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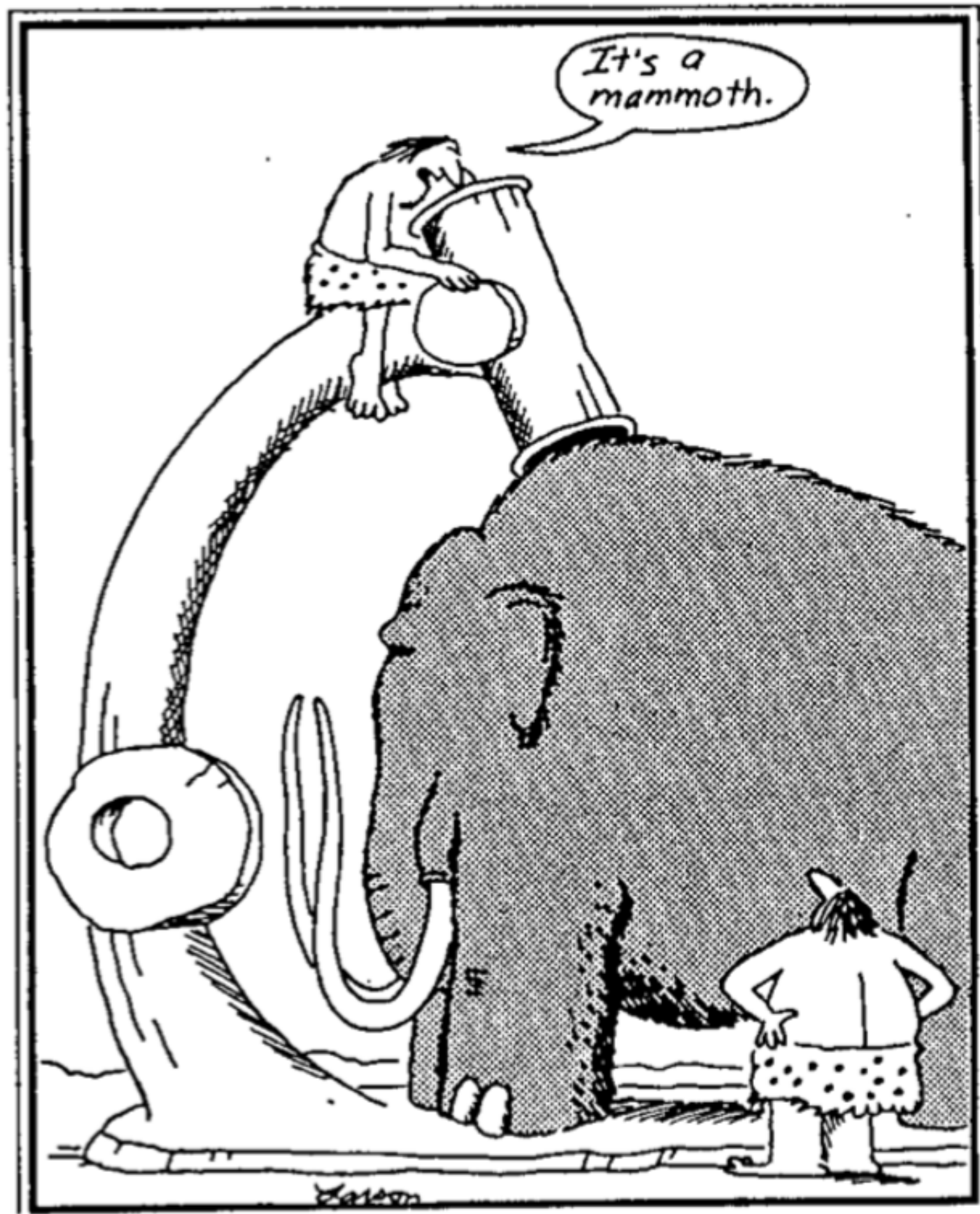
ALLA RICERCA DELLA MATERIA OSCURA

cos'è e come speriamo di trovarla



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Early microscope

VS





Valerio Ippolito
INFN Sezione di Roma

image credits: NASA and STScI

materia



materia



materia



materia



luce = materia
materia = luce?

