An Italian program for a spacecraft of new conception

by A. V. Autino

The goal: a safer shuttle, fully reusable

Last April 27th, in Capua, at CIRA, I attended to the roll-out of the USV (Unmanned Space Vehicle), a motorless technological demonstrator, targeted to experimental flights launched by a stratospheric balloon, at increasing quota, with the purpose to progressively increase the speed. The machine, 9.2 meters long, 1.3 tons heavy, will perform its first flight in July 2006, taking off from the ASI site of Milo (Trapani), in Sicilia. It will be lifted to the altitude of 25 kms by an aerostatic balloon, designed by ASI. USV can be maneuvered from earth via telemetry, with the goal to experiment the flight during the reentry from orbit. With its 500 sensors installed on board, the USV is defined by its builders a true flying laboratory, able to accumulate experimental data, recorded in the onboard memories, and transmitted to earth via telemetry.

The goals of the program, 180 million Euros worth (86 for phase A), include to create the technological bases for an improved and fully reusable space shuttle, both from the point of view of safety and from the ones of the consumptions and of the environmental impact, included the acoustic pollution, characteristic of the supersonic flight.

How? CIRA first of all wants to fly during the hot phase of the reentry in atmosphere. The current shuttle doesn't fly, in fact, on the contrary it falls inside the atmosphere with a flight order tilted of 40°. The dissipated energy is enormous, the danger for the astronauts too, as was tragically demonstrated be the reentry of the shuttle Columbia. Besides, if something goes bad, and the sole destination airport is missed, there is none possibility to divert on possible alternatives. The only chance to survive, for the astronauts, consists in depressurizing the spacecraft, sending forth a many meters long telescopic boom, and finally to unthread long such boom with the purpose to be able to leave the ship from a certain distance.

The requirements of the new vehicle describe besides an avionics and an aerodynamics which give the possibility to maneuver after the dive in atmosphere, lengthening the reentry time, improving therefore the energetic budget, decreasing the general risk, and allowing landing alternatives. Another important innovative aspect is given by the material, of new conception, which is required to withstand 2000 °C (against the 1600 of the shuttle). Furthermore, the material will allow the fusion in one only

block, very safer, wrt the glued tiles, susceptible to detach from the craft (the loss of even one only tile is cause of total catastrophe for the shuttle). In general terms, CIRA aims to pass from the current 1.5 shuttle efficiency of flight to 2.5, with an inclination order of reentry less than 30%, and in expectancy to be able to lower even more the nose, up to be able "to plunge" elegantly in the atmosphere, rather than to hit noisy "belly strikes".

The program foresees besides to fly the USV, in 2011, on board of the Vega launcher, also fully developed in Italy.

The space tourism business is at the horizon

The present journalists attending the press conference couldn't miss the possible connections with the transcontinental passengers transport, that's not so difficult to foresee using suborbital technologies, in a future not too far. Flying out of the atmosphere, the trip would be inertial for the most part, with the consequent considerable consumptions and pollution decrease.

Prof. Vetrella, chairman of ASI and CIRA, foresees possible commercial applications not before fifteen years: 7/8 years to develop the technology and as many to start the industrial construction of vehicles. But Virgin Galactic - I objected as TDF journalist -- is building a commercial spaceport in New Mexico, and it announces the first commercial suborbital flights already in 2008 (Virgin Galactic signed an agreement with Scaled Composites for the commercial exploitment of the technology experimented by SpaceShipOne, the winner of X-Prize in 2004). Aren't we in Italy limiting ourselves to the research, while others are developing the business?

The true problem for the realization of a SSTO, Prof. Vetrella replied to me, is the propulsion. If the propeller of SpaceShipOne is really a new conception one, and it allows, for instance, to turn on and to shutdown the motor, we have indeed reasons to be impressed by the enterprise of Jim Benson and Burt Rutan.

However SpaceShipOne has repeated the enterprise at the distance of three only days and didn't replace the motor: they only refuelled the fule and the oxidizer. This, together with the type of used fuel - rubbery -- seems innovative enough to me.

The questions, to me, are at least the following ones:

- will the technology experimented with SS1 allow to also climb a jet motor on the same vehicle?
- will it be possible to load the jet fuel and the rubbery fuel to complete the trip, on board of a SS1-like vehicle?
- will it indeed be possible to build and to make legal a vehicle for civilian passengers transportation within the 2008 deadline, stated by Virgin Galactic?
- as to the orbital flight, will the technology experimented with SS1 allow to push the performances up to reach the 27.000 km/h, necessary to go to LEO?
- did the research of Scaled Composites face the study of the high quotas aerodynamics, focusing on it an importance comparable to the one attributed by CIRA?

On the SpaceDev' web site we find some technical notes about the hybrid propeller equipping SpaceShipOne. We learn therefore that the motor not only can be turned on and shutdowned, but also throated. As to safety, the ignition totally depends on the combination of two elements, the plastic/rubber fuel and the N2O oxidizer, combination that is not explosive (the N2O is normally used to pressurize whipped cream). The fuel must have vaporized in presence of the oxidizer, otherwise the ignition doesn't happen, and the two separate components are fully inactive.

Obviously we cannot claim that many programs at the state-of-the-art can have birth in the current Italian situation, so disastered in general as far as the scientific research is concerned, and totally misinformed about the emerging space economy[1]. Nevertheless, it seems that the research postulated by CIRA, particularly the air-navigation at high altitudes and the heat resistant materials, can cover some interest, also for the protagonists of the enthusiastically phase opened by SpaceShipOne. The launching of USV is a good result indeed, and a very promising start, for Dr. Gennaro Russo - head of the CIRA' space programs - and for his equipe of researchers.

NOTES:

(1) Please see the acta of the First International Convention of Technologies of the Frontier "The global importance of the incoming Space Economy", held the April 1st 2006, in the medieval catle of Moncrivello (VC).

[004.AA.TDF.2006 - 01.05.2006]