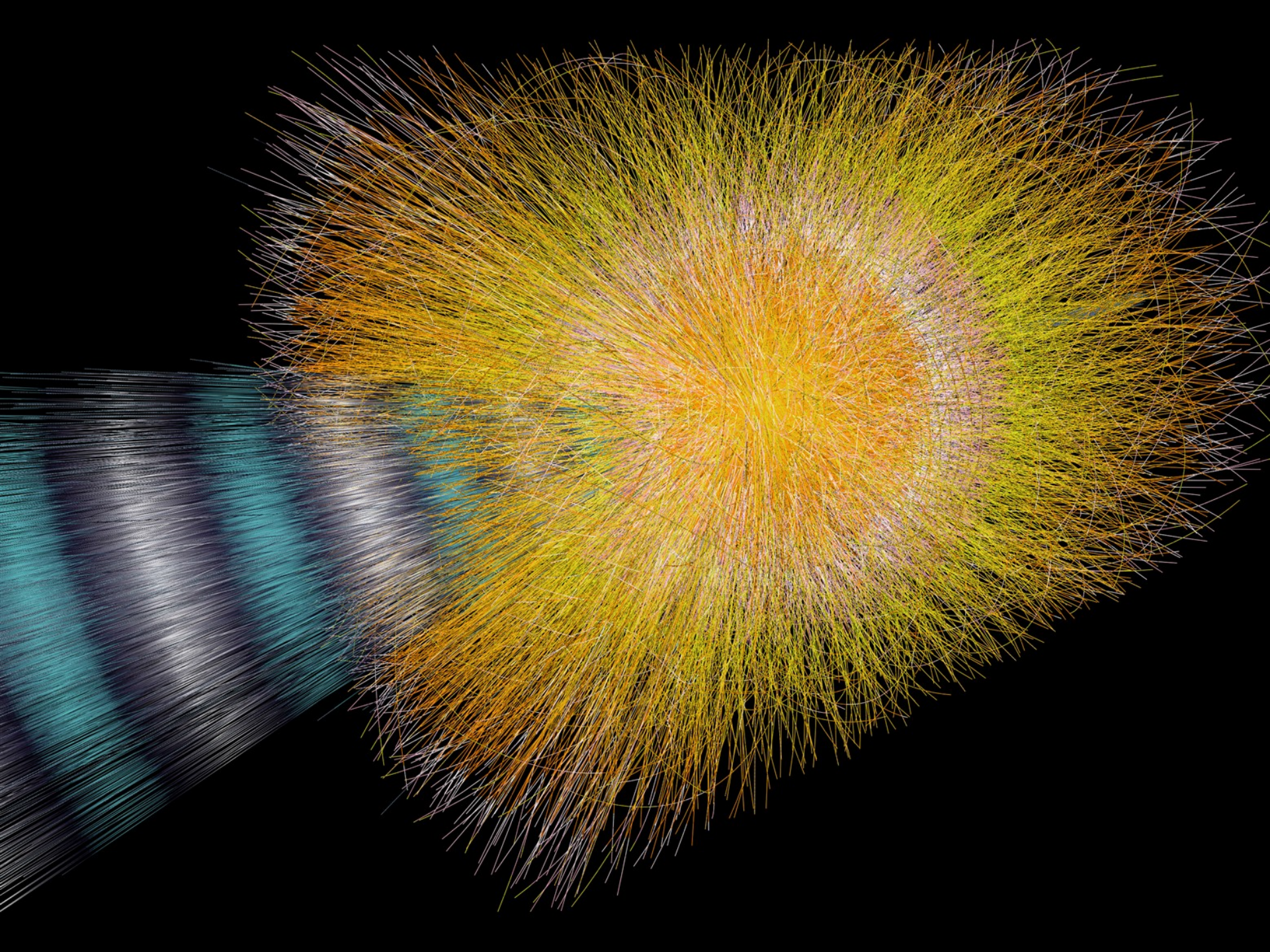
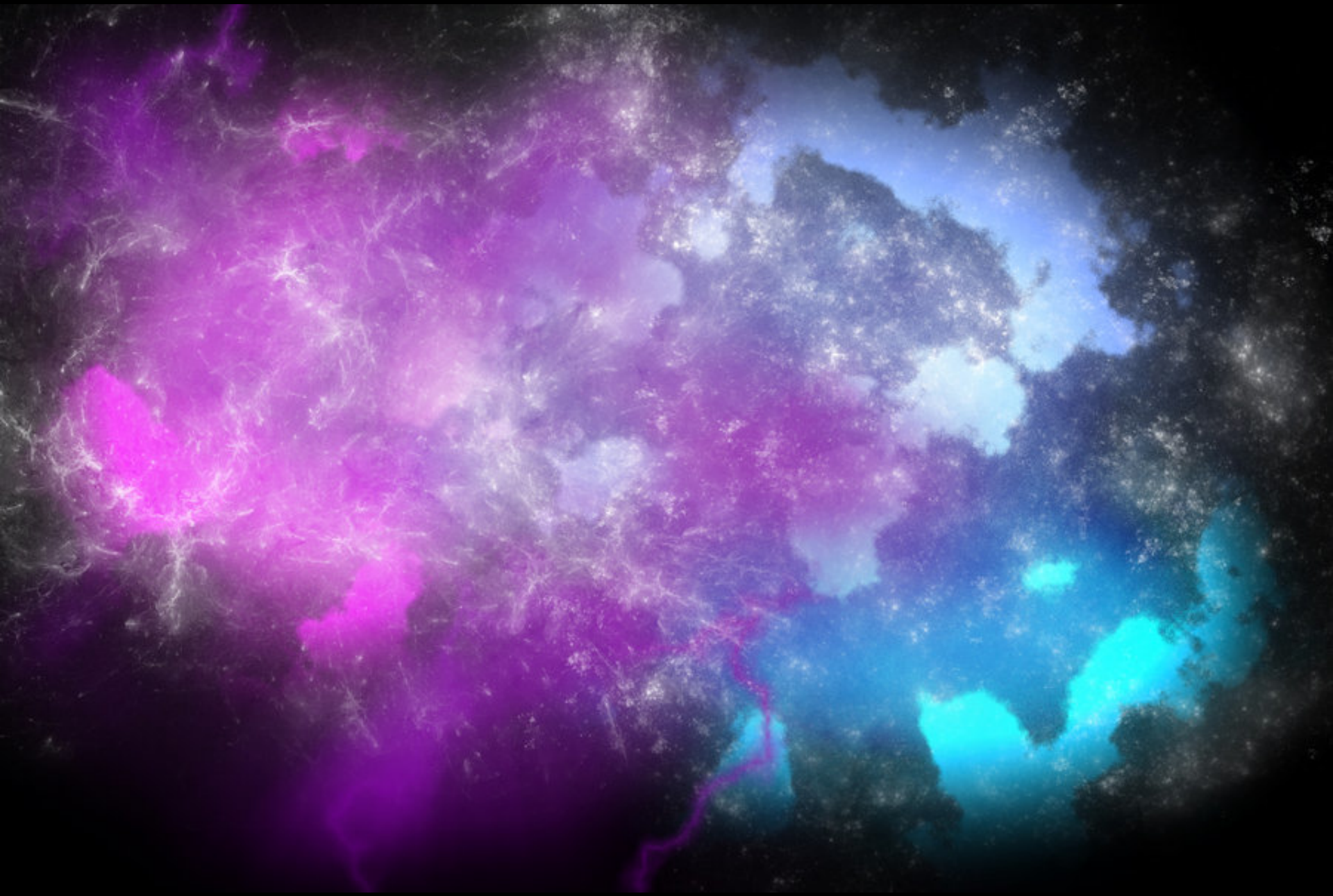
Italian Teachers Programme 09/2013

