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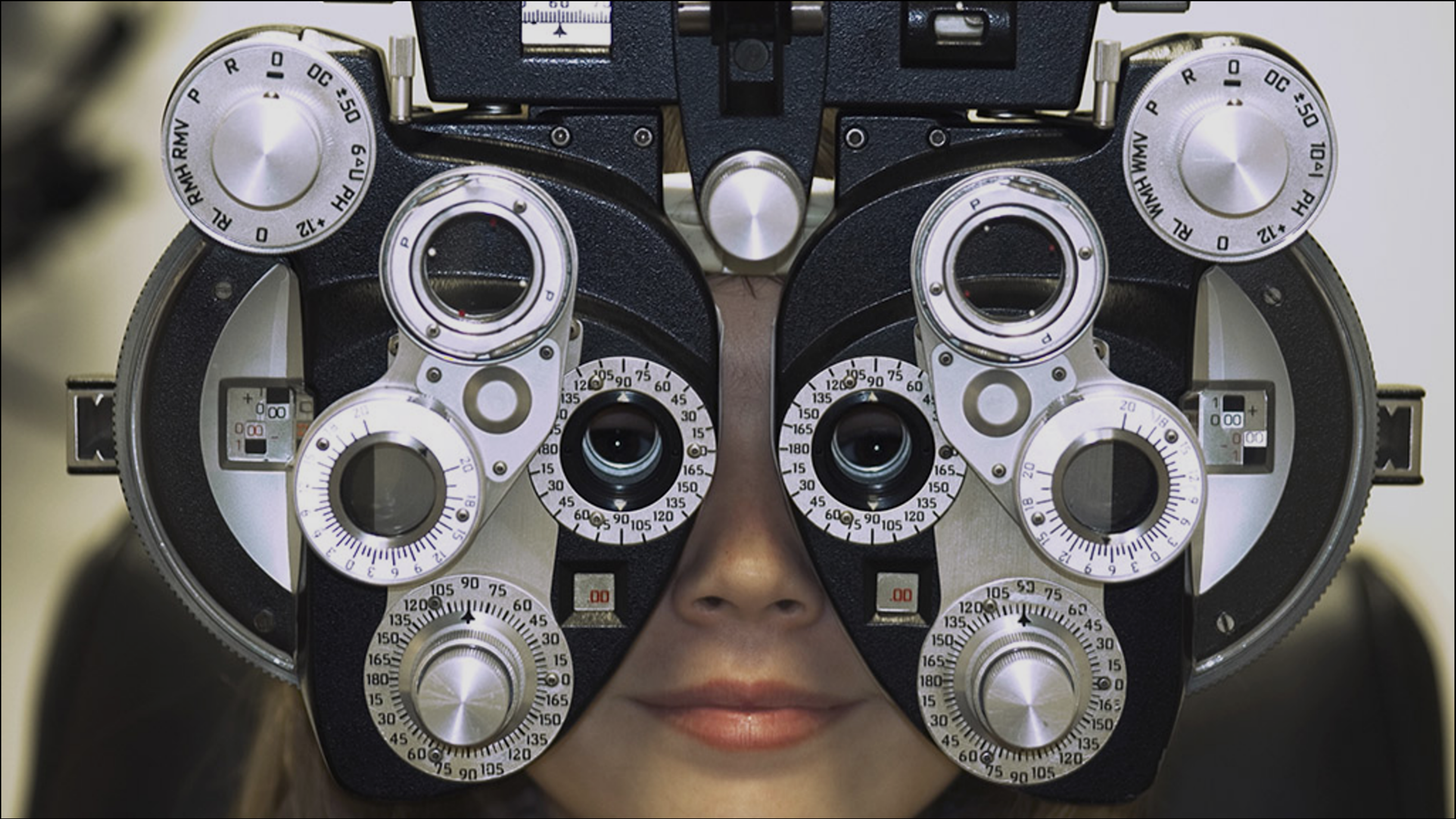
ALLA RICERCA DELLA MATERIA OSCURA

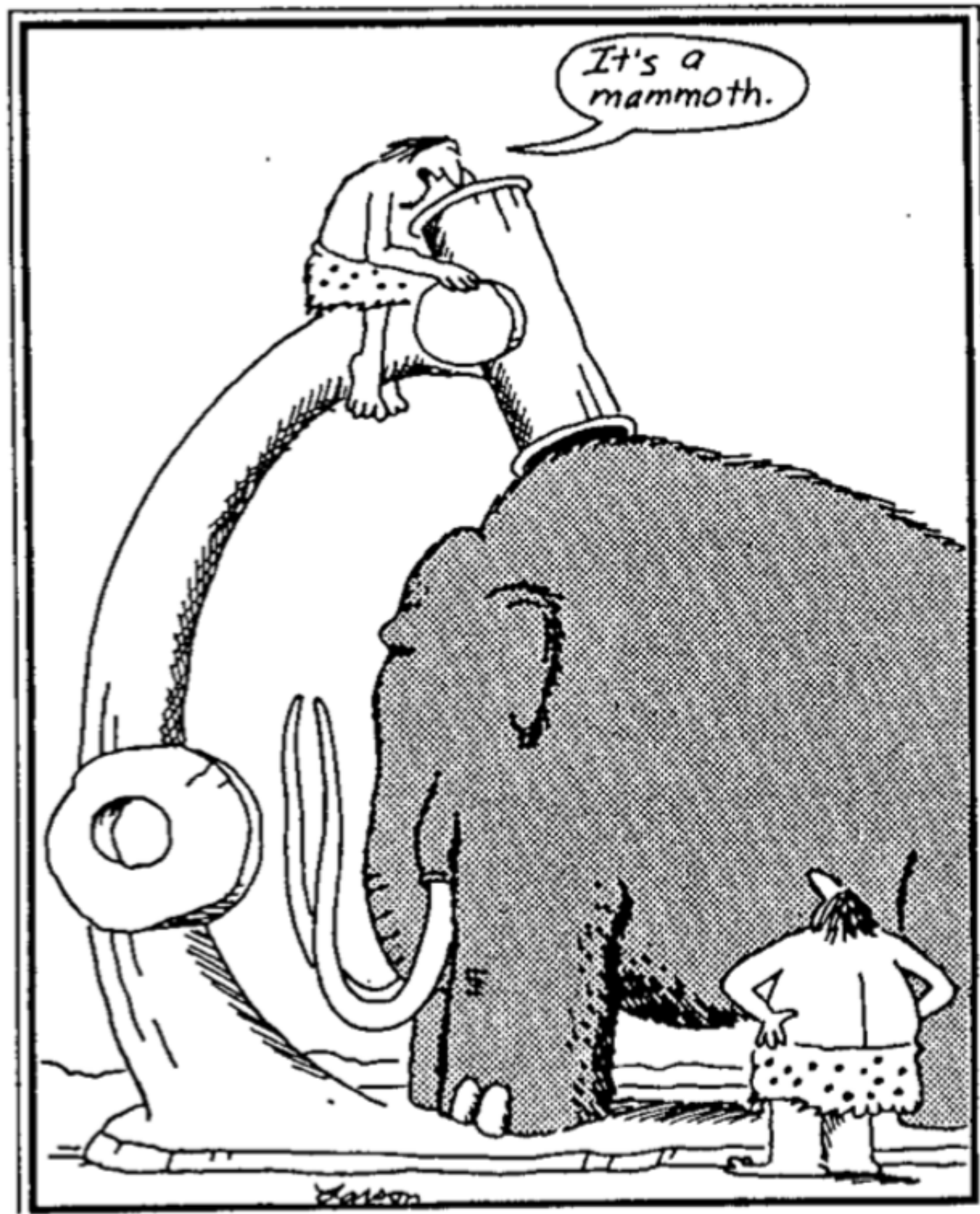
cos'è e come speriamo di trovarla



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INFN Sezione di Roma







Early microscope

VS





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INFN Sezione di Roma

image credits: NASA and STScI

materia



materia



materia



materia



luce = materia
materia = luce?

