Visualising the invisible

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Abstract
In addition to the optical camera Megacam, the Canada-France-Hawaii Telescope operates a large field infrared camera, Wircam, and a spectrograph/spectropolimeter, Espadons. When these instruments were commissioned, the challenge arose to create educational outreach programmes incorporating the concepts of infrared astronomy and spectroscopy. We integrated spectroscopy into discussions of extrasolar planets and the search for life, two topics routinely requested by teachers for classroom talks. Making the infrared accessible to students provided a unique challenge, one that we met through the implementation and use of webcams modified for infrared use.

Understanding spectra
Extrasolar planets and extraterrestrial life are two topics commonly requested by teachers for classroom talks. Reduced spectra, like the one of Titan, demonstrate how astronomers actually look for planets and life. Classroom talks start off by talking about handwriting and how we are able to recognise the handwriting of people that we know. Next we equate the handwriting of friends to the unique signature of the elements and compounds in the Universe. Much as the student can be confident who sent a note from the handwriting, an astronomer can be confident of an object’s composition based on its spectra despite their inability to travel to the object that they study. This analogy makes astronomical spectra more understandable to middle school age children. Once they understand the basics of spectra, the leap to shifted spectral lines and planet hunting is much smaller.

Infrared light
Explaining what infrared light IR is proves challenging. We found that while many children understand the individual components of optical light, microwaves, radio waves, and X-rays, they do not have a great grasp of the entire electromagnetic spectrum. The idea that all of those known quantities are the same, just with different wavelengths, is a leap that the children have not yet made. With the commissioning of Wircam, our wide field IR camera, we felt the need to create a simple, portable and cost effective way for children and adults to grasp the world that exists just beyond what we can see. To that end, we built an IR webcam. The directions were found on wikiHow1. The steps are quite simple and we purchased the most inexpensive webcam available at the local electronics store.

1 http://www.wikihow.com/Make-a-Webcam-Into-an-Infrared-Camera
The camera sees in the near IR, but not at the level of night vision. At wavelengths just outside our own visual limit, the difference between what we see and what the camera sees is striking. The light from the IR LED at the end of a television remote control is clearly seen at the peak wavelength of the camera. Skin coloration, organic dyes, colour differentiation between iris and pupil, and the lenses of sunglasses are invisible in the near IR. These differences, especially the remote control LED, make an impact on children of all ages.

Another benefit of the IR webcam is its portability. A basic demonstration can be done with one computer and the webcam. However, our display is slightly larger. We begin the demonstration by showing the children a diagram of the electromagnetic spectrum. Next, the children then look at themselves using an optical webcam. We then have children look at themselves using the IR webcam. Once they see the obvious changes to their appearance, we give the child the remote control and have them point it towards the camera. When the child sees the bright flash of light emitted by the IR LED, they are astonished. Without fail, children who participate in the activity ask why they cannot see the light with their eyes. And every child points the remote control in the direction of the optical camera after our explanation. By having both webcams available, the children are able to test what we are telling them. We end the demonstration by showing the children side-by-side IR and optical images from CFHT in order to show the benefits of the IR to astronomy.

Conclusion
Infrared astronomy and spectroscopy are areas of astronomy that often get short-changed in education outreach. By creating a few simple demonstrations, we have been able to help students see beyond the optical, into the invisible.