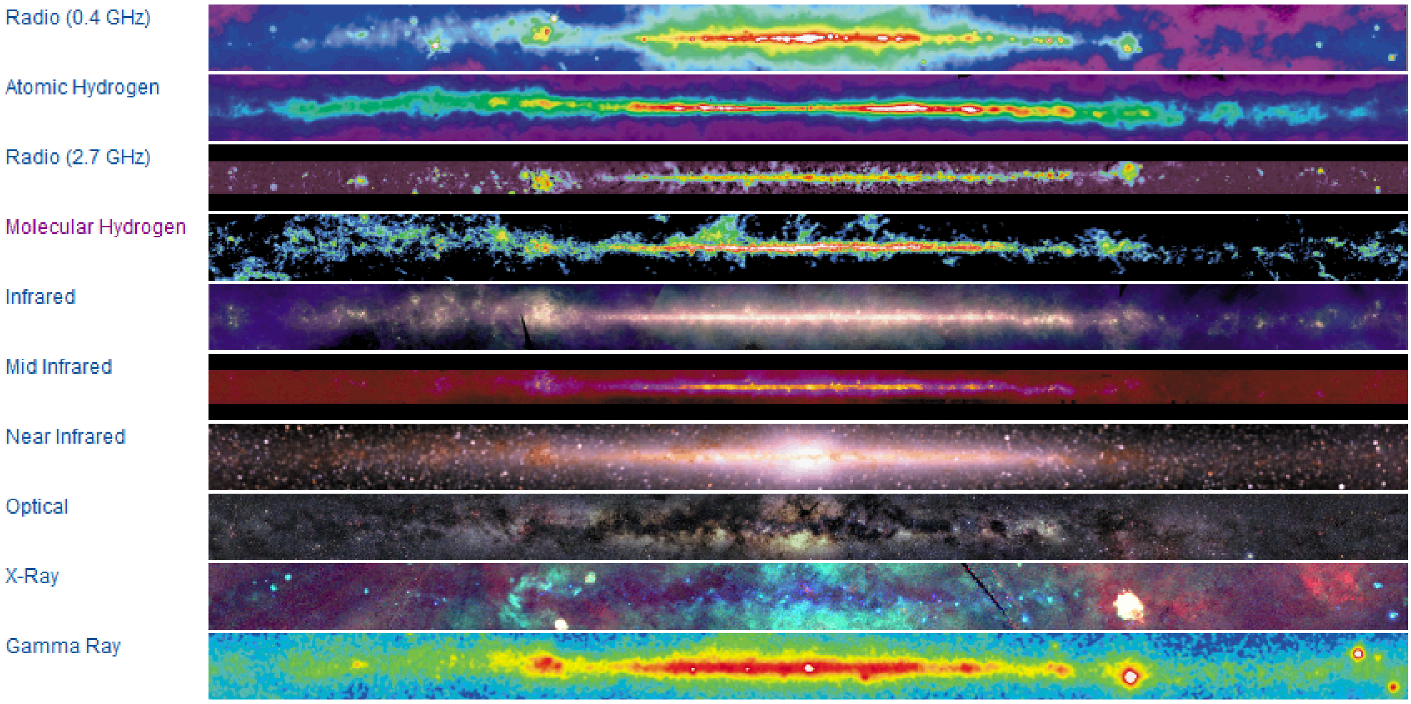
TS

observer
Ondes et particules

OBSERVATION DE LA GALAXIE

En prenant des multitudes d'images du ciel, on a réussi à faire des mosaïques d'images du ciel sur 360° où apparaissent les régions centrales de notre Galaxie vues du système solaire. Et ces panoramas ont été réalisés dans tous les domaines de longueurs d'ondes.

DOCUMENT1



1-Radio 408 MHz : Intensity of radio continuum emission from high-energy charged particles in the Milky Way,from surveys with ground-based radio telescopes (Jodrell Bank Mark I and Mark IA, Bonn 100-meter, and Parkes 64-meter). most of the emission is from electrons moving through the interstellar magnetic field at nearly the speed of light. Shock waves from supernova explosions accelerate electrons to such high speeds, producing especially intense radiation near these sources.

