

# Big data in basic science - creating opportunities or triggering crisis?

Gry M. Tveten

University of Oslo, Department of Physics



# Physics – the most successful branch of science?



Image credit: NASA/ESA



# Physics – the most successful branch of science?

**Explanatory power** ✓



# Physics – the most successful branch of science?

**Explanatory power** ✓

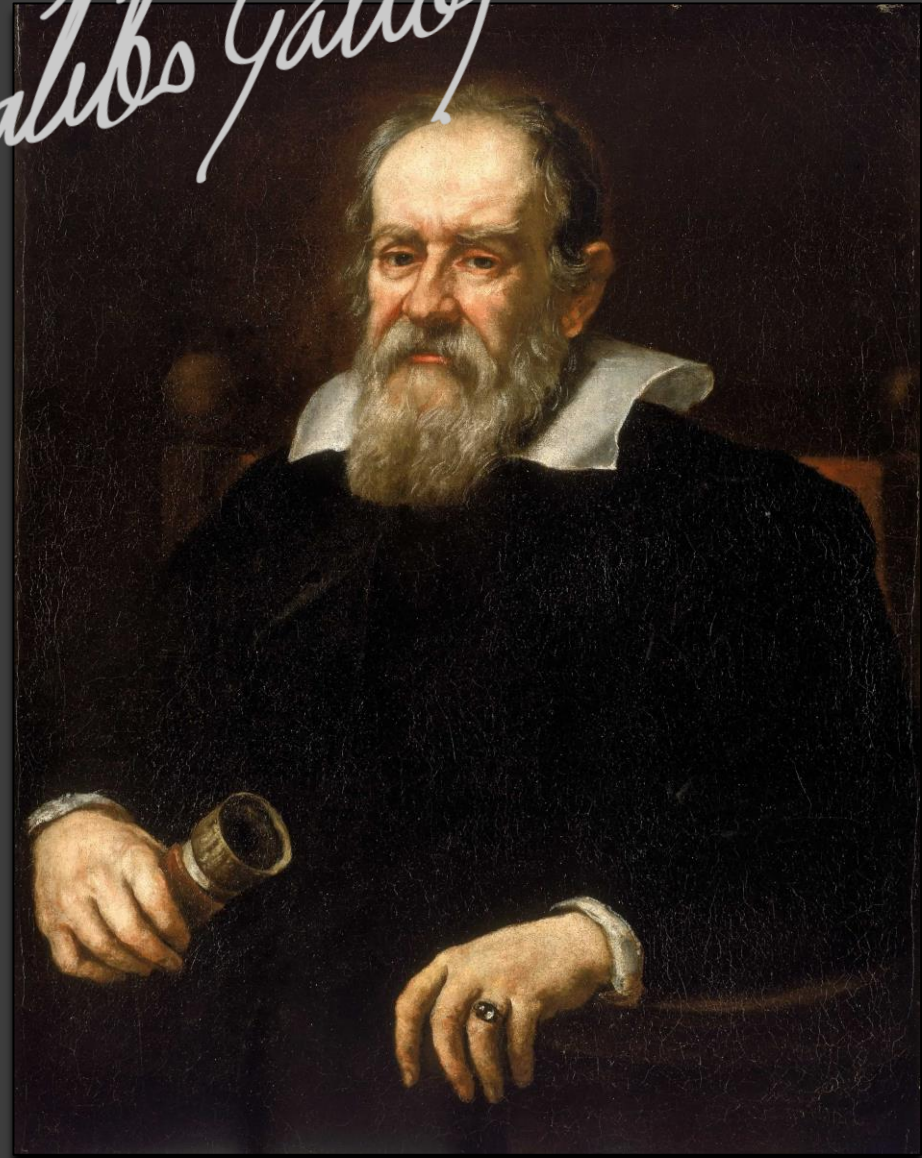
**Predictive power** ✓



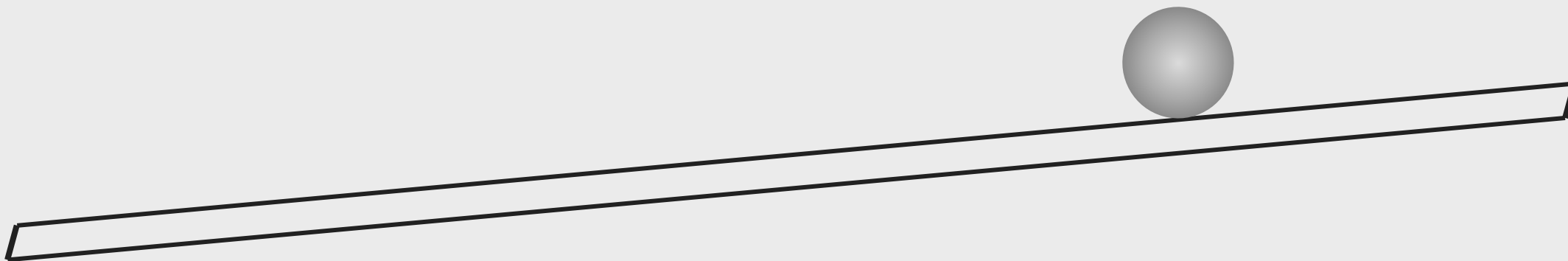


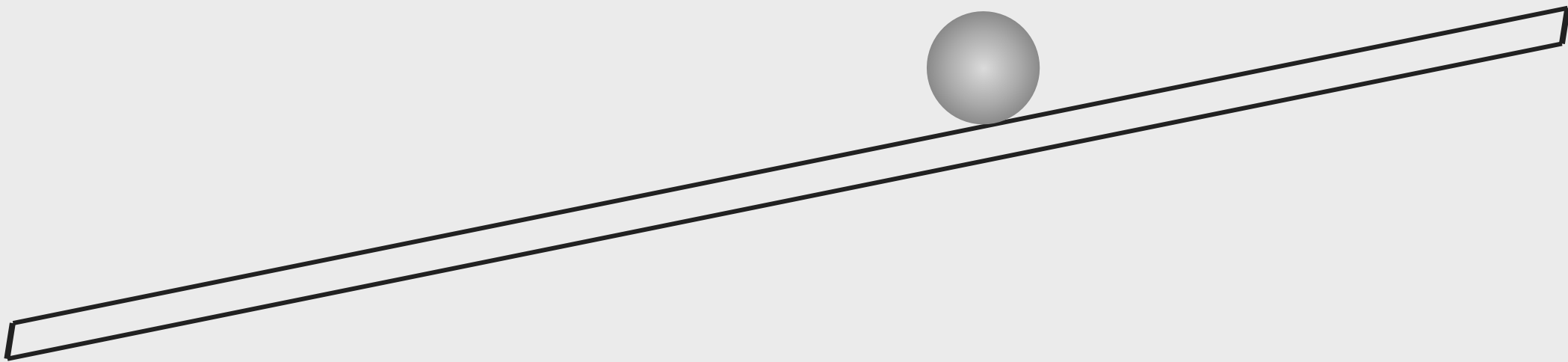
PINK de Thierry [[CC BY-SA 3.0](#)]

