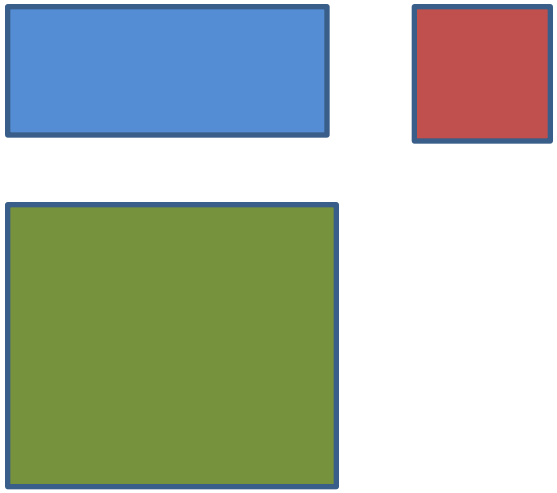
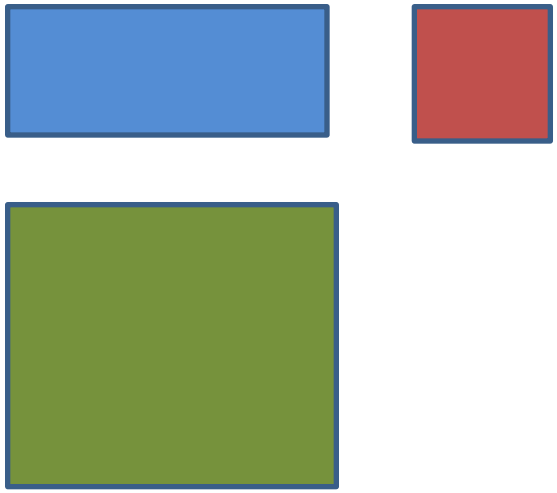


When physics goes wrong!

By
Leo Carlos-Sandberg
Paul Burgess
Josh Martin
Christopher Chung



Introduction

- Nuclear disasters (by Leo Carlos-Sandberg)
- Silly mistakes (by Paul Burgers)
- Natural disasters (by Josh Martin)
- Theoretical accidents (by Christopher Chung)

Nuclear Disasters

Windscale fire

10th of October 1957

Worst nuclear accident in Britain

Nuclear Disasters

Annealing process realises built up energy
Sensors were not in hottest parts, so thought it wasn't working
done again caused heating

Core caught fire (burned for 3 days)
Radioactive contamination was realised

Fall out
About 240 additional cancer cases (thyroid)
Milk contaminated and destroyed (1 month)
Clean up crew had no ill effects

Nuclear Disasters

Chernobyl disaster

26th April 1986

Worst nuclear accident in History

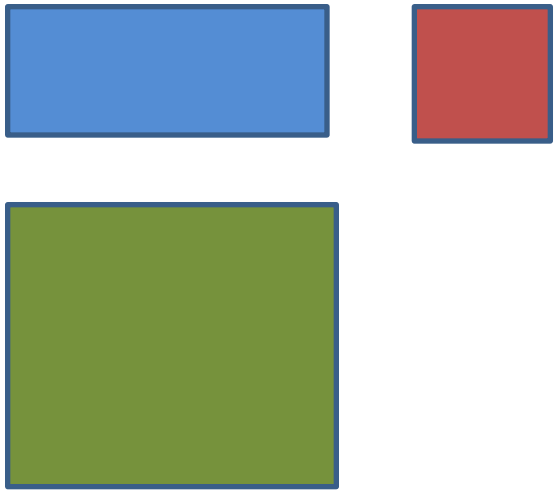
About 3000 times worse then Windscale

Nuclear Disasters

Accident was due in part to human error and design of reactor

Test energy supplied as turbines span down
Power surge (from inserting control rods)
Hot fuel and cooling water caused steam explosion
Leading to a fire (burned for 2 weeks)
Released at least 5% of core

Fall out
About 350,000 people resettled
31 directly related deaths
Death from side effects could be up to 4000



Physics Experiments Gone Wrong

Anatoli Bugorski

Most powerful proton accelerator at the time

Equipment was malfunctioning, Anatoli leaned in to see what was going wrong

Proton beam of around 200,000 rads shot through his skull

He saw a flash ‘brighter than a thousand suns’