materia



materia



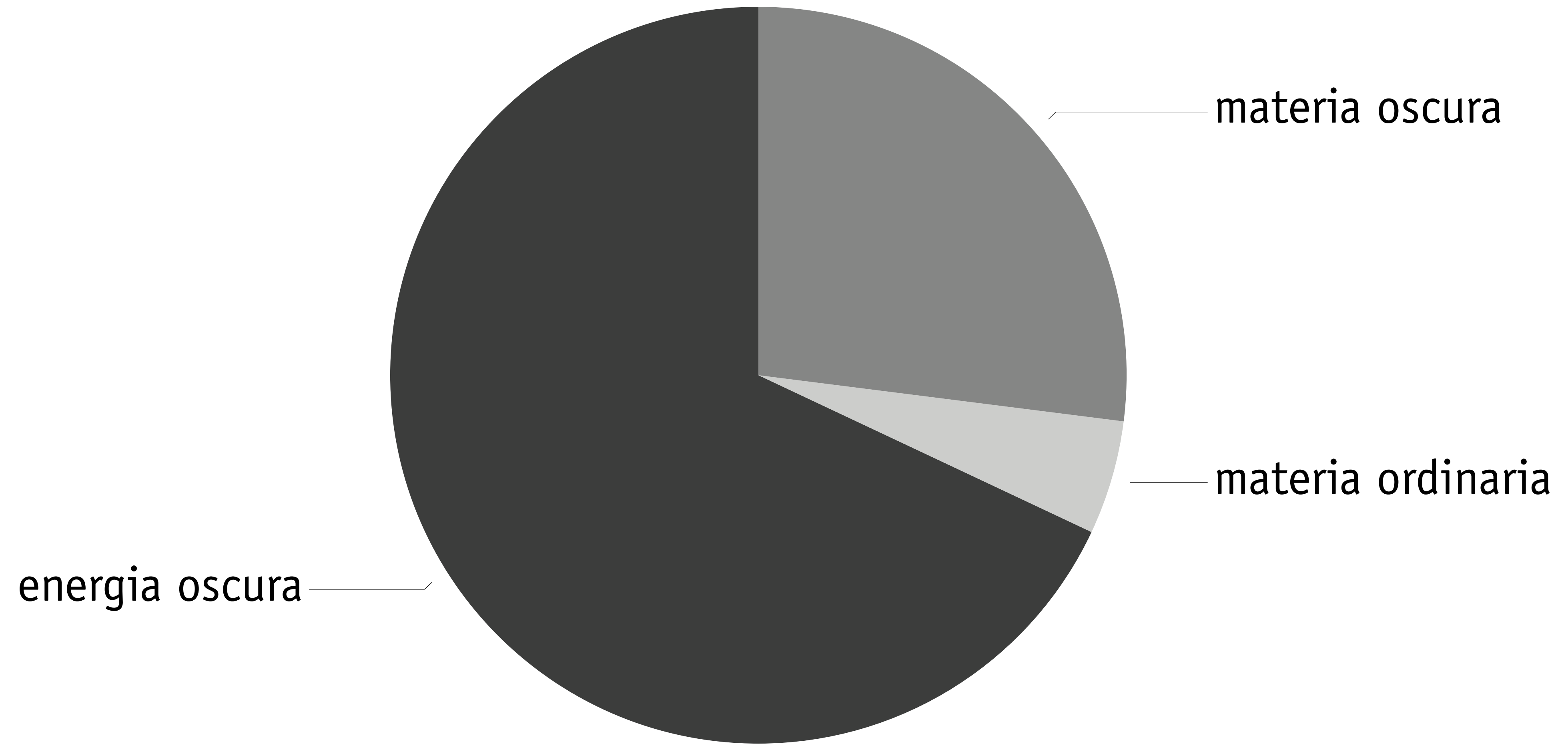
materia

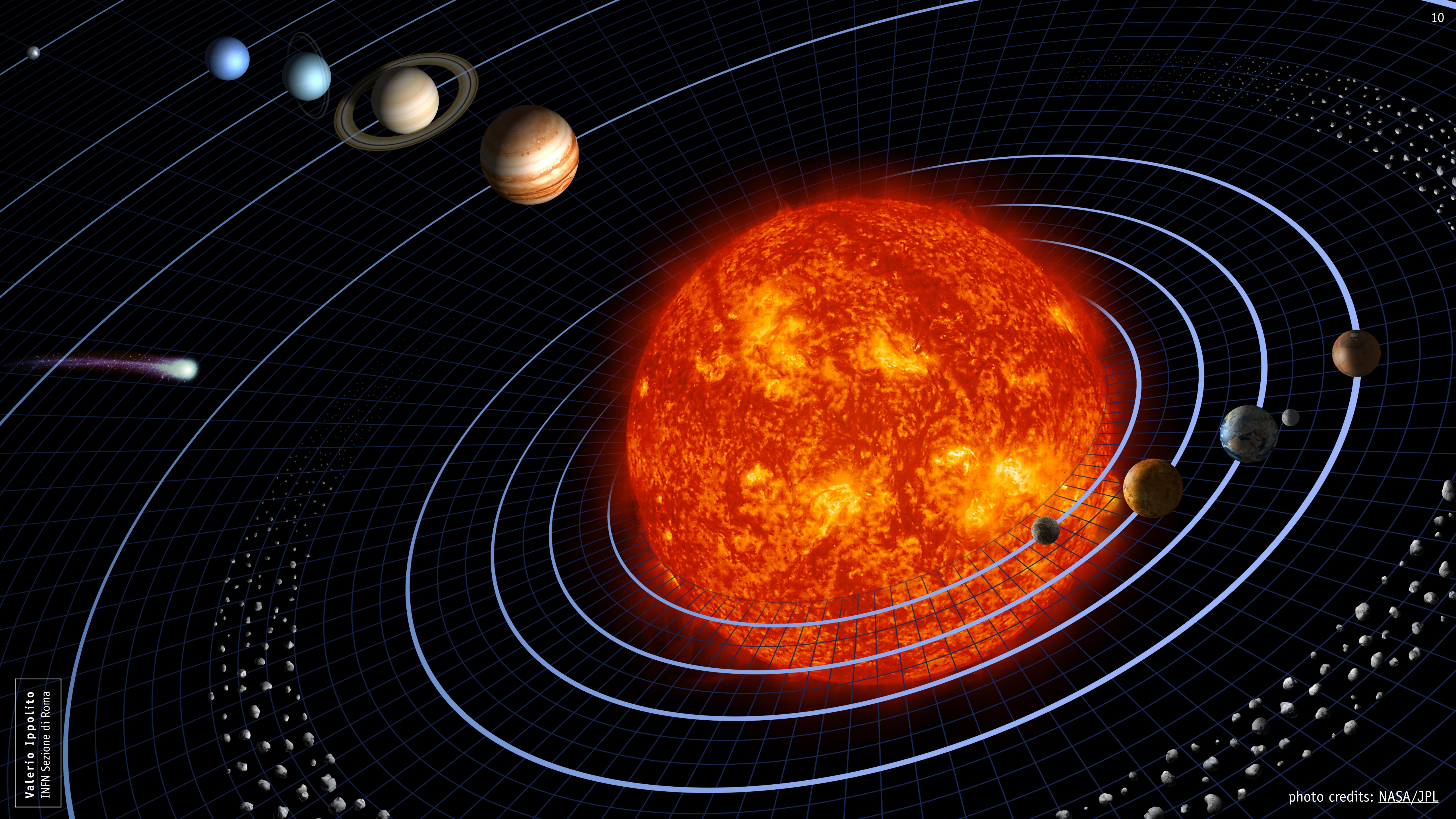


materia



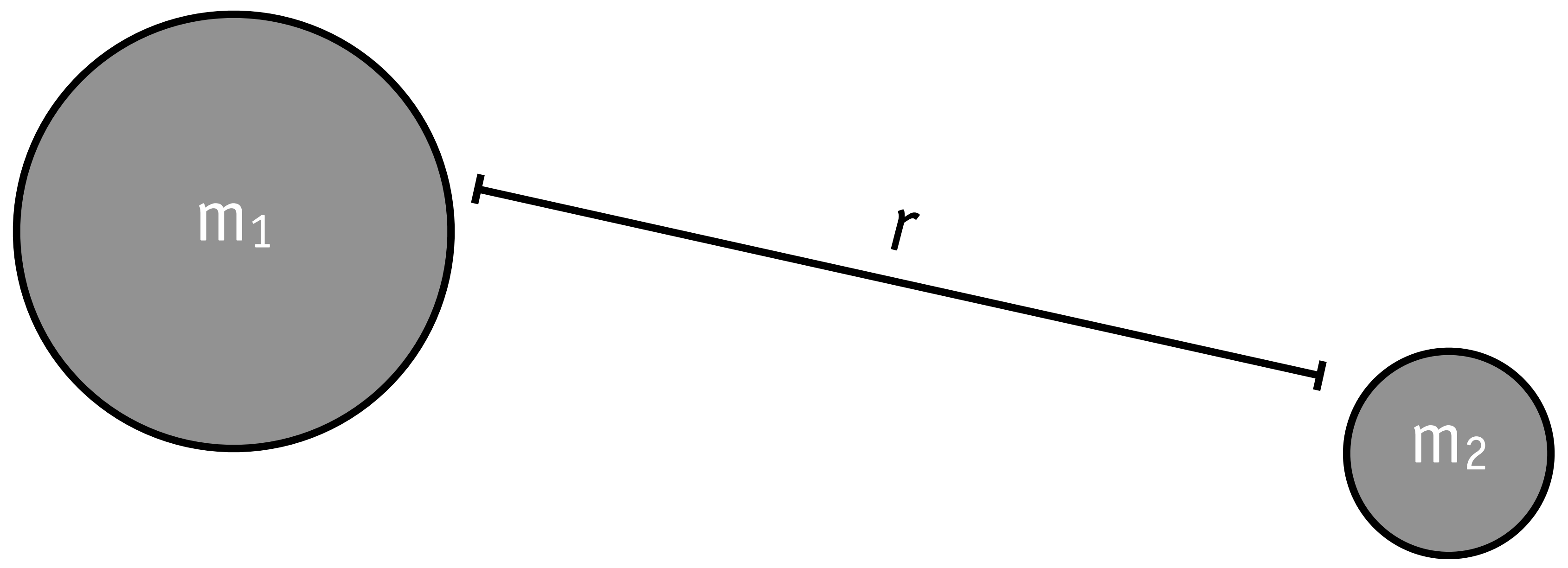




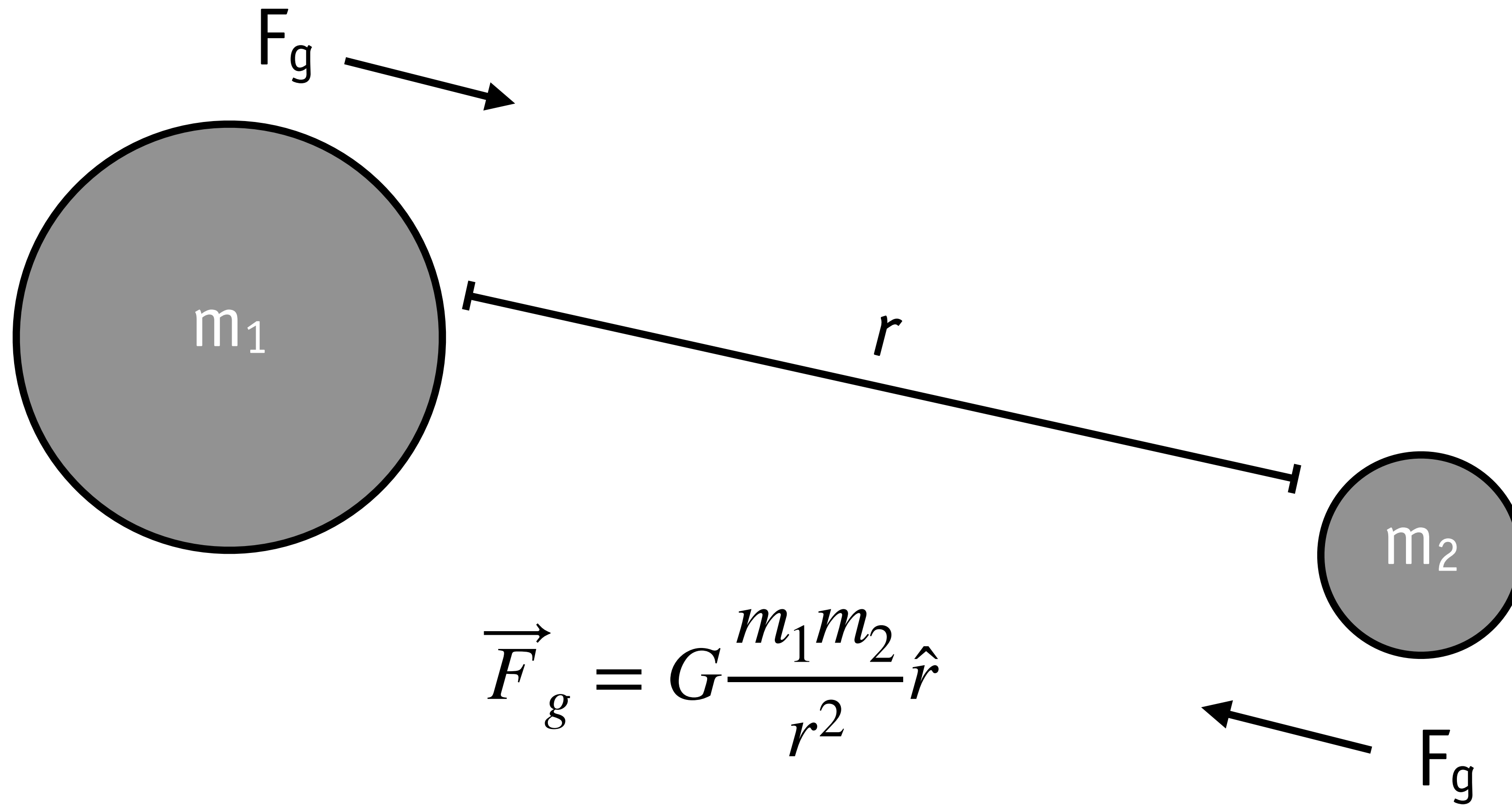


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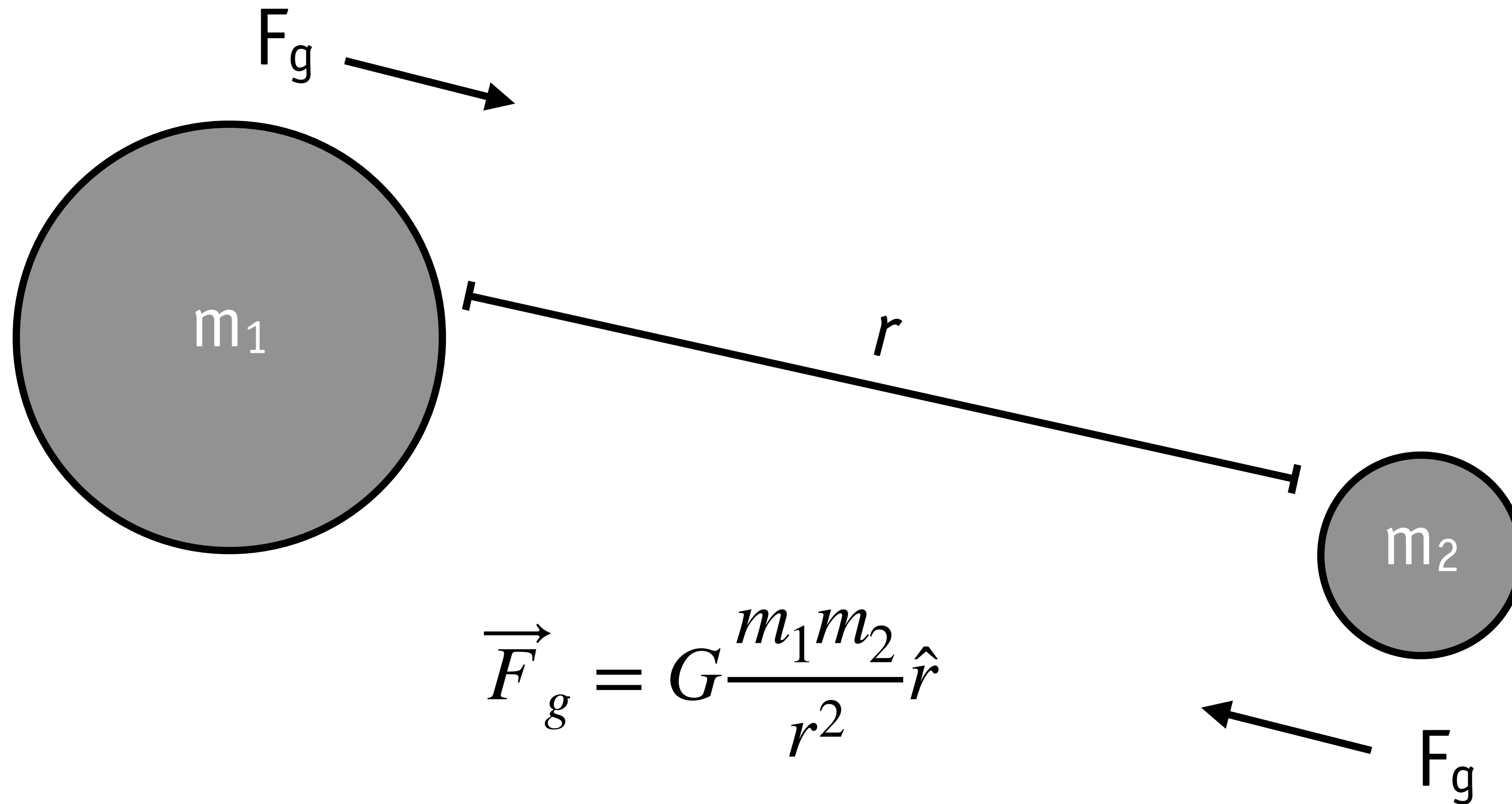
photo credits: NASA/JPL



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

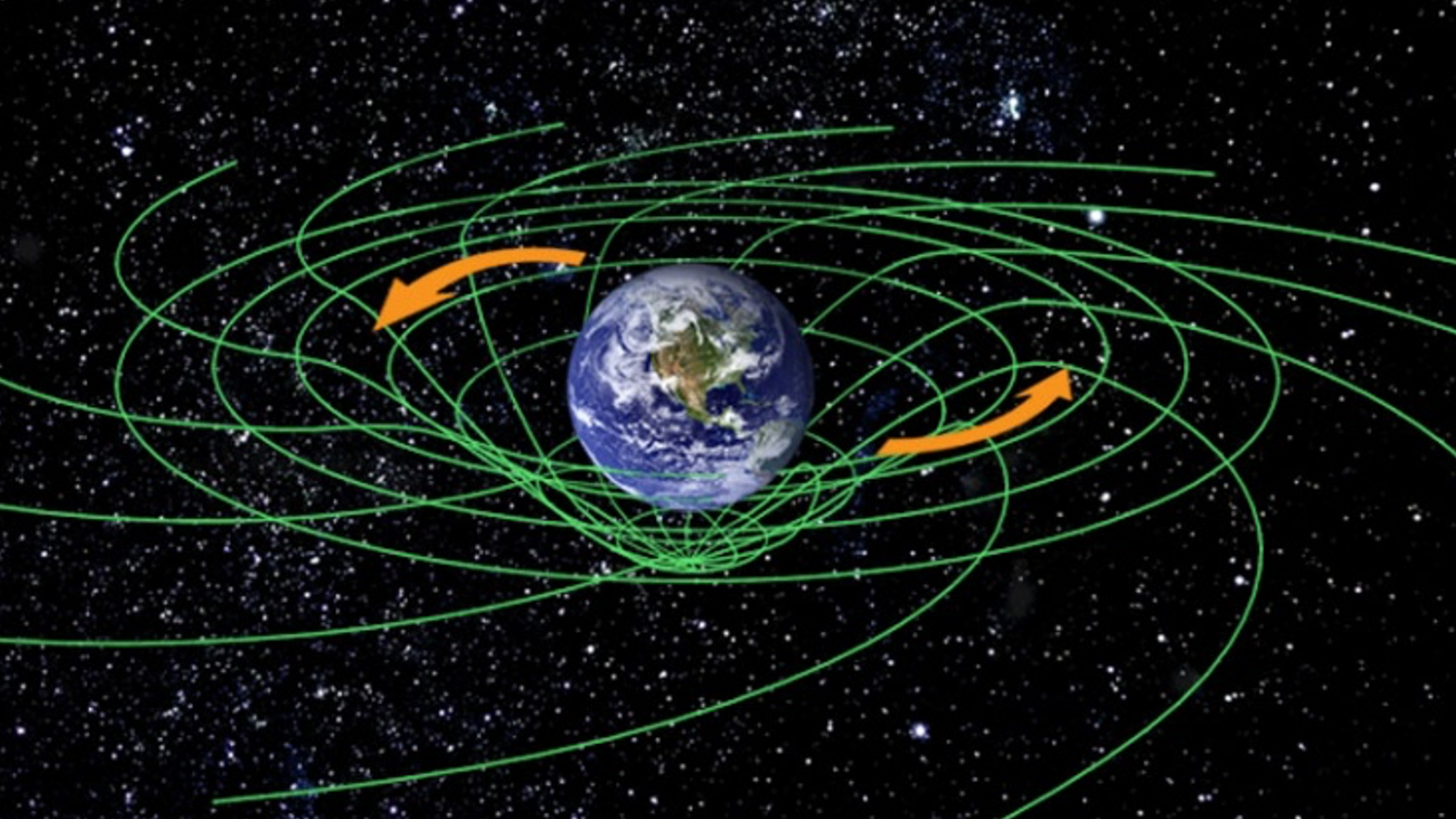


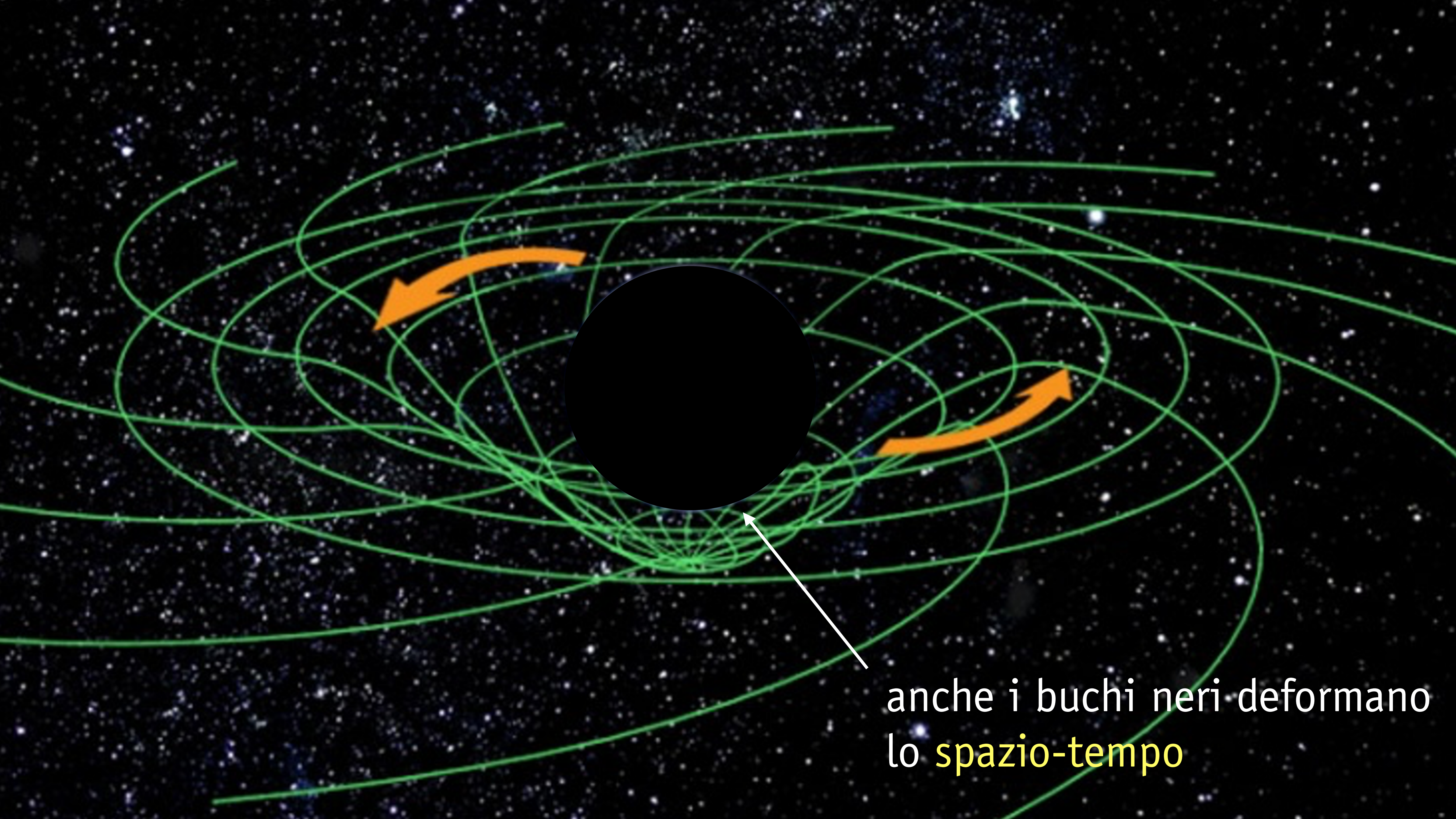
galassia a spirale

senza materia oscura

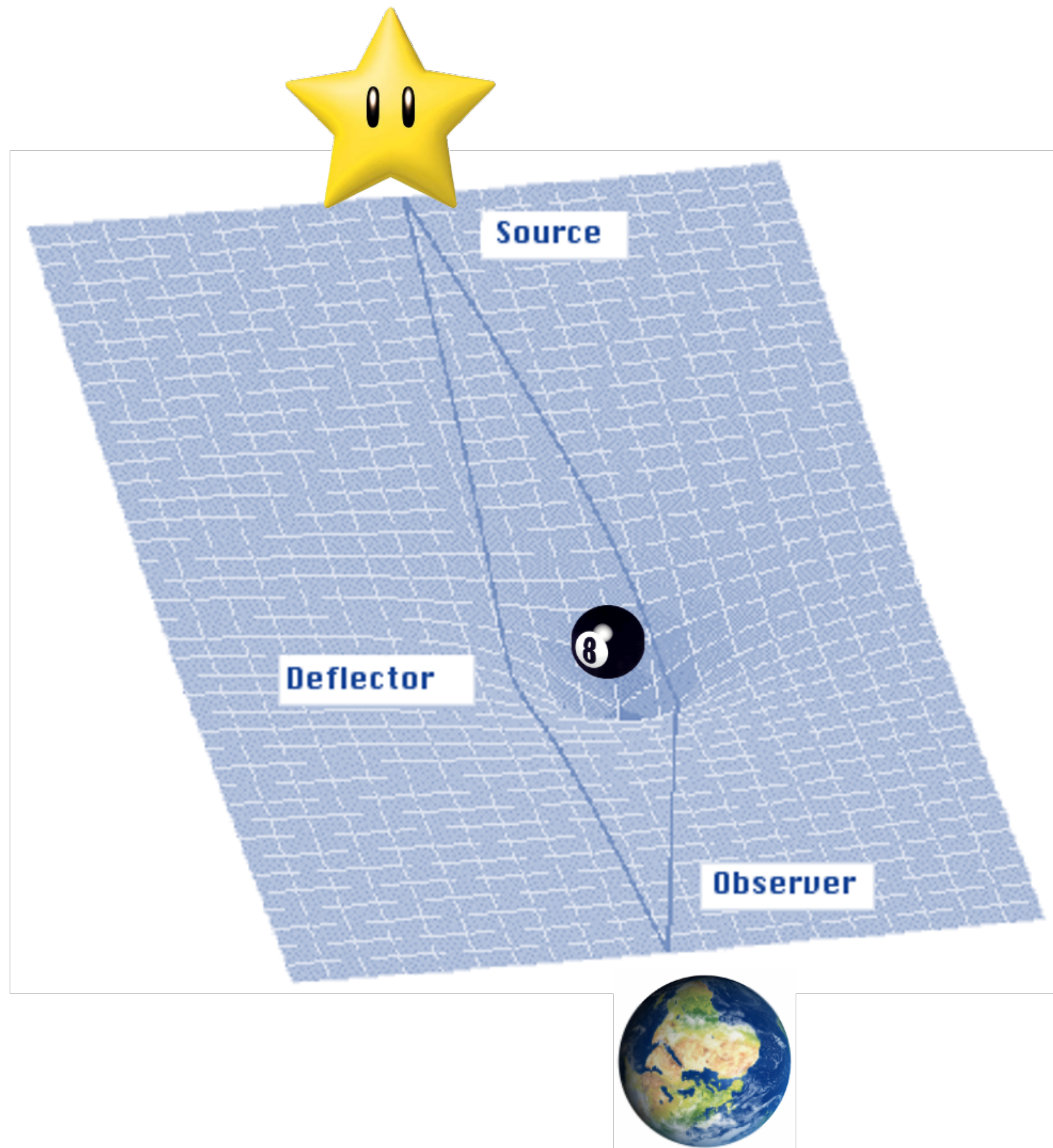
con la materia oscura







anche i buchi neri deformano
lo spazio-tempo



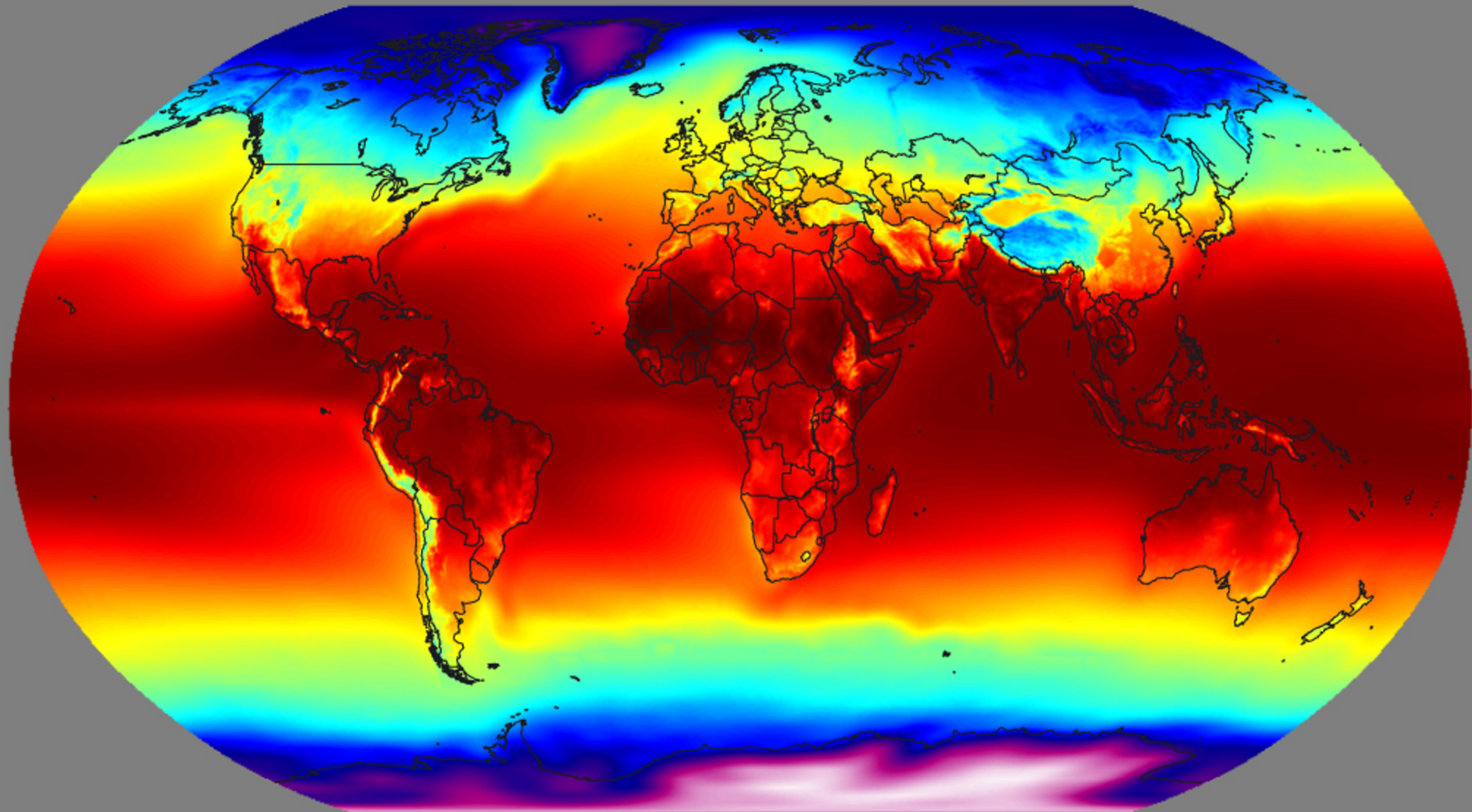
questa **deflessione**
risente della **materia**
oscura!

