

Potential aeromedical implications associated to hypersonic flight

Col. Marco Lucertini, MD

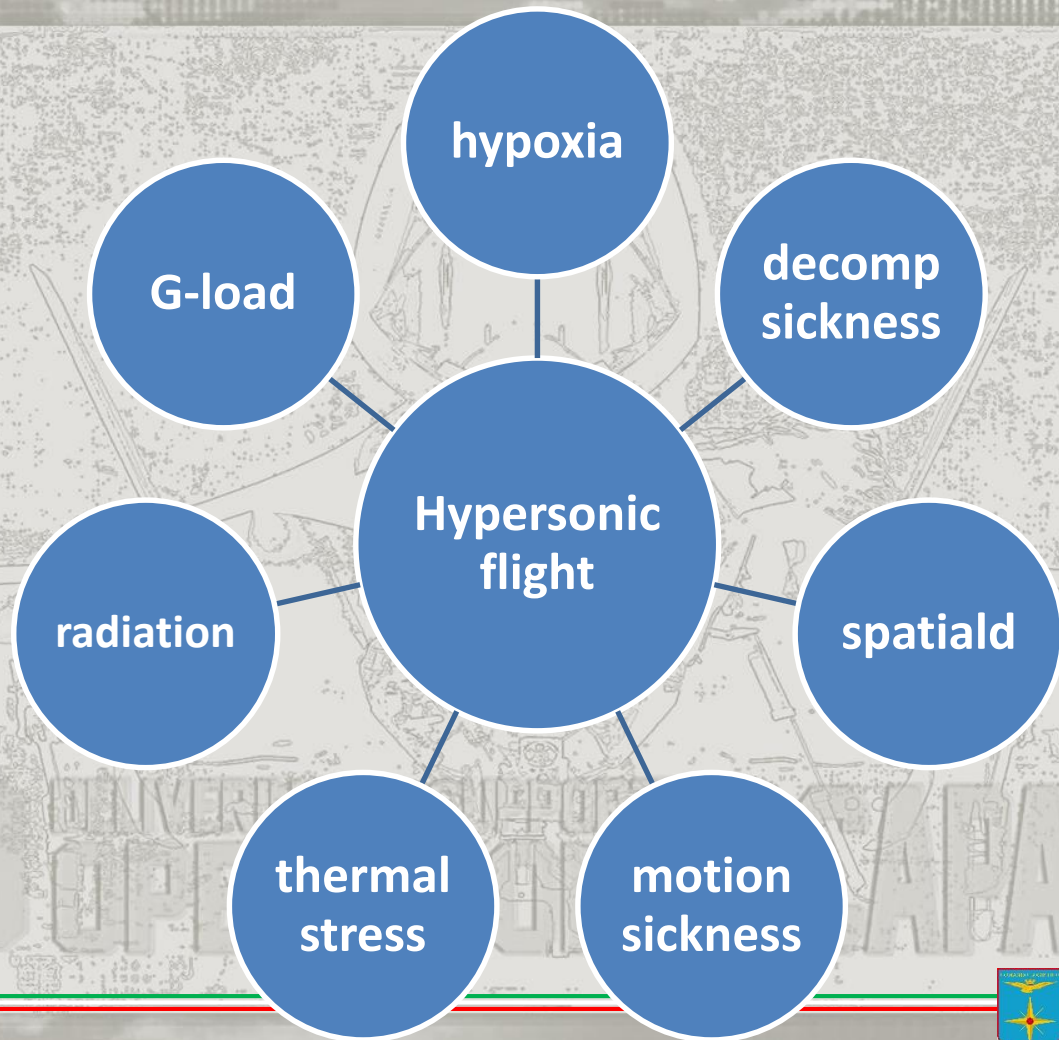
Italian Air Force – Flight Experimental Centre