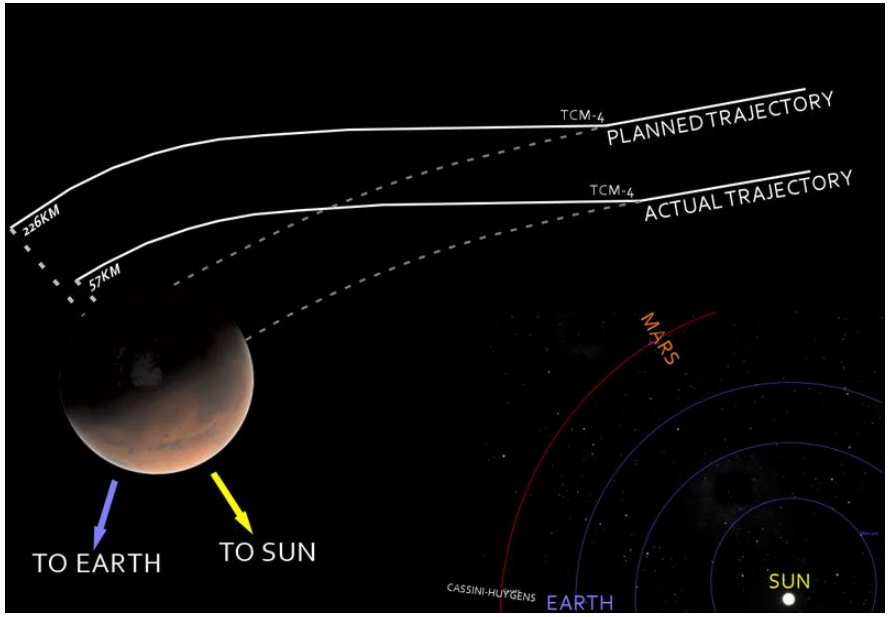
Exposure of 10,000 rads is considered fatal, yet Anatoli survived with paralysis

