Travel: Detailed Flight Plan

The payload will be launched from Cape Canaveral Air Force Station Launch Complex 46 at 15:59:35 ET on January 25, 2010, using an Athena II launch vehicle. The Athena II's Castrol 120 solid rocket first and second stages, and an Orbus 12D solid motor third stage will place its payload, the lander and rover into LTO. At perigee of the LTO, 300 km earth altitude, the craft, with its first three stages and the payload fairing jettisoned, will be traveling at 10.83 km/s. The period of this LTO is 785210 s. Thus, the travel time from LTO perigee to LTO apogee (and LOI), is half this time, or 392605 s, which equals 4 days, 13 hours, 3 minutes, and 25 seconds. This places the lunar intruder at LOI at 05:04:00 ET on January 30, 2010.

The Athena II provides a hydrazine fueled Orbit Adjust Module (OAM) for making orbital adjustments and transfers. It also contains the attitude control systems, guidance and navigation systems, telemetry transmitters, command and destruct receivers, and the necessary antennas. The OAM will perform minor orbit-keeping corrections, as well as provide the necessary ΔV to enter LLO. At LOI, (LTO apogee), the craft will have slowed to 1.09 km/s. However, to enter a circular lunar orbit, its velocity must be increased by the OAM to 1.64 km/s, requiring a ΔV of 0.55 km/s.

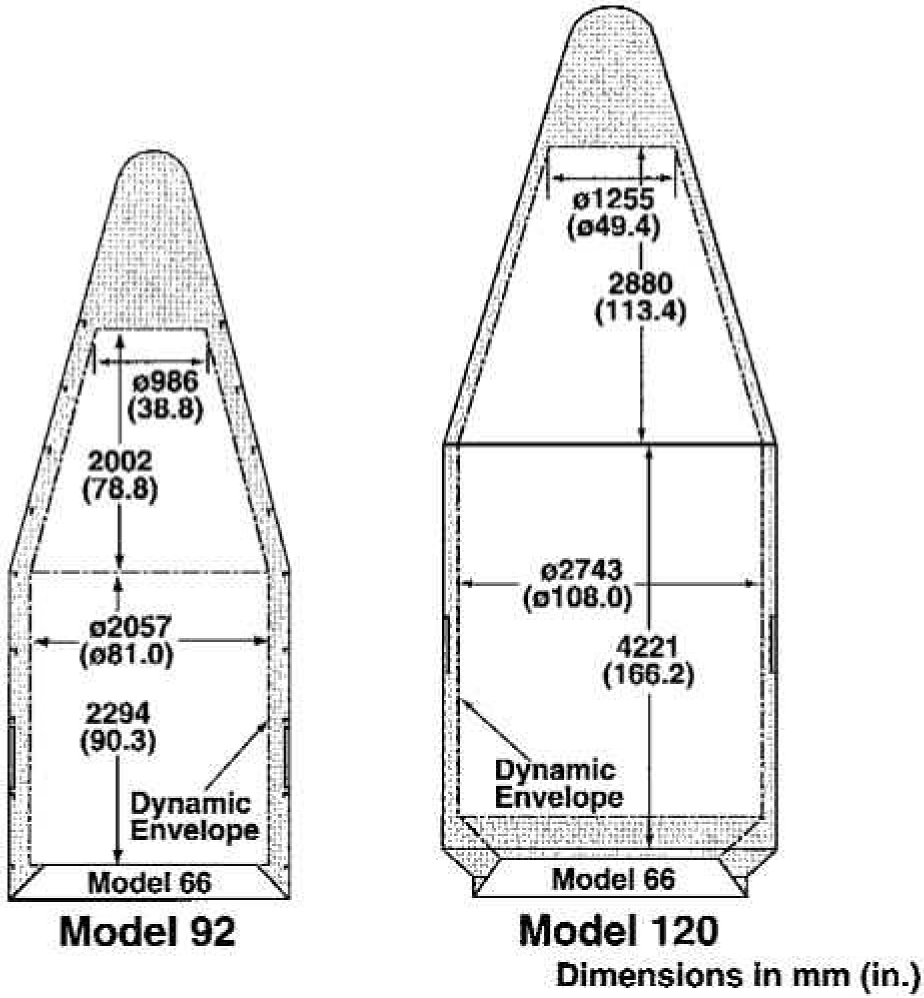
Once in its retrograde LLO, and the lander systems have targeted the desired landing location, the OAM will provide a small velocity-reducing burn, after which it will be immediately shed. With the reduced velocity, the orbit of the lander-rover assembly will decay, and the lander will make a powered descent to the surface.