materia



materia



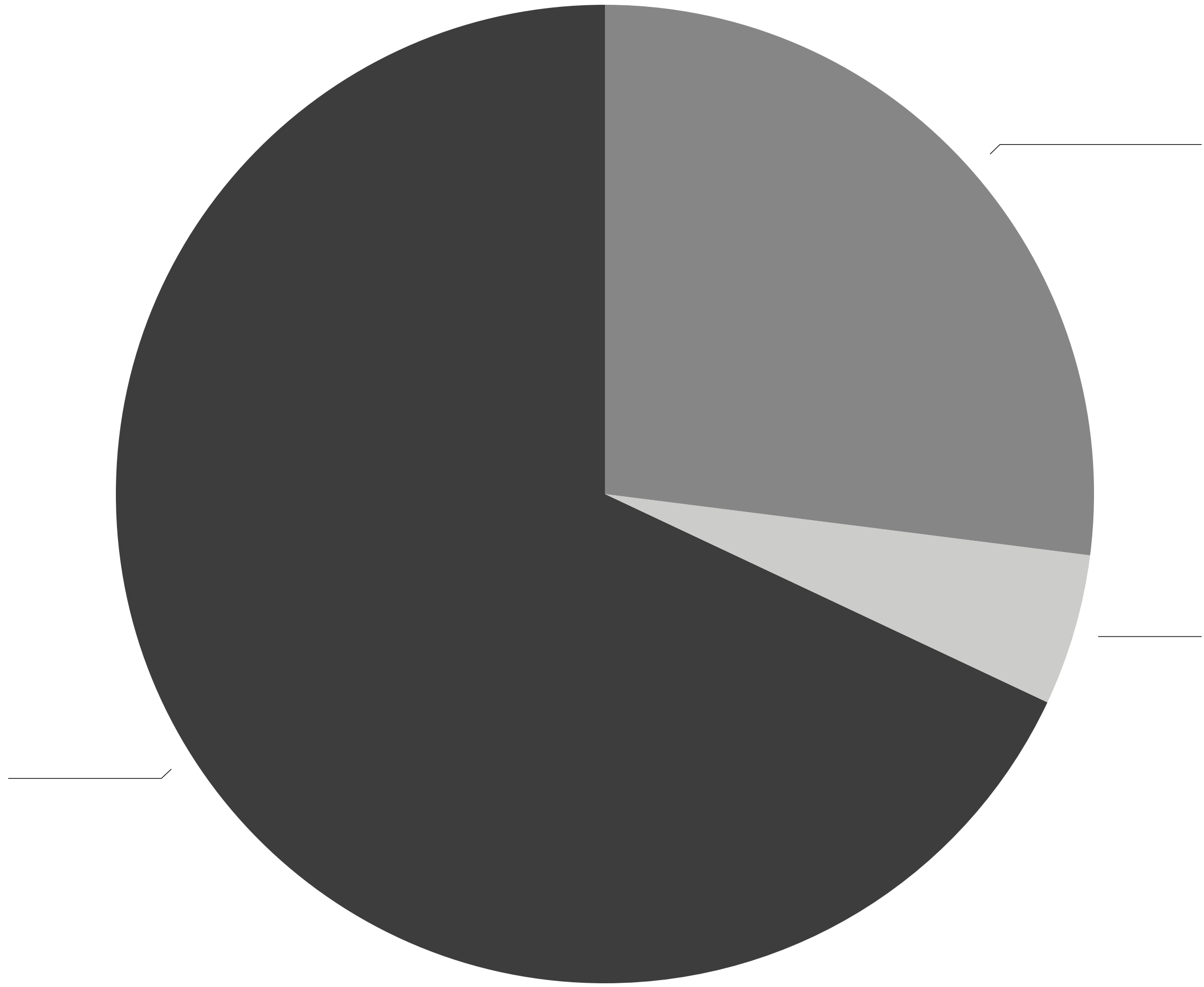
materia

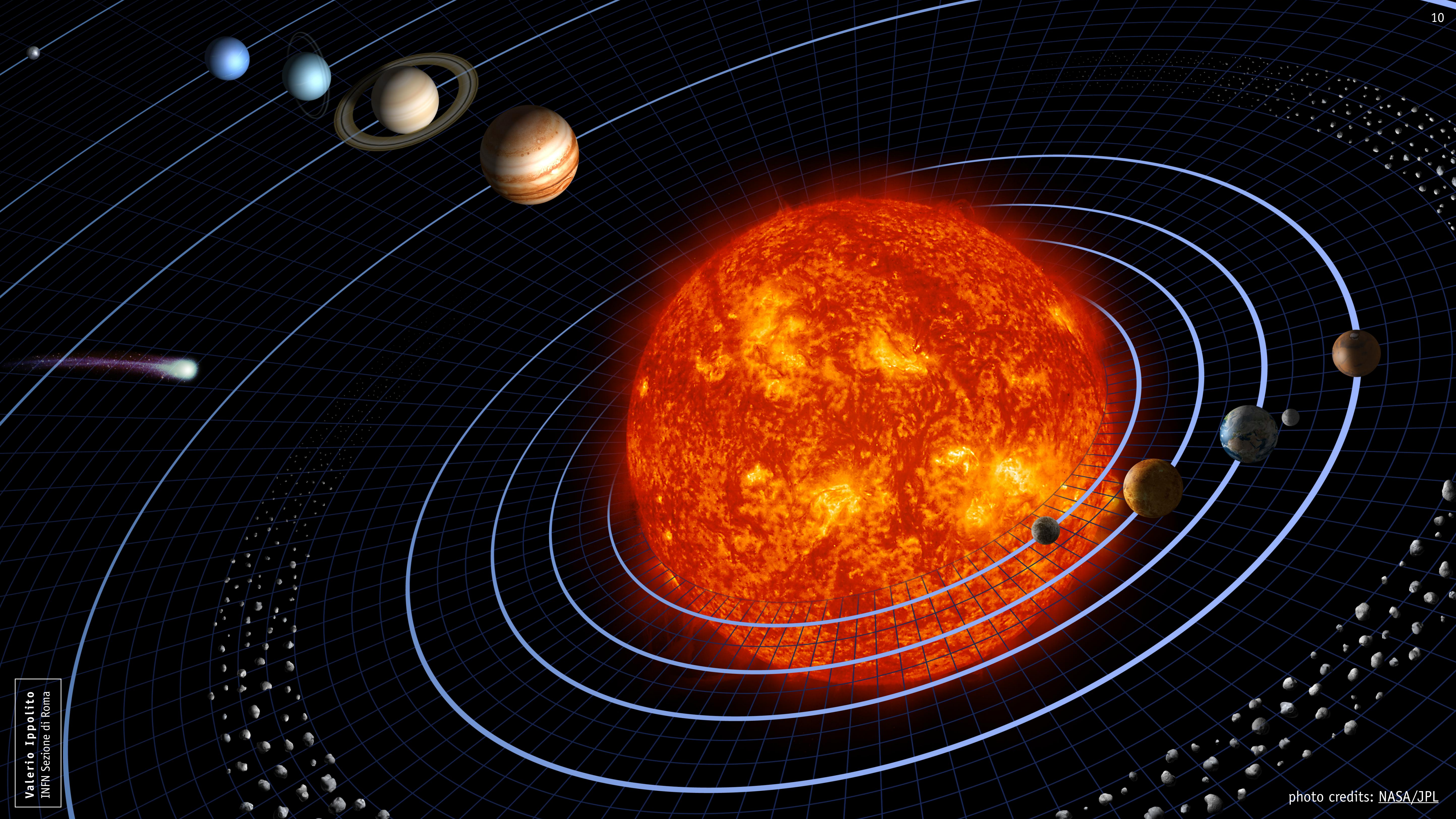


materia



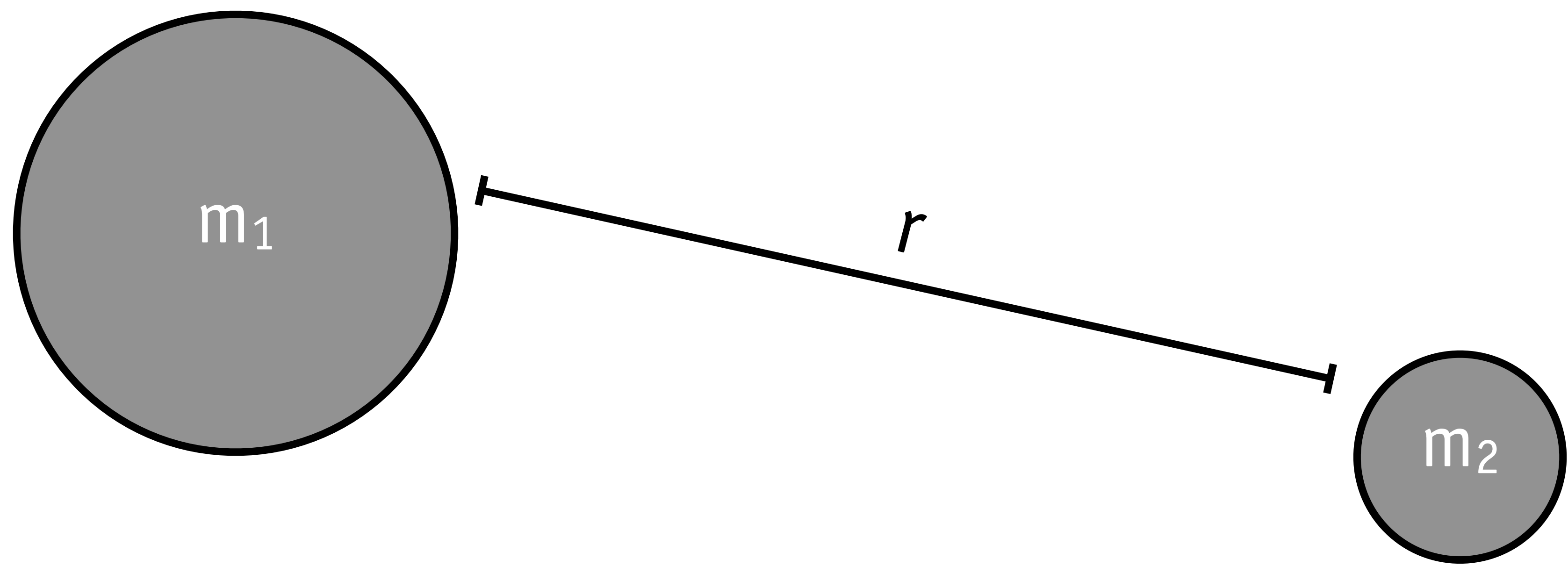




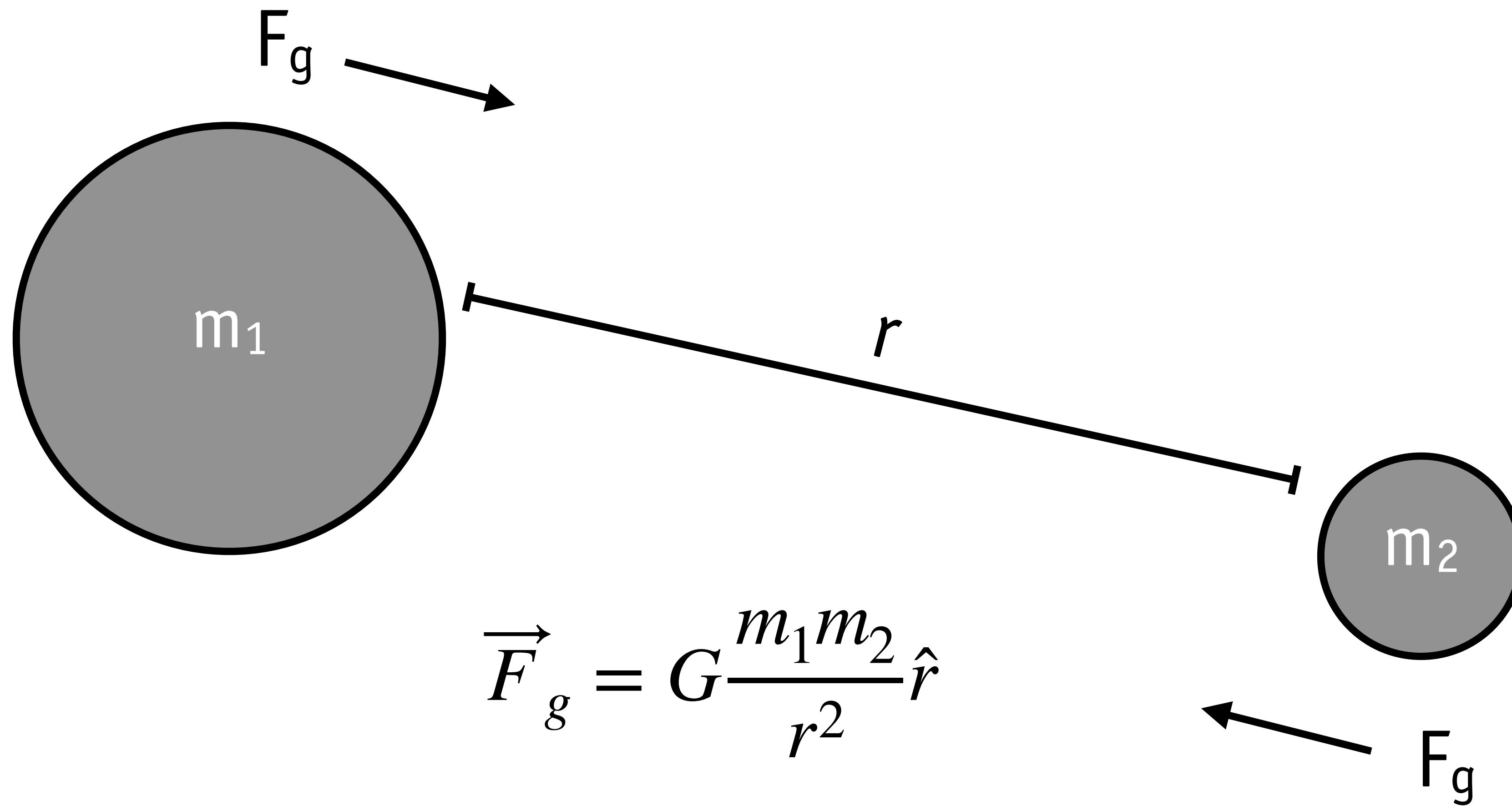


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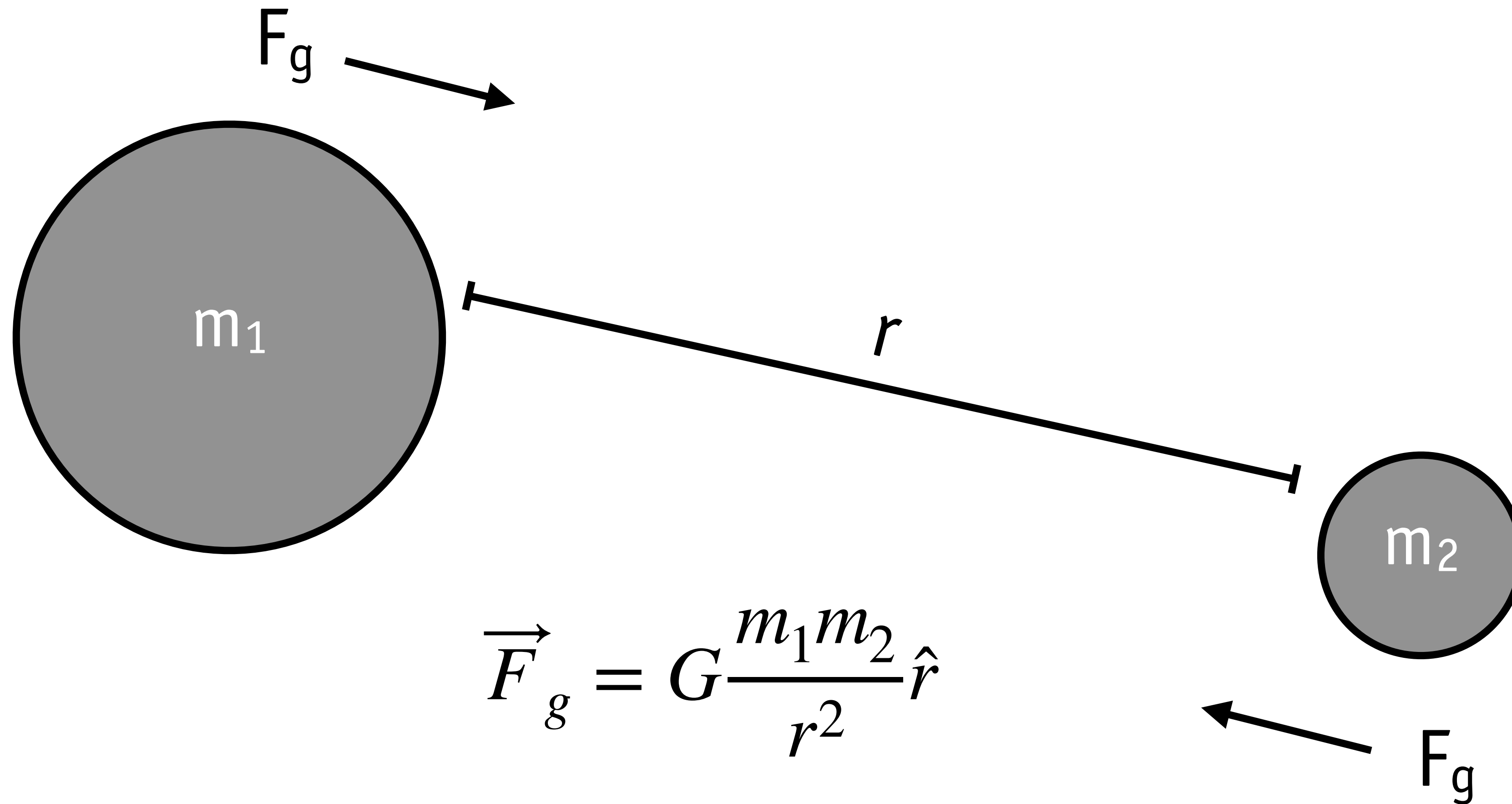
photo credits: NASA/JPL



la forza di gravità



la forza di gravità



e se guardiamo un po' più lontano?



galassia a spirale

senza materia oscura

con la materia oscura



galassia a spirale

senza materia oscura

con la materia oscura

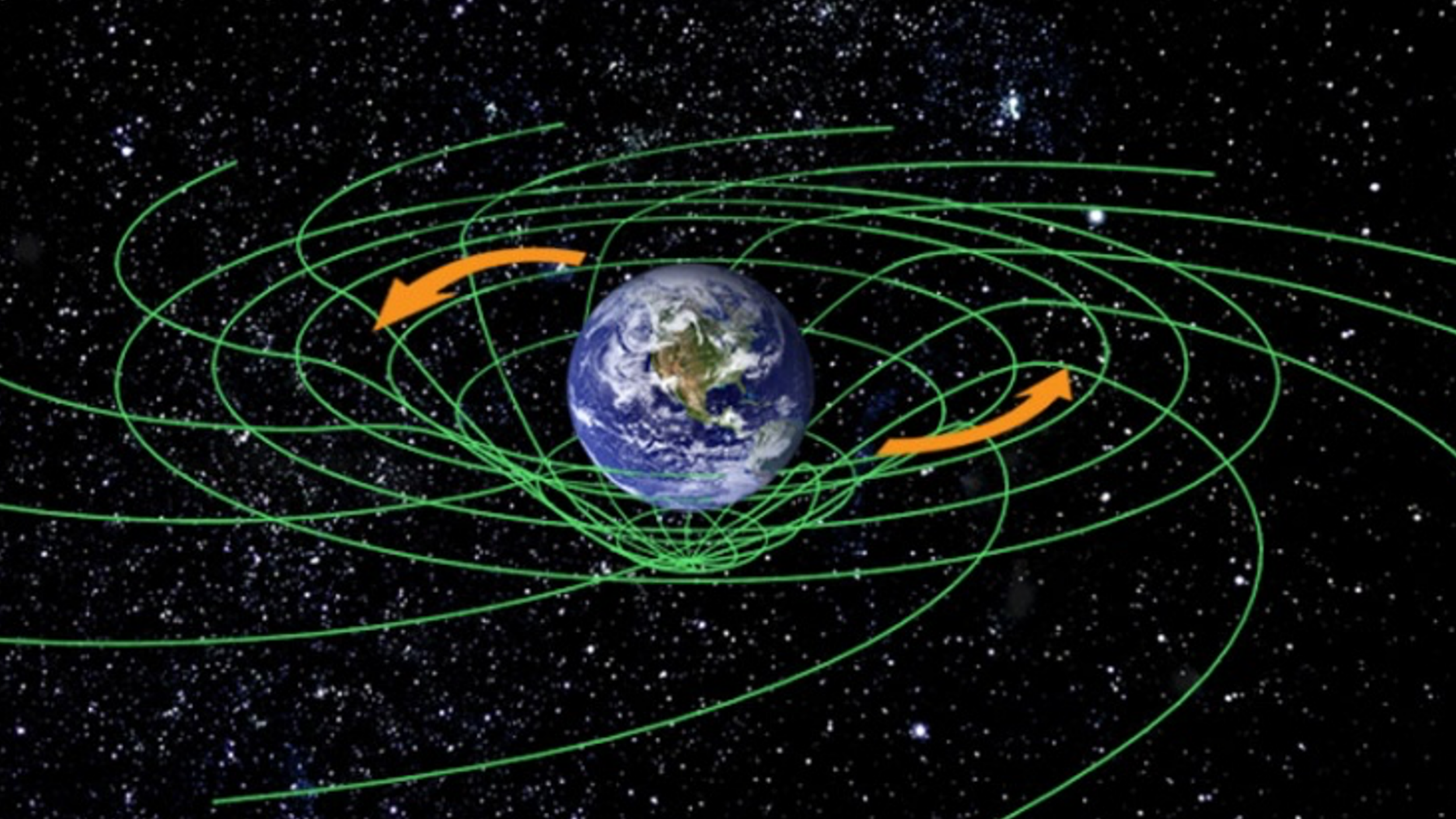


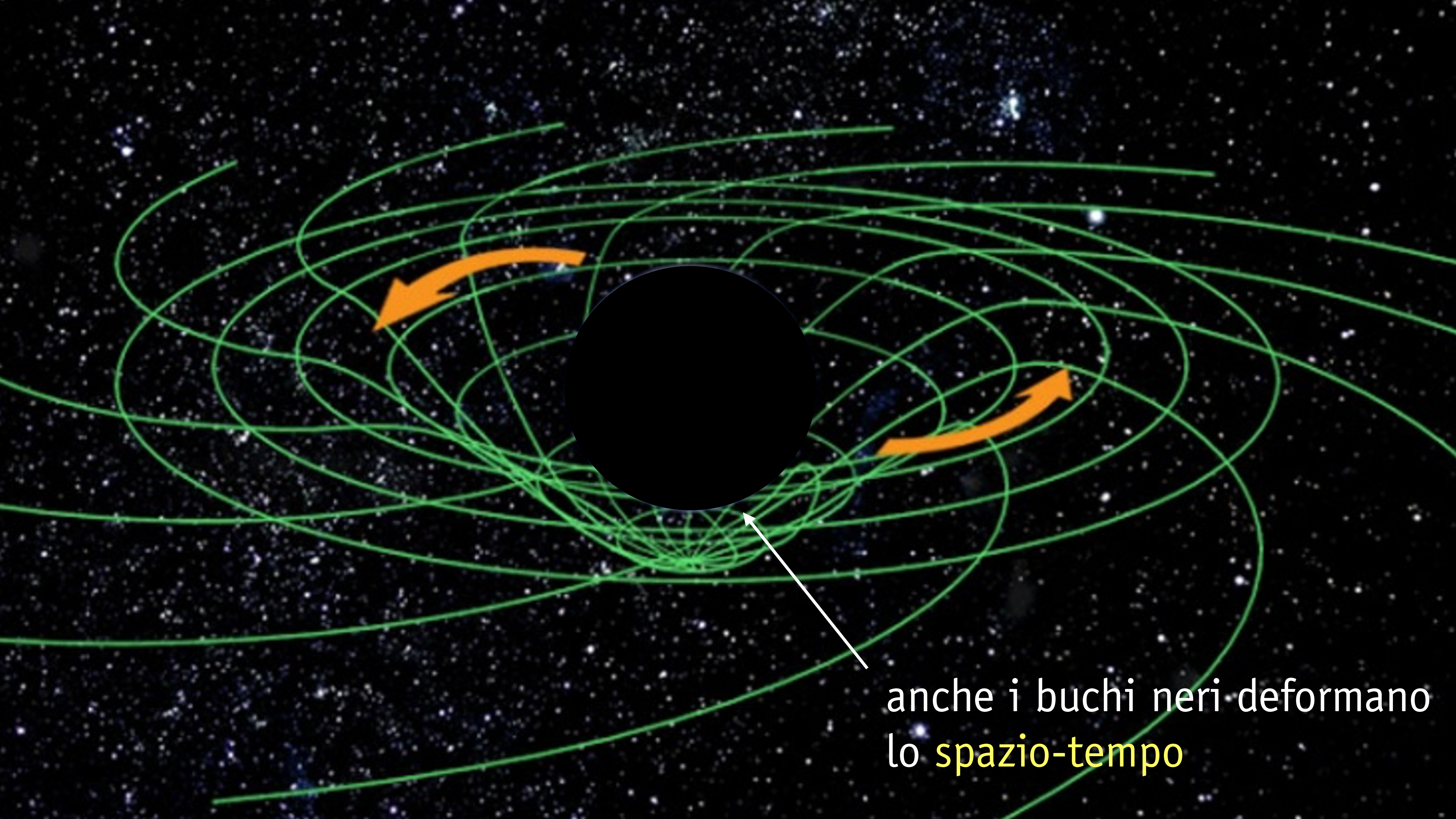
galassia a spirale

senza materia oscura

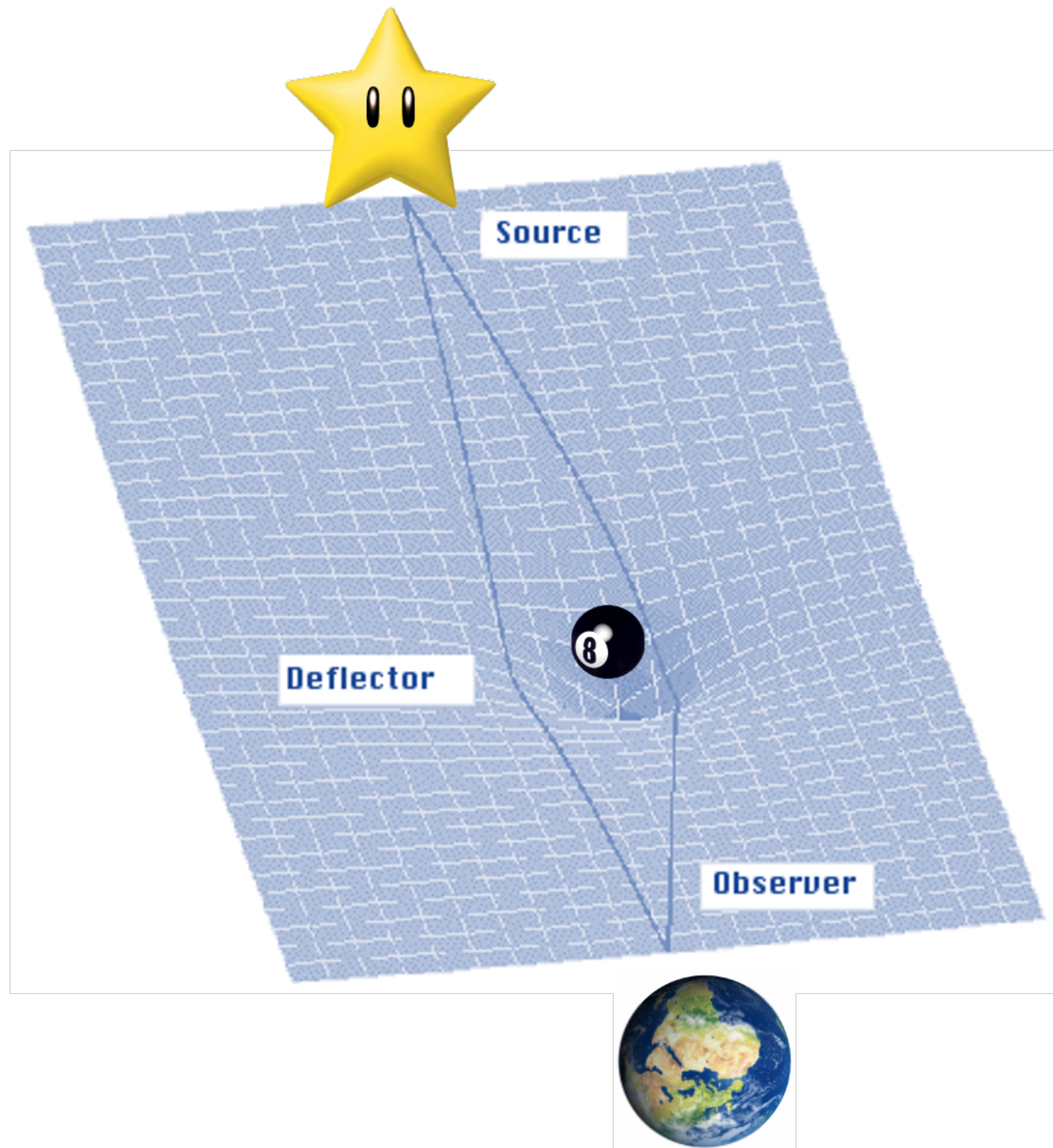
con la materia oscura







anche i buchi neri deformano
lo spazio-tempo



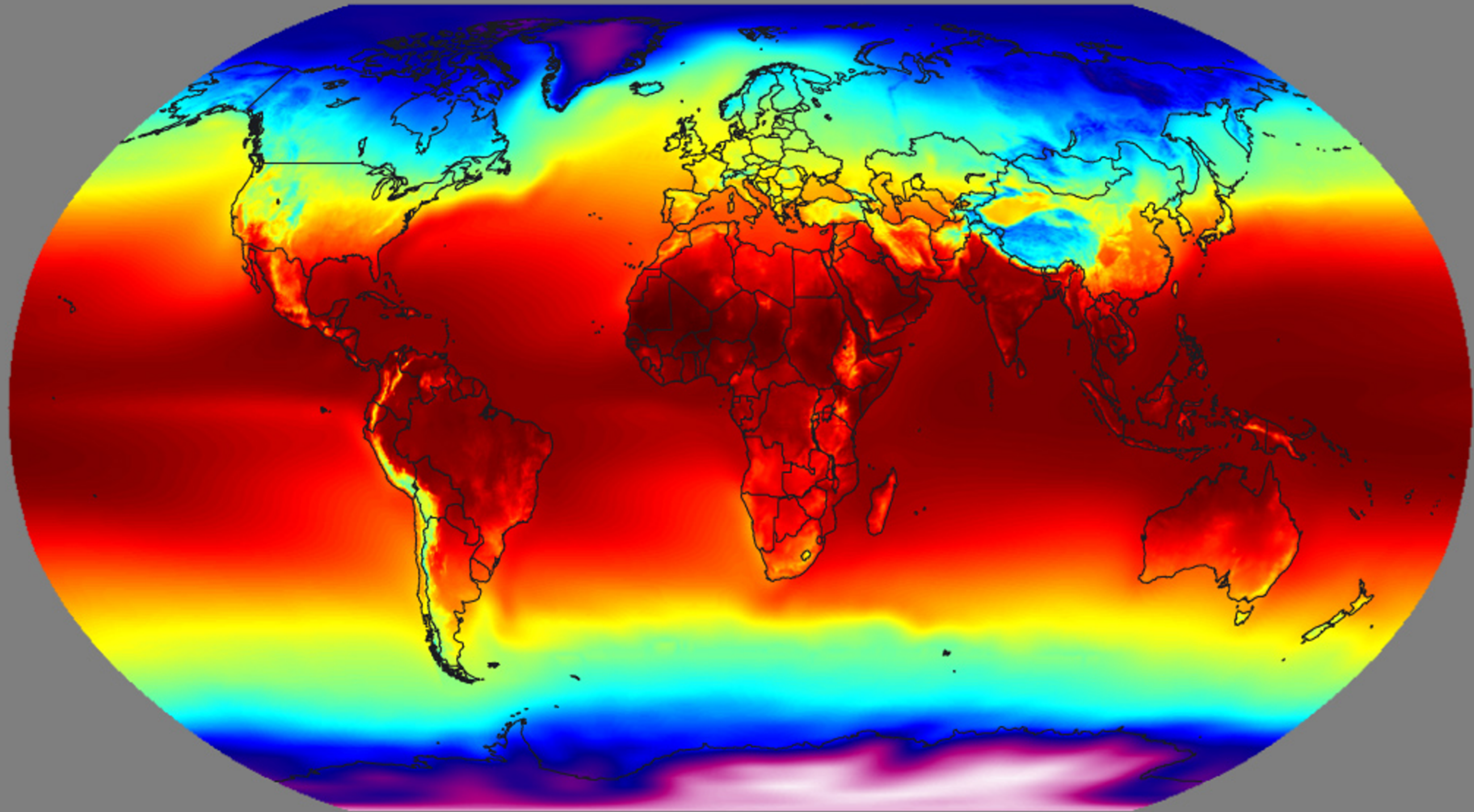
questa **deflessione**
risente della **materia**
oscura!