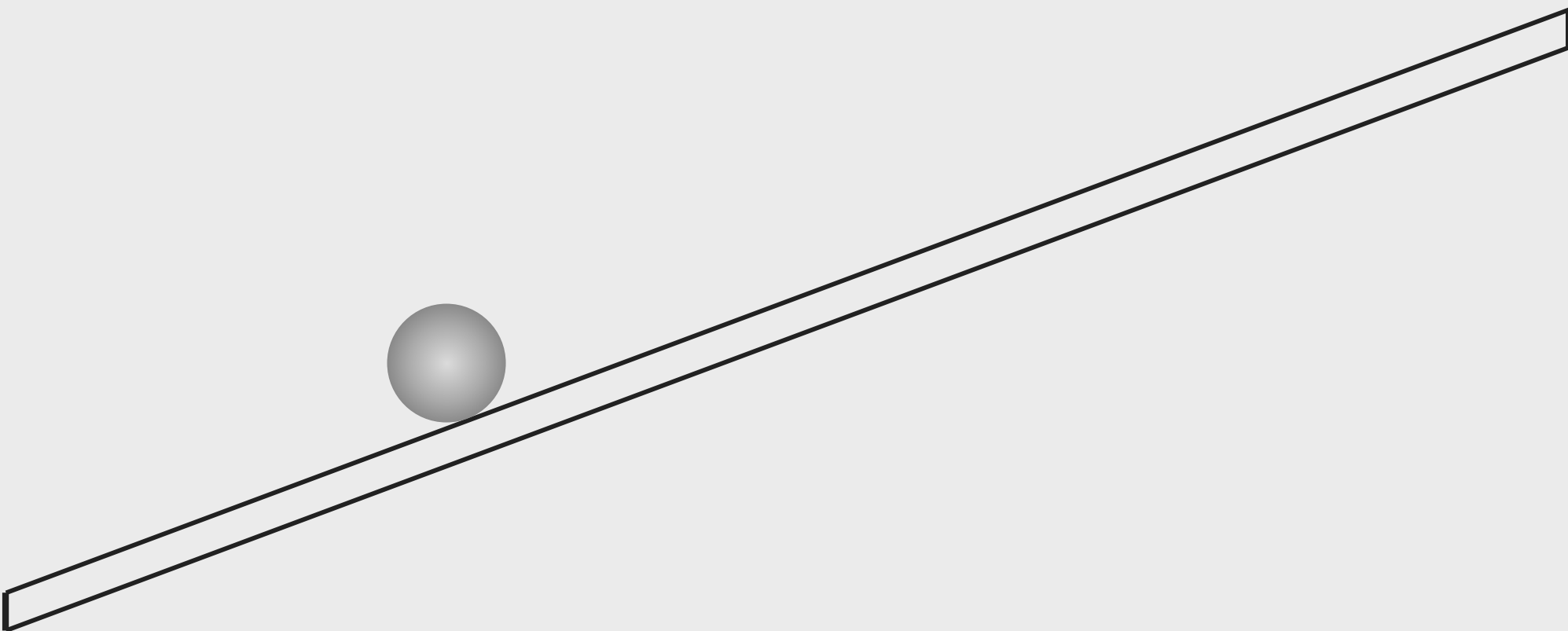
*Galileo Galilei*



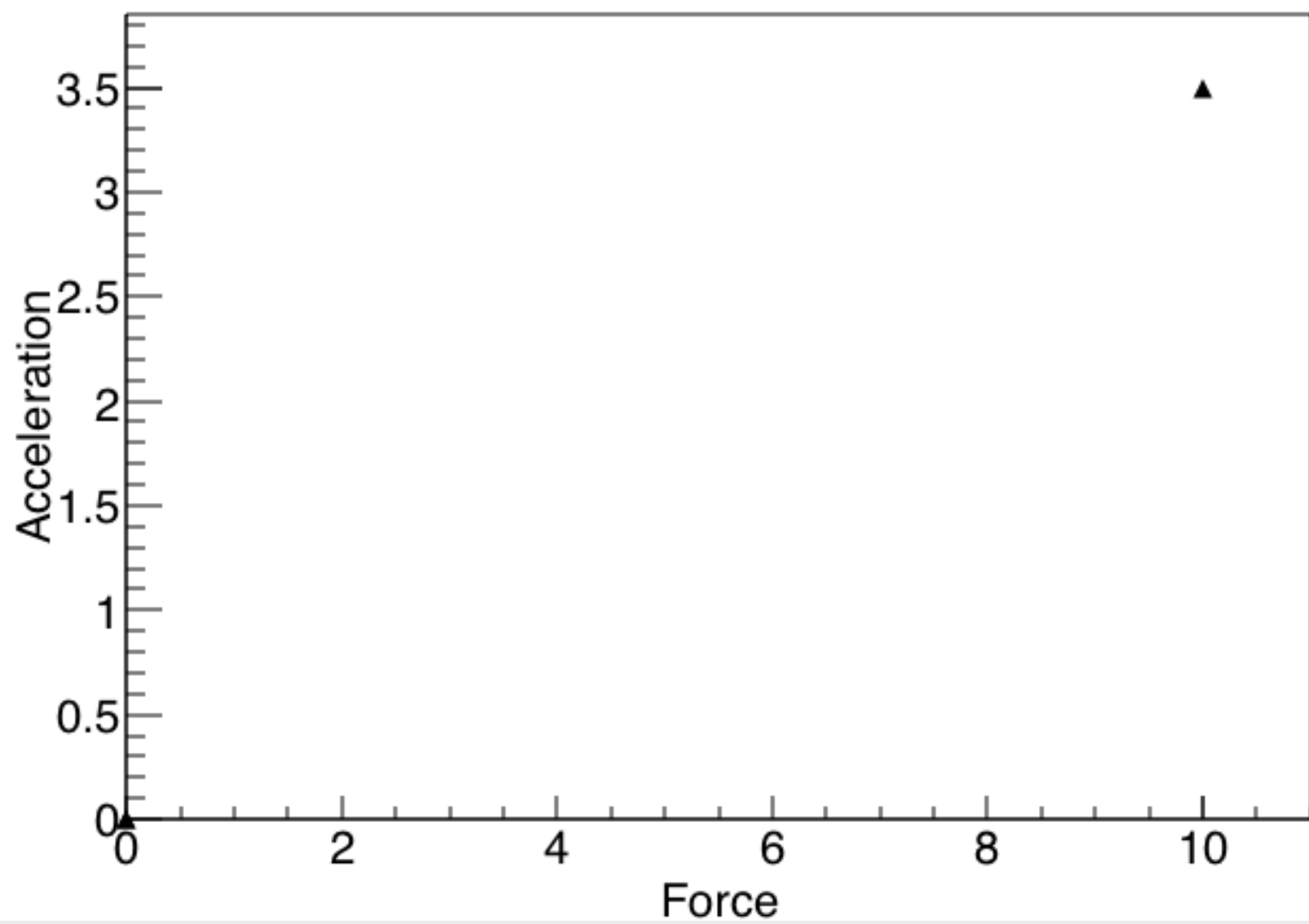
Justus Sustermans [Public domain]



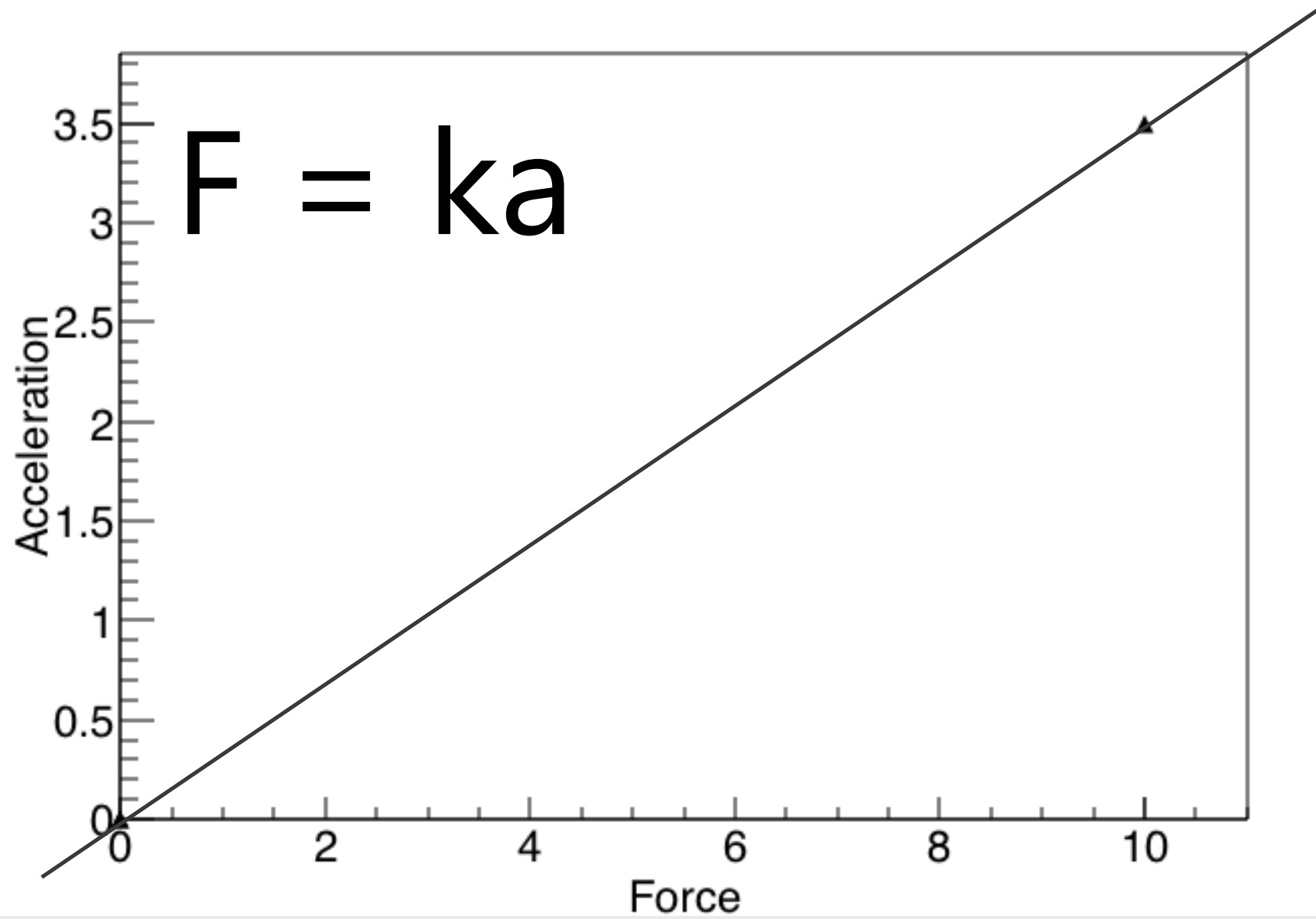








$$F = ka$$

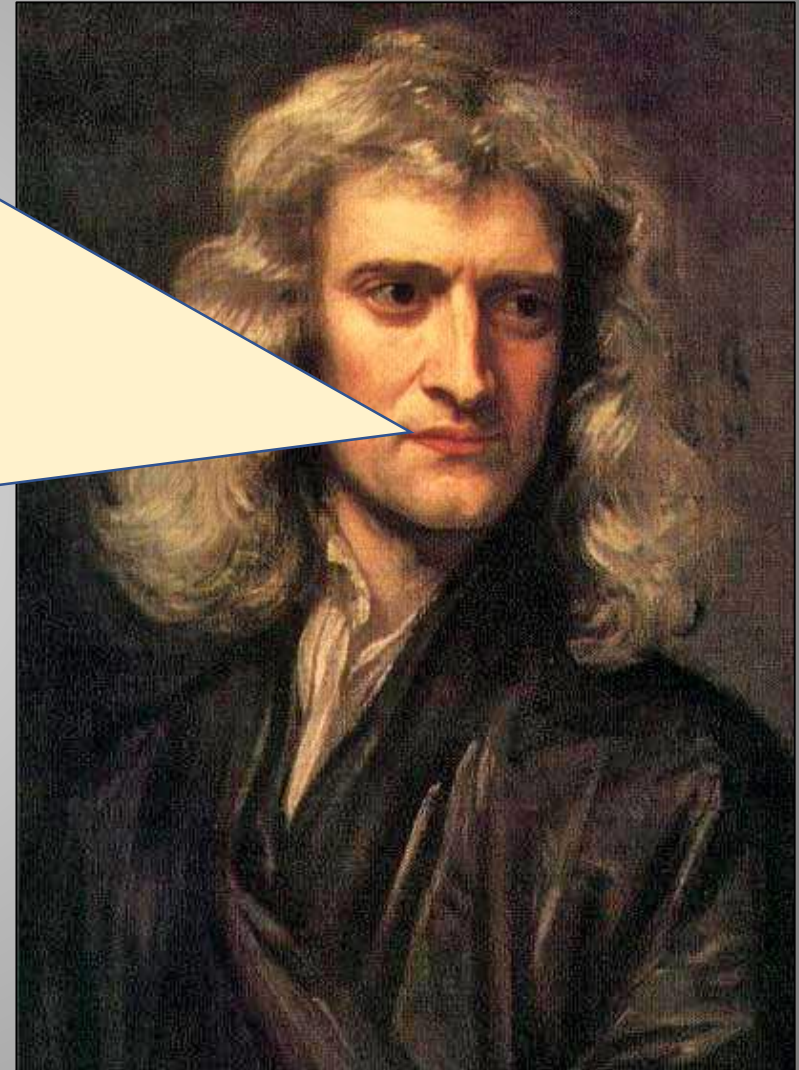




*J. Newton*

**LAW II:** The alteration of motion is ever proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed. — If a force generates a motion, a double force will generate double the motion, a triple force triple the motion, whether that force be impressed altogether and at once, or gradually and successively. And this motion (being always directed the same way with the generating force), if the body moved before, is added to or subtracted from the former motion, according as they directly conspire with or are directly contrary to each other; or obliquely joined, when they are oblique, so as to produce a new motion compounded from the determination of both.

