

# Hunting for ghost particles at the South Pole

Anna Franckowiak

**HELMHOLTZ**  
Young Investigators

Columbia Summer Lecture 24.6.2021

RUHR  
UNIVERSITÄT  
BOCHUM

**RUB**

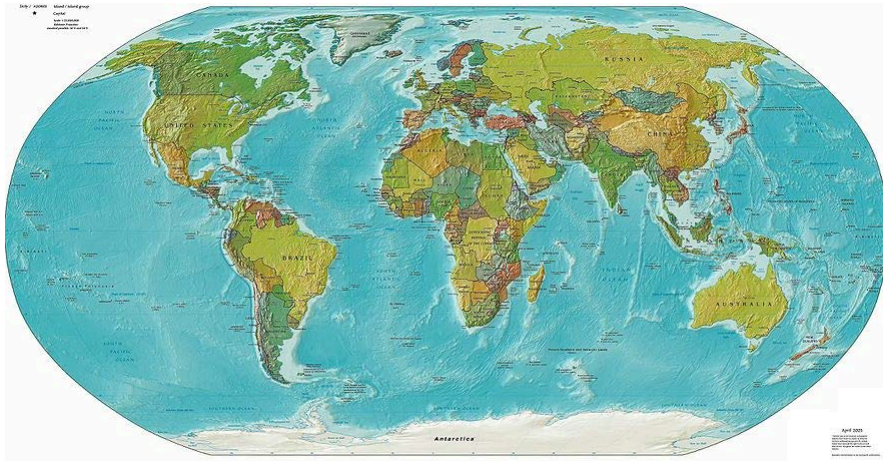