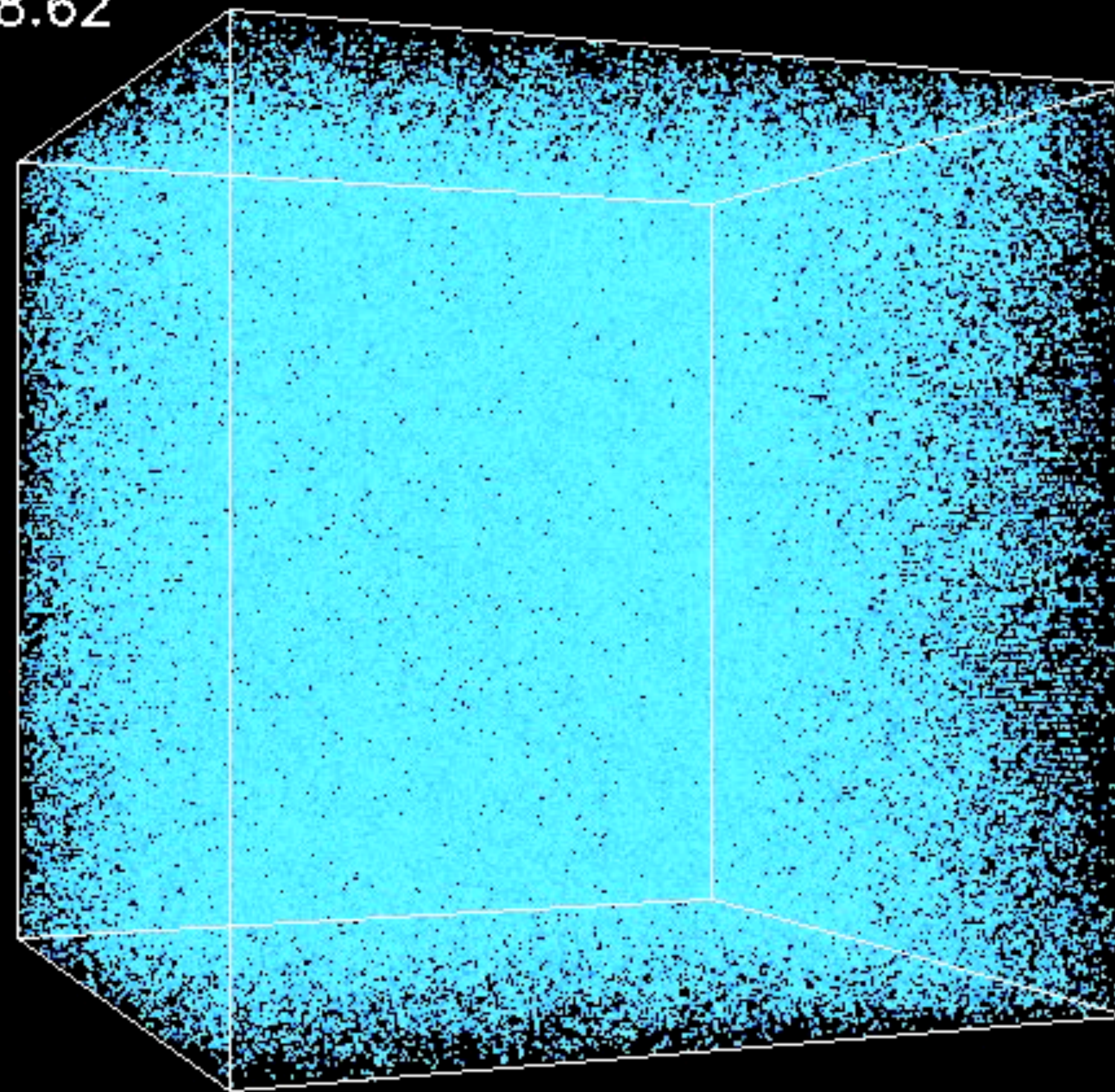
lenti gravitazionali, un'ulteriore prova della materia oscura!

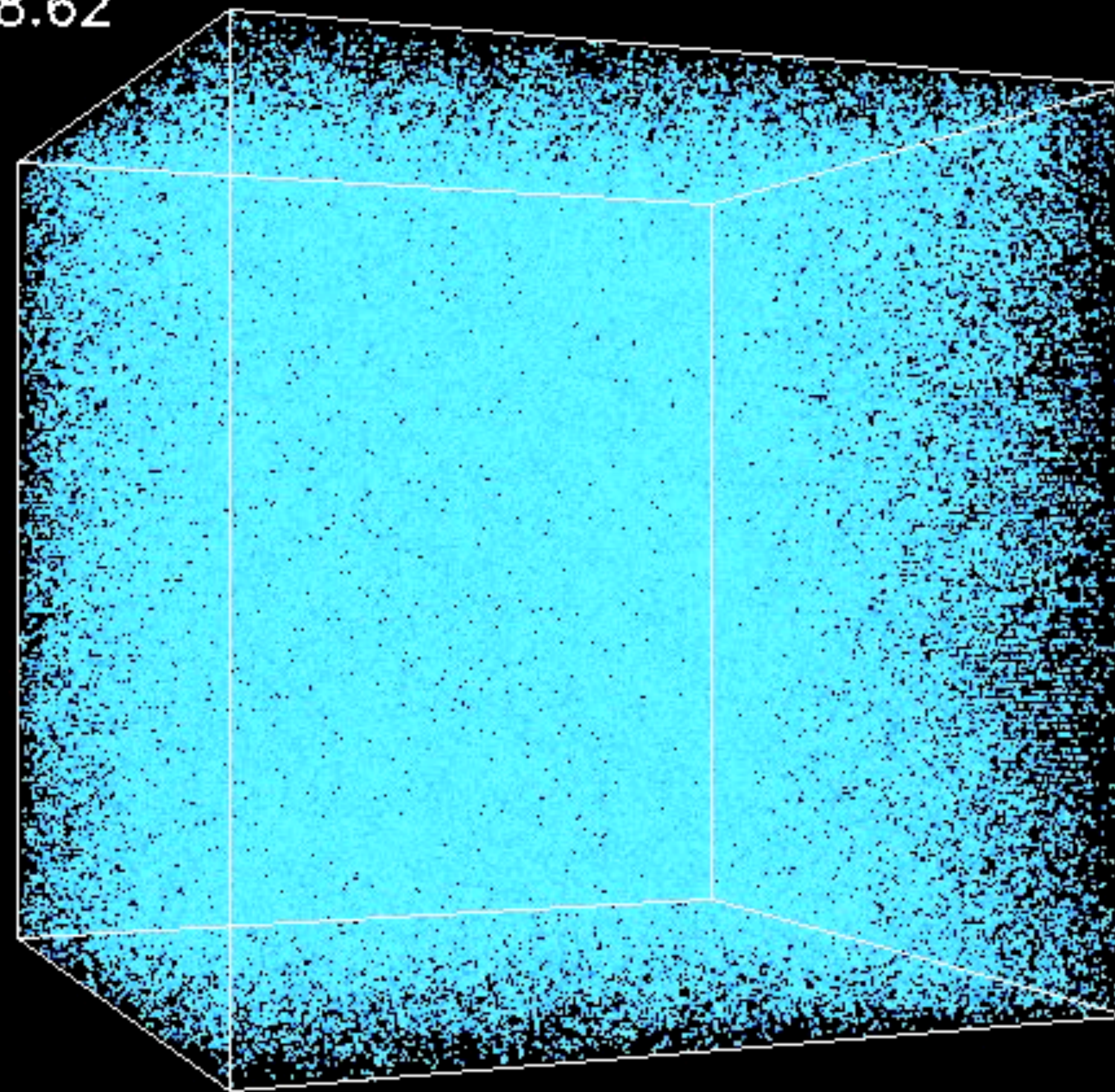


lenti gravitazionali, un'ulteriore prova della materia oscura!

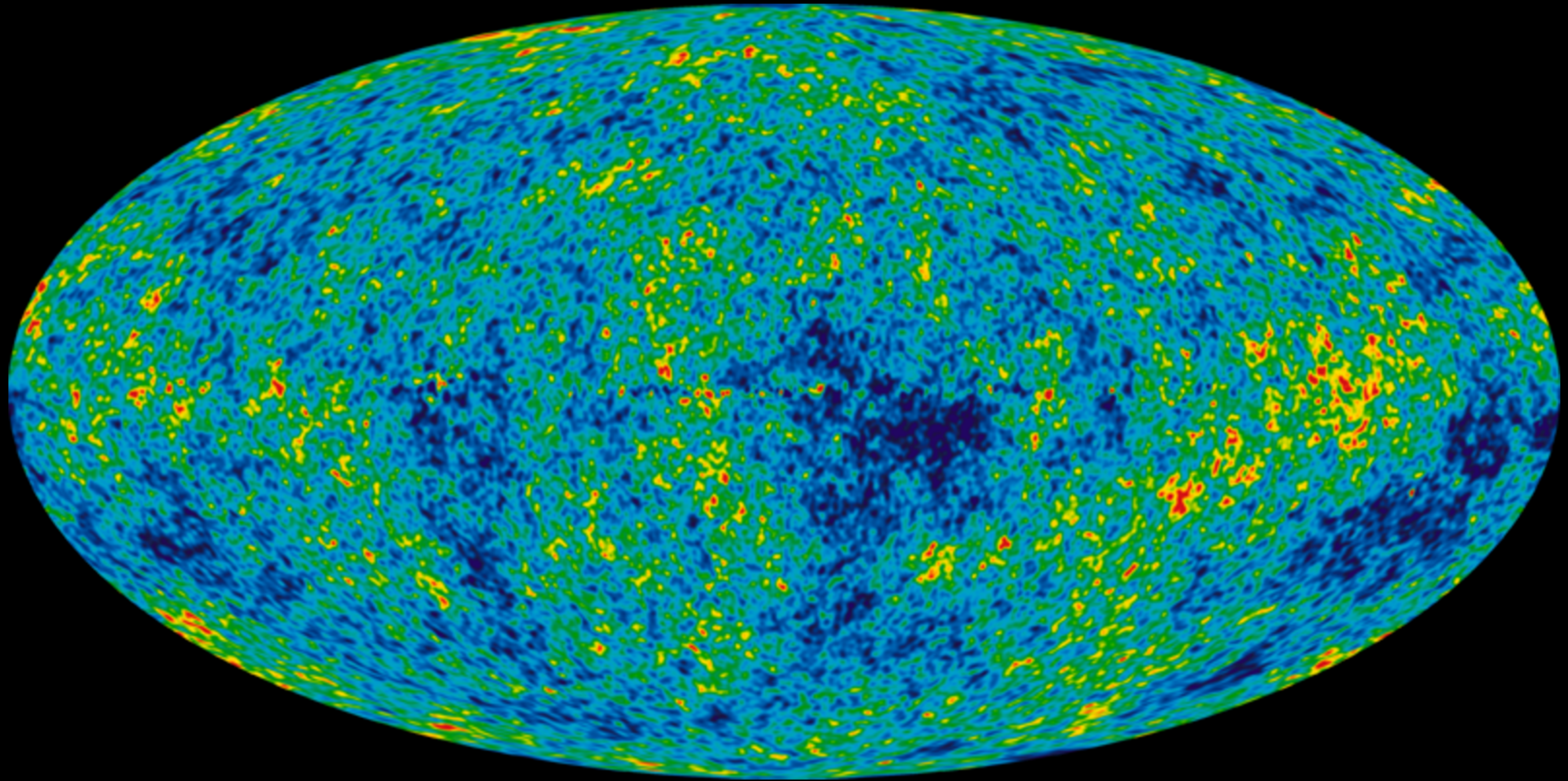


$Z=28.62$



$Z=28.62$ 

la temperatura dell'universo



variazioni di 1 parte su 100000 dovute alla materia oscura!