Mars Climate Orbiter

Launched by NASA in 1998 to observe Martian Climate

Lost contact during orbit stage

Computer programme had used flbs instead of Ns

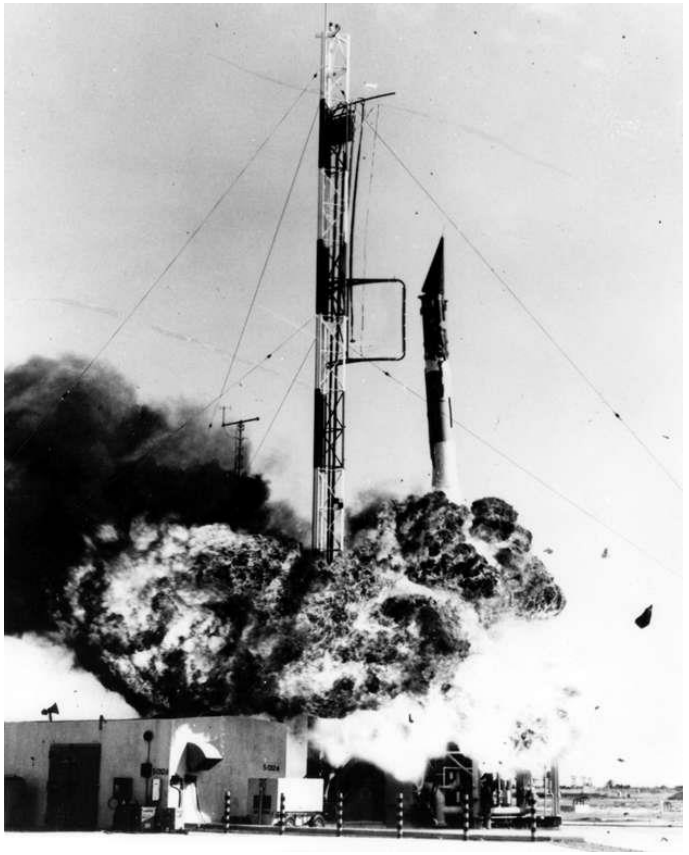


Vanguard Rocket Explosion

Intended to be the first rocket to deliver a satellite into space

First attempt blew up the second it was launched

Russians won the satellite race with Sputnik

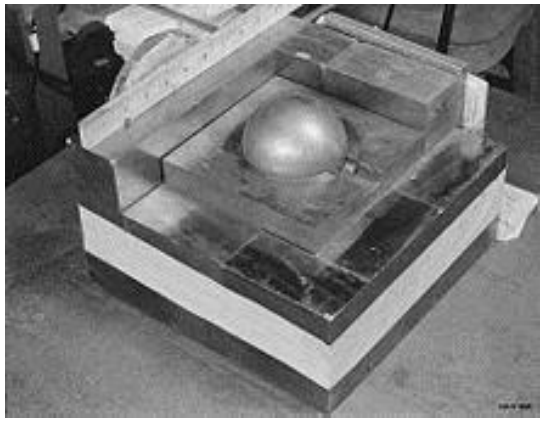


Demon Core

6200g core of plutonium, put in the 1st Atomic Bomb test since WWII

1st accident – Dropped a brick onto the core whilst undergoing experiments, Daghlian died 25 days later

2nd accident – Experiment to find when a core goes critical went wrong, Slotin's body shielded others, but he died 9 days later



Natural Disasters

- Hail Storms

Any thunderstorm which produces hail that reaches the ground is known as a hailstorm. Hail has a diameter of 5 millimetres or more.

Hail Records

Heaviest: 1.0 kg (Bangladesh, 14 April 1986)

Largest diameter: 0.2m, (Vivian, South Dakota, 23 July 2010)

Largest circumference: 0.48 m (Aurora, Nebraska, 22 June 2003)

More Hail Stuff

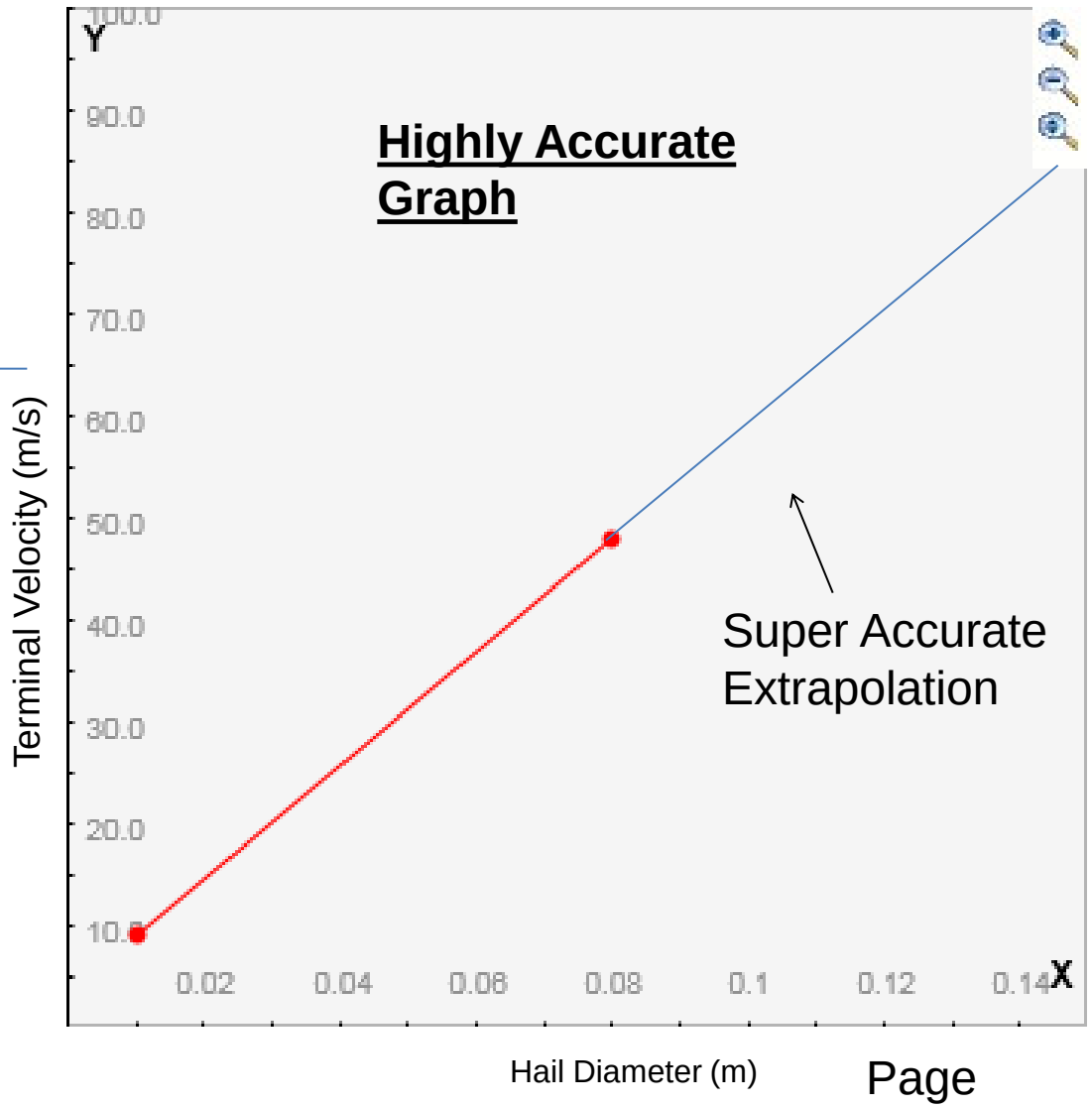
- Terminal velocity of hail varies. It is estimated that a hailstone of 1 centimetre in diameter falls at a rate of 9 metres per second, while stones the size of 8 centimetres in diameter fall at a rate of 48 metres per second.

