Thursday, July 18, 2019

Magnetic light. Scientific Reports: Radiation Astronomy-Visuals.

Old school Astro videography: Details of a ongoing process.

What is the old-fashioned spirit of real-time Visual Astronomy?

I think everyone can conjure up a mental image of astronomers at every level and place in history, gazing through the eyepieces of their telescopes at sights far away true Visual Astronomy.

The interaction of light with micro-structures. youtu.be/OS-4Pm7x5Ww

Radiation Astronomy-Visuals.

Part of Understanding the Moon Surface and Space-Moon interactions.

White is the color the human eye sees when it looks at light which contains all the wavelengths of the visible spectrum, at full brightness and without absorption. It does not have any hue.

Light resulting from the combination of all the colors of the Solar spectrum.

The natural medium emanating from the Sun and other very hot sources (now recognised as electromagnetic radiation with a wavelength of 400-750 nm), within which vision is possible is called light.

To shine, light on something is called: illuminate.

Fluorescence is the emission of light by a substance that has absorbed light or other electromagnetic radiation

It is a form of luminescence

In most cases, the emitted light has a longer wavelength, and, therefore, lower energy, than the absorbed radiation.

However, when the absorbed electromagnetic radiation is intense, it is possible for one electron to absorb two photons: this two-photon absorption can lead to emission of radiation having a shorter wavelength than the absorbed radiation.

The emitted radiation may also be of the same wavelength as the absorbed radiation, termed resonance fluorescence.

Luminosities:

Black is the color of outer space.

It is the darkest color, the result of the absence of or complete absorption of light.

It is the opposite of white and often represents darkness in contrast with light.

Opposite to white: colourless from the absence or complete absorption of light.

Also, so near this as to have no distinguishable colour, very dark.

White light is generated by the sun, by stars, or by earthbound sources such as incandescent lamps, fluorescent lamps and white LEDs.

Cumulus clouds look white because the water droplets reflect and scatter the sunlight without absorbing other colors.

White light reflected off objects can be seen when no part of the light spectrum is reflected significantly more than any other and the reflecting material has a degree of diffusion.

People see this when transparent fibers, particles, or droplets are in a transparent matrix of a substantially different refractive index.

Visible spectrum is the portion of the electromagnetic spectrum that is visible to (can be detected by) the human eye

Electromagnetic radiation in this range of wavelengths is called visible light or simply light

A typical human eye will respond to wavelengths from about 390 to 750 nm

In terms of frequency, this corresponds to a band in the vicinity of 400–790 THz

A light-adapted eye generally has its maximum sensitivity at around 555 nm (540 THz), in the green region of the optical spectrum.

The diffuse extragalactic background light (EBL) is all the accumulated radiation in the Universe due to star formation processes, plus a contribution from active galactic nuclei (AGNs).

This radiation covers the wavelength range between ~ 0.1-1000 microns (these are the ultraviolet, optical, and infrared regions of the electromagnetic spectrum).

The EBL is part of the diffuse extragalactic background radiation (DEBRA), which by definition covers the overall electromagnetic spectrum.

After the cosmic microwave background, the EBL produces the second-most energetic diffuse background, thus being essential for understanding the full energy balance of the universe.

The origin of this misconception of an astronaut cannot seeing stars in space is usually traced back to an interview with the crew of Apollo 11, where (it is claimed) Neil Armstrong said he couldn't see stars in space.

What the crew were actually discussing at the time was the inability to see stars on the daylight side of the Moon, which is not surprising given how bright the lunar surface can be relative to the airless black of space.

Even in space the stars aren't overly bright, and our eyes can lose dark adaption pretty quickly.

It's actually quite common to see images of planets and other objects against a starless black background.

Doesn't that support the idea of a starless sky in space?

No, since it's no surprise that an image focused on a bright object like a planet or moon won't have a long enough exposure to see stars clearly.

There are plenty of images from space that do show stars, as well as other faint phenomena such as the green airglow of our atmosphere.

We can all fall prey to the trap of holding misconceptions without really thinking about them.

That's part of the reason why we need to focus in Science.

The observed radiation density (the sky brightness of extragalactic background light) can be independent of finiteness of the Universe.

In astronomy, background commonly refers to the incoming light from an apparently empty part of the night sky, and background noise is electromagnetic radiation from the sky with no discernible source.

A mirror is a surface formed of a metal deposit, for example silver or aluminum, deposited on a support which is not itself traversed by the light.

There is a major difference between bathroom mirrors and mirrors used in telescopes.

