Blue Origin
Achievements and plans for the future
Blue Origin

- A private aerospace manufacturer and spaceflight services company
- Founded in 2000 by Amazon.com CEO Jeff Bezos
- Headquarters in Kent (Seattle), Washington
- Employs more than 1000 people (April 2017)
Blue Origin: company motto

Gradatim Ferociter,
Latin for “Step by step, ferociously”
Blue Origin

• Since its founding, the company was very secretive about its plans
• Blue Origin’s existence became public only in 2003, when Bezos began buying land in Texas
• In 2005, Bezos said Blue Origin was developing a manned sub-orbital space vehicle
• Only after 2015, the company emerged from its self-imposed silence
Charon

- Blue Origin’s first flight test vehicle
- Made one successful test flight on March 5, 2005 to an altitude of 96 m at Moses Lake, Washington
- Consisted of a welded aluminum airframe holding four Rolls-Royce Viper Mk.301 jet engines
- Is currently displayed at The Museum of Flight in Seattle, Washington
Charon
Goddard

• Also known as PM1 (Propulsion Module 1)
• Made its first test flight on November 13, 2006 to an altitude of 85 m and two fights in 2007 to higher altitudes from West Texas
• Little technical details are known. Powered by nine rocket engines, probably using hydrogenperoxide as fuel
Goddard
PM2 (Propulsion Module 2)

- Few technical details known. Powered by five BE-2 engines, using kerosene and peroxide (140 kN thrust per engine)
- Made a short test hop to 167 m altitude on May 6, 2011 using three engines
The second flight took place August 24, 2011, powered by all five engines.

It reached a speed of Mach 1.2 and an altitude of almost 14 km.

Unfortunately, the vehicle lost stability and exceeded its planned angle-of-attack, causing the range-safety system to terminate thrust. PM2 crashed in the desert.
Blue Origin: funding

• By July 2014, Bezos had invested over 500 million US dollar of his own money in Blue Origin
• Blue Origin completed work for NASA on several small development contracts, receiving 25.7 million US dollar by 2013
• Since 2017, Bezos is selling approx. 1 billion US dollar in Amazon stock each year to privately finance Blue Origin
New Shepard

- Reusable manned rocket developed for suborbital space tourism
- The crew capsule can carry six persons and has a launch escape system
- Powered by a single BE-3 engine burning liquid hydrogen and liquid oxygen (490 kN thrust)
New Shepard: development

- One development milestone became public: On 19 October 2012, Blue Origin conducted a successful Pad Escape with a full-scale suborbital Crew Capsule at its West Texas launch site.
- The capsule fired its pusher escape motor and launched from a launch vehicle simulator.
- It reached an altitude of 703 m before descending safely by parachute to a soft landing.
New Shepard: first flight (NS1)

- The first flight of the first New Shepard vehicle, NS1, was conducted on 29 April 2015
- An altitude of 93.5 km was reached
- The crew capsule was successfully recovered via parachute landing
- The booster stage crashed on landing and was not recovered due to a failure of hydraulic pressure in the vehicle control system during the descent
The successes of NS2

- New Shepard 2 or NS2 made 5 successful flights in 2015 and 2016.
- On the four first flights, the capsule reached just over 100 km altitude each time.
- The booster stage performed a powered vertical landing each time.
- On the 4th flight, a capsule landing with two parachutes instead of three was tried.
1. Launch
2. Separation
3. Capsule free flight
4. Drag brakes deploy and engine relights
5. Booster landing
6. Capsule landing
NS2 5th flight: in-flight abort test

- 5th and final test flight of NS2 was conducted on 5 October 2016.
- The principal objective was to boost the passenger module to the point of highest dynamic pressure and conduct a flight test of the in-flight abort system.
- NS2 was not expected to survive and land, but the booster remained stable after the abort, and successfully landed for the 5th and final time.
NS2 5^{th} flight: in-flight abort test
The crew capsule

- Room for six passengers, each with their own window ("biggest windows in space")
- Abort engine in the center of the capsule
- No pilots, entire system is autonomous, even no commands from ground control
- The passengers are allowed to unbuckle to enjoy weightlessness
- The passengers board the capsule 30 minutes before launch. The entire flight from launch to landing takes only 11 minutes
The crew capsule
What would a ride on New Shepard cost?

- Good question! Blue origin has not yet announced a price or price estimate.
- Let’s guess it would cost 200 000 US dollar (a flight on Virgin Galactic’s SpaceShipTwo costs 250 000 US dollar)
- 11 minutes = 660 seconds. At that price you would pay just over 300 US dollar per second of flight!
- In comparison: the flight on a SpaceShipTwo takes over 1,5 hours (including the climb to 15 km attached to the mothership)
New Shepard’s future

• New Shepard 3 has been built and shipped to the launch site in September 2017. Its crew capsule will have real windows for the first time. Initial flight tests of NS3 are expected before the end of this year.
• New Shepard 4 will be the first one to actually carry passengers. The first manned launches are expected in 2018.
• Will Blue Origin beat Virgin Galactic in launching the first paying space tourists? It is possible...
Blue Engine 4 (BE-4)
Blue Engine 4 (BE-4)

- Blue Origin is currently working on a much bigger engine than New Shepard’s BE-3: BE-4
- This engine uses liquid oxygen and liquid methane as fuels. It produces 2400 kN at full power
- Designed to be reusable. Design life: 25 launches
- Successfully fired for the first time on October 19\textsuperscript{th}, 2017 in West Texas
- This engine is in the running to power the first stage of the United Launch Alliance’s (ULA) new Vulcan launcher (first launch planned 2019)
- It will be the main engine for Blue Origin’s own orbital rocket, New Glenn.
Blue Engine 4 (BE-4)

October 19th test firing
Vulcan (ULA)

- Designed to replace ULA’s Atlas 5
- First flight expected 2019
- First stage will probably be powered by two BE-4’s, but Aerojet Rocketdyne’s AR1 is also in the running.
- Second stage: Centaur at first, later ACES
- First stage engines are planned to be reused: they will detach after cutoff, and descend with a heat shield and parachute, and be captured by a helicopter in mid-air.
New Glenn (Blue Origin)

- Blue Origin’s reusable orbital launcher
- First flight expected 2020
- First stage will be powered by seven BE-4’s, generating 17.1 MN thrust
- Second stage: one BE-4U (adapted to vacuum with larger nozzle)
- Third stage: one BE-3U
- Huge rocket: 95 m high (3 stage version), 7 m diameter. Unique: 7 m diameter payload fairing!
- 45 000 kg to LEO, 13 000 to GTO
New Glenn
New Glenn

- First stage will be fully reusable and land vertical on a barge in the ocean.
- Customers: OneWeb (5 launches) and Eutelsat (1 launch)
- Could carry people as well as cargo, crew module part of design.
New Armstrong

- Even bigger rocket planned by Blue Origin
- Very few details know
- Capable of Moon and Mars missions
- Seems similar to SpaceX’s Big F***ing Rocket (BFR)