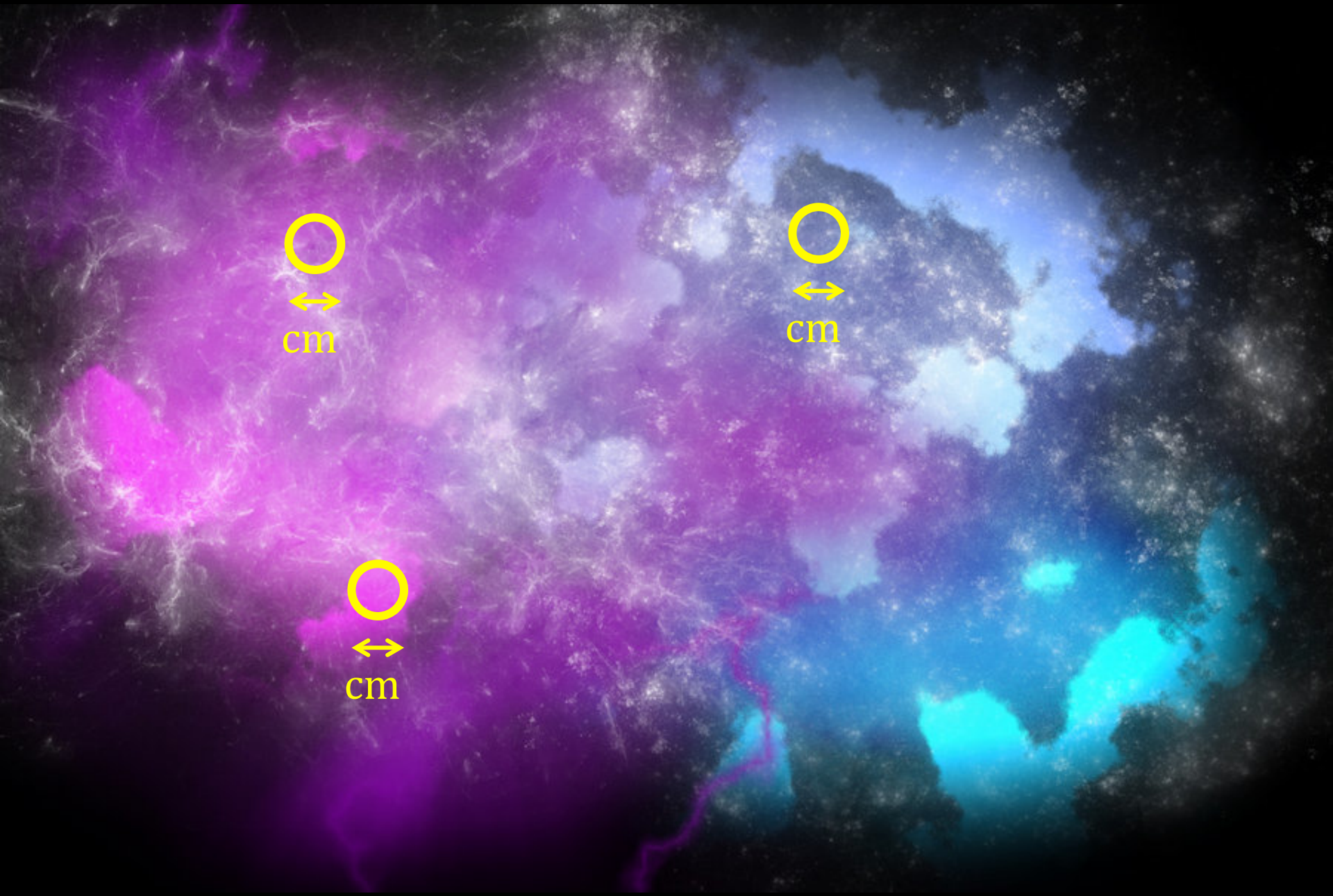
Cosmologia, LHC e bosone di Higgs

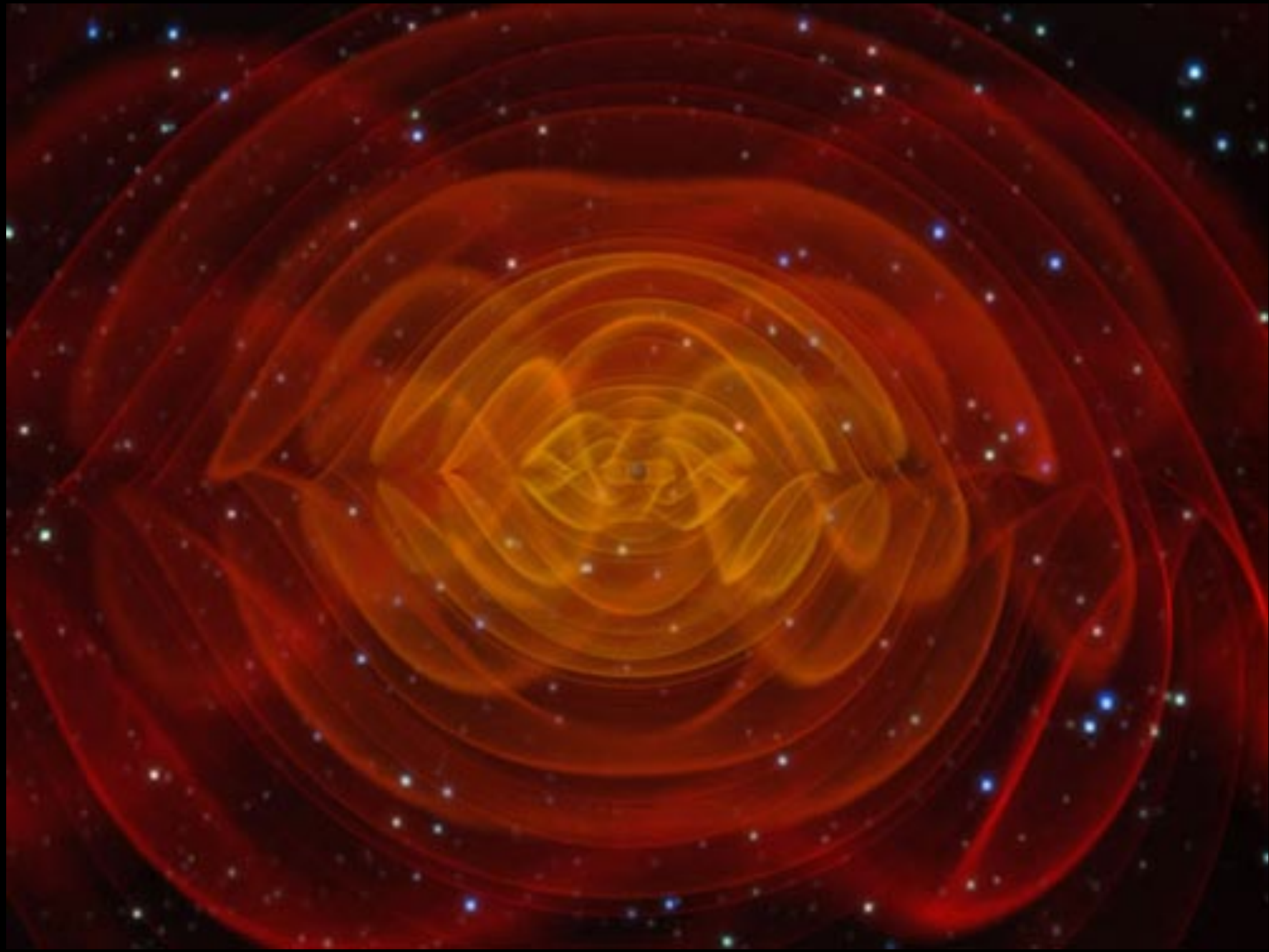
G.F. Giudice

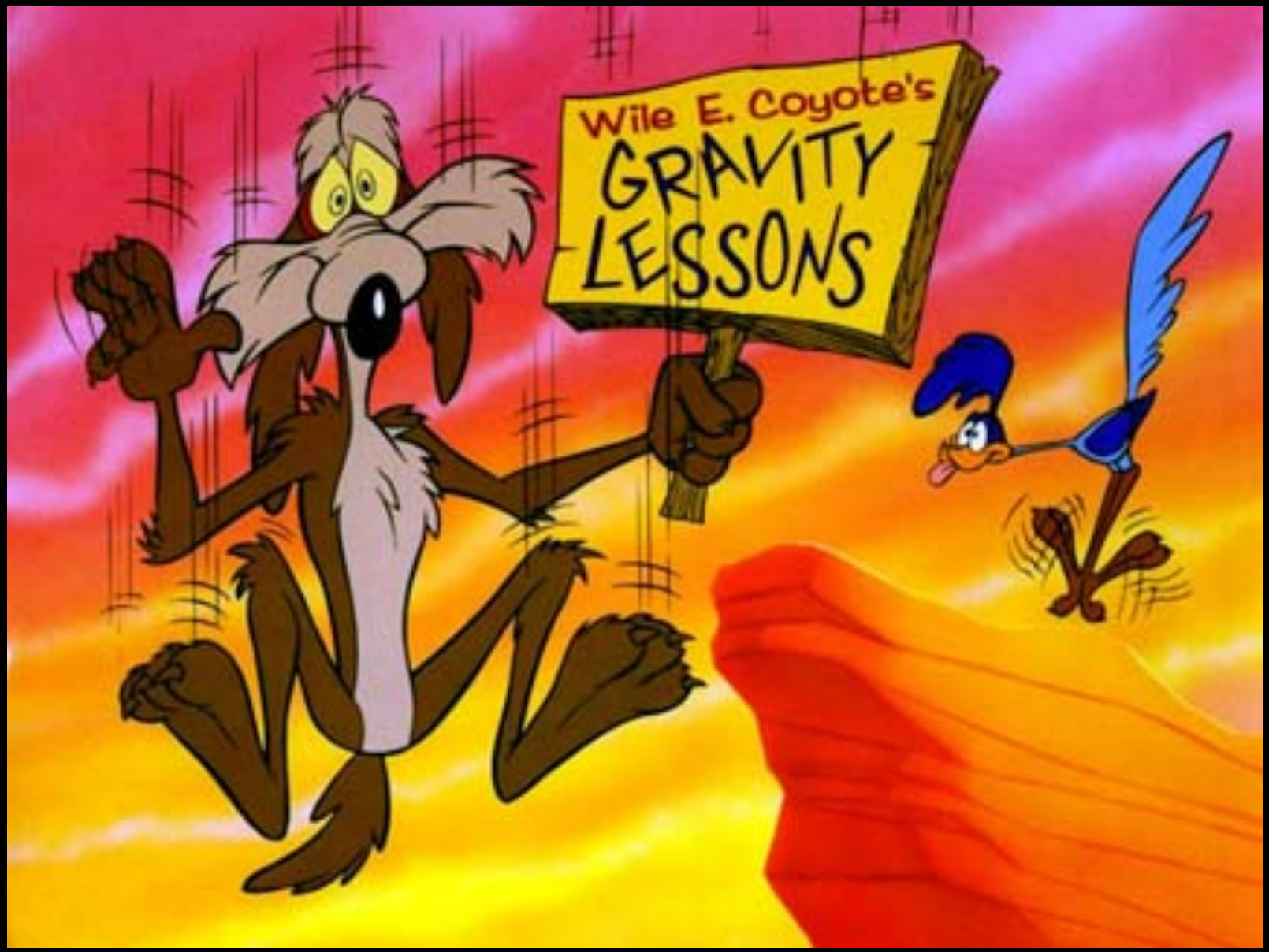
Un decimo di miliardesimo di secondo dopo il Big Bang…