Assuming Spherical Hail of Diameter 0.13m,
Terminal velocity would be 75m/s
Density Of ice 917 kg/m^3
Assume stopping distance of 2cm (which is generous!)

KE= 2967 J

Force of Impact 148 kN

Force Required to Cause skull fracture as little as 73N



Josh Martin

Natural Disasters

- Lightning Storm

Lightning is a massive electrostatic discharge between the electrically charged regions within clouds or between a cloud and the surface of a planet.
The charged regions within the atmosphere temporarily equalize themselves through a lightning flash, commonly referred to as a strike if it hits an object on the ground.
There are three primary types of lightning; from a cloud to itself from one cloud to another cloud and between a cloud and the ground.

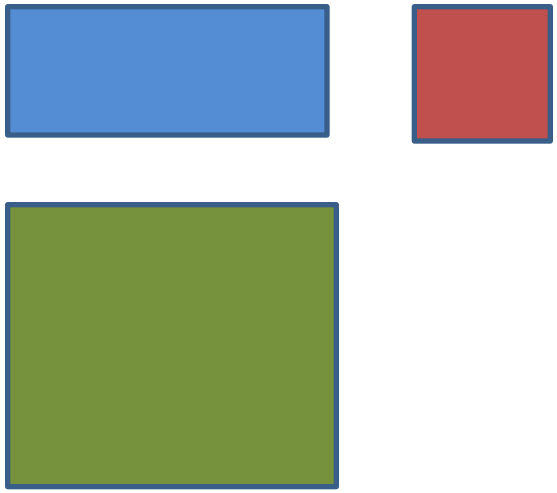
LIGHTNING

- In order for an electrostatic discharge to occur, two things are necessary:
- 1) a sufficiently high electric potential between two regions of space must exist; and
- 2) a high-resistance medium must obstruct the free, unimpeded equalization of the opposite charges.

- It is well understood that during a thunderstorm there is charge separation and aggregation in certain regions of the cloud; however the exact processes by which this occurs are not fully understood