2-Atomic Hydrogen : Column density of atomic hydrogen,derived on the assumption of optically thin emission, from radio surveys of the 21-cm transition of hydrogen. The 21-cm emission traces the "cold and warm" interstellar medium, which on a large scale is organized into diffuse clouds of gas and dust that have sizes of up to hundreds of light-years. Most of the image is based on the Leiden-Dwingeloo Survey of Galactic Neutral Hydrogen using the Dwingeloo 25-m radio telescope

3-Radio Continuum (2.4-2.7 GHz) Intensity of radio continuum emission from hot, ionized gas and high-energy electrons in the Milky Way, from surveys with both the Bonn 100-meter, and Parkes 64-meter radio telescopes. The majority of the bright emission seen in the image is from hot, ionized regions, or is produced by energetic electrons moving in magnetic fields.

4-Molecular Hydrogen Column density of molecular hydrogen inferred from the intensity of the J =1-0 spectral line of carbon monoxide, a standard tracer of the cold, dense parts of the interstellar medium. Such gas is concentrated in the spiral arms in discrete "molecular clouds." Most molecular clouds are sites of star formation. The molecular gas is pre-dominantly H_2, but H_2 is difficult to detect directly at interstellar conditions and CO, the second most abundant molecule, is observed . Frequency: **115 GHz**

5-Infrared : Composite mid-and far-infrared intensity observed by the Infrared Astronomical Satellite (IRAS) in 12, 60, and 100 micron wavelength bands. respectively. Most of the emission is thermal, from interstellar dust warmed by absorbed starlight, including star-forming regions embedded in interstellar clouds. The display here is a mosaic of IRAS Sky Survey Atlas images.

6- Mid-infrared (6.8 -10.8 microns) Mid-infrared emission observed by the SPIRIT III instrument on the Midcourse Space Experiment (MSX) satellite. Most of the diffuse emission in this wavelength band is believed to come from complex molecules called polycyclic aromatic hydrocarbons, which are commonly found both in coal and interstellar gas clouds. Red giant stars, planetary nebulae, and massive stars so young that they remain deeply embedded in their parental molecular gas clouds produce the multitude of small bright spots seen here.

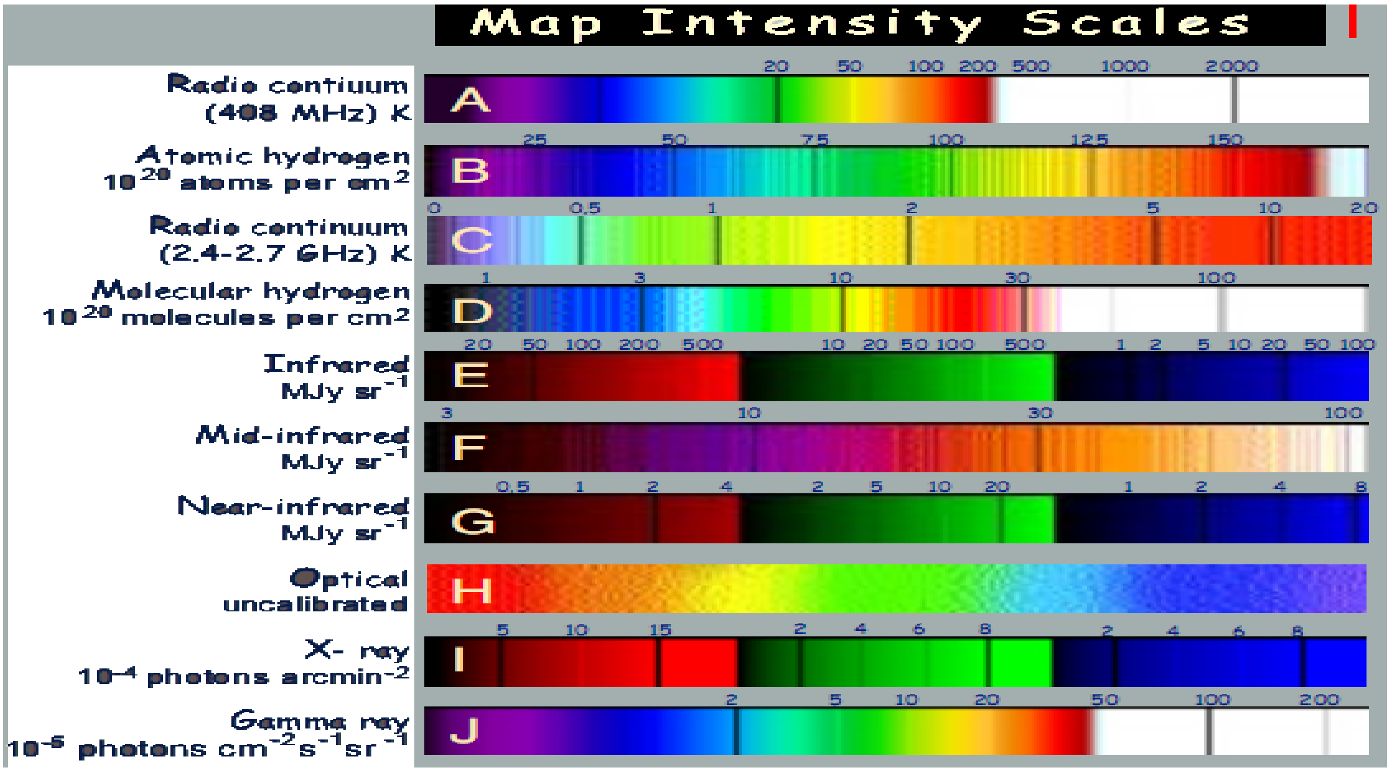
7- Near Infrared: Composite near-infrared intensity observed by the Diffuse Infrared Background Experiment (DIRBE) instrument on the Cosmic Background Explorer (COBE) in the 1.25, 2.2, and 3.5 micron wavelength bands. The images are encoded in the blue, green, and red color ranges, respectively. Most of the emission at these wavelengths is from relatively cool giant K stars in the disk and bulge of the Milky Way. Interstellar dust does not strongly obscure emission at these wavelengths.

