 meter in diameter and that was pretty much the largest possible size for the technology available at that time. Other means to improve observations had to be devised, in particular to improve the spatial resolution and be able to separate radio emission from different objects on the plane of the sky. Martin Ryle and and his colleague Vonberg both from Cavendish laboratory in Cambridge in the UK combined two antennas to study the radio emission of the Sun in a period of very low sunspot activity.

Notes

Summary

0m 16s



This required too large of an antenna to separate the emission of the fairly small solar disk on the plane of the sky from the global emission of the Milky Way at 200 megahertz, the frequency of interest for solar studies. But by using the combined beams of the two radio dishes separated by several times the wavelength of observations, 200 megahertz corresponds about to 1.5 meter in wavelength, Ryle and Vonberg managed to carry out this challenging observation. This is the shape of the instrumental beam formed by the pair of antennas taken from the original paper of Ryle. The narrower the beam, the sharpest the observations.

Notes

Summary

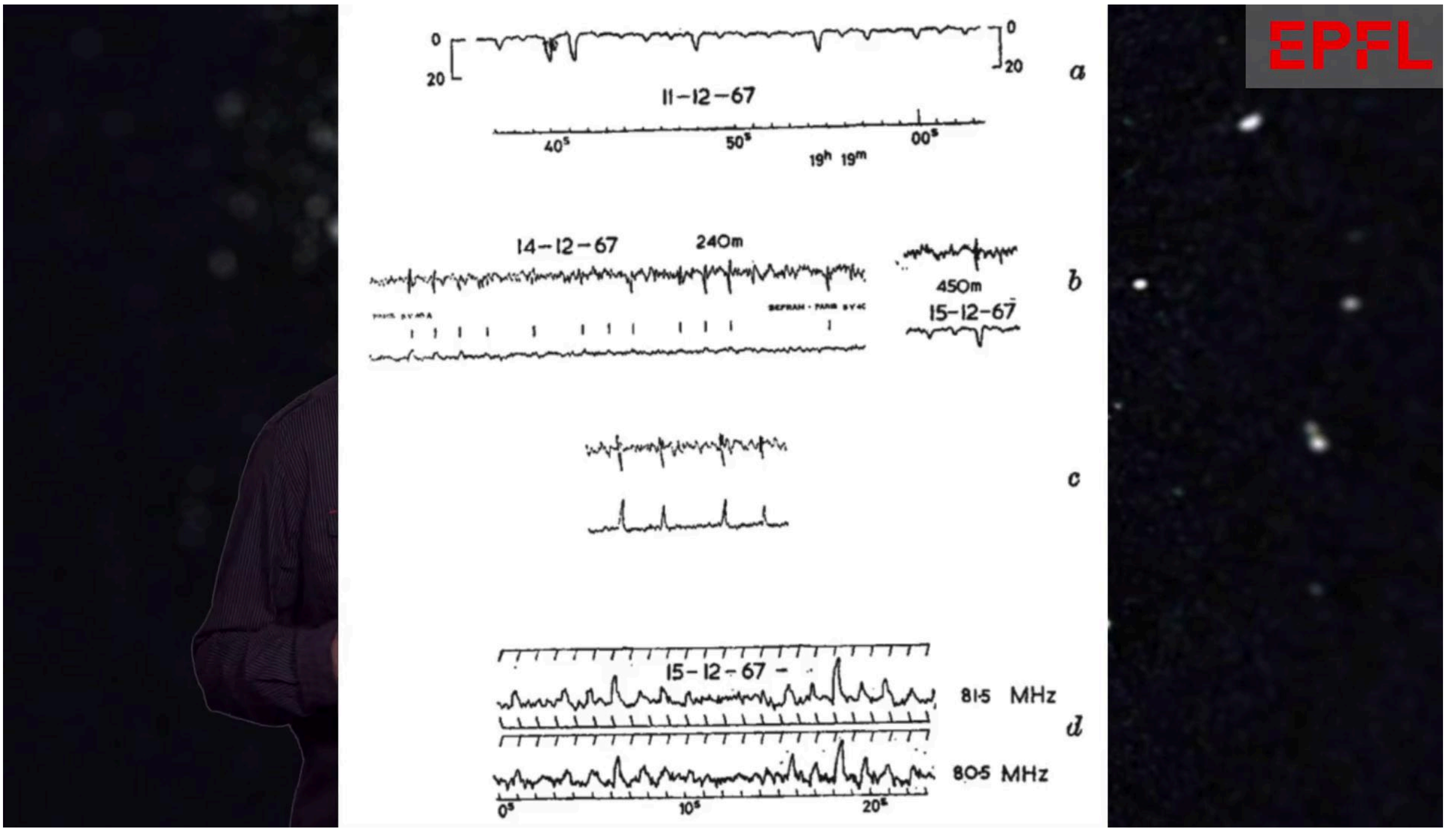
0m 50s

This beam is somehow the pencil size of the telescope. The narrow it is and the smallest are the details that can be seen in the observations. With their simple 2-dish telescope, Ryle and Vonberg invented, in fact, radio interferometry and this will be the subject of many of the lectures in this mooc. This fundamental technical innovation won Ryle the Nobel prize in physics in 1974. And this Nobel prize was shared with another radio astronomer, Antony Hewish, who discovered pulsars with his student Jocelyn Bell.

Notes

Summary

1m 33s



A few years earlier in 1967, Jocelyn Bell noticed that some radio sources were pulsating at an extremely regular rate, so regular that it was, in fact, thought for a while that the signal was sent by some extraterrestrial civilization.

Notes

Summary

2m 09s

But pulsars are nothing but fast rotating neutron stars emitting a strong radio signal along their magnetic axis. Pulsar astronomy is now established as a genuine field of astrophysics and has led to fundamental discoveries in the physics of compact objects in the universe such as neutron star. About at the same time, another breakthrough came in cosmology this time with the serendipitous discovery of the cosmic microwave background by Penzias and Wilson in 1964. A strong prediction of the big bang theory is that residual electromagnetic emission from the big bang must be present still nowadays and that this radiation must be that of a blackbody at a very low temperature around 2.73 kelvin degrees. This is a radiation that occurs in the frequency domain used by Penzias and Wilson to develop communication tool for the Bell laboratories. Penzias and Wilson indeed noticed that the radio noise they observed in their antenna that they were trying to remove was, in fact, present in every possible direction on the sky. All attempts of Penzias and Wilson to remove this noise failed one after the other as indeed, the signal was real and was of cosmological origin. All attempts of Penzias and Wilson to remove this noise failed one after the other as indeed, the signal was of cosmological origin.

Notes

Summary

2m 27s