A Space Elevator for the Far Side of the Moon. T.M.. Eubanks[1], [1]Asteroid Initiatives LLC, 12644 Chapel Rd, Clifton, Virginia 20124.

Introduction: Space Elevators are not commonly considered in near-term plans for space exploration, primarily due to a lack of suitable materials for the construction of a Terrestrial space elevator. A Lunar Space Elevator (LSE) [1] could, however, be constructed with existing materials and technology; a functioning elevator could be placed into service with a single launch of an existing heavy launch vehicle[2]. An LSE at Earth-Moon Lagrange Point 2 (EML-2), above the Lunar Farside, offers several advantages over the previously considered LSE at EML-1, and could considerably advance the exploration and development of the Farside, providing a communications platform for missions in locations with no line-of-sight to the Earth and a means of early sample return from the Farside.

Lunar Space Elevators: Unlike the terrestrial space elevator, which would be kept aloft by the Earth's rotational acceleration, for an LSE the Lunar gravitational force is counterbalanced by the Earth's tidal acceleration. The low tidal gradient at a distance of 384,000 km means that Lunar space elevators are thus very long. Table 1 shows some details of the baseline LSE for EML1 presented at LEAG in 2011 [2], together with information about the analogous elevator for EML-2 (with the same fiber material, Zylon[3], mass, etc.). While the Moon gravity is roughly spherical, the Earth's tidal gradient is slightly weaker on the Farside of the Moon, and so an EML2 LSE will be about 7% longer with a 14% reduction in surface lift capacity compared to an EML1 LSE of the same mass.

The Landing Site and Sample Return from the Lunar Farside: To date, all Lunar sample returns have been from from 10 sites on the Lunar NearSide. The LSE in Table 1 assume "natural" elevator landing sites (i.e., directly beneath the Lagrange Point), as these seem most appropriate for a initial elevator deployment. An EML-2 LSE could thus provide an immediate sample return from a previously unsampled region (and, indeed, from a previously unsampled hemisphere). The EML-2 landing site (Figure 1) is near Lipskiy Crater, just North of Daedalus Crater in very rugged and heavily cratered terrain in the Lunar Highlands.

Farside Communications. Communications has always been a severe complication for the engineering of missions to the Lunar Farside, as there is no direct line-of-site between the Earth and any location deep in the Farside (librations bring occasional line-of-sight to locations at the Farside-Nearside boundary). A EML-2 LSE would provide a communications mast visible from almost any location on the Farside, and could thus serve as a relay for communications with the Earth. There is, as yet, no standard for Lunar relay communications as there is for Mars Orbiter Relay, and this would have to be developed to take full advantage of this capability. (The Mars Relays use UHF radio links at ~ 400 MHz which would not be appropriate for the long distances for Lunar elevator relays.)

Other Farside Science. An EML-2 LSE would enable a variety of other Farside science, including the monitoring of particles and fields in near interplanetary space at EML-2 and at the far end of the elevator, and also along the Earth magnetotail at Full Moon, and the monitoring of the Farside for meteor impacts, as is already being done for the near-side[3]. The monitoring of the time of Farside impacts will be especially important if a Lunar seismological network is established, as impacts on the Farside will provide seismic waves traversing the Lunar core to Nearside seismometers. A EML-2 LSE would also make it possible to extend the Lunar seismological network to the Farside itself, providing a truly global Lunar monitoring network.

References: [1] Pearson, J., Levin, E., Oldson, J. & Wykes, H. (2005) Lunar Space Elevators for Cislunar Space Development. NIAC Phase I Final Technical Report, Star Technology and Research, Inc. (2005). [2]Eubanks, T. M. & Laine, M. (2011), LEAG, LPI Contributions 1646, 15. [3] *Zylon Fiber PBO Technical Information* (2001) Toyobo Corporation, Ltd, available from http://www.toyobo.co.jp/seihin/kc/pbo/technical.pdf [4] Oberst, J. *et al.* (2012) Planetary and Space Science 74, 179–193.

Lunar Elevator	LSE-EM1 NearSide	LSE-EML2 FarSide
String	Zylon PBO	Zylon PBO
Length	278544 km	297308 km
Total Mass	48,700 kg	48,700 kg
Surface Lift Capacity	128 kg	110 kg
Total Taper (in area)	2.49	2.49
Max Force	517 N	446 N
Landing Site	0° E 0°N	180° E 0°N

Table 1 : Lunar Elevators

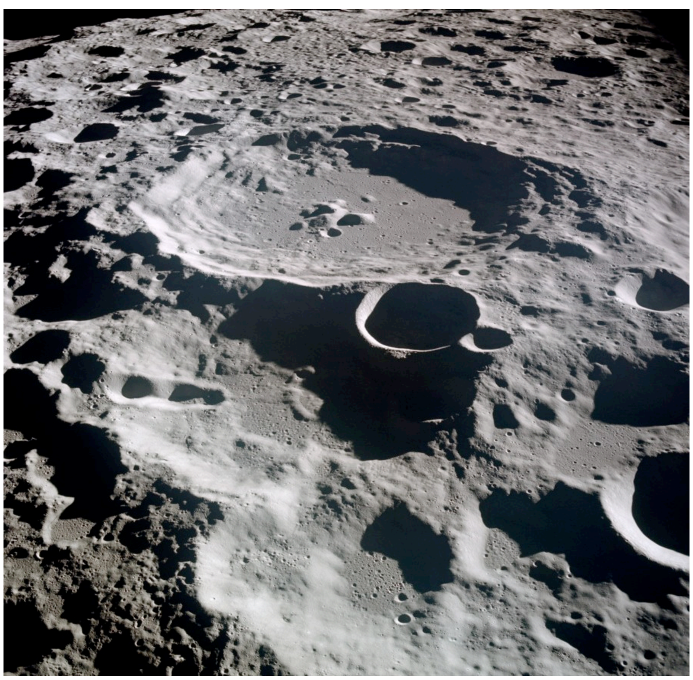

Figure 1 : Apollo 11 image of Daedalus Crater. The EML-2 LSE Landing site would be just below the bottom of this image; this view would be available ascending the elevator roughly an hour after leaving the surface.