More Lightningy Things

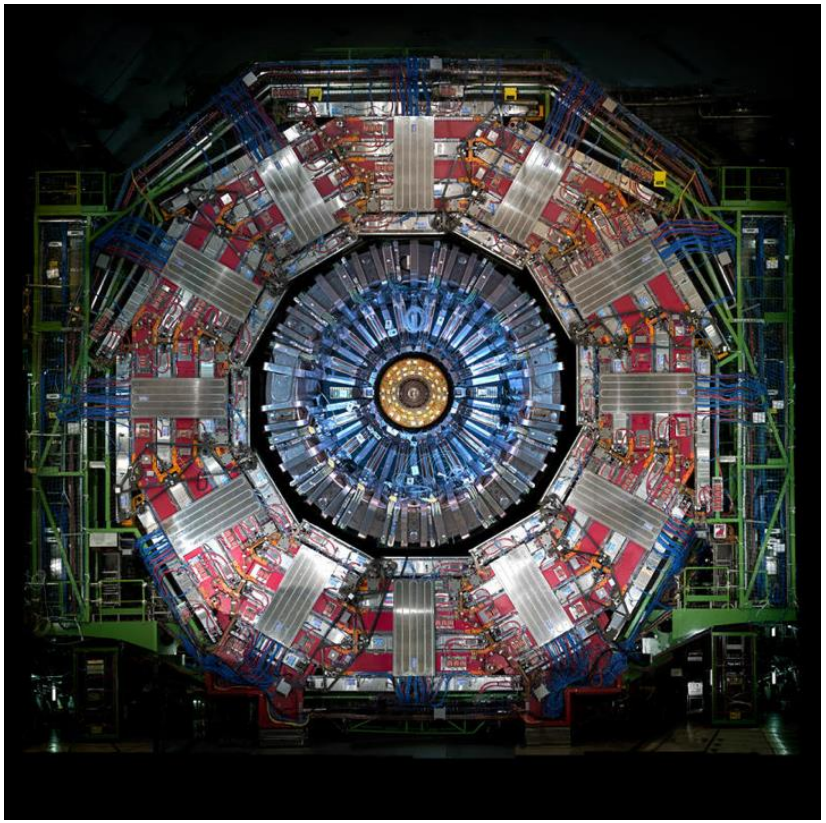
- On average three people die in the UK each year from lightning strikes, according to the Royal Society for the Prevention of Accidents. In the US, deaths have been in decline but are still in the region of 30 a year. More than 85% of those killed are male.
- In the UK, up to 60 people every year get struck and survive, but it's estimated that more than three-quarters of them suffer some form of permanent disability.
- Lichtenberg Figure Scars Caused by sudden high voltage discharge into insulating material such as your skin

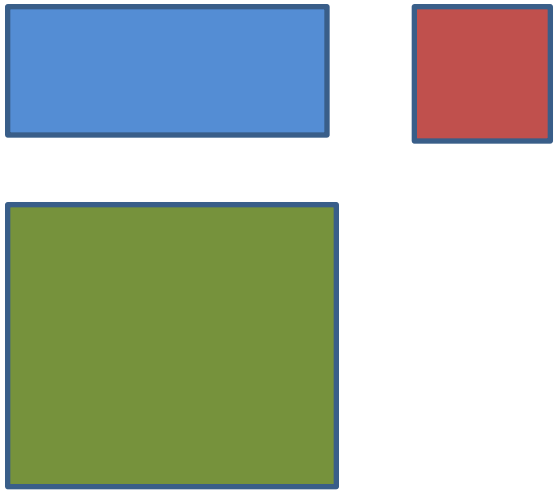


Theoretical Disasters

Falling into the LHC

- Each proton beam at full intensity will consist of 2808 bunches per beam.
- Each bunch will contain 1.15×10^{11} protons per bunch at the start of nominal fill.
- The particles in the LHC are ultra-relativistic and move at 0.999997828 times the speed of light at injection and 0.999999991 the speed of light at top energy.
- Each proton has an energy 7 TeV

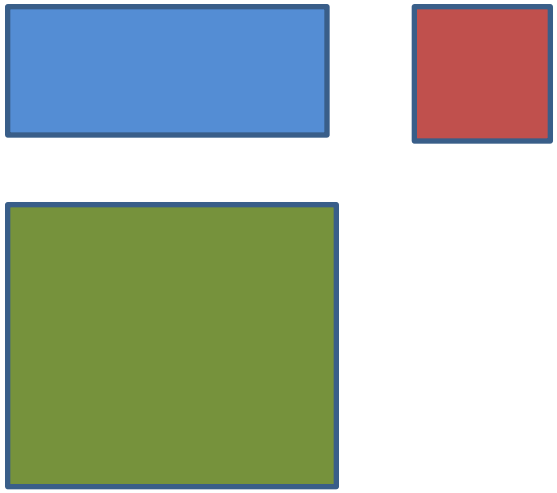




Boring scenario:

Protons shoot right through you as the particles that are your body do not have the energy nor reflective force to repel or obscure the proton's path. All you feel is a proton-sized needle penetrate through your body

Protons normally only collide interactively against other protons travelling at equally relativistic speeds and high energies that result in the interactions that are observed inside the LHC.



Interesting scenario:

The proton collides with the dense matter concentration known as you and imparts it’s energy into your body. At 7 TeV per proton this comes to a total proton beam power of around 380 MJ in kinetic energy colliding with your body at a very pinpointed area.