# Making a map

World map

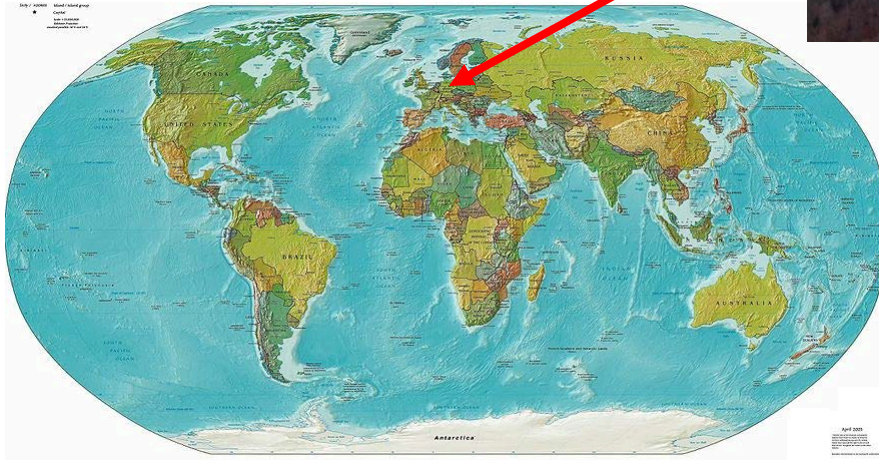


# Making a map

Ruhr-University Bochum



World map  
Germany



# Making a map

Ruhr-University Bochum



Germany

World map

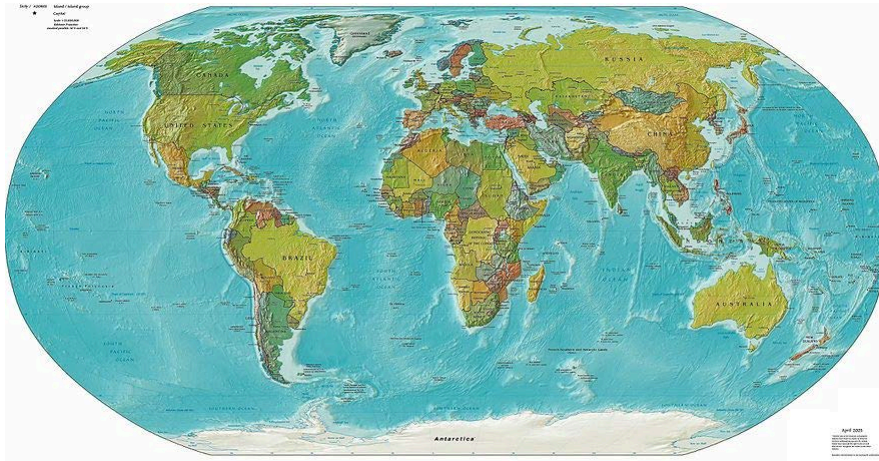