3rd International Symposium on Hypersonic Flight

Air Force Academy (Pozzuoli), Italy, May 30-31, 2019

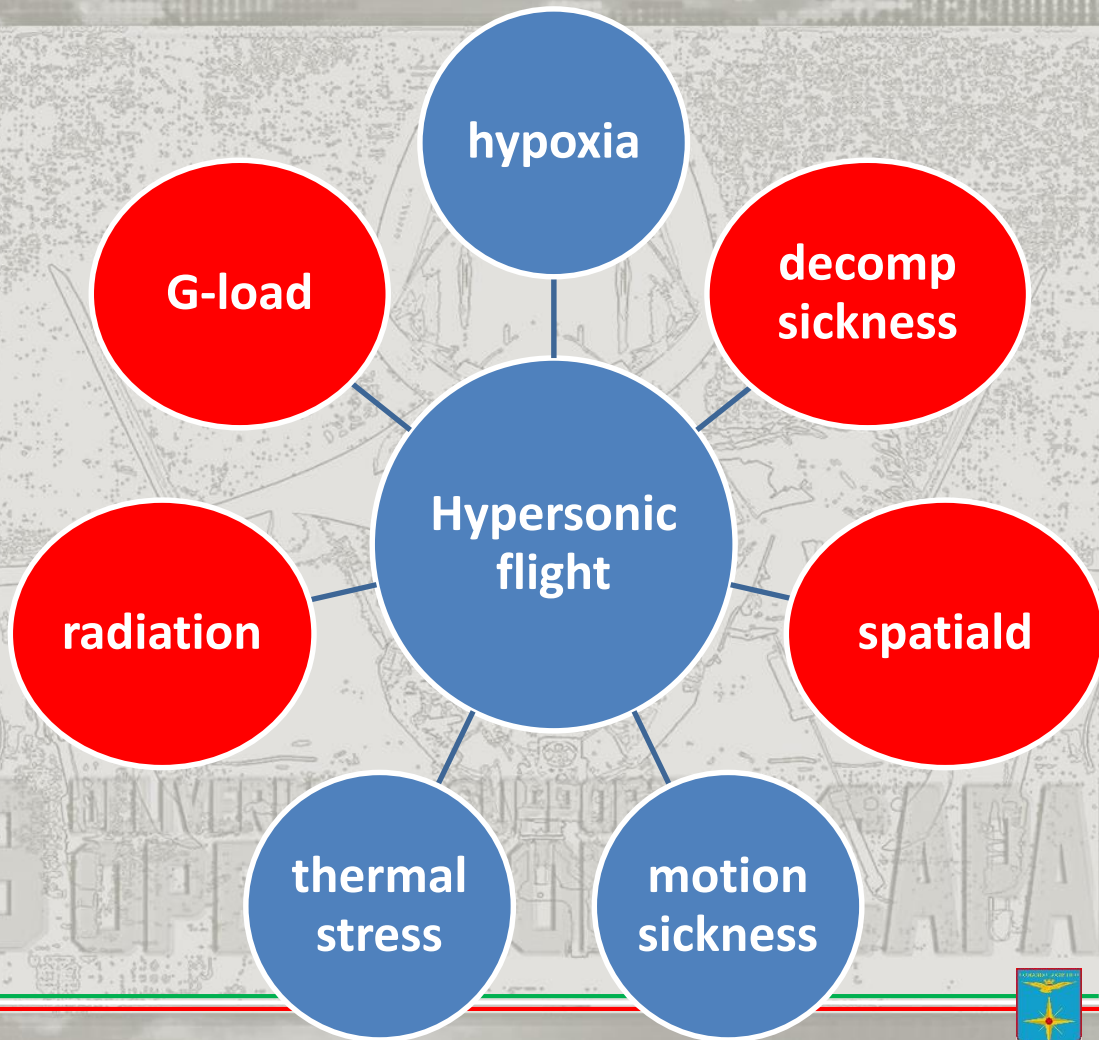