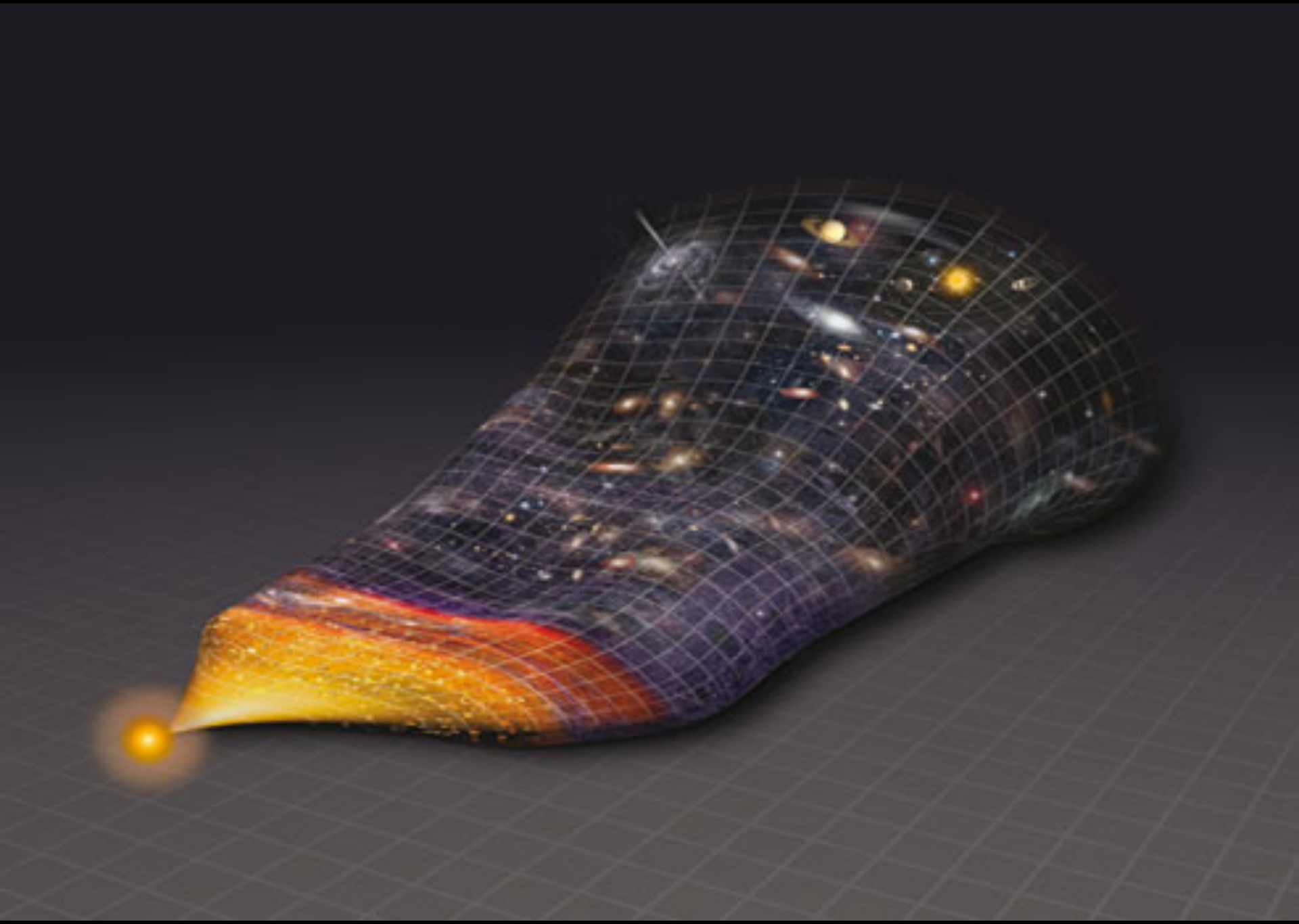


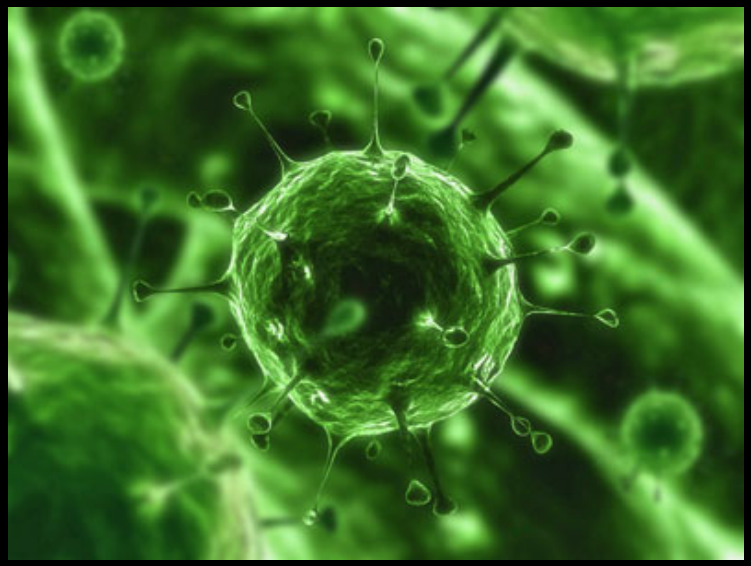



cm
cm
cm

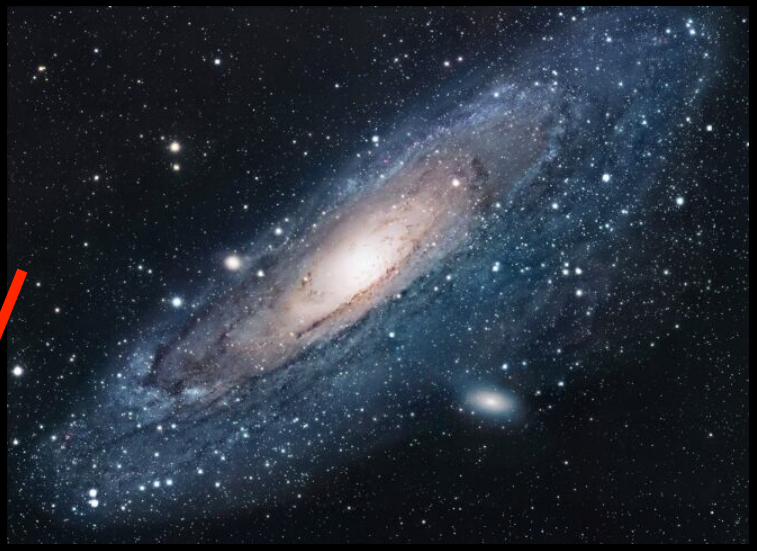



Wile E. Coyote's
GRAVITY
LESSONS

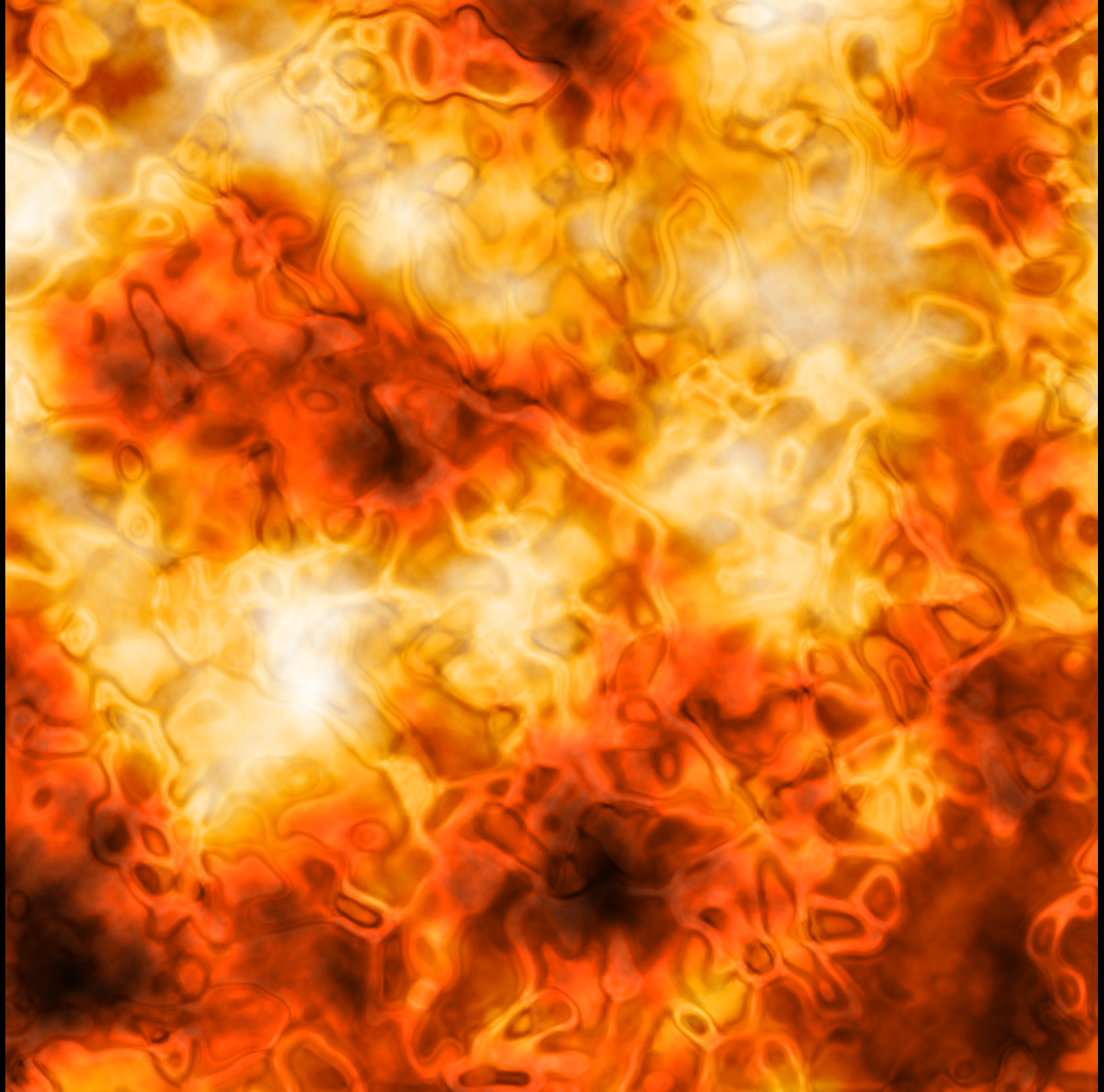


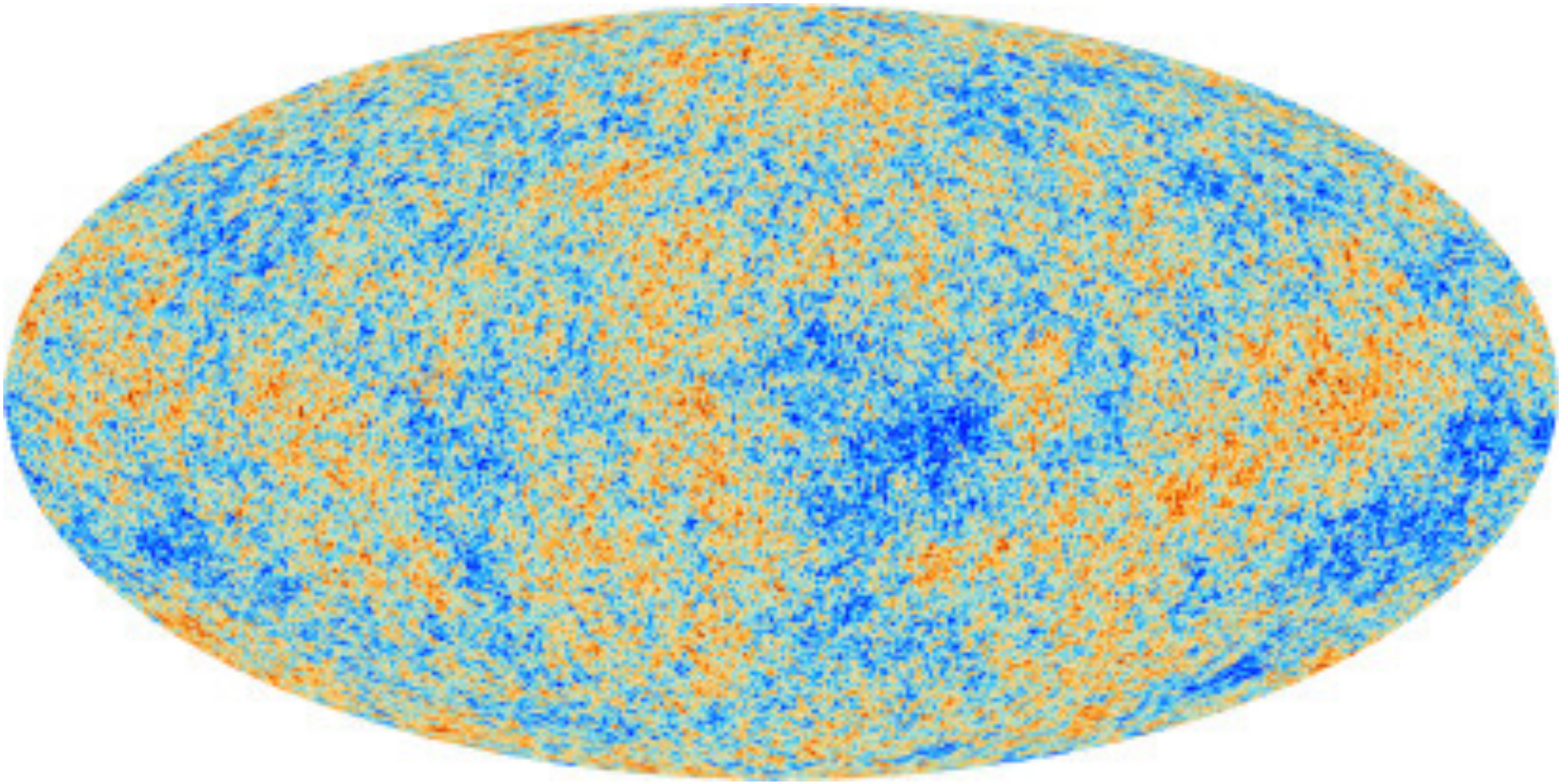


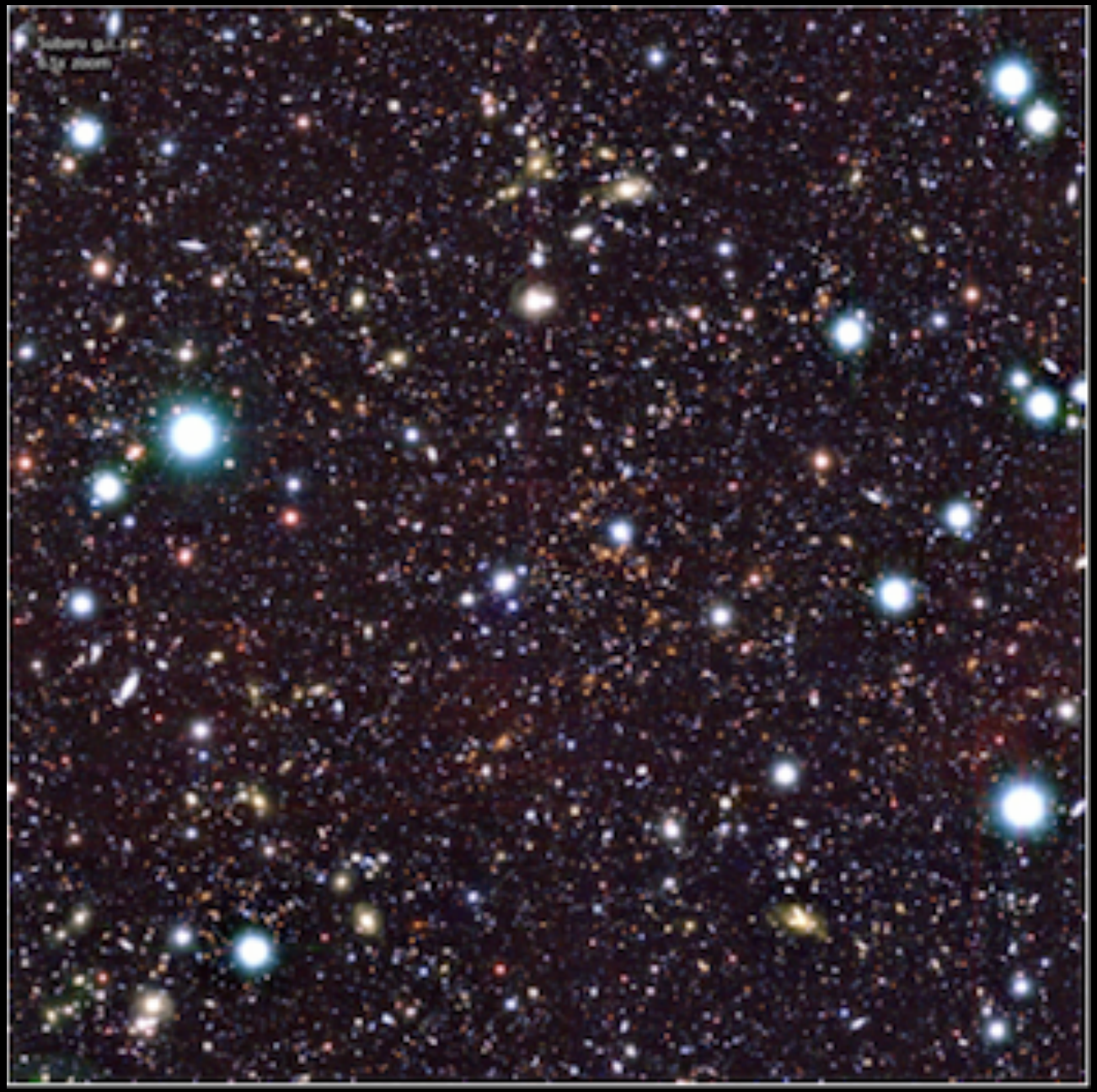
