



**Key words:** Red sprites, upper-atmospheric lightning

| <b>ESOCast Episode 81: Red Sprites</b>   |  |
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| <p><b>00:00</b><br/><b>[Intro]</b><br/>1. Midsummer in the Chilean Atacama Desert.</p> <p>As night falls, telescopes at ESO's observatories are just starting the night's observations.</p> <p>But all of a sudden a strange phenomenon appears in the distance.</p> <p>What could this be?</p> <p>Let's take a closer look!</p>   | <p><b>00:00</b><br/><b>[Intro]</b><br/>Malin Timelapse as sunset over desert and observations begin at the VLT<br/>Timelapses of PAO and La Silla</p> <p>Zoom-in on red sprite image</p> |
| <p><b>00:25</b><br/><b>ESOCast intro</b><br/>2. This is the ESOcast! Cutting-edge science and life behind the scenes at ESO, the European Southern Observatory.</p>  | <p><b>00:00</b><br/>ESOCast introduction</p>   |
| <p><b>00:50</b><br/><b>[Narrator]</b><br/>3. It's 20 January 2015, and ESO Photo Ambassador Petr Horálek is capturing the beauty of the Milky Way at the La Silla Observatory.</p> <p>Suddenly a series of short-lived flashes of red light appear out of nowhere above the horizon.</p> <p>At the same time, almost 600 kilometres away from La Silla, a cluster of massive</p> | <p>Horálek in Atacama desert</p> <p>Red sprite image</p> <p>Thunderstorm image taken by satellite</p>  |

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| <p>thunderstorms is raging over northern Argentina.</p> <p>Pointing his camera in the direction of the flashes, Petr photographs the very rare and peculiar features known as <i>Red Sprites</i>. This makes him one of a small group of people to successfully record them, and it's the first time that they have been captured from a major astronomical observatory.</p> <p>A week later, Petr travels further north to photograph the night skies above ESO's Paranal Observatory. Just a few hours before daybreak, he once again witnesses a flurry of these strange flashes over the Andes.</p> <p>From Petr's perspective, they appear to come from the direction of the rising galactic bulge of the Milky Way. But they actually originate from another huge complex of storms over Argentina, more than 600 kilometres from Paranal.</p> <p>The storms are so strong that Petr can observe and document another display of their activity. High in the atmosphere, gravity waves are generated by these storms and form ripples in the greenish layer of airglow.</p> <p>But what are these curious, airy spirits?</p> | <p>La Silla Observatory with red sprites</p> <p>Animation: Paranal</p> <p>Skies over Paranal, with red sprites</p> <p>Radar picture showing thunderstorm from space</p> <p>Skies over telescope, zooming to show ripples in the atmosphere</p> <p>Red sprite images</p> |
| <p><b>03:04</b><br/> <b>[Narrator]</b><br/> 4.<br/> In thunderstorms, most cloud-to-ground discharges are called negative lightning as they transfer negative charges to the ground. Barely five percent of all discharges are positive cloud-to-ground lightning, transferring positive charges from the thundercloud to the ground.</p> <p>Up to ten times more energetic than negative lightning, positive lightning seems to be what makes the Earth's atmosphere a playground for red sprites.</p> <p>Red sprites are a manifestation of complex</p>  | <p>Timelapses from ISS with thunderstorms and lightning</p> <p>Animation showing red sprites above storm clouds</p> <p>Various real images of red sprites</p>   |

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| <p>high-altitude electrical processes. They appear — dancing in the dark night skies — as red figures composed of beads, puffs and tendrils of light.</p> <p>These unusual flashes are formed at altitudes of up to 90 kilometres and get their distinct red hue from the excited nitrogen molecules in the atmosphere.</p>   | <p>Animation of red sprites</p>  |
| <p><b>04:09</b><br/><b>[Narrator]</b><br/>5. Red sprites were first suggested on theoretical grounds in 1925 by the Scottish physicist Charles Wilson.</p> <p>But it wasn't until 1989 that scientists from the University of Minnesota managed to capture the first image of a sprite on film as they were photographing aurorae.</p> <p>And just a few years later, the NASA Compton Gamma Ray Observatory managed to discover gamma bursts originating above thunderstorms — another consequence of lower-atmospheric lightning activity.</p> <p>Astronauts have a particularly good vantage point from space and have also photographed sprites using normal digital cameras.</p> <p>From space, sprites appear shortly after their corresponding lightning strike. In this image taken from space, both the sprite and the lightning flash are captured.</p> | <p>Image of Charles Wilson</p> <p>Images of red sprites</p> <p>Image of Compton satellite</p> <p>Video of atmosphere seen from space; still image of sprites</p> |
| <p><b>05:11</b><br/><b>[Narrator]</b><br/>6.<br/>There are many different species of high altitude atmospheric flashes on Earth, commonly known as upper-atmospheric lightning.</p> <p>Scientists have even speculated that similar phenomena could occur on other planets in the Solar System.</p>   | <p>Animation showing formation of sprites</p> <p>Saturn</p>  |

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| <p>Red sprites might be the most frequently photographed upper-atmospheric lightning phenomena on Earth, but they can appear rather dim when captured on camera. Furthermore, the exact time and location of their appearance in the sky is quite unpredictable. They have been found to show up over powerful and large thunderstorms — but only for a fraction of a second. These factors make them very hard to document and study.</p> <p>Red sprites remain mysterious, and any new image showing them is valuable to scientists trying to study these elusive spirits that dance above thunderstorms.</p> <p>And now ESO has also contributed a small piece to this intriguing puzzle in the Earth's atmosphere...</p> | <p>Series of images of red sprites</p>   |
| <p><b>06:22</b><br/><b>[Outro]</b></p>   | <p>ESOcast is produced by ESO, the European Southern Observatory.</p> <p><i>ESO builds and operates a suite of the world's most advanced ground-based astronomical telescopes.</i></p> |