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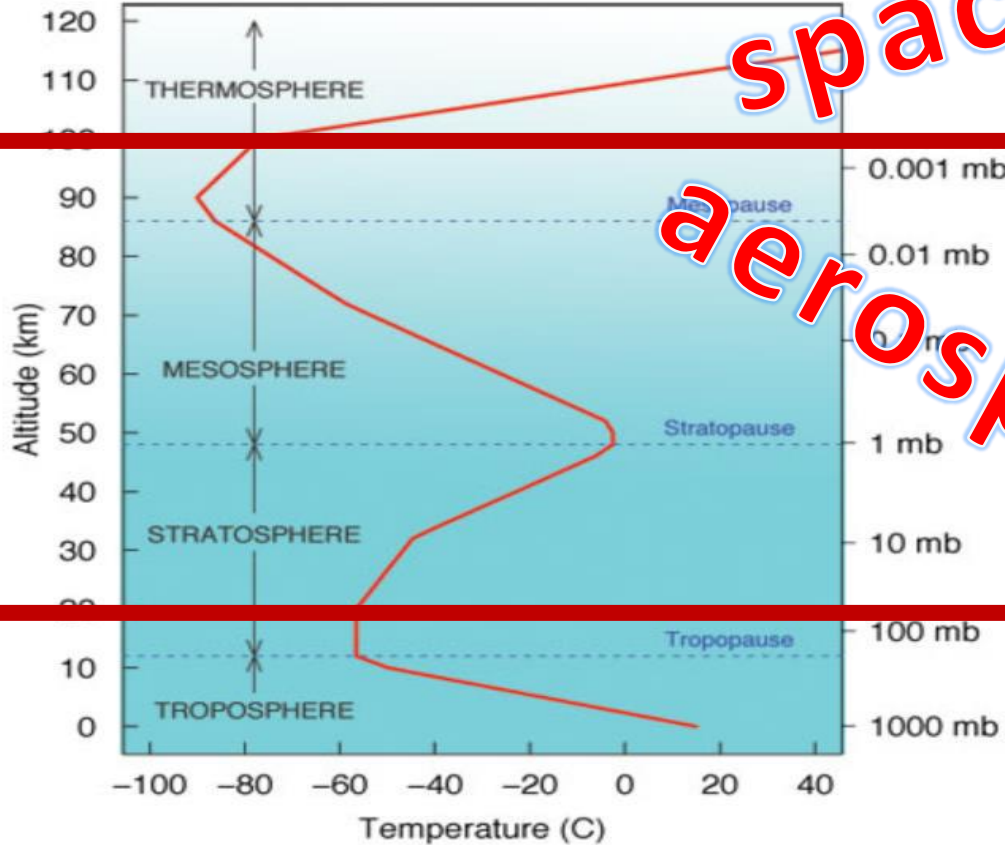
2019 SUPER AVIABILITY





