VIRTIS VISIBLE INFRARED THERMAL IMAGING SPECTROMETER FOR ROSETTA MISSION; Coradini A.[1], Capaccioni F.[1], Capria M.T.[1], Cerroni P.[1], De Sanctis M.C.[1], Magni G.[1], Reininger F.[1] Drossart P.[2], Barucci M.A.[2], Bockelee-Morvan D.[2], Combes M.[2], Crovisier J.[2], Encrenaz T.[2], Tiphene D.[2]; Arnold G.[3], Carsenty U.[3], Michaelis H.[3], Mottola S.[3], Neukum G.[3], Schade U.[3] ; Taylor F.[4], Calcutt S.[4], Vellacott T.[4], Venters P.[4], Watkins R.E.[4] ; Bellucci G.[5], Formisano V.[5]; Angrilli F.[6], Bianchini G.[6], Saggin B.[6] Bussoletti E.[7] Colangeli L.[8], Mennella V.[8] Fonti S.[9] Tozzi G.[10] Bibring J.P.[11], Langevin Y.[11] Schmitt B.[12] ; Combi M.[13] Fink U.[14] McCord T.[15] Ip W.[16] Carlson R. W. [17] Jennings D. E.[18] [1](IAS - Rome); [2] (Obs. Meudon); [3] (DLR-BE);[4] (Oxford Univ.); [5] (IFSI-Frascati);[6] (Univ. Padova); [7] (IUN/OA-Napoli); [8] (Oss. Napoli); [9] (Univ. Lecce); [10] (Oss. Arcetri); [11] (IAS-Paris); [12] (Lab. Glaciologie); [13] (SPRL Michigan); [14] (LPL Arizona);[15] (Univ. Hawaii); [16] (M.Planck, Lindau); [17] (JPL, Pasadena); [18] (Goddard,USA).

The VIRTIS instrument is proposed as part of the ROSETTA orbiter payload. It is a visible and infrared imaging spectrometer designed to fulfill the objectives of the VIRSTM model payload instrument and to take into account the new mission scenario. In order to fully achieve these objectives, the VIRTIS instrument performances have to exceed the specifications of the baseline model payload instrument. The VIRTIS instrument combines a double capability: (1) high-resolution visible and infrared imaging in the 0.25-5 μm range at moderate spectral resolution (VIRTIS-M channel) and (2) high-resolution spectroscopy in the 2-5 μm range (VIRTIS-H channel). This improved capability considerably enlarges the scientific return of the instrument. The two channels will observe the same cometary areas in combined modes to take full advantage of their complementarities.

VIRTIS–M (**–M**) is characterised by a single optical head consisting of a Shafer telescope combined with an Offner imaging spectrometer and by two bidimensional FPAs: the VIS (0.25–1 μm) and IR (1–5 μm).

VIRTIS–H (**–H**) is a high-resolution infrared cross-dispersed spectrometer using a prism and a grating. The 2–5 μm spectrum is dispersed in 8 orders on a focal-plane detector array. The IRFPA of **–M** and **–H** are both housed on bidimensional HgCdTe chips cooled to 70 K by an active cooler in order to reduce dark current. In order to reduce the background level both spectrometers are cooled down to 135K by means of a radiator (fig 1).

Objectives and Performances of the instrument:

The scientific objectives of VIRTIS are the followings: -to identify the nature of the solids on the nucleus surface and of the dust (composition of minerals, organics, ices) -to identify the gaseous species (molecules, radicals, ions), monitor the gaseous activity and space distribution -to map and monitor the temperature of the nucleus -to characterize the physical conditions of the coma.
The anticipated inhomogeneity of the nucleus, as already observed in the case of comet Halley, and the expected small size of the active areas are a driver for defining the spatial resolution of VIRTIS. The **–M** spatial resolution (3 $10.^{-4}$ rad) allows resolving of structures less then 3 m at a distance of 10 km. The 0.25-5 μm spectral range contains the spectral signatures of most minerals, organics and ices. To identify the signatures of minerals and H_2O ice, the spectral resolving power of **–M** (> 100) is needed accompanied by a $S/N > 100$ in order to determine the shape and the centre of the band. The imaging capability will enable correlation of spectral characteristics with surface morphology and local topography and detection of active areas. For organic compounds and hydrocarbon ices, the higher resolving power of **-H** (> 1000) is needed as well. **–M** will be able to map and monitor the nucleus temperature with uncertainties of about 5K at 1 AU and 10K at 2 AU (Fig 2).
Parent molecules are detectable through their fluorescence emissions, which are maximum in the 2-5 μm range. Infrared spectra of P/Halley and subsequent comets have shown that many molecules, including several types of hydrocarbons (possibly PAHs), are present. The high-resolution capability of **–H** (1500-2500) is well suited for the detection of these species. The sensitivity of this channel should allow the detection of an H_2O production rate of 3 $10.^{24}$ at 3 AU. The pixel FOV of **–H** is 3 times the **–M** pixel FOV, which should be sufficient for coma analyses. The visible channel of **–M** will study radicals and ions. Its high spatial resolution will be useful to retrieve the spatial distribution of these species and the dynamics of the coma (Fig 3).
In summary, the instrumental characteristics of VIRTIS are indicated in Table 1.

