VIR-VISUAL INFRARED MAPPING SPECTROMETER OF DAWN MISSION **A.** Coradini[1], M. C. De Sanctis[2], M.T. Capria[2], E. Ammannito[1], S. Fonte[1], G. Filacchione[2] ,G. Magni[1], A. Bini [3], I. Ficai Veltroni[3] and the Dawn Science Team. [1] Istituto di Fisica dello Spazio Interplanetario, INAF, Via fosso del cavaliere, 100, Rome 00133, Italy, angioletta.coradini @ifsi-roma.inaf.it, [2]Istituto di Astrofisica Spaziale e Fisica Cosmica, INAF, Rome 00133, Italy, [3] Galileo Avionica Firenze-Italy

Introduction: Dawn is a NASA PI mission (PI Christopher Russel of UCLA) of "Discovery" class[1], [2]. Dawn is also an international mission since NASA is supported by ASI (Italian Space Agency) and DLR (German Space Agency) that are respectively in charge of providing the VIR spectrometers and the two cameras. Dawn Mission will be the first mission visiting the dwarf planet closer top the Earth, Ceres. Moreover Dawn will visit Vesta, that is also a very special body, being one of the few asteroids of the main belt that are supposed undergo to a differentiation. Therefore Vesta is an important example of intermediated objects that possibly undergo to a pristine differentiation, might be due to the decay of short lived radioactive elements. Only in situ observation will be able to disentangle the real nature of Vesta and Ceres. Dawn mission is perfectly suited to do that, thanks to its payload that will permit to study the geology (thanks to FC, the cameras), the geochemistry (thanks to the Grand, gamma spectrometer) and mineralogy (thanks to VIR- MS, the imaging spectrometer). Here we will describe the VIR-MS characteristics. VIR-MS is an imaging spectrometer coupling high spectra and spatial resolution in the Visible (0.25-1 micrometer) and IR (0.95-5 micrometers) ranges. We have developed a spectrometer able to cover both Visible and IR regions of the spectrum combining these two spectral ranges in one instrument because diagnostic minerals have absorption bands in the Visible and NIR regions. We will describe VIR and its expected performances in terms of understanding both Vesta and Ceres.

The Vir instrument. VIR will permit to study the mineralogical composition of the Ceres and Vesta surface, coupling high spectra and spatial resolution. Moreover VIR will help in understanding if the similarity between reflectance spectra of Vesta and HED meteorites and vestoids, possibly fragments of Vesta. To achieve these goals it is important to have a good spectral coverage: in fact diagnostic minerals show absorption bands in the Visible and NIR regions.
Determination of the mineral composition of surface materials in their geologic context is a primary Dawn objective. The nature of the solid compounds of the asteroids (silicates, oxides, salts and ices) can be identified by visual and infrared spectroscopy using high spatial resolution imaging to map the heterogeneity of asteroid surfaces and high spectral resolution spectroscopy to determine the composition unambiguously. Medium resolution spectral images in the visible and infrared ranges allow us to have information on the mineralogical composition of the asteroid surface. Spectral resolution added to spatial resolution is needed to have important information on surface geology, so that will be possible the identification of mineralogical provinces, obtaining compositional maps. Such maps will provide information on the relationship between global and local spectral characteristics.

Calibration Procedure. Vir instrument has a complex internal calibration unit consisting in two spectral lamps that were calibrated on ground [3]. The two lamps can be turned on independently to test the performances of the instrument in the Vis and IR range. During the first activities of the commissioning the internal calibration unit has been used in order to check the performances of the instrument. In the figures 1a and 1b below we show the data acquired in flight: high spatial and high spectral profile of the calibration procedure. Each calibration session is constituted by 7 steps. At step 4 the IR calibration lamp is switched on and 5 frames acquired. At the next step the IR lamp is switched off, and the VIS calibration lamp is switched on. In this way it is possible to check the integrity of both the detectors.