Kindergarten

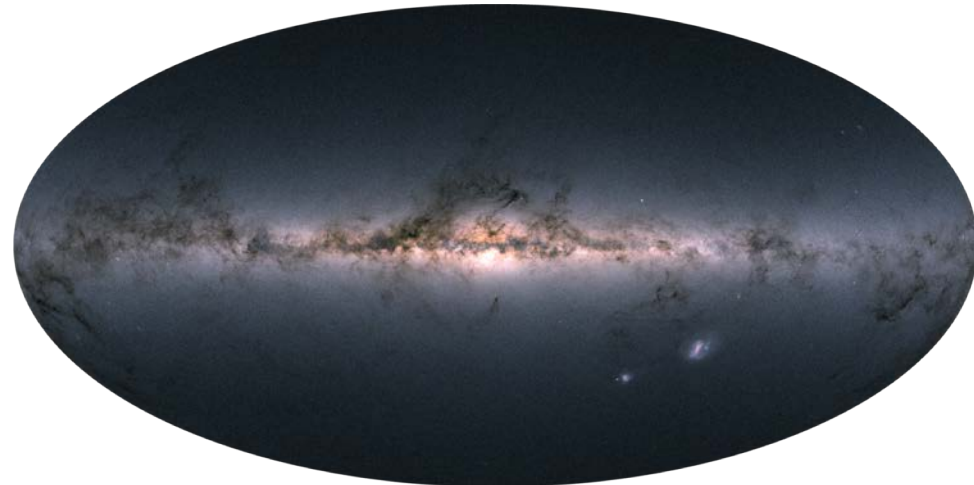


# Making a map

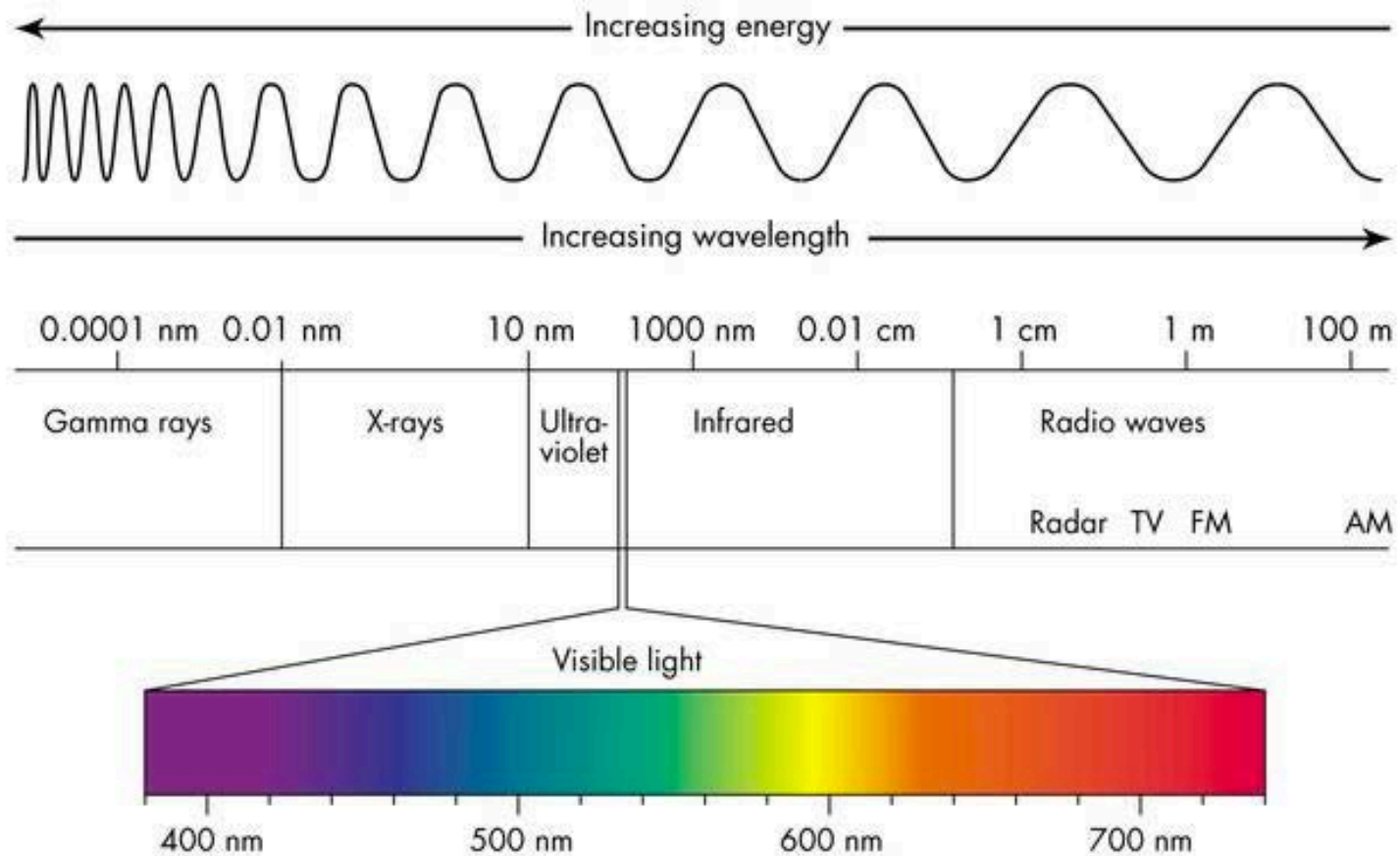
World map



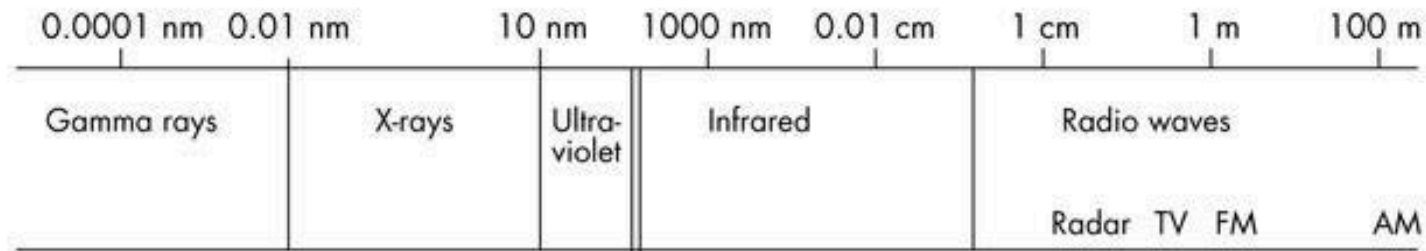
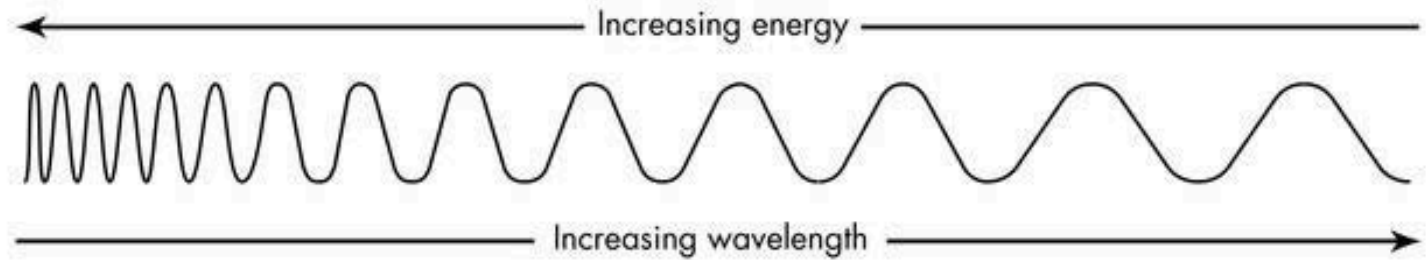
Sky map