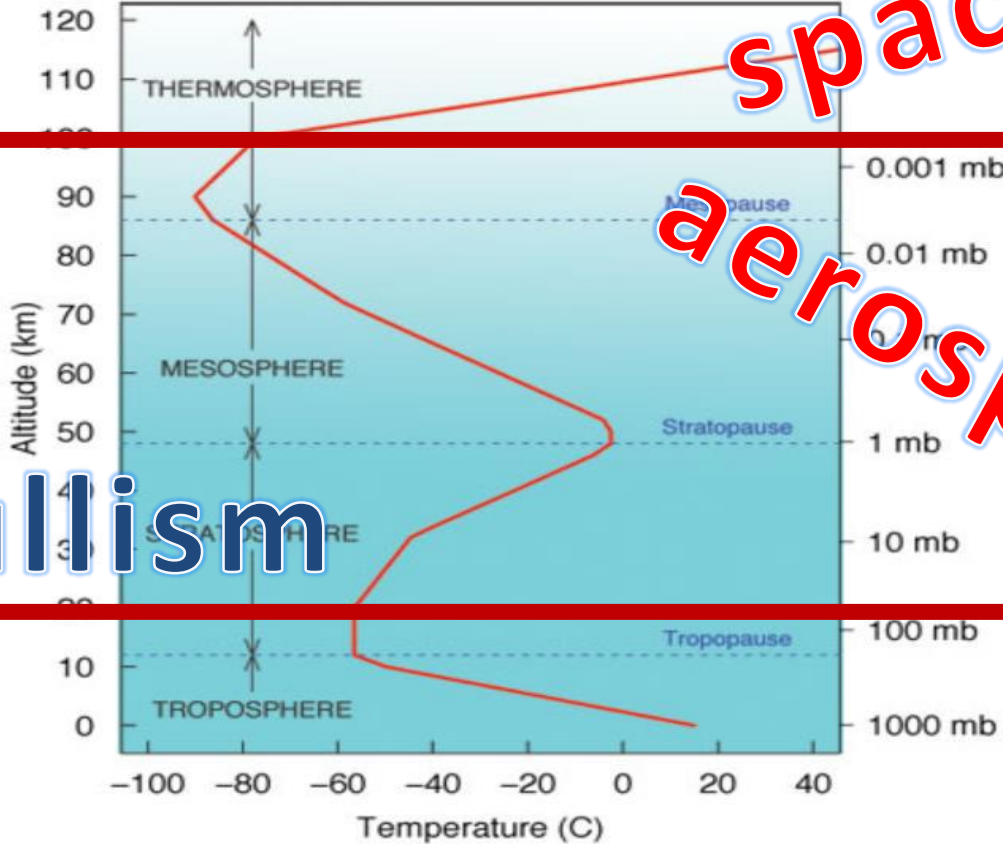


the atmospheric environment





the atmospheric environment



ebullism

space
aerospace

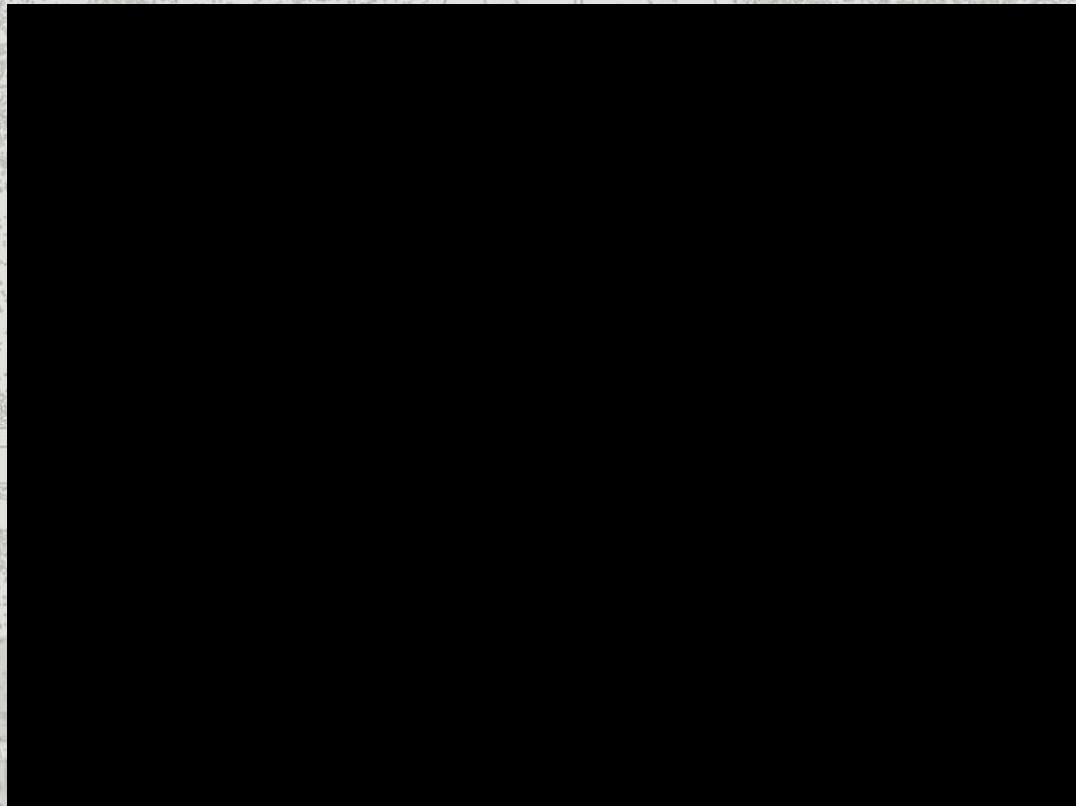




ebullism

Ambient pressure equivalent to 47 mmHg