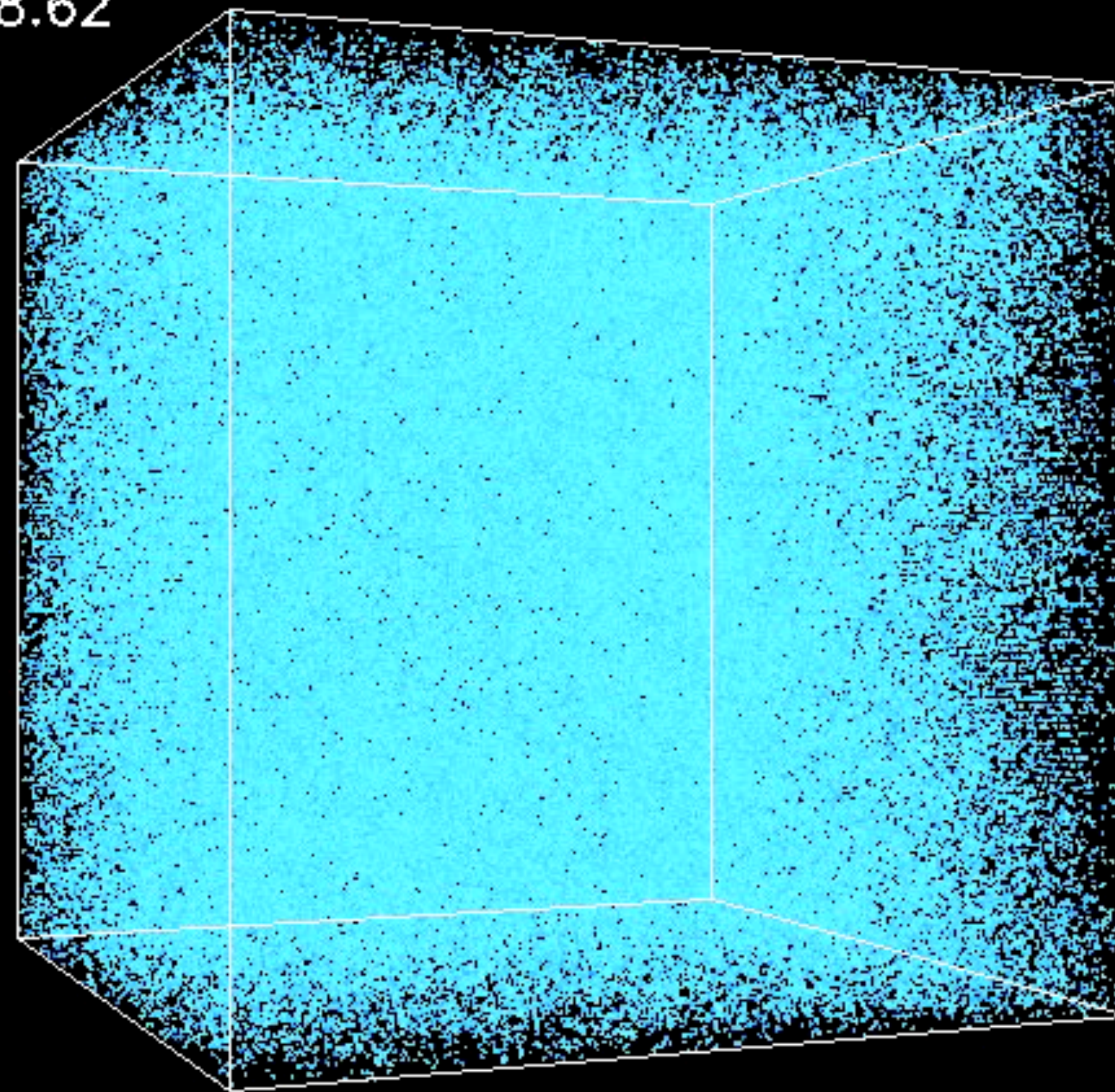


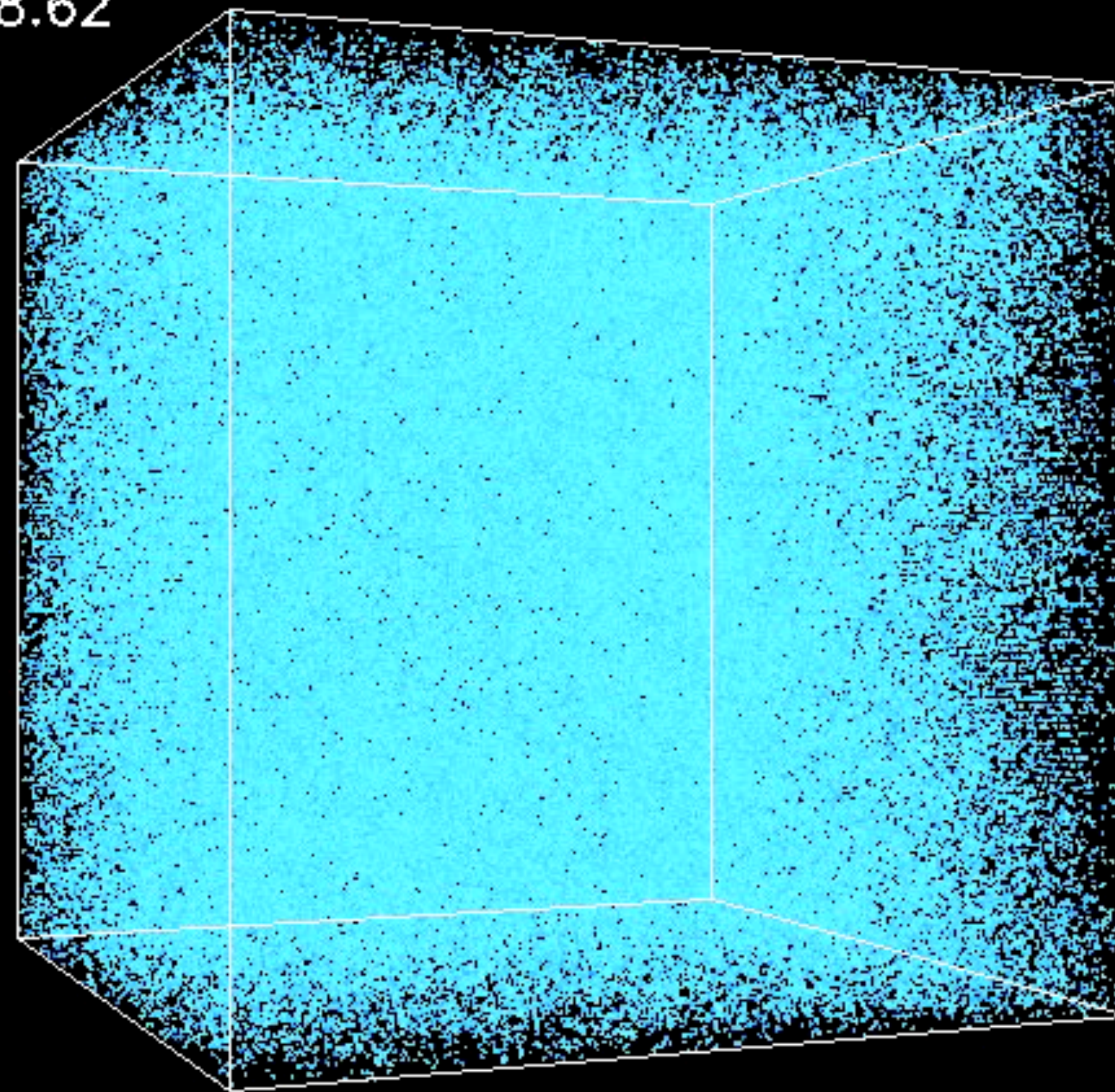
lenti gravitazionali, un'ulteriore prova della materia oscura!



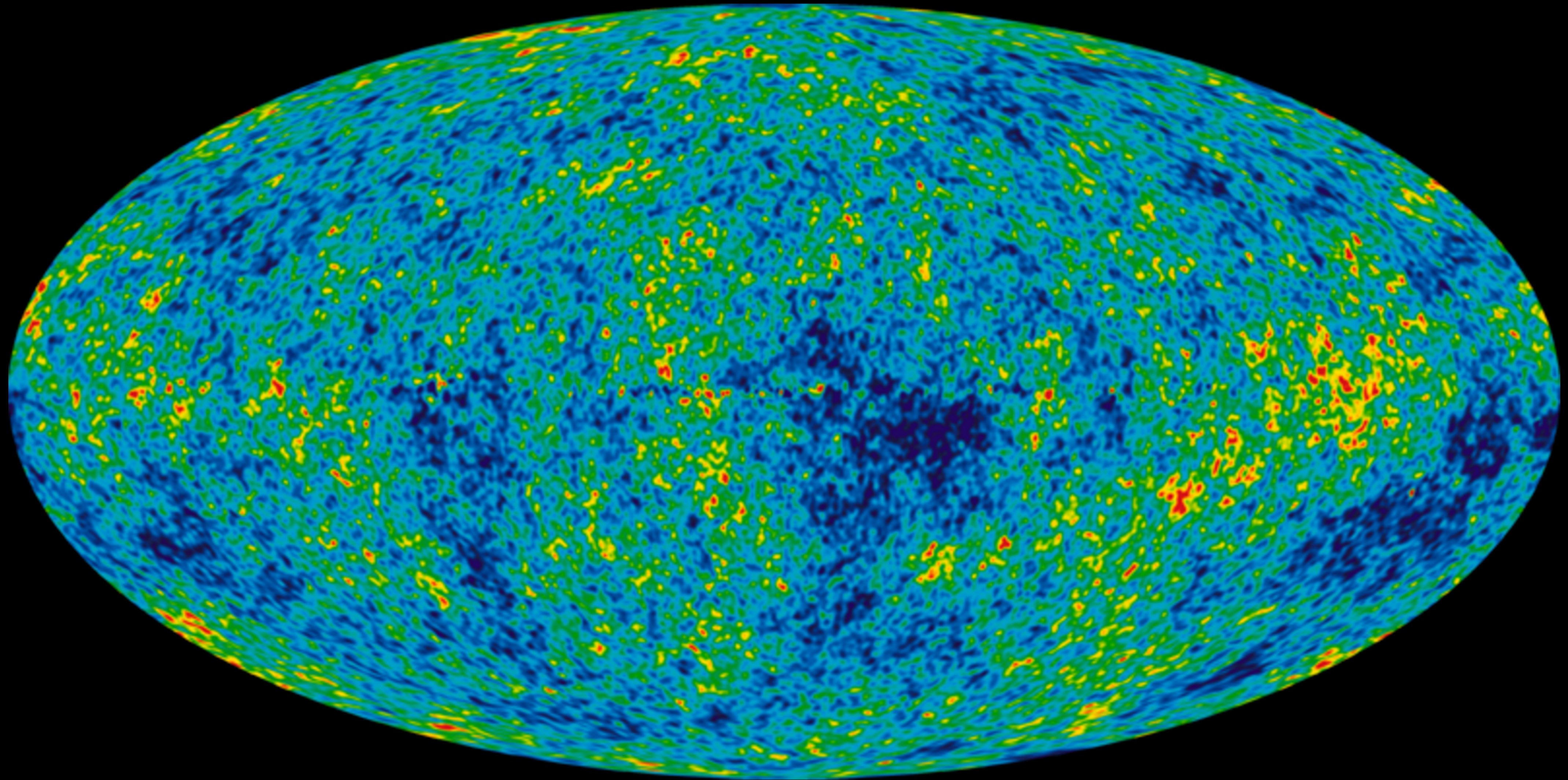
lenti gravitazionali, un'ulteriore prova della materia oscura!



$Z=28.62$ 

$Z=28.62$ 

la temperatura dell'universo



variazioni di 1 parte su 100000 dovute alla materia oscura!