# The different shades of light



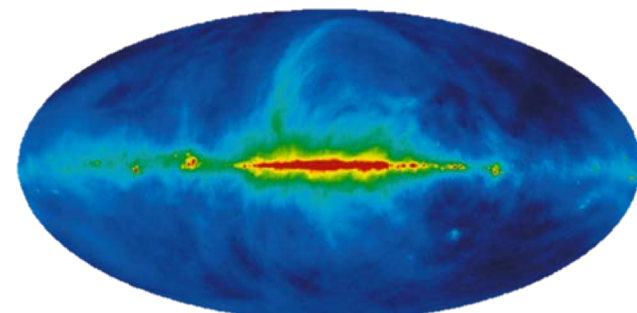
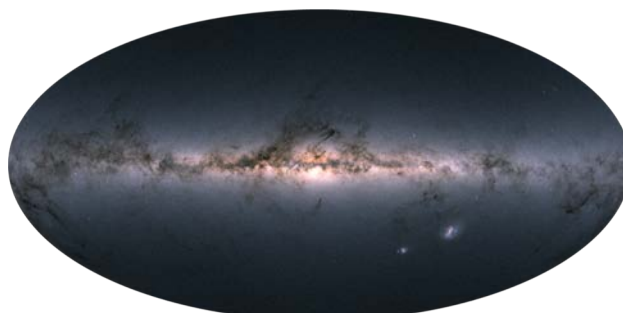
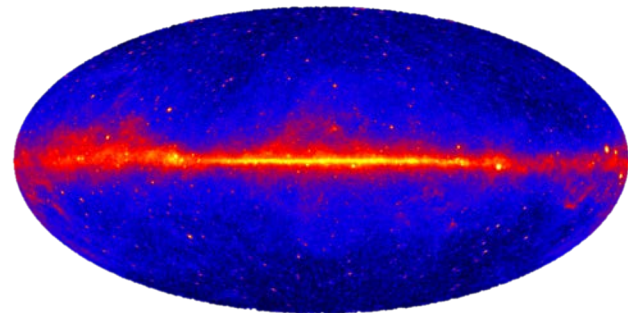