corresponds to the saturated water-vapor pressure at body temperature (37°). This is observed at 63,000 ft. (Armstrong line).





2019



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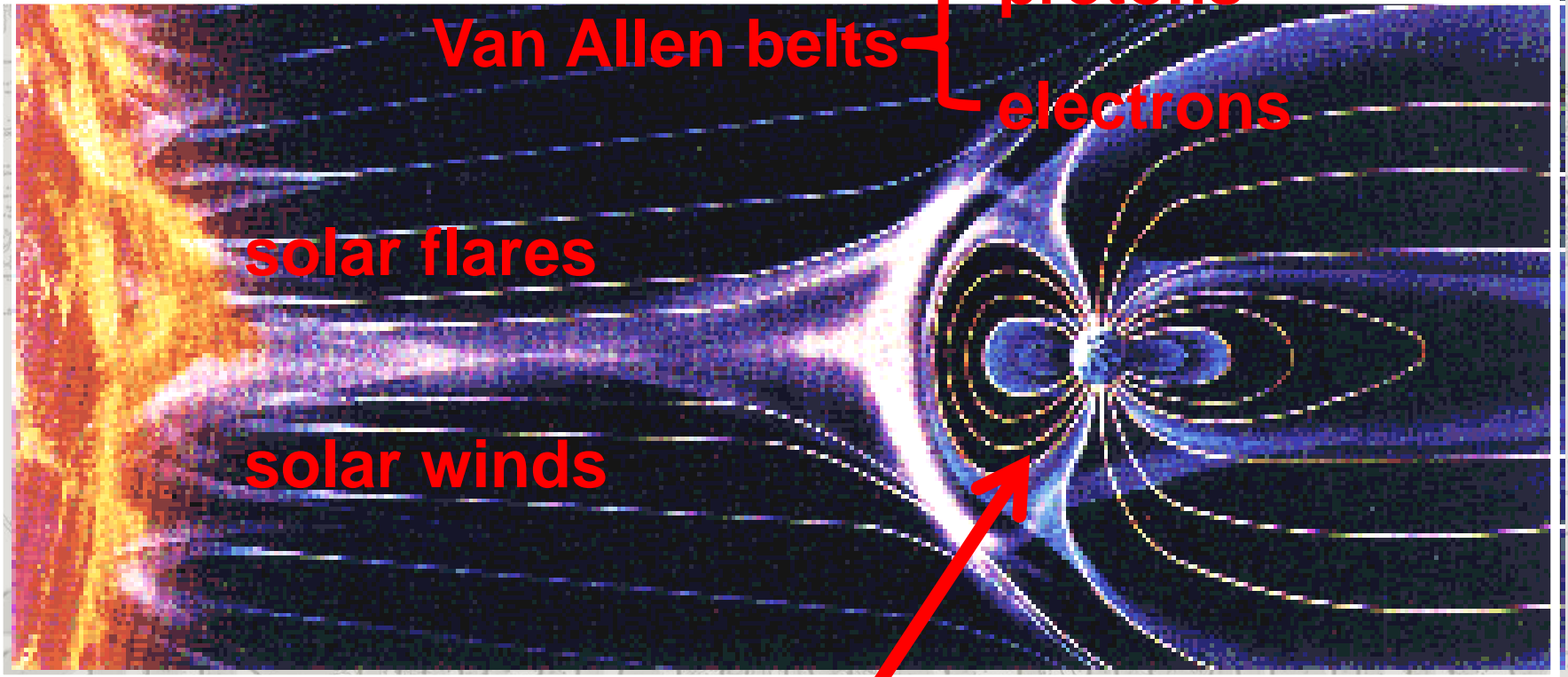