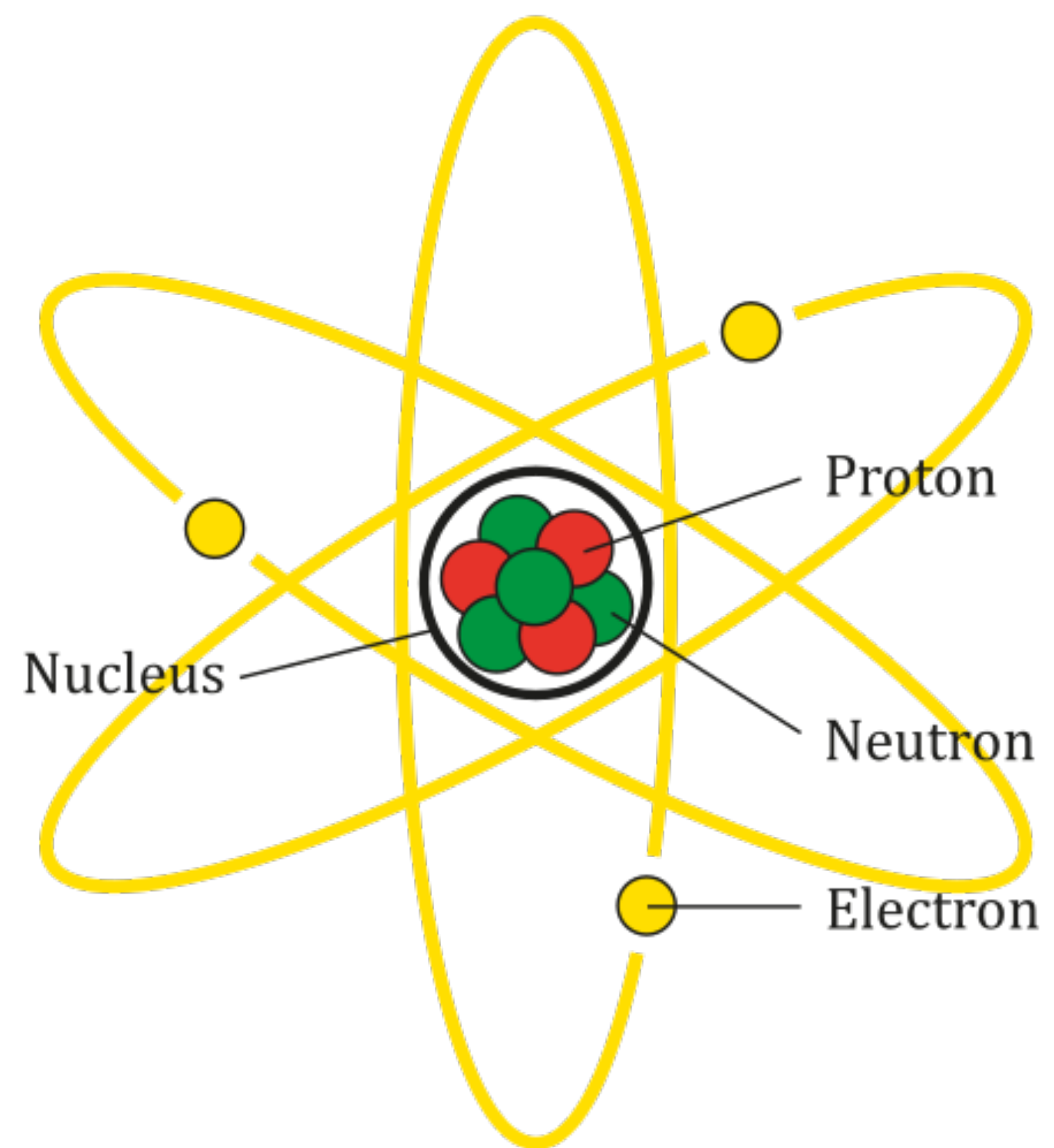


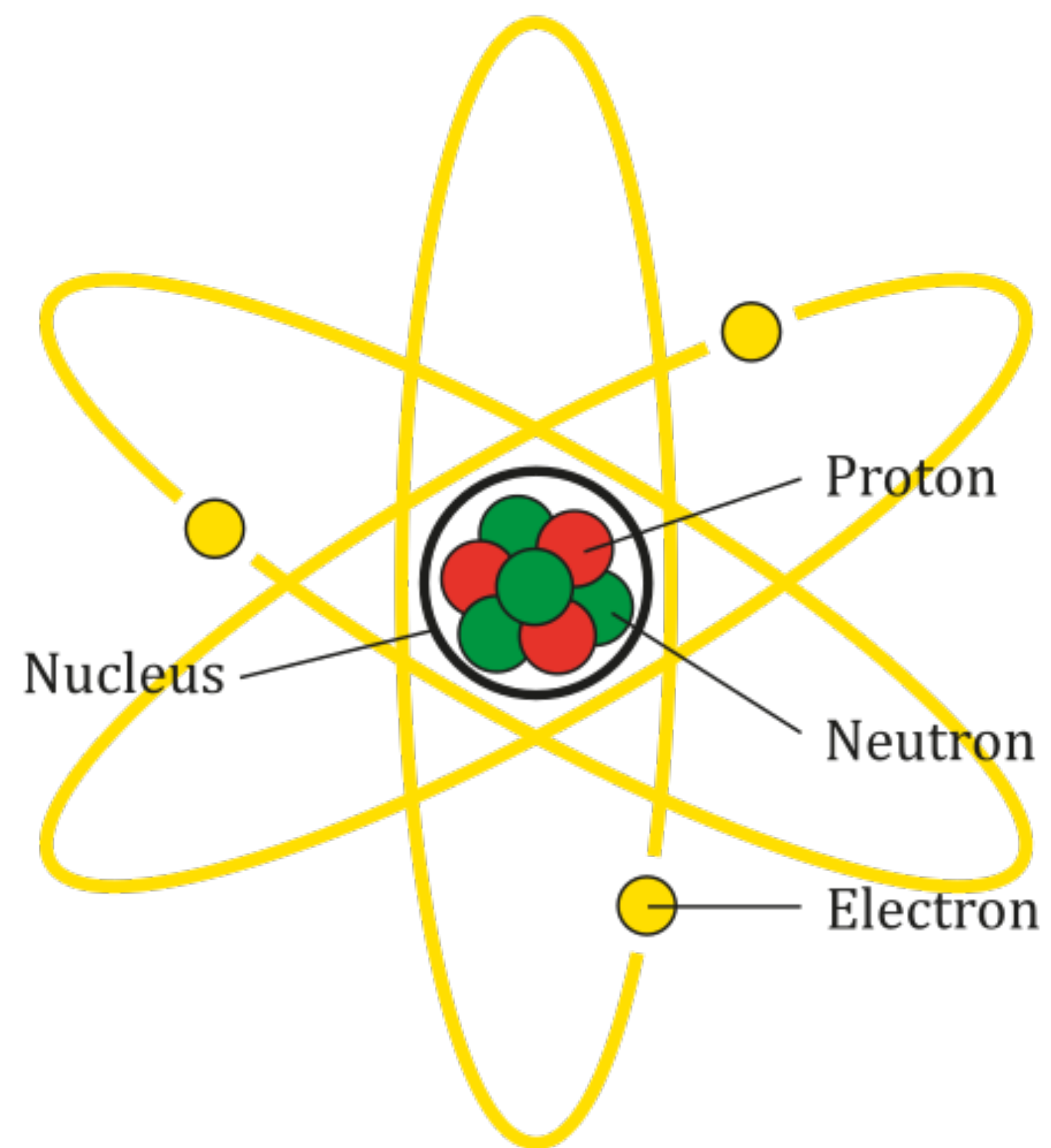
materia oscura



materia oscura

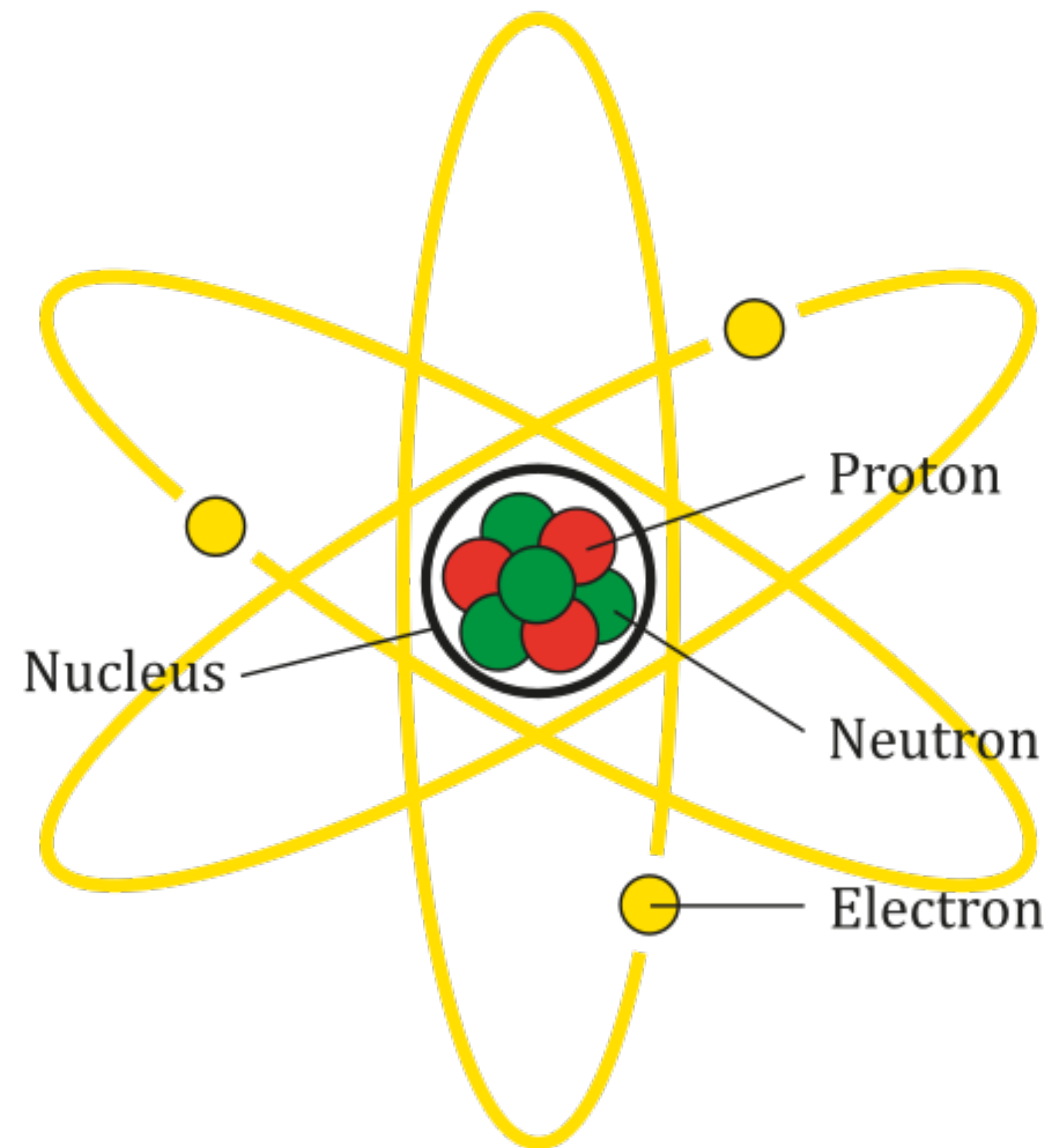






+

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



+

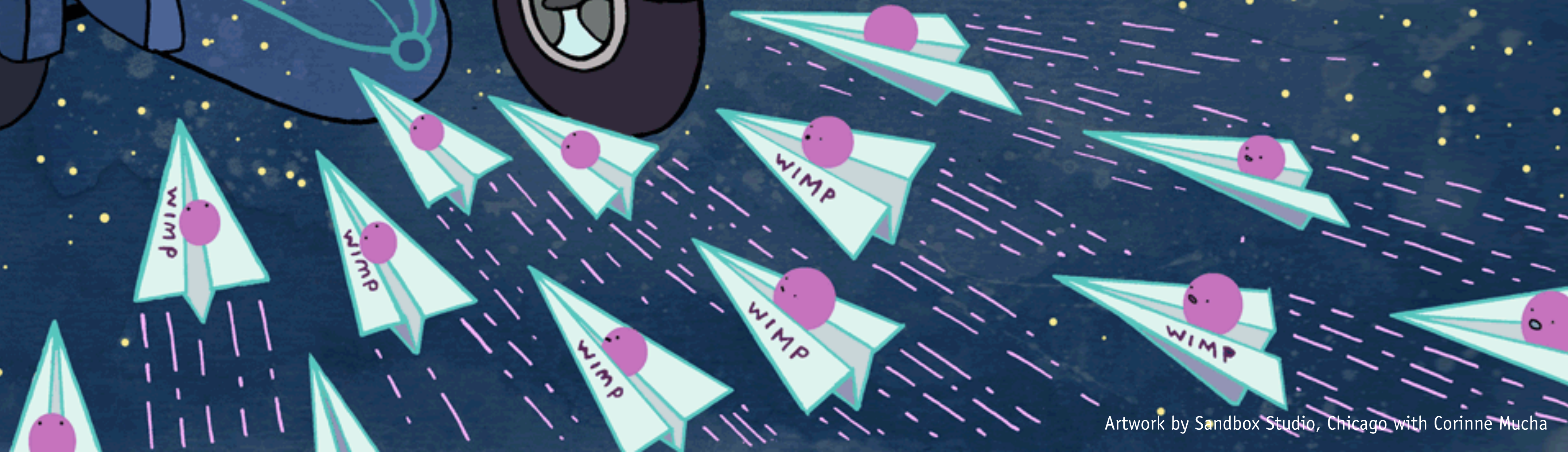
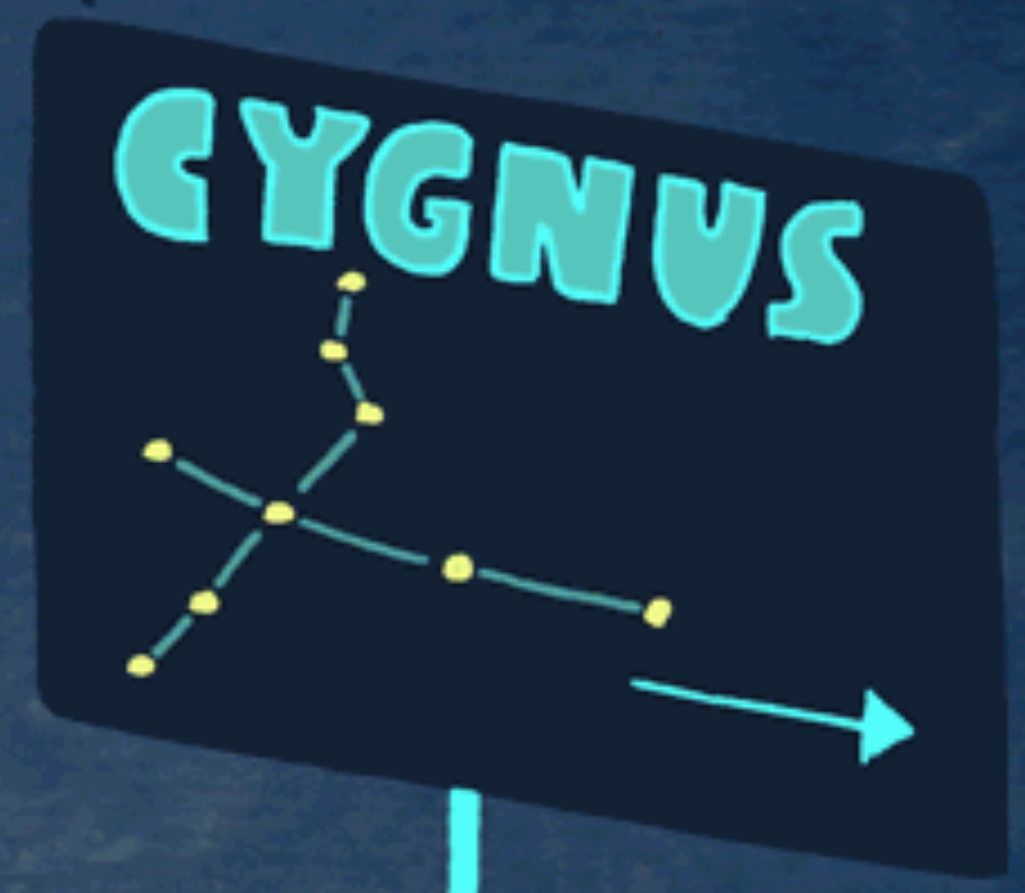
$e, \mu, \tau, \gamma, u, d, c, s, t,$
 $b, g, W, Z, \nu_e, \nu_\mu, \nu_\tau, H...$

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



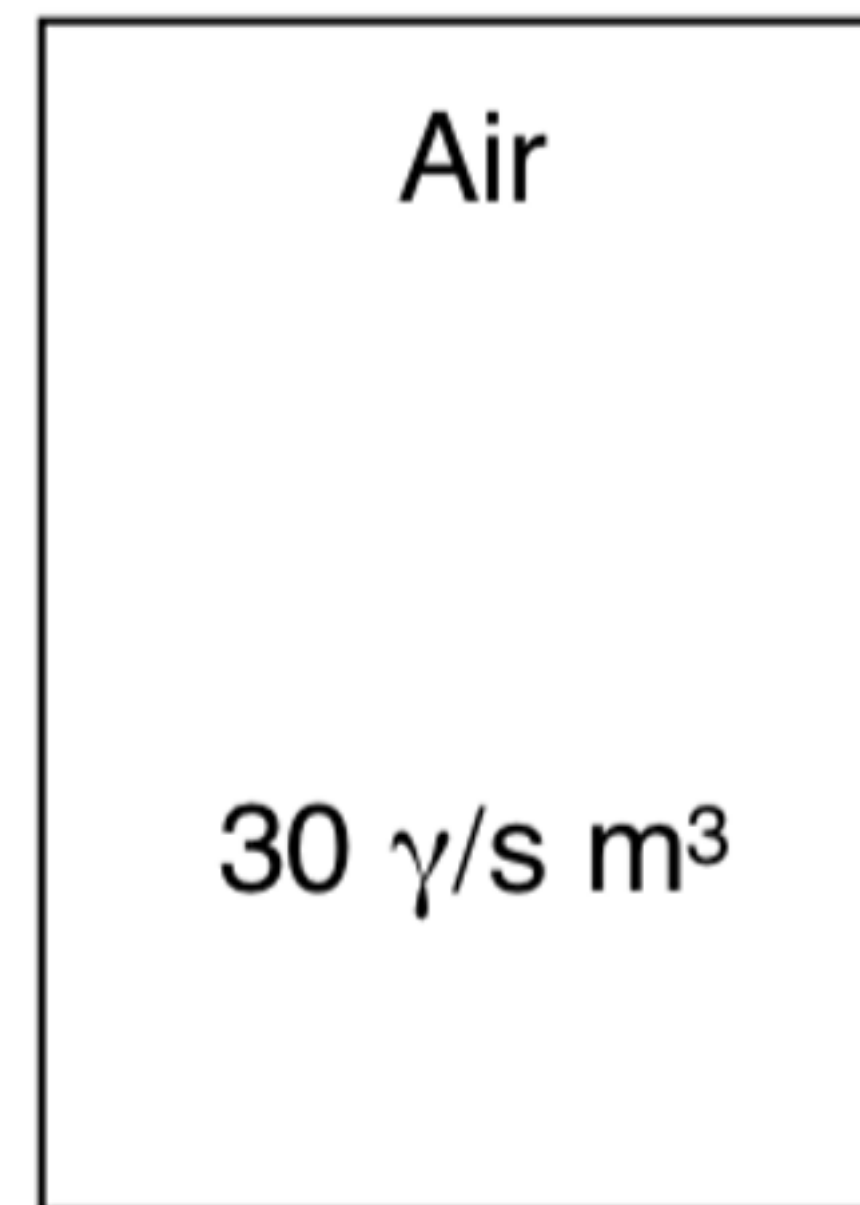
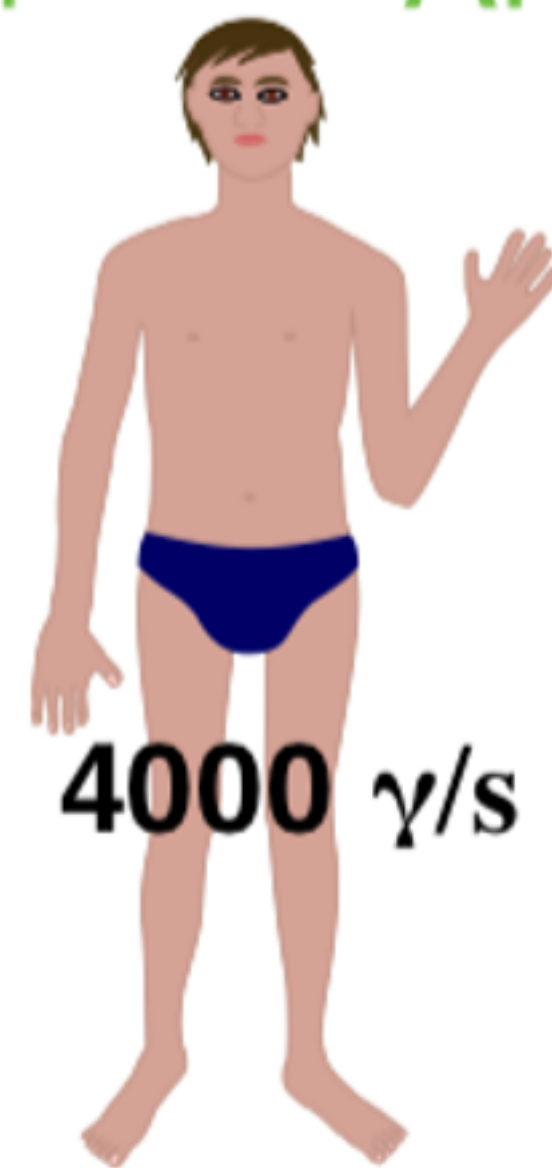
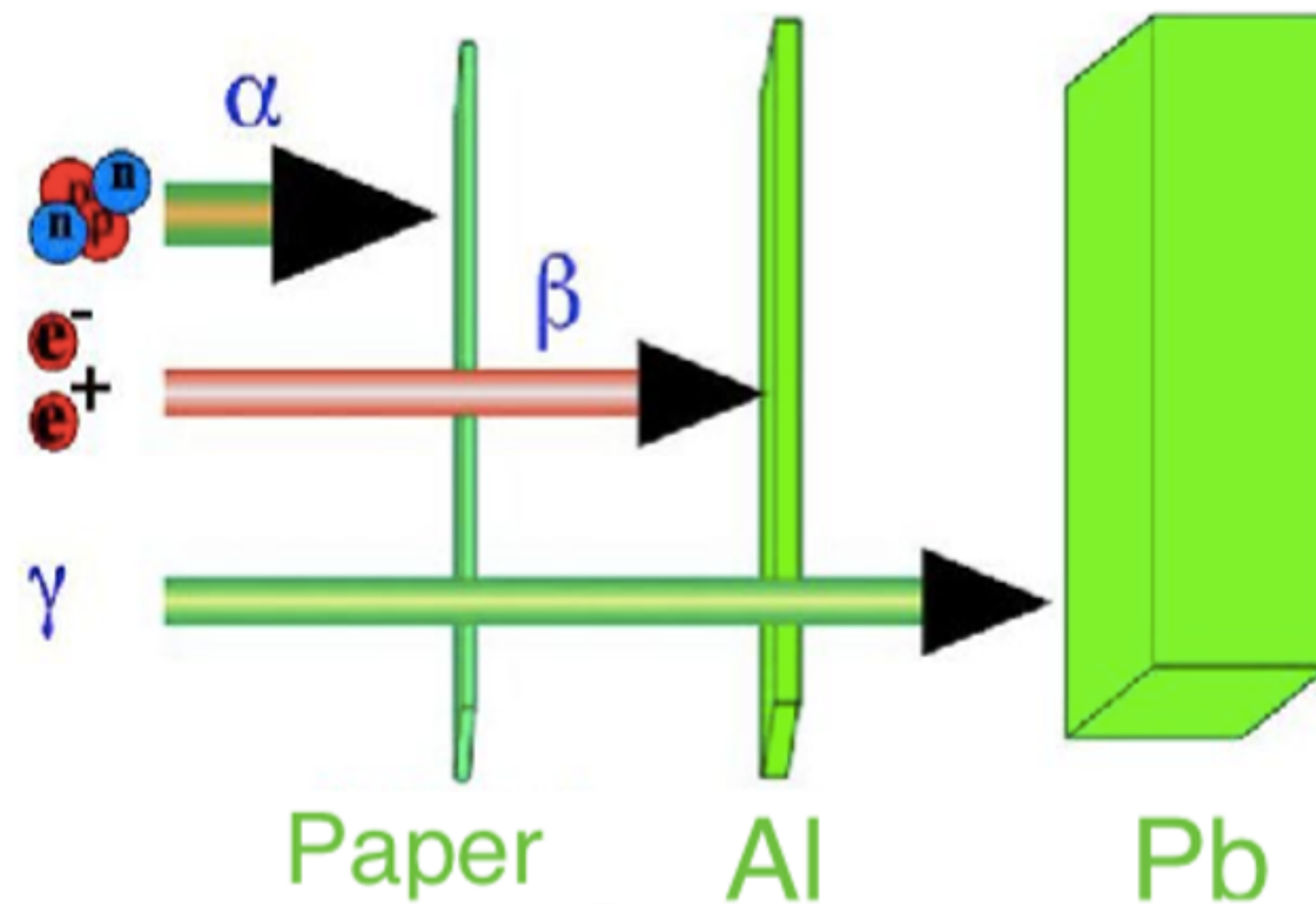
rivelatore
(bersaglio che
rincula)

