CAL POLY PACE SYSTEMS

StarBooster™ Project

The StarBooster™ Project explores the concept of remotely controlled, fixed wing, flyable booster rockets that exercise a vertical launch followed by aircraft flight and horizontal landing. The Reusable Launch Vehicle (RLV) application is a fully reusable first stage booster. The first stage RLV lifts a second stage and payload to orbit before flying horizontally back to earth for a runway landing. The rockets have very short turn around times and give access to space a less expensive alternative to expendable launch vehicles and the space shuttle. RLV's represent an idea whose time has come, and CPSS is helping to demonstrate one vision of the future. The vision comes from **Starcraft Boosters, Inc.**, which has designed this completely reusable first stage booster for taking payloads to space. The booster lifts expendable upper stages and payloads to a staging point, then drops off and does a glideback or fly-back to a runway using jet power. Researchers at NASA Langley Research Center are analyzing various configurations of RLV's and were interested in seeing a small scale flight demonstration of the unique StarBooster™ configuration. Cal Poly had just the right high power rocket and radio control experience to take on the project.

The StarBooster™ configuration that CPSS originally used for its subscale demonstrator testing is shown here. The intent of the project is concept validation and data collection during flight that will aid in design and analysis of the full-scale vehicle. The subsonic rocket demonstrators have a conventional vertical launch, and then as the rocket begins its descent after its peak altitude, an R/C control system is used to fly the rocket as a glider to a controlled landing.

More About the StarBooster Concept

The StarBooster has a number of exciting potential applications which could make access to space significantly safer and more affordable. StarBooster Inc. has listed some of the following as selling points for their booster.

A pair of StarBooster 200's attached to an expendable upper-stage

The versatile StarBooster 200™ plus existing or imminent ELV stages will:

- Blanket the LEO/MEO/GTO/GEO commercial market
- Provide economical re-supply for the *ISS*
- Provide new, lower cost capability to TLI or LLO
- Act as a booster for or as a backstop for *VentureStar*
- Serve as NASA *LFBB* Demonstrator & *X-Plane* Launch Platform
- Fulfill forthcoming DoD needs for *Space Plane* launch to Mach 19

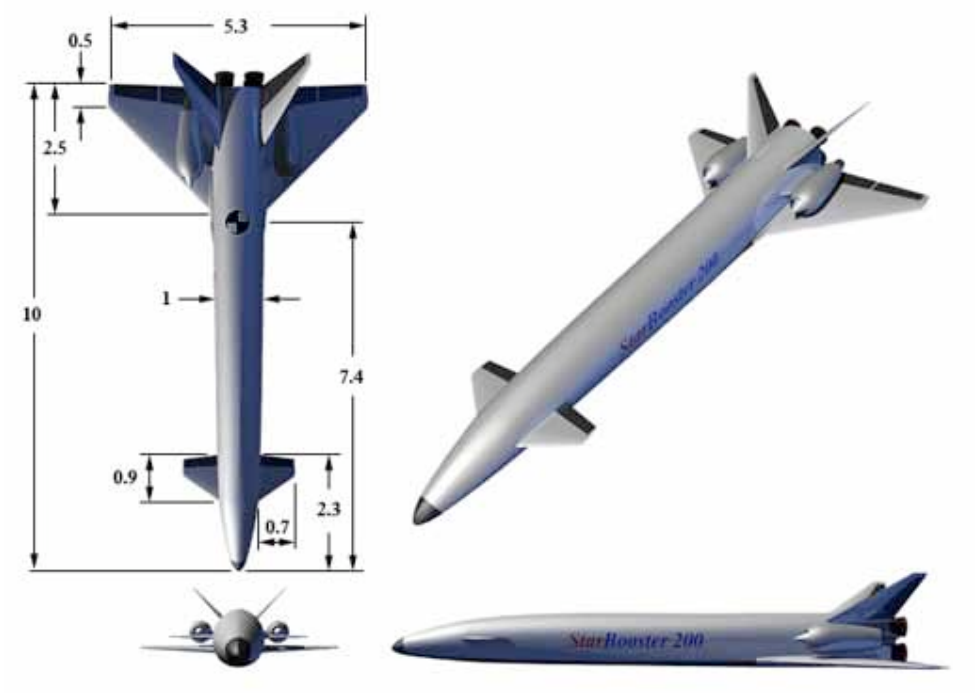
StarBooster 200™ will evolve to TSTO for greater savings & with larger derivatives as:

- Booster for a new, partially reusable cryogenic stage, *StarCore III*
- Space Shuttle Flyback Booster with commercial flight experience
- Human Mars missions *HLLV* (80 ton LEO payload class)
- Space Tourism (100+ passenger class)
- Potential *Space Solar Power* launch (an incredibly large market)

CPSS' Role in the StarBooster Project

The NASA Langley Research Center has begun a feasibility study of this project, which may culminate in a decision on whether or not to support the production of the StarBooster. Cal Poly Space Systems has been asked by NASA Langley Research Center to build a scale model of the StarBooster to demonstrate some important flight characteristics. Can it make a stable climb? Can it fly back and make a safe landing? These are simple questions with not-so-simple answers that CPSS will have to tackle.

StarBooster 200 on its return flight after lifting an upper-stage to the outer reaches of the atmosphere



2000-2001 Flight Program's First Launch - March 18, 2001

On Sunday, March 18, 2001, Cal Poly Space Systems launched its latest model of the StarBooster 200 reusable fly-back booster in Fresno, CA at Maddox Farms. This, the first of four scheduled flights, was a test of the vehicle's all new structure, aerodynamics and on-board systems before expensive telemetry is installed on future flights.

After launch the vehicle made a stable climb exactly as predicted under power of an M-1939 solid rocket motor with a peak thrust of nearly 600-lb. At take-off the vehicle weighed 81 pounds and after burning its fuel and expending water ballast at apogee, weighed 54 pounds. At 8 seconds after launch the left canard broke free of the vehicle under the stress of dynamic pressure. According to an on-board integrating accelerometer the vehicle reached nearly 400 MPH.

The loss of the left canard caused the vehicle to roll several times before the main wing stalled and the vehicle entered a flat spin. The pilot was unable to recover from the spin and the vehicle sank steadily while maintaining the spin.

The consequences of the erratic trajectory to the rest of the vehicle systems is being evaluated. All on-board systems failed to respond after the vehicle departed controlled flight. Fortunately, the vehicle made a soft-landing on its belly and was nearly intact.

The new construction materials and techniques proved highly successful in producing a light, strong vehicle which exceeded expectations upon surviving the uncontrolled landing. A thorough stability and control analysis will be performed using knowledge gained from this flight.

CPSS PRESS RELEASE
December 8, 2001

Cal Poly Space Systems Launches Double StarBooster Configuration

San Luis Obispo, CA – The Cal Poly Space Systems (CPSS) rocket club of Cal Poly San Luis Obispo entered the next testing phase of its StarBooster program by launching a dual-StarBooster configuration. The StarBooster is a reusable fly-back booster conceived by StarCraft Boosters, Inc. and designed to act as dual strap-on boosters to a separate center stage that would go on to orbit. CPSS demonstrated the airworthiness of a single 10-foot StarBooster model during last school year's efforts, and is now tackling the complications of modeling the ultimate 3-piece design.

The rocket, consisting of two 3-foot StarBoosters (red and blue) strapped to a center stage (white), lifted off the pad powered by the single motor in the center stage. Moments later, the two StarBooster engines were "air started". Only two of the three engine plumes are clearly visible in the picture. The third was indeed active, just obscured from view (actually, upon close inspection, a faint orange can be seen through the smoke beneath the blue StarBooster). This portion of the flight successfully demonstrated the stability of the configuration during liftoff and the early moments of the flight. The rocket did experience some deviation from "straight and true" which will be studied to determine the cause (assymetric engine thrust/timing, assymetric lift from the wings, etc.).

The pyrotechnics designed to release the StarBoosters at apogee did not fire. Fortunately, the parachute had been sized with this eventuality in mind, so the entire rocket configuration glided safely back to earth as a single unit. Initial inspection suggests that a wire to the pyrotechnic charges had come loose under the g-loads of the liftoff.

The patriotic color scheme also had a practical design intent. Had the StarBoosters separated as planned, the remote-control pilot of each unit would have had to be able to readily spot the StarBooster he was controlling. Color differentiation was important.

CPSS expects to launch this configuration again early in 2002.

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