Feature Article

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1 Aug 2009

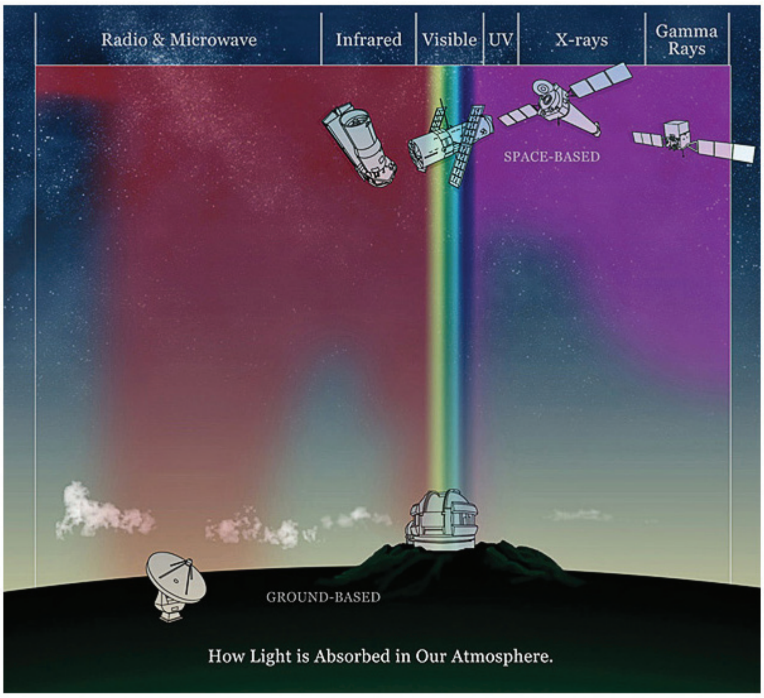
Salim holds a PhD in Astrophysics from Vienna University, Austria. He has been with the European Space Agency (ESA) since 1991. In 2000 he moved to ESA/ESTEC in the Netherlands and joined the Science Directorate. He was involved in Gaia, the billion-star detector from 2001 to 2005, where he created the first Astronomical Virtual Organisation, which was known as GaiaGrid. Currently Salim heads the IT, Communication and Education Service in the Science Directorate. Salim speaks about six languages and has lived pretty much everywhere!

Why do we actually go into space? What is it that drives us towards putting up more and more satellites to observe the Universe, when at the same time we are building bigger and bigger telescopes on the ground? For the professional astronomer this is obvious. For the public at large, it isn't.

Why Do We Study Astronomy From Space?

In the early sixties, the first "space" balloons were launched to the edge of the Earth's atmosphere to get a glimpse of the Universe using sensitive instruments that could observe the skies in the X-ray region of the electromagnetic spectrum. It was a major breakthrough for astronomers to be able to actually go beyond the visible region of the spectrum, allowing them to take a look at the violent Universe with another perspective. X-ray astronomy was born.

On the other extreme, high up on mountains astronomers could place observatories, allowing them to see in the region beyond the visible and towards longer wavelengths. The cold Universe became apparent and with it infrared astronomy thrived. This was the beginning of human exploration in spectral regions beyond visible light. Multi-wavelength astronomy was born.



The light our eyes naturally see is called visible light. However, it is only a small part of the electromagnetic spectrum. Special instruments allow us to detect other sections, such as radio waves and infrared. However, not all these are detectable from Earth, because the atmosphere blocks them.
Image credit: NASA/CXC/M. Weiss.

A golden age

Today's instruments and telescopes are larger, more sensitive, better, and reveal a lot more than ever before. Remember the first images from the corrected Hubble Space Telescope? They fascinated us. They showed a Universe that, even in visible light, was completely unknown. With satellites like ESA's XMM-Newton or NASA's Chandra, we are beginning to discover phenomena that we could only dream of some 40 years ago! Active galactic nuclei, violent stellar explosions, and proof of the makings of black holes fill scientific literature! On the other end, newly launched giant infrared observatories such as Spitzer and Herschel will takes us into the wombs of the Galaxy, where stars are being born. The sky will never be the same. It is a wonderful time to be here and to experience all these phenomena.

