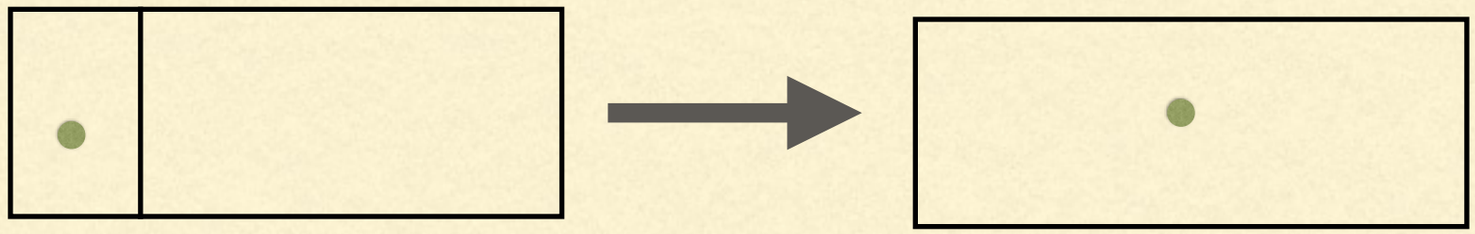
A SETA DO TEMPO NO MUNDO DA FÍSICA QUÂNTICA

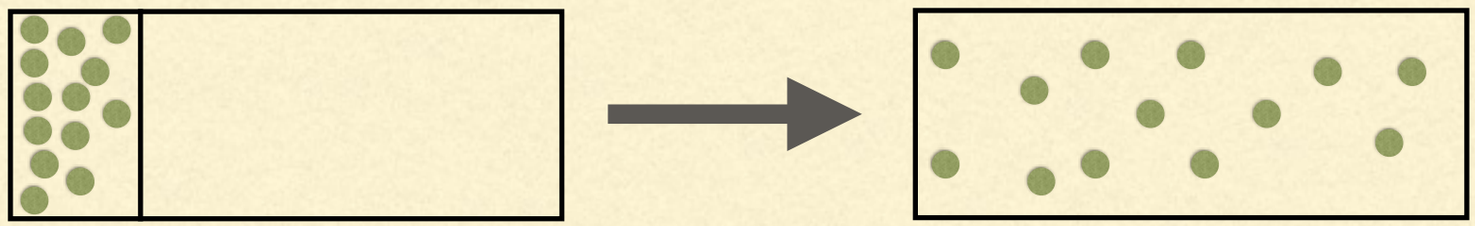
GABRIEL LANDI - INSTITUTO DE FÍSICA DA UNIVERSIDADE DE SÃO PAULO

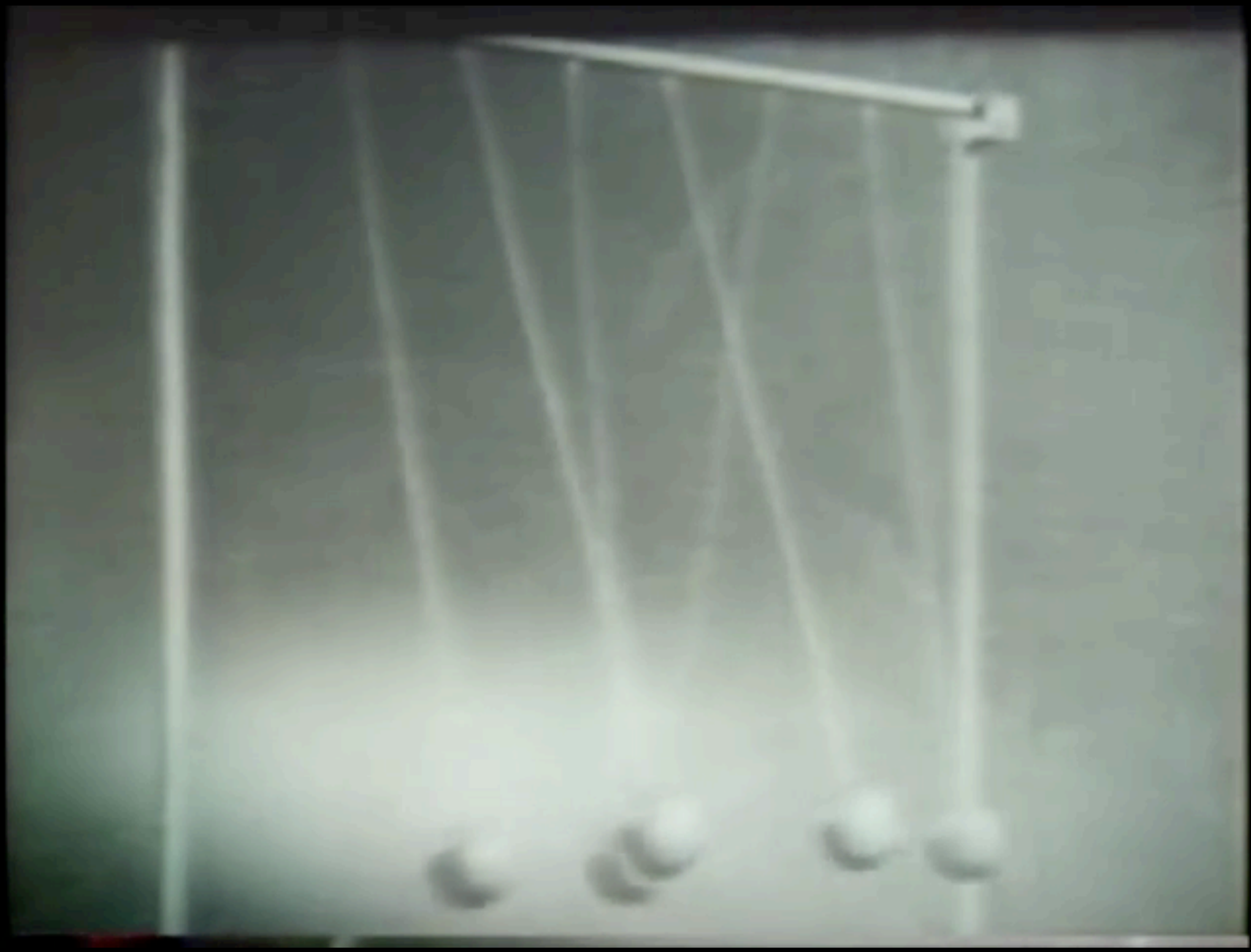
A SETA DO TEMPO E A 2ª LEI DA TERMODINÂMICA