SD related flight mishap

***Major Michael J Adams
X-15 test pilot
Nov. 15th 1967***



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Van Allen belts

protons

electrons

solar flares

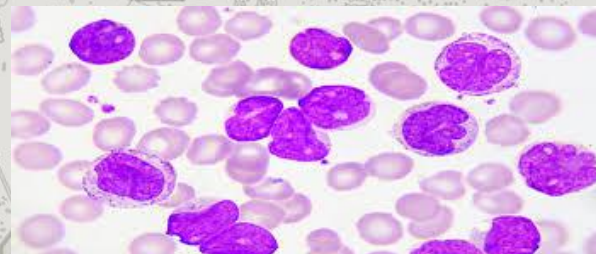
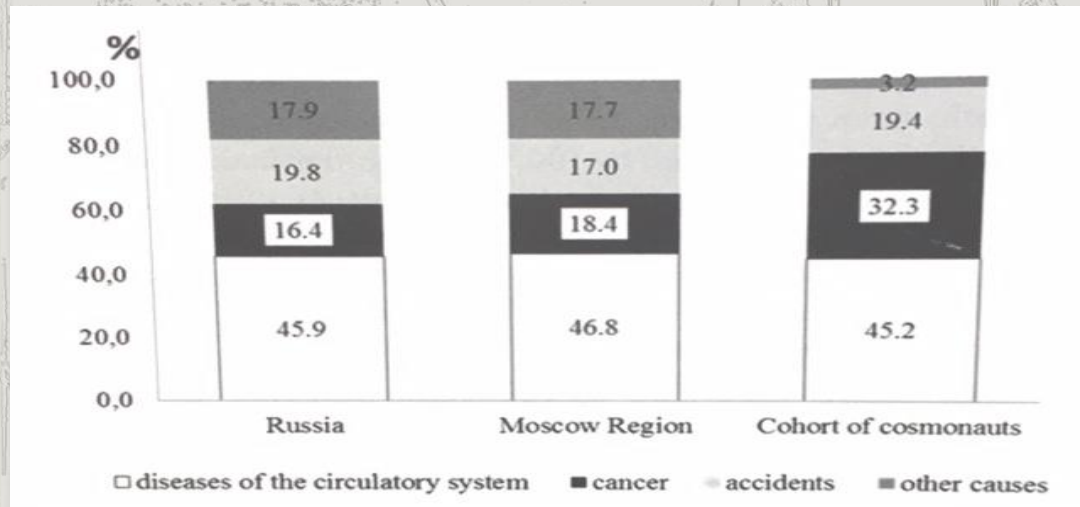
solar winds

GCR



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mortality among Russian/Soviet cosmonauts



from Ushakov et al 2017



The typical chest x-ray corresponds to more than 10 suborbital flights

x-ray exam

< 0.2 mSv

Outer space

~ 1.8 mSv/day

CT scan

2 ~ 15 mSv

Astronaut's life

< 1 Sv (+3% risk)

