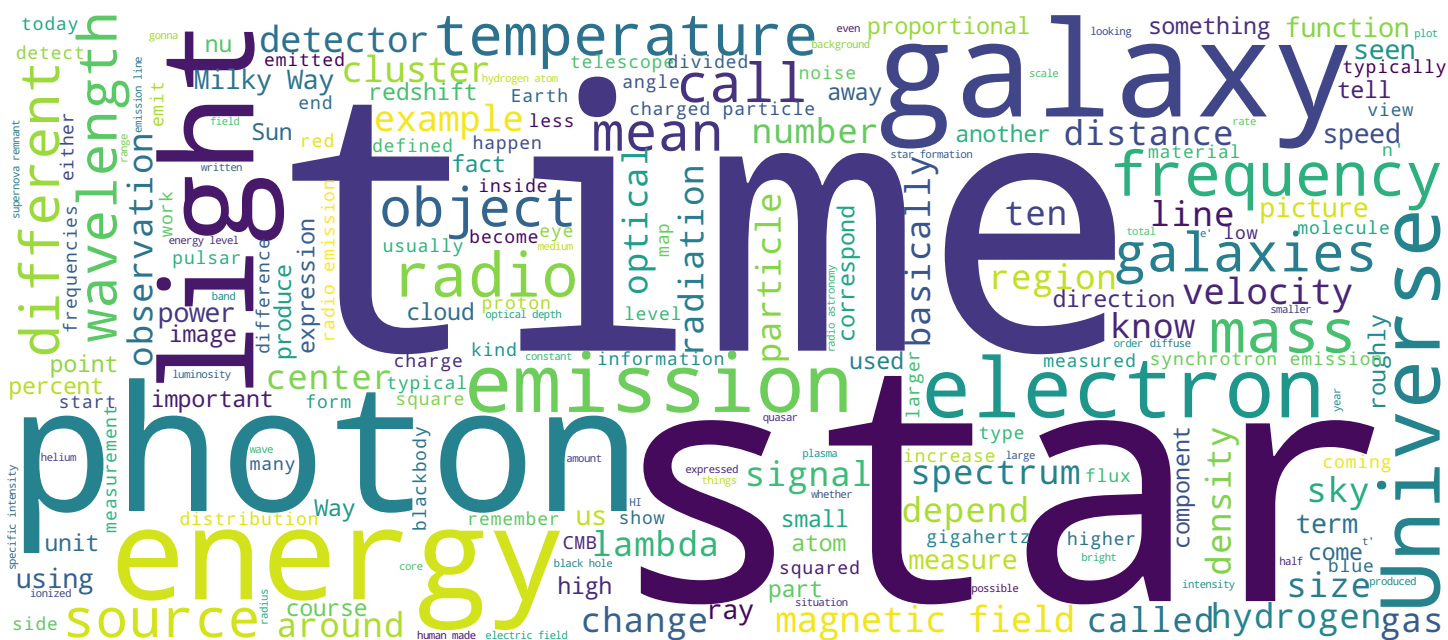


The Universe At Radio Wavelengths

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Title¹

idio array in South Africa"



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Video



Multi-wavelength observations are complementary as they don't trace the same physical phenomena