[1792 translation \(from Latin\)](#)

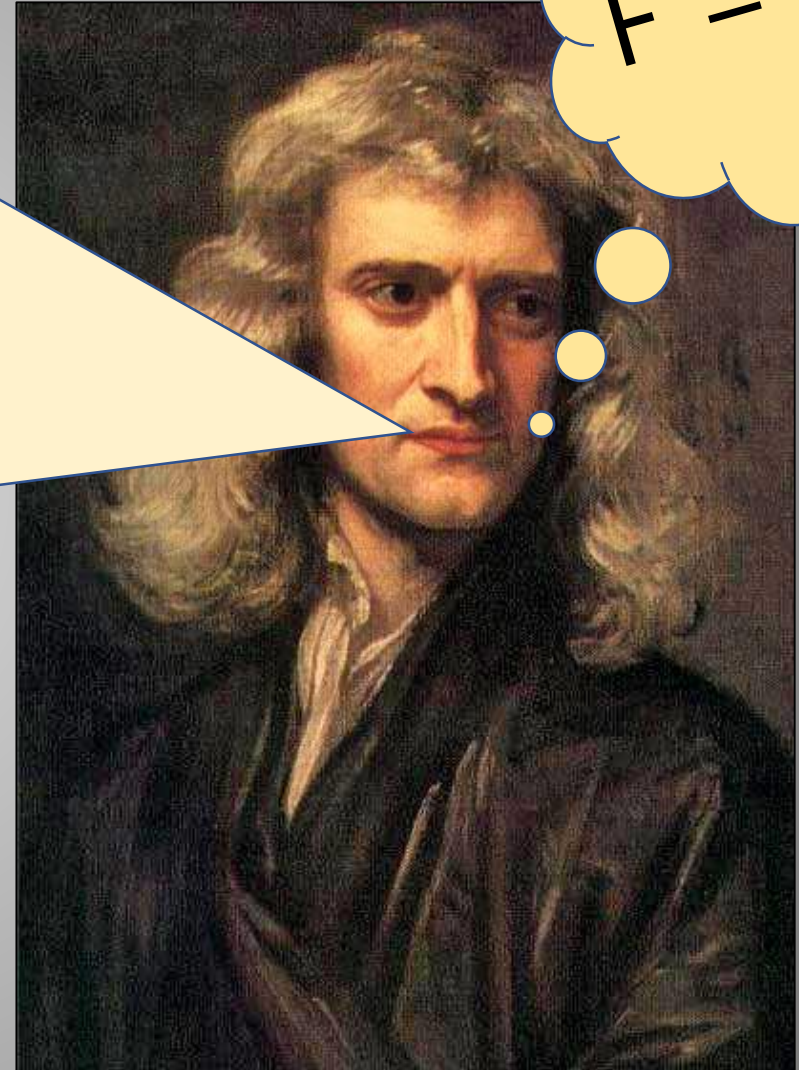


After Godfrey Kneller,  
[Offentlig eiendom](#)

*J. Newton*

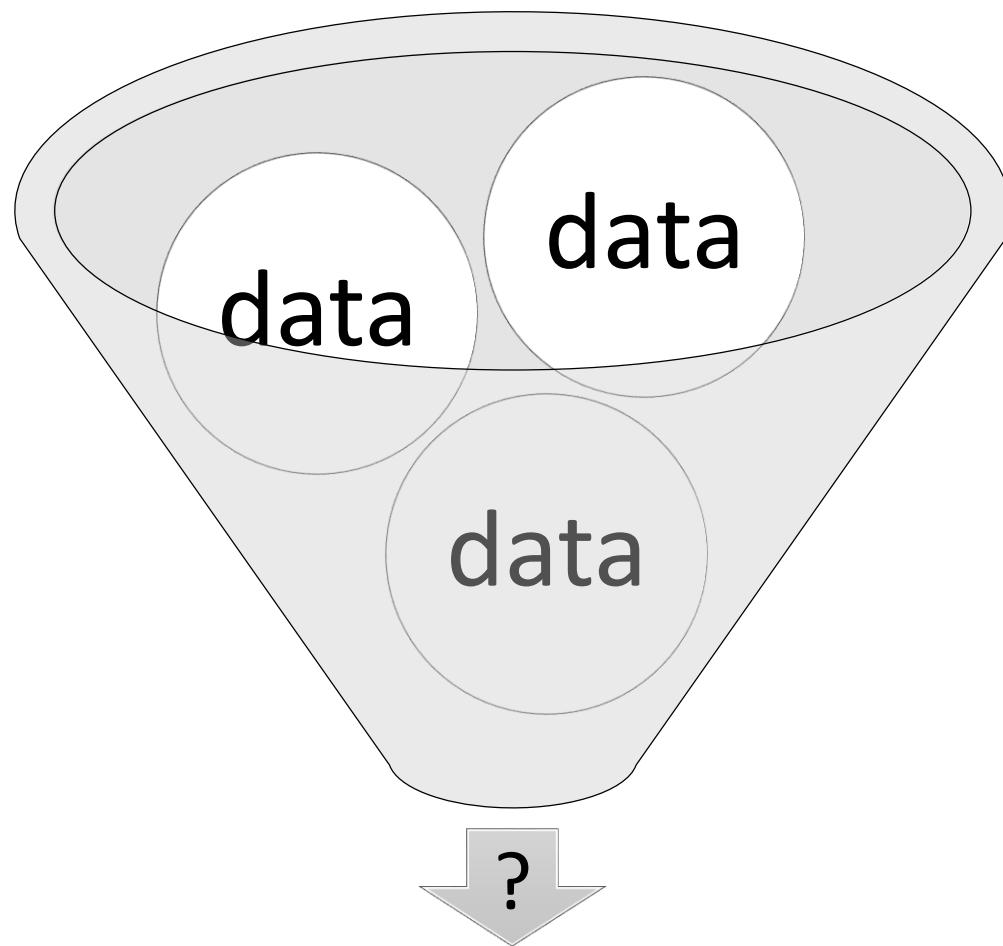
**LAW II:** The alteration of motion is ever proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed. — If a force generates a motion, a double force will generate double the motion, a triple force triple the motion, whether that force be impressed altogether and at once, or gradually and successively. And this motion (being always directed the same way with the generating force), if the body moved before, is added to or subtracted from the former motion, according as they directly conspire with or are directly contrary to each other; or obliquely joined, when they are oblique, so as to produce a new motion compounded from the determination of both.

[1792 translation \(from Latin\)](#)