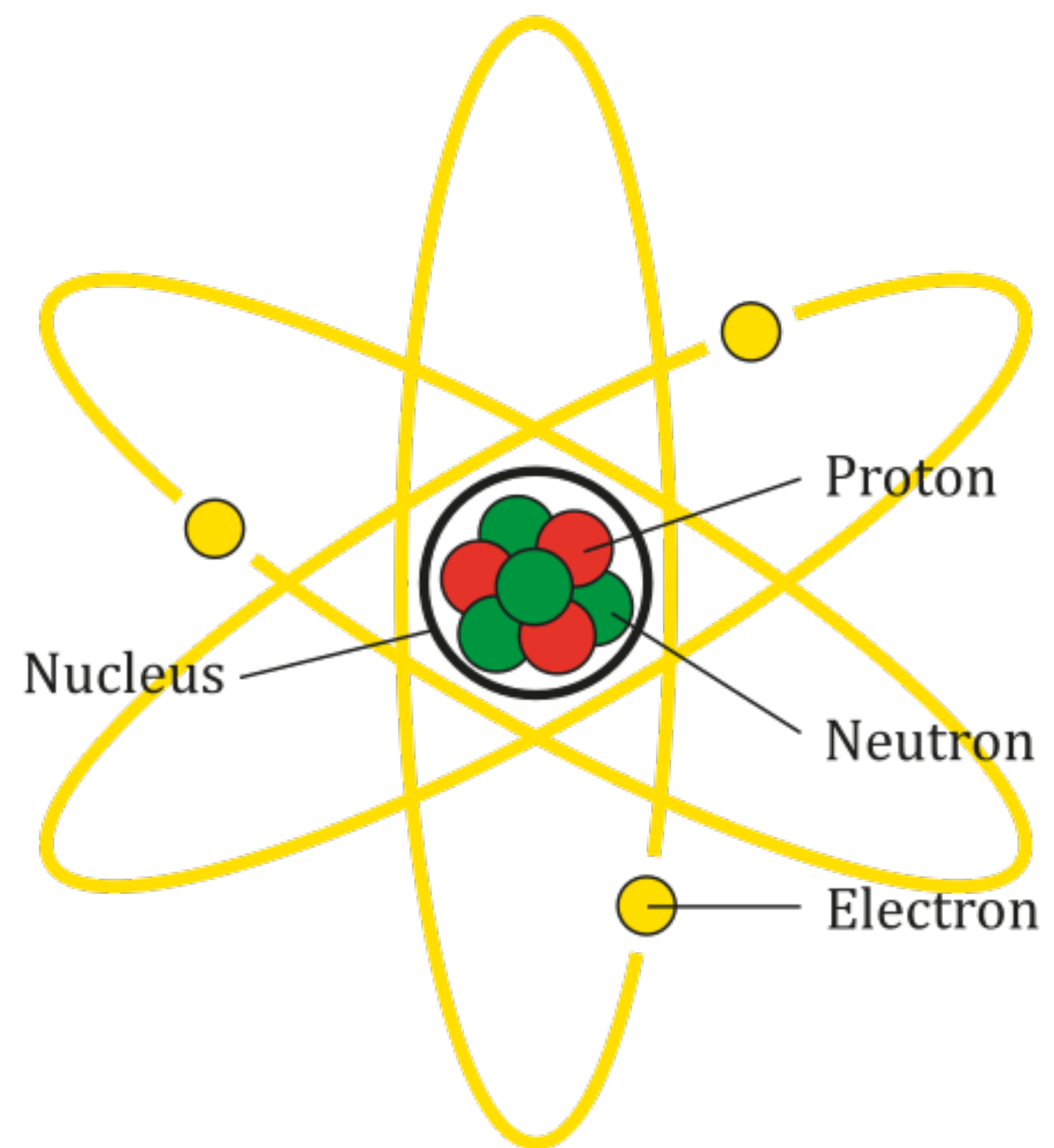


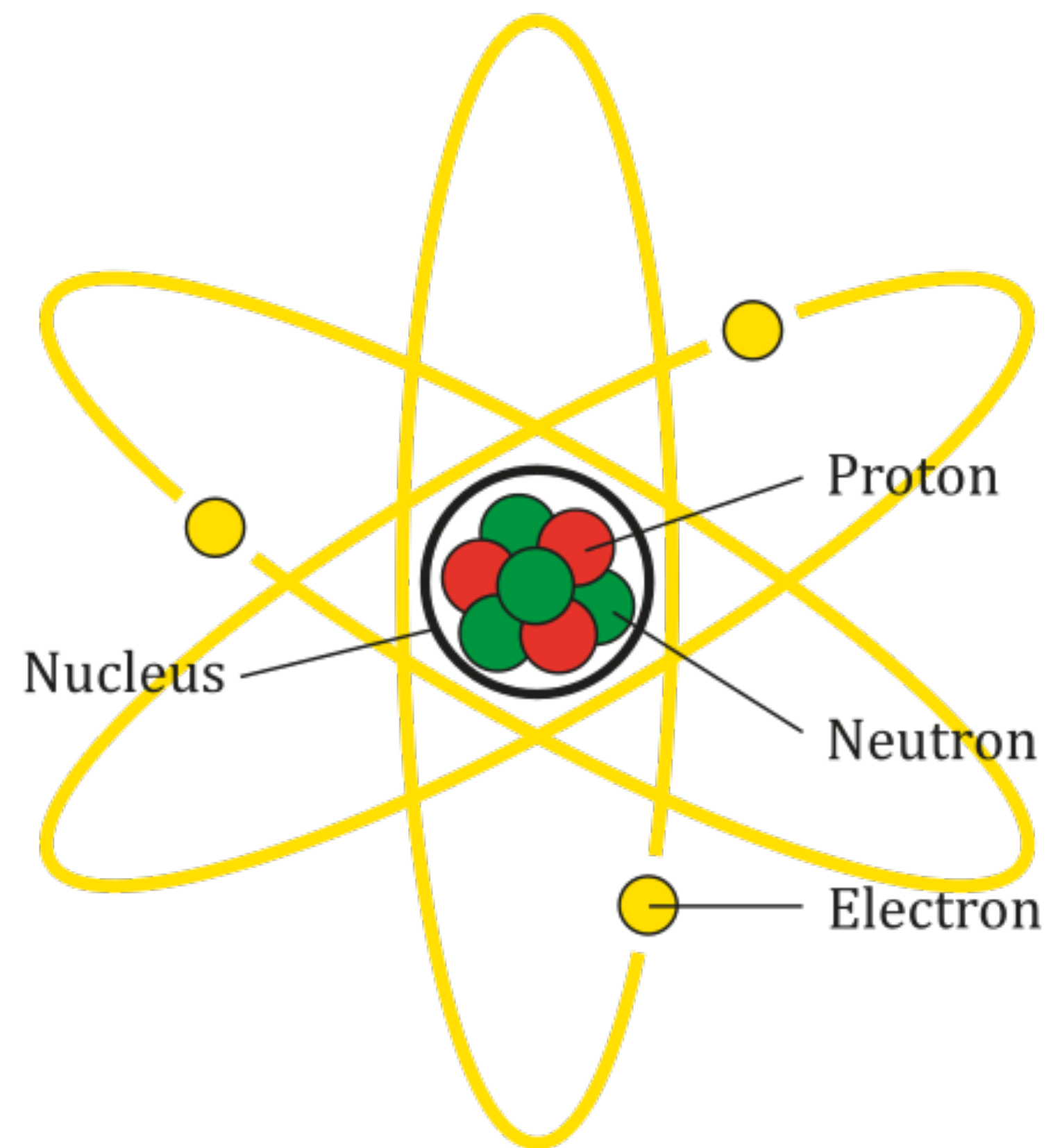
materia oscura



materia oscura

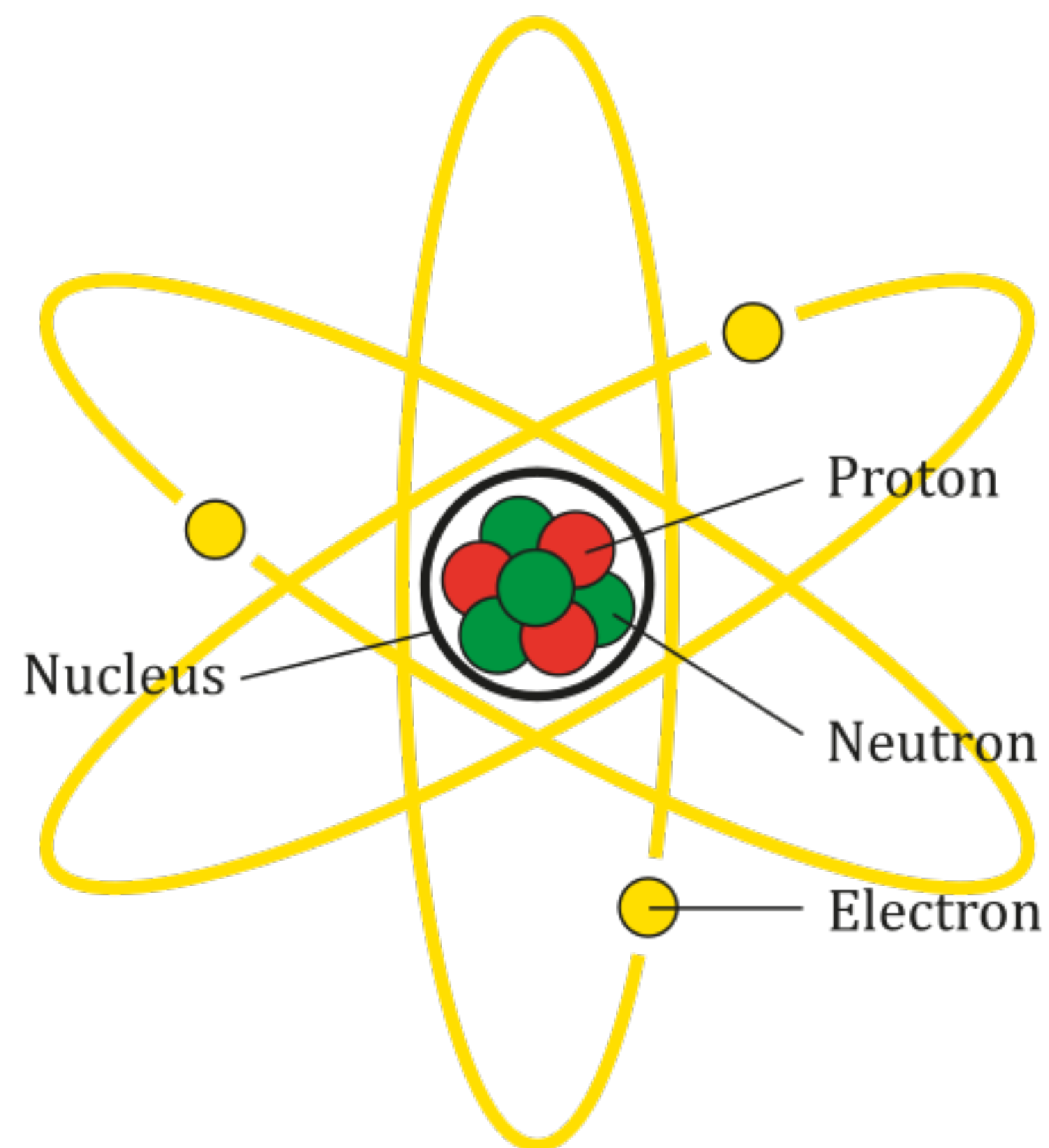






+

$e, \mu, \tau, \gamma, u, d, c, s, t,$
 $b, g, W, Z, \nu_e, \nu_\mu, \nu_\tau, H\dots$



+

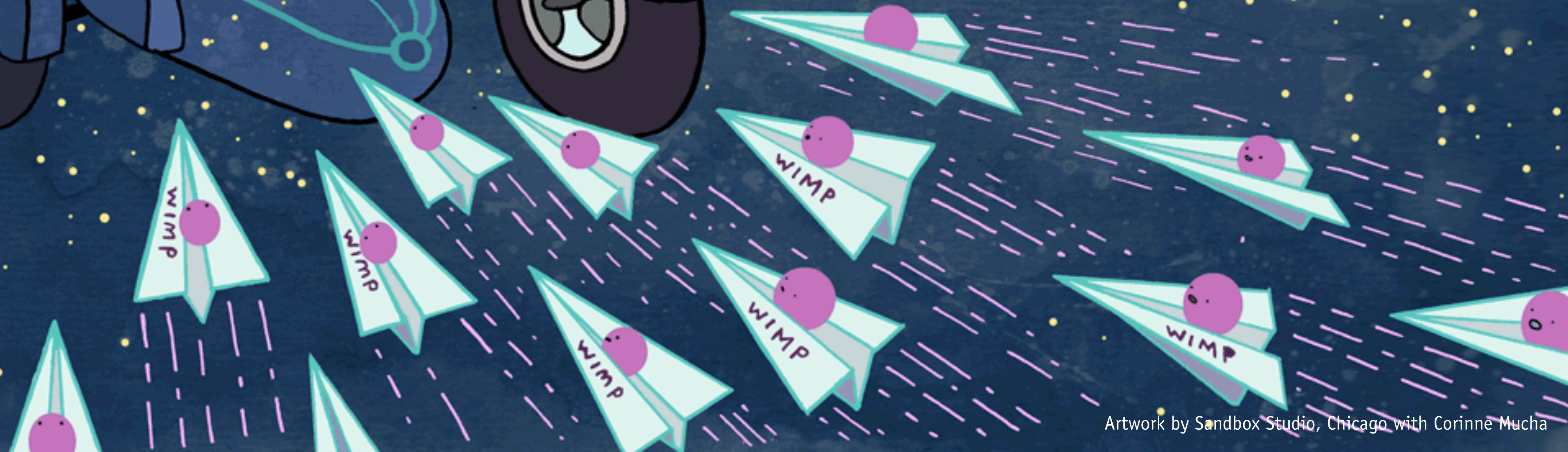
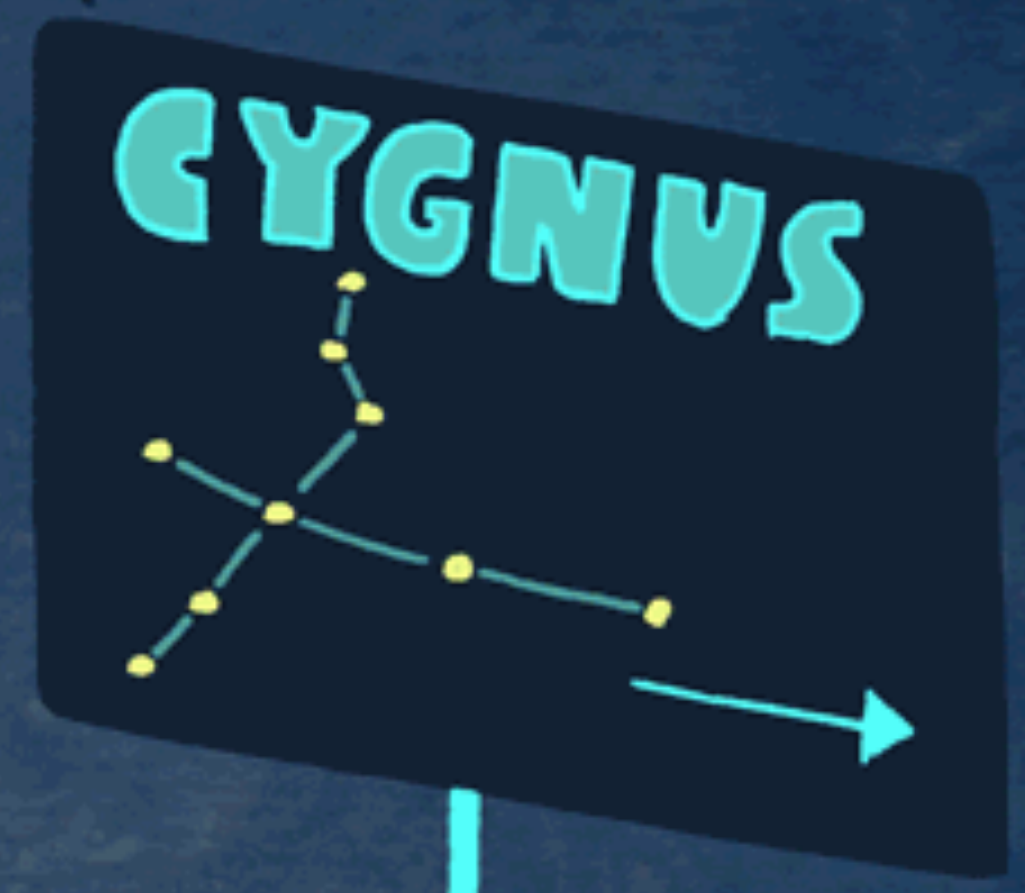
$e, \mu, \tau, \gamma, u, d, c, s, t,$
 $b, g, W, Z, \nu_e, \nu_\mu, \nu_\tau, H\dots$

lettere dell'alfabeto: **26**

particelle che conosciamo: **>33**

quante spiegano la materia oscura: **zero**





materia oscura

un qualche
bersaglio

misuriamo questo
"rinculo"



← rivelatore
(bersaglio che
rincula)

← materia
oscura

↑ vento di
materia
oscura



rivelatore
(bersaglio che
rincula)

materia
oscura

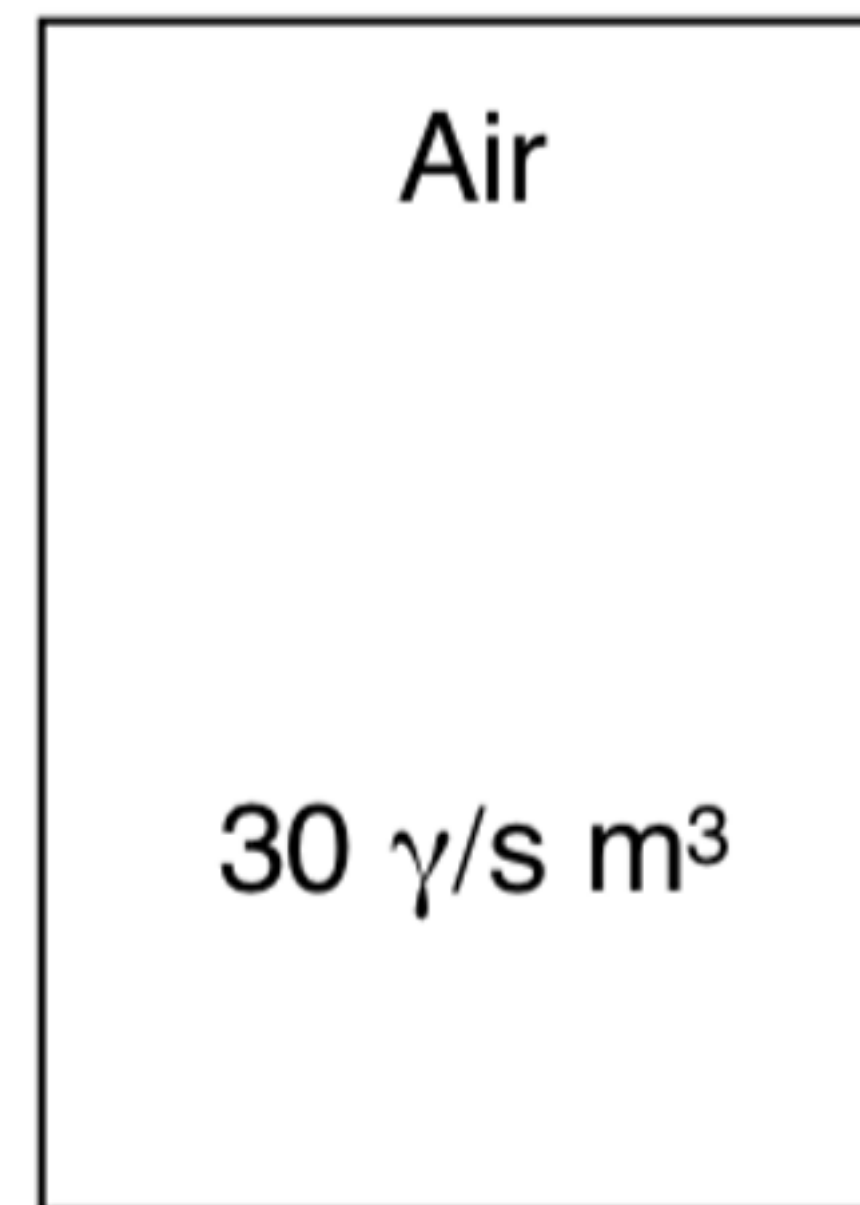
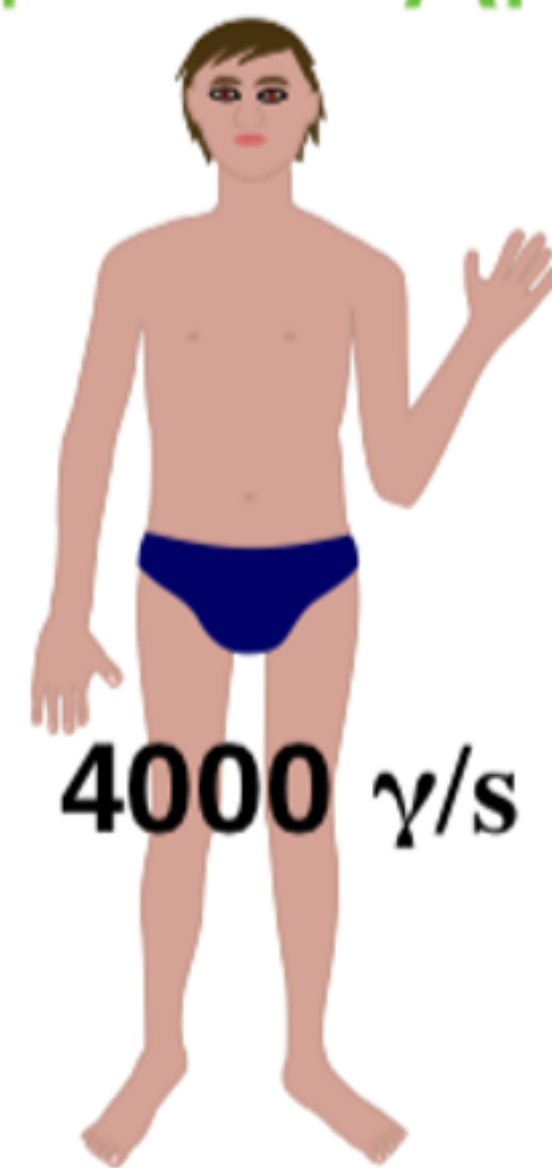
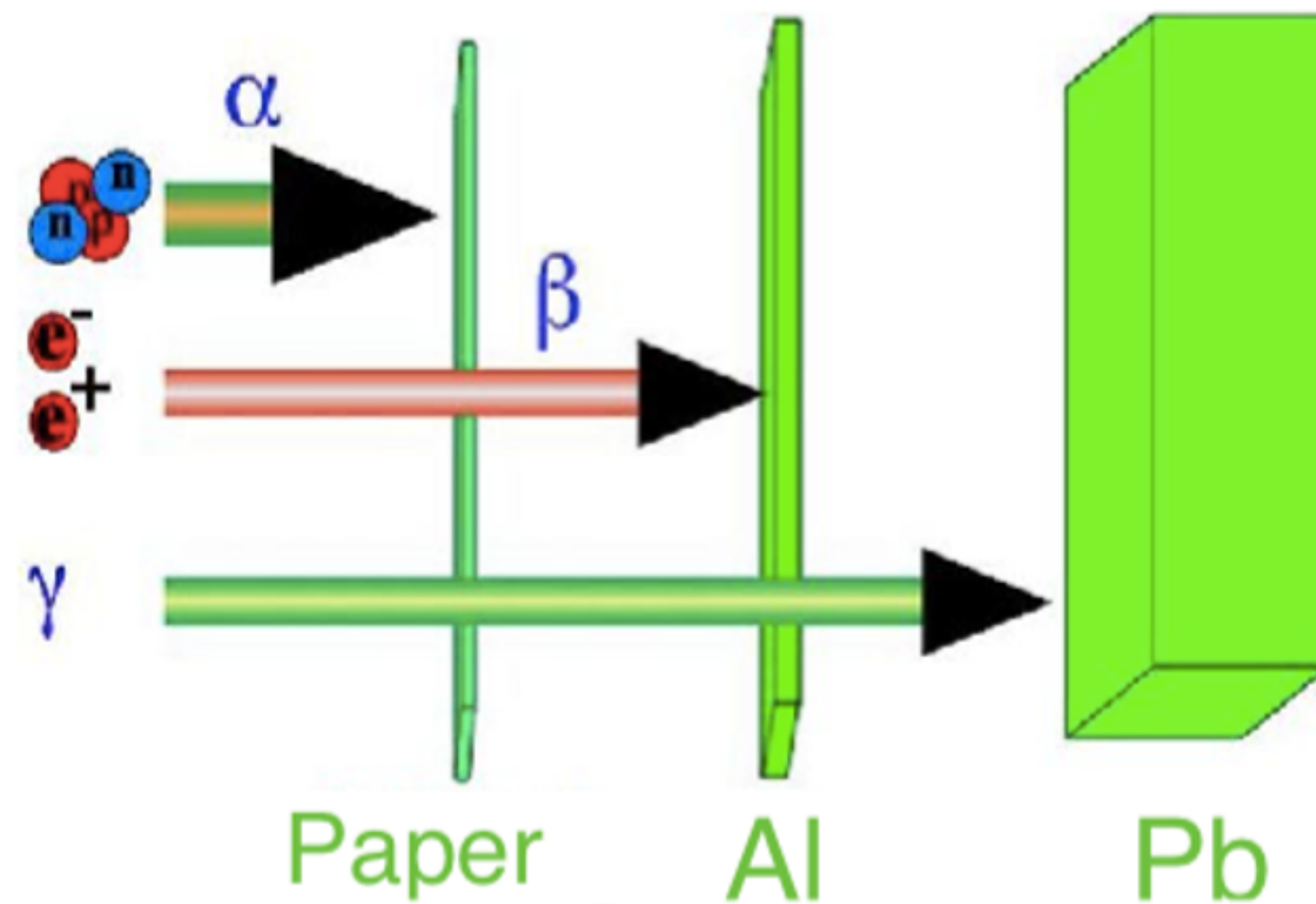
vento di
materia
oscura