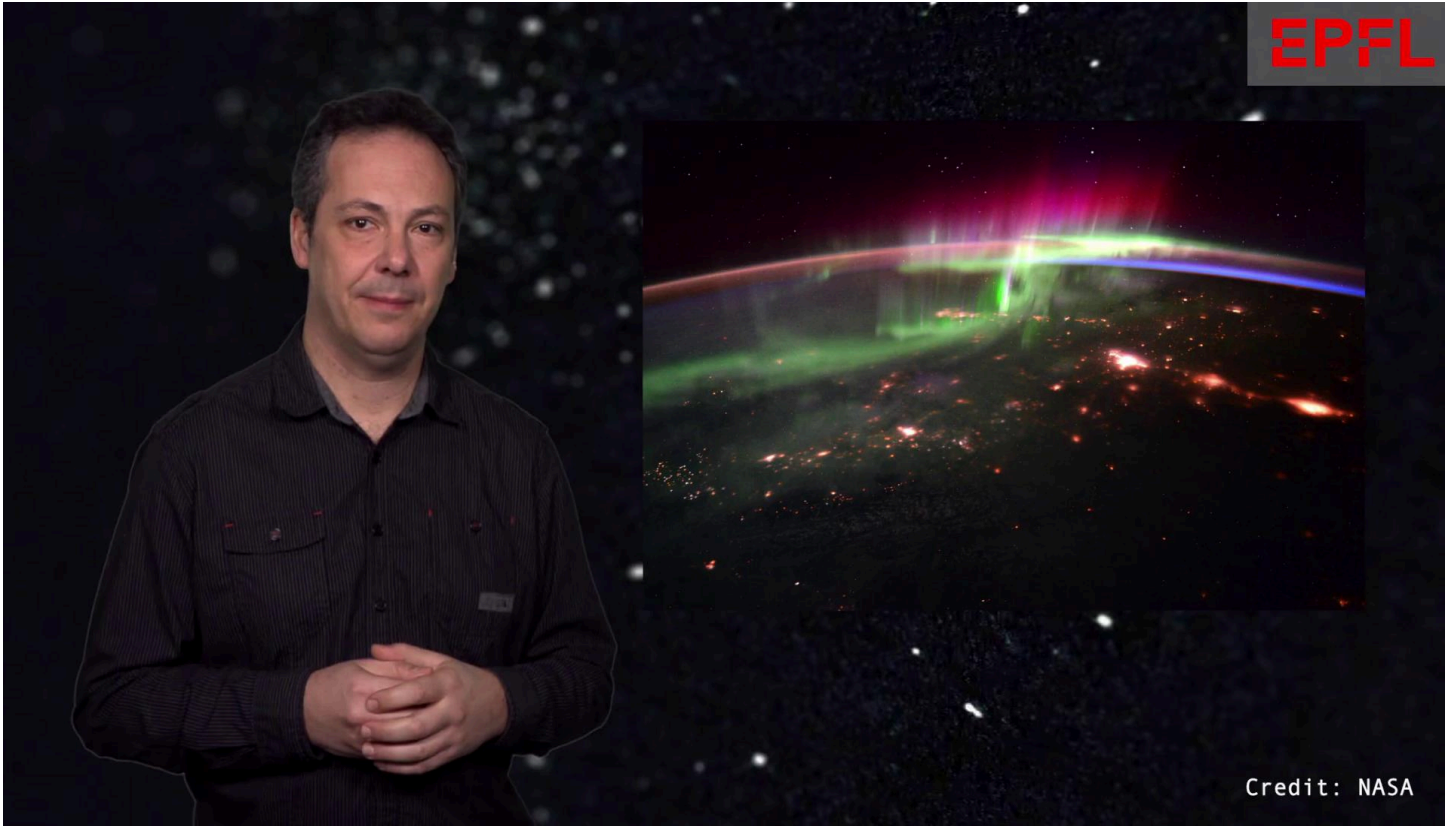
The information reaching us from outer space is conveyed by light. The latter can be interpreted in terms of photons or in terms of electromagnetic waves. Not only at optical wavelength as we are used to see in the solar spectrum or in the spectrum of stars but all the way from Gamma and X-rays to the visible domain, visible to the eye, up to the radio domain. Photons carry energy and momentum. The longer the wavelength, the less energy they carry. For this reason physical processes at work behind the production of radio photons are less energetic than the ones producing photons of shorter wavelength.

Notes

Summary



0m 05s



And also for this same reason it is vital to observe celestial bodies at all possible wavelength including the radio as the range of observed wavelength reflects the underlying broad range of physical phenomena at play in astronomical objects. And a vast variety of astronomical objects emitting the radio starting with our Sun and the planets in our solar system most of the radio radiation of the Sun is due to the presence of magnetic field and charged particles. This is illustrated here where particles spiral around curved magnetic field lines and emit synchrotron radiation just like in a particle accelerator. These lines originate from sunspots which emit both in the optical and in the radio domains. A much more local example of radio emission are Radio Frequency Interferences, RFI caused by polar aurora. These are spectacular examples of an astronomical phenomenon emitting not only in the optical and producing these beautiful moving shapes on the sky but also at radio wavelength as the cause for the aurora is the motion of charged particles trapped in the terrestrial magnetic field and colliding particles in the Earth's atmosphere.

Notes

Summary





When an aurora is particularly strong natural RFI signals can very well affect human-made radio signals and disturb, for example, radio communications or even shut them down completely. On a bit larger scale now everyone has had the opportunity to see our Milky Way from a dark remote place. Hundreds of millions of stars shine together to form spectacular volutes pertaining the whole dark sky. But this is only part of the light reaching us, that part visible to our eyes. If our eyes could see Gamma rays or X-rays, this is what we would see at night or if we could see the radio light like microwaves, our Milky Way would look like this and at slightly longer wavelength, 21 centimeter exactly, we would be able to see emission by cold hydrogen which is present everywhere in our Milky Way. And at even longer wavelength starts synchrotron emission by charged particles in the interstellar medium. Combining observations at all wavelengths provide a wealth of information to astrophysicists and cosmologists but these signals emitted by remote sources are faint and they are all affected by human-made signals known as light pollution. This is the night sky seen by satellites orbiting the Earth.

Notes

Summary



2m 14s



Credit: Matt Goodman

As you can see, there are very few spots on Earth that combine all requirements to host a good astronomical site. Good weather first, low humidity, little atmospheric turbulence and, of course, dark sky. And in the radio, the topic of this mooc, the situation is very similar. Human-made radio waves pollute astronomical observations and we have to build radio observatories in remote places far away from areas heavily polluted by mobile phones and radio devices in general. Some of the best sites for radio astronomy include the Andes in South America or high altitude plateaus in Asia, Australia and South Africa. This mooc will tell you why and how astrophysicists use radio observations to unveil and study the physical mechanism powering the universe and its components.

Notes

Summary



3m 39s