materia
oscura


vento di
materia
oscura



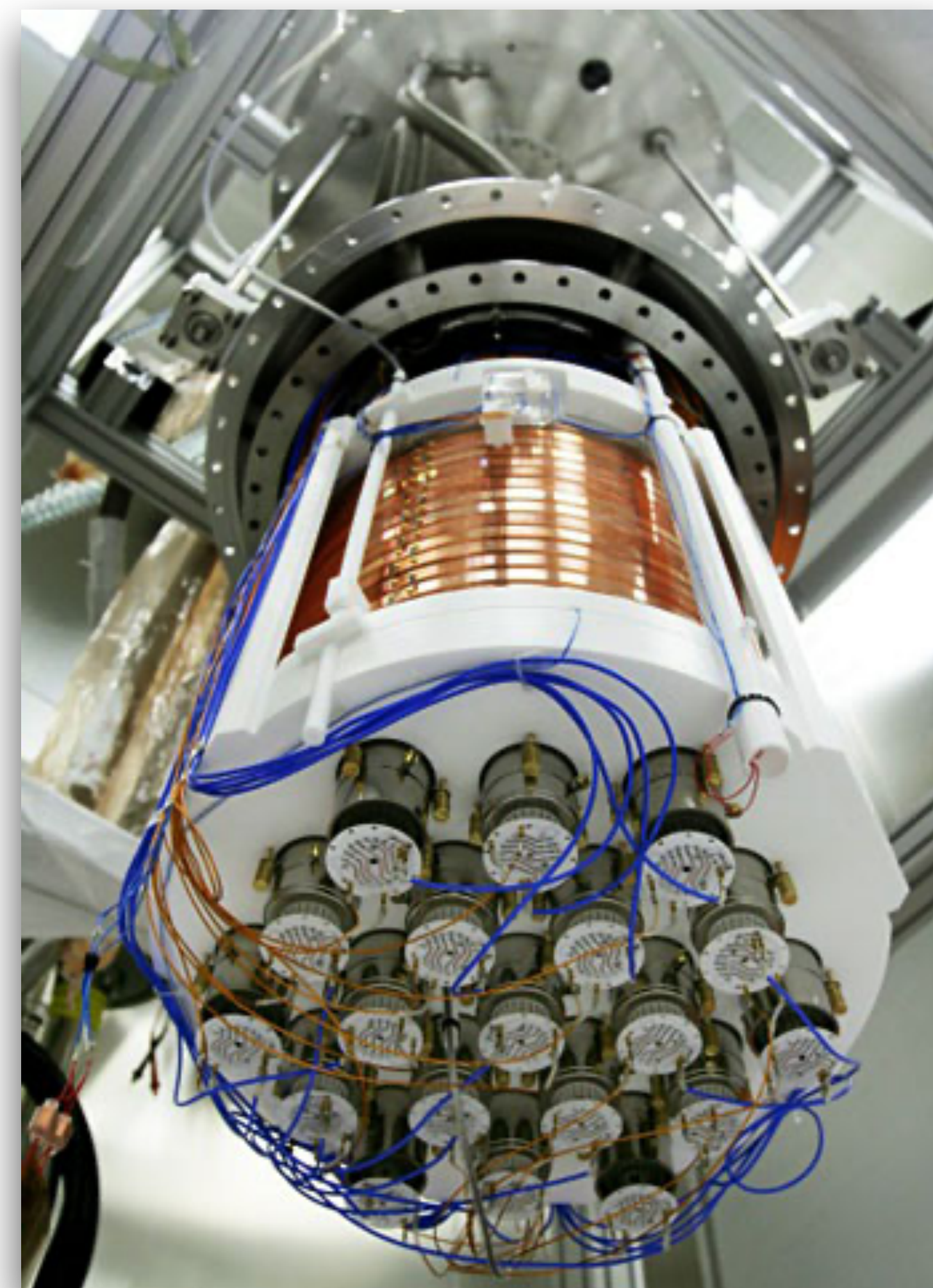
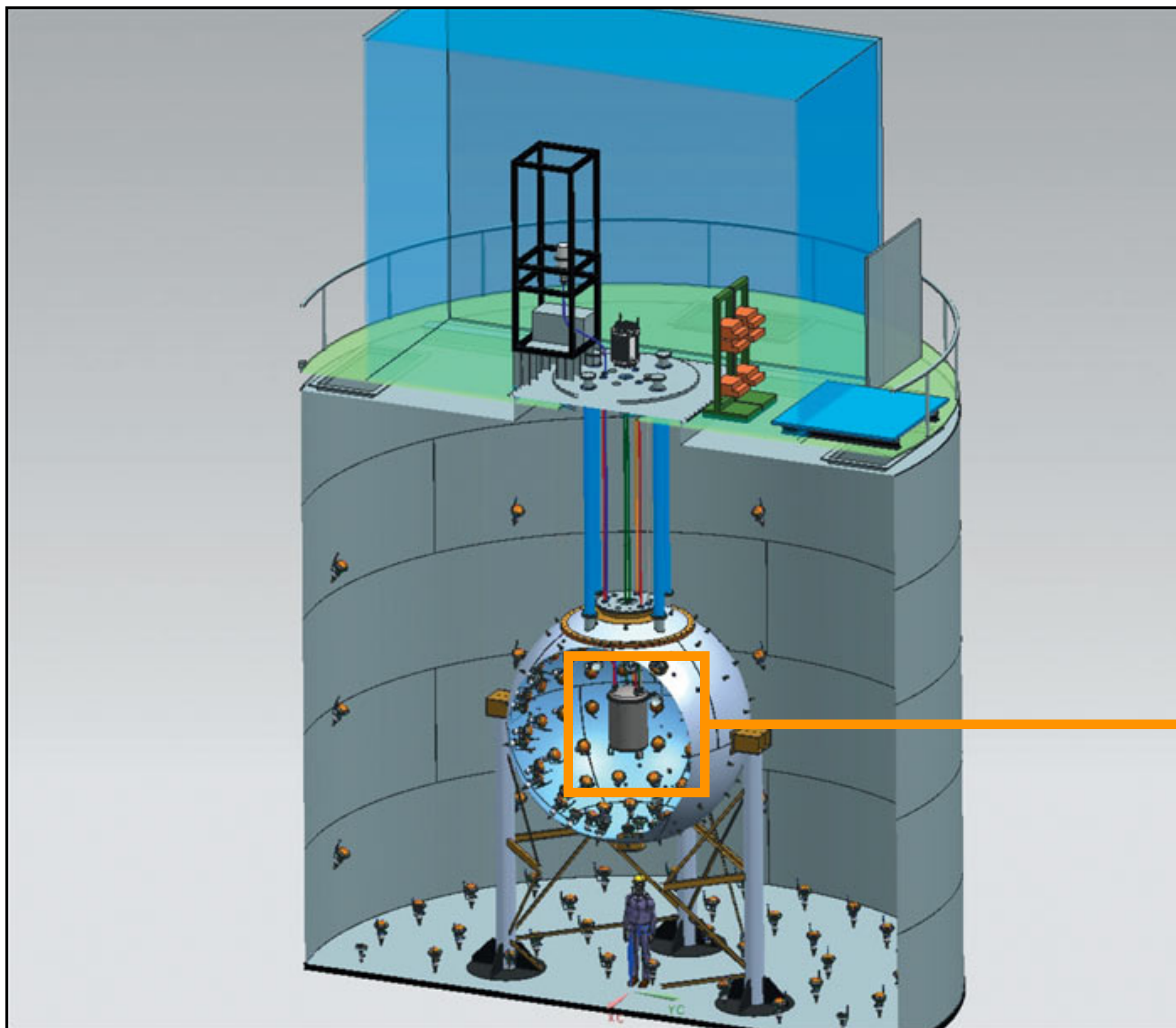
RADIOACTIVITY CONTROL



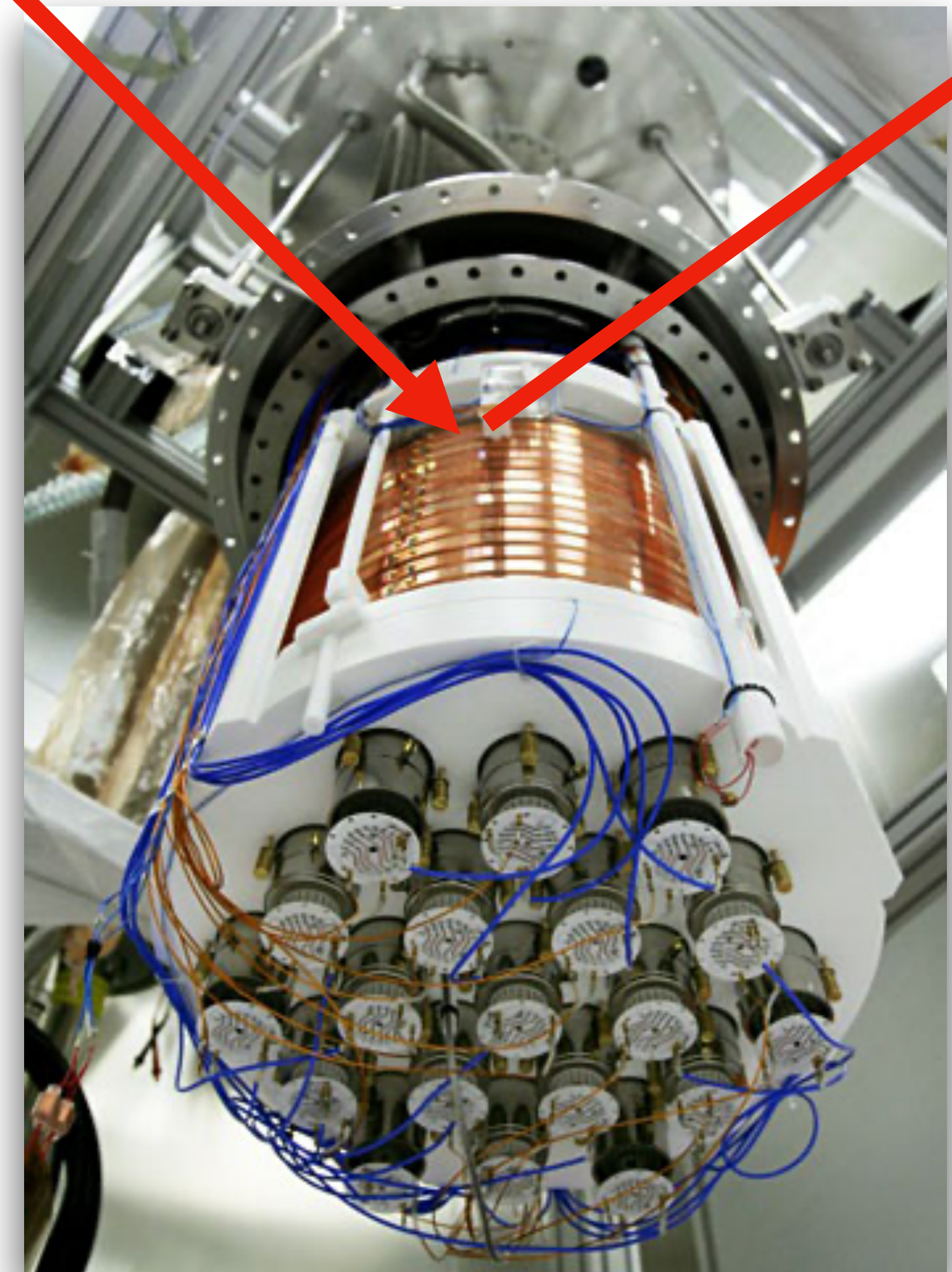
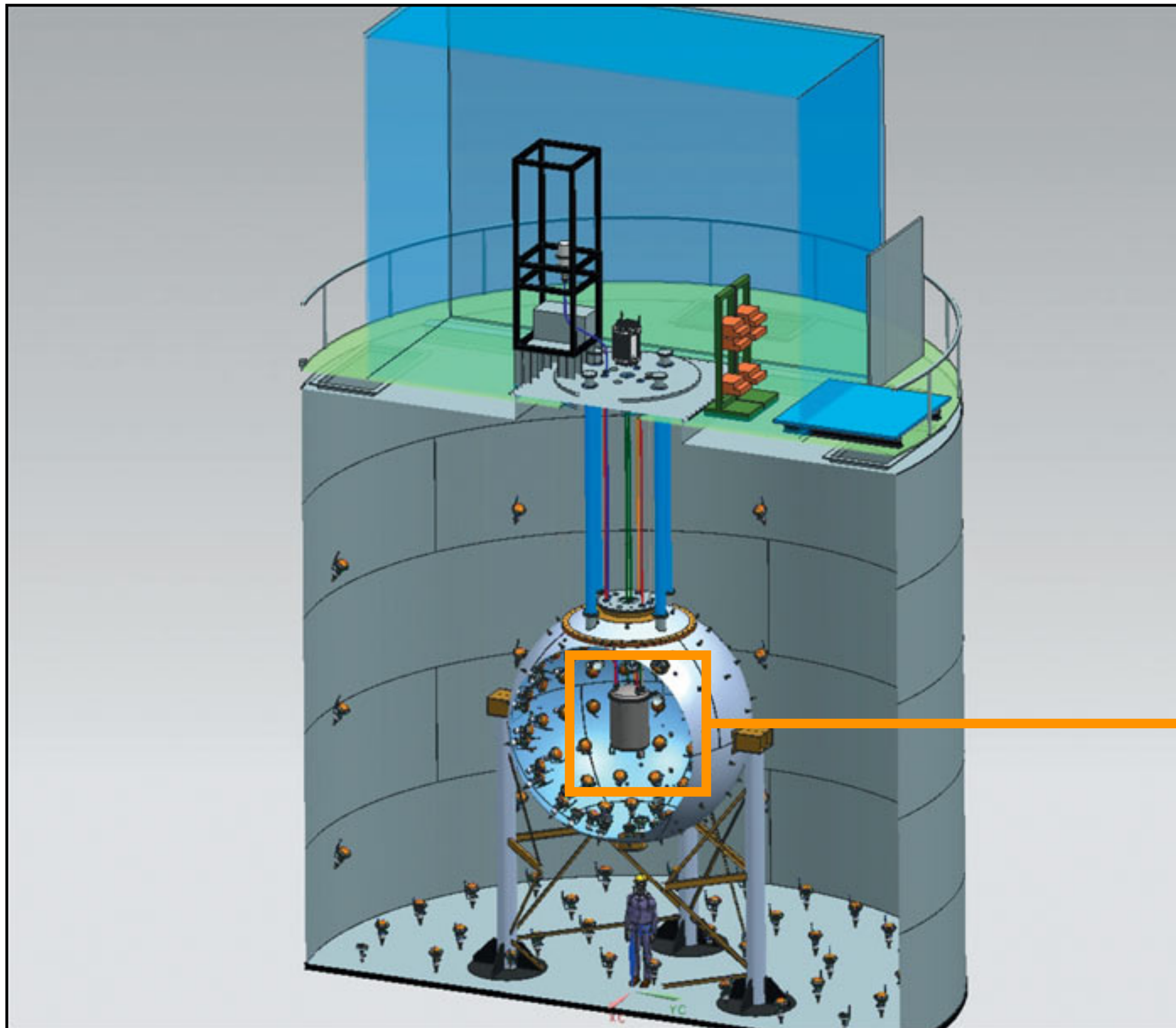
Radiopure materiale in radiopure environments



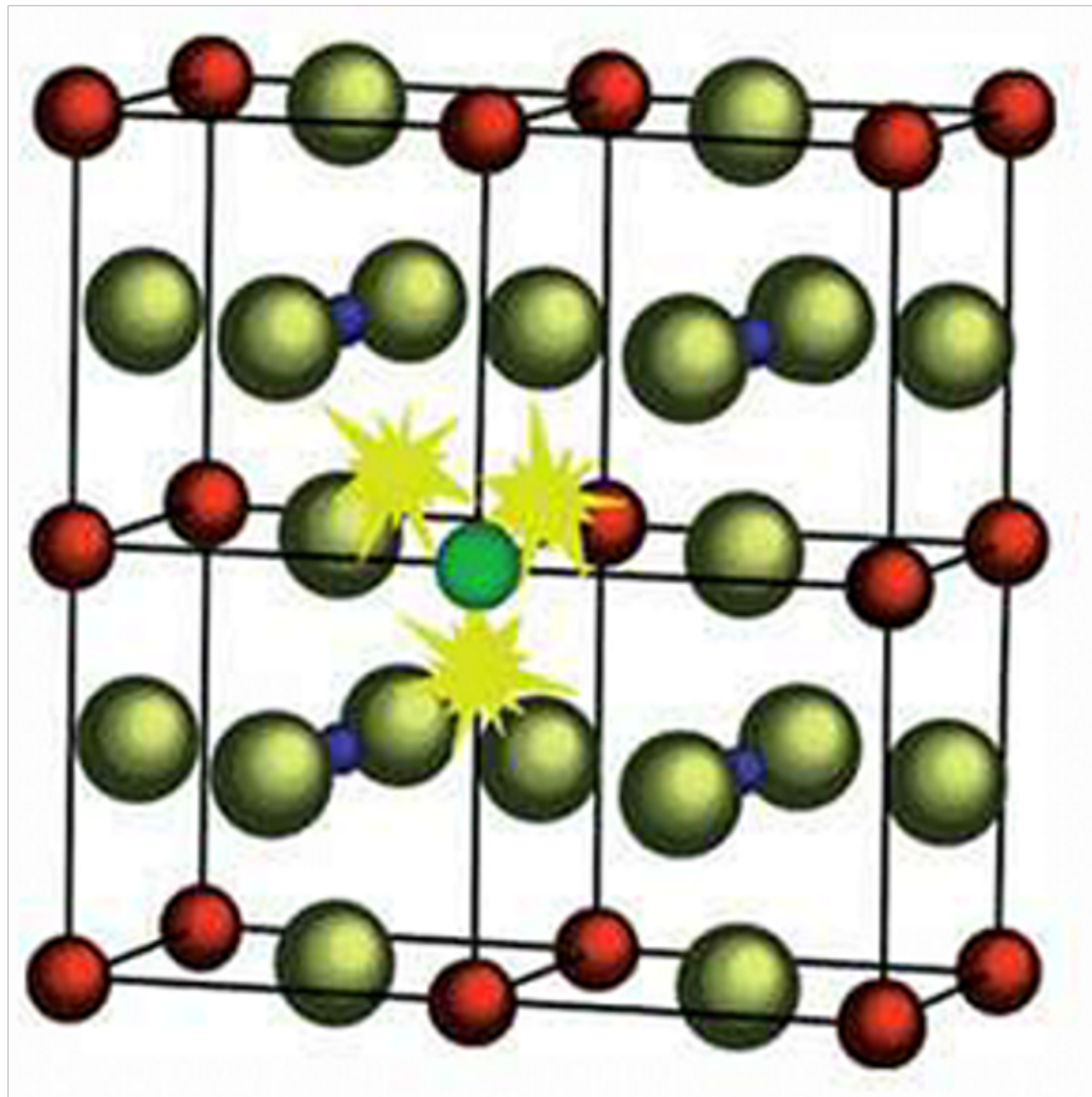
sotto 1600 m di roccia:
Darkside-50 ai Laboratori
Nazionali del Gran Sasso
(INFN)