10 nm

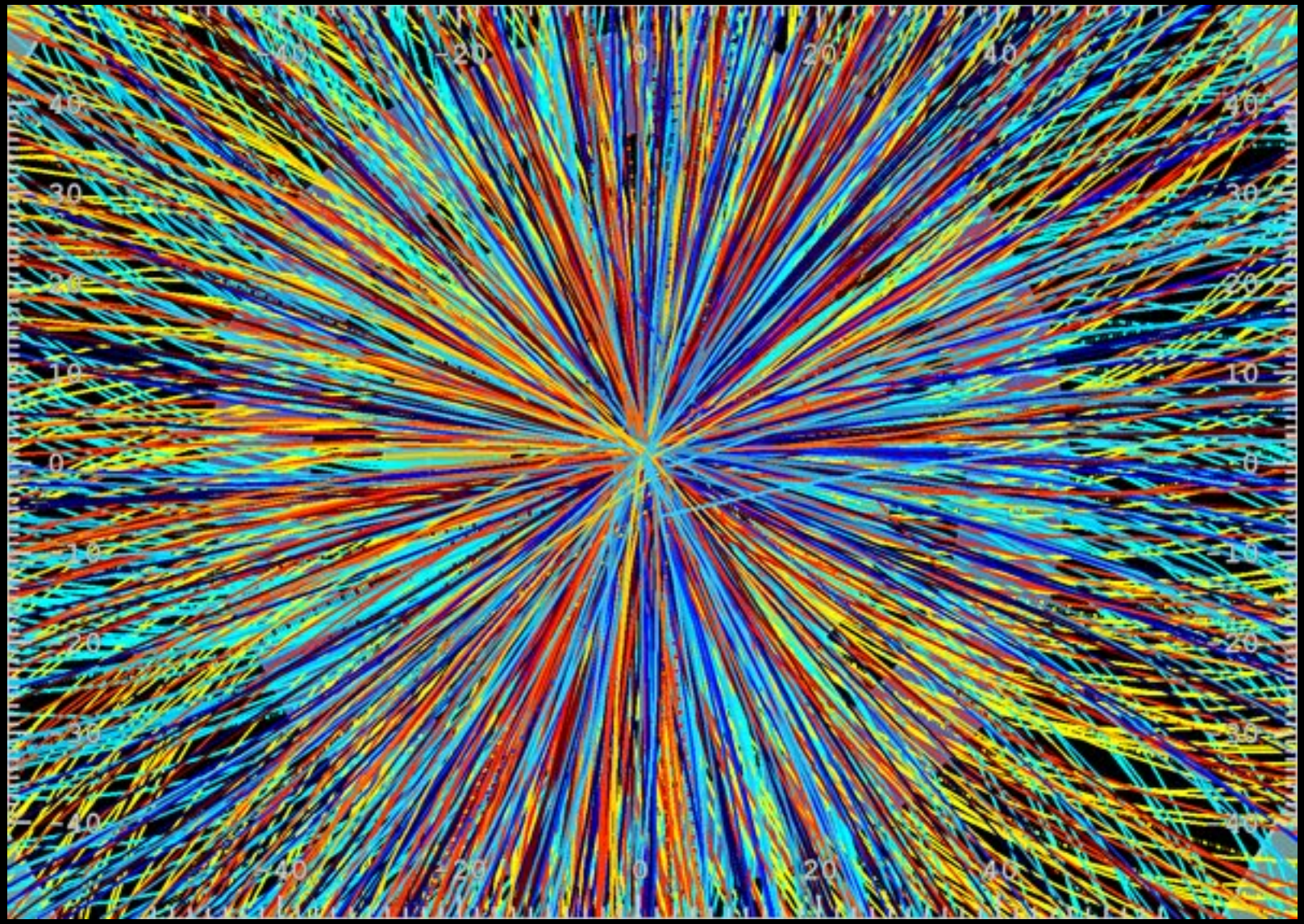


800 kpc








−20
0
20
40
−40
30
20
10
0
10
20
30
40
−40
−20
0
20
40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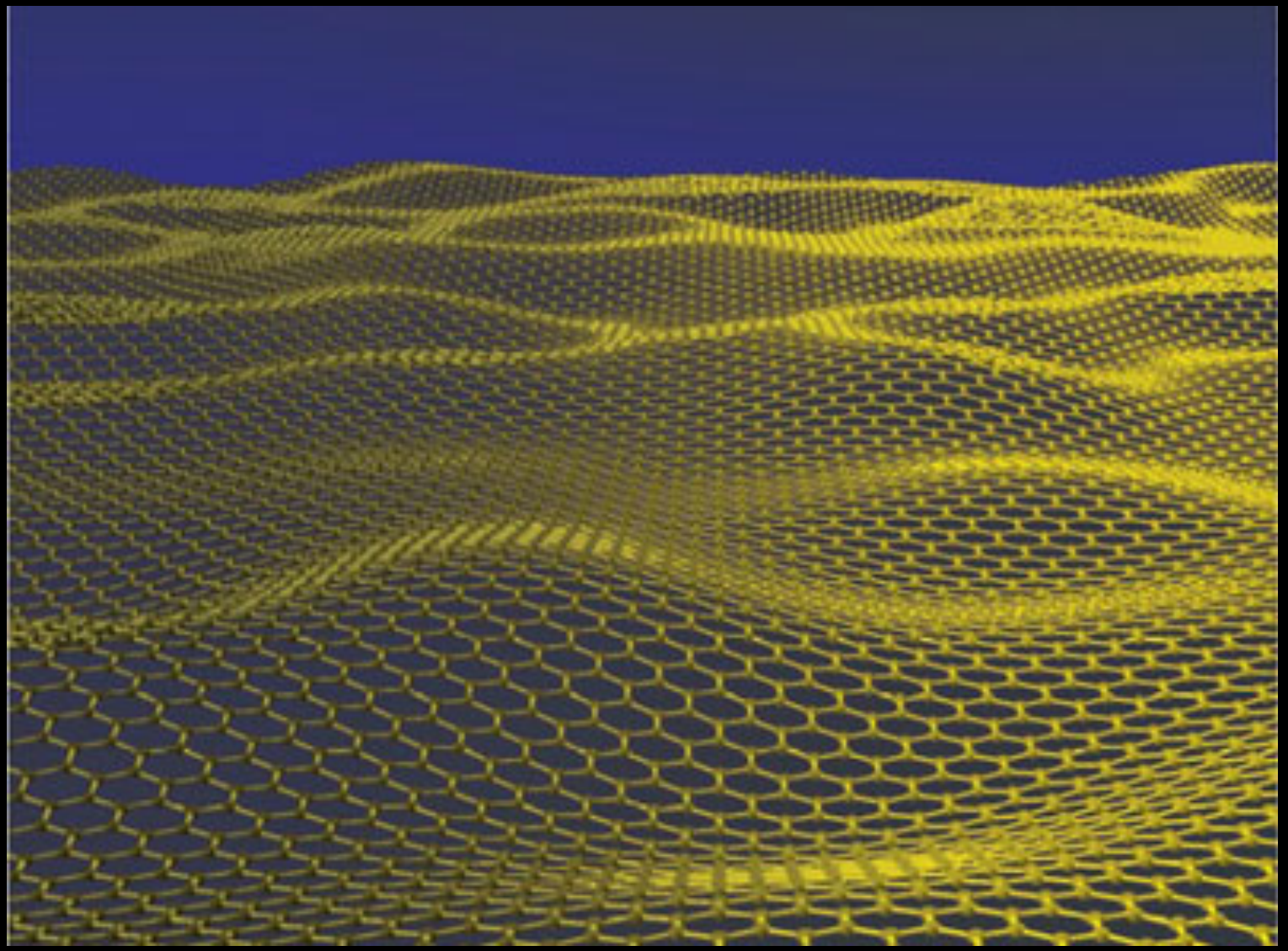
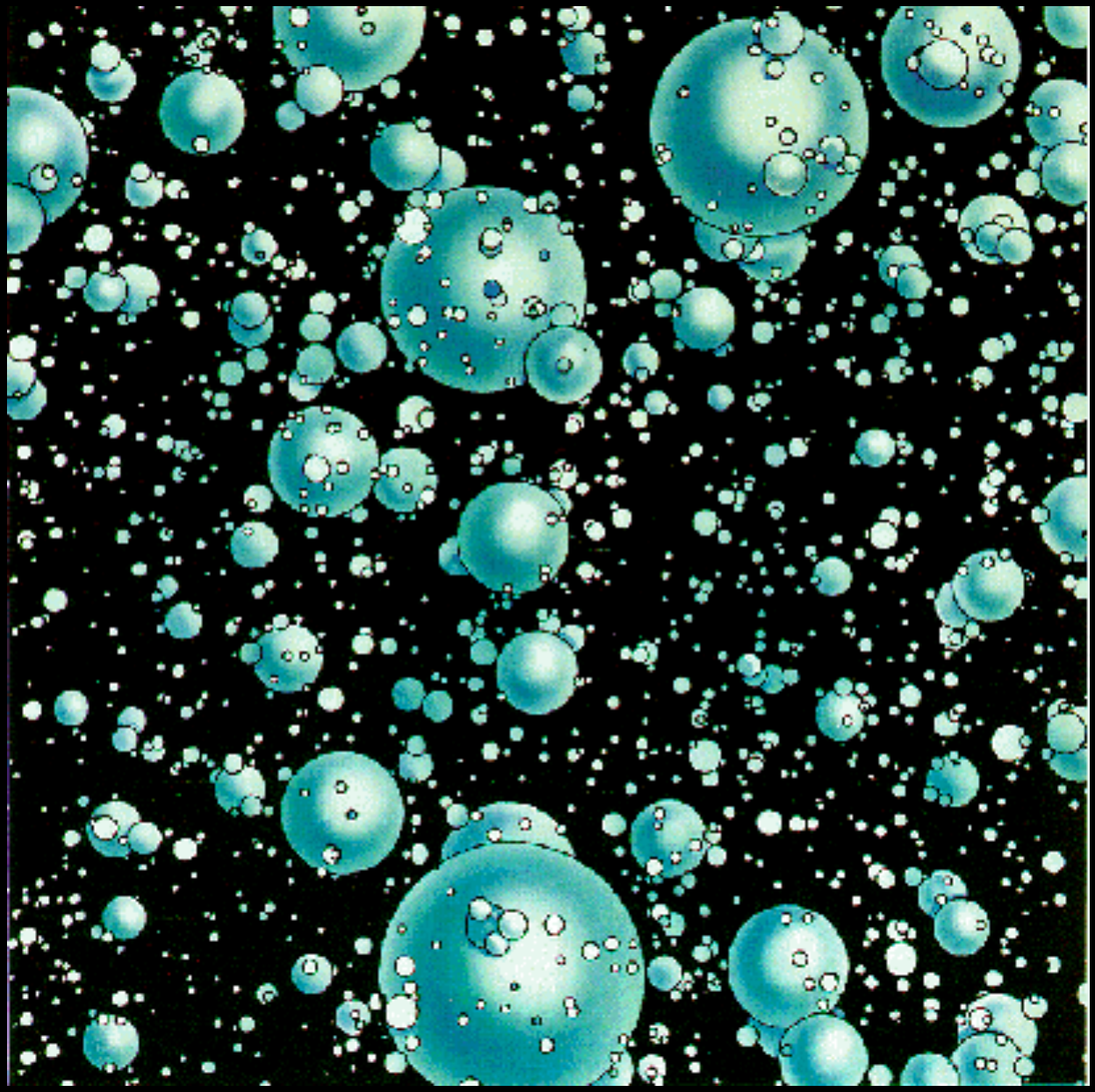
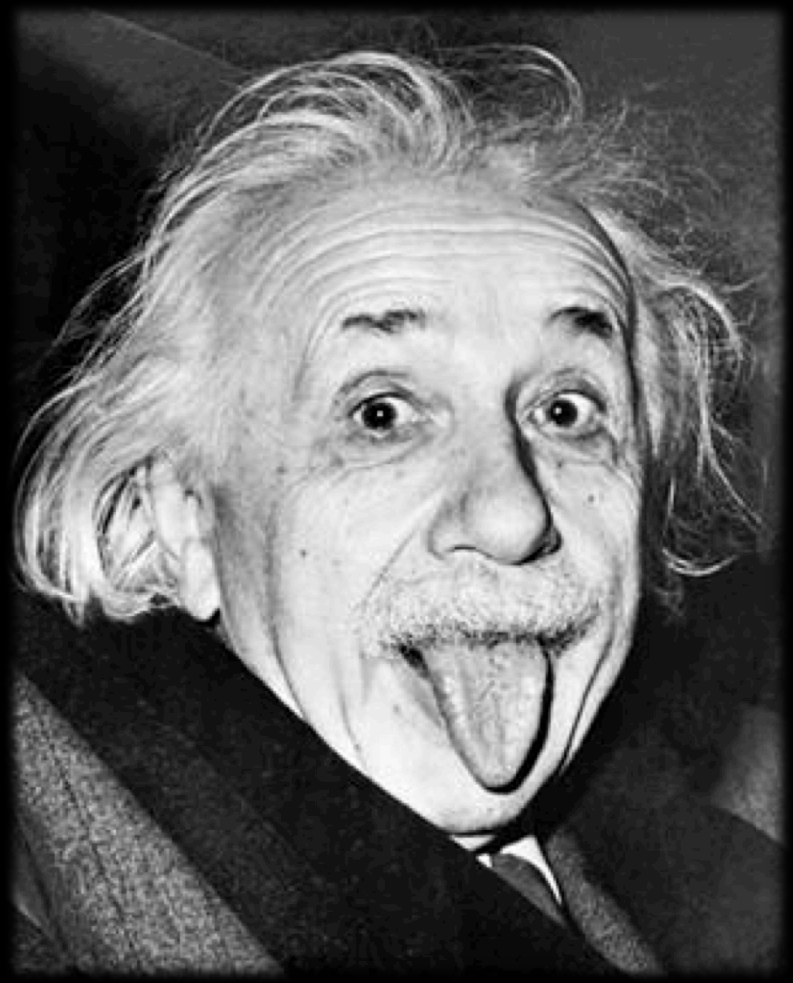