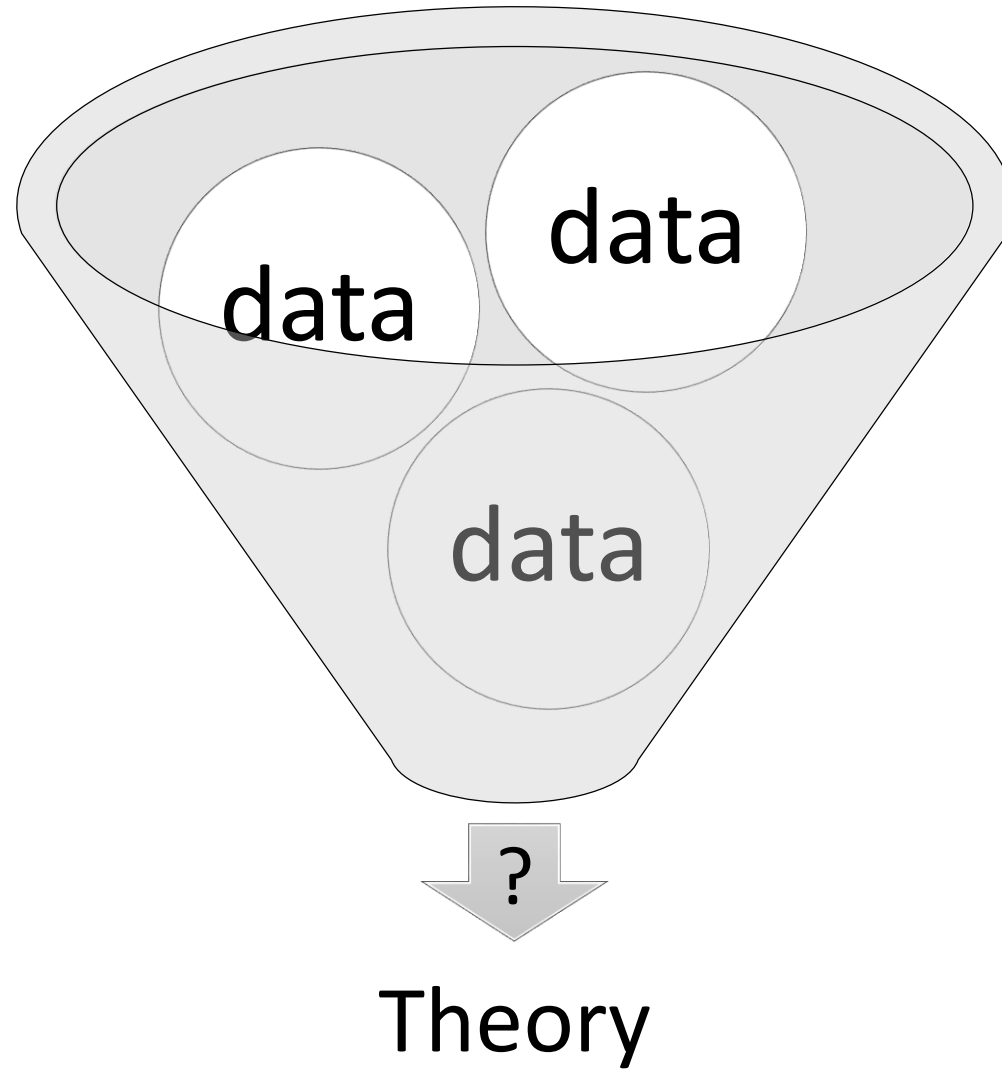


After Godfrey Kneller,  
[Offentlig eiendom](#)





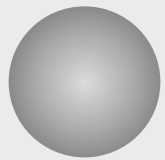
Theory

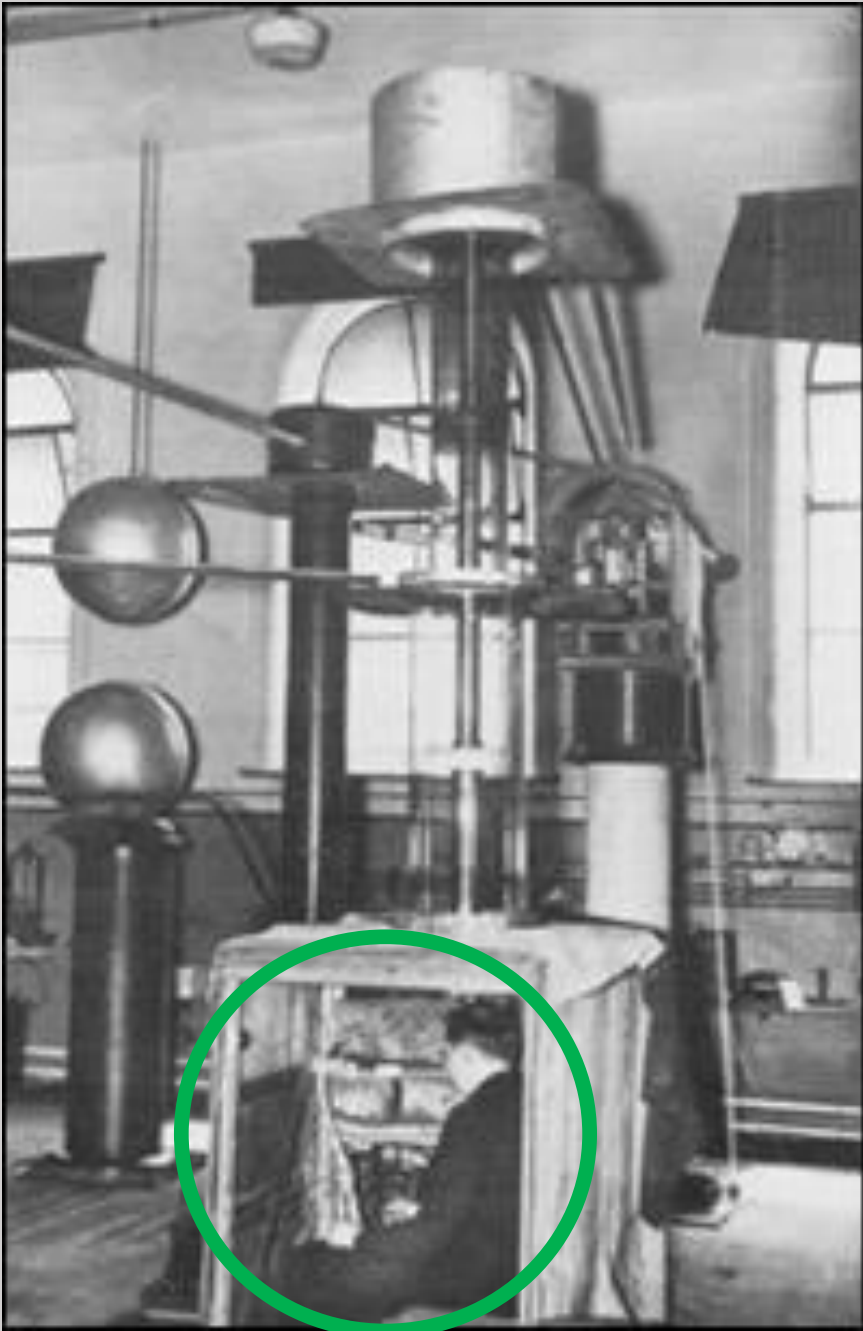


**“Your model must be based upon physics!”**

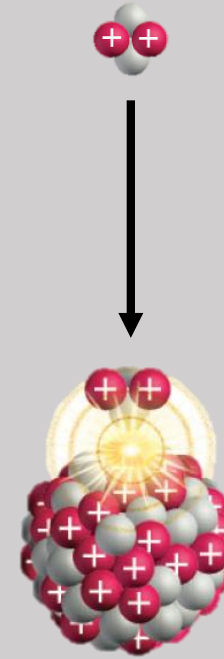


**Newton measured here on earth,  
drew conclusions on the movement  
of celestial bodies**



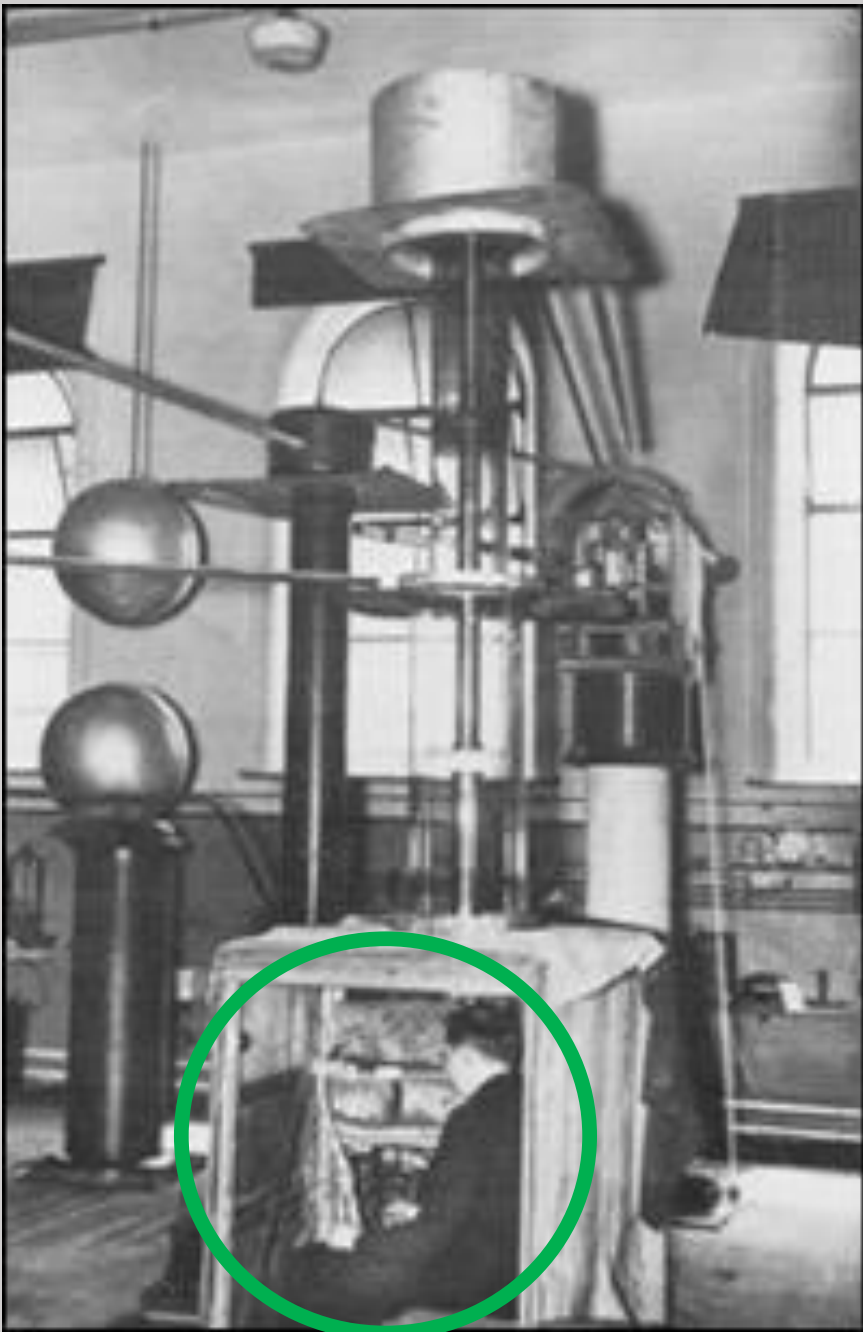


Cockcroft and Walton, 1932



Cockcroft and Walton, Proc. Roy. Soc., A, wZ. 137, PL 12.

