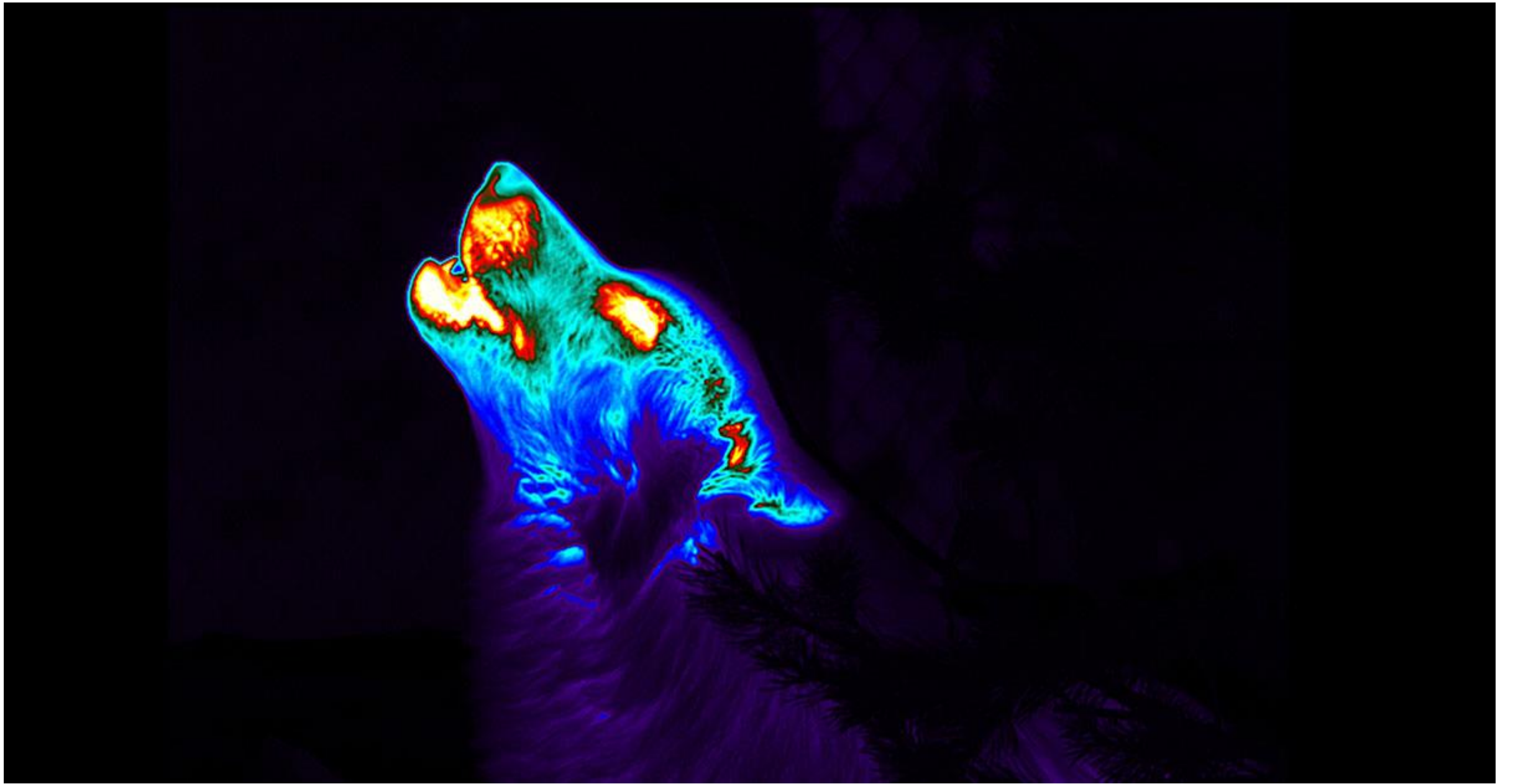


How Do Thermal Cameras Work?

Flir article series

<https://www.flir.com/discover/rd-science/how-do-thermal-cameras-work/>



How do thermal cameras work?