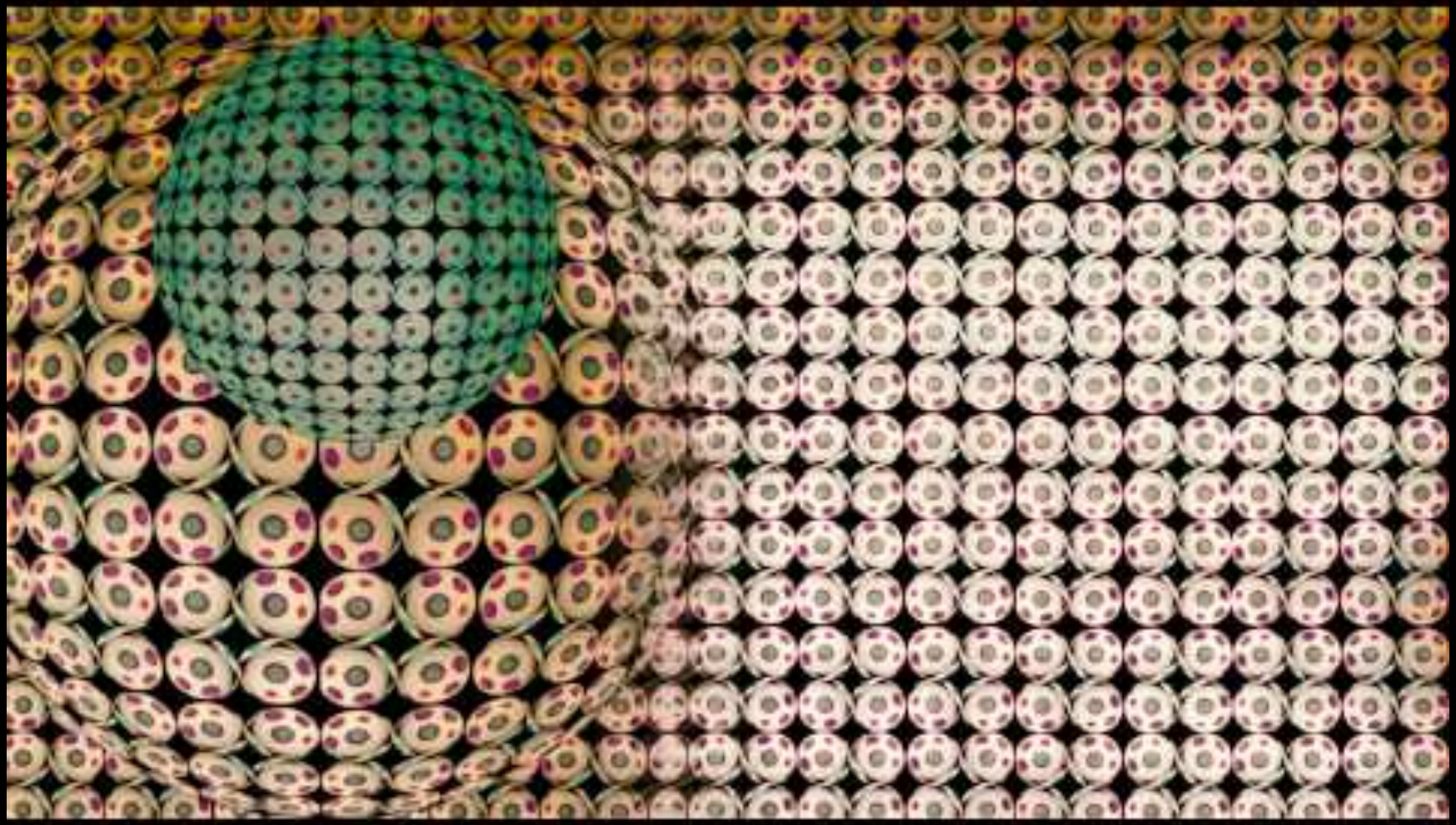


$E=mc^2$

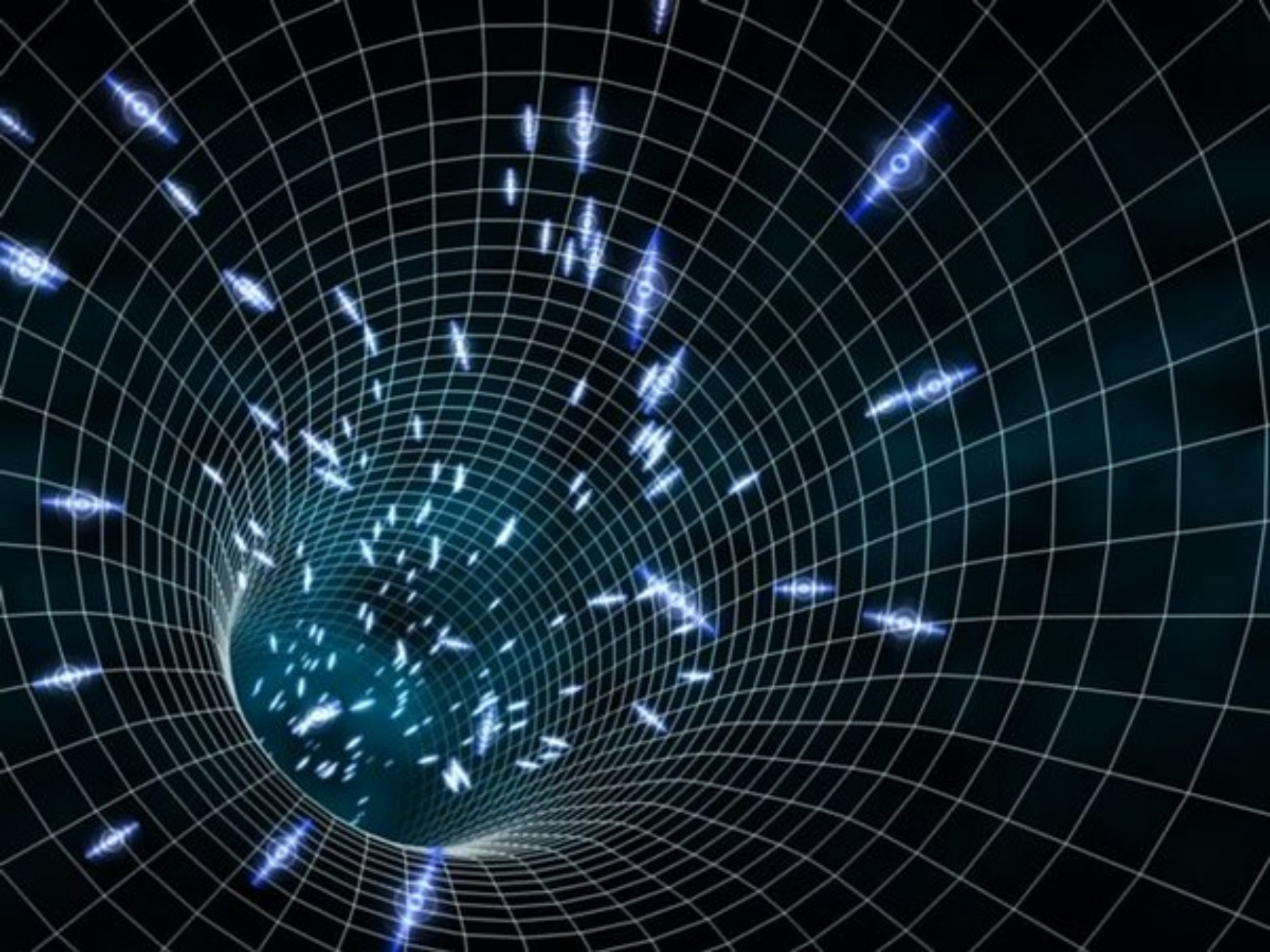
Higgs

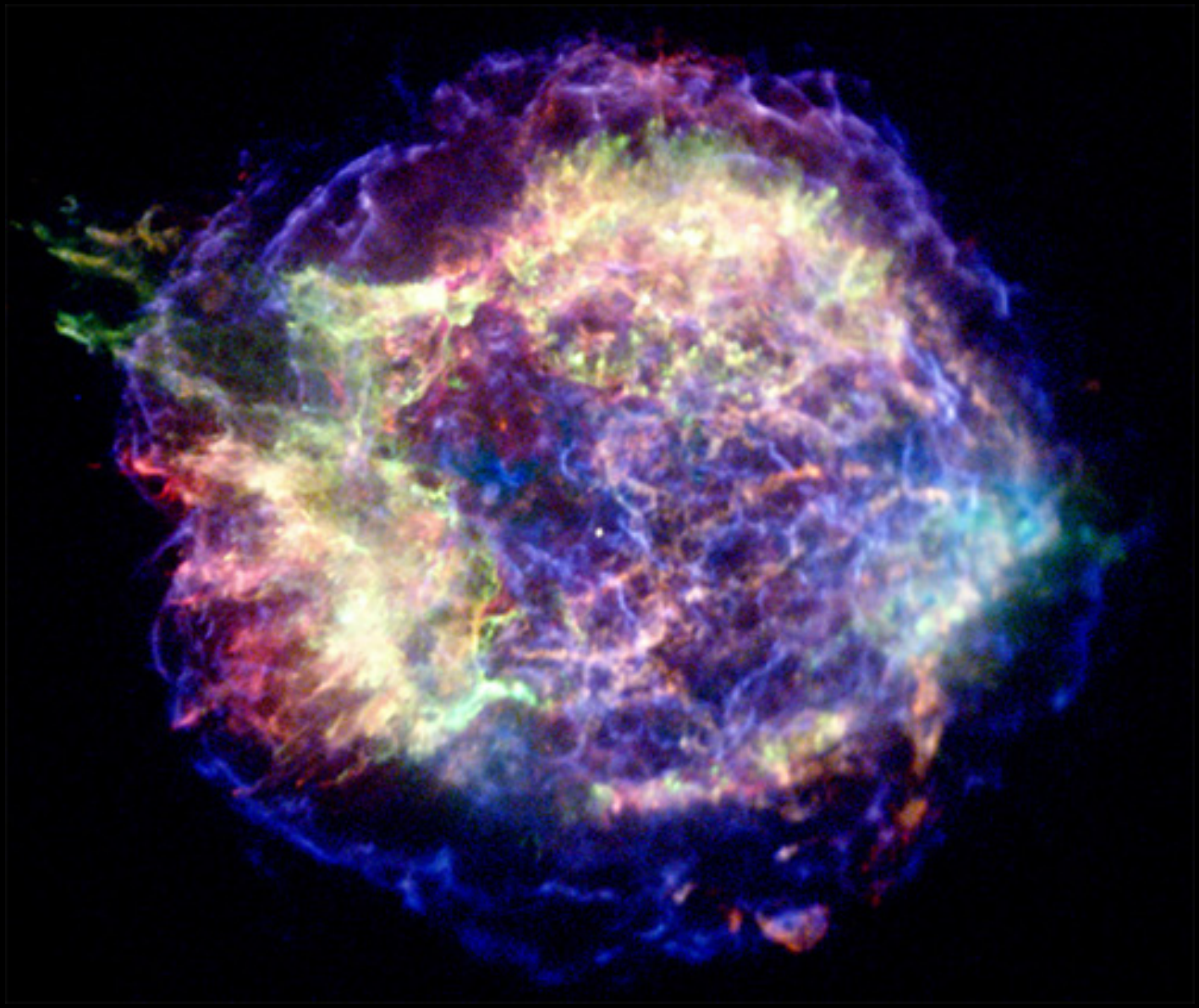
Higgs

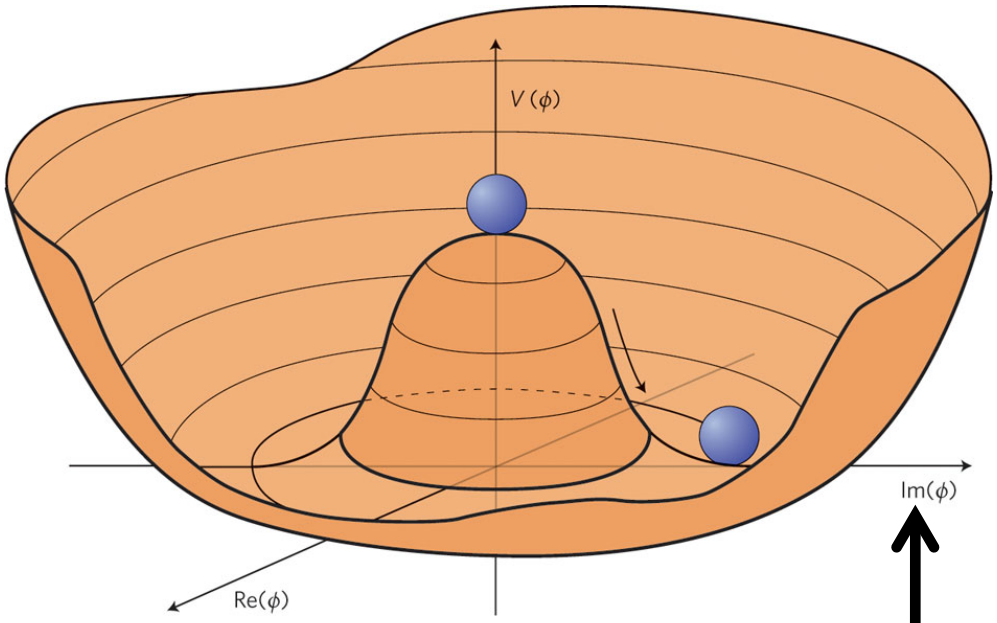
0,2 %



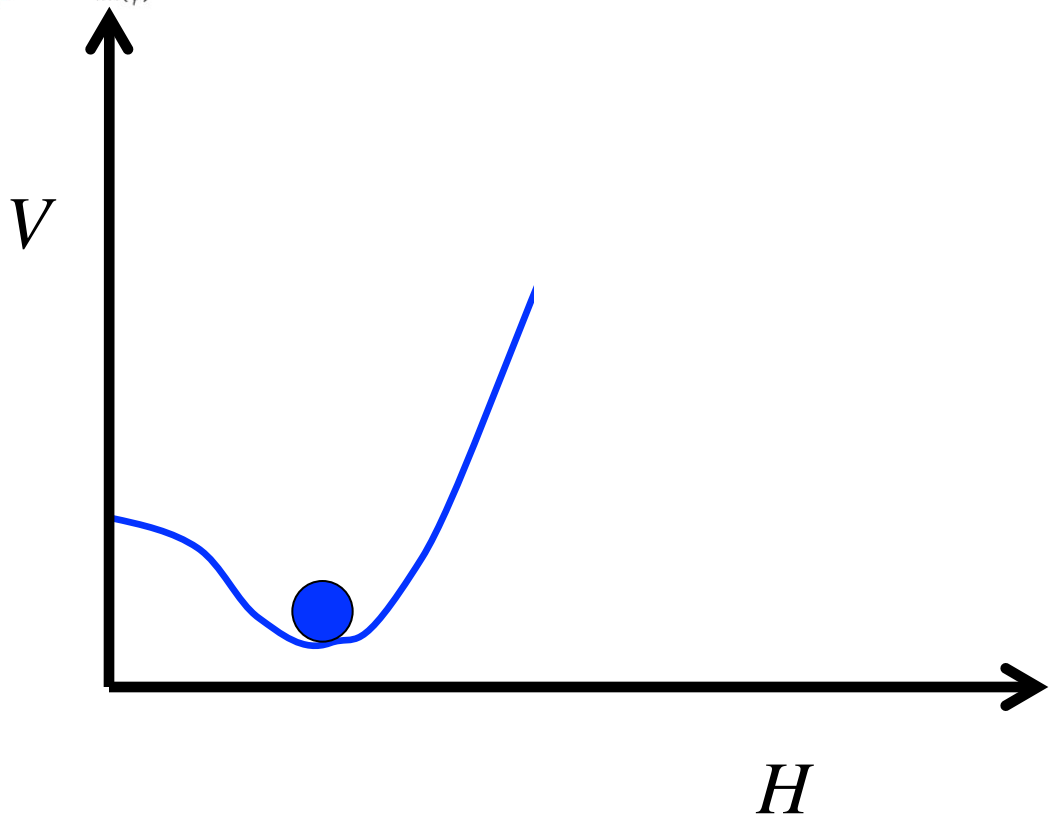
Massa del bosone di Higgs = 125-126 GeV



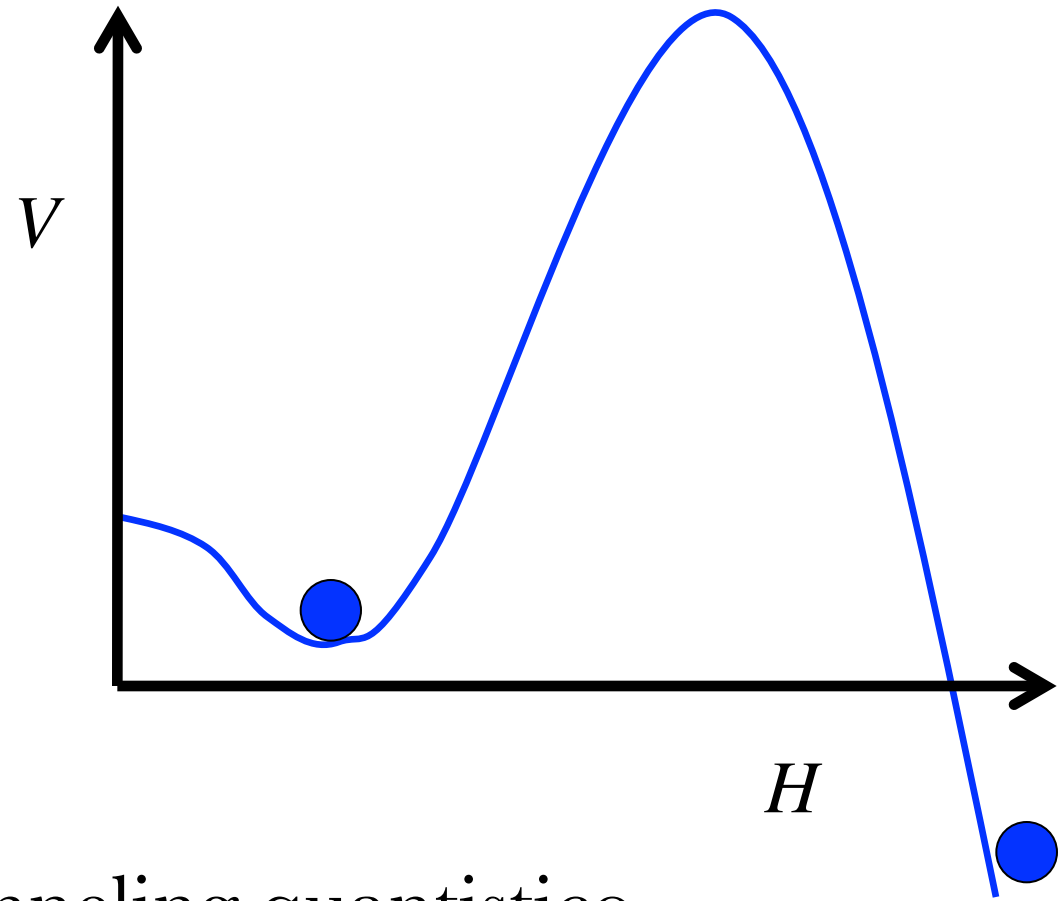




$$V(H) = -\mu_H^2 |H|^2 + \lambda |H|^4$$

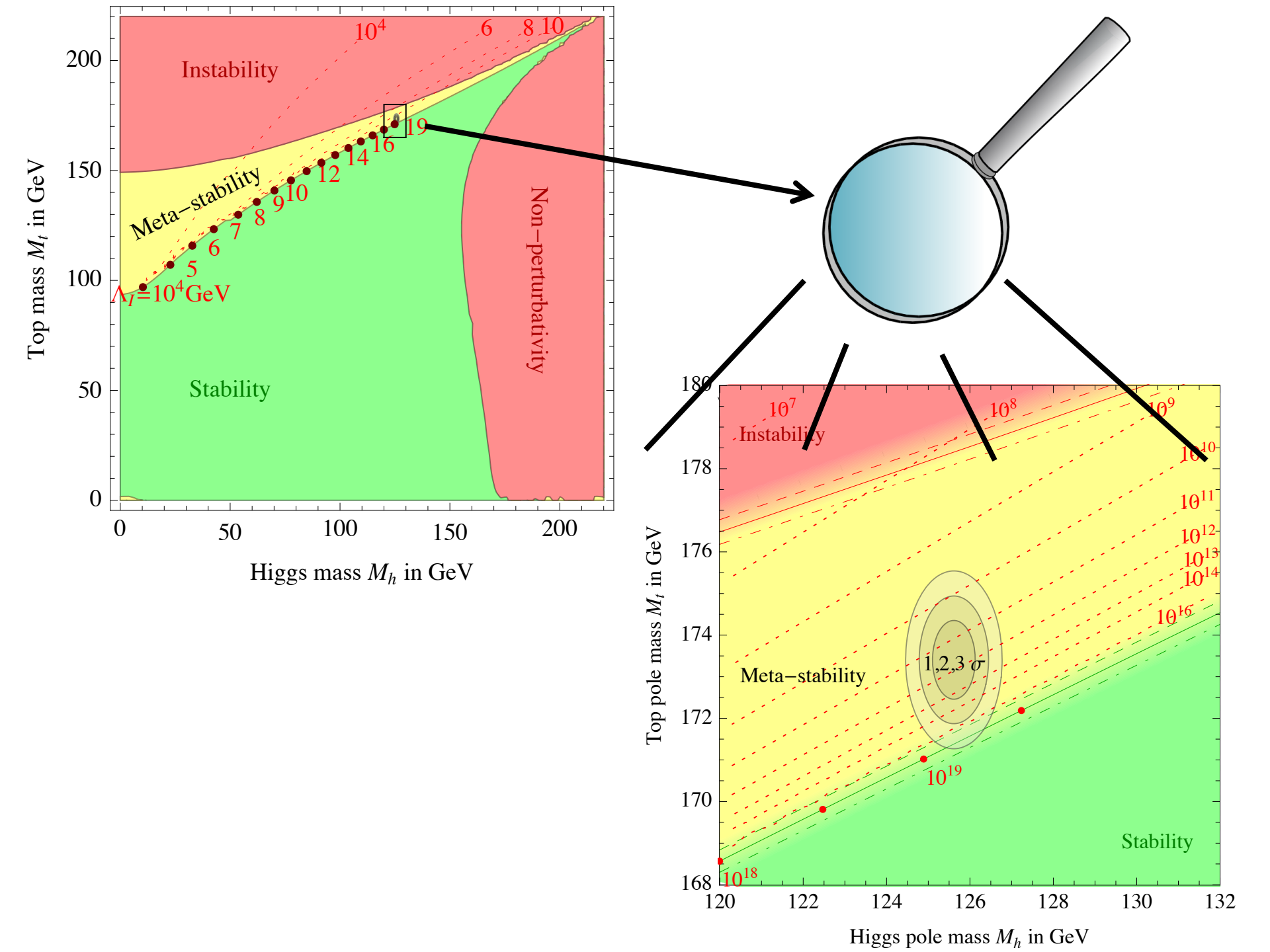


- massa Higgs
- mass top quark

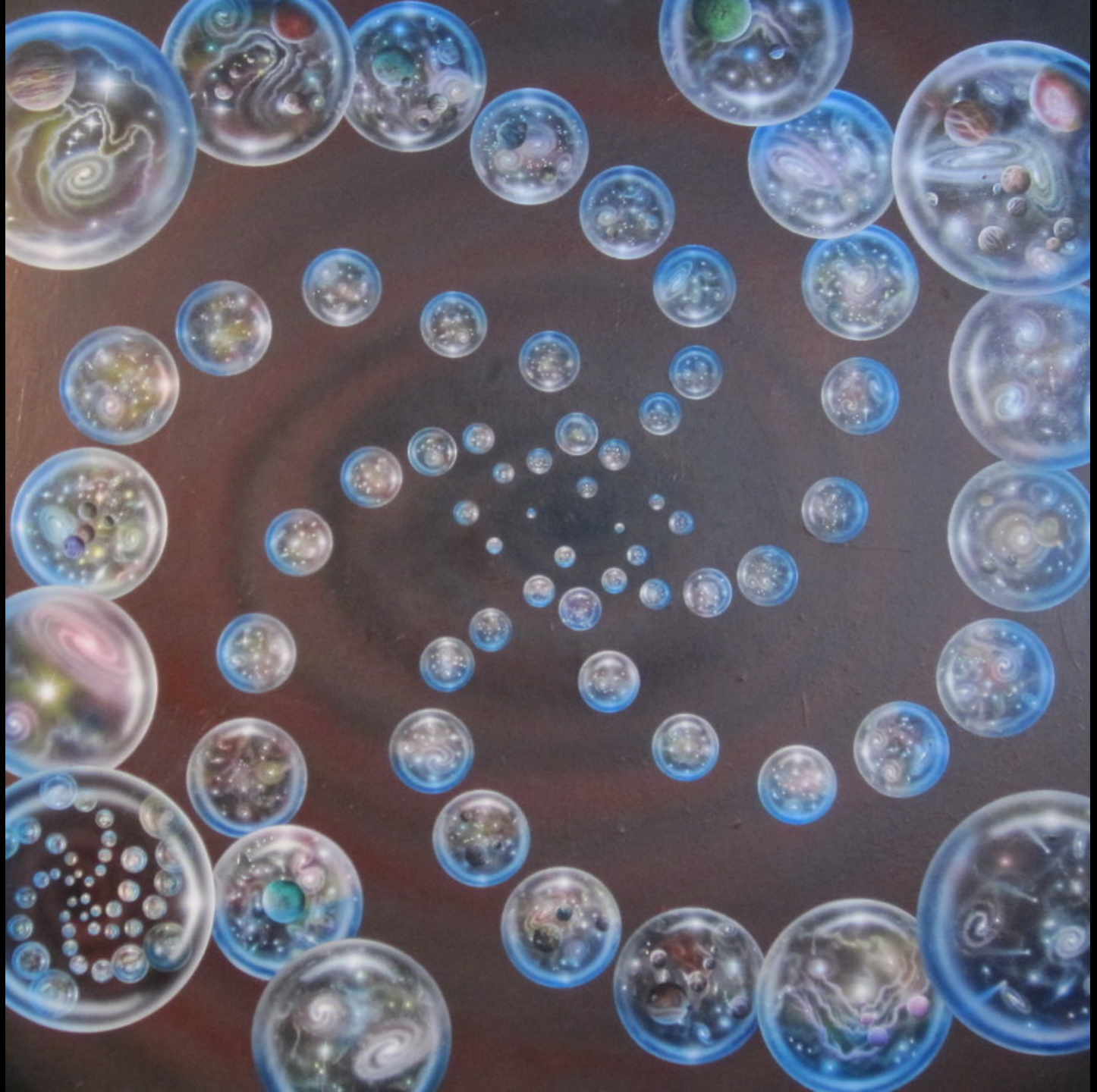


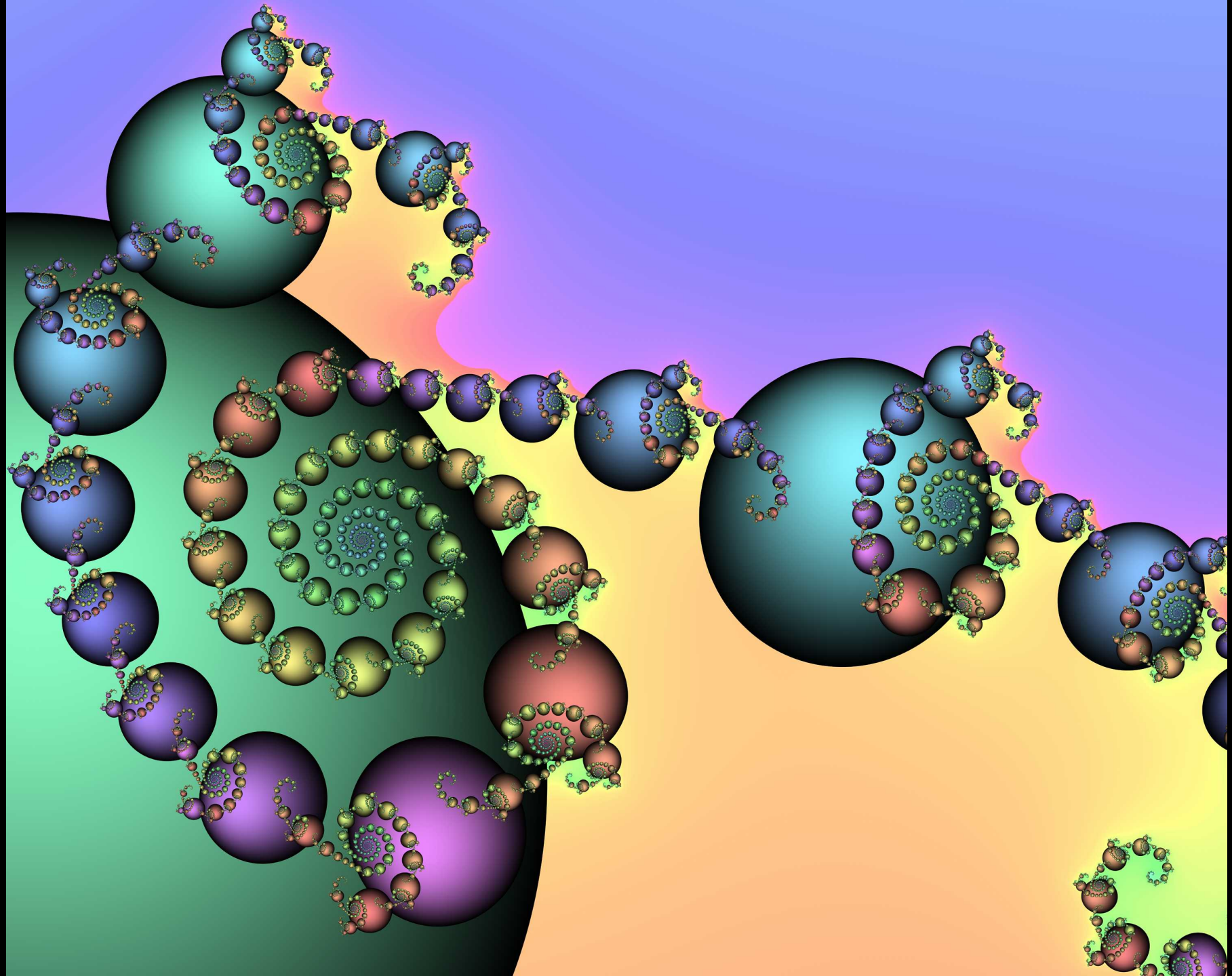
- Tunneling quantistico