scintigraphy

2 ~ 10 mSv

ISS 6 mo. mission

80-160 mSv

risk area

> 100 mSv

Suborbital flight

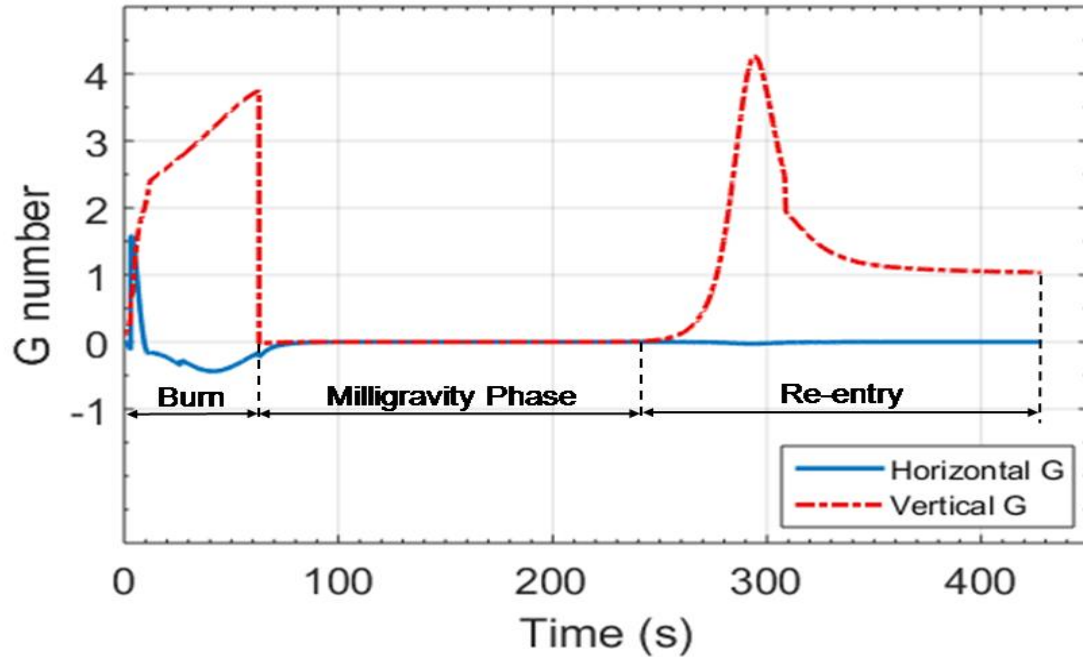
< 0.01 mSv

2019 OPERATIONAL CAPABILITY



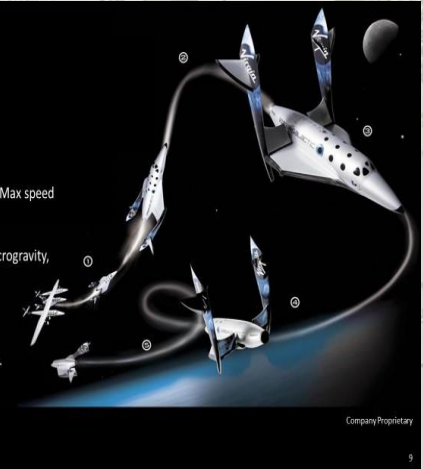
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SS2 mission profile model



Flight Profile

- 1) Air Launch at Approx. 50,000'
- 2) Rocket boost for ~60 seconds. Max speed ~Mach 3.5
- 3) 3-4 minutes of high quality microgravity, apogee > 50 miles
- 4) Feathered re-entry
- 5) Glide landing on home runway.