Indeed, the metal deposit is, in the first case, deposited at the rear of the glass wall.

The glass then protects the deposit from wear and oxidation.

However, before and after the reflection on the metallic deposit, the light passes through the glass thickness.

This method can not be used in Astronomy.

The crossing of the glass causes parasitic reflections, a loss of light and chromatic aberrations.

In the case of telescope mirrors, the metal is deposited at the front of the glass wall.

The latter is then no longer protected, forcing the mirror to be regularly re-illuminated.

Kirchhoff's Laws.

The spectrum of an object is the variation in the intensity of its radiation at different wavelengths.

Objects with different temperatures and compositions emit different types of spectra.

By observing an object's spectrum, then, astronomers can deduce its temperature, composition and physical conditions, among other things.

Kirchhoff's Laws are:

- A hot solid, liquid or gas, under high pressure, gives off a continuous spectrum.
- A hot gas under low pressure produces a bright line or emission line spectrum.
- A dark line or absorption line spectrum is seen when a source of a continuous spectrum is viewed behind a cool gas under pressure. The wavelength of the emission or absorption lines depends on what the molecules are. What atoms or molecules exist depend on

  - temperature
  - chemical composition

The revolution of electromagnetism.

Magnetism represents a set of physical phenomena in which objects exert attractive or repulsive forces on other materials.

The electric currents and the magnetic moments of the fundamental elementary particles are at the origin of the magnetic field which generates these forces.

All materials are influenced, more or less complex, by the presence of a magnetic field, and the magnetic state of a material depends on its temperature (and other variables such as pressure and the external magnetic field) so that a material can have different forms of magnetism depending on its temperature.

Permanent magnets have permanent magnetic moments at the origin of ferromagnetism.

However, most materials do not have permanent moments.

Among these, some are attracted by the presence of a magnetic field (paramagnetism) others are on the contrary repulsed by it (diamagnetism) others still have a much more complex relationship with an applied magnetic field (antiferromagnetism)

Substances that are negligibly affected by magnetic fields are considered to be non-magnetic, so-called non-magnetic substances.

Scientific and technical progress.

The magnetic field is a magnitude having the character of a vector field, that is to say characterized by the data of a norm, a direction and a direction defined at any point in space, allowing to model and quantify the magnetic effects of electric current or magnetic materials such as permanent magnets.

There are two types of external magnetic field sources:

the proper magnetic moment of the particles, called spin (from which the permanent magnets originate) the electric current, that is to say the overall displacement of electric charges.

Magnetization is a vectorial size that characterizes macroscopically the magnetic behavior of a sample of matter.

It is the sum of orbital microscopic moments and magnetic spin moments of electrons and atoms.

It is measured in amperes per meter; Faraday has shown that every substance is magnetizable, but most often the effect is appreciable only in an intense magnetic field.

Substances that undergo actions of the same nature as iron but much less intense are called paramagnetic.

Spherical nanoparticles of a size of a few hundred nanometers represent a single optical system.

According to theoretical predictions based on the Mie theory, they can present strong magnetic resonances in the visible spectral domain.

It is well known that a pair of oscillating electrical charges of opposite signs, oscillating electric dipole, produces electromagnetic radiation at a frequency of oscillations.

Magnetic dipoles are very common sources of magnetic field in nature.

The magnetic dipole field is usually calculated as the limit of a current loop that contracts to a point.

The field profile in this case is similar to that of an electric dipole with a significant difference that electric and magnetic fields are exchanged.

The most common example of magnetic dipole radiation is an electromagnetic wave produced by an Excited Metal Split Ring Resonator (SRR), the building block of metamaterials.

The actual currents excited by external electromagnetic radiation and circulating inside the SRR produce a transverse magnetic field oscillating up and down in the center of the ring, which simulates an oscillating magnetic dipole.

The major advantage of these artificial systems lies in their ability to respond to a magnetic component of incoming radiation and thus to exhibit zero or even negative magnetic permeability at optical frequencies, which does not exist in nature.

This offers the possibility of designing unusual material properties such as masking or superlative negative refraction.

The SRR concept works very well for gigahertz, terahertz and even near infrared frequencies (a few hundred THz).

However, for shorter wavelengths and in particular for a visible spectral range, this concept fails because of increasing losses and technological difficulties for the production of smaller and smaller broken ring components.

Designs based on metal nanostructures have been proposed to shift the magnetic resonance wavelength into the visible spectral range, however, they all suffer from losses inherent in metals at visible frequencies.