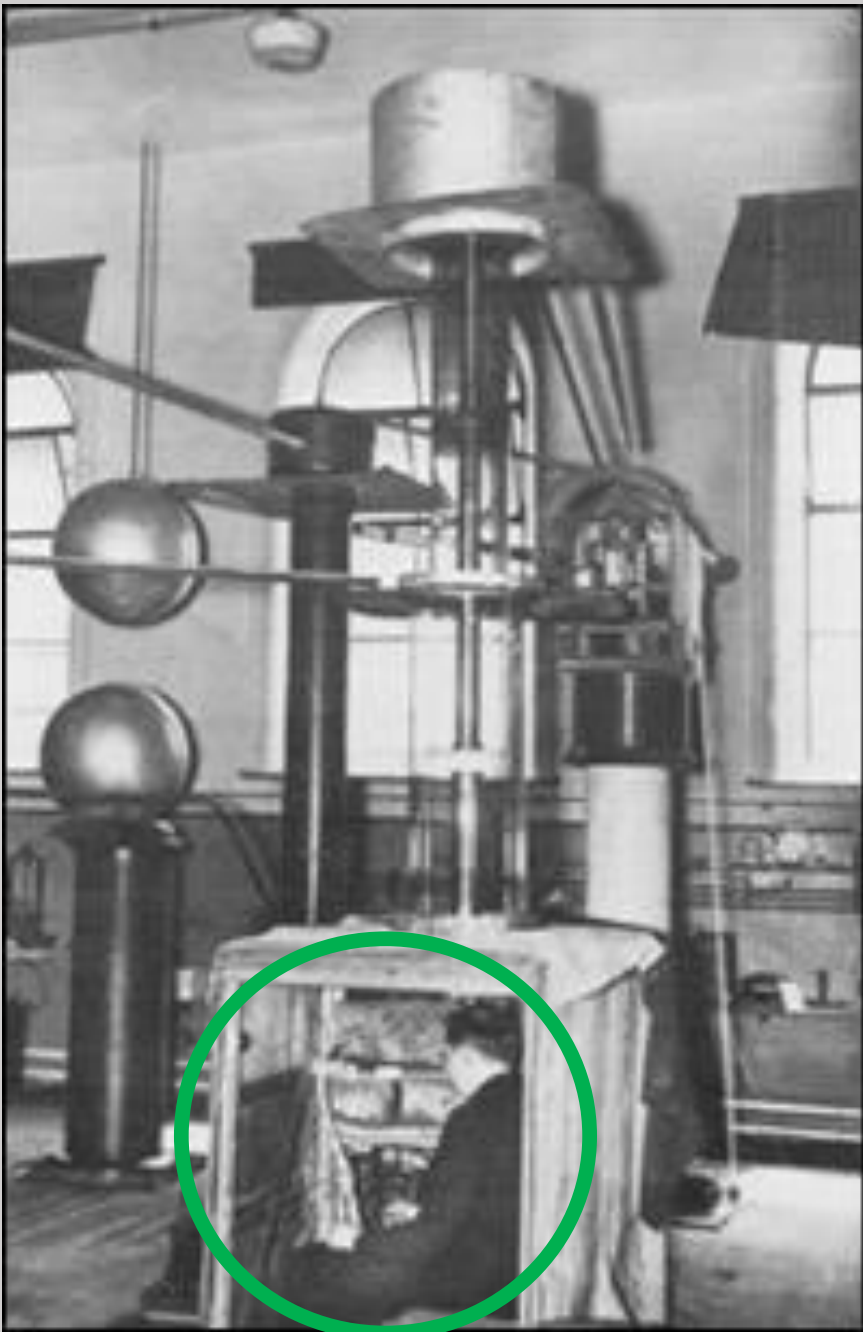




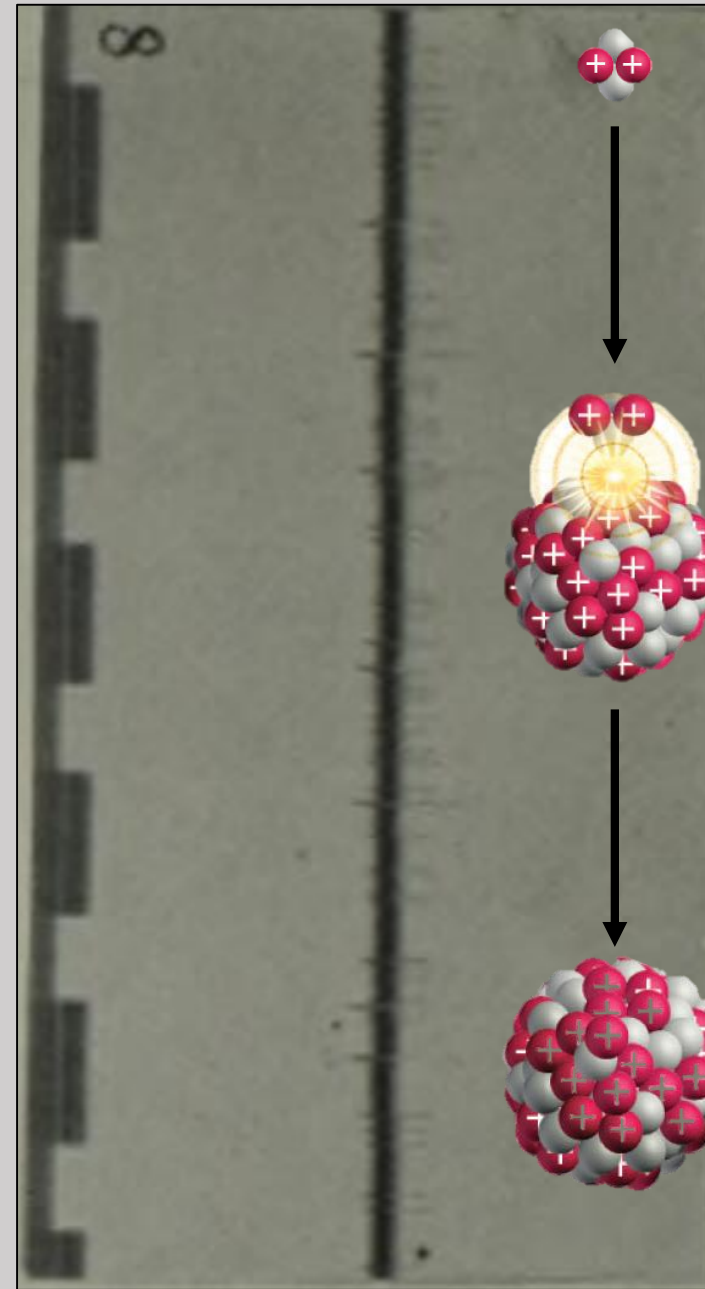
Cockcroft and Walton, 1932



Cockcroft and Walton, Proc. Poy. Soc., A,wZ. 137, PL 12.



Cockcroft and Walton, 1932



Cockcroft and Walton, Proc. Roy. Soc., A, wZ. 137, PL 12.



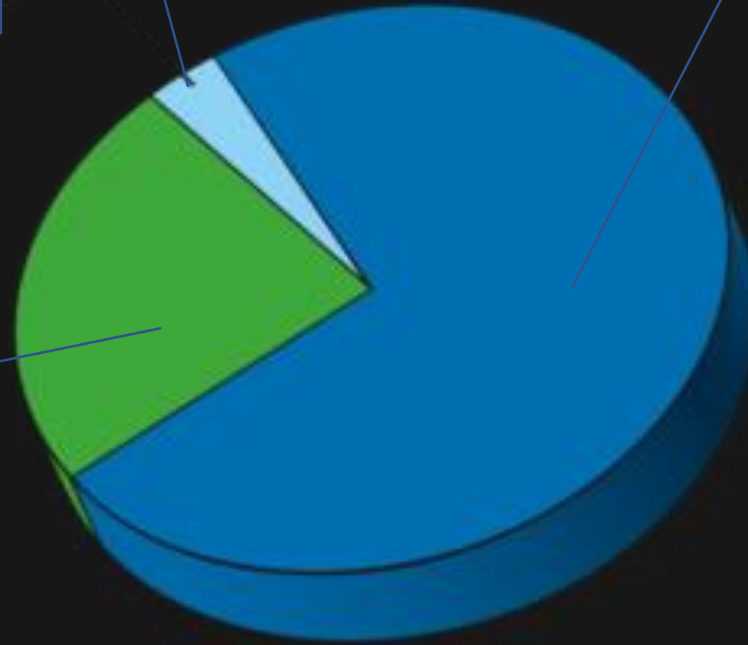
**Collecting data points has become “cheap”**

