

0.1 High level goals

0.2 Mission drivers

Given the nature of the mission, being JUNO an interplanetary mission starting from a distance of around 1 AU, with an nominal distance from the Sun of 5.2 AU, and operating in an highly radiation intense environment, the following drivers have been identified:

1. Providing enough electricity during the duration of the mission

The journey of JUNO is long and passes through different regions of the solar system. Solar panels were chosen to provide electric energy across the mission over a nuclear source, since it has been decided that it was better to advance technology of solar cells rather than developing a new reactor. The system needed is thus oversized at 1 AU: the radiation on Jupiter is in fact up to 96% lower on Jupiter than on Earth. Furthermore the operations are scheduled to begin around 5 years into the mission, so degradation of the solar cells must be taken into account. The final design consists in 3 solar arrays, 9 by 2.65 m each, resulting in about 60 m² and granting a maximum power of 14 KW around Earth and up to 500 W around Jupiter. It was the first S/C to operate with solar panel at such distance from the Sun. They are mounted on the side of hexagonal body of the S/C at 120° one by the other and are deployed after booster separation. The spacecraft is spinning at around 1.4 RPM during this phase and the deployment of the solar arrays slows it down. A crucial element must be considered during the cruise phases: nominally the high gain antenna, that is mounted with the same positive direction of the solar arrays, is doing Earth pointing to communicate data but, at some point during the cruise phase, due to the proximity of the Sun, thermal requirements dictate a change in attitude and thus the spacecraft won't be pointing directly the Sun. Moreover, since the fly-by around Earth is done to gain ΔV , the S/C will be in an eclipse for around 20 minutes: batteries are thus needed. Two lithium-ions battery of 55 Ah each are present. The nominal polar orbit around Jupiter allows Sun pointing during the whole science operation Phase (NOME DELLA FASE A CUI CI RIFERIAMO). INSERIRE RIFERIMENTI: VIDEO, SLIDES LAVAGNA, JUNO Mission

2. Providing the correct temperature range across the instruments during operation and the journey

The delicate suites of instrument present onboard JUNO require a very narrow range of temperature to operate, as low as $\pm 1K$. The MWR instruments in fact needs is to measure with high accuracy the microwave emission from Jupiter. During the cruise phase JUNO will pass as close as 0.88 AU from the Sun, so the S/C will need to protect the P/L from the incoming heat. Passive solutions were preferred to maintain simplicity and reliability during the whole mission period. Juno's thermal control subsystem uses a design with heaters and louvers. It consists of an insulated louvered electronics vault atop a heated propulsion module. LINK NASA JPL

3. Shielding the instruments from the harsh environment of Jupiter

To accomplish its goals, JUNO will need to cross the Jupiter radiation belts: a heavy shielding structure is needed. Its task is to reduce the exposition level of the electronics by a factor of 800: S/C in LEO are needed to shield up to 0.65 T, while on Jupiter the expected intensity of the magnetic field is 518 T. The measured value measured by JUNO at its perijove is 776 T, 50 % higher than expected. The vault in which all the electronics is preserved is cubed shaped and it is made of 1 centimeter thick titanium, 144 Kg in total. Moreover, star trackers are

0.3 Functional analysis

0.4 Main mission phases

0.5 ConOps

0.6 Payload analysis

0.7 Mission analysis