Another approach to obtain a strong magnetic response with low losses is to use nanoparticles made of high refractive index dielectric materials.

As a result of the exact Mie solution of light scattering by a spherical particle, there is a particular parameter range in which a strong magnetic dipole resonance can be obtained.

Remarkably, for refractive indexes above a certain value, there is a well-established hierarchy of magnetic and electrical resonances.

Unlike plasmonic particles, the first resonance of dielectric nanoparticles is a dipolar magnetic resonance.

It occurs when the wavelength of the light inside the particle is equal to the diameter.

Under these conditions, the polarization of the electric field is antiparallel to the opposite limits of the sphere, which generates a strong coupling with the currents of movement of the circulation while the magnetic field oscillates from top to bottom in the middle.

An interest in Astronomy + Photogaphy.

Electrical charge:

It can be shaken very gently, of the order of Hertz.

It will then create a radio wave.

If it is excited very quickly, of the order of a million billion times per second, it is a visible light wave.

Even faster, and it will be X-rays and gamma

Features on Earth, the Moon, and some other bodies have, to some extent, retroreflective properties.

Light striking them is backscattered, or diffusely reflected preferentially back in the direction from which it has come rather than in other directions.

If the light comes from the Sun, it is reflected preferentially back toward the Sun and in nearby directions.

For example, when its phase is full, the Moon reflects light preferentially toward the Sun and also Earth, which is in almost the same direction.

As viewed from Earth, the full Moon therefore appears brighter than it would if it scattered light uniformly in all directions.

Similarly, near new moon, sunlight that has been backscattered from Earth toward the Sun and also the Moon, which is in almost the same direction, and then backscattered again from the Moon toward Earth appears much brighter, as viewed from Earth, than it would without the retroreflective effects.

The retroreflection is produced by spheres of transparent material on the reflecting surface.

When it encounters a transparent sphere, light is preferentially reflected and refracted in a path, within the sphere, which exits it in the direction from which it entered.

On Earth, the spheres are droplets of water in clouds.

On the Moon, large numbers of solid glassy spheres are found on the surface.

They are thought to have been formed from drops of molten ejecta, produced by impact events, which cooled and solidified before falling back to the surface.

Does the light of the moon reflect ultraviolet radiation (or any other radiation-particle) on the surface of the Earth?

Yes: there is also UV radiation although, just like the sun, they are attenuated by the atmosphere and are much less intense than the sun.

At best, about 1-400 000, during the full moon in tropical latitudes.

In addition to UV is also an abundance of infrared spectrum as well as visible spectrum reflected by the Earth.

The Vintage Astronomy.

Old school Astro videography:

The image of a TV is a series of linear scans, starting from the top, and ending at the bottom of the screen.

At the beginning of television, the quality of the phosphorescent elements of the tube was poor.

Therefore, when the beam swept the bottom of the screen, the top had already disappeared, resulting in a phenomenon of flicker, strongly felt by the human eye for 25 Hz or 30 Hz.

The simplest solution would have been to speed up the scan rate, but this also required increasing the frame rate, which was expensive in bandwidth.

A smarter solution was to omit every second line in each image, allowing to double the scan rate while keeping the same bandwidth.

Thus, a first pass displays all the odd lines in half the time for an entire image, and a second pass displays the missing even lines: this is called interleaving.

The same number of scan lines for an image is obtained, and the screen is scanned twice to display a single image.

The term frame (field) refers to a scanning pass.

An image is thus made of two frames, since it takes two scans to define the image.

The cameras, which function as an inverted television, also adopted this interlace of the scan.

In the first half of an image's time, a first shot sets all odd lines, and one half of a frame later, a second shot sets even lines.

What must be understood here is that the two shots are distant in time (half a picture)

And even if these two shots are complementary from a spatial point of view (the two scans are complementary in the frame) these two shots do not display the same content.

If a subject moves in the field, it will have a different position on each of the two frames: we then have a zig-zag effect on each frame.

This problem is partly solved by a device of birefringent crystalline blades that spread the details by splitting the light rays.

This results in a loss of definition that gives the PAL and SECAM systems a vertical resolution multiplied by 0.7 (Kell factor) and is actually only about 400 lines.

The first cameras, operating on the same principle as televisions, analyzed the image formed by the objective using a cathode ray tube.

Since the late 1980s, they have a CCD or CMOS type camera sensor.

It can be seen that there is a difference between the number of lines composing the image and the number of lines displayed.

This represents a difference of 49 lines in 50 Hz and 45 lines in 60 Hz.