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image credits: [A. Chantelauze](#), [S. Staffi](#), and [L. Bret](#)

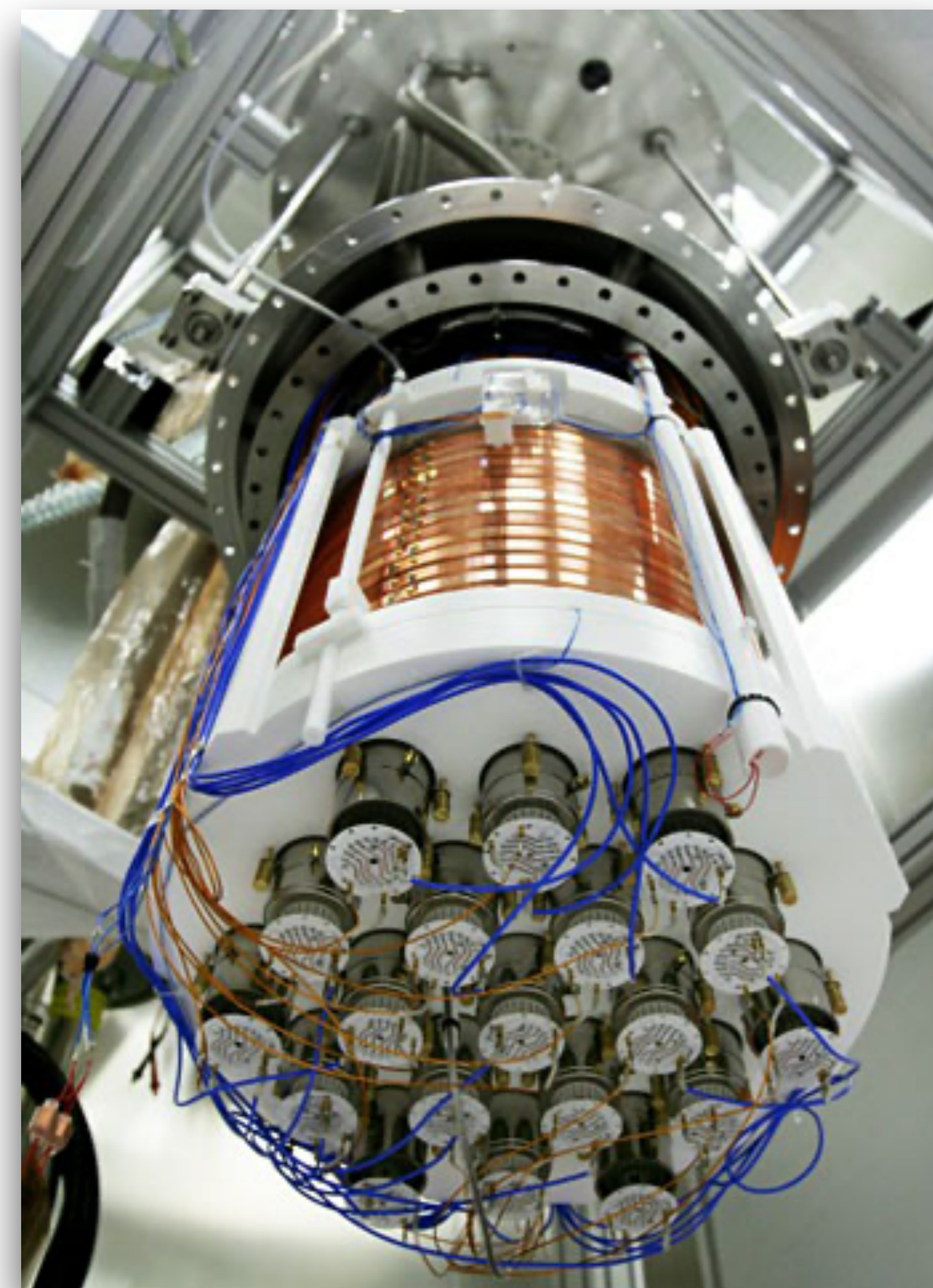
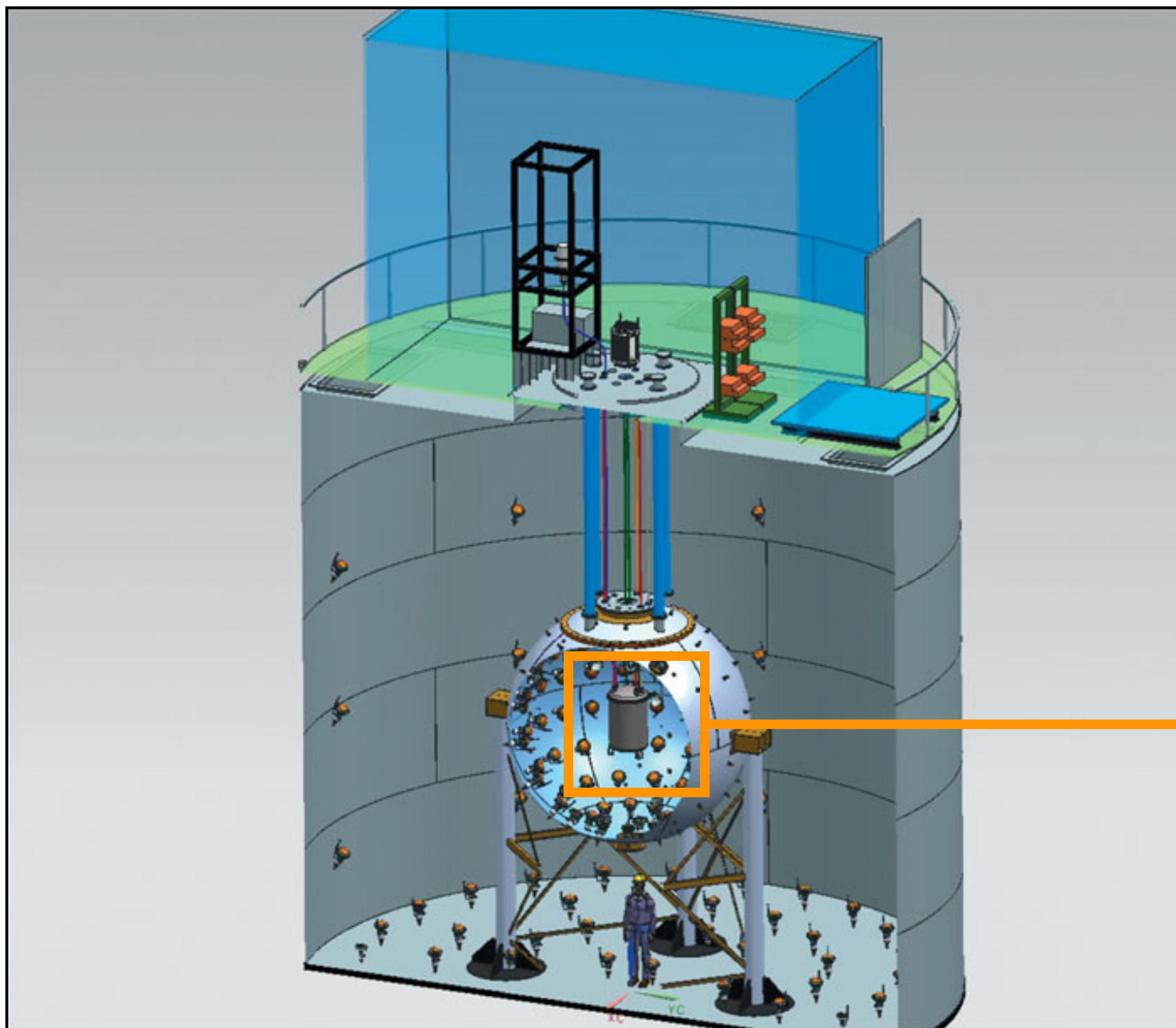
RADIOACTIVITY CONTROL



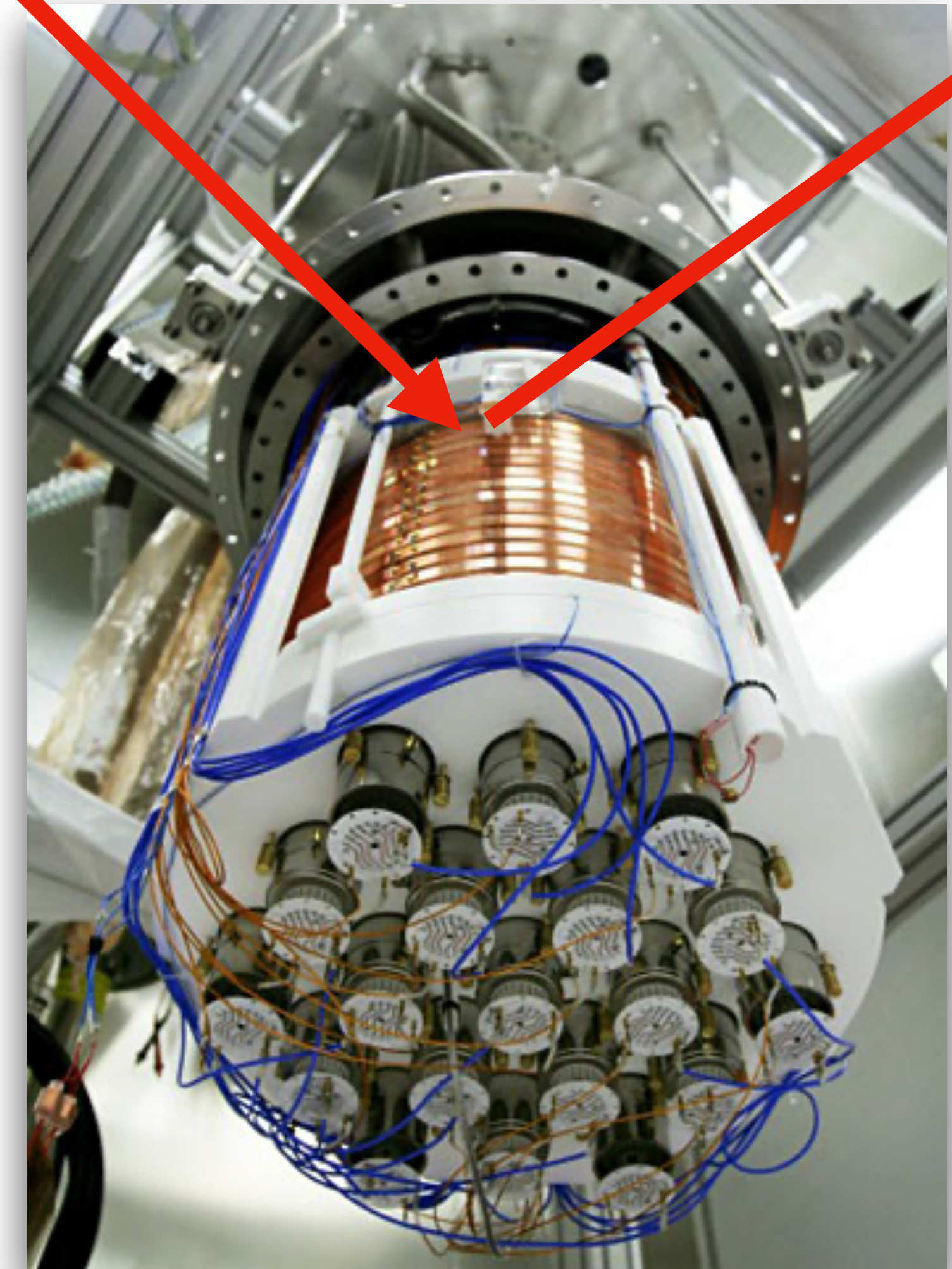
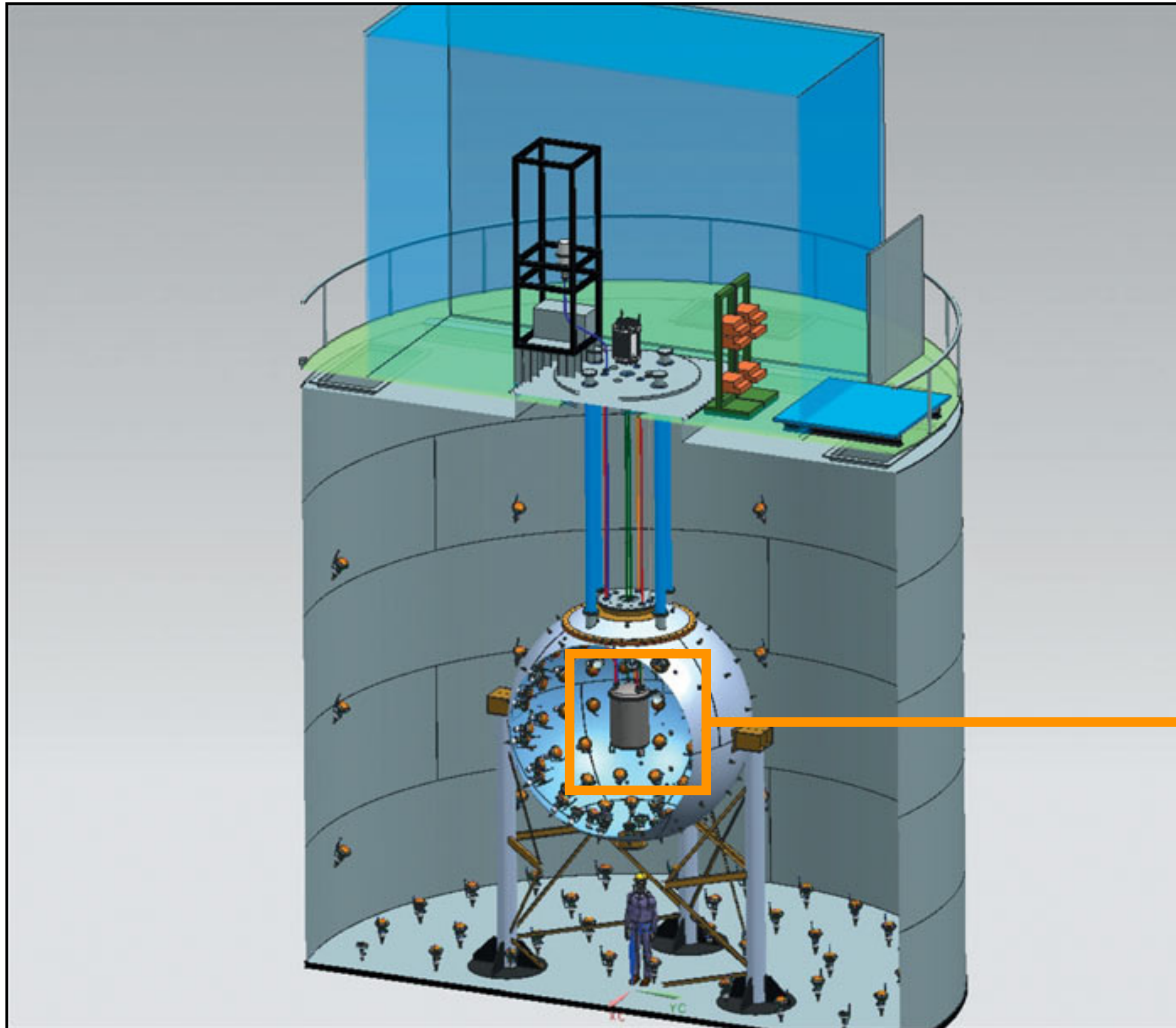
Radiopure materiale in radiopure environments



sotto 1600 m di roccia:
DarkSide ai Laboratori
Nazionali del Gran Sasso
(INFN)