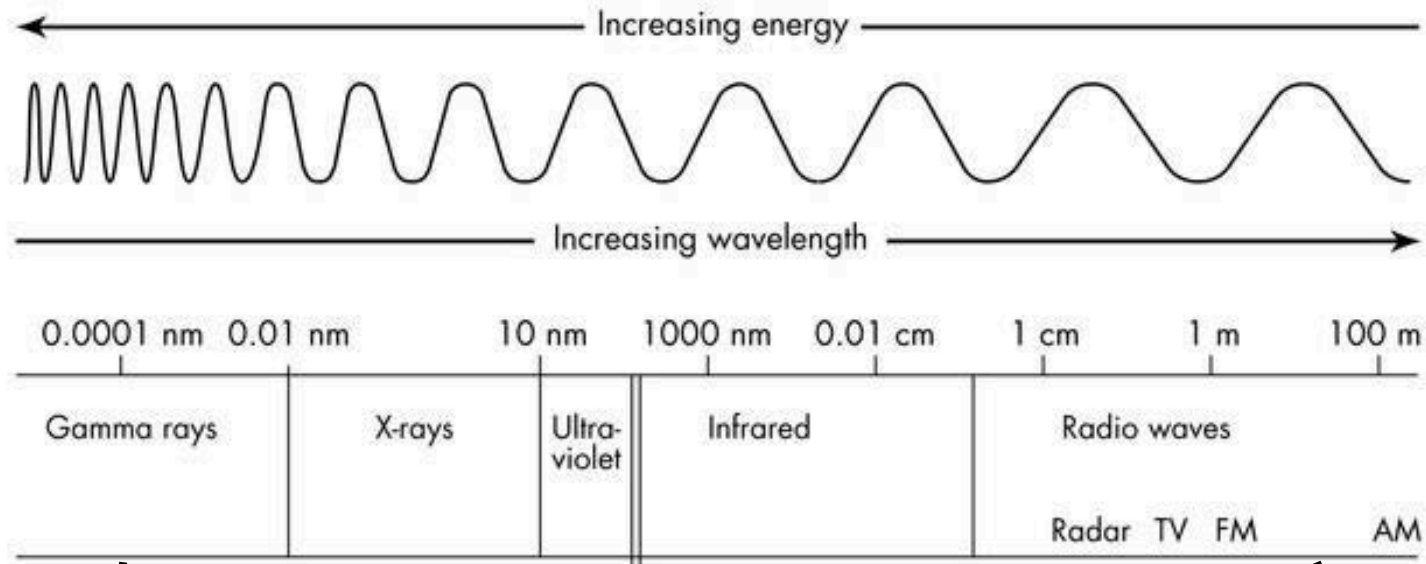


gamma-ray

visible

radio

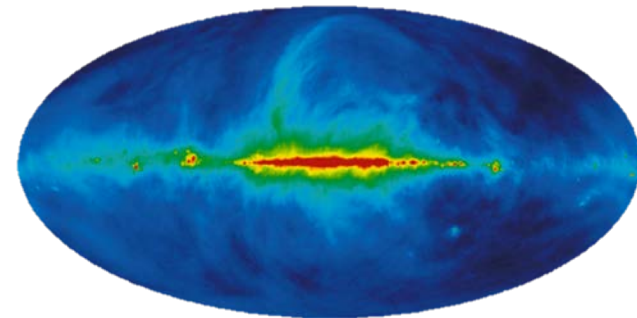
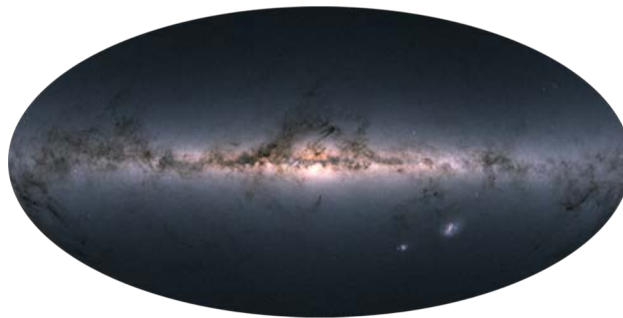
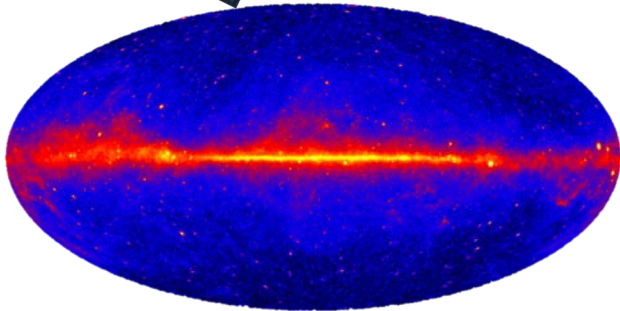




gamma-ray

visible

radio



**What if we could use something  
that's not light?!**

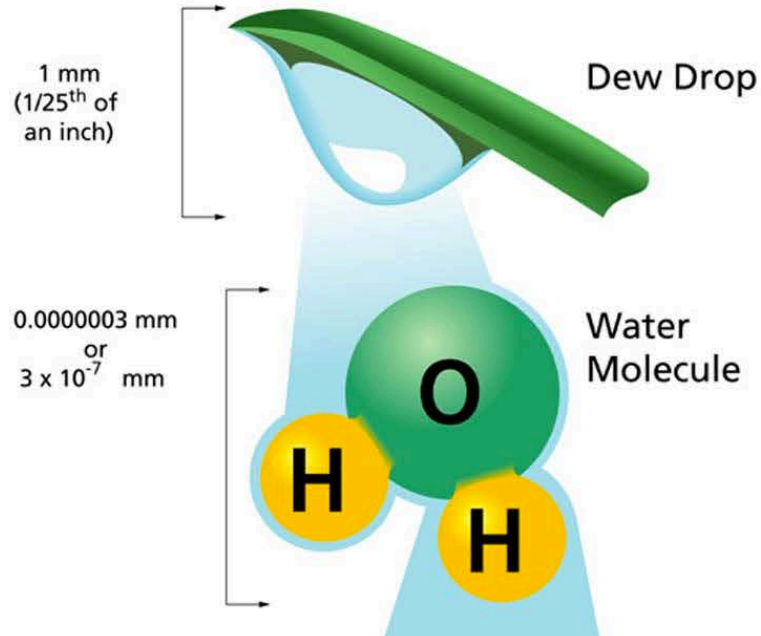
**What if we could use something  
that's not light?!**

