APHELION ORBITALS

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The Nanolauncher Vision

Over the past four decades, the satellite launch industry has evolved complex hardware and processes that are aligned with the requirement multi-ton, high-cost missions. Yet in the new space market, this philosophy stands outdated in contrast with the newfound need for agility and rapid turnaround time. The launch industry is progressively out of sync with the multitude of commercial developments that has enabled the adoption of small satellite (e.g. Cubesat) technology on a widespread scale. By compressing timeframes and costs to what is within the operating bounds of most businesses, a new look on space will truly enable mass commercialization.

The recent revival in commercial space has overseen the construction of even larger launchers to bringing down the cost per kilogram into orbit and to lay the foundations the space tourism. The strategy of building large expands access through gradually lowering costs, but, in turn, abstracts customers from launch vehicle technology, making launch options even more inflexible and reducing the number of access points into space. It leaves behinds areas of commercialization and resource utilization where missions need to be optimized for delivering thousands of smaller spacecraft into different orbits. The creation of large, expensive, multi-use vehicles prohibits the expansion of such doorways and increases the threshold to launch technology. If we are to set our eyes on creating much larger markets capable of making profound impacts on our ways of life, scaling up is not enough.

The responsive launch movement is gaining momentum, evident in the boom of private launch companies in recent years. These Smallsat launch vehicles have been conceived in the same tradition of conservative design under the backdrop of an industry used to high launch prices, and provide a low entry point for these enterprises which are trying to squeeze themselves into an increasingly crowded field. Fundamentally very little has changed in these vehicles besides their privatization and modernization.

The only path to materializing the vision of accessible space is to allow the proliferation of launchers at such a scale where a ride to space is only a ticket away. This means building more bridges across the gap that lies between us and the universe. This means making the technology accessible, low-cost, and plentiful. We cannot merely build the same launchers, and just build them smaller. The approach and the design choices have to undergo a fundamental change, right down to the business model itself.

Since our first ventures into space, the economy has seen revolutions in automation and mass manufacturing that have drastically brought down the cost large mechanical systems. The rest of the transport industry has established efficient supply chains which enables them to deliver products at extremely low costs. Launch vehicle components have the potential to reach the same level of maturity, yet we are missing the supply chain and volume needed for such vertical integration. Yet the world has changed. Even without this premise, modernized production techniques such as additive manufacturing can easily bridge this volume gap by enabling companies to produce small batch of parts at incredible tolerances with low costs. Launch vehicles are machines no more complex than a small car or truck, yet their small volumes, high engineering and verification costs, and complex manufacturing has kept the bar of entry high. We have set out to change this. We want to see them one day dominate the skies like any other mode of transportation.

Our founding coincides with the rise of the fastest growing segment in the space sector. With a huge number of nanosatellites requiring a launch in the foreseeable future and the rideshare launch market being completely saturated, a large growing market for customers that require dedicated launch opportunities, nanosatellite constellations, and mission flexibility is left wide open. Our launch technology enables us to expand the mission capabilities of small spacecraft based on the premises of modern advancements in scaling and the cost effective nature of mass produced, small sized vehicles. In a way, the nanolauncher aims to be comparable first personal computer ever produced: it is to bring space to the hands of individuals.

Company Summary

Aphelion Orbitals, Inc. was founded to greatly expand access to orbit for nanosatellite and Cubesat spacecraft users through development of a game-changing ultra-small dedicated nanosatellite launch system and process. Thousands of small satellites are either waiting for a launch opportunity or will require one within the next 5-10 years, creating a substantial market opportunity for new providers in the industry. Our goal is to provide an end-to-end solution from nanosatellite structures to payloads, software, and dedicated launch services. Notably, the projected growth of the launch market will allow us to achieve rapid growth and return on investment.

The exponential growth in the utilization of nanosatellite technology is a result of its applications in commercial data collection, the requirement for space access from academia, and progress in electronics miniaturization which allow advanced features that used to require large, multi-ton spacecraft to be packaged into sub 10 kg class satellites. The increasing saturation of available ride-share capacity and difficulty manifesting secondary payloads inhibits the utilization of small satellites commercially, and has given rise to the need of dedicated nanosatellite launch services.

Our business model focuses on addressing this opportunity by developing a dedicated nanosatellite launch system capable of deploying large quantities of these satellites at a very low cost and with tailored mission profiles. Among our nanosatellite launch competitors we stand out through new developmental approaches and engineering practices, enabling cost reductions through decreased complexity, higher launch rate, reusability, mass production and vertically integrated processes. The bottom line is that our approach to space access will allow us to reduce development costs and operate the first regularly scheduled launch service.

As of mid-2017 a total sum of $290,000 has been invested into the company. We operate a research and development facility in Union City, NJ, and our main offices are located in Titusville, FL, at the heart of the space coast.

Products and Services

Our business is divided into two core sections which complement each other for a turnkey space access solution from concept to launch.

• Launch services – Feynman provides a payload delivery system capable of placing the spacecraft into the specified orbit suited for the client's mission. The Trailblazer sounding rocket is a suborbital counterpart to the launcher which provides low-cost space access for testing, research, and academia.
• Nanosatellite components - We supply both complete satellite buses for integration into our launch vehicle and retail parts with a focus on straightforward management for flexibility and ease of use. We also provide the services to design and produce our client's payload, allowing corporations with no prior experience in the usage of space resources to easily and cost effectively attain their desired results.