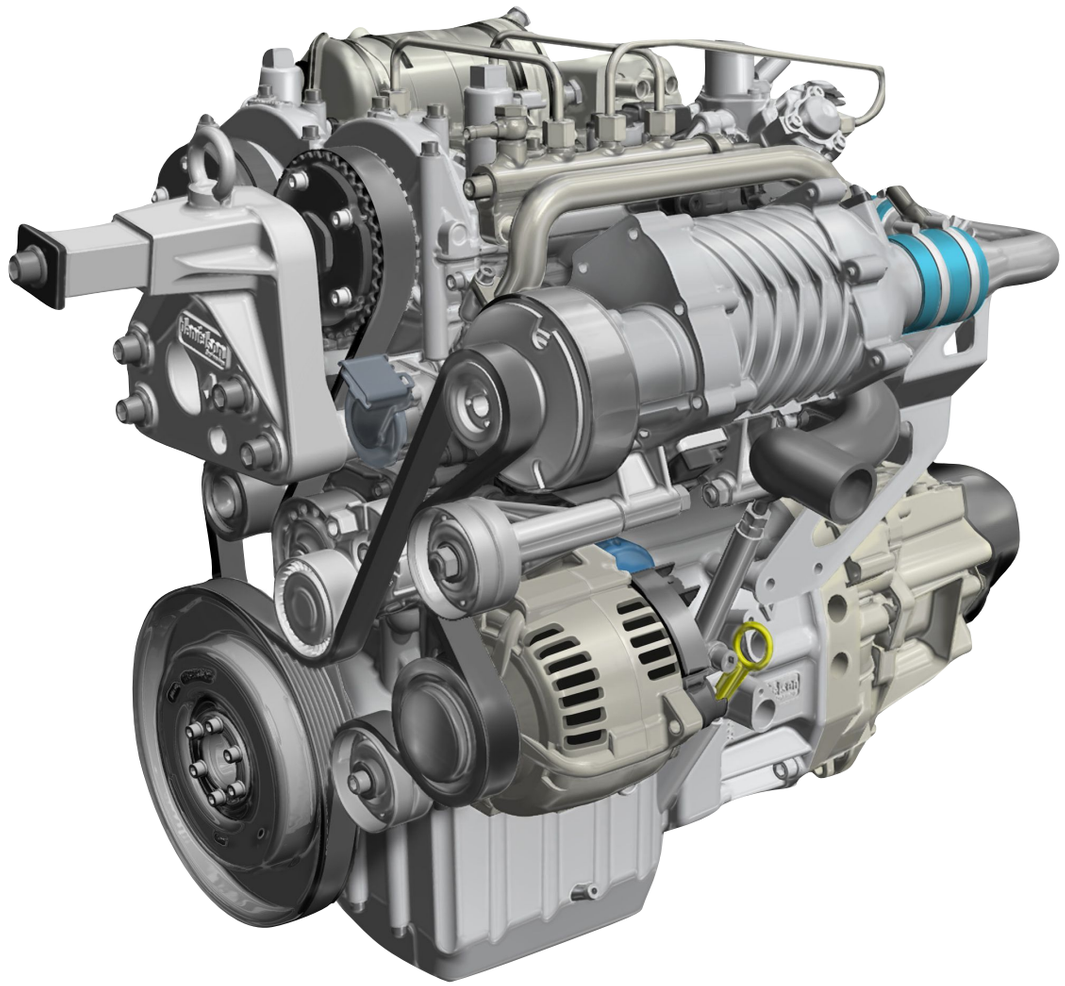
Prof. George Porter, Nobel em química

ORIGEM DA SETA DO TEMPO







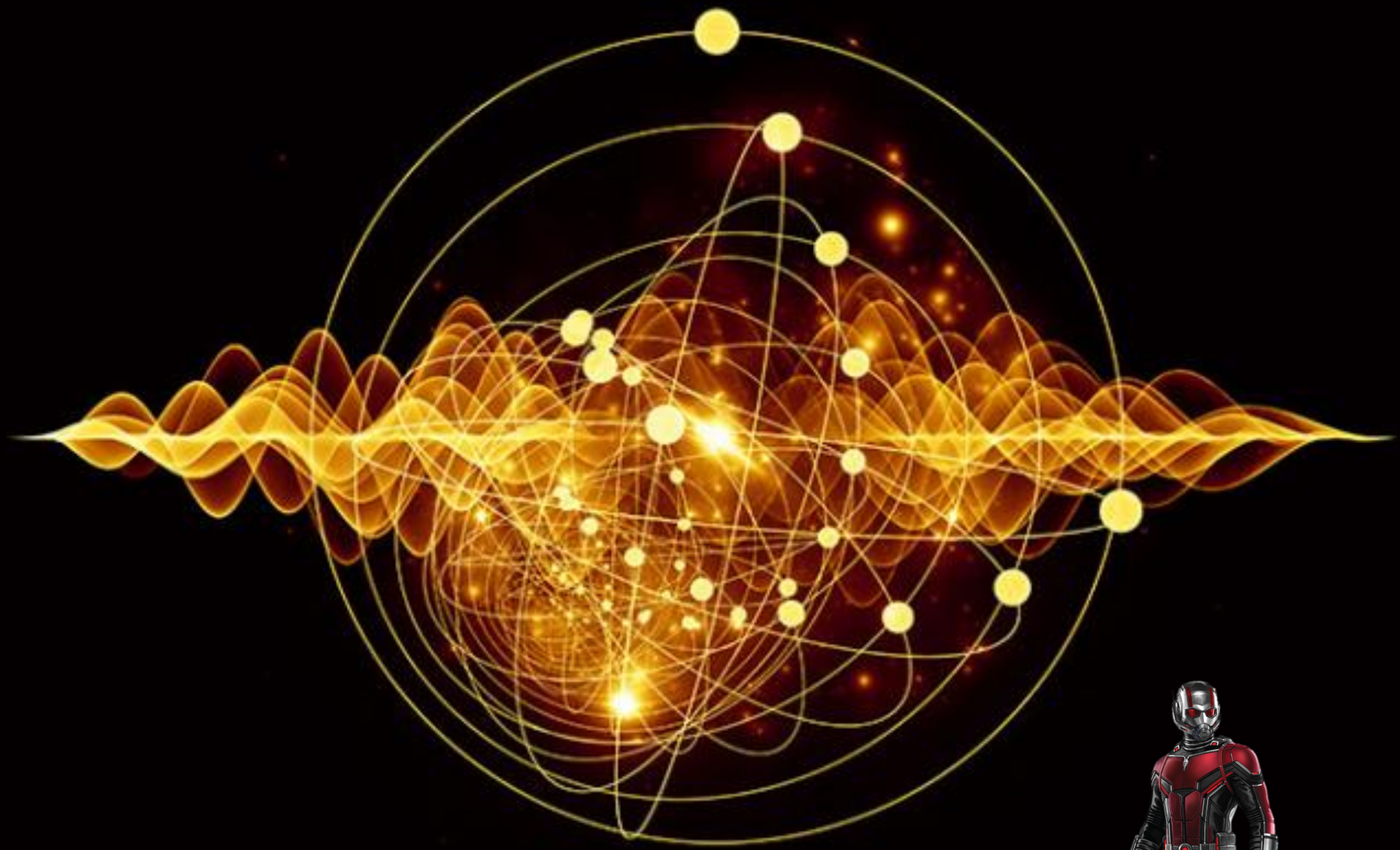


4


T- 00:00:01
STAGE 1 TELEMETRY
SPEED
ALTITUDE
00000
km/h
00.0
km
UPCOMING
LIFTOFF
STARTUP
THE FALCON 9 FLIGHT COMPUTERS HAVE TAKEN CONTROL OF THE COUNTDOWN
LAUNCH: CRS-12
STARTUP
LIFTOFF
MAX-Q
MAIN ENGINE CUTOFF
STAGE 1 BOOSTBACK
STAGE 1 ENTRY BURN
STAGE 1 LANDING
SECOND STAGE ENGINE CUTOFF
DRAGON DEPLOY
ARRAY DEPLOY
SPACEX


T+ 00:08:21
STAGE 2 TELEMETRY
SPEED
ALTITUDE
17751
km/h
227
km
UPCOMING
SECO
STAGE 1 LANDING
THE FIRST STAGE OF FALCON 9 IS ATTEMPTING AN EXPERIMENTAL LANDING ON THE AUTONOMOUS SPACEPORT DRONE SHIP
LAUNCH: CRS-8
ENGINE CHILL
FALCON INTERNAL POWER
STARTUP
MAX-Q
S2 STARTUP
EXPERIMENTAL LANDING
DRAGON DEPLOY
DRAGON INTERNAL POWER
STRONGBACK
LIFTOFF
MECO
BOOSTBACK BURN
SECO
SPACEX

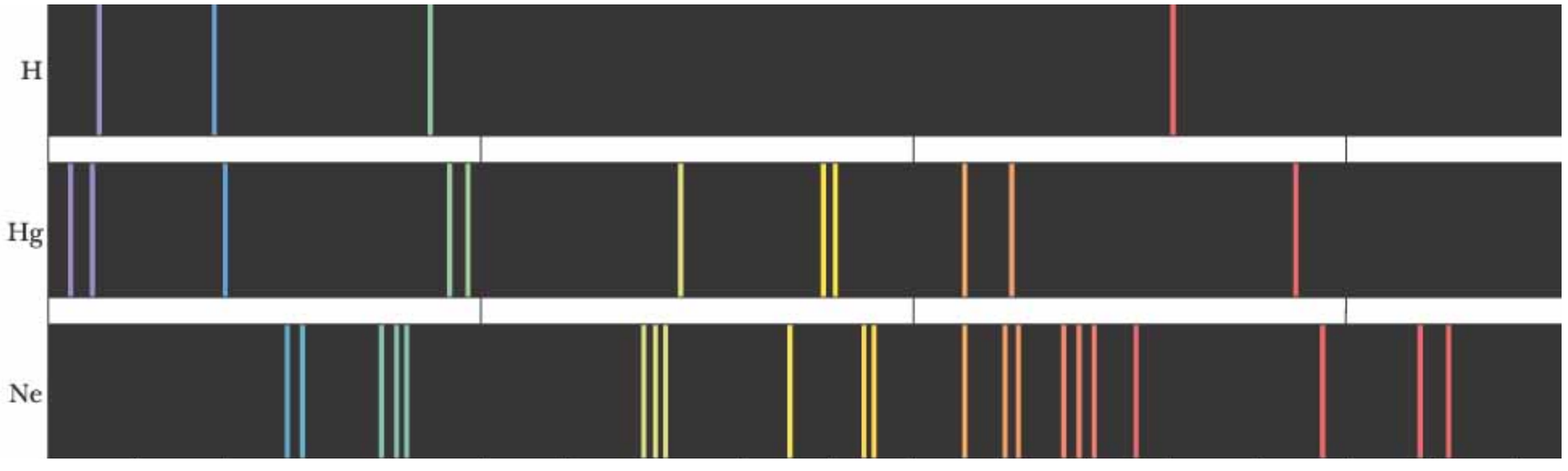

LG
TEMP
MODE
TIMER
FAN SPEED
POWER



O MUNDO QUÂNTICO

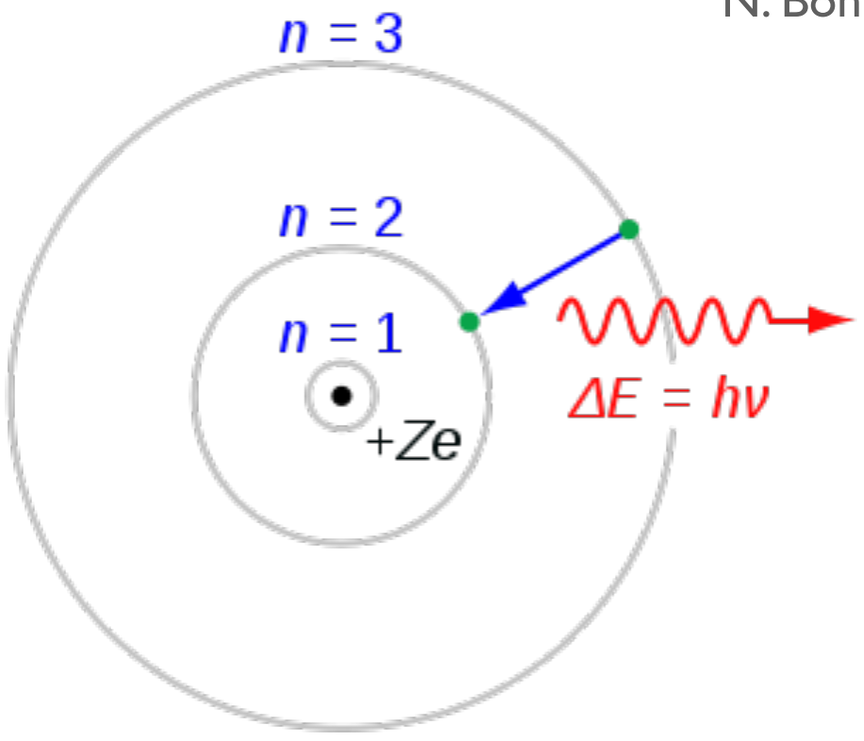

OPEN

LINHAS ESPECTRAIS



N. Bohr

- Elétrons habitam apenas certas órbitas.
- Quando um elétron pula de uma para a outra, ele emite ou absorve um fóton.