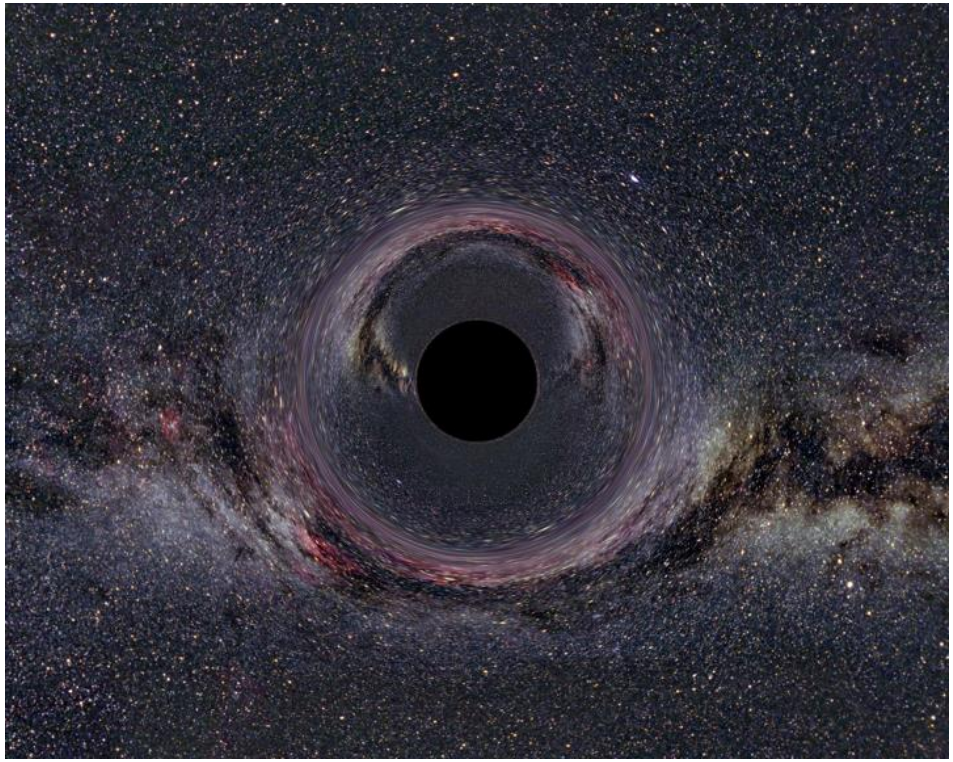
The collision occurs and your body spontaneously explodes or if you’re an interesting realist you’ll probably settle for just getting cancer or burning alive.

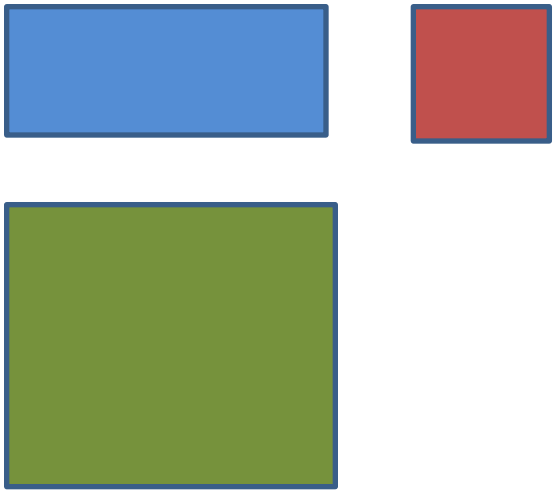
Falling into a black hole

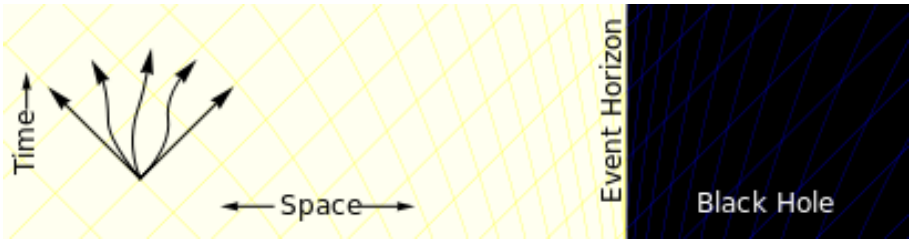
As we all know, black holes are sufficiently dense masses that cause a gravitational field so large that nothing can escape it's pull.