- Tunneling termico

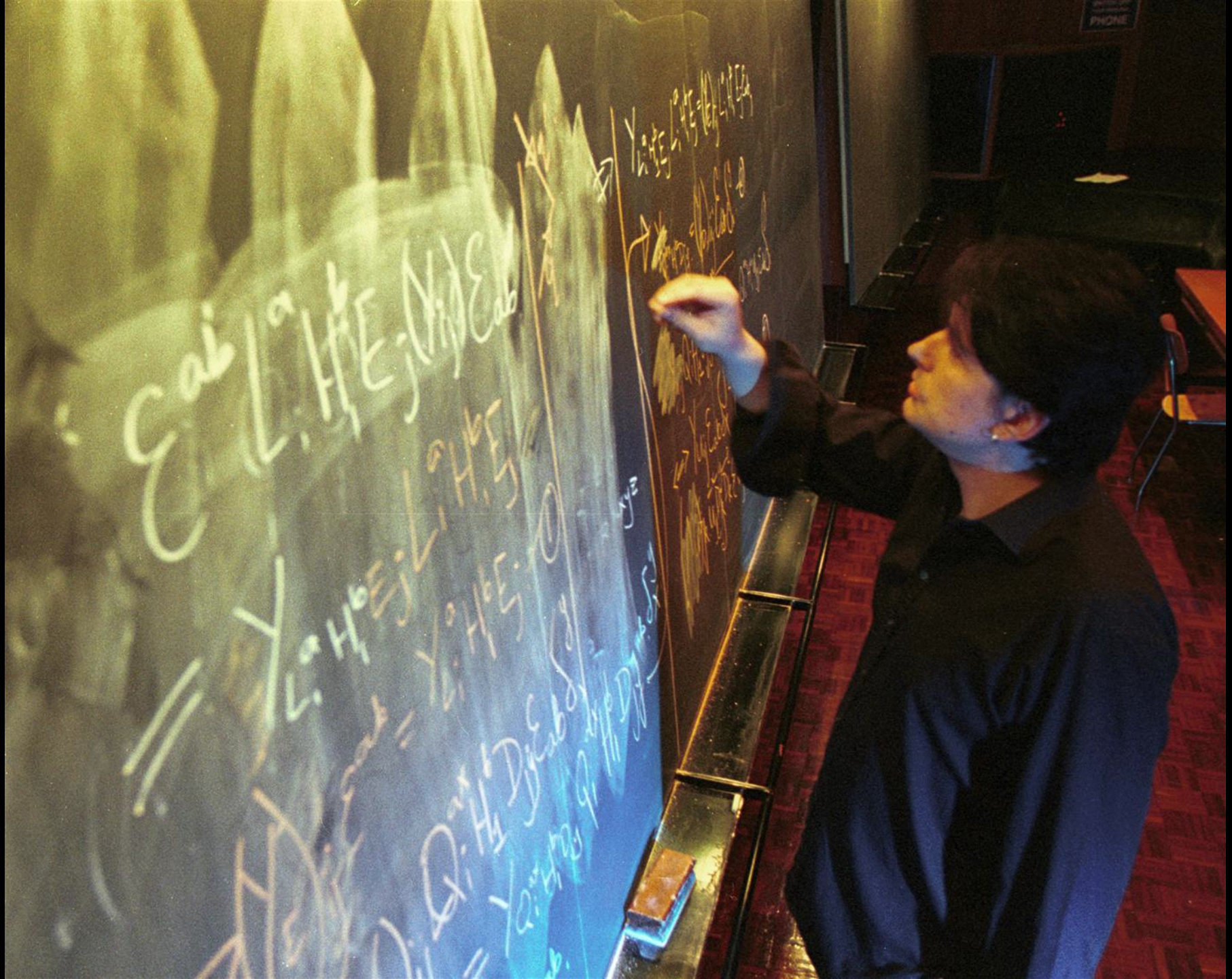
Massa del bosone di Higgs = 125-126 GeV

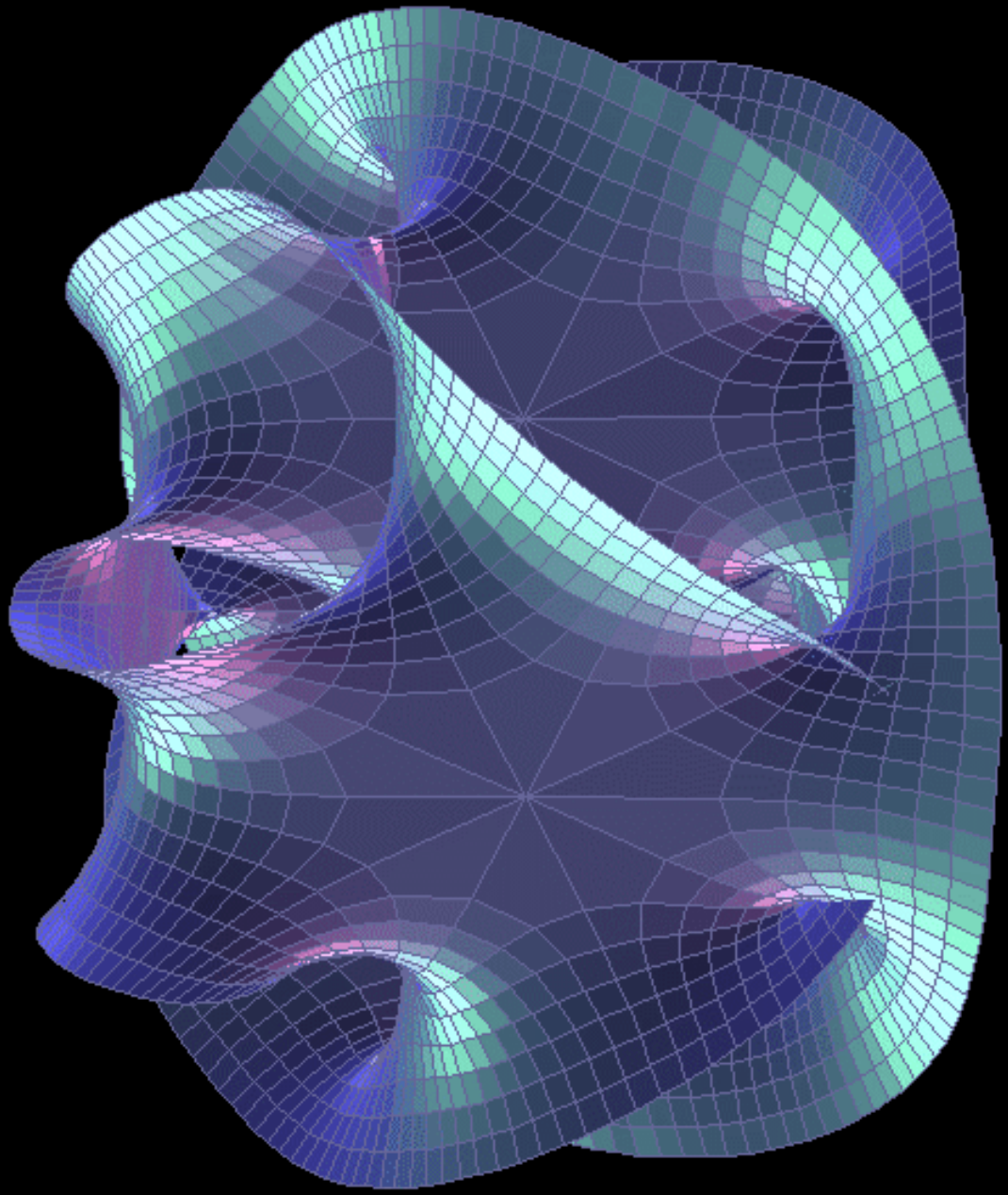

Instability
Meta−stability
Stability
Non−perturbativity
10^4
6
8
10
12
14
16
19
9
7
5
Λ_I=10^4GeV
Top mass M_t in GeV
Higgs mass M_h in GeV
0
50
100
150
200
10^7
10^8
10^9
10^{10}
10^{11}
10^{12}
10^{13}
10^{14}
10^{16}
10^{18}
10^{19}
1,2,3 σ
168
170
172
174
176
178
180
120
122
124
126
128
130
132
Top pole mass M_t in GeV
Higgs pole mass M_h in GeV

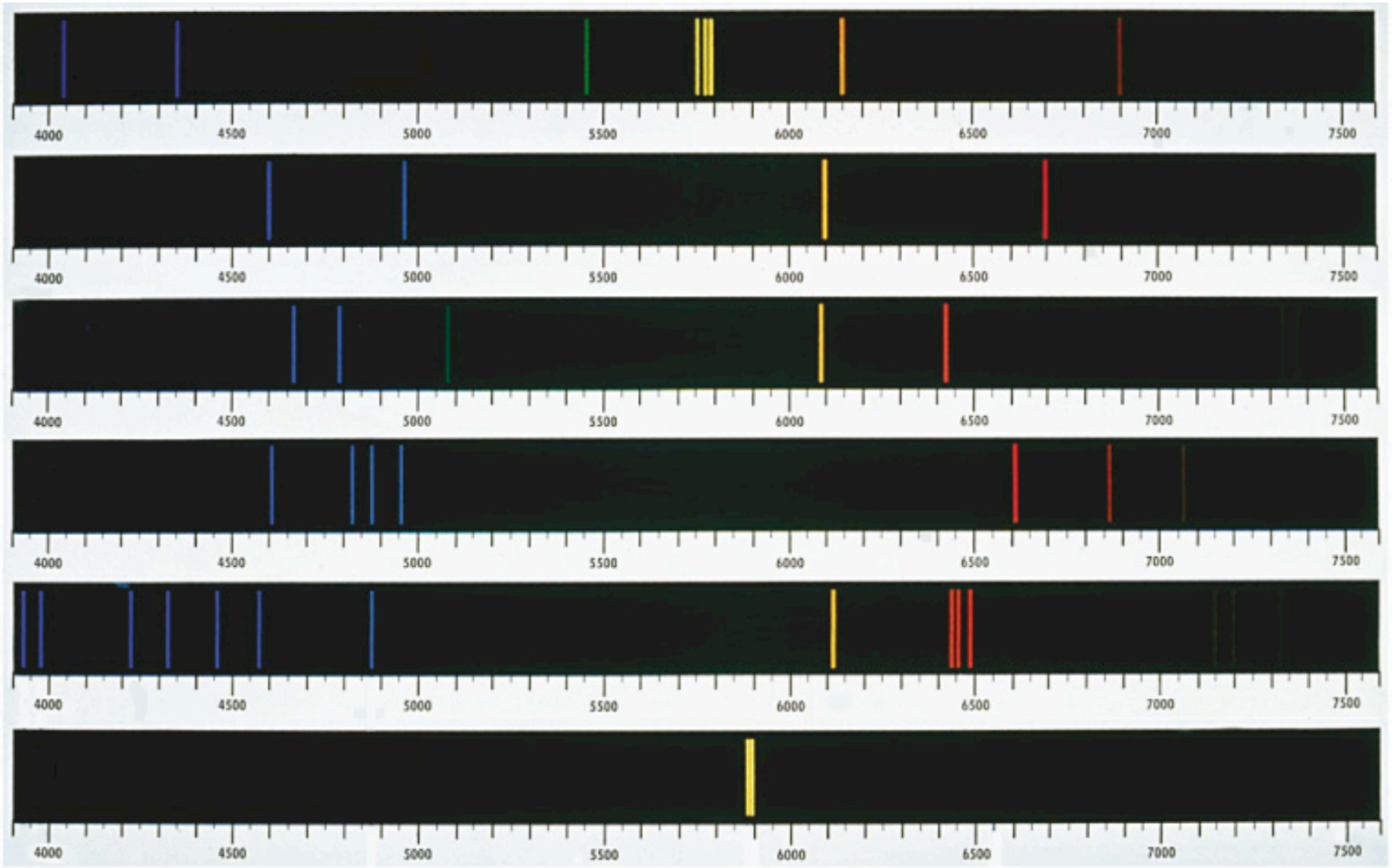
Perché?