Launch Vehicles

The Feynman launcher forms the core of our business. Positioned in the optimal 10-20kg kilogram range, its extremely low cost and high launch rate opens up new possibilities for nanosatellite design and effective space access. It offers dedicated flight opportunities for Cubesat class spacecraft that has a growing requirement for mission flexibility, launch slots, and turnaround time. We provide a number of unique, key competencies.

- Regular launches and ticket-like manifestation
- Specialized team allow customer-requested payload accommodations and tailored launch profiles for every mission
- Highly streamlined, consistent production process as a result of mass produced components and high launch rate

- Reduced development and manufacturing costs due to lower complexity of a small scale vehicle
- Lighter components and first stage allow partial reusability and cost reduction

A dedicated vehicle opens up new possibilities in both the launch market and nanosatellite design. Its low cost and high turnover rate allow us to hold launches at consistent intervals, providing a regular transportation route for space. This cuts lead time significantly and open up space access to a new level of convenience while allowing us to streamline vehicle production and easily control costs.

Such a concept has a growing appeal to commercial users and mission-critical satellites used in academia: with the definition of this class of spacecraft expanding into a plethora of potential applications, the demand for a dedicated, reliable, and flexible launch vehicle that is not interdependent with other rideshare payloads is starting to show. We complement this with a variety of services.

- System integration support and mission management services from start to launch
- Ground support infrastructure at launch site
- Spacecraft integration and client consultation
- Launch insurance

The nanolauncher strategy relies highly on a cost-conscious development philosophy. By effective design and mass production, we are able to tap into the inherent simplicity of smaller vehicles to scale down complexities in manufacturing. Furthermore, we will see the added benefit of economies of scale: while large vehicles can launch in the single digits or low dozens every year, we could be expected to fly up to 50 times a year (that represents a mere 20% of the current market). The large production rate, complemented by innovative production methods, allow for a true revolution in launcher costs.

Non-expendable designs generally suffer from issues in recovery and utilize cost-prohibitive implementations. Reduced size allows us to reuse key components with a little development cost and a low mass penalties. Our studies show that realization of this could result in a cost reduction of up to 25% per flight on top of our current estimates. By adopting a modular design methodology, we also open up future upgrade paths for larger payloads.

Complementing the Feynman launcher, we are producing Trailblazer on a regular basis to both cater to commercial needs and provide a precursor to its larger sibling. Trailblazer shares a multitude of components with Feynman, allowing us to quickly mature the technology needed for the vehicle and at the same time providing a platform for low-cost suborbital flights.

The suborbital platform utilizes key innovations such as high-performance composites, miniaturized control systems required for the realization of nanolaunchers, and new construction techniques such as additive manufacturing that offer cost and mass saving advantages.

The sounding rocket market is currently restricted to flight opportunities offered by NASA and sporadic commercial flights from companies such as Blue Origins, despite high demand. Trailblazer will be the only commercial sounding rocket to offer regularly available, dedicated flight, provide suborbital flight opportunities that are invaluable to microgravity research, flight testing, and the pharmaceutical industry, complementing Feynman in both commercial and technological respects.

Nanosatellite Solutions

Aphelion Orbitals will bring to market its Cassiopeia line of products in 2017. An ongoing optical communications development program and a full suite of space and radiation simulation facilities place us at the forefront of technology development. This positions us to cater to the growing demand for integrated solutions, higher data-rate communications, and interplanetary spacecraft systems.

Cubesat components by major manufacturers suffer from fragmentation and a poor amalgamation of standards and software. The nanosatellite design process for academia or for commercial applications often involves jumping through different software interfaces and hardware manufacturers, drastically increasing cost and lead time of a project. We fill the gap by providing a product line of tightly integrated modules and a highly user-friendly user interface for programming. Plug and play operation is enabled by our software wrappers and payload processor, while complex housekeeping tasks are handled autonomously and interfaced through a simple API. This enables users to focus only on their payload instead of the spacecraft bus.

Our product line will be rapidly expanded and supplemented with a series of spacecraft attitude control systems that stems from our existing research, enabling turnkey solutions. Our technologies, utilizing advanced composite, metal, and graded-Z 3D printed materials in-orbit will provide customization services of the chassis for our customers at no additional cost, further accompanying our design philosophy of moving unnecessary work from our customers to the spacecraft manufacturer for lower lead times, ease of use, and tighter integration.

Target Customers

The mass proliferation of launch technology and easy space access bring a plethora of advantages to a wide range of clients.

- Low cost, rapid nanosatellite constellation construction and maintenance for communications, resource identification, and monitoring
- Missions which need to fly on specific orbits that are not accessible through rideshare flights or are incredibly rare, such as high inclination or polar orbits
- Irregular nanosatellite launches, potentially hazardous payloads, experimental satellites, or mission risk reduction by deploying complex mechanisms pre-flight, as allowed by the larger fairing volume
- Spacecraft which need to be powered on or monitored real-time before deployment
- Commercial clients looking for a fast, guaranteed launch opportunity to realize a return on investment without lining up for months or years on a rideshare launch

Trailblazer will pioneer the market as the first regular, commercial launch service. It targets both academic (ionospheric, atmospheric, and microgravity research) and commercial clients. We allow space exposure and deployable payloads through customer-provided payload sections. Competition from NASA and providers such as Blue Origin is limited due to their high cost and limited number of launches per year.

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