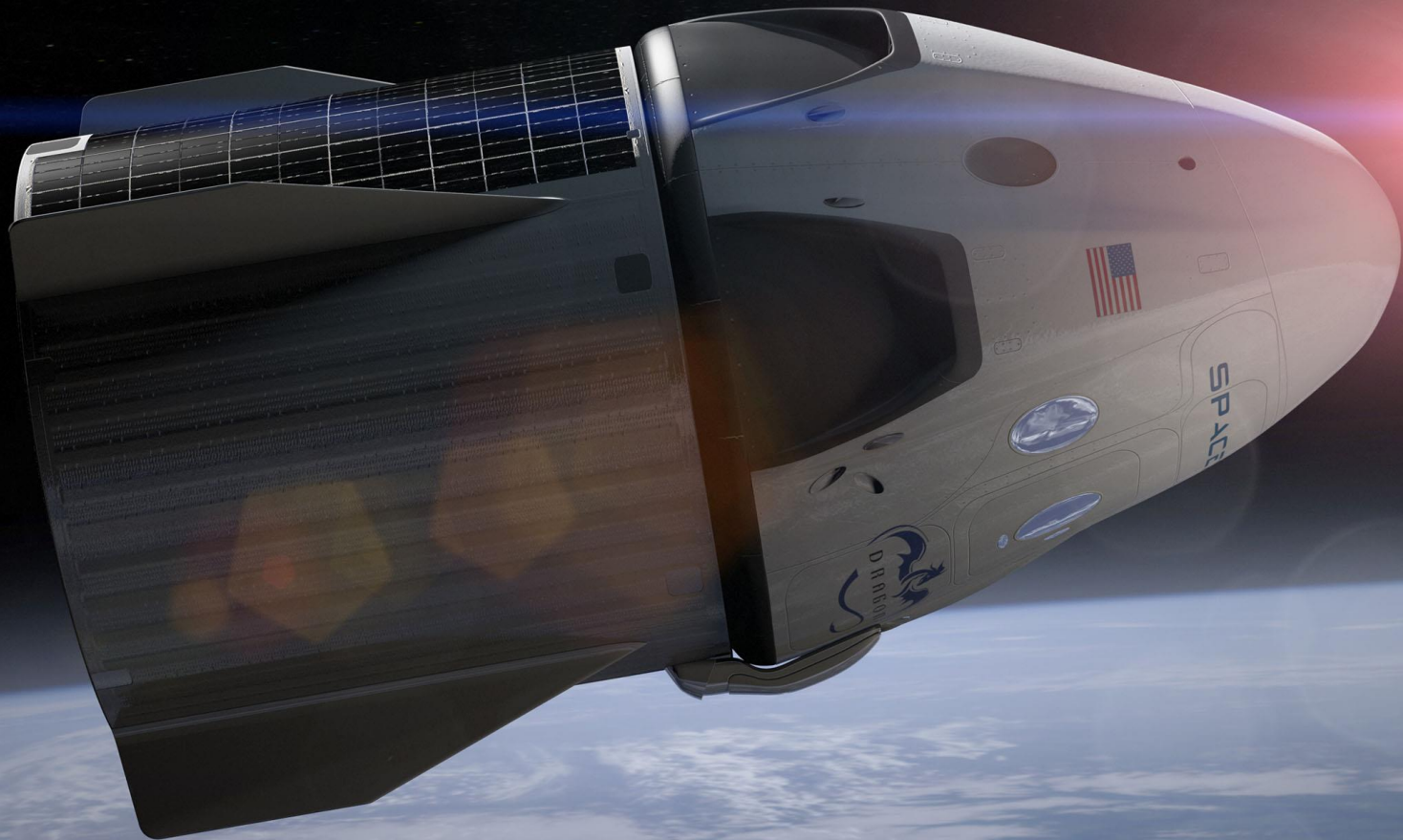


SAFETY OF FLIGHT

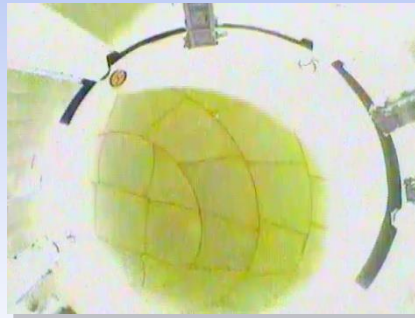
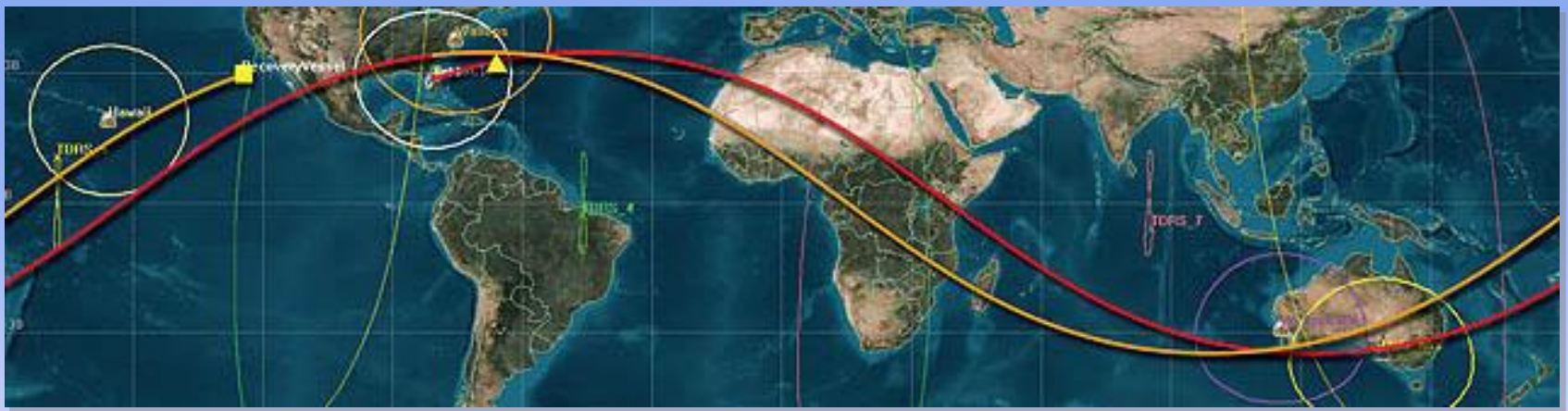
Aircraft vs. Spacecraft