8- Optical : Intensity of visible (0.4 - 0.6 micron) light from a photographic survey. Due to the strong obscuring effect of interstellar dust,t he light is primarily from stars within a few thousand light-years of the Sun, nearby on the scale of the Milky Way. The widespread bright red regions are produced by glowing, low-density gas. Dark patches are due to absorbing clouds of gas and dust, which are evident in the Molecular hydrogen and Infrared maps as emission regions. The exposures were made between July 1997 and January 1999 at sites in the United States, South Africa, and Germany.

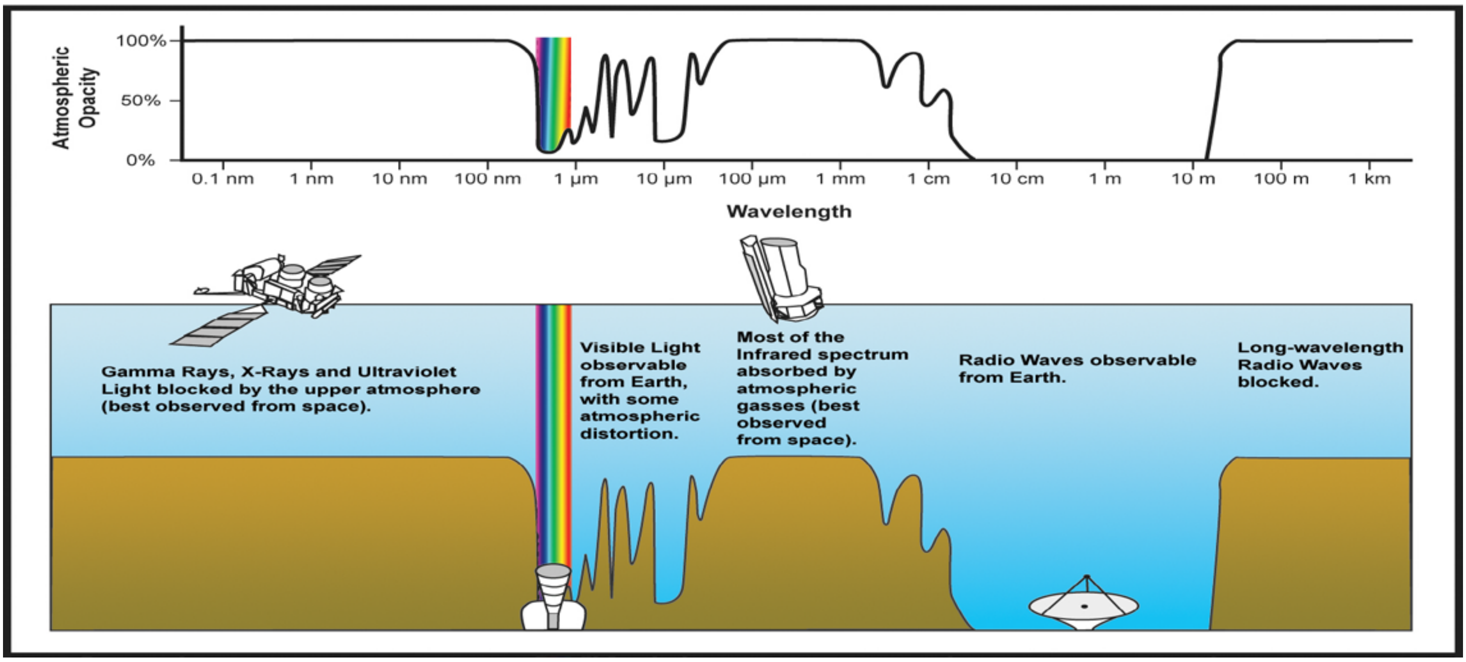
9- X-Ray: Composite X-ray intensity observed by the Position-Sensitive Proportional Counter (PSPC) instrument on the Röntgen Satellite (ROSAT). Images in three broad, soft X-ray bands centered at 0.25 , 0.75, and 1.5 keV are encoded in the red, green, and blue color ranges, respectively. In the Milky Way, extended soft X-ray emission is detected from hot, shocked gas.