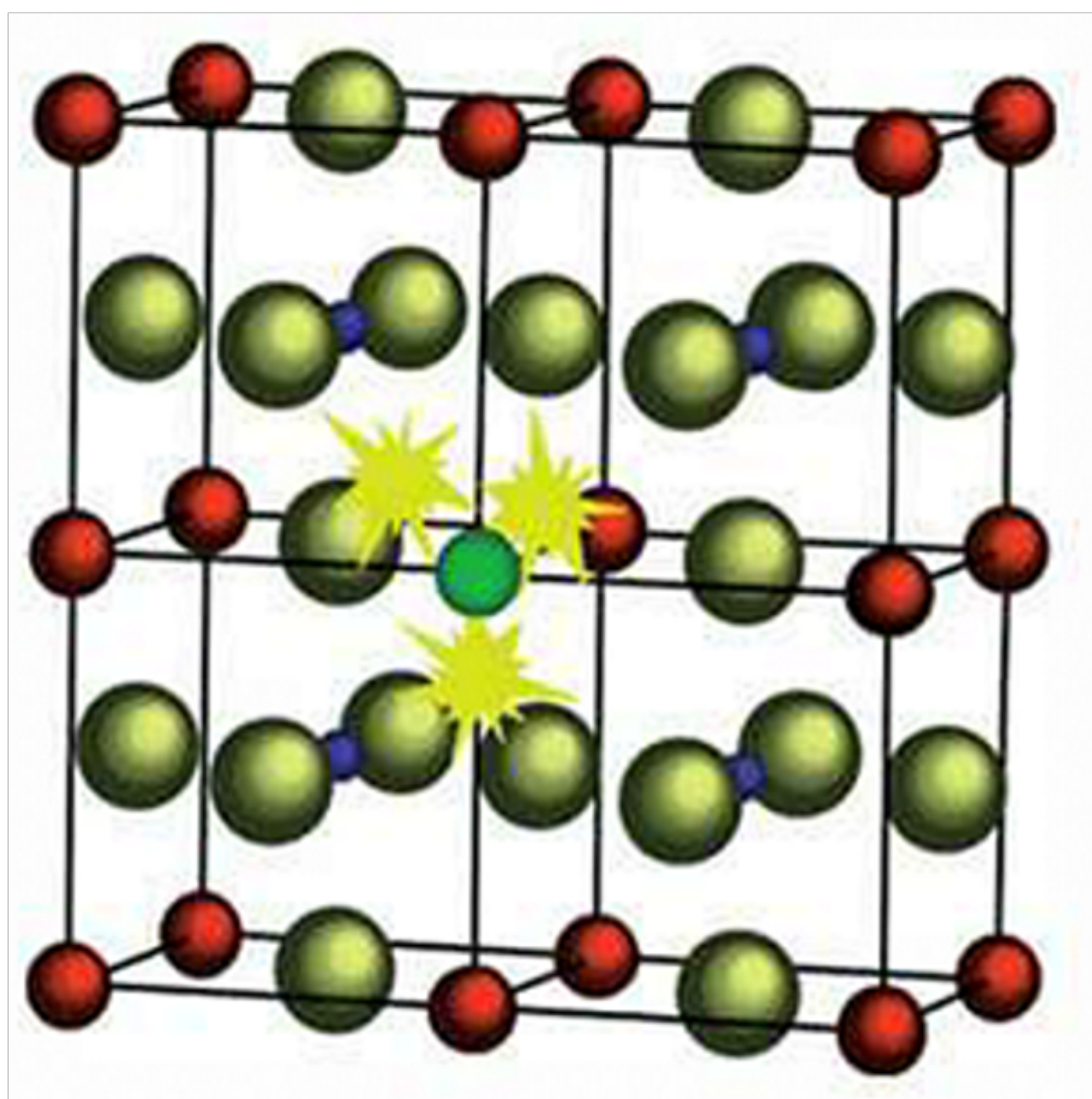


**particella misteriosa
di materia oscura**





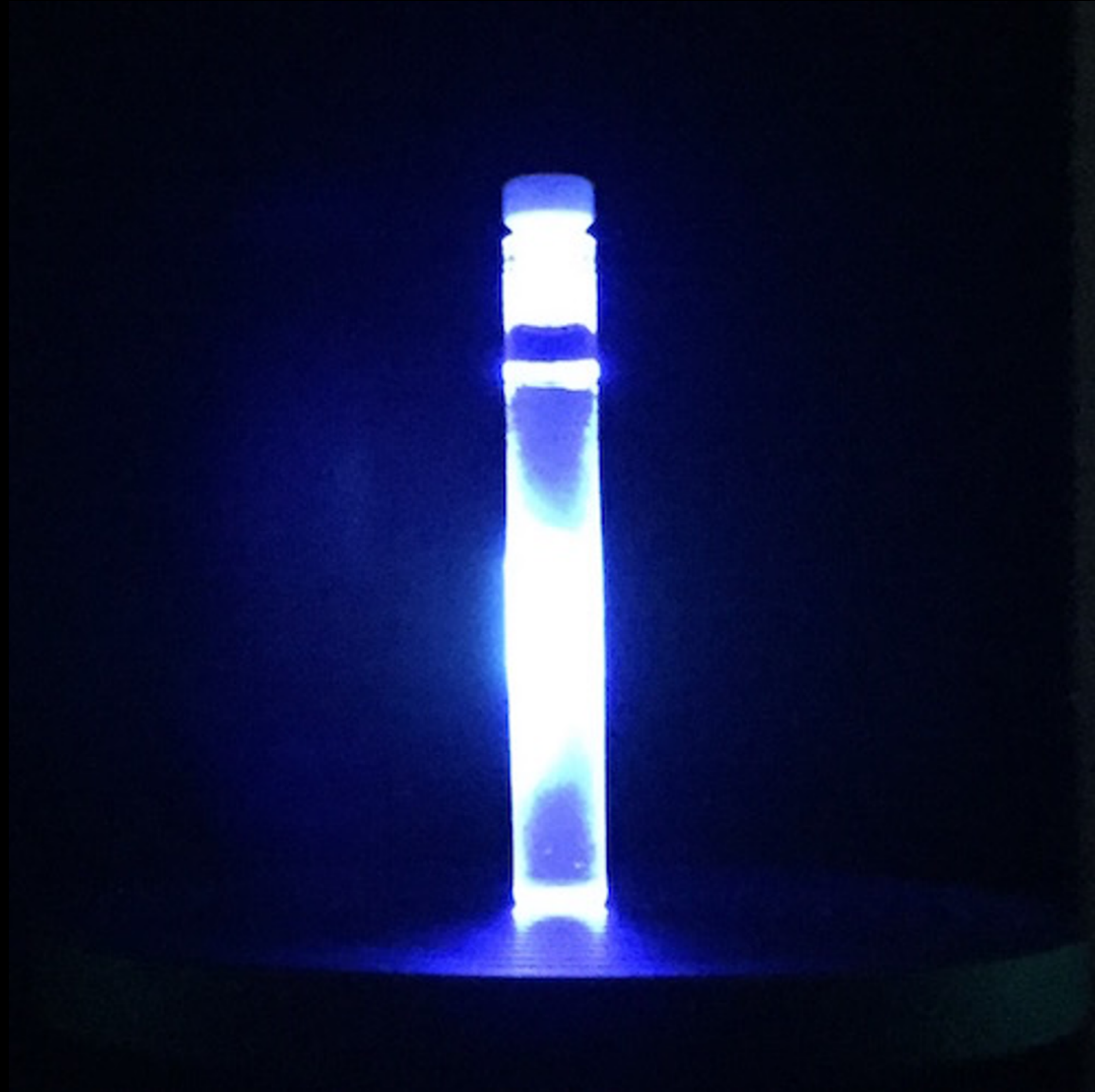
DarkSide-50
(DarkSide-20k dal 2027,
400 volte più grande!)

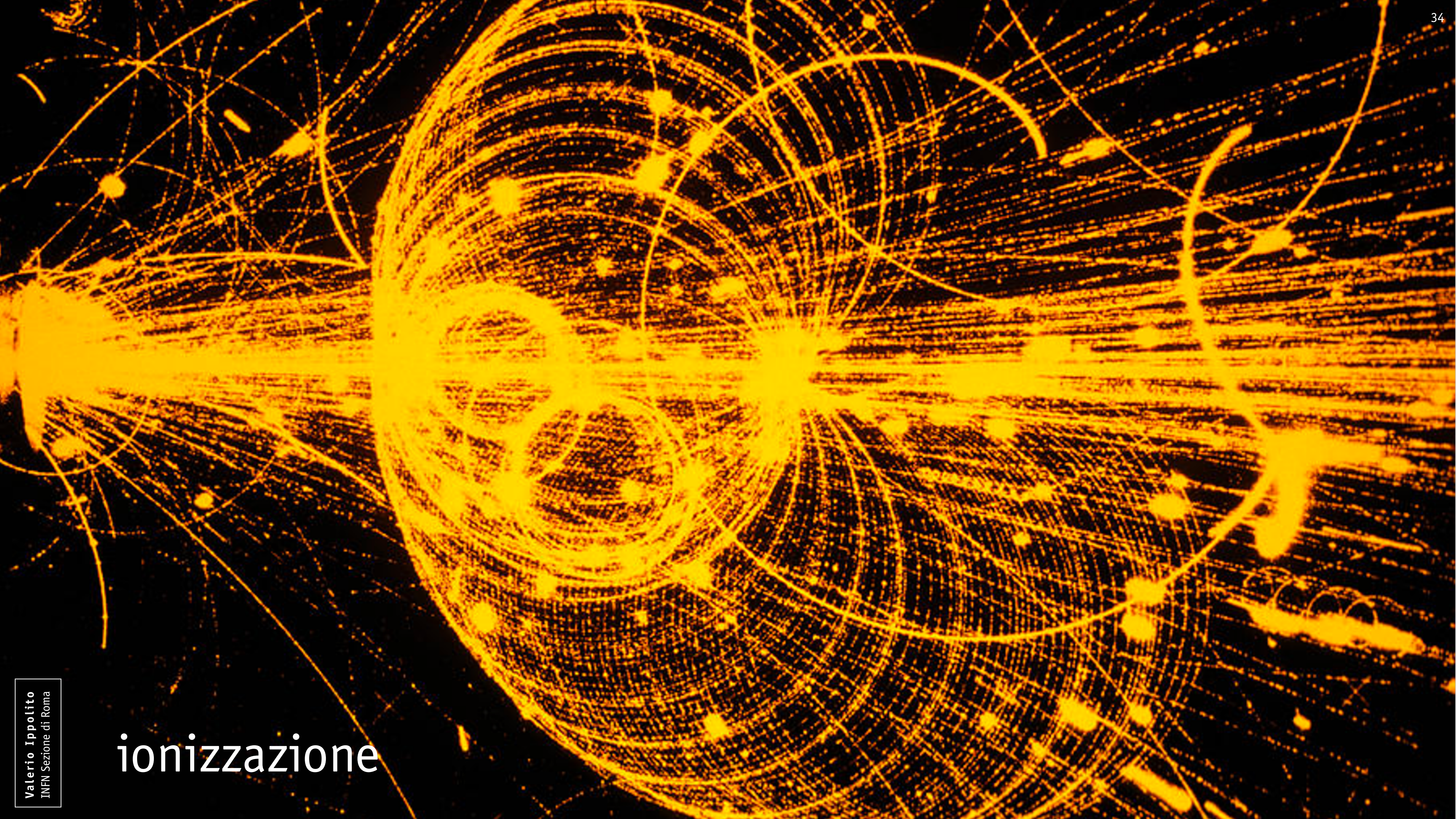


i rinculi sono **rari** e "eccitano" gli altri atomi

quando succede, misuriamo
elettroni e fotoni emessi

luce di scintillazione





ionizzazione

tutto questo in
rivelatori **giganteschi**

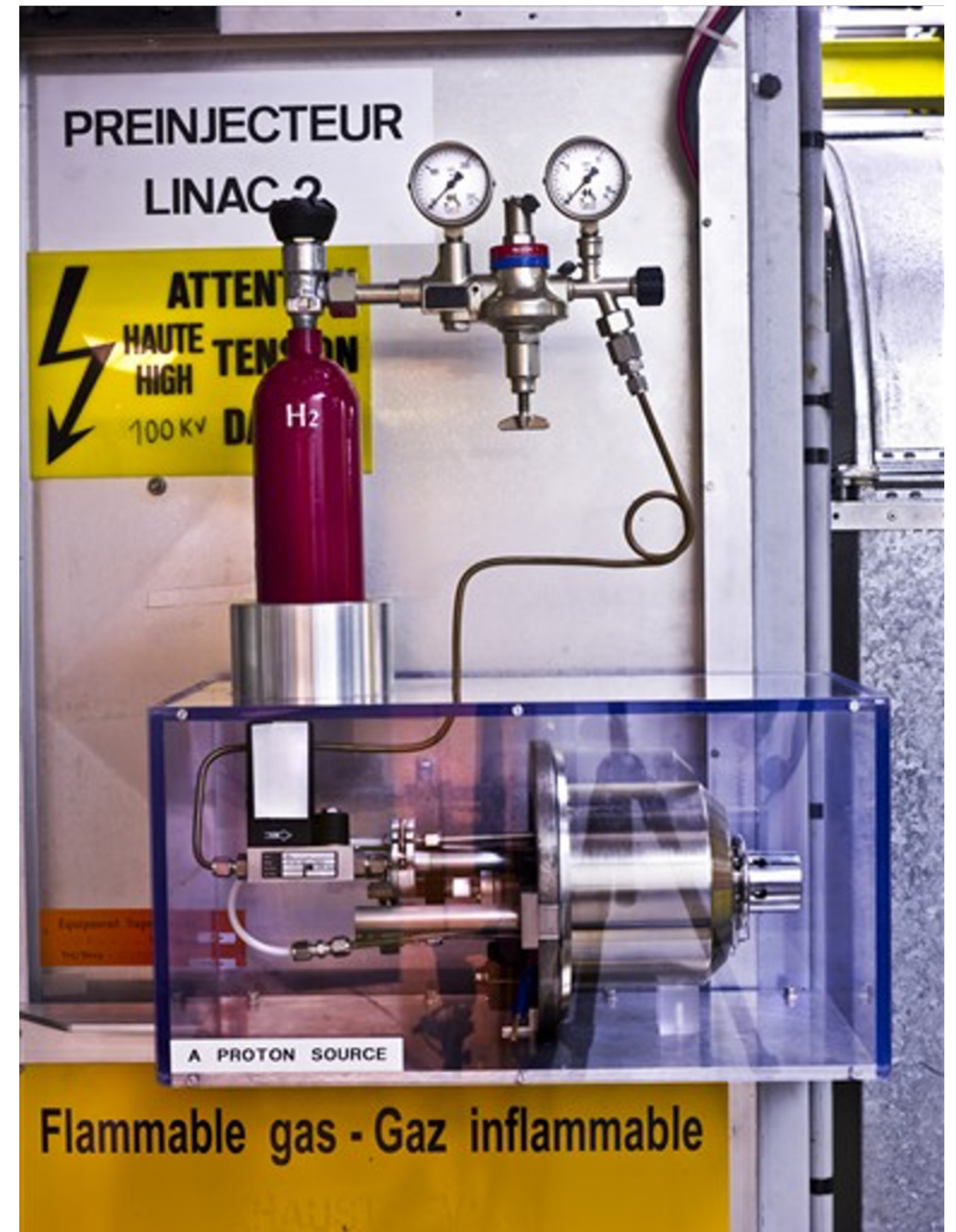


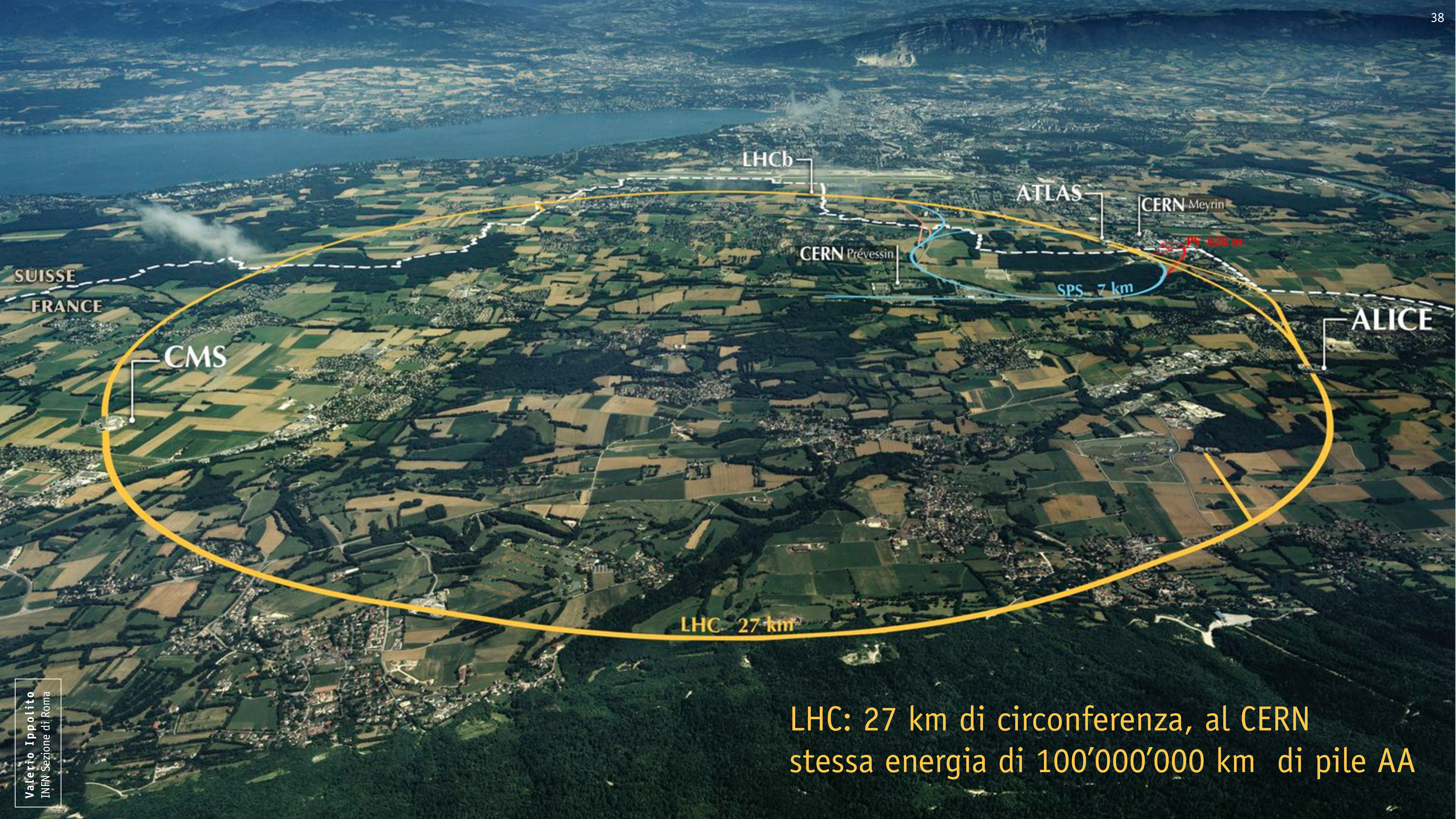
proviamo a **creare** materia oscura

facendo scontrare **protoni**

al **99.999999896%** della velocità della luce

e vedendo che succede...