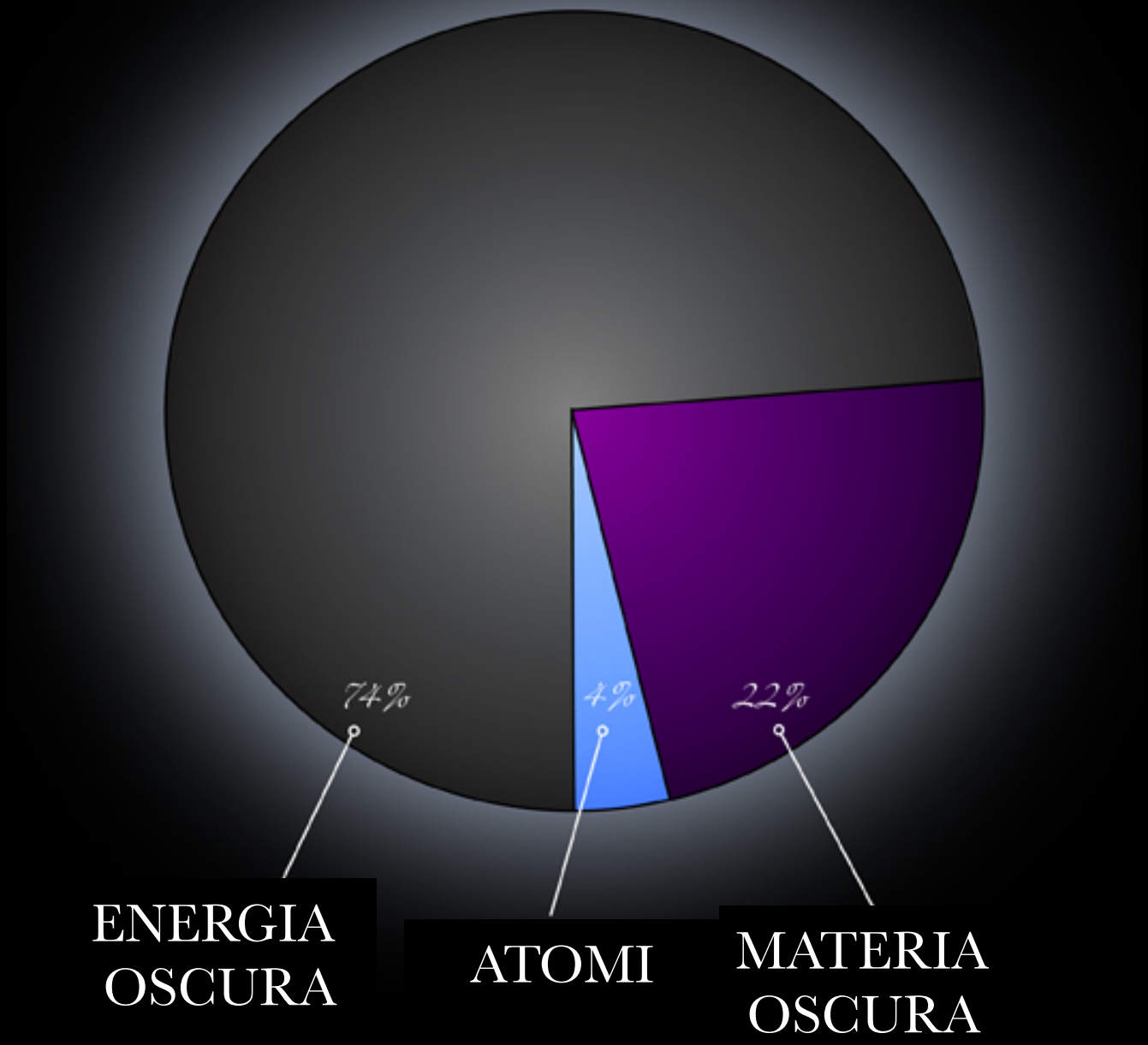


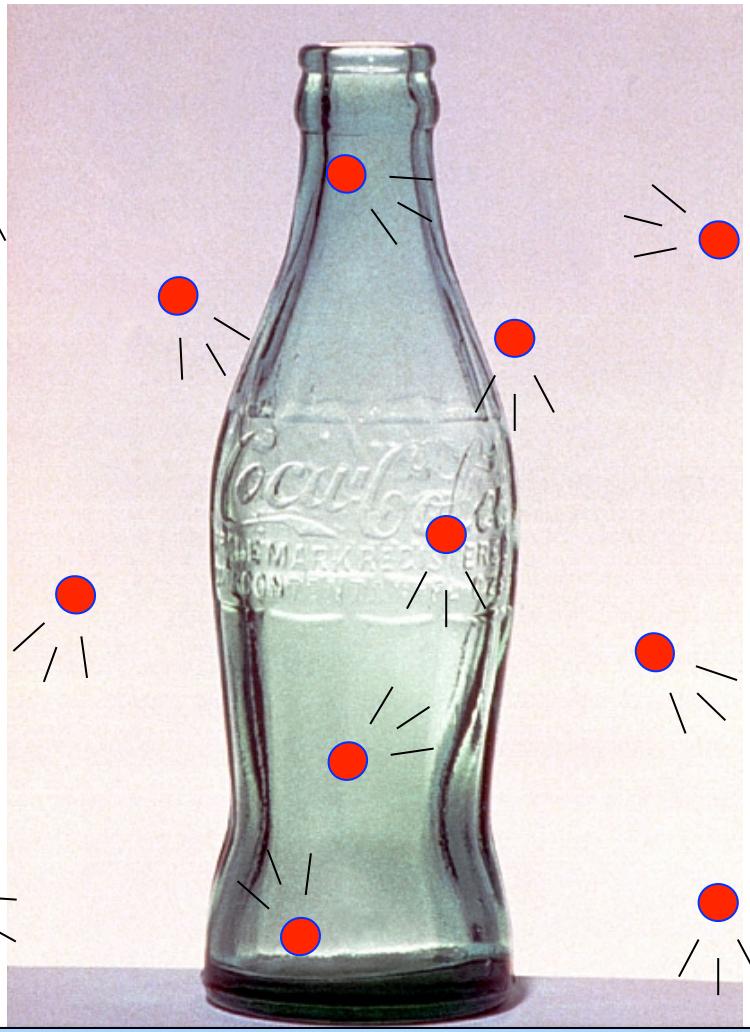







Hg
Li
Cd
Sr
Ca
Na
4000
4500
5000
5500
6000
6500
7000
7500

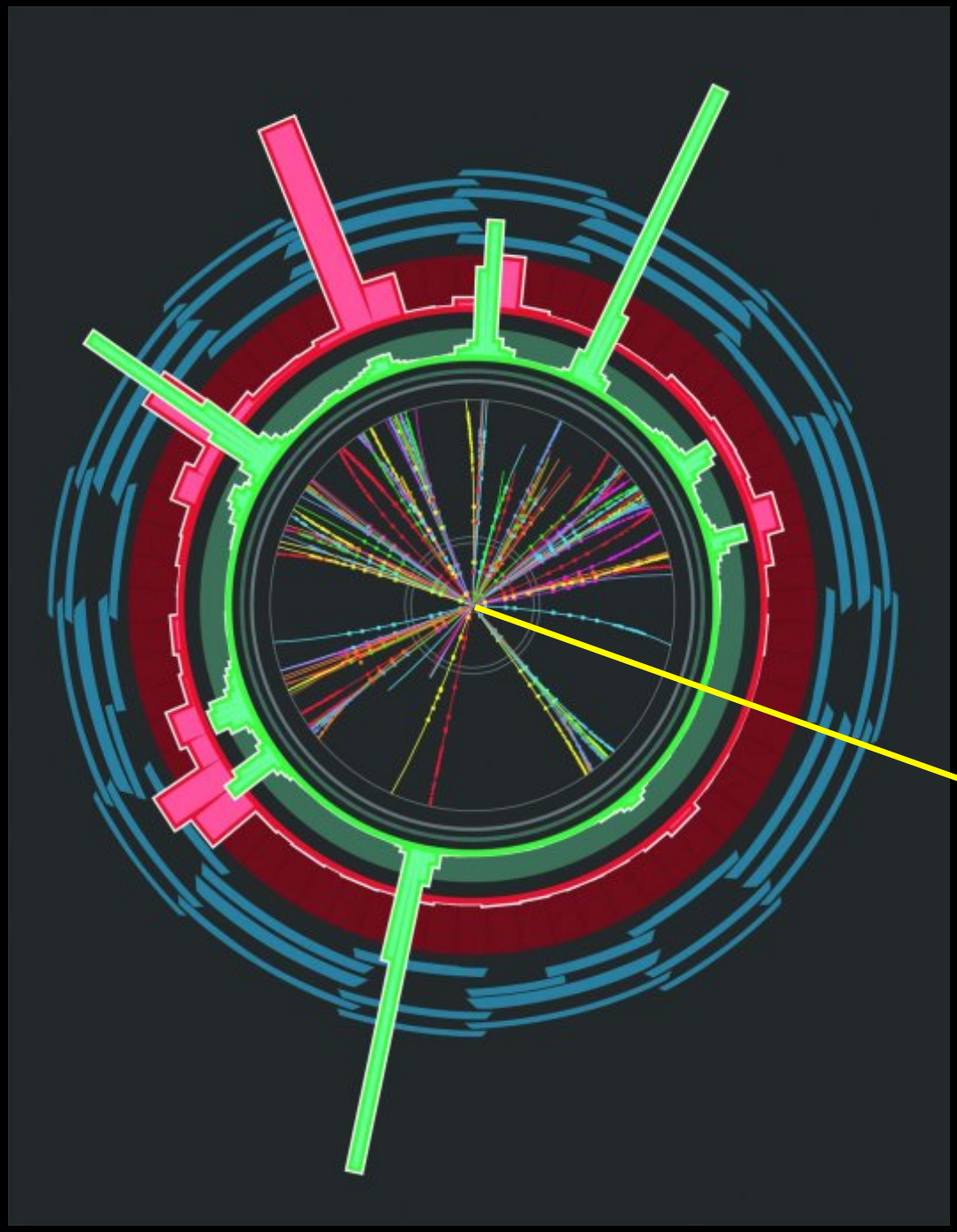

74%
4%
22%
ENERGIA OSCURA
ATOMI
MATERIA OSCURA



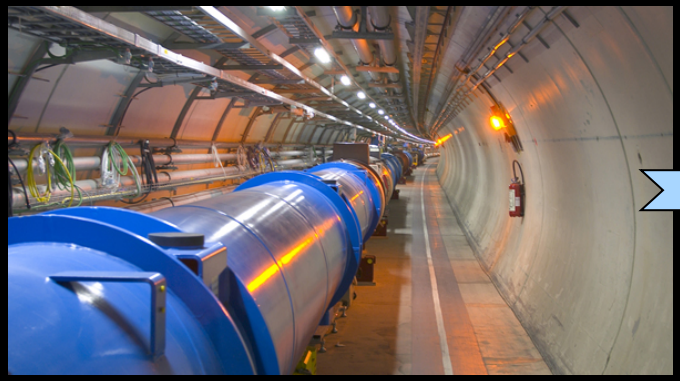
1 000 000 km/h

materia: 6×10^{24} kg

materia oscura:
0.6 kg


materia
oscura

Ricerca diretta



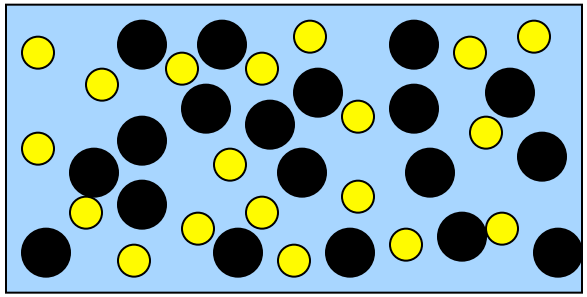
LHC

DM

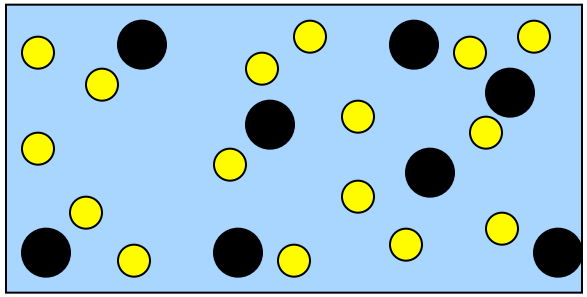
Ricerca indiretta

Legame materia oscura ←→ LHC

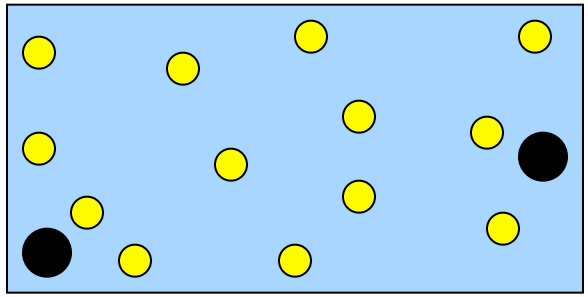
Se una particella stabile e massiccia si trova in equilibrio termico nell'universo primordiale, possiamo calcolare la sua densita' attuale