**particella misteriosa
di materia oscura**



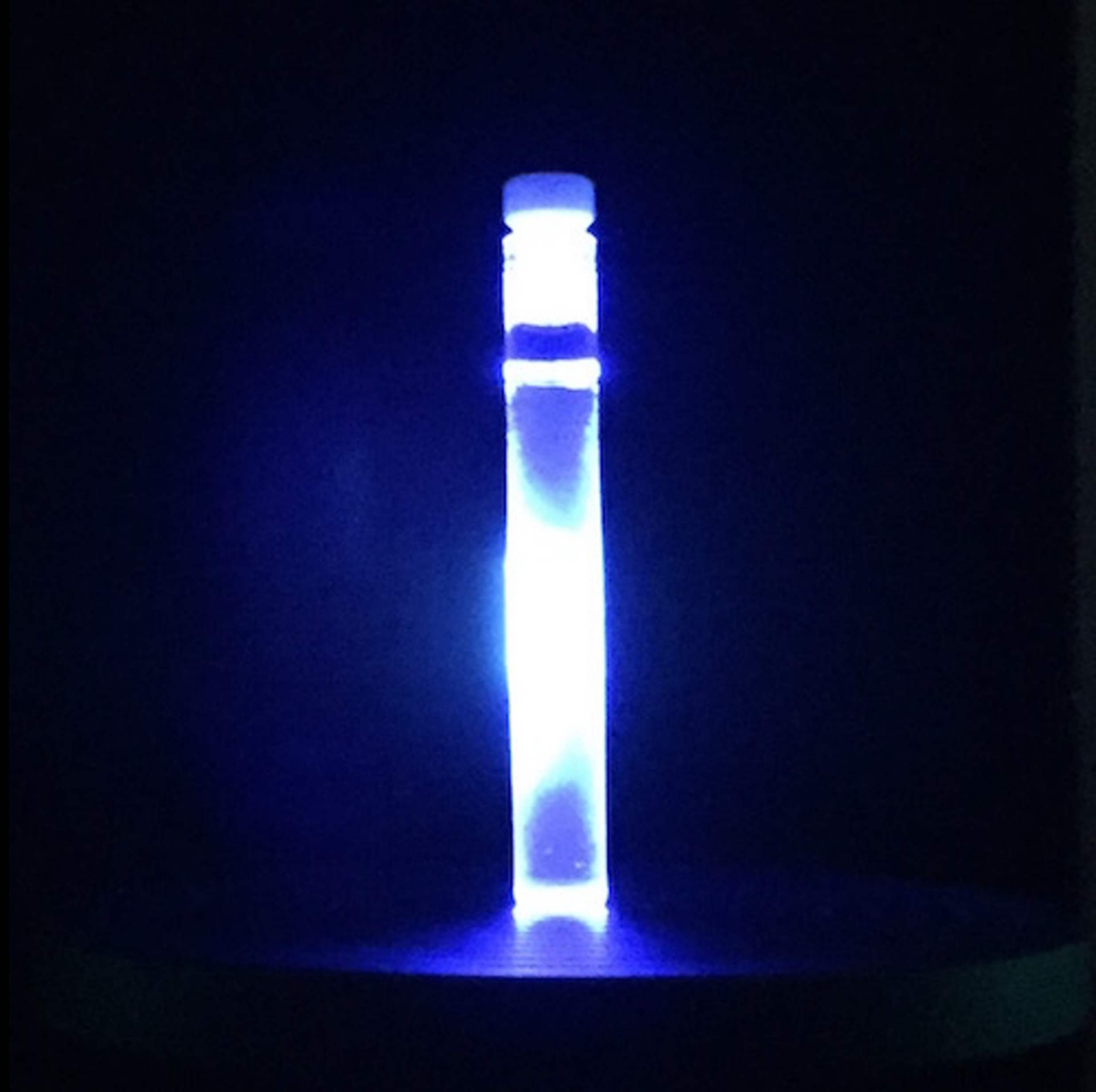


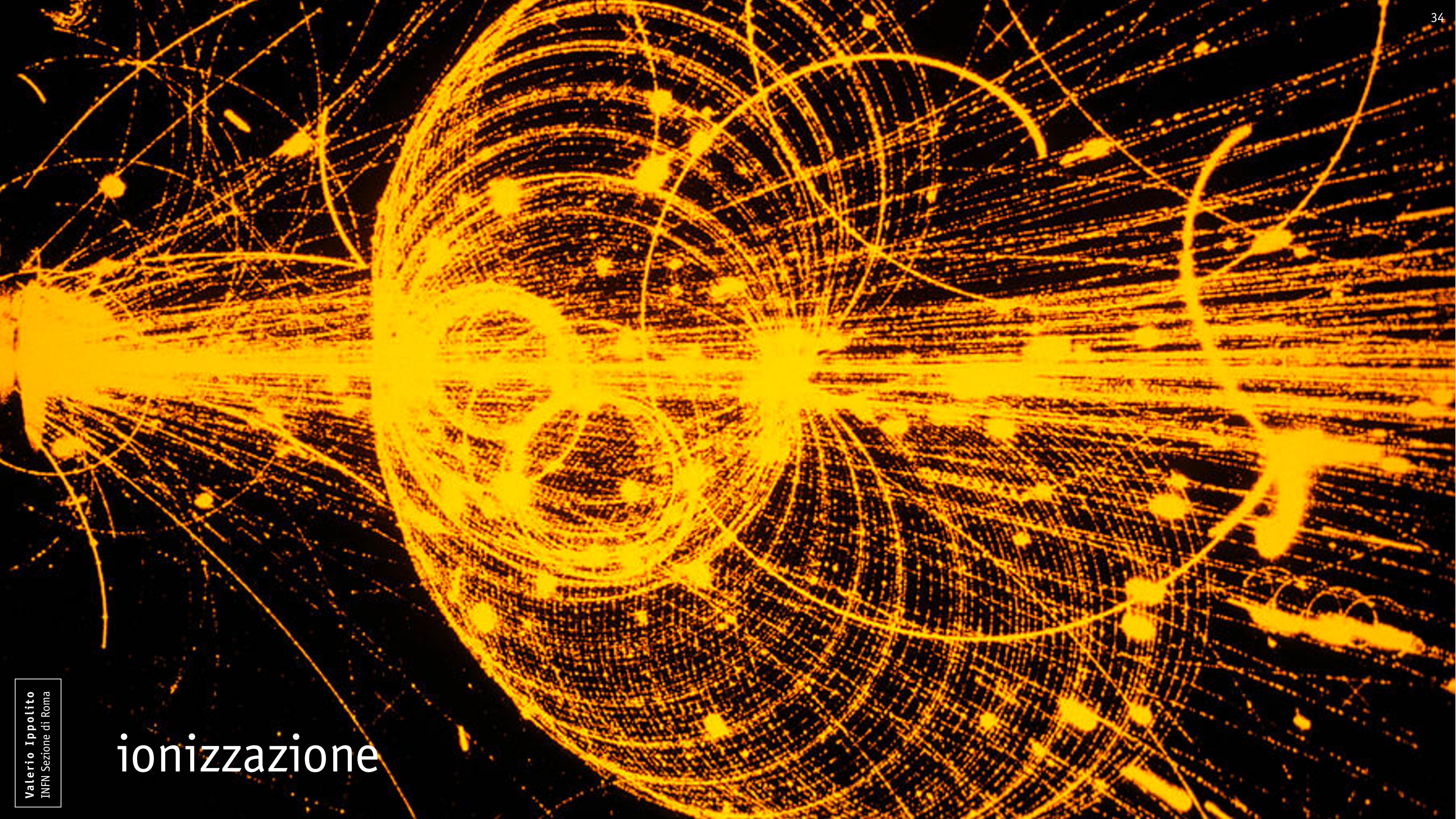


i rinculi sono **rari** e "eccitano" gli altri atomi

quando succede, misuriamo
elettroni e fotoni emessi

luce di scintillazione





ionizzazione

tutto questo in
rivelatori **giganteschi**



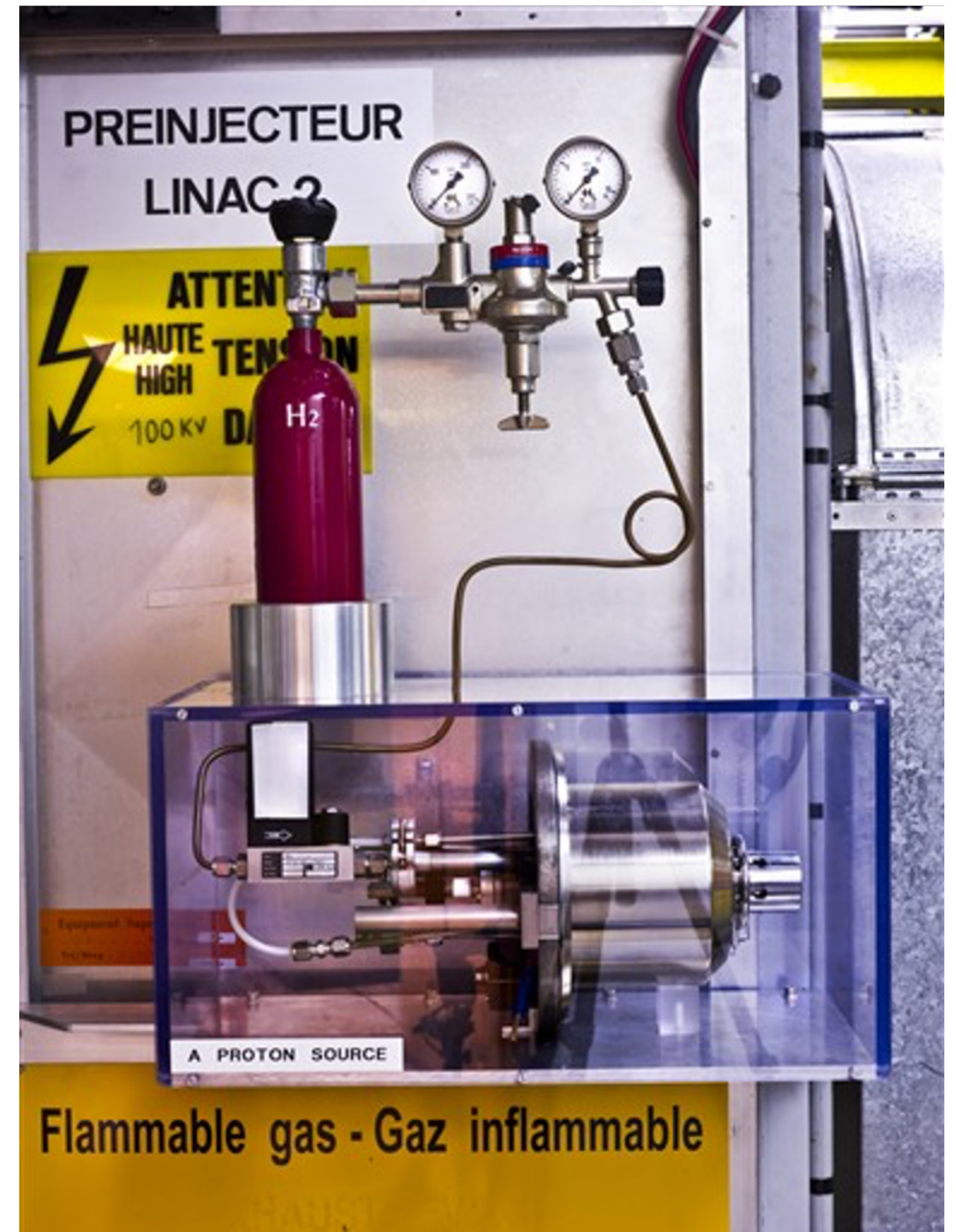
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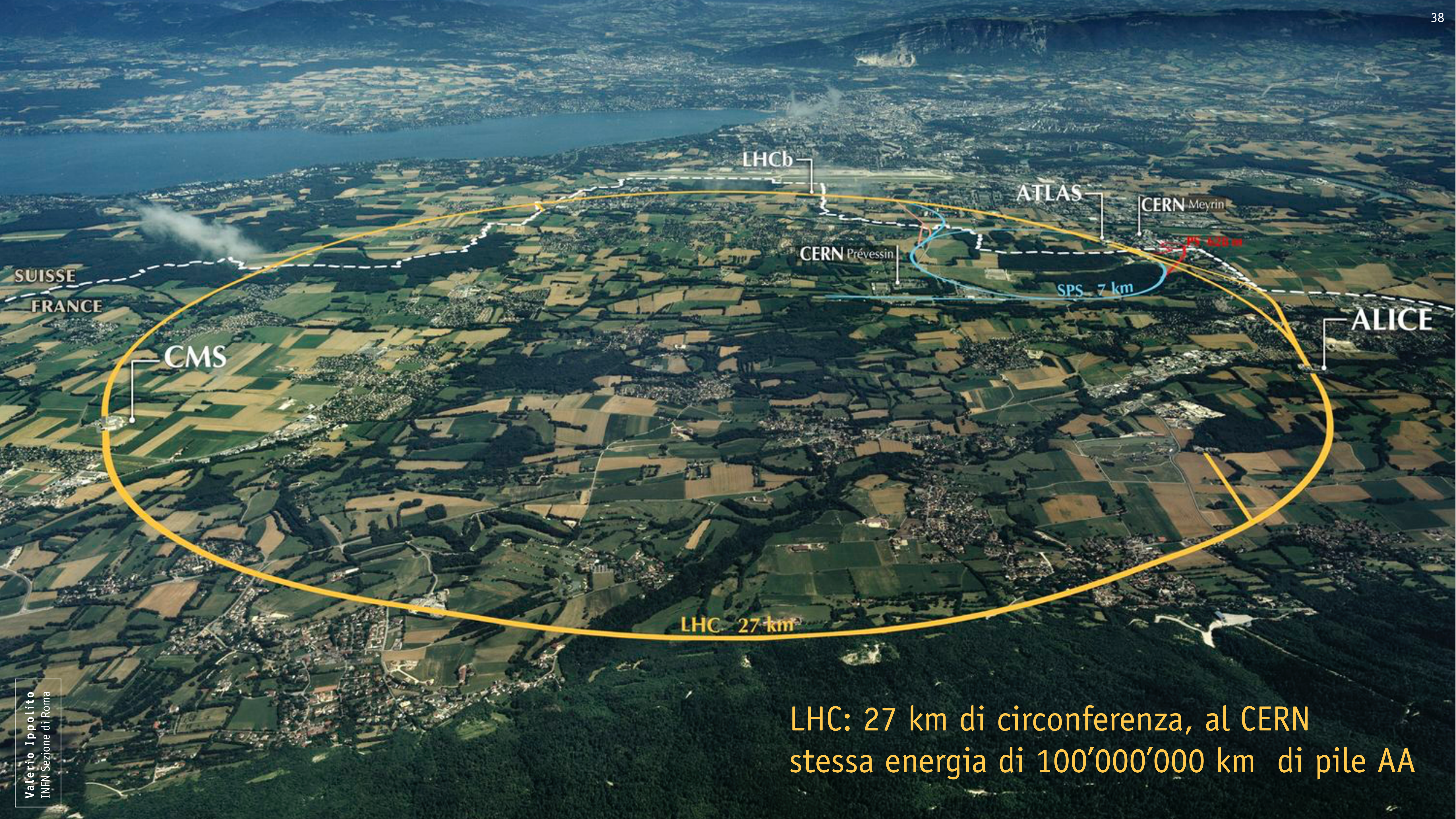
proviamo a **creare** materia oscura

facendo scontrare **protoni**

al **99.999999896%** della velocità della luce

e vedendo che succede...