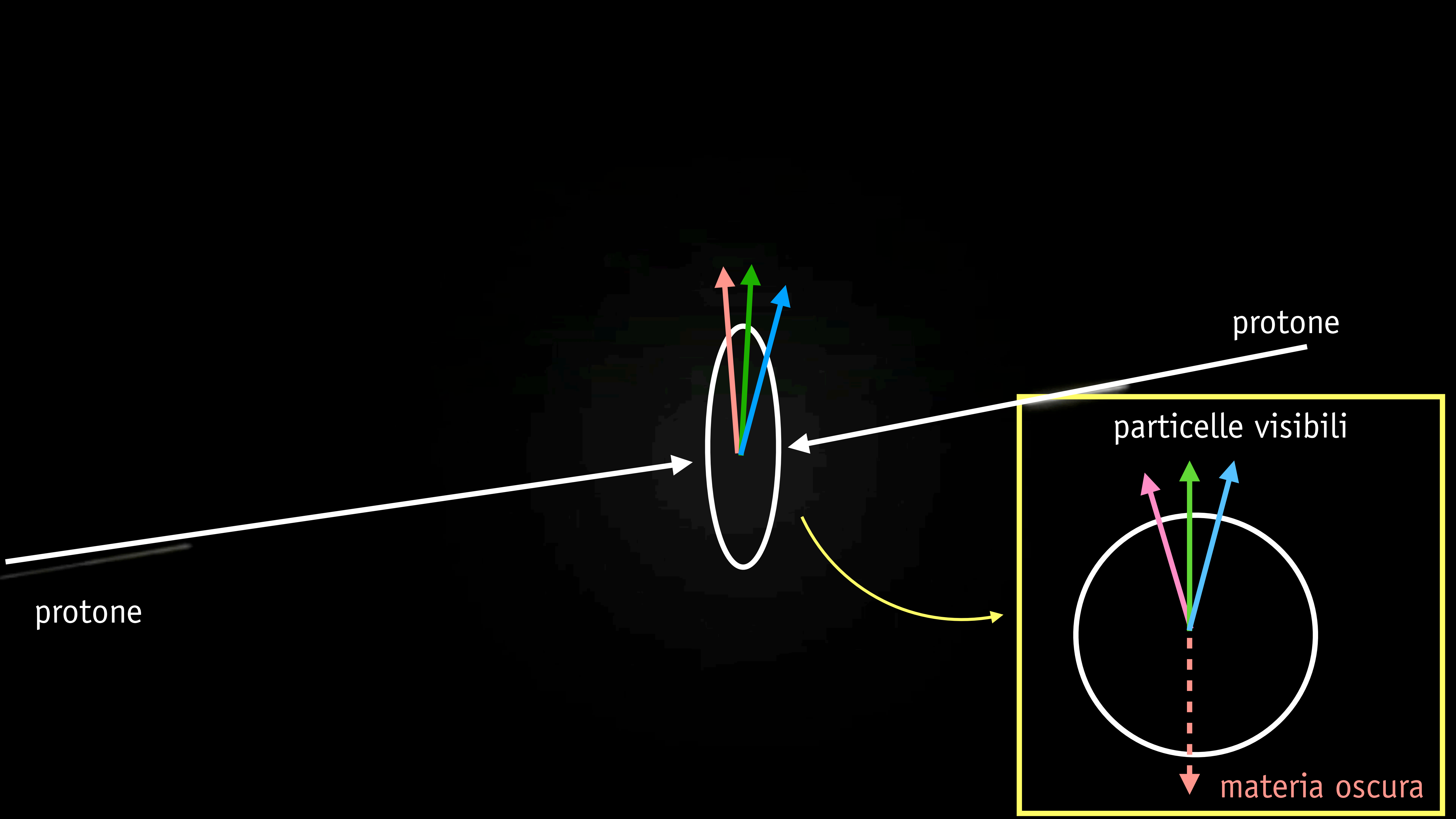


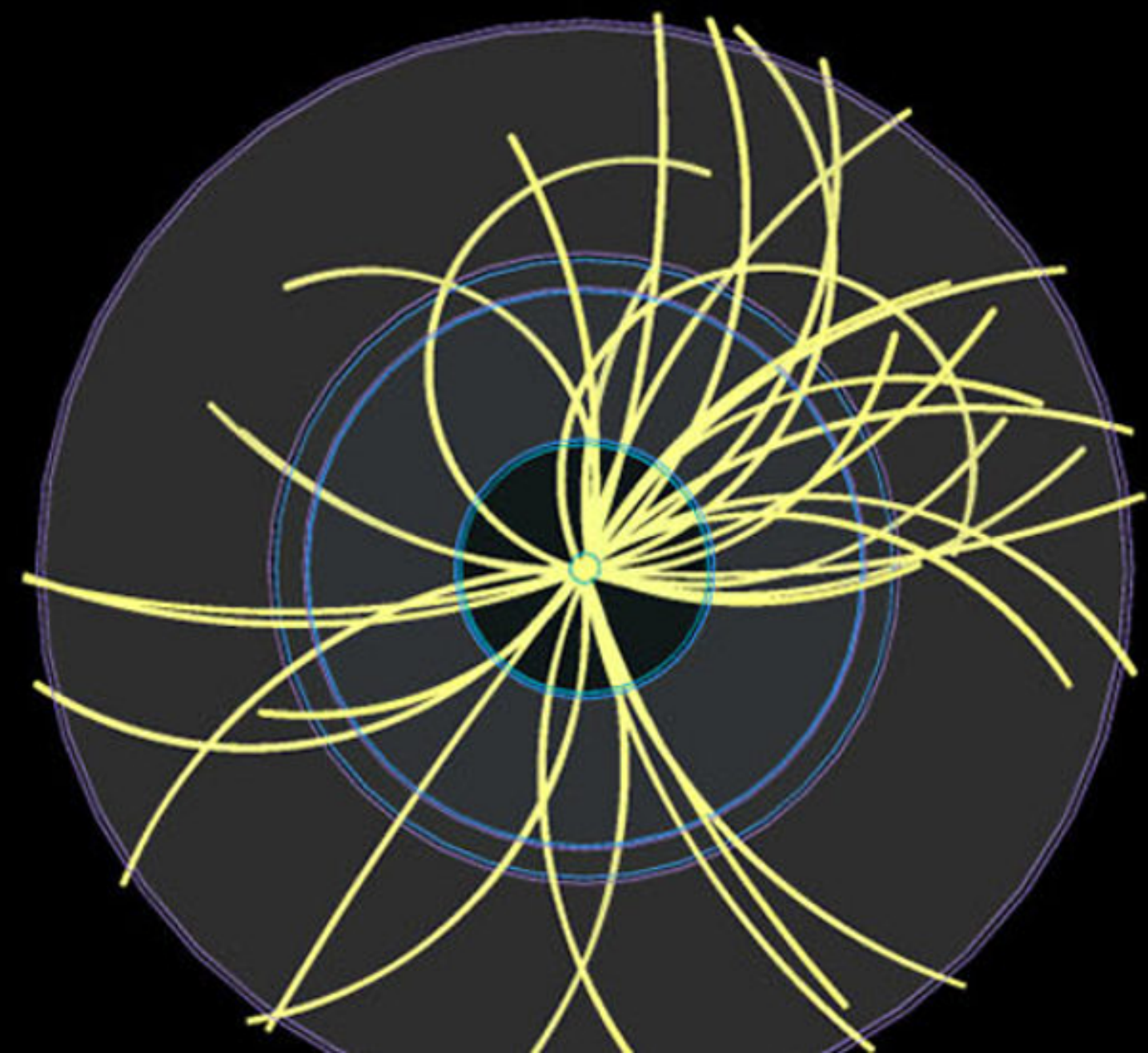
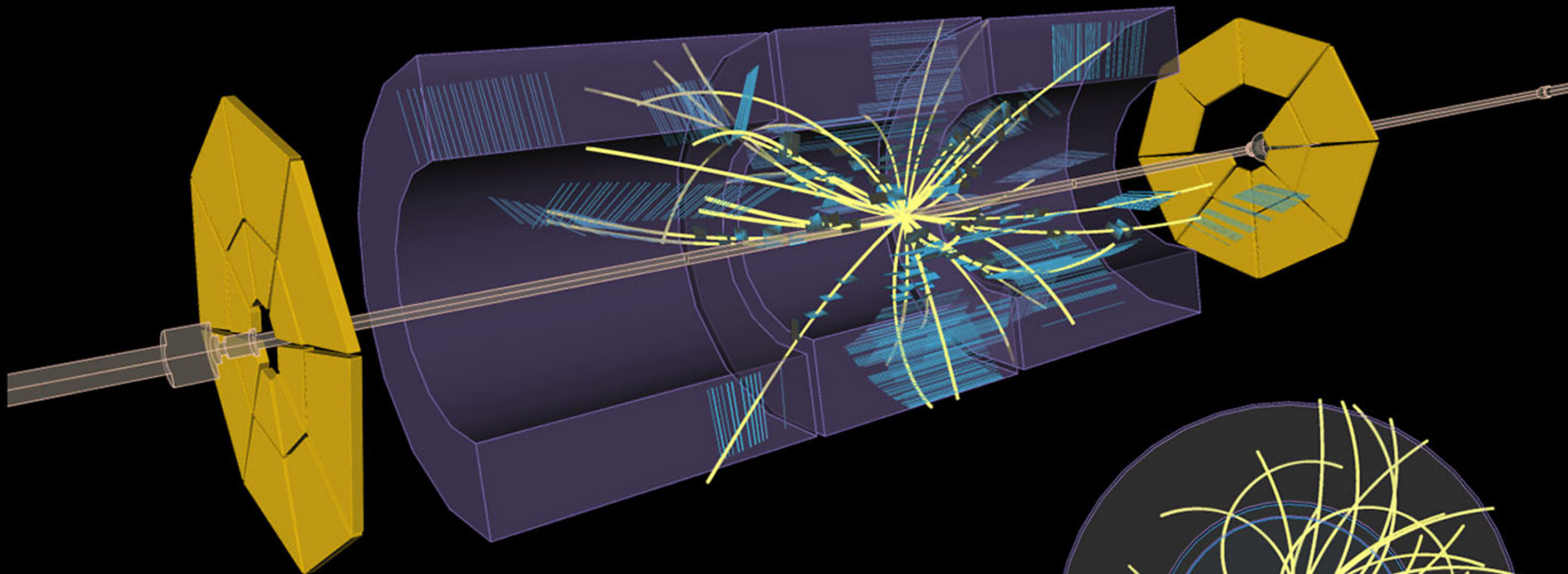


LHC: 27 km di circonferenza, al CERN
 stessa energia di 100'000'000 km di pile AA



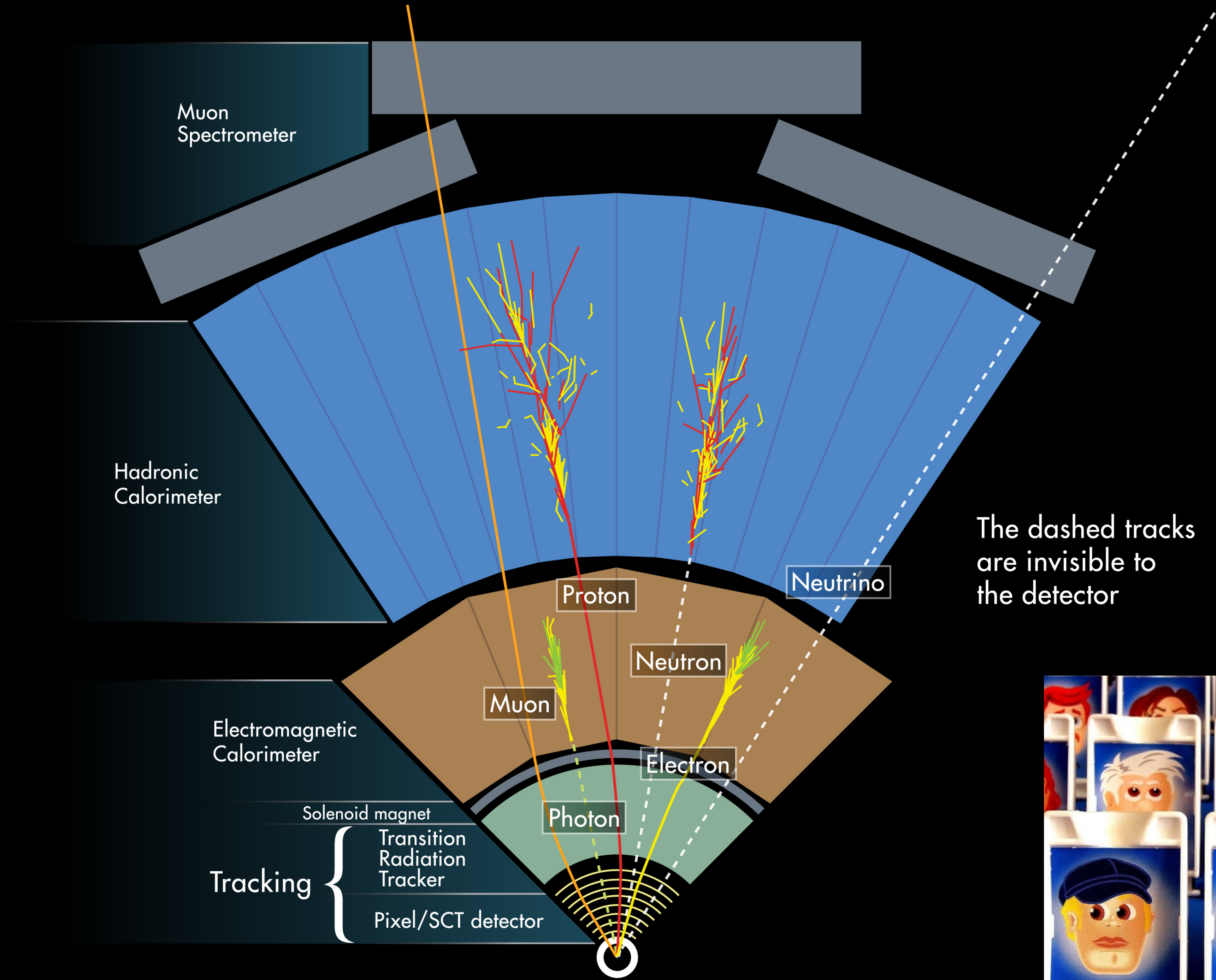






ATLAS
EXPERIMENT

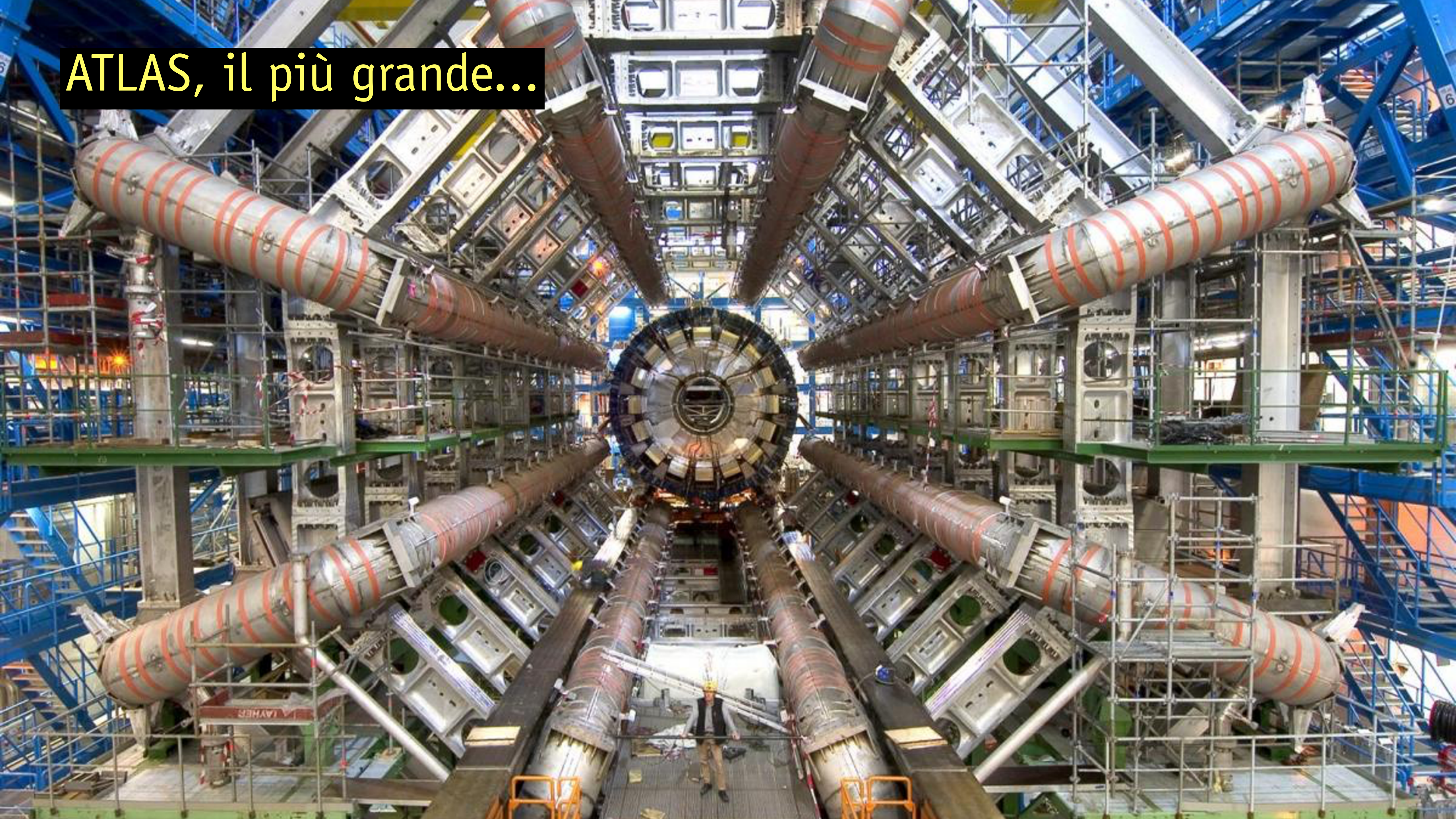
Run: 263962
Event: 20805
2015-05-05 09:39:47 CEST



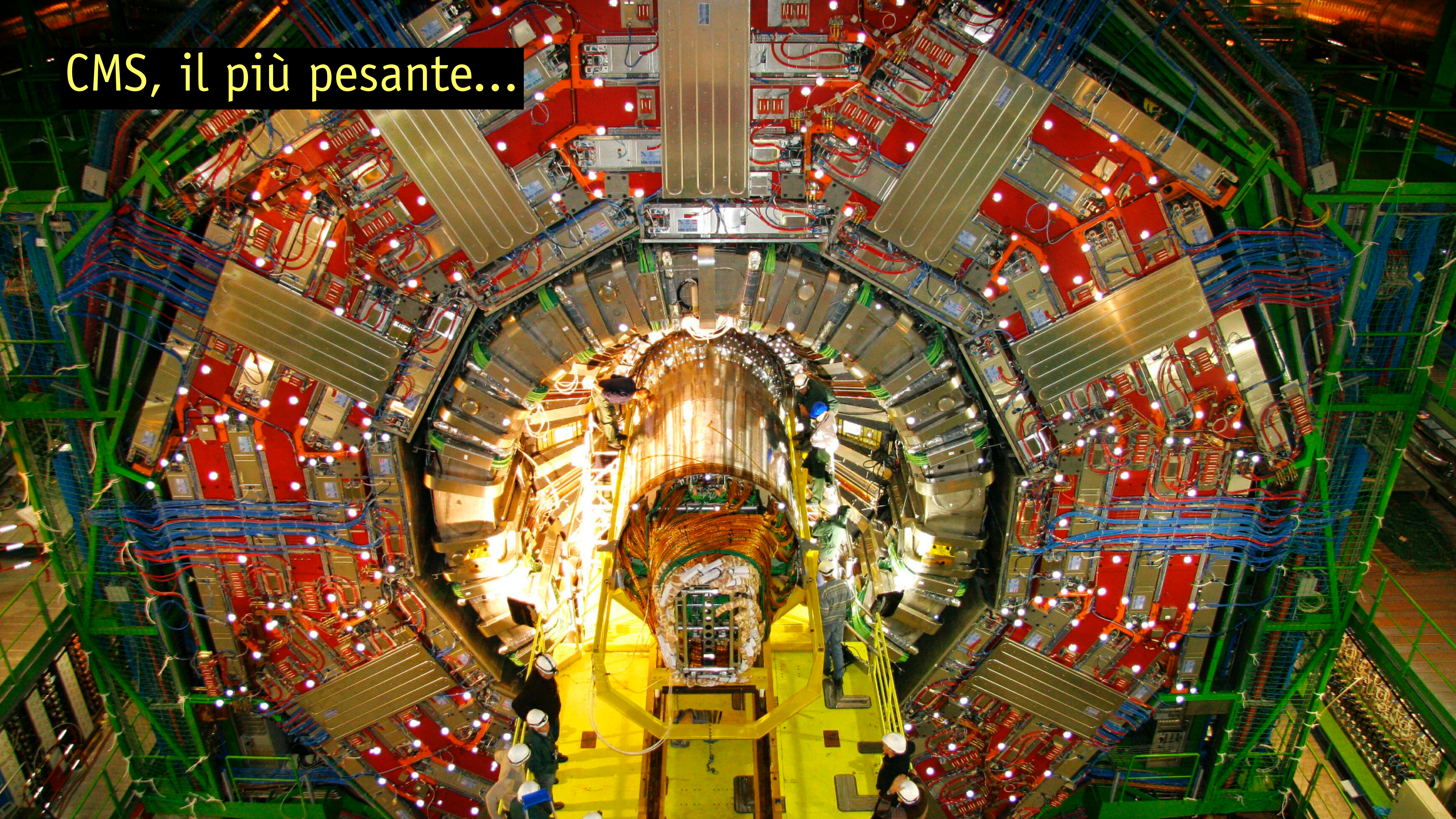
credits: ATLAS experiment, regoledegioco.com



ATLAS, il più grande...



CMS, il più pesante...