T >> M



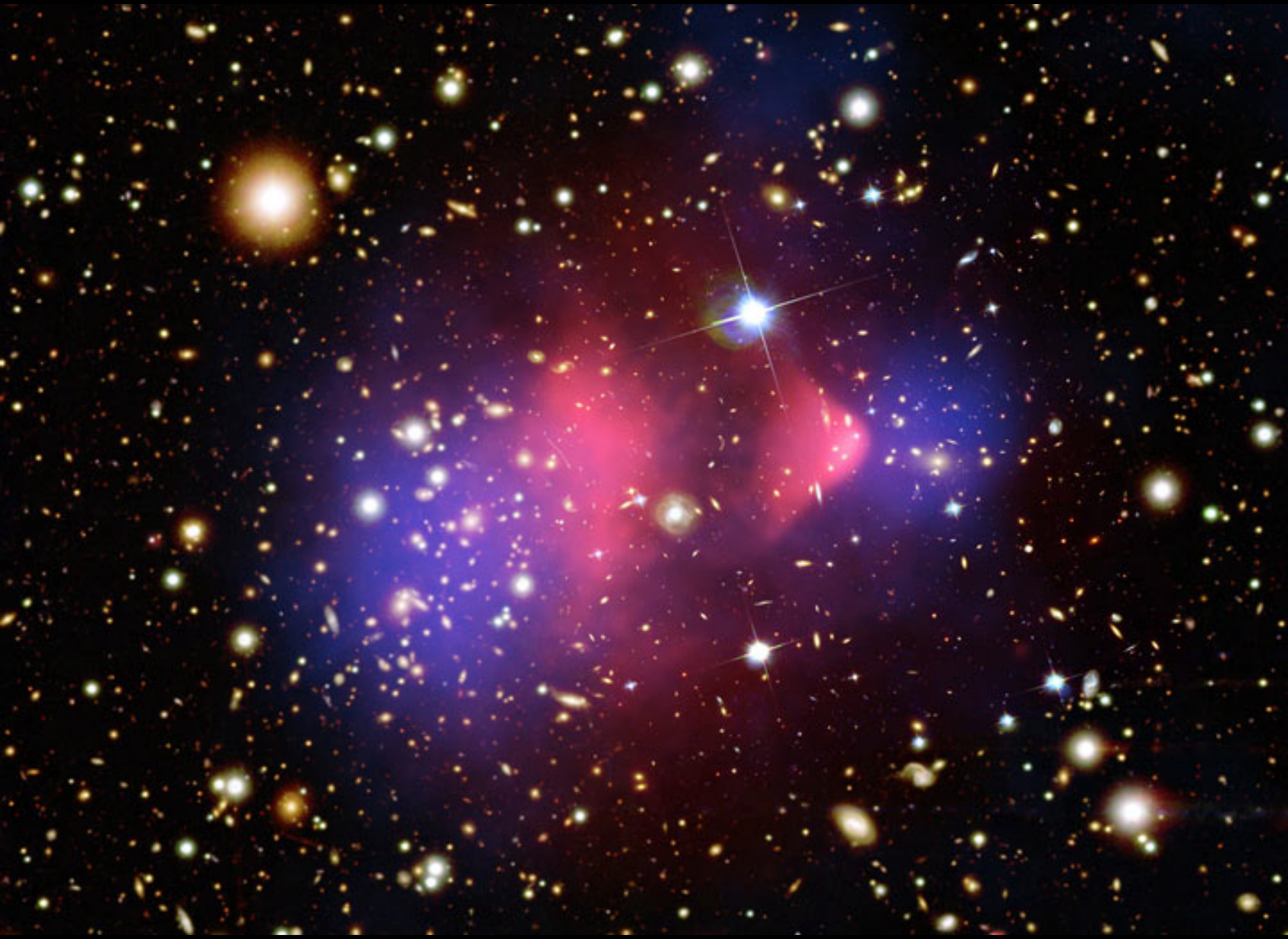
T ≈ M

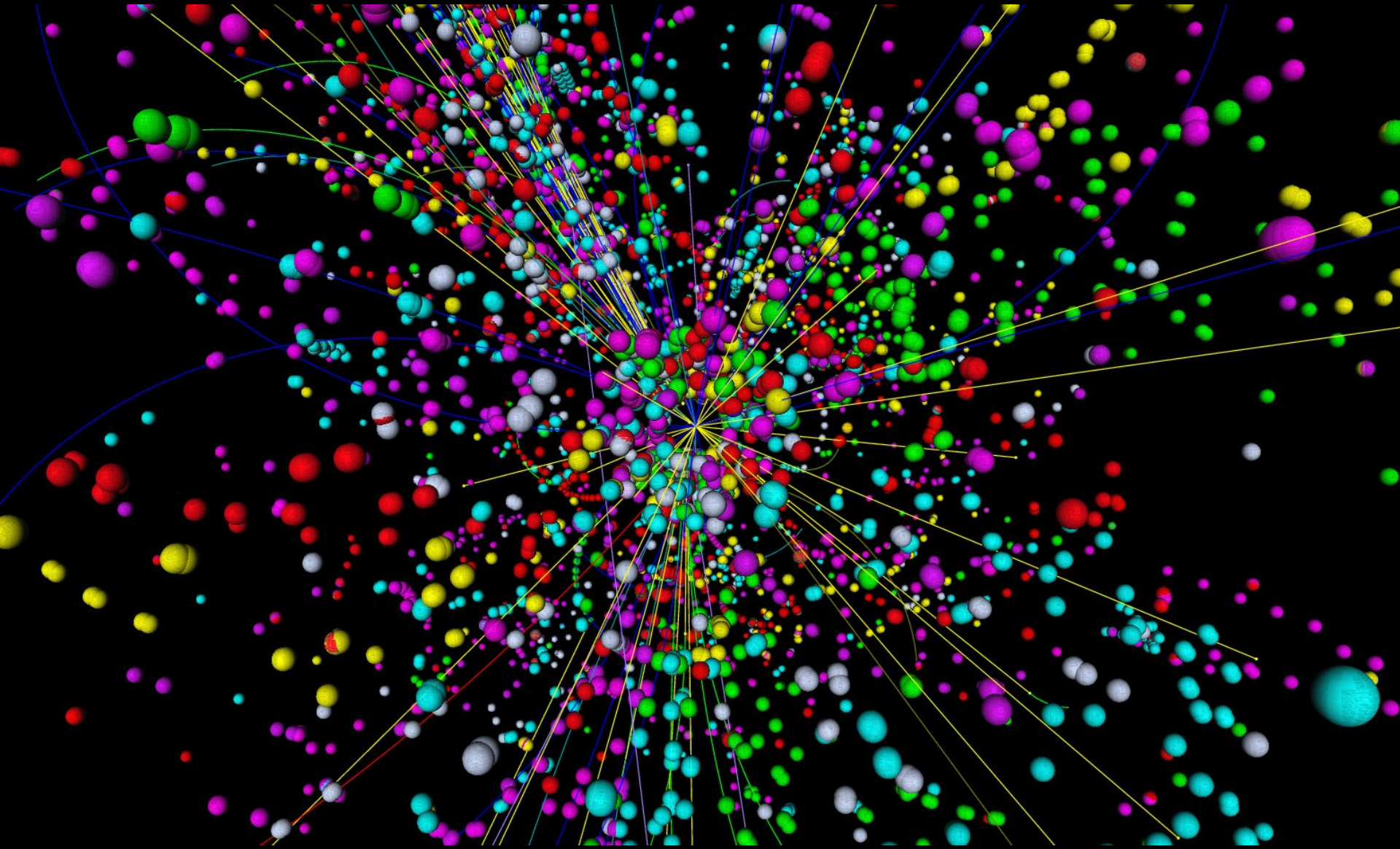


T << M

$$\sigma = \frac{k}{128\,\pi\,M^2} \quad \Rightarrow \quad \Omega_{DM} = 0.22 \left(\frac{M}{\sqrt{k}\ \mathrm{TeV}} \right)^2$$

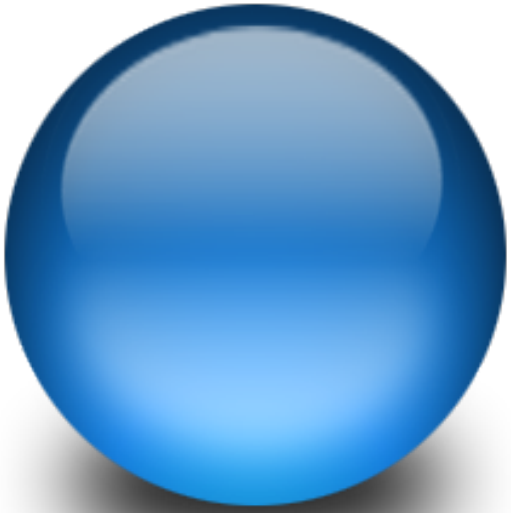
Coincidenza:
produzione di materia oscura a LHC?

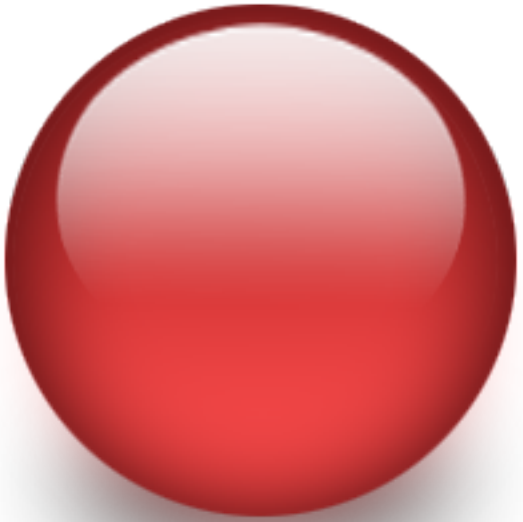


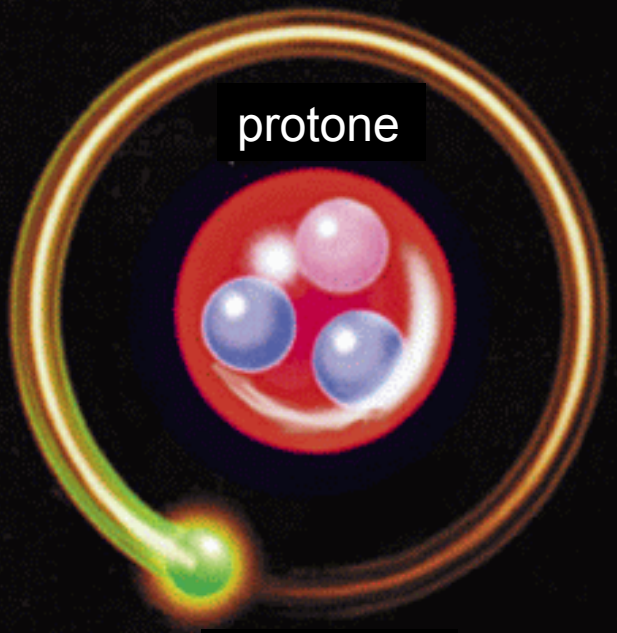


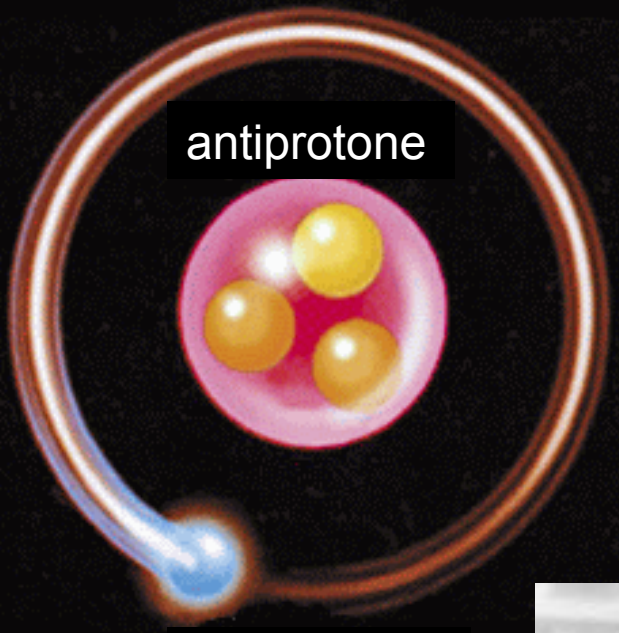

1
EURO


R
R
2002









idrogeno

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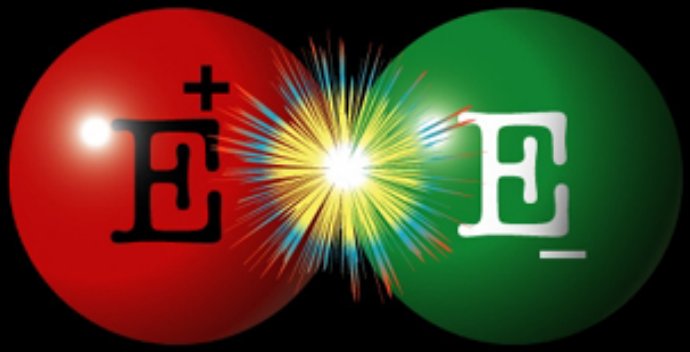

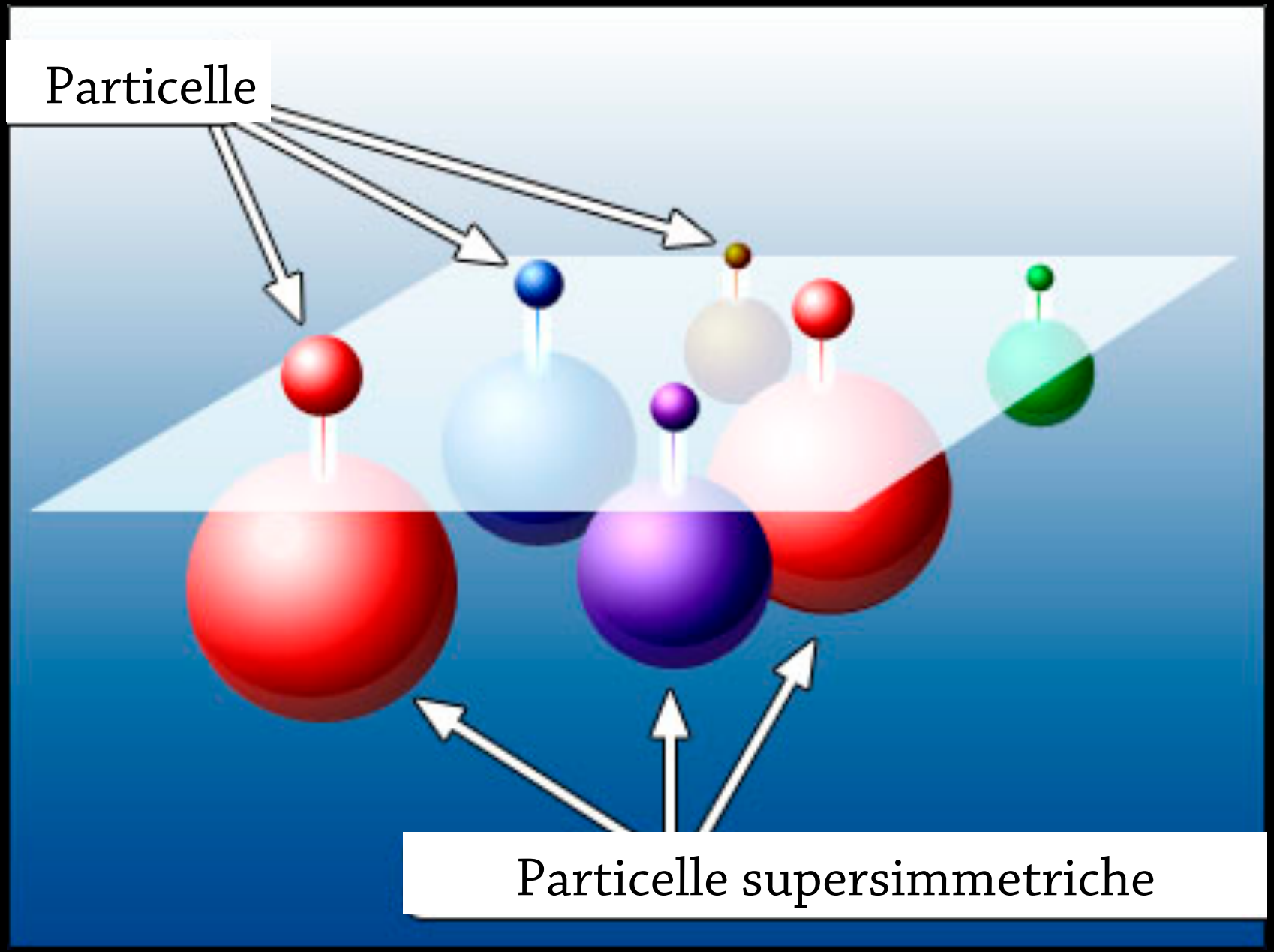
Particelle
Particelle supersimmetriche