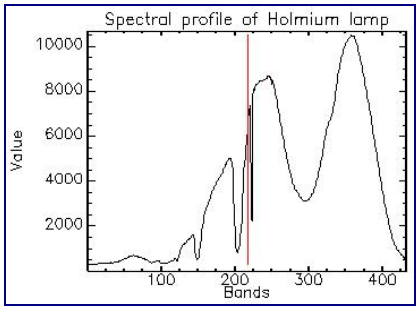

Figure 1 a: Spectral profile (raw data) vis lamp, equipped with Holmium filter. Order sorting filter is on channels 218-224.

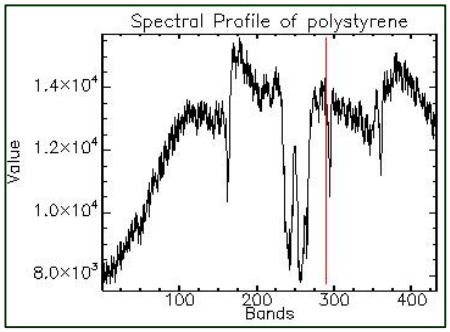

Figure 1 b: Spectral profile (raw data) of the infrared lamp equipped with Polystyrene filter. Order sorting filters are placed on the channels 45-62, 148-165, 284-294 and 349-359.

Vir Performances with external source. The instrument has been also intensively tested during a second period of commissioning activity. In particular, after a detailed test of functioning of all the subsystems, an acquisition of an external source was performed. The source selected was the star Arcturus since it has a strong emission in the IR and is a "standard Star". The test of external point source was successful: VIR acquired Arcturus spectra.

We include a few pictures showing the good performances of VIR when acquiring a point source. We imaged Arcturus with different integration times for the two FPA, being 17 sec for Visual and 13 sec for the IR. Figures 2A and 2 B are respectively the Arcturus uncalibrated spectra in the VIS and IR. The IR spectrum has been "dark-removed".

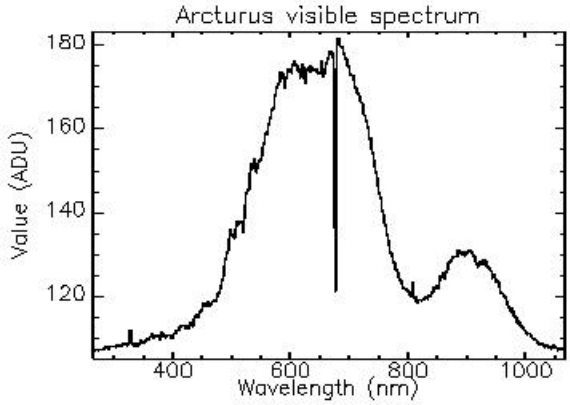

Fig. 2 a: Arcturus Visible spectrum acquired by VIR.

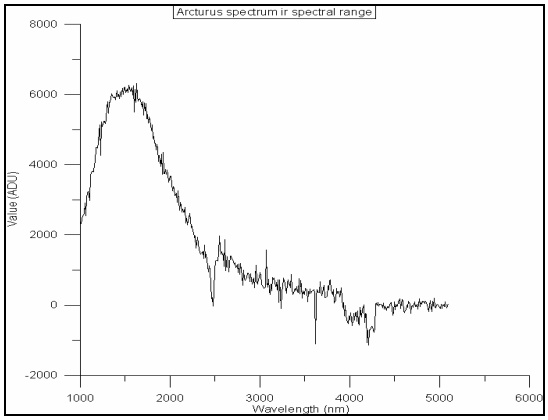

Fig2.b: Arcturus Infrared spectrum acquired by VIR.

Conclusion. The first test of VIR has been very successful and we expect to collect many new scientific data during the Dawn cruise first, and afterwards, when it will reach its primary targets Vesta and Ceres.

References:

1. [1] Russell, C. T. et al., (2007) Earth, Moon, and Planets, *101*, pp. 65-91. [2] Russell,C. T. et al., (2007), Advances in Space Research, *40*, 193-201. [3] Melchiorri, R., Piccioni, G., Mazzoni, A., (2003) Review of Scientific Instruments, *74*, 3796-3801.