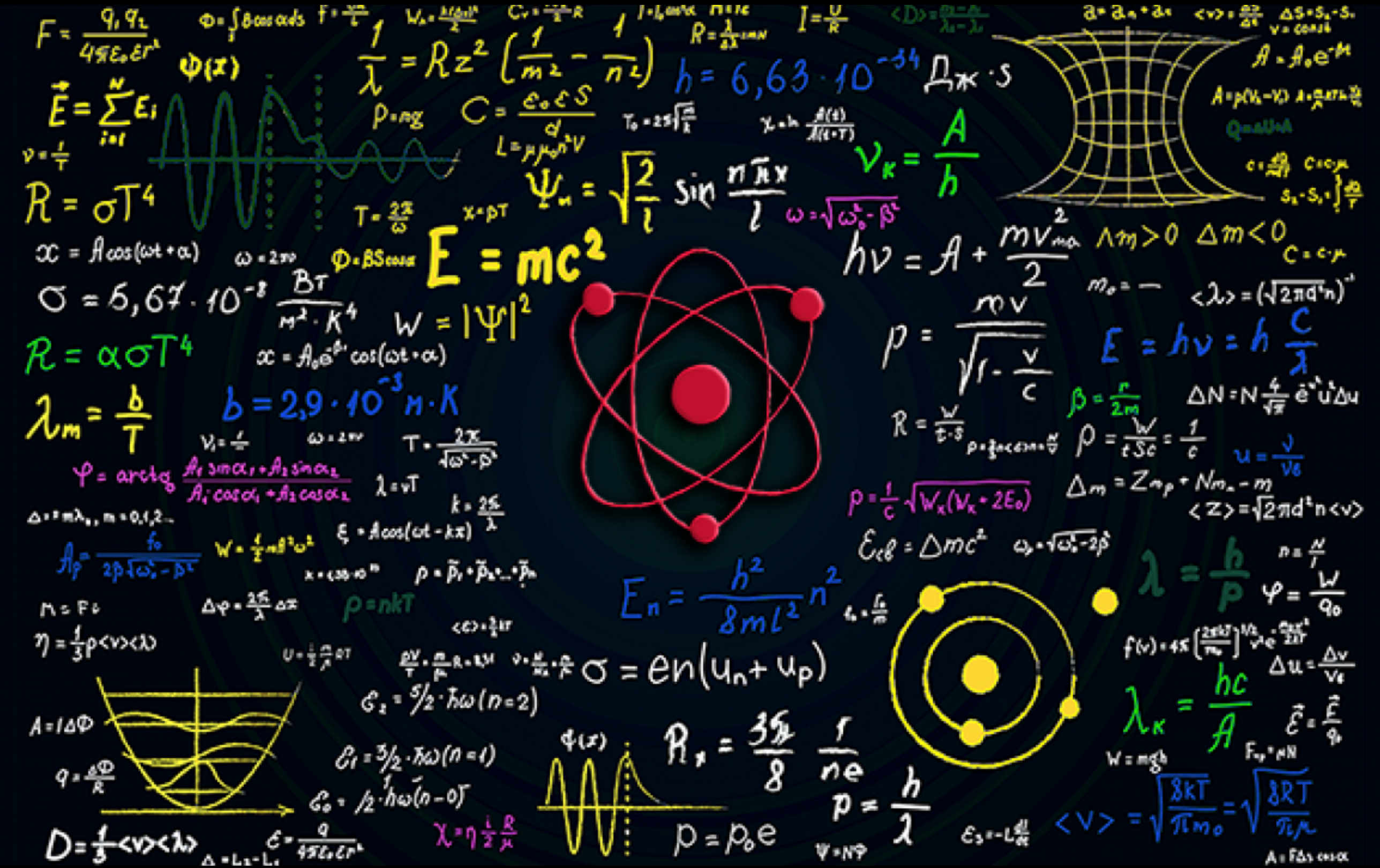


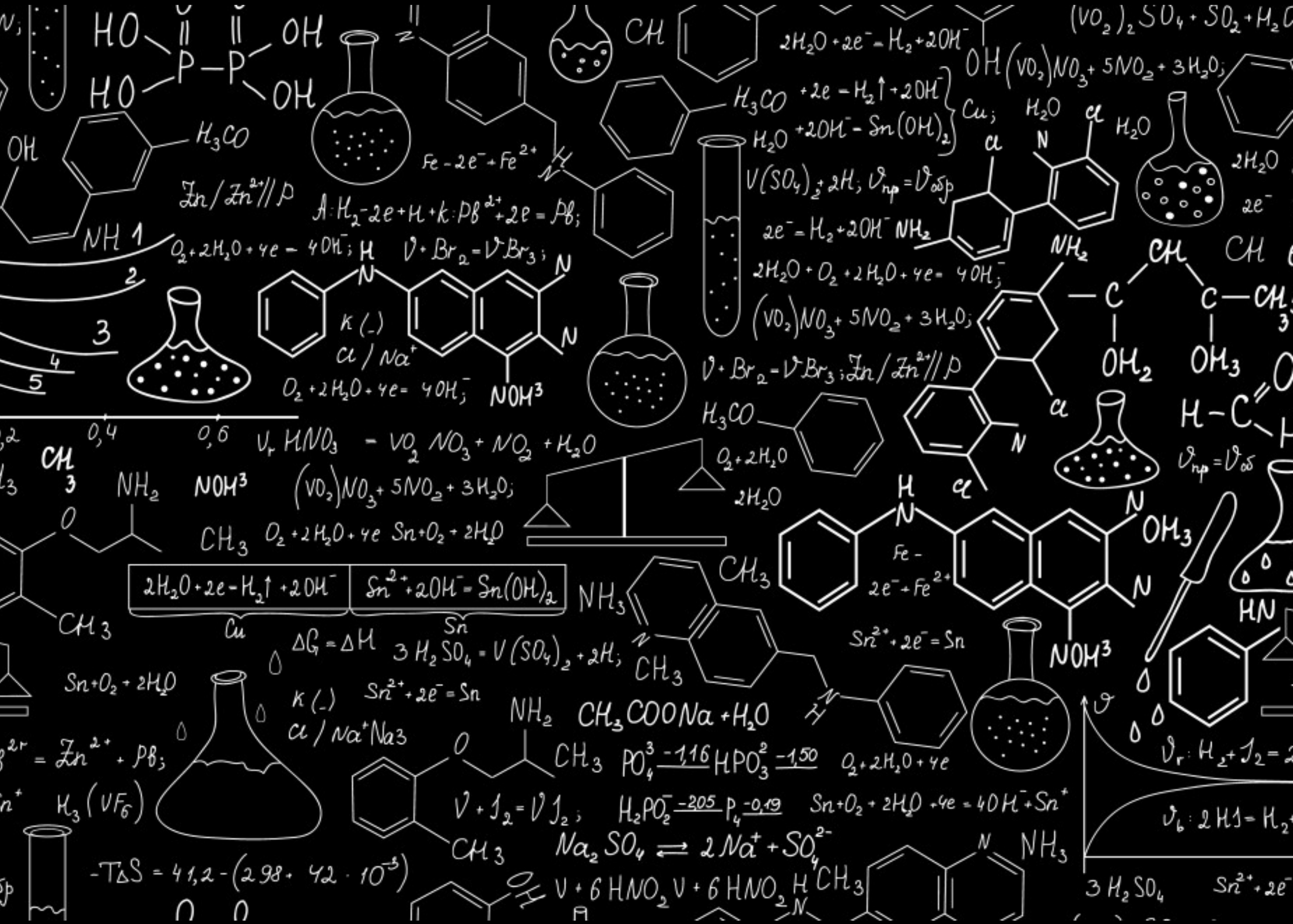
MECÂNICA QUÂNTICA - 1926

SCHRÖDINGER

HEISENBERG

DIRAC

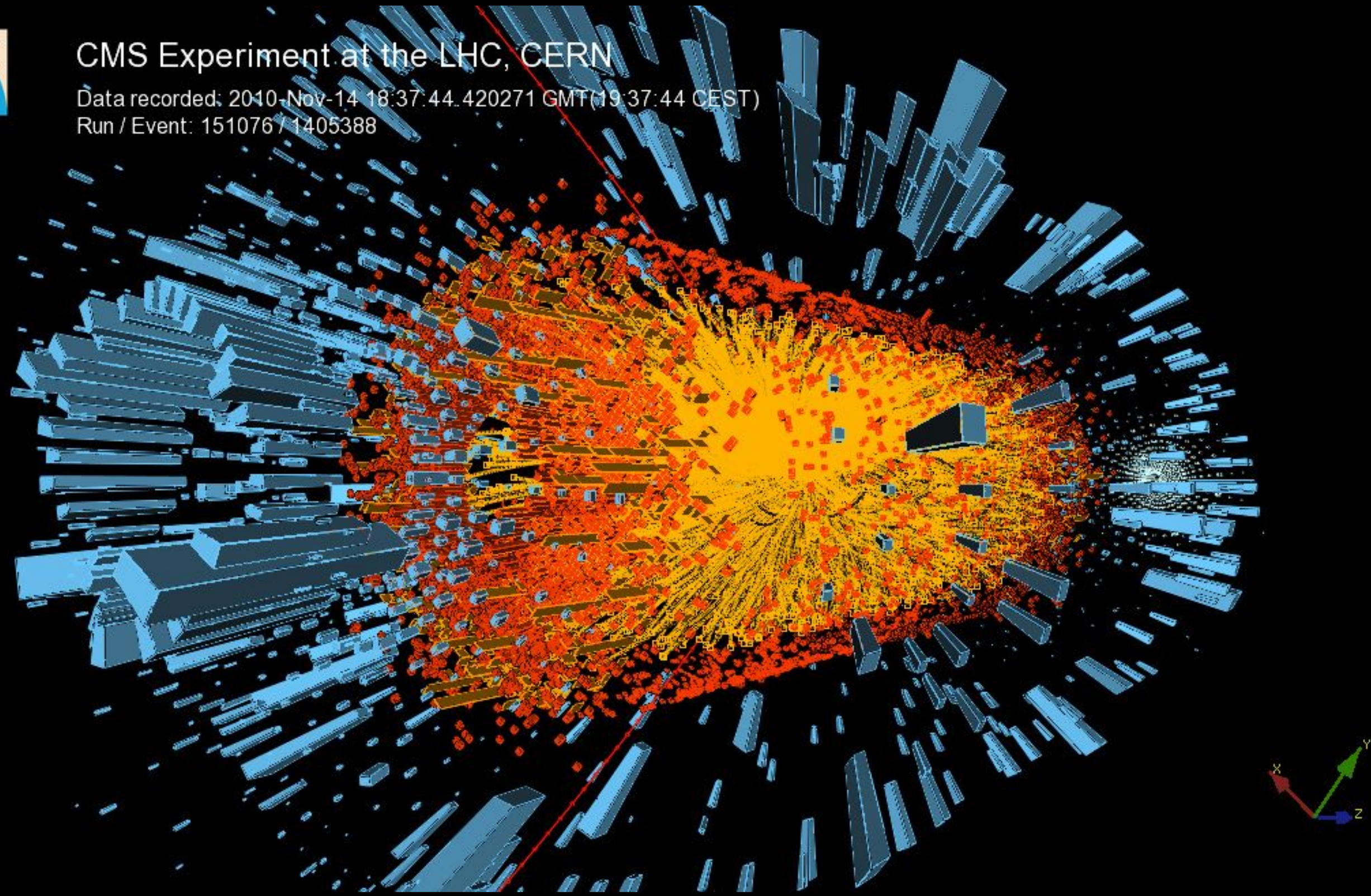

$F = \frac{q_1 q_2}{4\pi\varepsilon_0 \varepsilon r^2}$
$\Phi = \int B\cos\alpha\, ds$
$\frac{1}{\lambda} = Rz^2\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$
$h = 6{,}63 \cdot 10^{-34}$ Дж·с
$\Psi(x)$
$\vec{E} = \sum_{i=1}^{N} E_i$
$C = \frac{\varepsilon_0 \varepsilon S}{d}$
$L = \mu\mu_0 n^2 V$
$\Psi_n = \sqrt{\frac{2}{l}} \sin\frac{n\pi x}{l}$
$\nu_к = \frac{A}{h}$
$R = \sigma T^4$
$x = A\cos(\omega t + \alpha)$
$E = mc^2$
$\sigma = 5{,}67 \cdot 10^{-8} \frac{Вт}{м^2 \cdot К^4}$
$W = |\Psi|^2$
$h\nu = A + \frac{mv_{max}^2}{2}$
$R = \alpha\sigma T^4$
$x = A_0 e^{-\beta t}\cos(\omega t + \alpha)$
$\lambda_m = \frac{b}{T}$
$b = 2{,}9 \cdot 10^{-3}$ м·К
$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}}$
$E = h\nu = h\frac{c}{\lambda}$
$\varphi = \arctg \frac{A_1\sin\alpha_1 + A_2\sin\alpha_2}{A_1\cos\alpha_1 + A_2\cos\alpha_2}$
$\lambda = vT$
$\xi = A\cos(\omega t - kx)$
$W = \frac{1}{2}m\beta^2\omega^2$
$p = nkT$
$E_n = \frac{h^2}{8ml^2}n^2$
$\sigma = en(u_n + u_p)$
$p = p_0 e$
$p = \frac{h}{\lambda}$
$\lambda = \frac{h}{p}$
$\lambda_к = \frac{hc}{A}$
$\Delta N = N\frac{\Delta}{\sqrt{\pi}} e^{-u^2}\Delta u$
$\Delta m = Zm_p + Nm_n - m$
$\langle v \rangle = \sqrt{\frac{8kT}{\pi m_0}} = \sqrt{\frac{8RT}{\pi\mu}}$