These lost lines are necessary, they represent the time necessary for the electron beam sweeping the cathode ray tube to go up from the bottom of the image towards the top.

If the horizontal frequencies are almost the same in 50 Hz and in 60 Hz, it is that it makes it possible to use the same circuitry of horizontal sweeping, thus to realize economies.

Color shooting takes place according to an optical prism which distributes the light on three sensors, in front of which there is respectively a red, green and blue filter.

Thus, each sensor only records light information about a color.

Then you just have to record and restore the 3 RGB components on a color monitor that accepts all three RGB inputs: there are three signals instead of one.

Not only should all cable connections be tripled between the different equipment, but also triple the recording tracks on a video recorder, triple all the production equipment, and even broadcast equipment.

The challenge, therefore, was to create a single signal encompassing three different pieces of information, which should not be mixed before processing by the receiving station.

The challenge was also to maintain full compatibility with the black and white posts still very present in homes.

The researchers worked to create a video signal that included red, green, blue, and black and white in the same pipe, without mixing.

It was forbidden to have a black and white camera AND a color camera.

It was therefore necessary to manufacture black and white from the three RGB components.

Based on the sensitivities of the eye to the different colors, the specialists took 59% green, 30% red and 11% blue. They had invented a new term: luminance (Y)

Black and white TVs could therefore see black and white images from color cameras.

How now to add to this Y the information of colors making it possible to find our original RGB?

Since there was already light (the Y), it was necessary to color this black and white with information of colors which contained, they, no value of light, but only indications of hue and saturation.

Once agreed for this black and white colorized, it was necessary to find the trick that would transmit light (Y) and chroma (C).

Electronic processes with very long names were born.

For example, there is "quadrature amplitude modulation, suppressed subcarrier"

These solutions had to mix two signals so that they could discriminate on reception, but also to have no visible interference in the spectrum of the black and white signal.

These solutions were found and applied.

Thus were born the NTSC in the United States, the SECAM in France, and the PAL in Germany.

Encoding transforms RGB into a black and white compatible color signal.
NTSC, SECAM and PAL are three different types of encodings that are incompatible with each other.

Switching from one coding type to another is called "transcoding".
More generally, the term transcoding is used when changing the way of coding information

The difference brought by the solar reflection and the outer space is well determined.

More

Moon phase: Last crescent or Descending Moon (concave)

Reflective Sun movements.

youtu.be/3TzxXrIw2VM

Please, enlarge.

Notice how much the Solar reflection is visible in the first video.

By the way Without a real atmosphere,

The Lunar temperature rises during the day at + 120 ° C to fall on the dark side at -180 ° C.

The difference in temperature that a rock presents between its illuminated face and that plunged into the shadows thus reaches 300 ° C, a value more than 10 times greater than the differences that are known on Earth, where the atmosphere plays a regulating role.

The subsoil is a true permafrost, frozen at 2 m deep by -17 ° C and then progressing by 1.75 ° per meter of depth.

Computer displays have specific resolutions and scan modes that are just as specific.

The 8-bit and the first 16 and 32-bit microcomputers were intended for connection to a television set, so their video output was 740/50 or 525/60.

Standards used on PC are different.

It is because of the different scanning frequencies that it is not possible to connect a computer directly to a TV, it can even destroy the TV.

In addition, a color encoder (PAL, SECAM or NTSC) is required to make a video recording of a computer image.

That's why some vintage computers have a video output independent of the output for the monitor.

The videotape , also called videocassette, sometimes even K7, is a magnetic medium that can be recorded or viewed using a VCR.

This medium contains a videogram.

The videocassette includes a reel of magnetic tape that can scroll and read or record video and audio signals.

During playback or recording, the tape is generally wrapped around a rotating drum that includes the read heads.

The tracks are most often recorded on the helical model on the strip, that is to say in oblique slices.

Most often, a slice corresponds to a half-frame or frame of the video signal.

Recording can be analog (FM) or digital.

The term transcoding is mainly used in the fields of computer science, audio-visual and telecommunications.

Although the name can be applied to other media (written, coded messages, etc.)

The videos 1 2 3 and the lunar glitch are necessary test which generates the defects that are (for me) data and before getting the real images from the cameras.

Readings:

Scientific report.

Abstract on Magnetism.

Optics for the engineer: digital resources.

Quora California: The Top Writers Program.

Astro PDF JP Rivet CNRS Observatoire de la cote d’Azur.

Lights on the Universe Paris Observatory.

Posted by Veronica IN DREAM at 11:39 PM