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SpaceHub: an intermediate step towards Mars

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The CNS is the Competence Centre for Space of the Italian Institute for the Future (IIF), a non-profit association that studies future scenarios by promoting awareness of the challenges that the future poses to humanity in the coming decades, by fostering trade between the scientific-technological and socio-humanistic research.

The goal of the CNS is the dissemination and fruition of Space by a growing number of citizens, in order to foster a positive public orientation to astronautical activities in the Earth's outer space, that is what we call Civil Astronautics. The CNS intends in particular to encourage and develop the private sector access to the "Near Space", region extending from the Earth surface to the Low Earth Orbit (LEO) and characterizing the outpost of the so-called Fourth Environment. At the same time, the concept of "Near Space" is also interpreted as an expression of closeness to humanity; therefore, the CNS has also the aim of promoting the consideration of Space as a new component of the future environmental of the Human life.

The OrbiTecture project, proposed by CNS and oriented to the study of a future generation infrastructure node, placed in LEO, will see the continued presence of about hundred people and guarantee the functions of peer, maintenance hangars and integration, scientific laboratory and resort.

The genesis of the idea starts from simple considerations:

1. The costs of transfer to orbit will have to be reduced trying to reduce the mass. The answer to this invitation is given by innovation technology, which allows to build in orbit with 3D printing lean structures, which will not have to withstand the launch loads.
2. The dependence on the Mother Earth will have to be limited by trying to sustainability solutions with the implementation of agrarian cultures.
3. Future missions to Mars and the Moon will be supported with the creation of training environments.

While the current space station is a juxtaposition of parts, each with its own function (in a sense analogous to the first "motor coaches"), the proposed idea has an image concise and understandable. The SpaceHub will host in its spherical central body research, environments for cultivation and a hub for the docking of the shuttles to/from the Earth and towards space exploration. Two toroids (one simulating the gravity on the Moon, the other with Mars' gravity) will offer living habitats, socialization spaces and areas for the private relax of all the occupants of the space station.

The central sphere, called 'Miranda', has a radius of 22 meters, a volume of about 45,000 cubic meters partially pressurized. The interior twin toroids, called 'Aristarchus' performs the function of 'Moon Village' and green area for crops and has a radius of 34 meters, a volume of about 12,000 cubic meters totally pressurized. Finally, the external toroid, called 'Galilei' performs the function of 'Mars Village' and green area for crops and has a radius of 83 meters, a volume of about 26,000 cubic meters fully pressurized.

The internal spaces of the torus will be such as to meet the needs and survival needs of around one hundred inhabitants.

The basic elements for human survival are made up in fact of oxygen, water and food according to well-known quantities taken into account also for the International Space

Station. The basic requirements that must have the crops will be the reduced size, a high production, a high nutritional power, and a short cultivation cycle, such as for example, rice or potatoes that may be the basis of a space nutrition feeding.

Considering the characteristics of the proposed crops, the estimated necessary cultivation area is 60 m², which could be for example composed as follows: 5 m² of lettuce, 20 m² of potato, 15 m² soybeans, 10 m² wheat and 10 m² tomato. The crops would provide about 50% of edible biomass, while the remainder would be reused to obtain nutrients for the crops. To close the material loop, a waste recycling system must be able to make the waste produced by man to crops available again.