$D = \frac{1}{3}\langle v\rangle\langle\lambda\rangle$
$\eta = \frac{1}{3}\rho\langle v\rangle\langle\lambda\rangle$
$\varphi(x)$

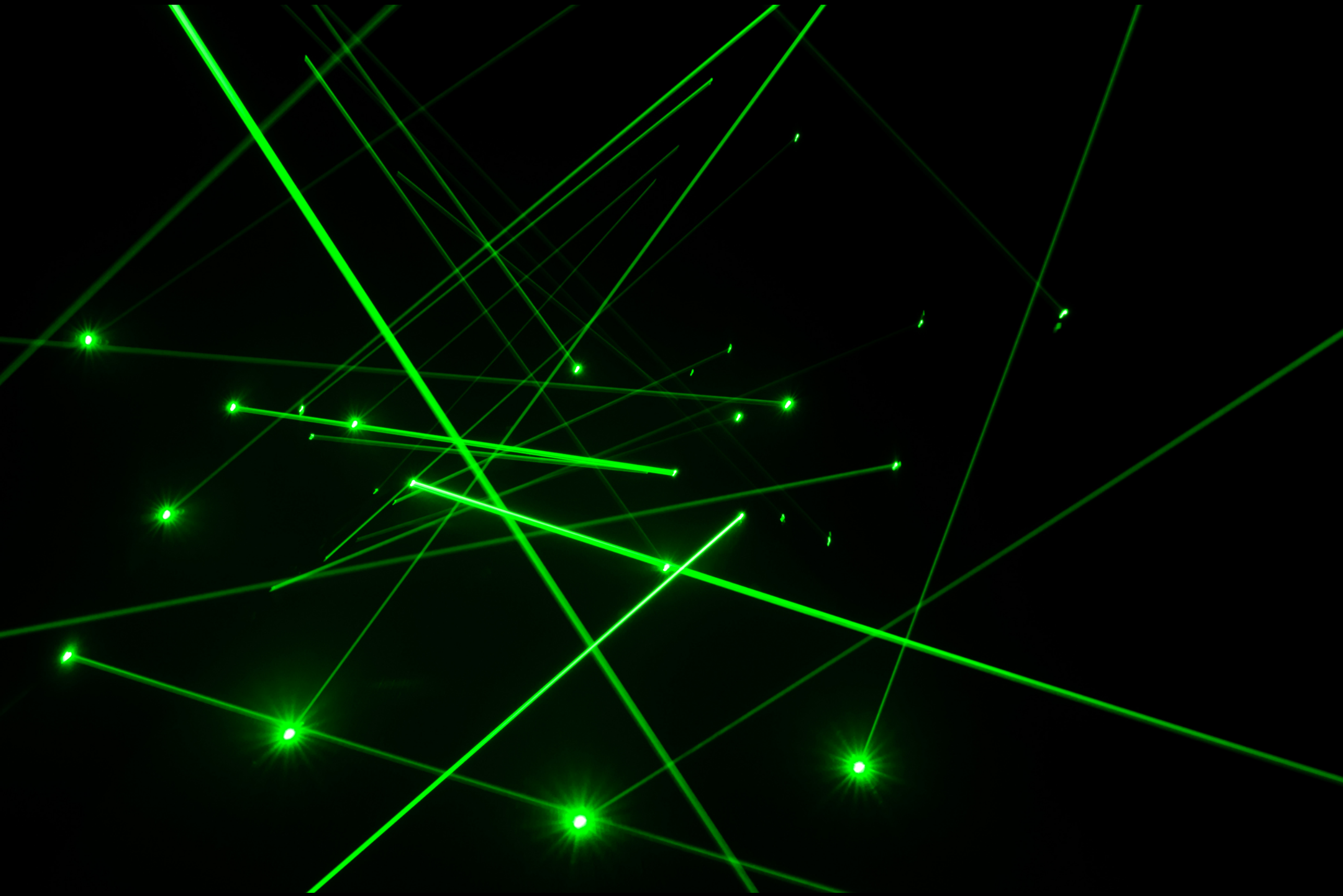

HO OH HO OH P P
H_3CO
OH
$Zn/Zn^{2+}//P$
$Fe-2e^-=Fe^{2+}$
$A: H_2-2e+H+k: Pb^{2+}+2e=Pb;$
NH 1 2 3 4 5
$O_2+2H_2O+4e-4OH^-;$
$V+Br_2=VBr_3;$
K (-) Cl / Na+
$O_2+2H_2O+4e=4OH^-;$
NOH3
0,2 0,4 0,6
$V_r\ HNO_3 - VO_2NO_3+NO_2+H_2O$
$(VO_2)NO_3+5NO_2+3H_2O;$
CH_3 NH_2 NOH^3
$O_2+2H_2O+4e\ Sn+O_2+2H_2O$
$2H_2O+2e-H_2\uparrow+2OH^-$ | $Sn^{2+}+2OH^-=Sn(OH)_2$
Cu Sn
$\Delta G=\Delta H$
$3H_2SO_4=V(SO_4)_2+2H;$
$Sn+O_2+2H_2O$
K (-) Cl / Na+Na3
$Sn^{2+}+2e^-=Sn$
$-T\Delta S=41,2-(298+42\cdot10^{-3})$
$V+1_2=V1_2;$
$CH_3COONa+H_2O$
$PO_4^3\ -1,16\ HPO_3^2\ -1,50\ H_2PO_2^-\ -2,05\ P_4\ -0,19$
$Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$
$V+6HNO_2\ V+6HNO_2$
$2H_2O+2e^-=H_2\uparrow+2OH^-$
$+2e-H_2\uparrow+2OH^-$
$+2OH^--Sn(OH)_2$
$V(SO_4)_2+2H;\ \vartheta_{пр}=\vartheta_{обр}$
$2e^-=H_2+2OH^-$
$2H_2O+O_2+2H_2O+4e=4OH^-;$
$(VO_2)NO_3+5NO_2+3H_2O;$
$V+Br_2=VBr_3;\ Zn/Zn^{2+}//P$
O_2+2H_2O
$2H_2O$
$Fe-2e^-=Fe^{2+}$
$Sn^{2+}+2e^-=Sn$
$(VO_2)_2SO_4+SO_2+H_2O$
$(VO_2)NO_3+5NO_2+3H_2O;$
Cu; H_2O Cl N Cl H_2O
$2H_2O$
$2e^-$
NH_2 CH CH
C C CH_3
OH_2 OH_3
Cl N Cl
H N N OH_3
Fe-
$2e^-+Fe^{2+}$
N N
NOH^3
HN
ϑ
$\vartheta_r: H_2+J_2=$
$\vartheta_6: 2H1=H_2$
$3H_2SO_4$ $Sn^{2+}+2e^-$
NH_3 CH_3 CH_3
$Sn^{2+}+2e^-=Sn$
O_2+2H_2O+4e
$Sn+O_2+2H_2O+4e=4OH^-+Sn^+$
$\vartheta_{пр}=\vartheta_{обр}$