Garrett Reisman, August, 2014



COTS C1 – Dec 8, 2010

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Crew Dragon

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Crew Dragon - Details



- Capable of carrying up to 7 crewmembers
- ECLSS system
- Powerful launch escape system
 - 8 SuperDraco engines provides escape capability all the way to orbit
 - Capability for propulsive landing with backup parachutes for safety
- Impact attenuating landing legs
- Designed to take NASA astronauts to and from the International Space Station
 - But our advanced heat shield is capable of lunar missions, in addition to flights to and from Earth orbit

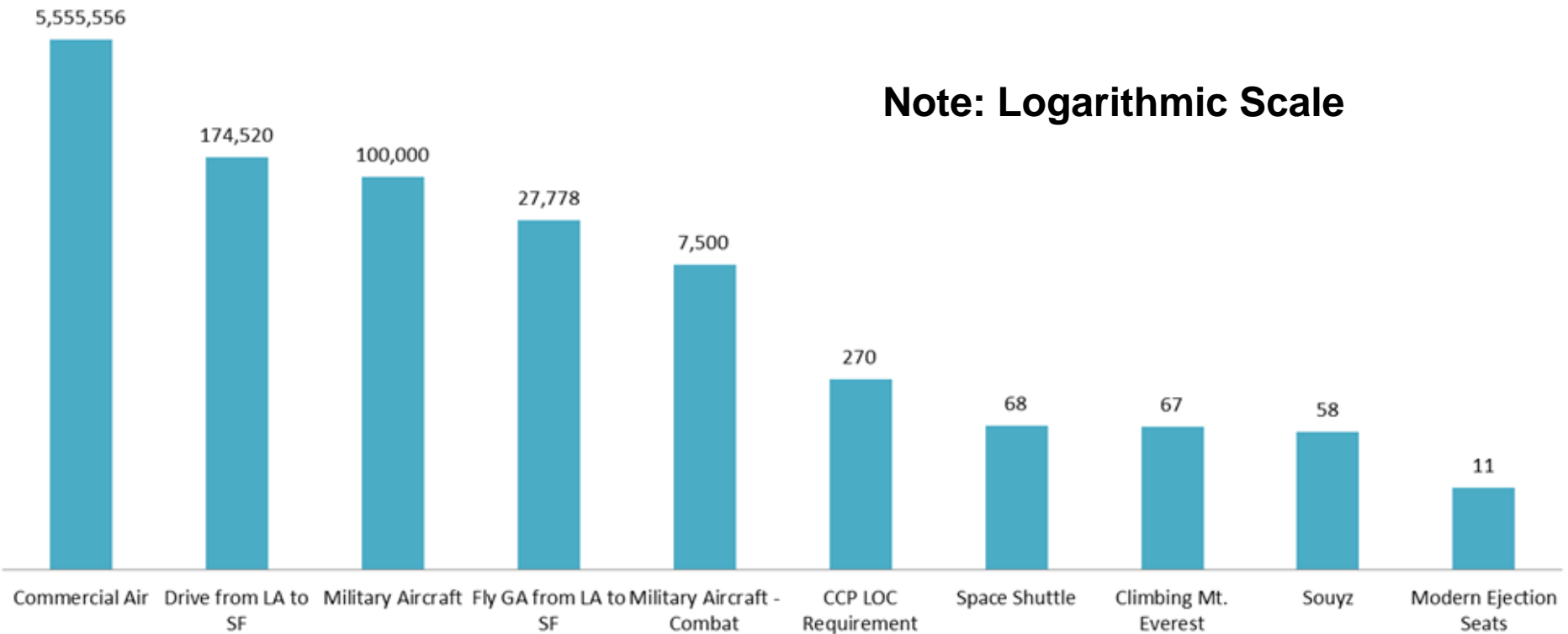


We aspire to be like you...



Chance of Fatality (1 in X)

Note: Logarithmic Scale



Why is spaceflight so hard?



- Physics

- Kinetic energy – 30x speed, 100x energy

	Mass (lbs.)	Velocity (mph)	Energy (Joules)
Boeing 757	242,000	552	3.35×10^9
Crew Dragon	20,180	17,500	2.80×10^{11}

- Loads

- Up to 30g's for launch abort scenarios

- Thermal environment

- Vibe and acoustics

- Radiation

Why have we not closed the gap faster?



- Flight rate
 - Shuttle averaged 4.5 sorties per year
- Rate of new vehicle development
 - Dragon test flights – first in over 30 years
- Difficult to incorporate new technologies
 - Risk aversion leads to strong incentives to use familiar (old) technology
- Difficult to make vehicle improvements
 - High cost structure makes modifications expensive
 - Certification process discourages changes to baseline vehicle configuration

This is SpaceX.



Dragon V2 - Animation



Thank you.

SPACEX