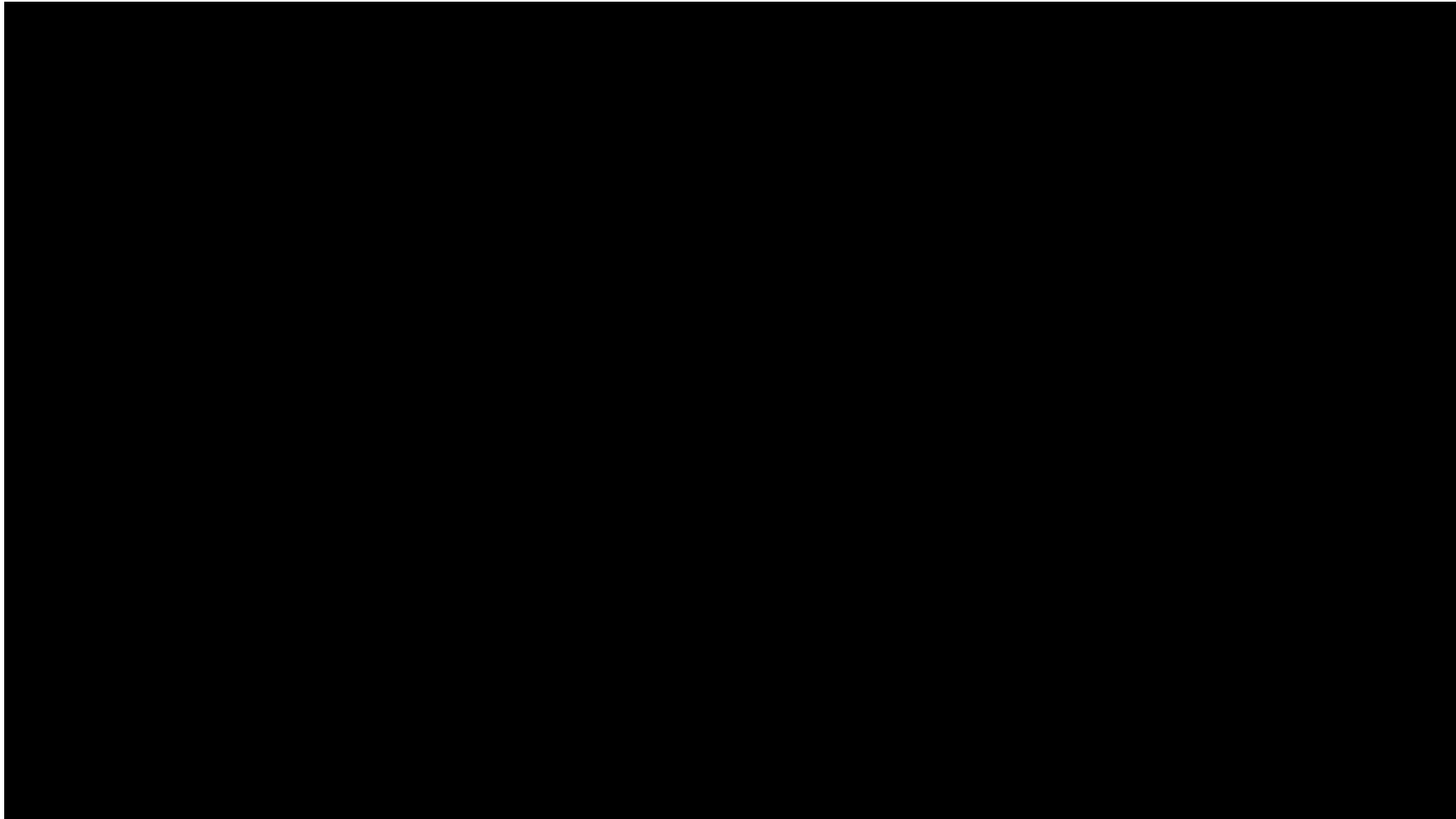
- A thermal camera is a non-contact device that detects infrared energy (heat) and converts it into a visual image. Let's dive into the science of thermal cameras and the invisible world of heat they allow us to see.