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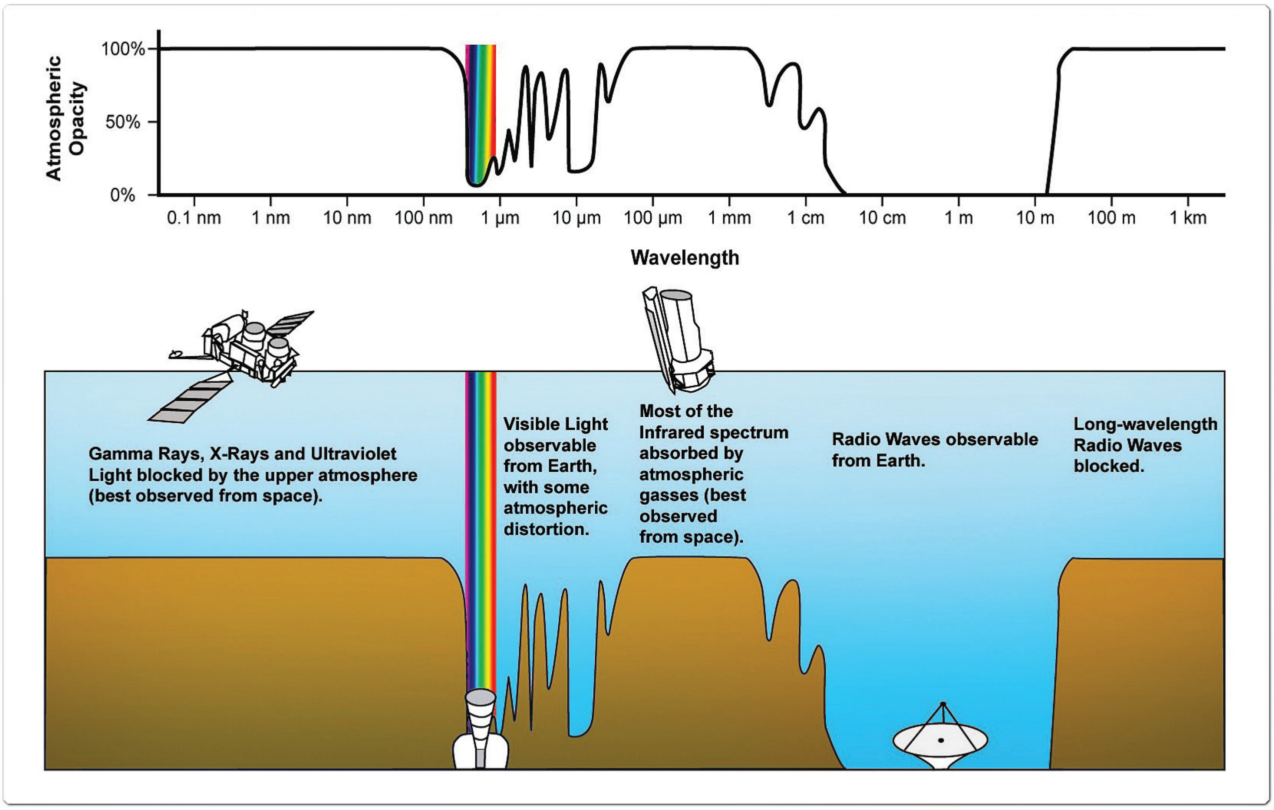

ESA spacecraft cover the full range of the electromagnetic spectrum from space, from microwaves to gamma-rays.
Image credit: ESA.

Modern technology

With the advancement of technology on Earth, today we can certainly match Hubble's capabilities with ground-based telescopes. Projects such as the European Southern Observatory's (ESO) VLT or ALMA are pushing optical technology to the limits to bring us qualitative data in visible light. The driving factor for space telescopes is certainly what is invisible from the ground. That is financially justifiable. That is why our focus in space is high-energy astrophysics (X-rays and gamma-rays), because we'll never be able to build ground-based telescopes to cover those wavelength regions. The same applies to the far infrared and beyond. We need dedicated observatories up there to study phenomena over long periods of time.

However, as long as Hubble is in orbit we will make the most of it, while its maintenance is cheaper than building something new.

The Orion Nebula looks spectacular in infrared, revealing detail that is normally invisible.
Image credit: ESO.

Today there are basically two types of satellites. Those that have a pointing function; meaning they need to be pre-programmed every once in a while to observe certain objects, and survey satellites that are in robot-mode. Principal Investigator satellites are regularly pre-programmed with a set of pointings in order to study specific objects in the sky over longer periods or in more detail. Objects like the Orion Nebula, where the birth of stars takes place is a fascinating region of the sky for the infrared experts, while the galactic centre of our Milky Way is cluttered with black hole candidates and dying stars that can be studied by ESA's XMM-Newton X-ray spacecraft or Integral in the gamma-ray region.

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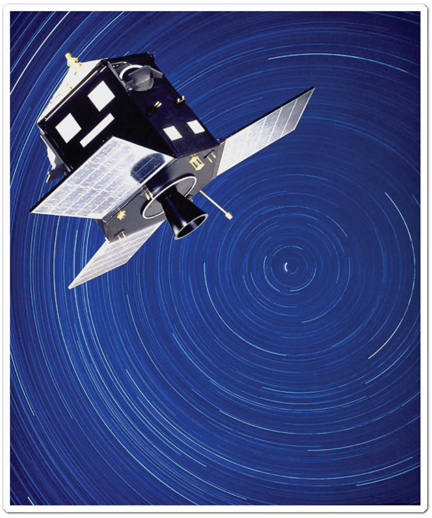

Unique to Europe, Hipparcos is the very first space mission for measuring the positions, distances, motions, brightness, and colours of stars.
Image credit: ESA.

Maintaining a vigil

There are, however, several survey spacecraft that scan the sky for specific phenomena. Hipparcos, the first astrometric satellite of its kind and its successor Gaia, to be launched in the near future, have contributed to astronomy in a very fundamental way by measuring over 100,000 stars' positions. With Gaia, we hope to measure one billion stars, thereby giving us insight into the evolution of the Galaxy and to study relativistic effects in more detail. Planck and WMAP are studying the Cosmic Microwave Background to answer questions about the origins of the Big Bang. Much work and research has yet to be carried out before we can even get a small glimpse of this vast Universe.

With telescopes on the ground and our satellites in space, humankind continues to push curiosity further and evolve our understanding of the heavens above!

This feature article was written as part of the Cosmic Diary Cornerstone project for the International Year of Astronomy 2009. To find out more, check out www.cosmicdiary.org and www.astronomy2009.org.