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Table 1: VIRTIS

	Spectral range	Spectral Res.Power	Pixel IFOV	FOV (deg)
VIRTIS-M	0.25-5 μm	100-500	0.25 x 0.25 mrad	3.6x3.6
VIRTIS-H	2-5 μm	1500-2500	0.45x2.25 mrad	-

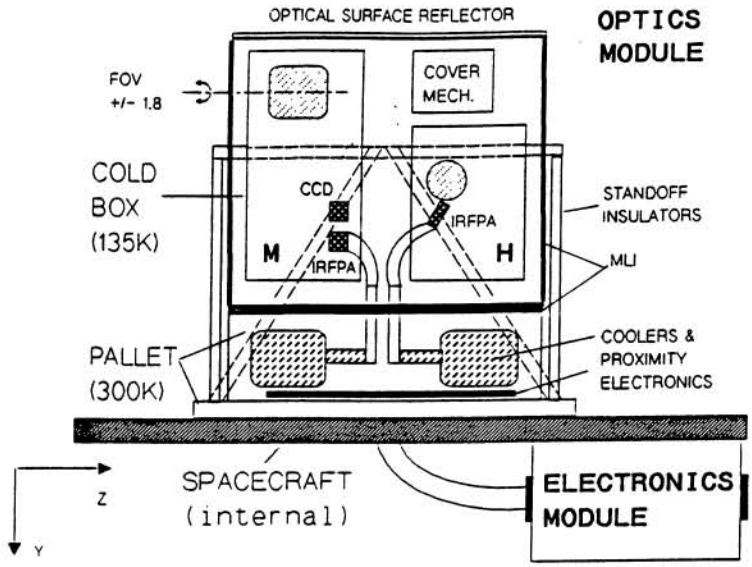

Fig.1 VIRTIS Block Diagram

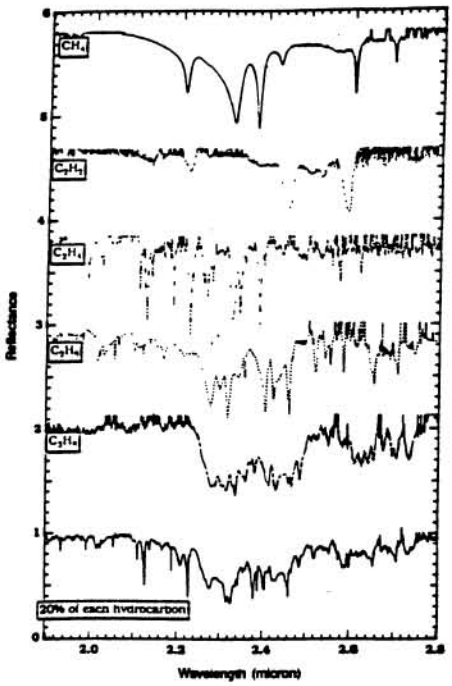

Fig.2 Spectra of 5 different solid hydrocarbons and a mixture of them.

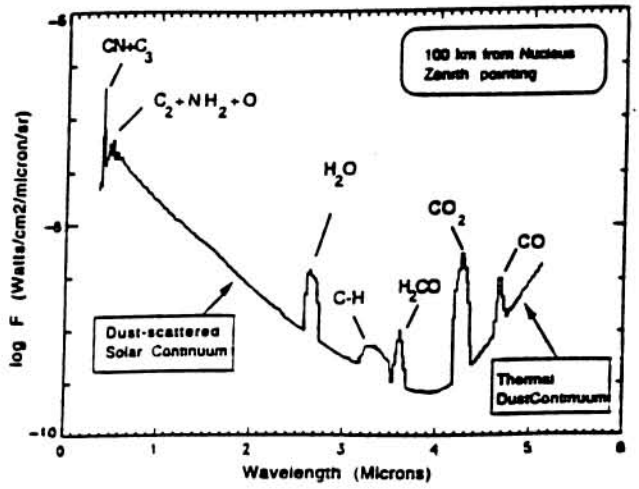

Fig.3 Synthetic Vis-IR spectrum of the coma.