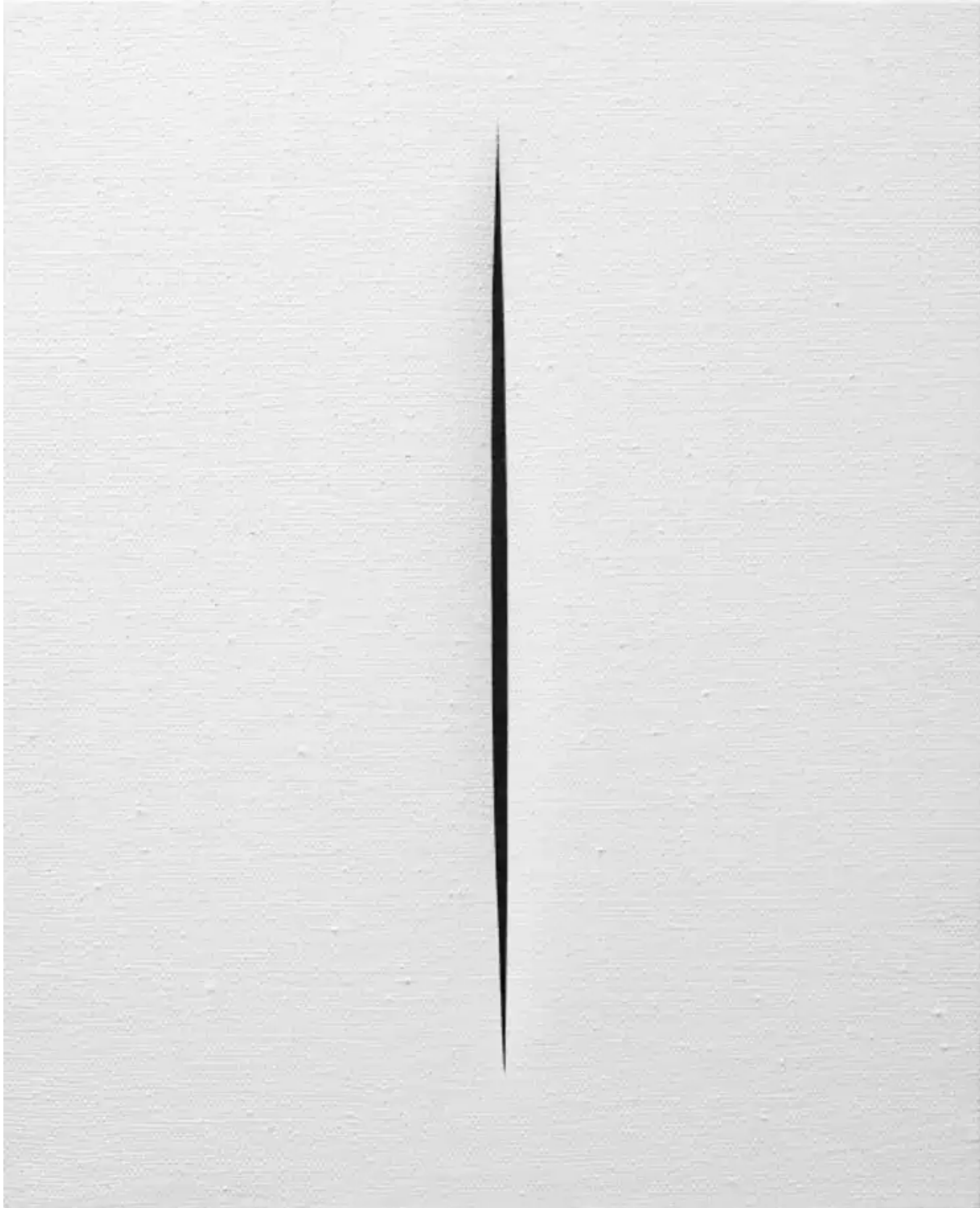
Un giorno Alice arrivò a un bivio sulla strada e vide lo Stregatto sull'albero.”

“Che strada devo prendere?” chiese.

La risposta fu una domanda: “Dove vuoi andare?”

“Non lo so”, rispose Alice.

“Allora, – disse lo Stregatto – non ha importanza.”



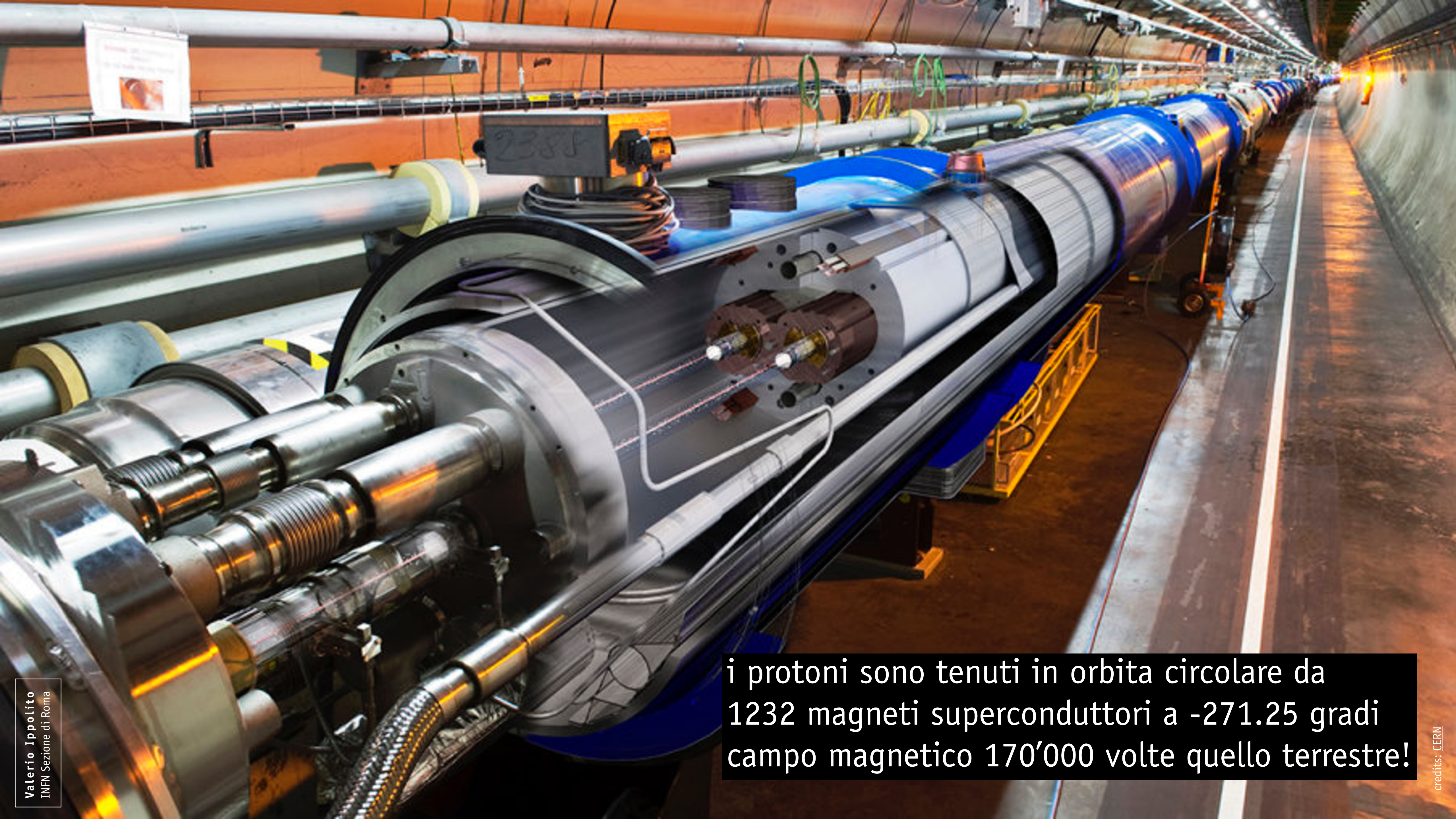
85% della materia
dell'universo

proviamo a **intercettarla**

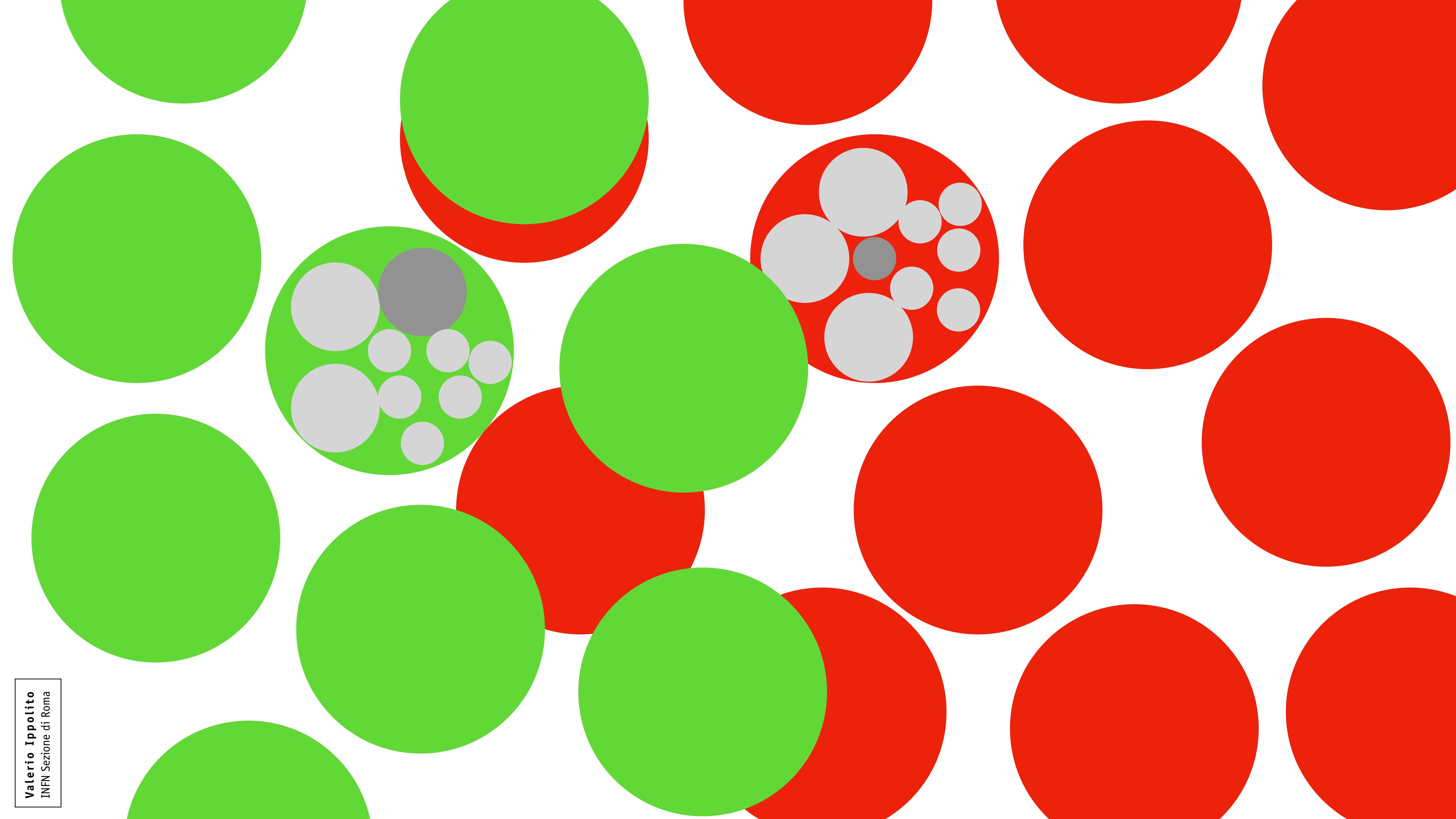
proviamo a **crearla**

il viaggio è iniziato!

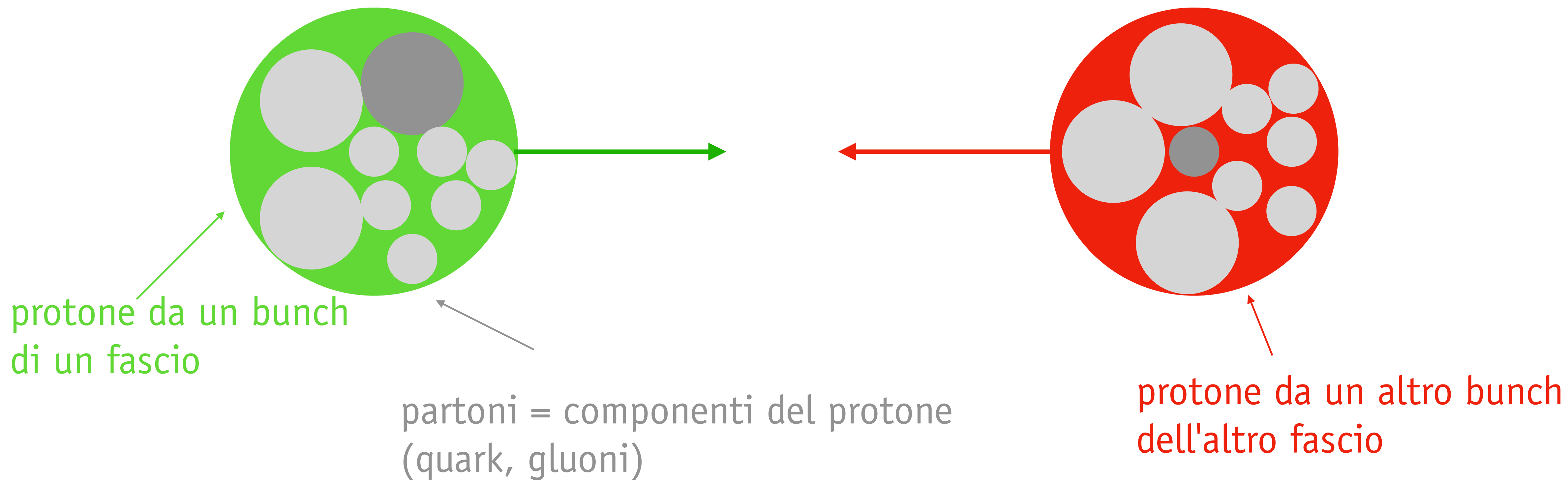
Backup



i protoni sono tenuti in orbita circolare da 1232 magneti superconduttori a -271.25 gradi campo magnetico 170'000 volte quello terrestre!

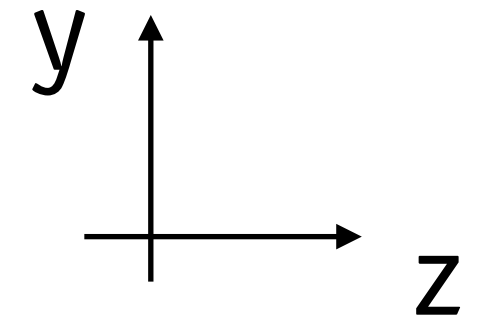


QUANDO DUE ~~PROTONI~~ PARTONI SI SCONTRANO



- protoni: velocità "orizzontale" vicina a quella della luce
 - **partoni**: pure, ma ignota!
- **ma**: nelle altre due direzioni, partoni (e protoni) quasi fermi

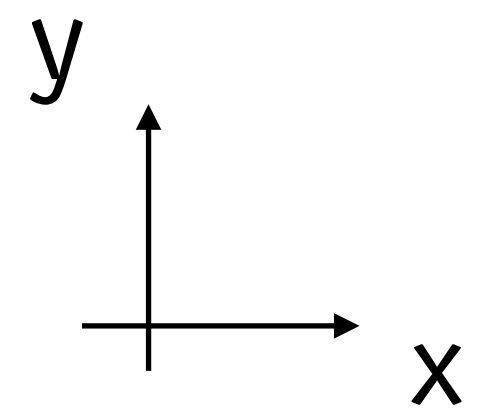
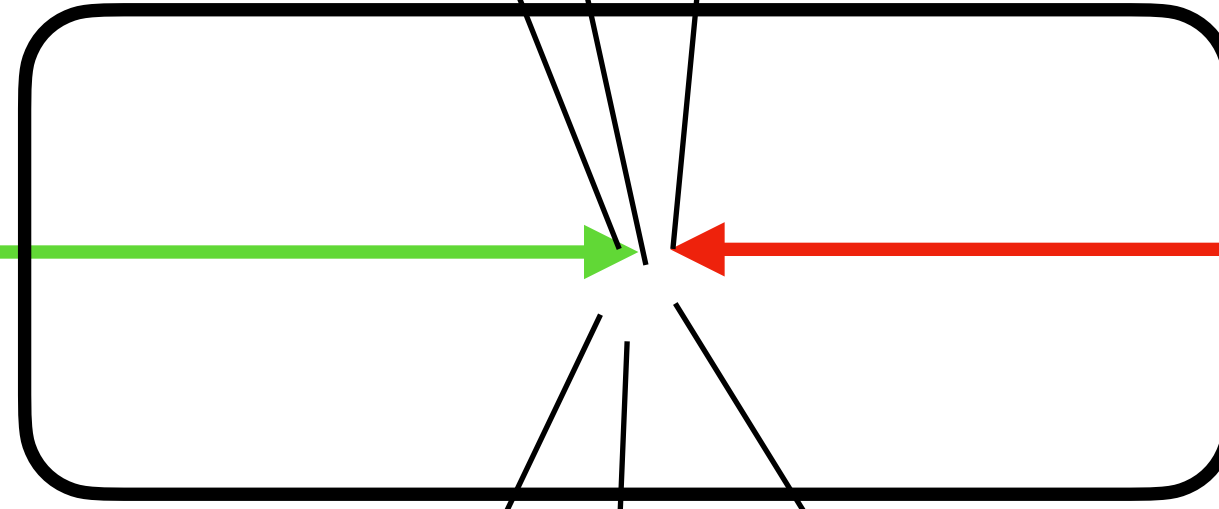




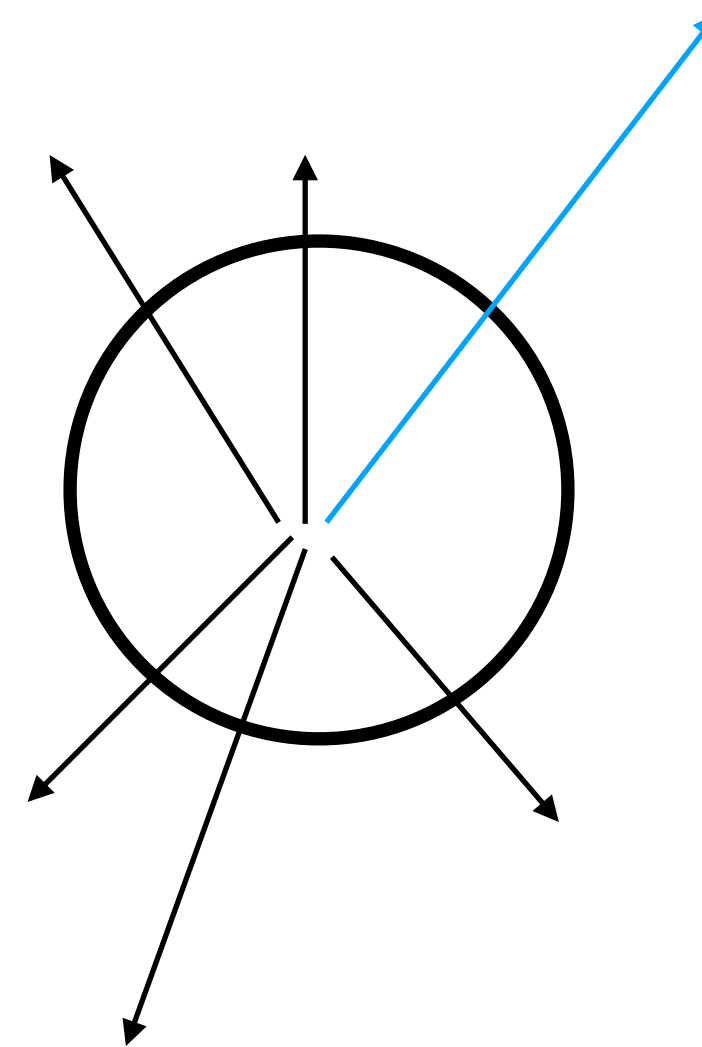
protoni



protoni



piano trasverso
"a somma zero"



- ermeticità:
ricostruire tutte le
particelle
- un "indovina chi?"
basato su rivelatori
in sequenza