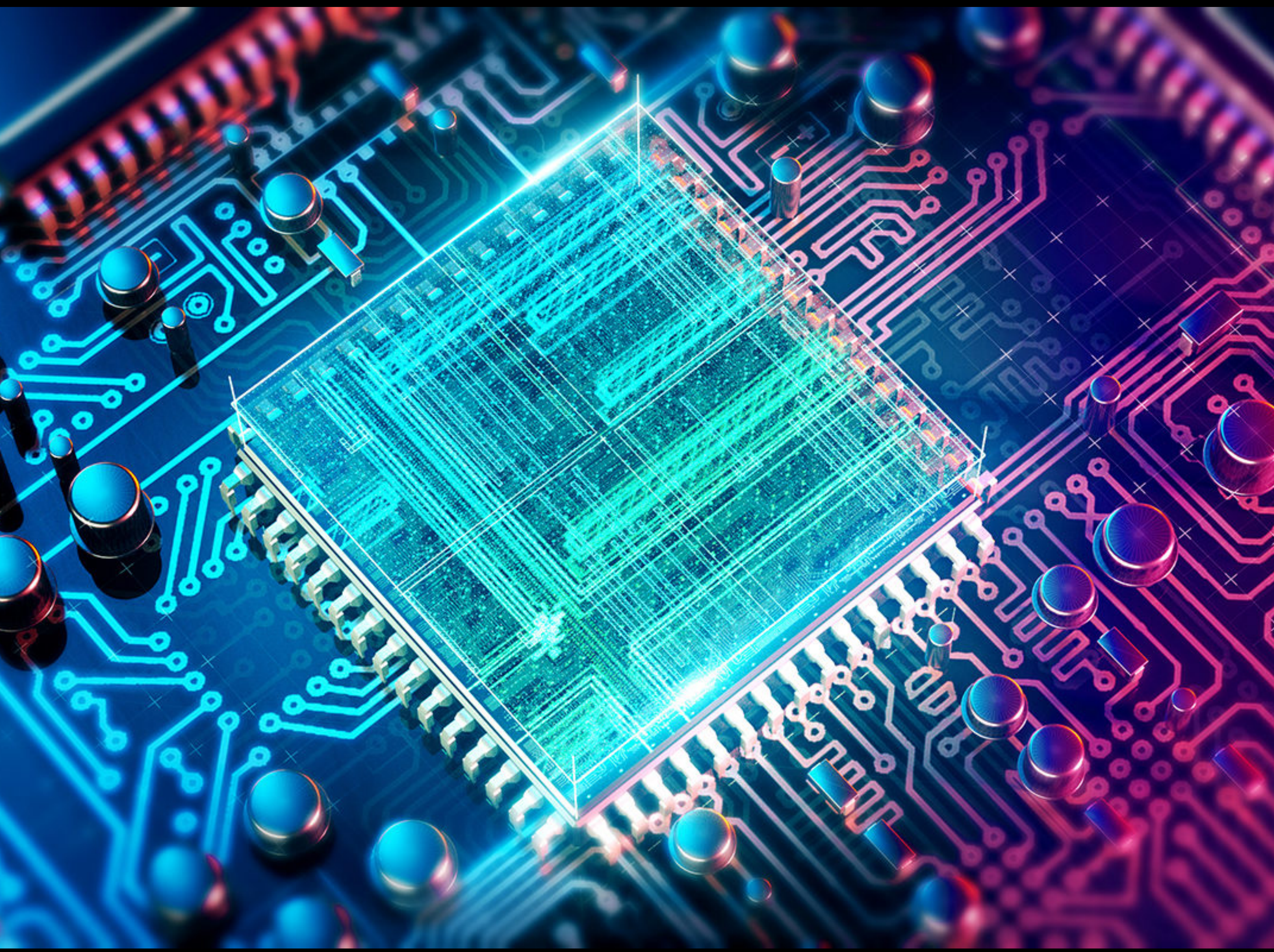
CMS Experiment at the LHC, CERN

Data recorded: 2010-Nov-14 18:37:44.420271 GMT(19:37:44 CEST)