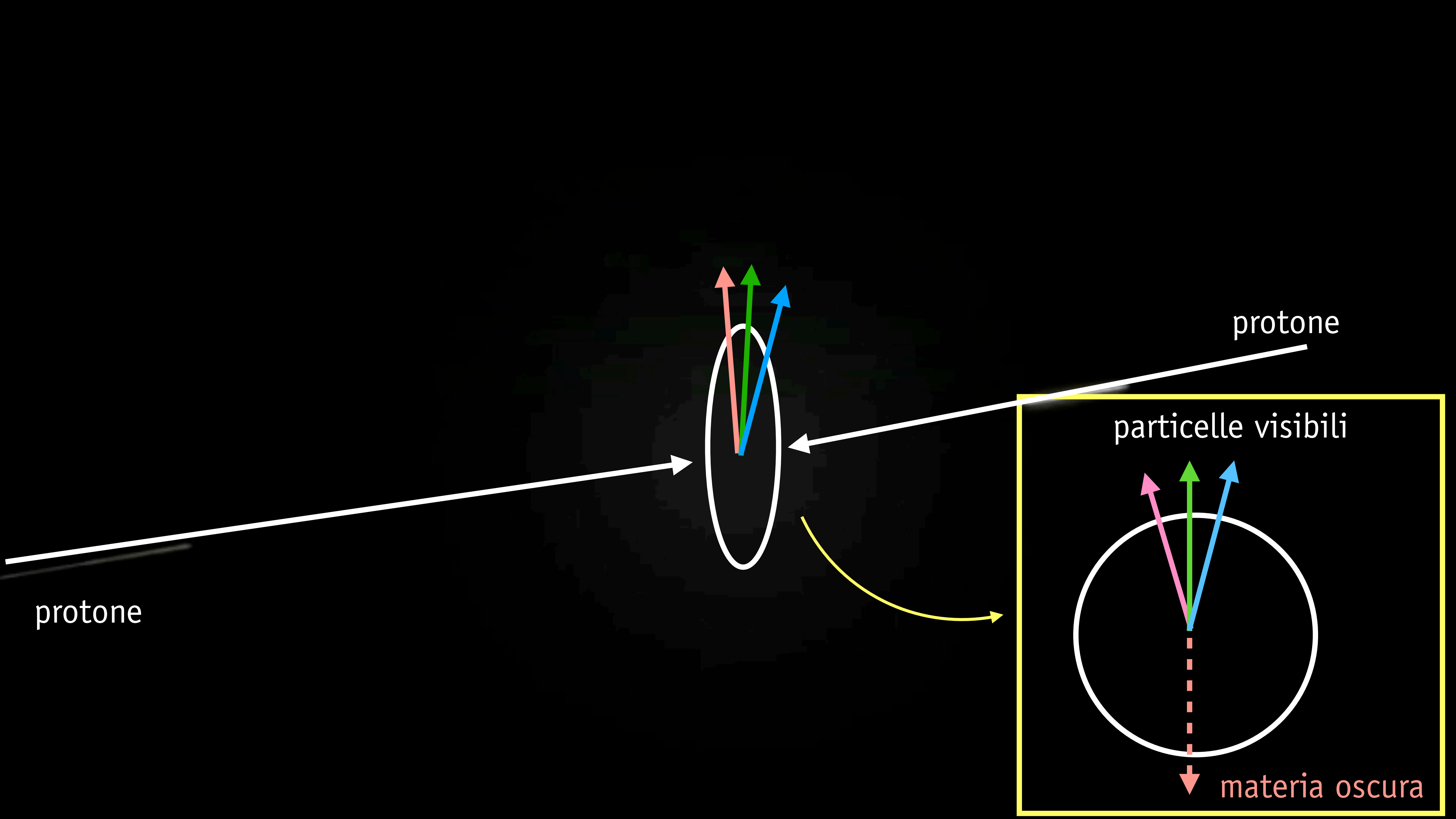


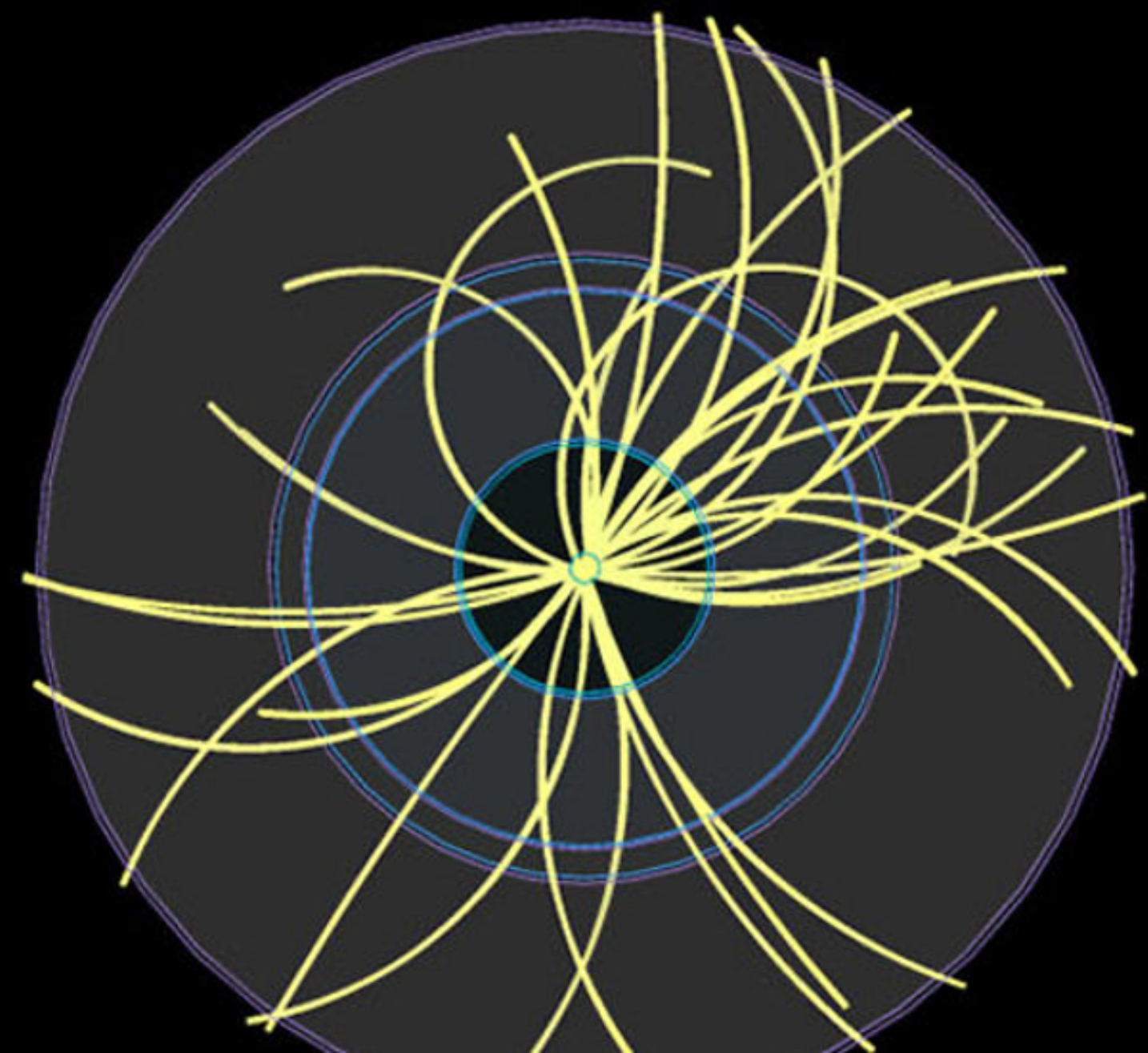
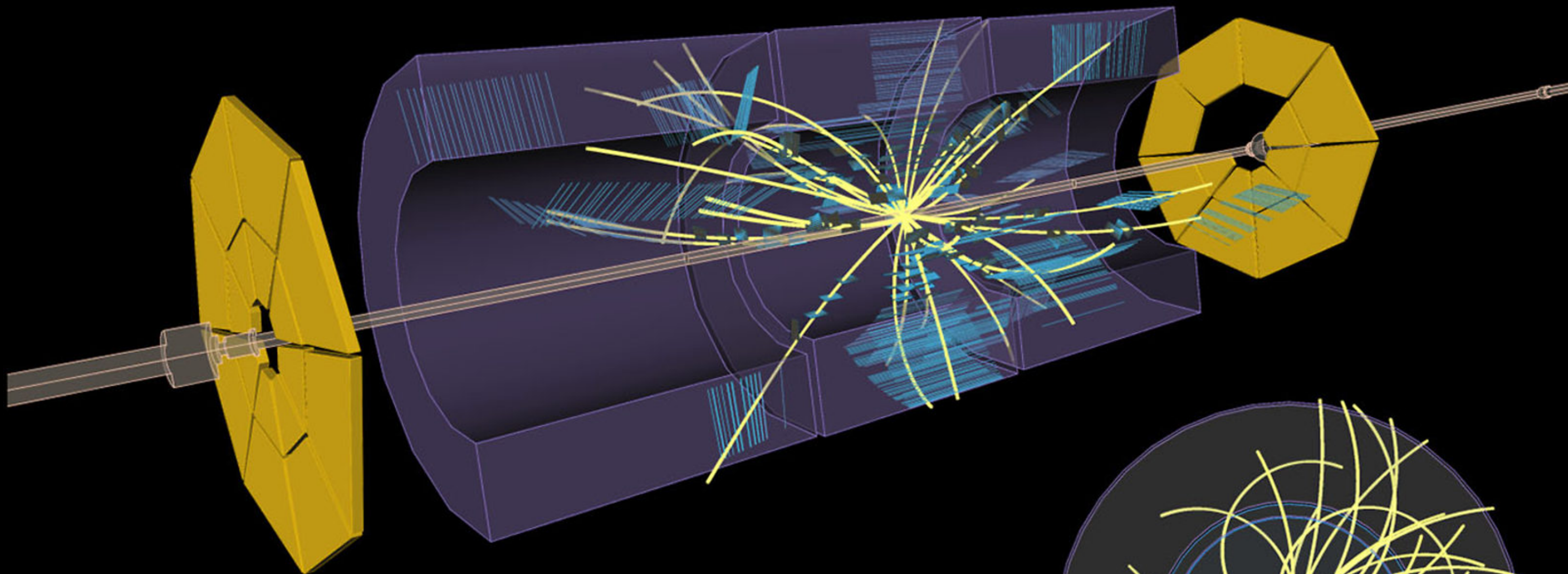


LHC: 27 km di circonferenza, al CERN
 stessa energia di 100'000'000 km di pile AA



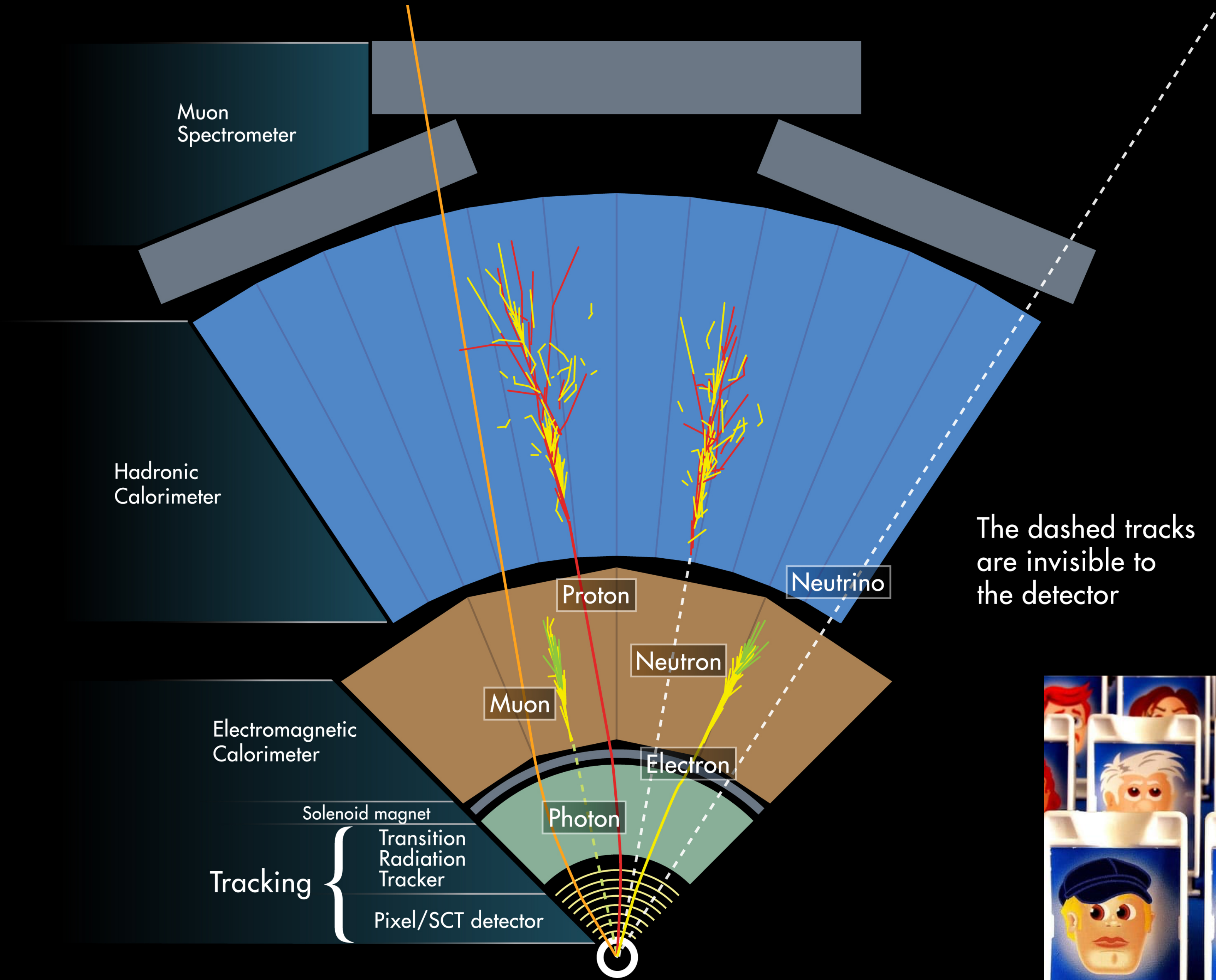






ATLAS
EXPERIMENT

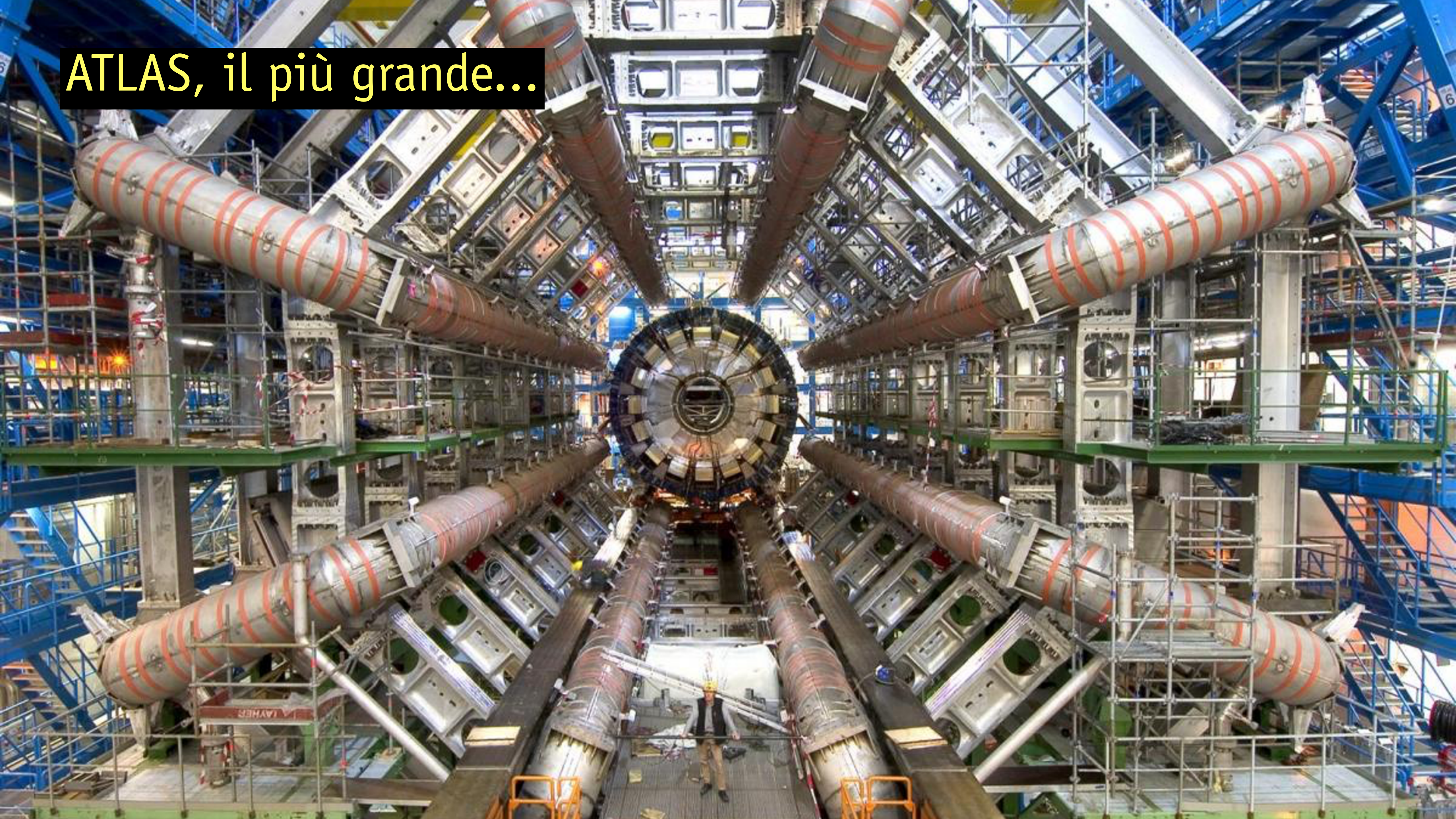
Run: 263962
Event: 20805
2015-05-05 09:39:47 CEST



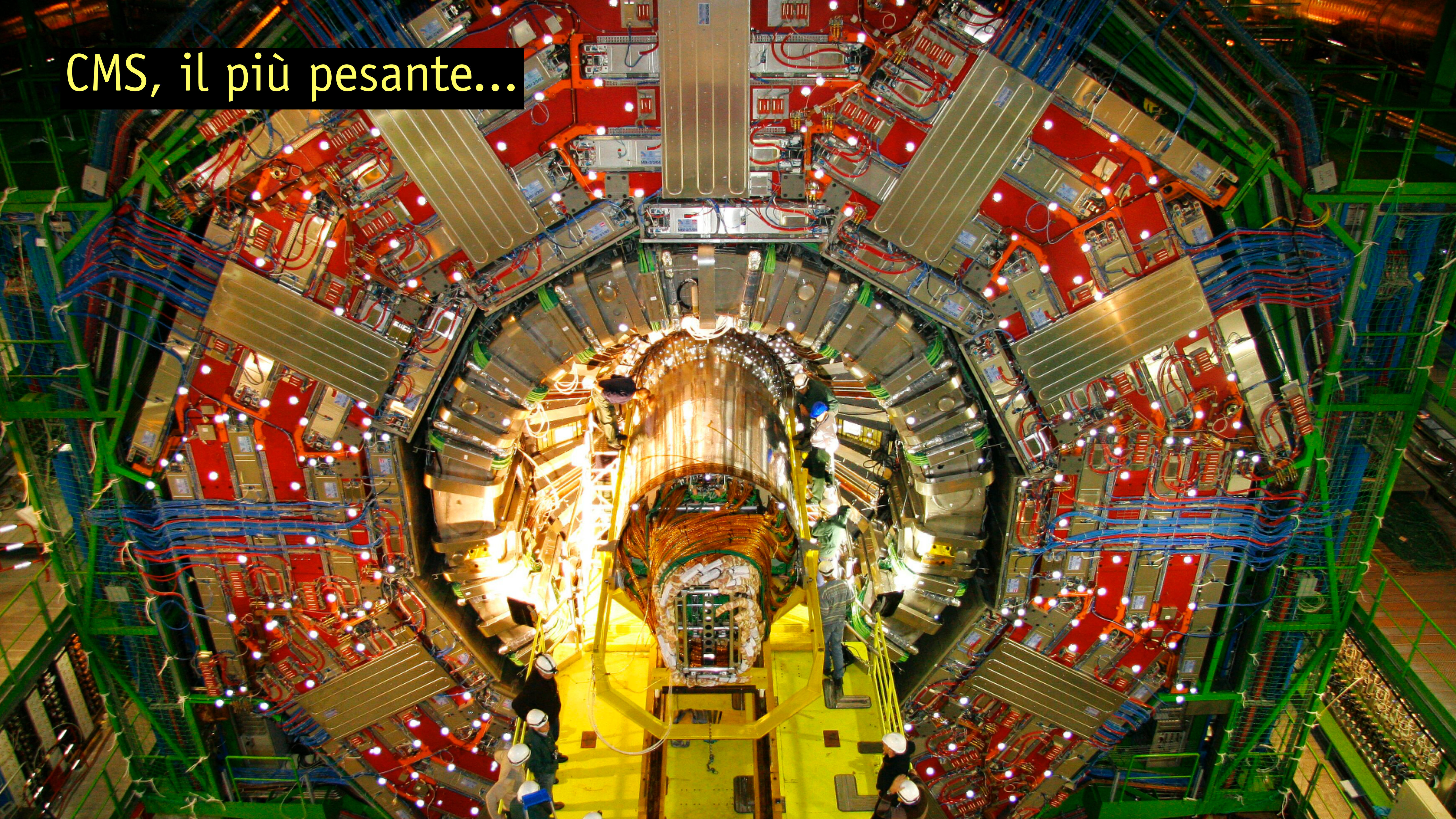
credits: ATLAS experiment, regoledegioco.com



ATLAS, il piú grande...



CMS, il più pesante...