## Ordinary matter

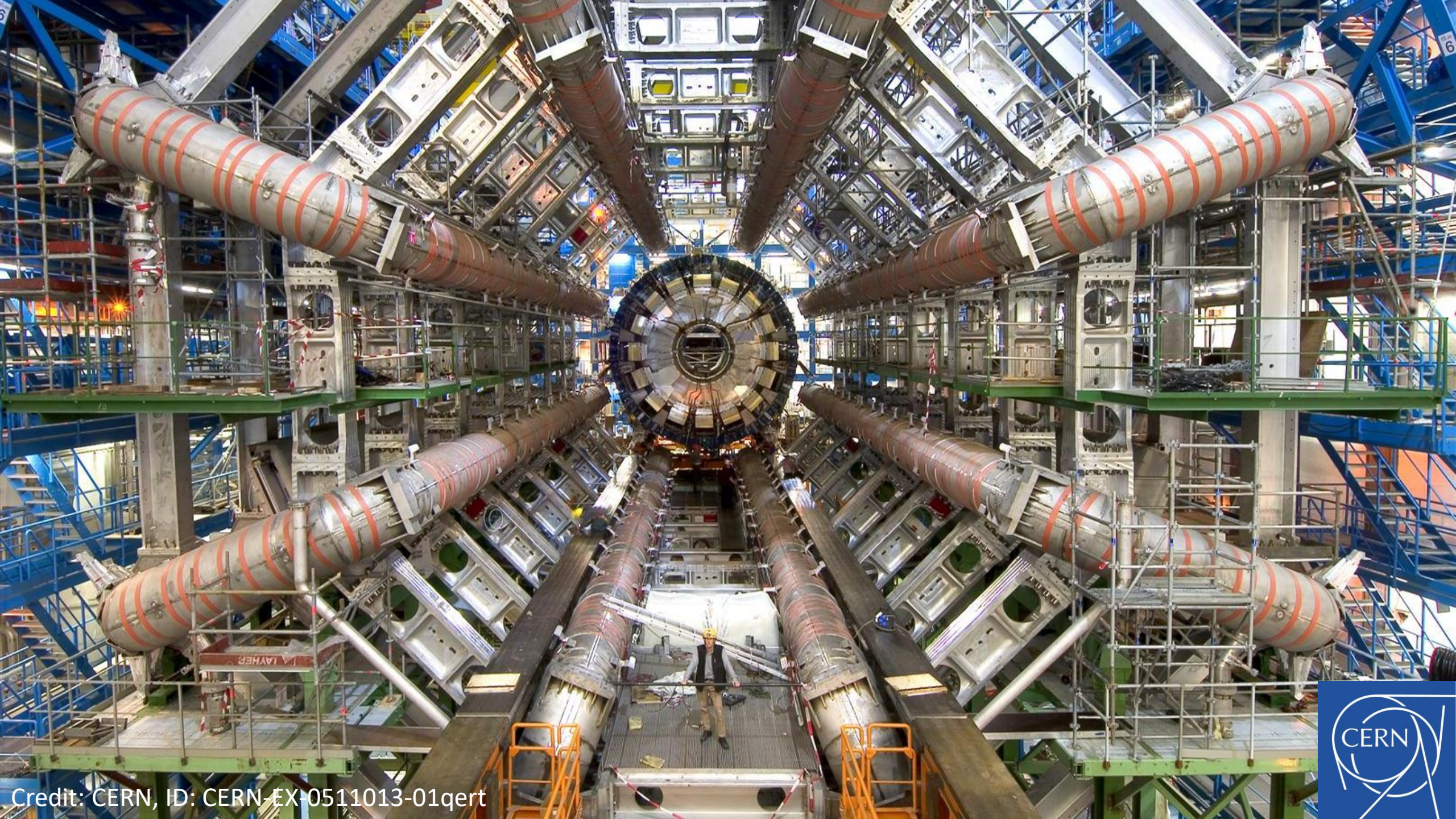


Dark matter  
?

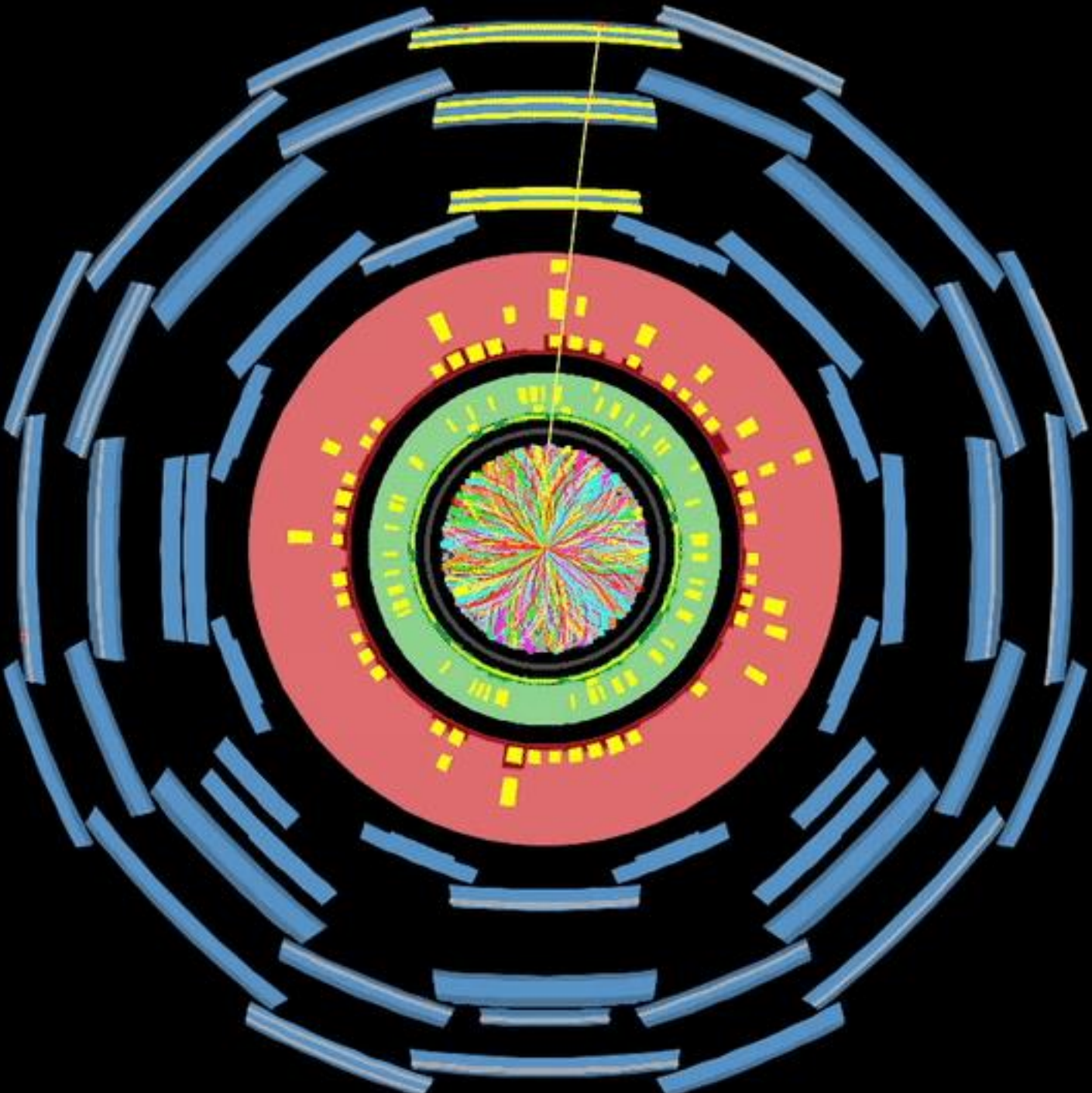
Dark energy  
?











# CERN Data Centre passes the 200-petabyte milestone

The CERN Data Centre passed a major milestone on 29 June 2017 with more than 200 petabytes of data now archived on tape

6 JULY, 2017 | By [Mélissa Gaillard](#)



CERN's Data Centre (Image: Robert Hradil, Monika Majer/ProStudio22.ch)





**The digitisation of science creates opportunities:**

**One woman's background  
is another's foreground!**

# **Example: Multi-messenger Astronomy**



**Artist's impresion of neutron star merger**

**Credit:**ESO/L. Calçada/M. Kornmesser

# **The open science movement**

**Sharing data** ✓

**Sharing software for data analysis etc.** ✓

**Sharing results** ✓

**Open access publishing** ✓



**Is it safe to share?**

# My experience is positive!



Oslo Cyclotron Laboratory, University of Oslo

Oslo, Norway



Repositories 11



People 1



Projects 0

# Neutrino 'faster than light' scientist resigns

🕒 30 March 2012



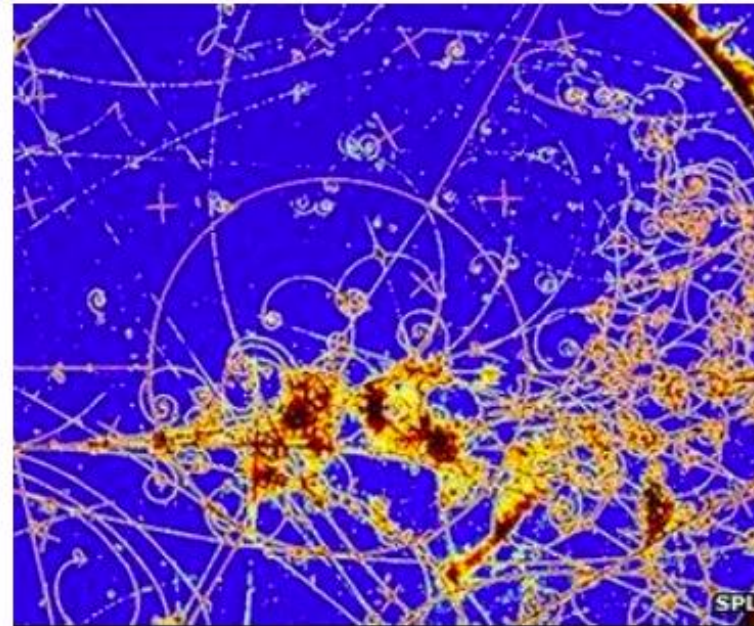
🔗 Share

**The head of an experiment that appeared to show subatomic particles travelling faster than the speed of light has resigned from his post.**

Prof Antonio Ereditato oversaw results that appeared to challenge Einstein's theory that nothing could travel faster than the speed of light.

Reports said some members of his group, called Opera, had wanted him to resign.

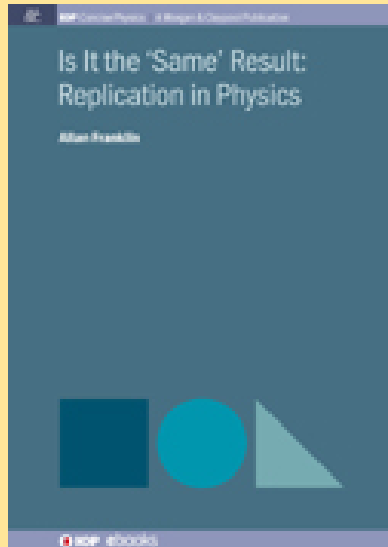
Earlier in March, a repeat experiment found that the particles, known as neutrinos, did not exceed light speed.