9- Gamma Ray : Intensity of high-energy gamma-ray emission observed by the Energetic Gamma-Ray Experiment Telescope (EGRET) instrument on the Compton Gamma-Ray Observatory (CGRO). The image includes all photons with energies greater than 300 MeV. At these extreme energies, most of the celestial gamma rays originate in collisions of cosmic rays with hydrogen nuclei in interstellar clouds. The bright, compact sources near Galactic longitudes 185°, 195°, and 265° indicate high-energy phenomena associated with the Crab, Geminga, and Vela pulsars, respectively.

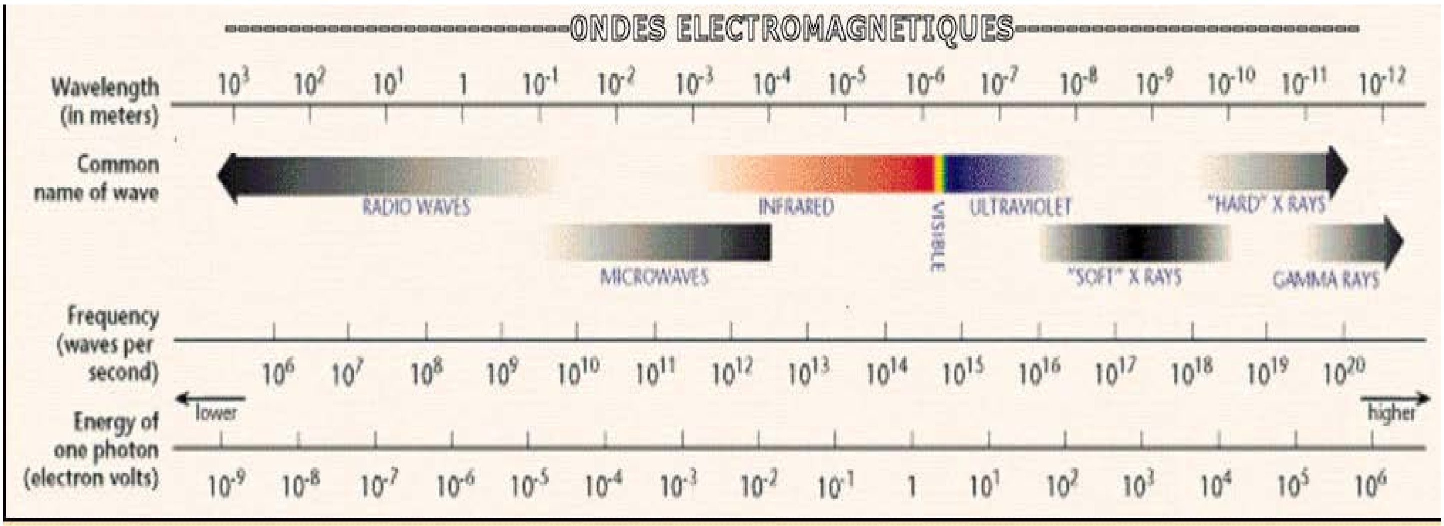
Document 2:



Document3



Document 4



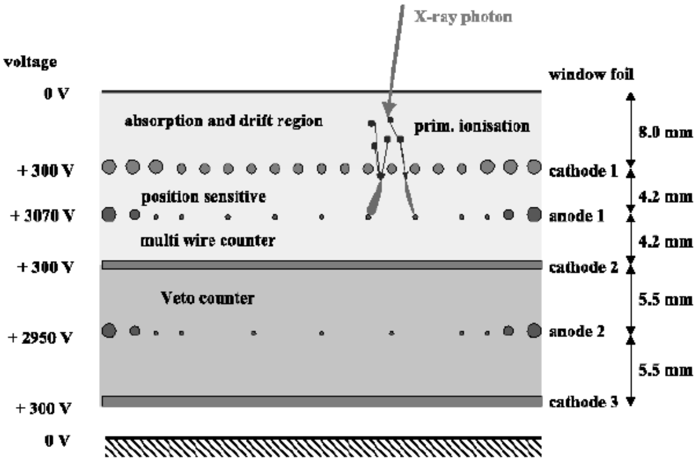
Document5

images	Longueur d'onde (m)	Fréquence ν(Hz)	Energie par photon E(eV)	Domaine de longueur d'onde	Origine de l'émission	Instruments utilisés
1						
2						
3						
4						
5						
6						
7						
8						
9						

Document 6

ROSAT was a German Aerospace satellite X-ray telescope, with instruments built by Germany, the UK and the US. It was launched on 1 June 1990, on a Delta II rocket from Cape Canaveral, on what was initially designed as an 18 month mission, with provision for up to five years of operation. ROSAT actually operated for over eight years, finally shutting down on 12 February 1999.

Position Sensitive Proportional Counters (two) (PSPC) :Each Position Sensitive Proportional Counter (PSPC) is a thin-window gas counter. Each incoming X-ray photon produces an electron cloud whose position and charge are detected using two wire grids. The photon position is determined with an accuracy of about 120 micrometers. The electron cloud's charge corresponds to the photon energy



QUESTIONS

1- **document 4 :**
   a. Que représentent les 4 lignes du diagramme
   b. Indiquer en français sur ce diagramme les limites et les noms des différents domaines de longueur d'ondes électromagnétique
   c. Longueur d'onde : λ(m) = c(m/s) x T(s) (avec c = $3x10^{8}$ m/s) . Energie transportée par un photon E(J)=h(J.s) x ν(Hz) avec h = 6.63 x 10^{-34} J.s ; 1 eV = 1.6 10^{-19} J. En prenant un exemple quelconque de longueur d'onde sur le diagramme, calculer la fréquence de l'onde et l'énergie transportée par un photon .

2- **Document 2 :**
   a. Le document 1 montre des images dans toutes les longueurs d'ondes même en dehors du domaine visible, comment cela est-il possible ?
   b. Expliquer à quoi sert cette « map intensity scale » et pourquoi pour l'image optique, c'est marqué « uncalibrated ».

3- **Document 3 :**
   a. Qu'explique ce document 3 ?
   b. Quels en sont les conséquences pour les instruments utilisés ?

4- **Document 1**
   a. A l'aide des données du document 1, compléter tout le tableau du document 5. Pour les instruments utilisés, on indiquera : télescope terrestre, radiotélescope ou telescope spatial
   b. Quel est le domaine de longueur d'onde où il n'y a pas d'images ?
   c. Justifier la nature des instruments utilisés.
   d. Quel est l'intérêt d'observer l'univers dans d'autres domaines de longueurs d'ondes ?

5- **Document 6 :** exemple de capteur
   a. Comment s'appelle le capteur utilisé, quels rayonnements permet-il de capter ? Sur que genre de télescope est-il installé ?
   b. Résumer le fonctionnement de ce capteur.