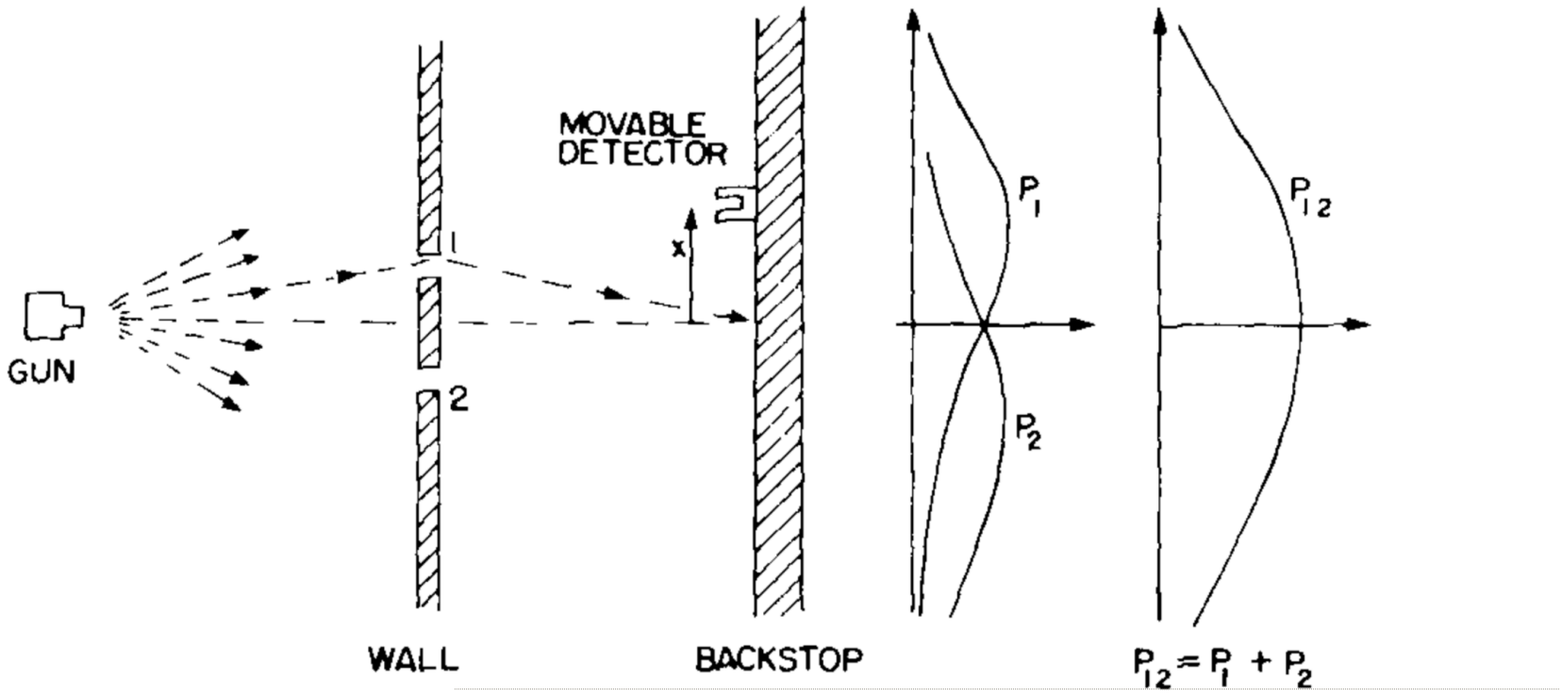
Run / Event: 151076 / 1405388

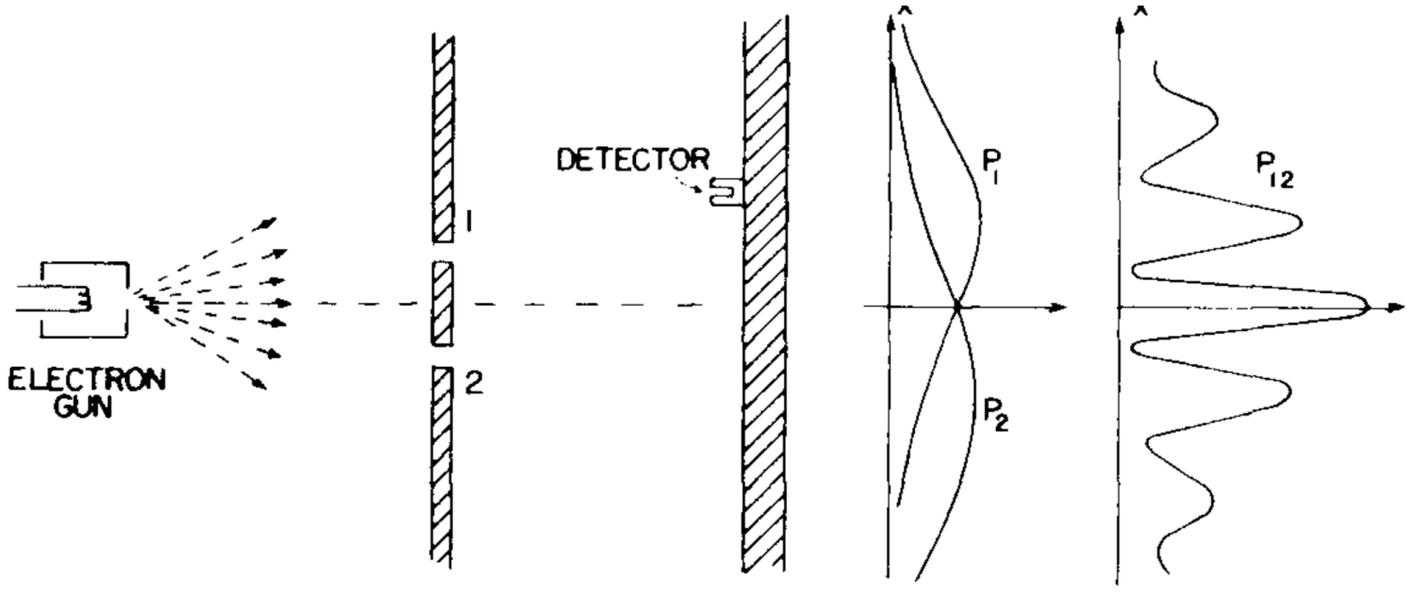


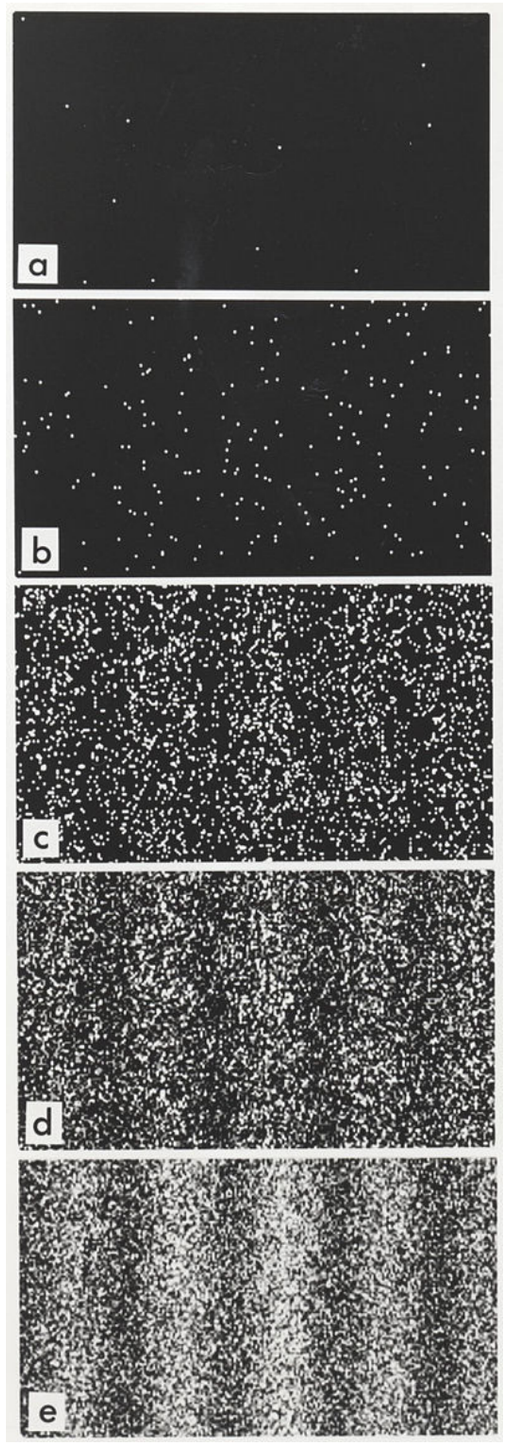


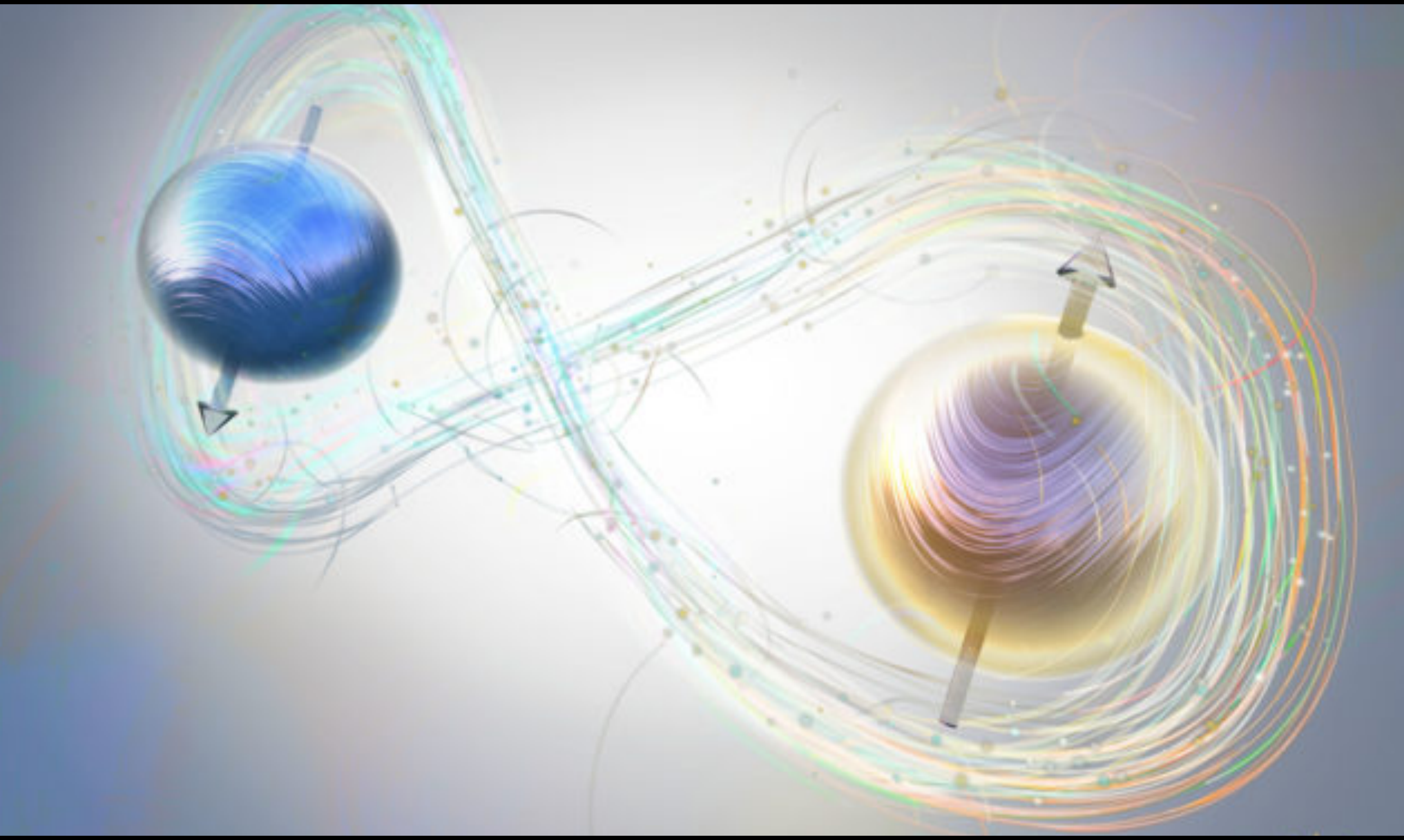


PRINCÍPIO DA SUPERPOSIÇÃO

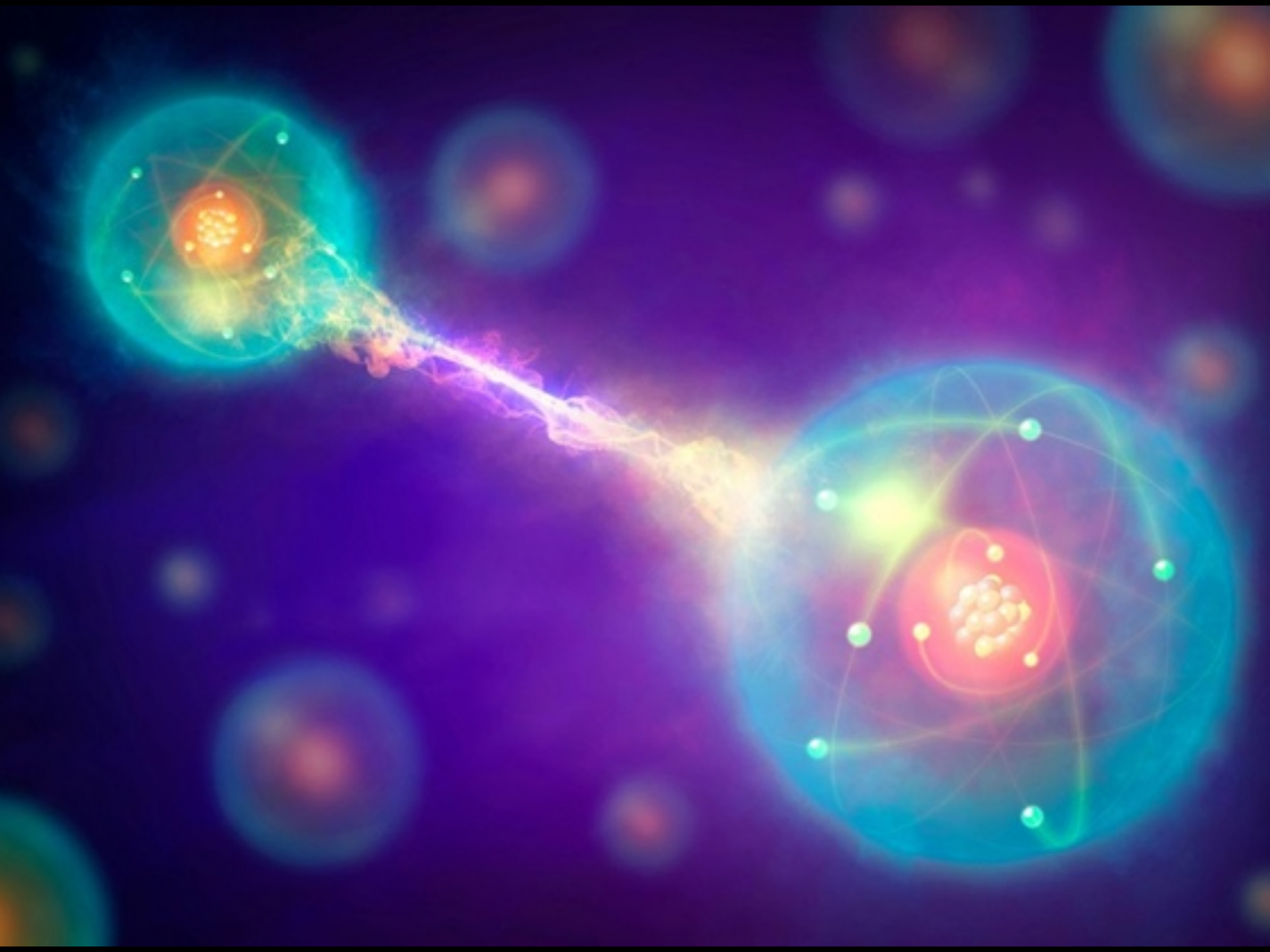


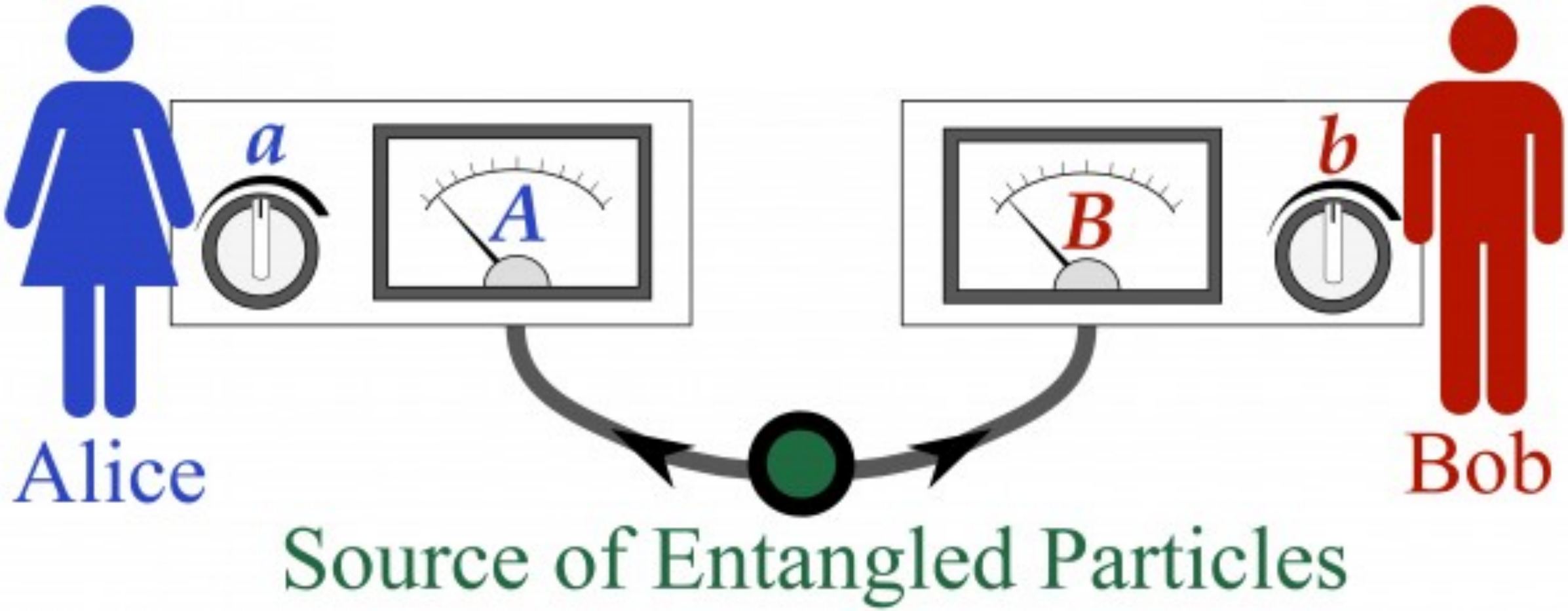






EMARANHAMENTO



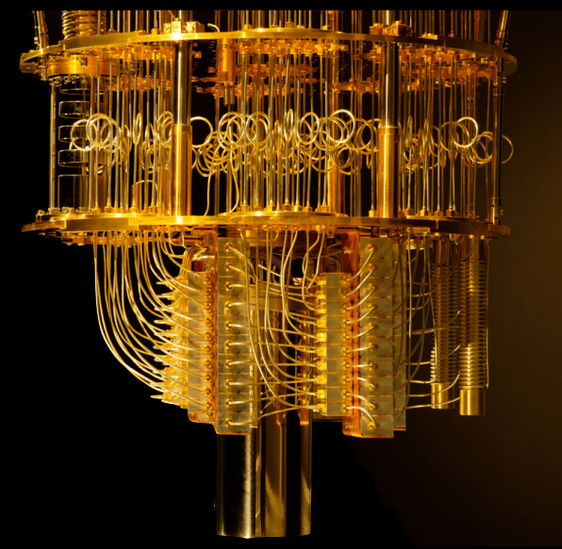

a
A
B
b
Alice
Bob
Source of Entangled Particles

✓Sensores quânticos

- Sensores ultra precisos para detectar campos magnéticos, campos gravitacionais, etc.

✓Comunicações quânticas:

- Comunicações encriptadas ultra-seguras



✓Computação quântica

- Programas exponencialmente mais rápidos, que são inviáveis com computadores tradicionais.