The results of the neutrino experiment shook the world of physics



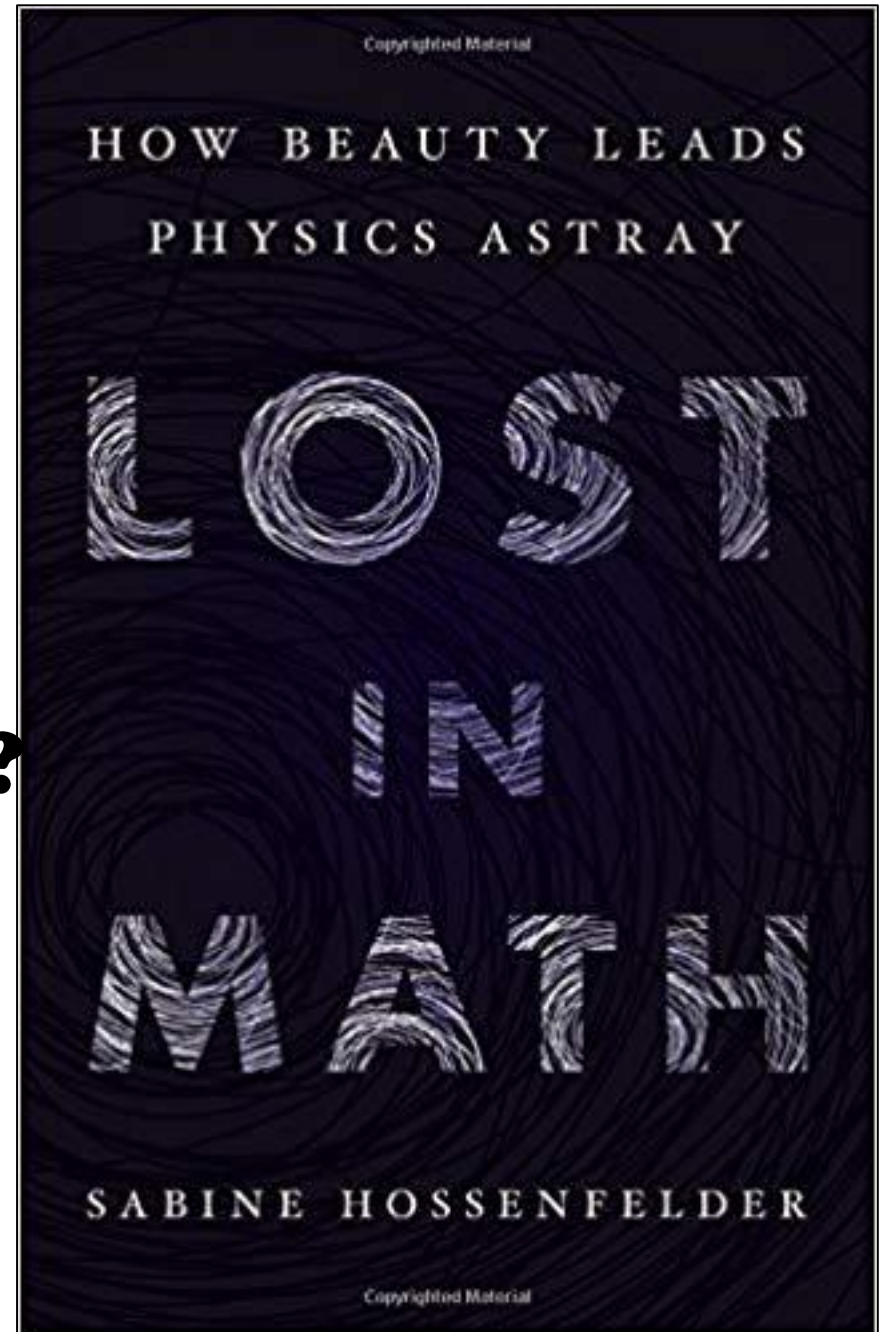
# REPLICATION CRISIS



Physics version: Is it the same?

