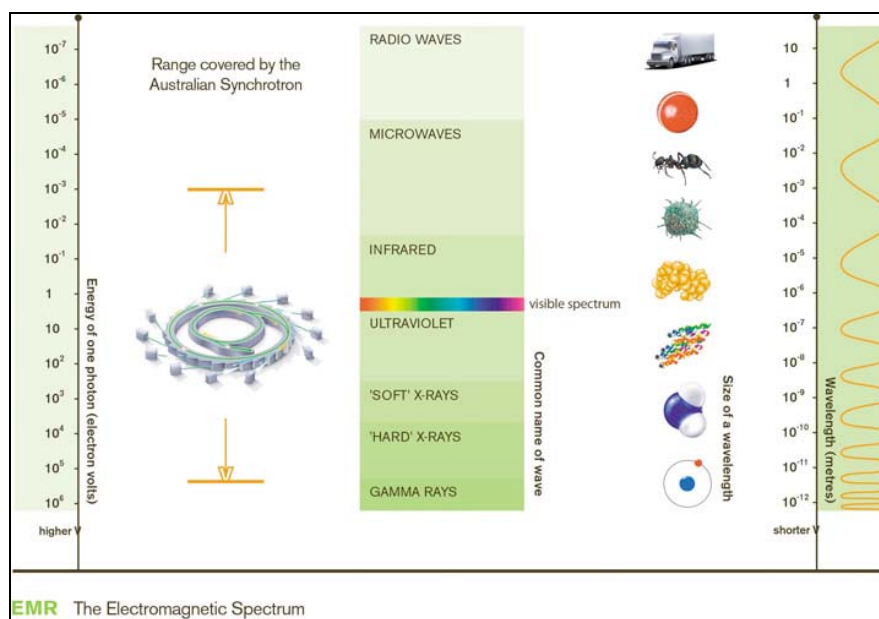


# Synchrotron Investigations

## 4.1 Detecting invisible radiation

### Background

Synchrotrons produce extremely intense electromagnetic radiation (EMR) which is used in scientific research. It produces EMR in a range from infrared to the much higher energy hard X-rays used to destroy cancer cells.



### Where the Australian Synchrotron fits into the electromagnetic spectrum

Image courtesy: Australian Synchrotron, State of Victoria

Currently we have a good understanding of how EMR is produced and its properties. This is due to the accumulation of knowledge gathered by many curious scientists over time.

When sunlight falls on your eyes, the brain registers it as a visible image. But there are invisible parts in the spectrum that we can't see because human vision is sensitive only to a narrow range of wavelengths, known as the visible spectrum.

The only way to detect this invisible radiation is to use special instruments. The spectrometer collects different wavelengths of EMR and analyses them. In this activity, students will re-enact Herschel's and Ritter's experiments, seeing for themselves that radiant energy exists above and below the visible portion of the spectrum.

In the 19th century, astronomers William Herschel and Johann Ritter proved the existence of invisible waves of sunlight. Herschel proved the existence of infrared waves, and Ritter the existence of ultraviolet rays.



### The history of detecting invisible radiation

Sir Frederick William Herschel, (15 November 1738 - 25 August 1822) was a German-born British astronomer and composer who became famous for discovering the planet Uranus. He discovered *infrared radiation* in 1800 and also made many other discoveries in astronomy.

#### Sir William Herschel

*Image courtesy: AIP Emilio Segrè Visual Archives*

#### Johann Wilhelm Ritter

*Image courtesy: Molecular Expressions, Florida State University*

Johann Wilhelm Ritter (December 16 1776 - January 23 1810) was a German chemist and physicist. He was born in Samitz bei Haynau, Silesia (now part of Poland). Ritter made very important discoveries regarding electrochemistry and ultraviolet light. He is credited with discovering the ultraviolet part of the electromagnetic spectrum in 1801 and the dry pile electric battery. Ritter initially referred to the new type of radiation as chemical rays, but the title of ultraviolet radiation eventually became the preferred term. Ritter died at a young age in Munich, possibly due to using his own body in electrical experiments.



**Johann Wilhelm Ritter  
(1776-1810)**

### Notes on the experiment

It is important that while conducting the experiments the spectrum is not moved. The temperature changes are small, therefore careful reading without parallax errors are important for each thermometer. Good digital thermometers work best.

Ultraviolet sensitive beads are cheap and available from CSIRO Education in Australia ([www.csiroshop.com](http://www.csiroshop.com)) or small packs are available from [weatherstation@aanet.com.au](mailto:weatherstation@aanet.com.au). UV beads are also available from [www.SteveSpanglerScience.com](http://www.SteveSpanglerScience.com) and come in assorted quantities (UV Bead Standard Pack – 250 beads, UV Bead Large Pack – 1000 beads, UV Bead Super-Size Pack – 2500 beads). This site also has a large number of other exciting experiments that teachers could use the beads for.

As with all classroom experiments, it is strongly suggested that teachers trial the experiment before presenting it to students.