**Tiny particles called *Neutrinos!***

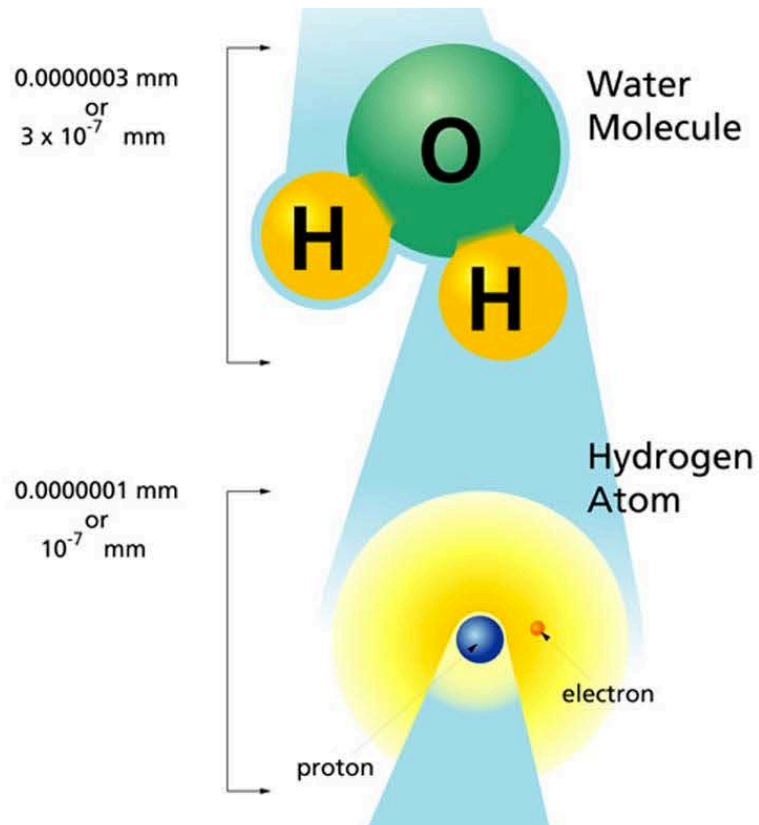
# The tiniest particles - What the world is made of?



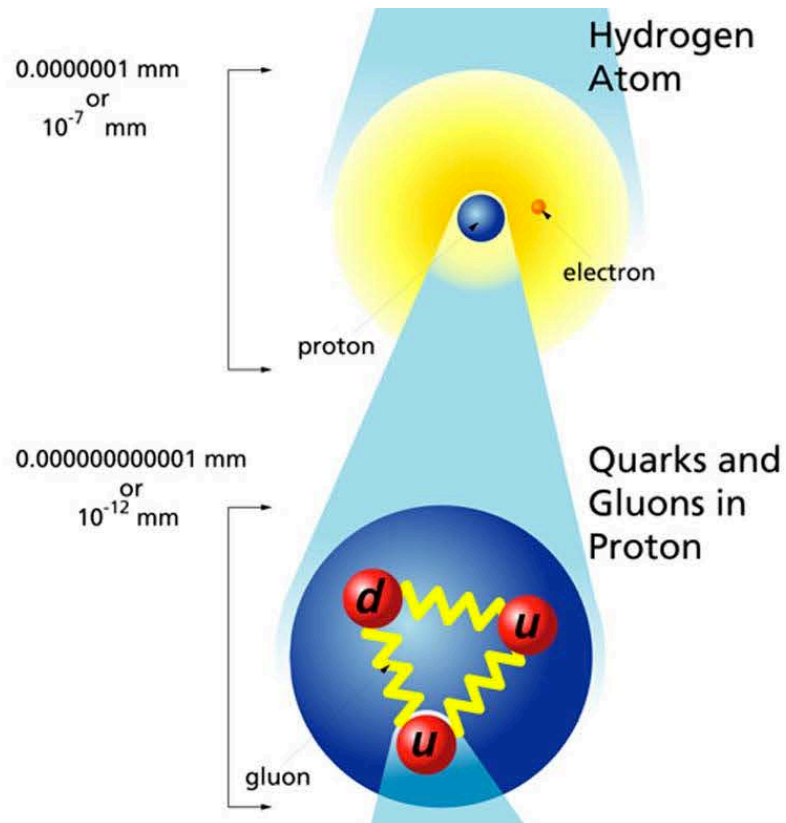
# The tiniest particles - What the world is made of?



# The tiniest particles - What the world is made of?



# The tiniest particles - What the world is made of?



The smallest particles are the building blocks of everything (including us!)