The lander assembly is 1500 kg fully fueled, which allows enough fuel to make a controlled, powered descent to the lunar surface. From the Tsiolkovsky rocket equation, $\Delta V = v_e \ln\left(\frac{M+P}{P}\right)$, where v_e is the motor's exhaust velocity, M is the propellant mass, and P is the payload mass. With a payload mass of 1500 kg, the OAM, which produces 2.16 km/s exhaust velocity, a propellant mass of only about 500 kg is required to achieve the desired ΔV to enter LLO. However, it will be fueled with 1000 kg to account for any other necessary burns, which is well within the OAM's capacity.

As the Athena II is able to place 1896 kg into low earth orbit, geostationary transfer orbit, or interplanetary orbits, it is an adequate medium-payload vehicle for placing the lander in LLO. By keeping the overall payload dimensions and weight to a minimum, Darkside Logistics is able to use the a smaller payload vehicle, with a launch price of only $26 M, as opposed to larger vehicles, with launch prices of $70-150 M.

Athena II rocket at Cape Canaveral launch site, destined for the moon, containing the Lunar Prospector probe, 1998 <David—full res. Image 1500x2300 available at http://images.ksc.nasa.gov/photos/1998/high/KSC-98PC-0103.jpg>

The figure below shows the inner dimensions of the Athena's payload fairing. The dimensions of the lander assembly, fully packed are ?????. Thus, it may be easily integrated within the standard payload fairing. However, last minute additions enlarging the payload size could be easily integrated with the larger model payload fairing, if necessary.



Athena II payload fairing configurations

After a powered descent from low lunar orbit, the lander will guide itself to the target landing destination. The chosen landing location is near that of the Apollo 11 mission in the Mare Tranquillitatis (Sea of Tranquility). This location is optimal for establishing a lunar spaceport as it is near the lunar equator. The Mare (the dark spots easily visible from earth, resembling oceans) are low, flat regions consisting of hardened basaltic lava flows. Thus such a location is ideal for supporting the anticipated lunar traffic. An additional goal for landing in this region is to locate and photograph the original Apollo 11 equipment, including the Lunar Module's descent stage, the American flag, and any remaining experiment packages or equipment left by the Apollo 11 crew. As the lunar coordinates of the Apollo landing sites are quite accurately known with respect to local landmarks, and the control systems are highly accurate, it is expected that we will be able to place the rover quite precisely, within several kilometers of the Lunar Module, well within the rover's maximum range. Apollo 11's Lunar Module is known to rest at 0.6875ºN latitude, 23.4333ºE longitude, at the western edge of the Mare Tranquillitatis.

The figure below shows the desired landing spot on the moon.

After landing, the lander will deploy the rover and all its auxiliary systems. Both rover and lander will undergo a pre-programmed systems check, and transmit their statuses to the ground control station. Per the Lunar X-prize requirements, the rover will then begin photographing itself, the lander, and panoramic views of the surrounding terrain, roving with high-definition video, and completing any other required tasks. The rover will also transmit the required first "moon-to-earth email" as a string of ASCII text. This message will be transmitted with the aforementioned media, and is required to be stored on the rover before earth departure.

The first moon-to-earth email message to be sent will contain the following:

“I'm like that guy who single-handedly built the rocket and flew to the moon. What was his name? Apollo Creed?

-Homer Simpson”