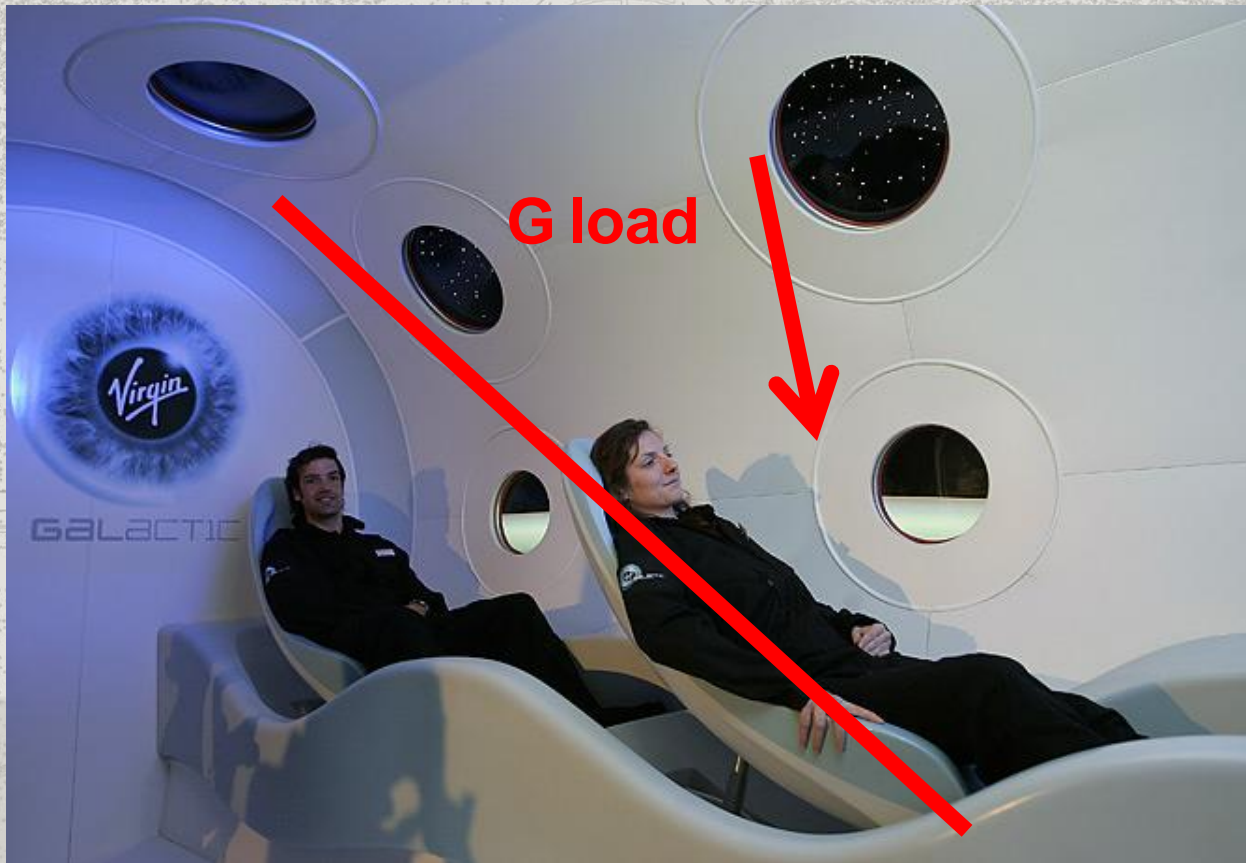


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QUALITY



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G load



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What can we do ?





open questions

international rules

current certifications

evidence based

approach

pilots
cabin crew
passengers



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Conclusions

Spaceflight exposes individuals to an environment that is far more hazardous than that which is experienced by personnel who fly on current airline transports.

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Pre-existing medical conditions can be aggravated or exacerbated by exposure to stressors such as acceleration and microgravity.

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Spaceflight exposes individuals to an environment that is far more hazardous than that which is experienced by personnel who fly on current airline transports.

Pre-existing medical conditions can be aggravated or exacerbated by exposure to stressors such as acceleration and microgravity.

The orbital spaceflight database is based upon medical standards for astronaut selection and certification that are very restrictive.

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The orbital spaceflight database is based upon medical standards for astronaut selection and certification that are very restrictive.

Most hazards can be prevented via aircrew/passenger dedicated physiological admission criteria, adequate training, and a scientific approach to medical data collection





questions ?



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