0.1 High level goals

0.2 Mission drivers

0.3 Functional analysis

0.4 Main mission phases

0.5 ConOps

0.6 Payload analysis

0.6.1 Instruments overview

As previuosly described in section 0.1 the mission scientific goals are quite numerous and diverse. Thus, to achieve all of them the payload consists of several instruments, 9 to be precise, covering a wide spectrum of experimantations. Here we have a brief overview of all the singular instruments, unless otherwise specified only the sensors are mounted on the exterior of the spacecraft while all the relevant electronics are located inside the radiation vault.

• **Magnetometer (MAG):** As the name implies its objective is to accurately measure Jupiter's magnetic field, achieved by employing a fluxgate magnetometer, a scalar helium magnetometer and star cameras. All the sensors are mounted on the magnetometer boom located at the end of one of the solar array wings to reduce the interference from the spacecraft itself. Even then the presence of two magnetometers allows to subtract this contribution from the measurment.

• **Microwave Radiometer (MWR):** It consists of six antennas which measure six different frequencies (600 MHz, 1.2 GHz, 2.4 GHz, 4.8 GHz, 9.6 GHz and 22 GHz) in order to investigate the Jovian atmosphere below the visible external layer. A key objective of this analysis is also the determination of the abundace of water inside the planet. The antennas are mounted on two sides of the exagonal prism that constitutes the main body of the spacecraft.

• **Gravity science:** It's quite a unique instrument as it's composedboth by a space and a ground elements. The space segment is tasked with amplifying and sending back radio signals which are instead generated and received by the ground station. By measuring the doppler shift in the returningsignal from Juno is possible to characterize Jupiter's gravitational field. Thus the instrument hardware mainly consists of the high gain antenna which is mounted on top of the radiation vault on the main deck and points in the same direction as the solar arrays.

• **Jupiter Energetic-particle Detector Instrument (JEDI):** It detectshigh energy electrons and ions present in the Jovian magnetosphere which arediscriminated by composition. Each sensor is characterized by six electron and six ion viewing directions that together cover a $12° \times 160°$ field of view. In total three sensors are present on Juno, twoarranged to obtain an almost compete 360° view perpendicular to the spacecraft spin axis whle the third one is instead aligned with it to achieve a full scan of the sky over one spin period. As the JEDI sensors are self-contained units no electronic hardware is present in the radiation vault.

• **Jovian Auroral Distribution Experiment (JADE):** It detects low energy electrons and ions with the same goal of characterizing the magnetosphere as JEDI. The instrument comprises of three identical electron energy per chrage analyzers (JADE-E) and a single ion mass spectrometer (JADE-I). The electron sensors are located on the three sides of the spacecraft that do not house the solar arrays pointing outwards, to again obtain a complete view normal to the spin axis. The spectrometer field of view, instead, contains the spin axis and like the third JEDI sensor it scans all the sky over a full rotation.

• **Ultraviolet Spectrograph (UVS):** This instrument images and measures the spectrum of the Jovian aurora in order to understand its morphology and source. The chosen ultraviolet range of $68-210nm$ covers all of the most important UV emissions form the aurora, mainly the H Lyman series and longer wavelenghts from hydrocarbons. The sensor is mounted on the side of Juno, relying once more on the spinning of the spacecraft to achive a full sweep of the planet.

• **Radio and Plasma Waves (Waves):** Its objective is to study both components of the electromagnetic field generated by plasma and radio waves inside the polar regions of Jupiter's magnetosphere to understand its interaction with the atmosphere and magnetic field. To detect the electric component a V-shaped dipole antenna is used, wihle for the magnetic component amuch smaller magnetic search coil is employed. Both sensors cover a vast range of frequencies, namely from 50 Hz up to 40 MHz.

• **Visible-spectrum Camera (JunoCam):** It's designed to provide highly detailed color images of Jupiter to help and support public engagement of the mission. The instrument is thus only comprised of the camera itself, mounted on the side of the spacecraft, and all the necessary electronics which, given the less crital objective and relaxed radiation tolerance requirments, aren't housed in the radiation vault.

• **Juno Infra-Red Auroral Mapper (JIRAM):** It's an infra-red imager and spectrometer that studies the Jovian atmosphere in the $2 - 5\mu m$ range complementing both the atmospheric and magnetospheric experiments. This instrument is also completely housed outside of the radiation vault since it is a late addition after mission selection, reason for both relaxed radiation requirments and the less than ideal positioning of the sensor on the aft deck of the spacecraft.

0.6.2 Payload and Goals correlation

There is a notable overlap in the main objectives of the payload instruments, both in the sense that multiple ones collaborate towards a single scientific goal, but also in the sense that a single instrument can addres multiple goals. All of these relations are exemplified in the following table.

Mission goals	Instrument objectives
a	b
c	d

Table 1: Mission goals and instrument objectives correlation

0.6.3 Payload and Phases/ConOps correlation

Another high-level correlation can be highlighted between the mission phases/ConOps and the activities of the payload as shown below.

Mission phases/ConOps	Payload activities
a	b
c	d

Table 2: Mission phases/ConOps and Payload activities correlation

0.7 Mission analysis