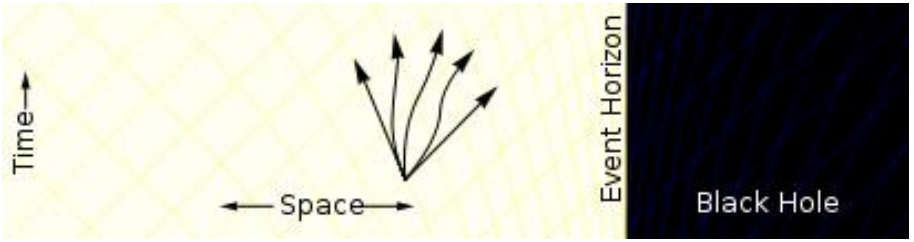
The event horizon is a boundary in space time beyond which escape from the respective gravitational pull becomes impossible.

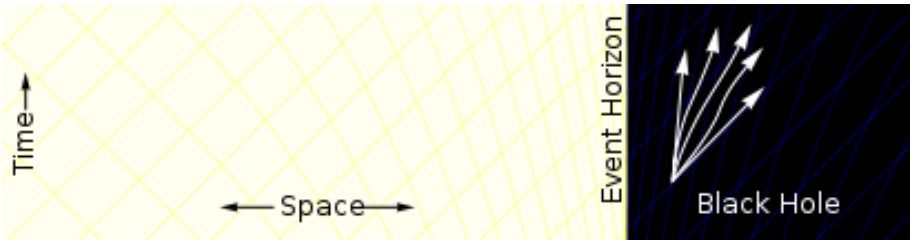
Obviously outside the event horizon you will still experience the gravitational pull from the black hole but there will be a finite escape velocity in order to escape the (significant) gravitational field.





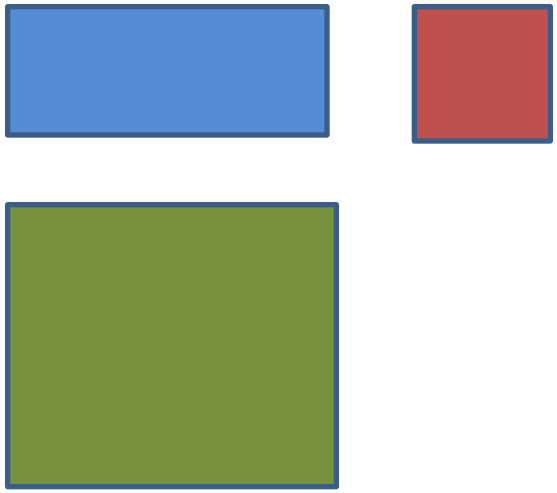




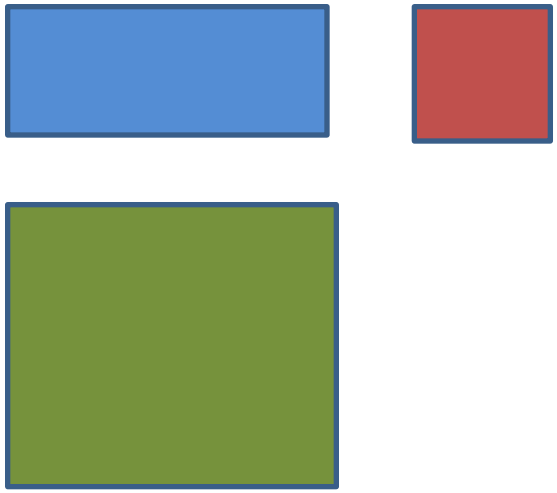


Since even light cannot escape a black hole once within the event horizon this suggests that the escape velocity is at a speed greater than the speed of light which requires that a force equal to that needed to accelerate to greater than the speed of light is required to reach escape velocity and due to (my probably skewed understanding of) the conservation of energy this implies that the black hole exerts a force equal to in magnitude but opposite in direction to normal space on anything within the hole.

This means that if you were inside a black hole and enough time is allowed for acceleration before you hit the unknown core of the black hole and die, you will be travelling faster than light, which in theory is impossible but who knows what happens inside a singularity?



The Real Question



Conclusion