The most **elusive** elementary particles are called ***Neutrinos***

# Neutrino fact sheet

## Neutrinos

- are subatomic particles
- have almost no mass
- have no charge
- tiny probability to hit a nucleus while traveling through matter

Proton/neutron



Electron mass



Neutrino mass





*The chances of a neutrino actually hitting something as it travels through all this howling emptiness are roughly comparable to that of dropping a ball bearing at random from a cruising 747 and hitting, say, an egg sandwich.*

The Hitchhiker's Guide to the Galaxy, Douglas Adams



# How are neutrinos produced?

On Earth in nuclear  
power plants



# How are neutrinos produced?

On Earth in nuclear power plants



In the center of the Sun



# How are neutrinos produced?

On Earth in nuclear power plants



In the center of the Sun

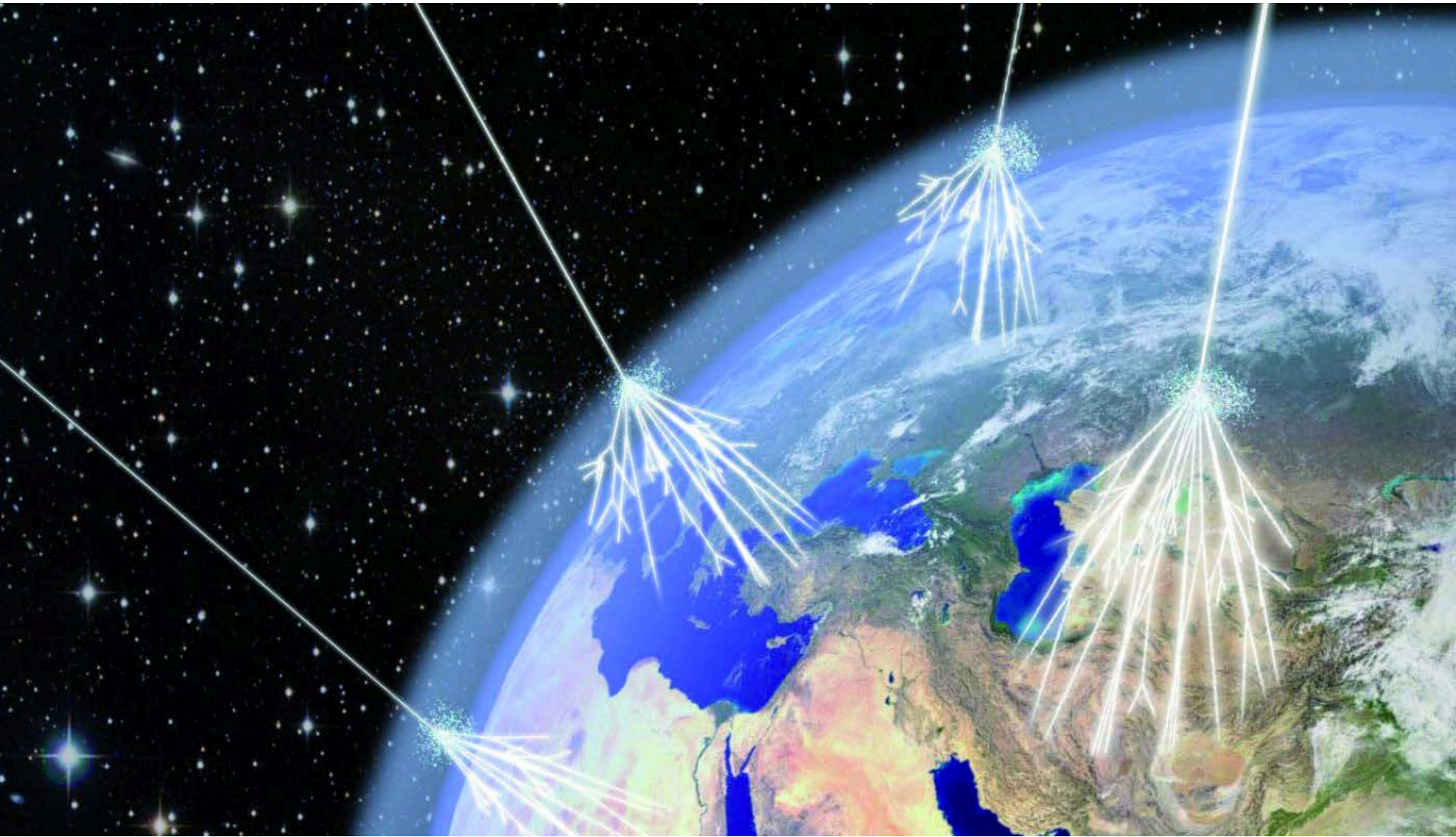


In the most violent processes in distant galaxies



# Neutrinos trace the most energetic processes

# Cosmic Rays



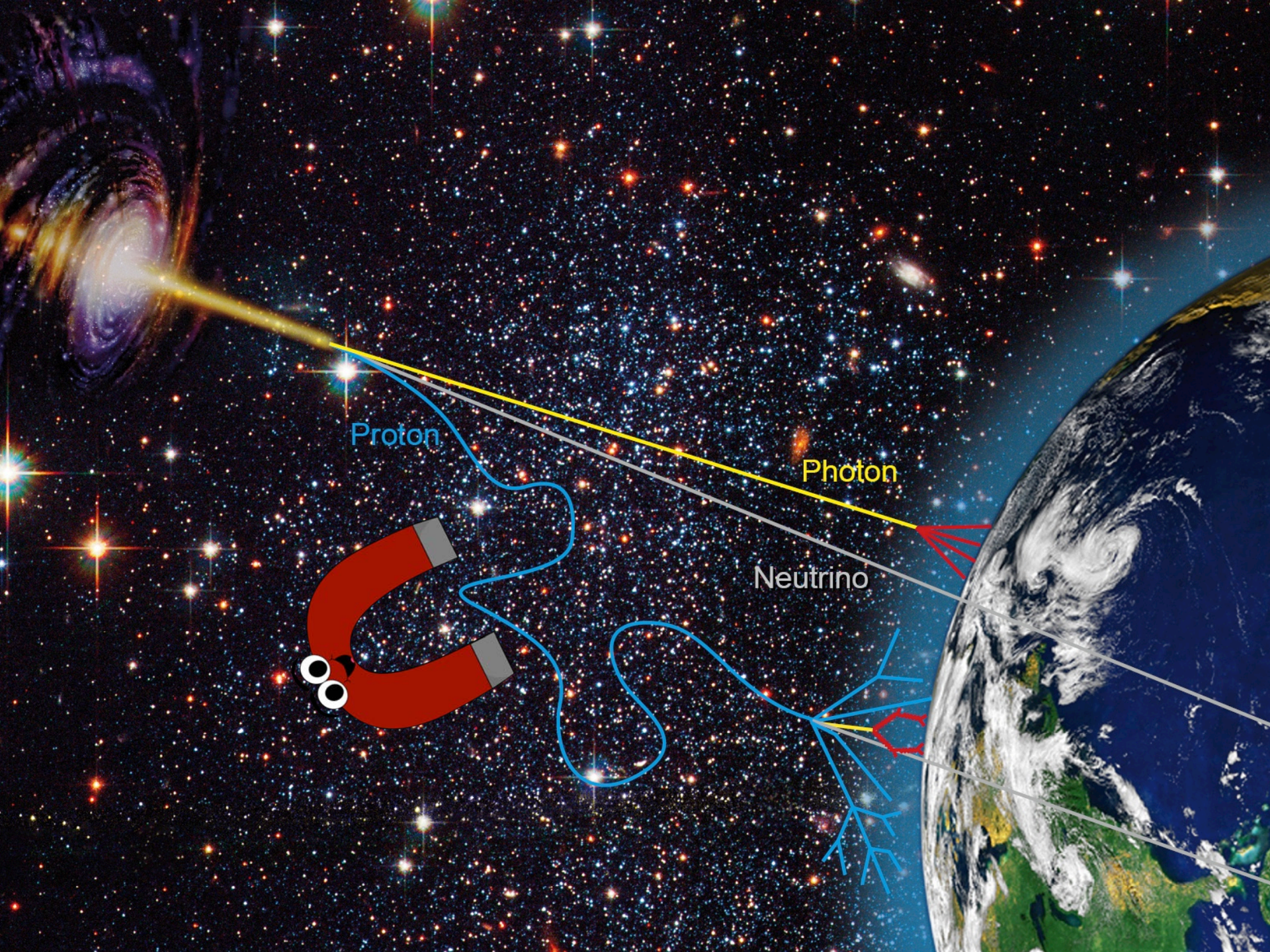


# Large Hadron Collider at CERN



# Large Hadron Collider at CERN





Proton

Photon

Neutrino