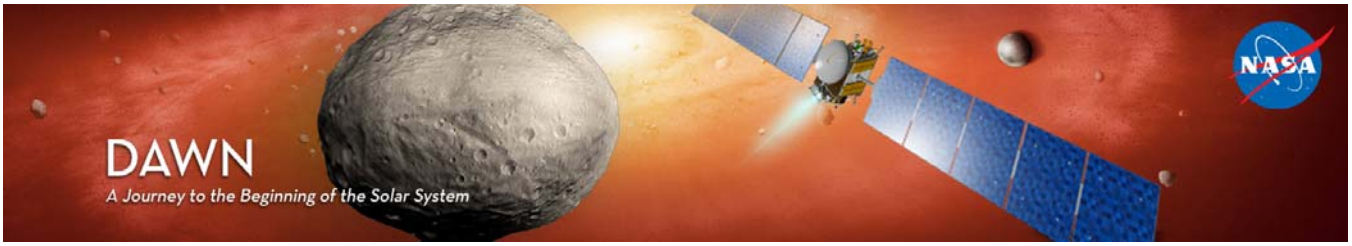

Interactions of Energy and Matter: Dawn Instrumentation

PowerPoint Script: Framing Camera

STUDENT SCRIPT TO ACCOMPANY POWERPOINT PRESENTATION

This text is designed to accompany the PowerPoint presentation that describes the design and function of the Framing Cameras that are part of the Dawn Spacecraft Instrumentation Package. This information will help you answer the questions in the Framing Camera Student Report Sheet.

> ***Note: Some of the slides in this presentation include some animation effects. The instruction to {click} indicates that you should use either a "keystroke" or a mouse depression to advance the animation.***

Slide 1
The Dawn spacecraft carries two identical framing cameras, whose primary science goal is to return images that map the surfaces of Vesta and Ceres. Only one framing camera will operate at any one time.

{click to Slide 2}
The Framing Cameras are the scientific imaging system of the Dawn mission.

{click to Slide 3}
The Framing Cameras are the "eyes" of the spacecraft. They contribute to the navigation system of the spacecraft.

In this section, we will be learning more about the Framing Cameras, including what they do and how they work.

{click to Slide 4}

Write your answers to these questions on your Framing Camera Student Report Sheet

What region of ***electromagnetic radiation (EMR)*** from Ceres and Vesta will the Framing Cameras measure?

What frequency and wavelength regions of EMR are classified as visible radiation?

What frequency and wavelength regions of EMR are classified as infrared radiation.

How does the ***energy*** of gamma rays compare with the energy of the rest of the EMR waves?

{click to Slide 5}
What will the Framing Cameras do when Dawn gets to Vesta and Ceres?

The Framing Cameras will return images that map the surfaces of Vesta and Ceres. These images will be used to:

{click}
create global ***topography***, ***albedo***, and color maps of Vesta and Ceres using clear and narrow band filters;

{click}
determine the shape, volume, and mass of Vesta and Ceres;

{click}
measure spin rates;

{click}
map the elemental and mineralogical composition of Vesta and Ceres;

{click}
study crater ***morphology*** and their distribution on Vesta and Ceres;

{click}
search for fractures and evidence of geologic processes on Vesta and Ceres; and

{click}
determine the reflectance characteristics of Vesta's and Ceres' surfaces.

{click to Slide 6}
The Dawn spacecraft carries two framing cameras that are designed to operate in cold temperatures, as low as -60° C, and the vacuum environment of space. Only one of them will be active at any one time.

Their four-lens optical systems

{click}
will focus electromagnetic radiation from the sun that is reflected from Vesta and Ceres to form images of their surfaces.

{click}
This optical system is encased in a titanium tube, which also has

{click}
venting ports used to create a vacuum in the optical system that matches that of the environment in space.

The framing camera is also the “eye” of the spacecraft.

{click}
A mirror cube, mounted on the titanium tube, is used for navigation. It measures the alignment of the camera with respect to the spacecraft coordinate frame.

{click to Slide 7}
Each of the framing cameras has a

{click}
cylindrical camera head capped by a

{click}
stray light ***baffle*** that shades the optics in the lens barrel from light ***reflected*** from the spacecraft.

{click}
When the cover door

{click}
is closed, it protects the hardened ***refractive*** radiation-proof glass lenses and filters in the lens barrel.

When the cover door is open, reflected electromagnetic radiation from the surfaces of Vesta and Ceres can enter the camera.

{click}

The four-lens optical system focuses the incoming electromagnetic radiation that is reflected from the asteroid's surface and sends it through a filter wheel

{click}
which has eight positions—one with a clear filter from 450-950 nm and seven filters centered at 430, 540, 650, 750, 830, 920, and 980 nm. These wavelengths translate to 4.30×10^{-7} to 9.80×10^{-7} meters, which are within the visible and infrared ranges. These filters will be used for spectral analysis of Vesta's and Ceres' surfaces.

Write your answers to these questions on your Framing Camera Student Report Sheet

Compare how light interacts with the four lenses in the Optical System compared with how it interacts with the filter wheel.

How is light reflected, transmitted, and refracted

a) before it comes into the Framing Camera and

b) as it moves through the Framing Camera?

{click to Slide 8}
The framing cameras are equipped with a

{click}
1024 x 1024 frame transfer ***charge-coupled device (CCD)*** which converts electrical charge data into

{click}
surface images.

{click}
On the Dawn spacecraft, the Framing Camera shares the data processing unit box (DPU) with the VIR spectrometer. The DPU compresses and buffers the data from both the camera and spectrometer.

Each camera has independent readout electronics with data processing units that compress the images into desired formats.

Write your answers to these questions on your Framing Camera Student Report Sheet

What is the purpose of the Charge-Coupled Device (CCD)?

Describe the output of the Framing Camera as shown on this slide.

{click to Slide 9}
The Framing Cameras on the Dawn Spacecraft will utilize the interactions of energy and matter to collect scientific data about Vesta and Ceres.

{click}

Write your answers to this question on your Framing Camera Student Report Sheet

What energy and matter interactions are involved in the scientific measurements made by the Framing Cameras?