DETECTING INFRARED WAVES, NOT VISIBLE LIGHT

- The first thing to know about thermal cameras is they don't work like regular cameras. Regular daylight cameras and the human eye both work on the same basic principle: visible light energy hits something, bounces off it, a detector receives the reflected light, and then turns it into an image.
- Thermal imagers make pictures from heat, not visible light. Heat (also called infrared or thermal energy) and light are both parts of the electromagnetic spectrum, but a camera that can detect visible light won't see thermal energy, and vice versa. Thermal cameras capture infrared energy and use the data to create images through digital or analog video outputs.

Craig Beals explains the electromagnetic spectrum on Invisible Labs.



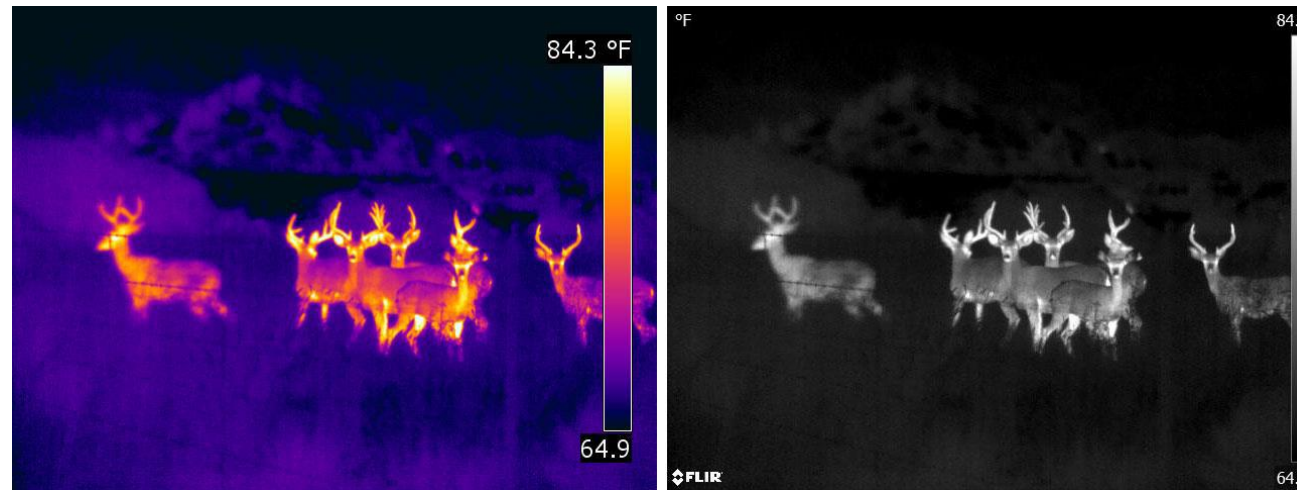
Craig Beals explains the electromagnetic spectrum on Invisible Labs.

Thermal camera components

- A thermal camera is made up of a lens, a thermal sensor, processing electronics, and a mechanical housing. The lens focuses infrared energy onto the sensor. The sensor can come in a variety of pixel configurations from 80×60 to 1280×1024 pixels or more. This is the resolution of the camera.
- These resolutions are low in comparison to visible light imagers because thermal detectors need to sense energy that has much larger wavelengths than visible light, requiring each sensor element to be significantly larger. As a result, a thermal camera usually has much lower resolution (fewer pixels) than visible sensors of the same mechanical size.

WHAT ARE THERMAL CAMERAS ABLE TO DETECT?

- Heat sensed by an infrared camera can be very precisely measured, allowing for a large variety of applications. A FLIR thermal camera can detect tiny differences in heat—as small as 0.01°C —and display them as shades of grey or with different color palettes.



The same image with heat differences displayed in the ironbow and white hot palettes.

Heat signature

- Everything we encounter in our day-to-day lives gives off thermal energy—even ice. The hotter something is the more thermal energy it emits. This emitted thermal energy is called a “heat signature.” When two objects next to one another have even subtly different heat signatures, they show up quite clearly to a thermal sensor regardless of lighting conditions. This allows thermal cameras to see in complete darkness or smoke-filled environments.