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## Commercial space flight takes wing

The first private-sector flight to the International Space Station opens up a myriad of opportunities for science, says Alan Stern.

Next week, SpaceX, an aerospace company in Hawthorne, California, working with NASA, is scheduled to launch the first cargo resupply mission by a commercial space company to the International Space Station (ISS). Its Falcon 9 orbital rocket will deliver a Dragon capsule stocked with food, water and other astronaut provisions to the station.

The flight will be the first of many resupply missions, under contract by NASA to SpaceX in a deal worth around US\$1.6 billion. But more importantly, it represents the entry of commercial space companies into the big league. It will place SpaceX at the heart of ISS operations and will open up important capabilities for science by increasing the number of future science experiments aboard the ISS and providing a way to bring samples produced in microgravity back to Earth.

The flight is a watershed, but it is just the beginning of the potentially game-changing capabilities and economic promise of the emerging commercial space industry for science.

Take the realm of suborbital spaceflight — missions that stay just a short time in space — which has been used effectively by researchers around the world for more than 60 years to test new techniques and technologies, conduct special purpose observations and train students. But the concept is about to undergo a reboot, as commercial firms such as Virgin Galactic in Las Cruces, New Mexico, and Blue Origin in Seattle, Washington, along with less well known but equally interesting entrants XCOR Aerospace and Masten Space Systems in Mojave, California, and Armadillo Aerospace in Heath, Texas, revolutionize suborbital access by lowering costs to a tenth of those today by flying reusable rather than throw-away space vehicles.

Together, these firms will vastly increase access to microgravity for scientists, instrument technology testers and educators, in much the same way that personal computers expanded access to computing in the 1980s from the mainframe machines of the 1970s.

And commercial space companies offer science capabilities and options at more than just the low altitudes at which the station and suborbital vehicles fly. The Google Lunar X Prize is spurring companies such as Moon Express in San Francisco, California, backed by deep-pocketed Internet moguls, to offer flights to the Moon for cut-rate prices.

How? Moon Express and its competitors hope to build a twenty-first-century robotic space business niche by amalgamating payloads from various universities, labs and countries, and sharing the costs. They are betting that although few countries and private entities can afford the one to two

hundred million dollars to mount a lunar mission, many can afford to share the cost with half a dozen others, thereby reducing the cost of lunar missions to perhaps a few tens of millions of dollars — or even less — for small payloads.

Space firms also have attractive deals for science in Earth orbit. For space experiments needing short stays (weeks to months), Space X is offering cut-rate access to orbit aboard Dragon, and the opportunity for later re-flight.

Bigelow Aerospace of Las Vegas, Nevada, intends to take the commercial space concept to a new level — by constructing a fully functional orbiting lab that could rival the available volume and crew complement of the ISS. Bigelow's station will give private companies and the 150 or so smaller countries that are not a part of the ISS consortium the capability

to fly experiments and experimenters for stays of three months or longer — perhaps even years. And although pricing is still in flux, Bigelow hopes that mission prices will be less than what small science satellites cost today.

Some of these nascent ventures may be successful, others not. And some are less conventional than others. Perhaps the most conventional, and most game-changing in the long run, is SpaceX's promise of Falcon rocket launches at costs of \$55 million that have the same capabilities as rockets now offered almost exclusively at costs of \$150 million or more.

Those lower prices have caught the eye, and the purse, of big-name communications satellite suppliers such as SES, based in Betzdorf, Luxembourg; Iridium McLean, Virginia; and Orbcomm in Fort Lee, New Jersey, who have showered SpaceX with

contracts for more than a dozen launches.

It is unlikely to be long before science agencies such as NASA and ESA, which are feeling the simultaneous pinch of cost overruns and budget squeezes, begin to make similar contracts. Over a series of missions, a saving of \$100-million dollars per launch could add up to more than a billion extra dollars in the bank — and that, in turn, could result in science missions that might otherwise not have been possible.

Who says that commercial spaceflight is possible only for wealthy space tourists and communication satellite operators? Commercial space ventures will provide scientists with much needed and welcome new ways to advance their research by making space easier and cheaper to access. ■

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