QUSPIN

AN ATOMIC DEVICES COMPANY

ALGORITMO DE SHOR

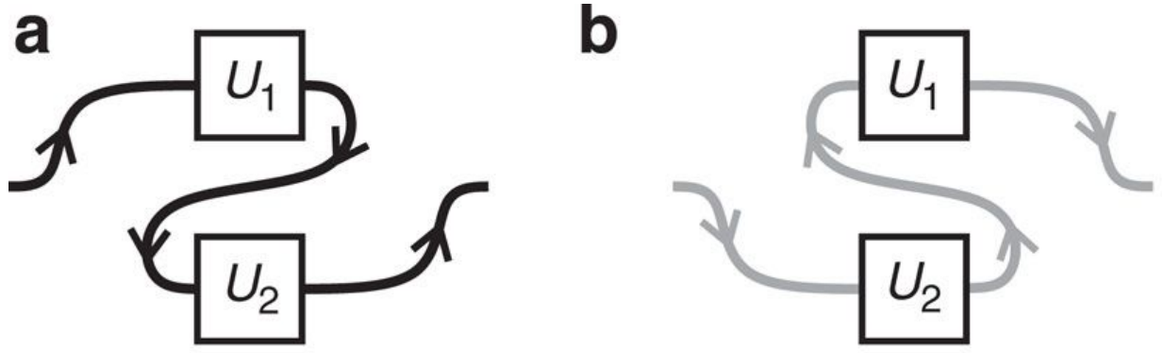
$$63 = 3 \times 3 \times 7$$

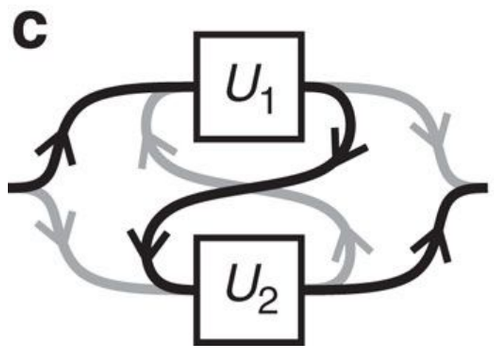
$$195 = 3 \times 5 \times 13$$

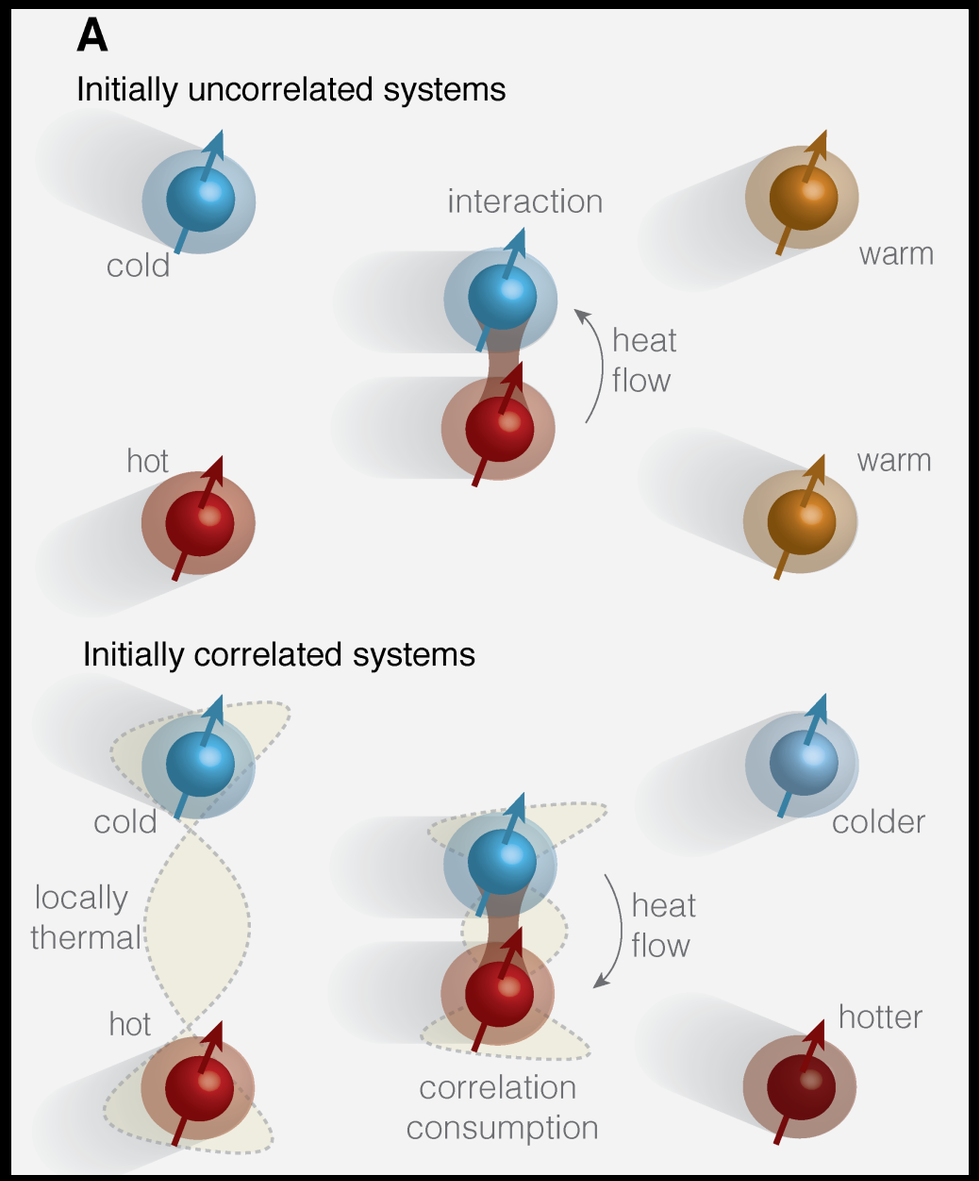
$$2434500 = 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 5 \times 541$$

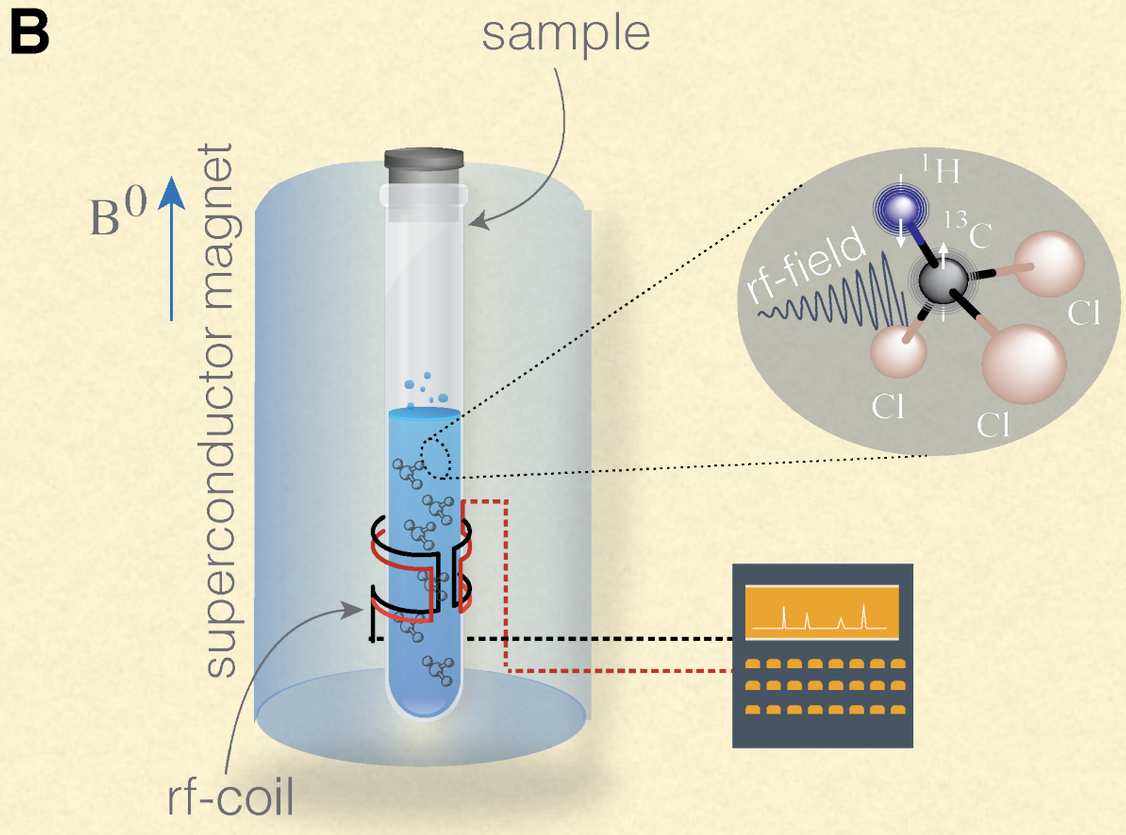
UM COMPUTADOR QUÂNTICO SERIA CAPAZ DE REALIZAR ESSA TAREFA DE FORMA **EXPONENCIALMENTE** MAIS RÁPIDA

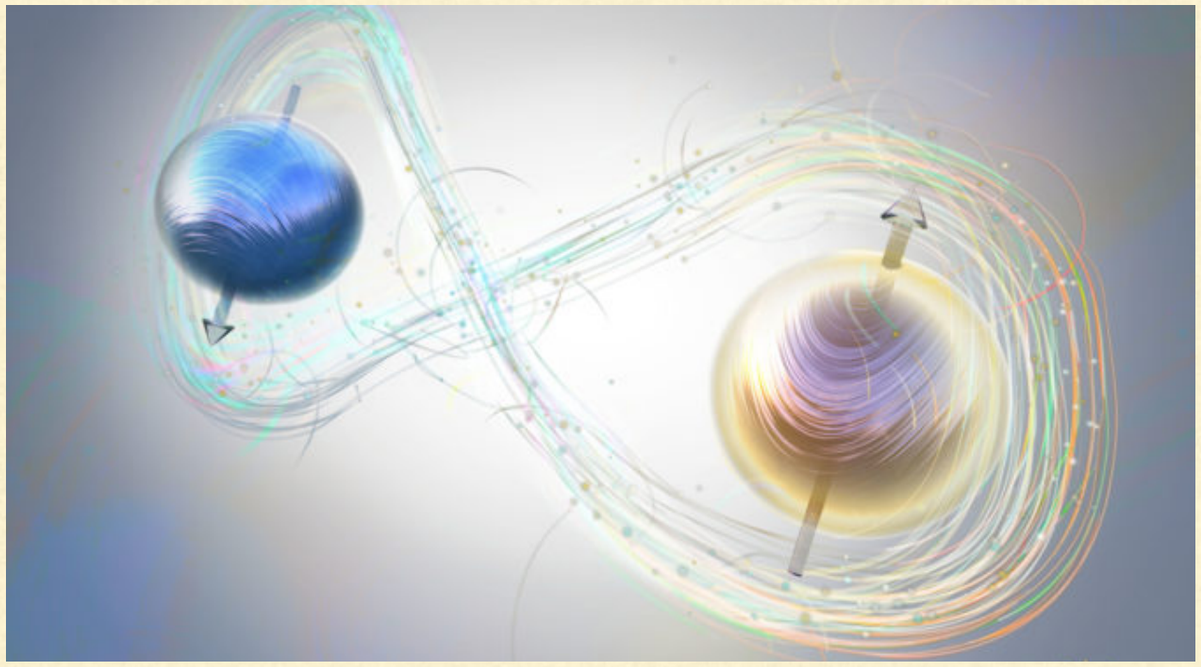
NÚMERO	TEMPO (S)
$10^{100}+1$	0,04
$10^{101}+1$	0,0094
$10^{102}+1$	0,75
$10^{103}+1$	82,2


a
U_1
U_2
b
U_1
U_2


c
U_1
U_2


A
Initially uncorrelated systems
cold
interaction
warm
heat
flow
hot
warm
Initially correlated systems
cold
colder
locally
thermal
heat
flow
hot
correlation
consumption
hotter


B
sample
B^0
superconductor magnet
rf-coil
rf-field
^1H
^{13}C
Cl
Cl
Cl



SE O MUNDO GIRASSE AO CONTRÁRIO

LEONARDO MARTINELLI - UFRJ

Vencedor do festival *quantum shorts 2019* em Cingapura.

THE BORDER TERRITORY

QUANTUM DOMAIN

CLASSICAL DOMAIN

PHOTONS
ELECTRONS
ATOMS

GRAVITY WAVE DETECTOR

SUN
PLANETS

US

QUANTUM FLUIDS

QUANTUM BILL OF RIGHTS
INTERFERE IF YOU CAN!!!
SCHRODINGER'S EQUATION

CLASSICAL LAW AND ORDER
DO NOT INTERFERE!!!
NEWTON'S EQUATIONS
SECOND LAW OF THERMODYNAMICS

OBRIGADO!