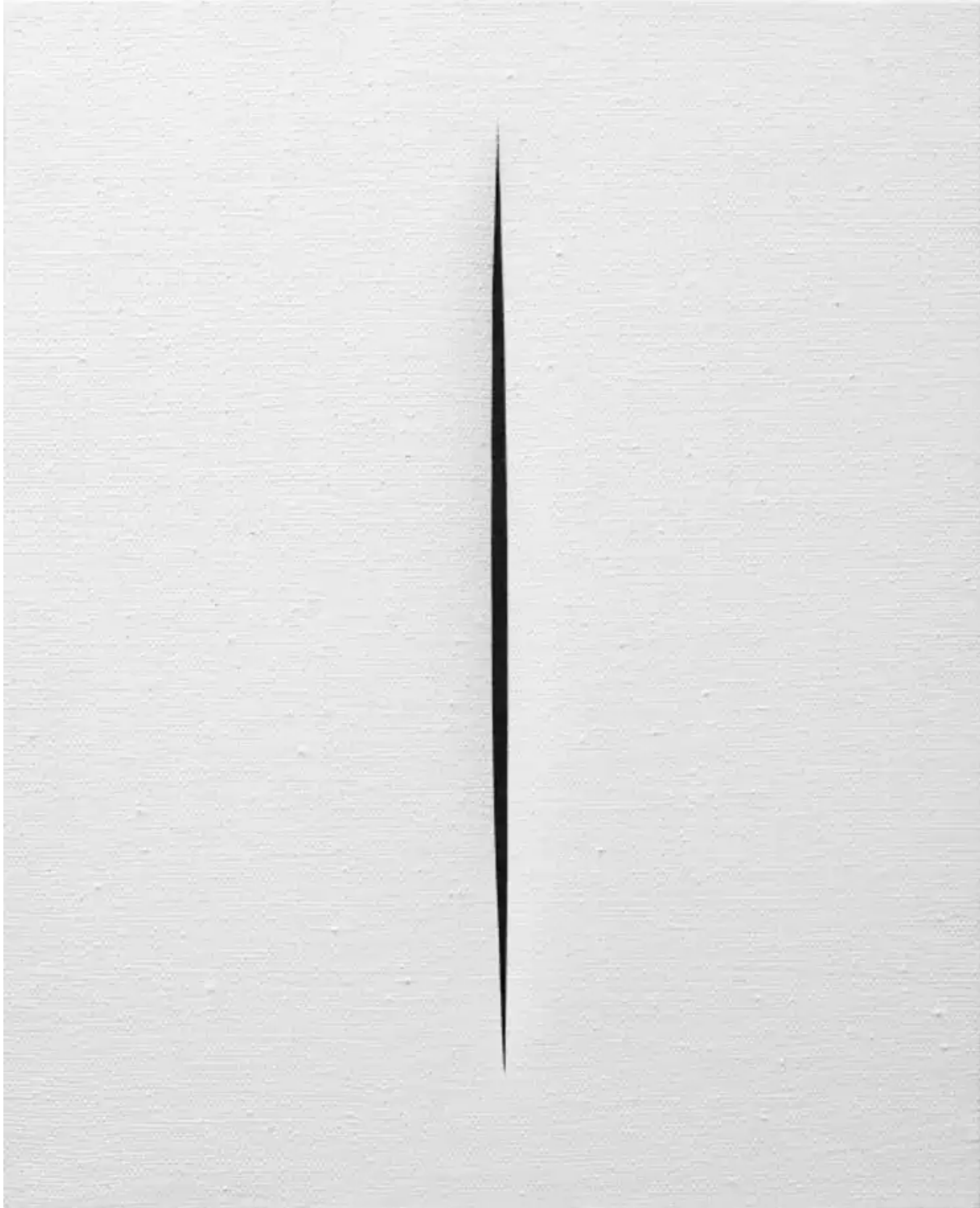
Un giorno Alice arrivò a un bivio sulla strada e vide lo Stregatto sull'albero.”

“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.”



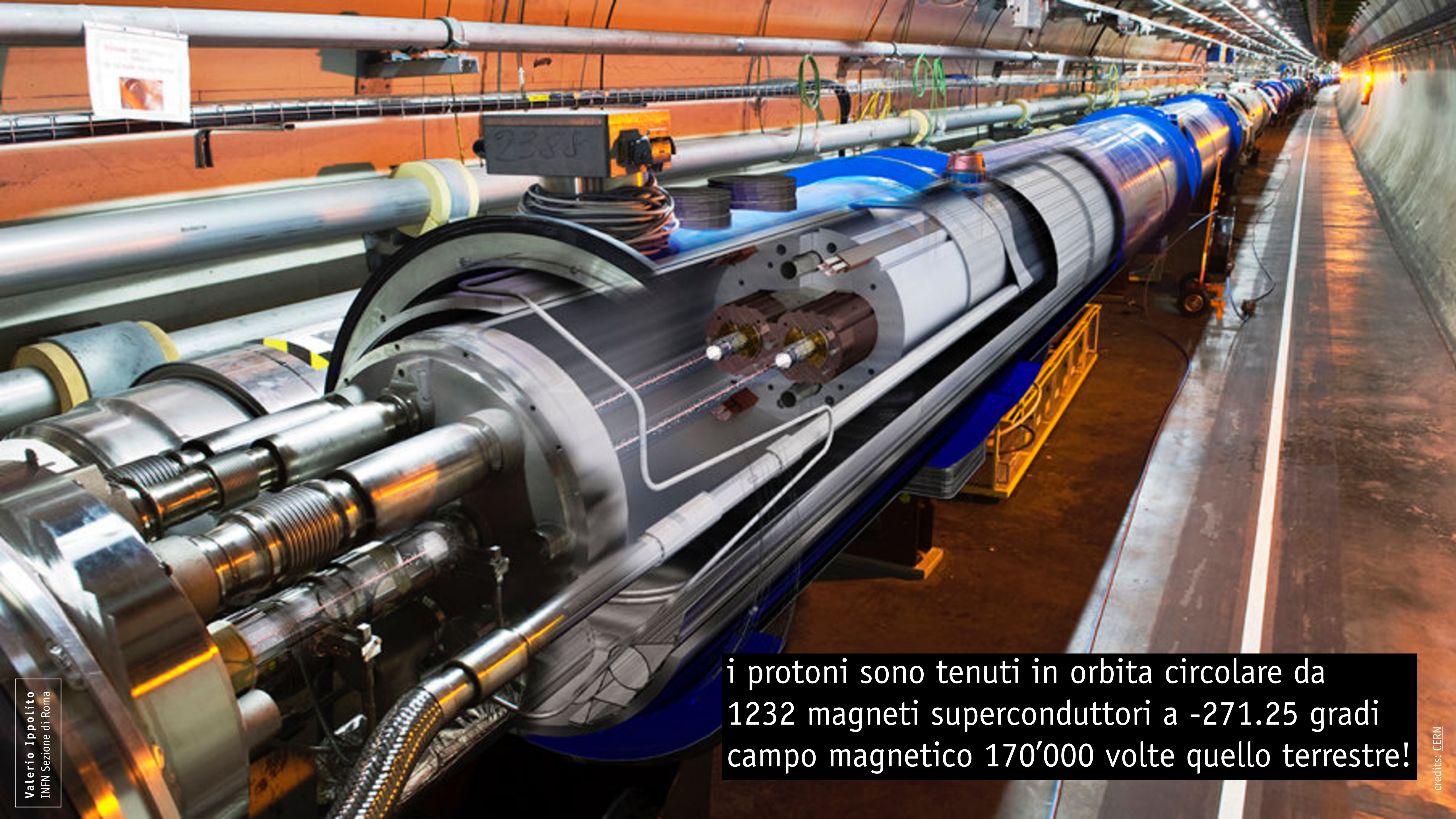
85% della materia
dell'universo

proviamo a **intercettarla**

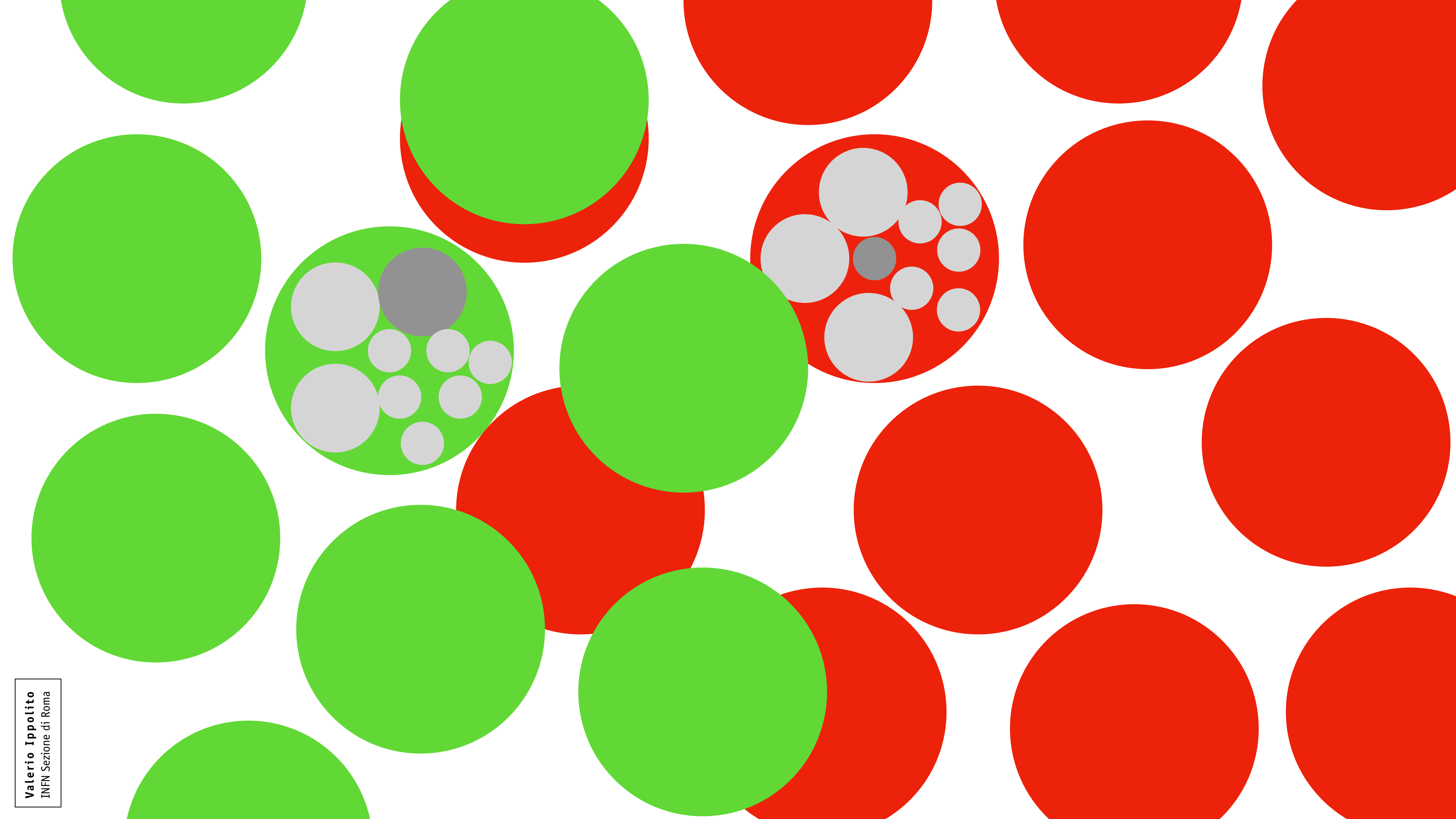
proviamo a **crearla**

il viaggio è iniziato!

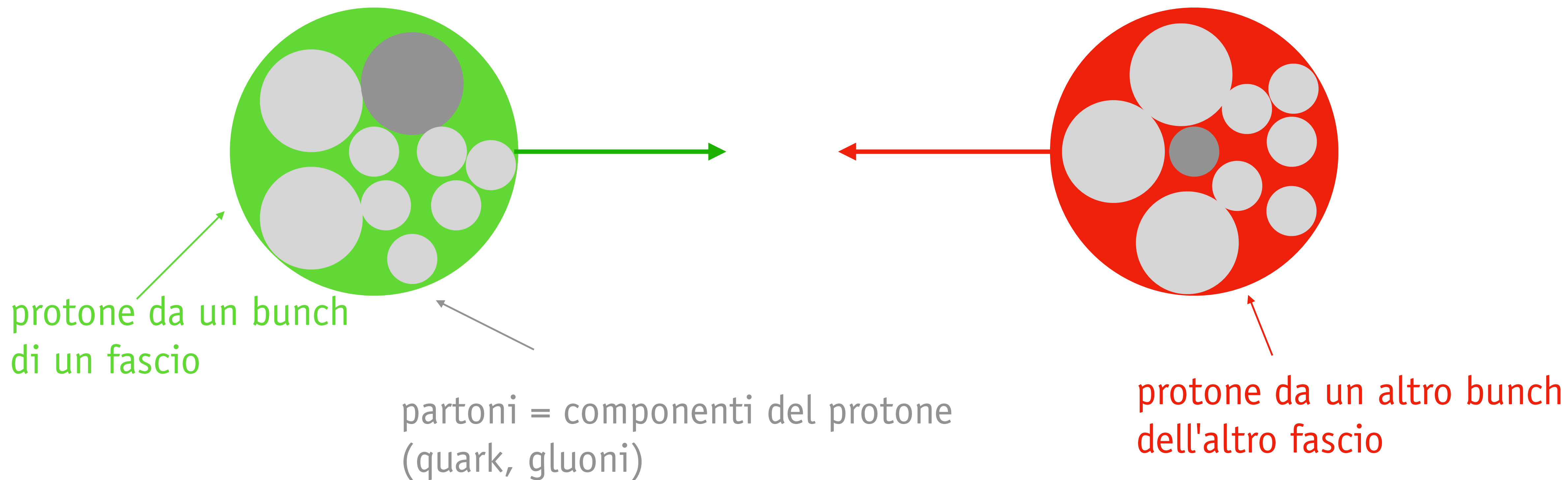
Backup



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

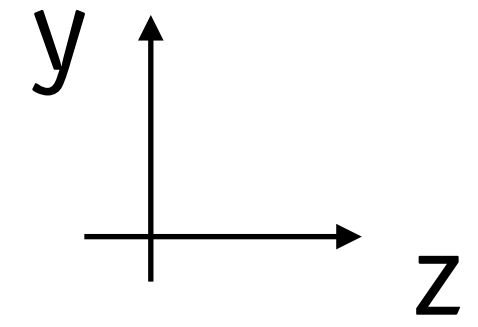


QUANDO DUE ~~PROTONI~~ PARTONI SI SCONTRANO



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

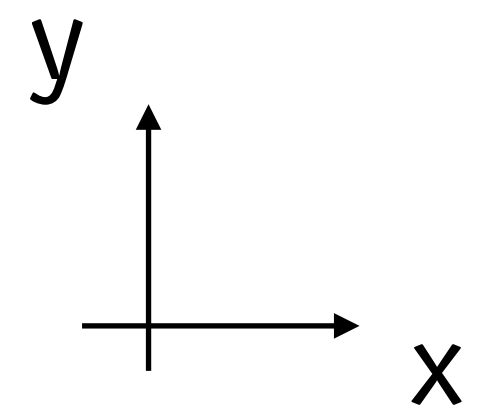
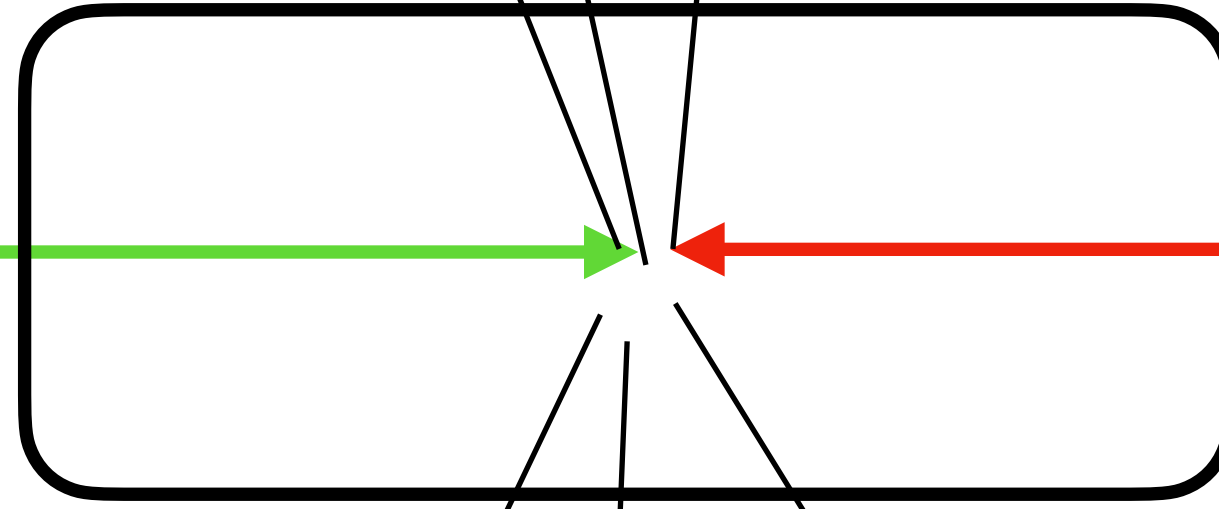




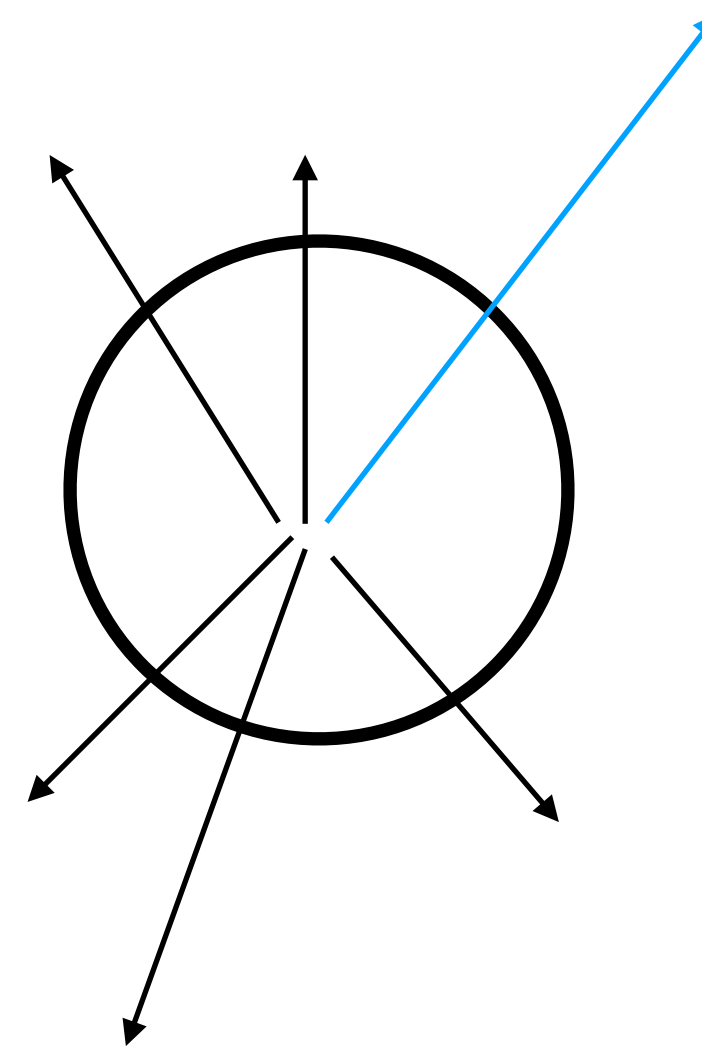
protoni



protoni



piano trasverso
"a somma zero"



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