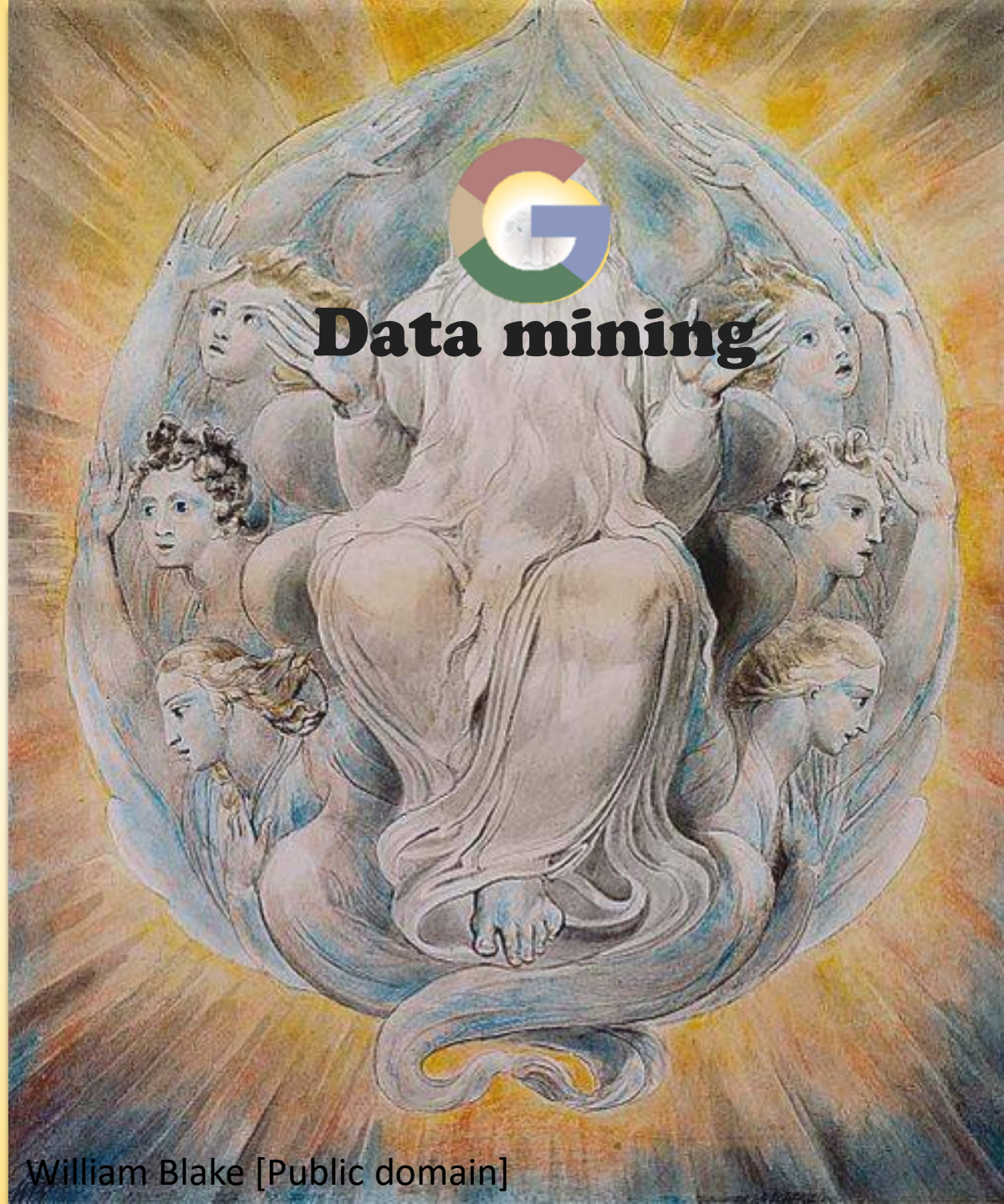
**Lost in math?**

**Or lost in the quest for more data?**



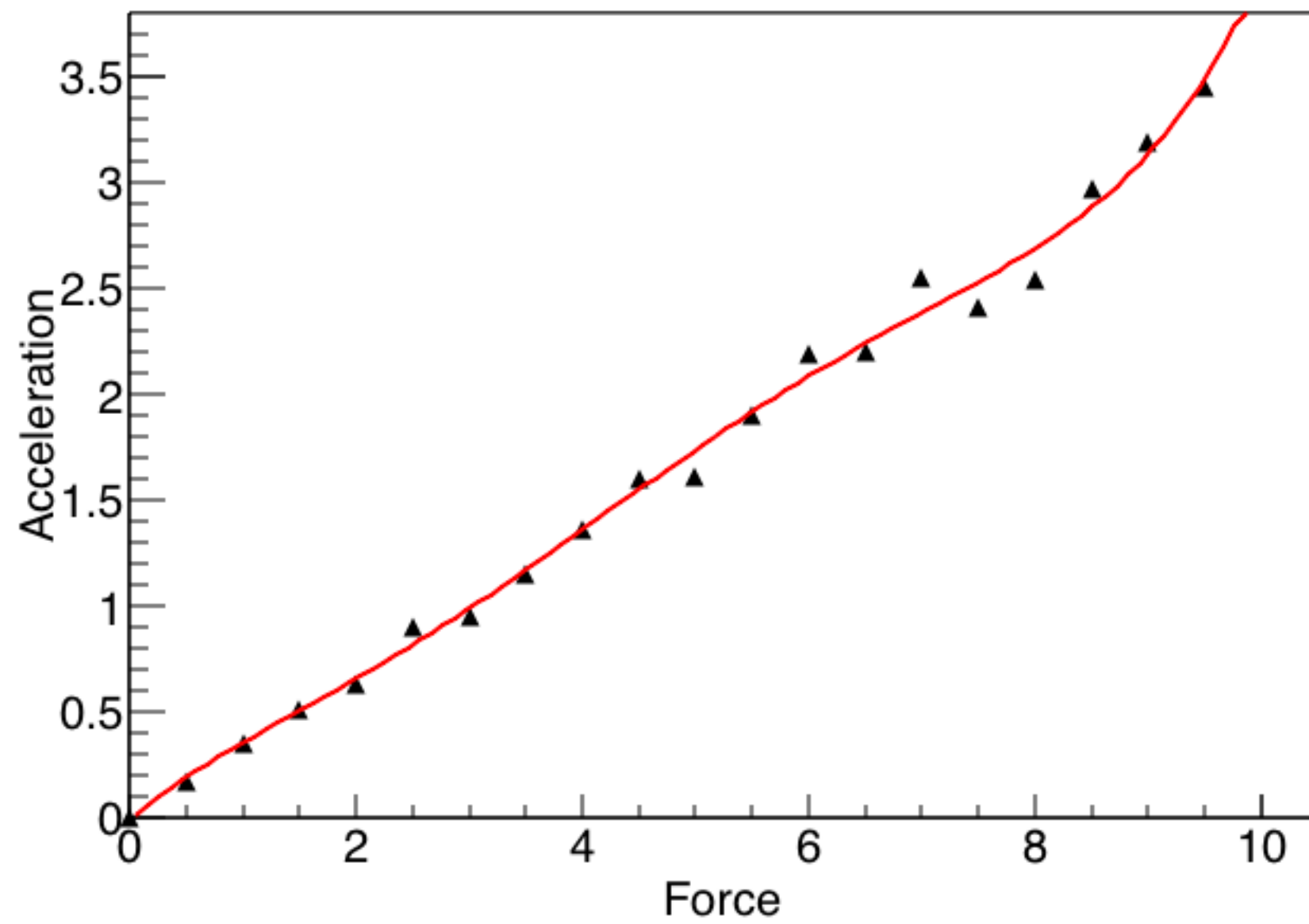


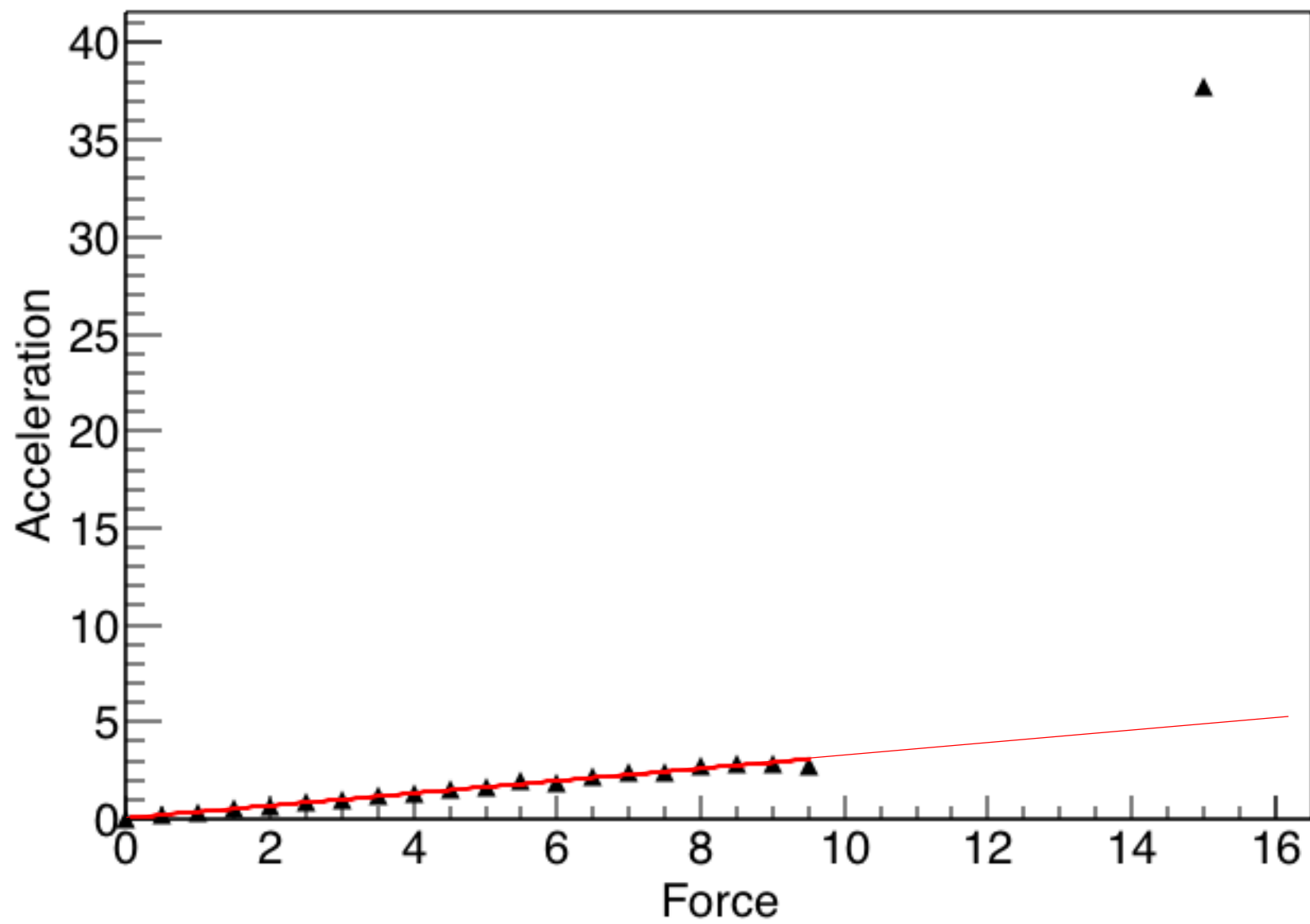
# Data mining

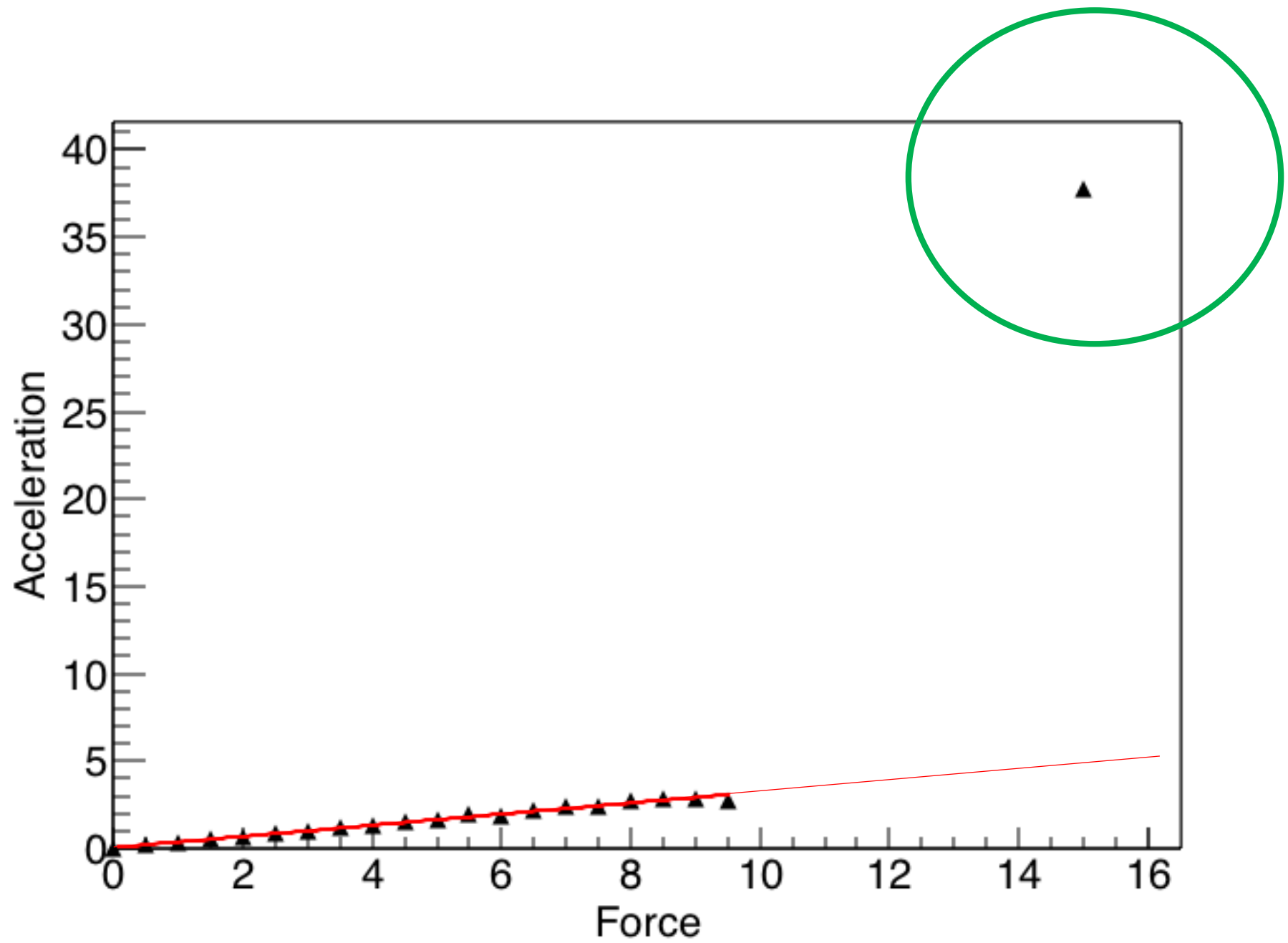


William Blake [Public domain]











JUDEA PEARL  
*WINNER OF THE TURING AWARD*  
AND DANA MACKENZIE

# THE BOOK OF WHY



THE NEW SCIENCE  
OF CAUSE AND EFFECT

**Don't give up understanding.**