Matematikens mysterier
- från svarta hål till artificiell intelligens -

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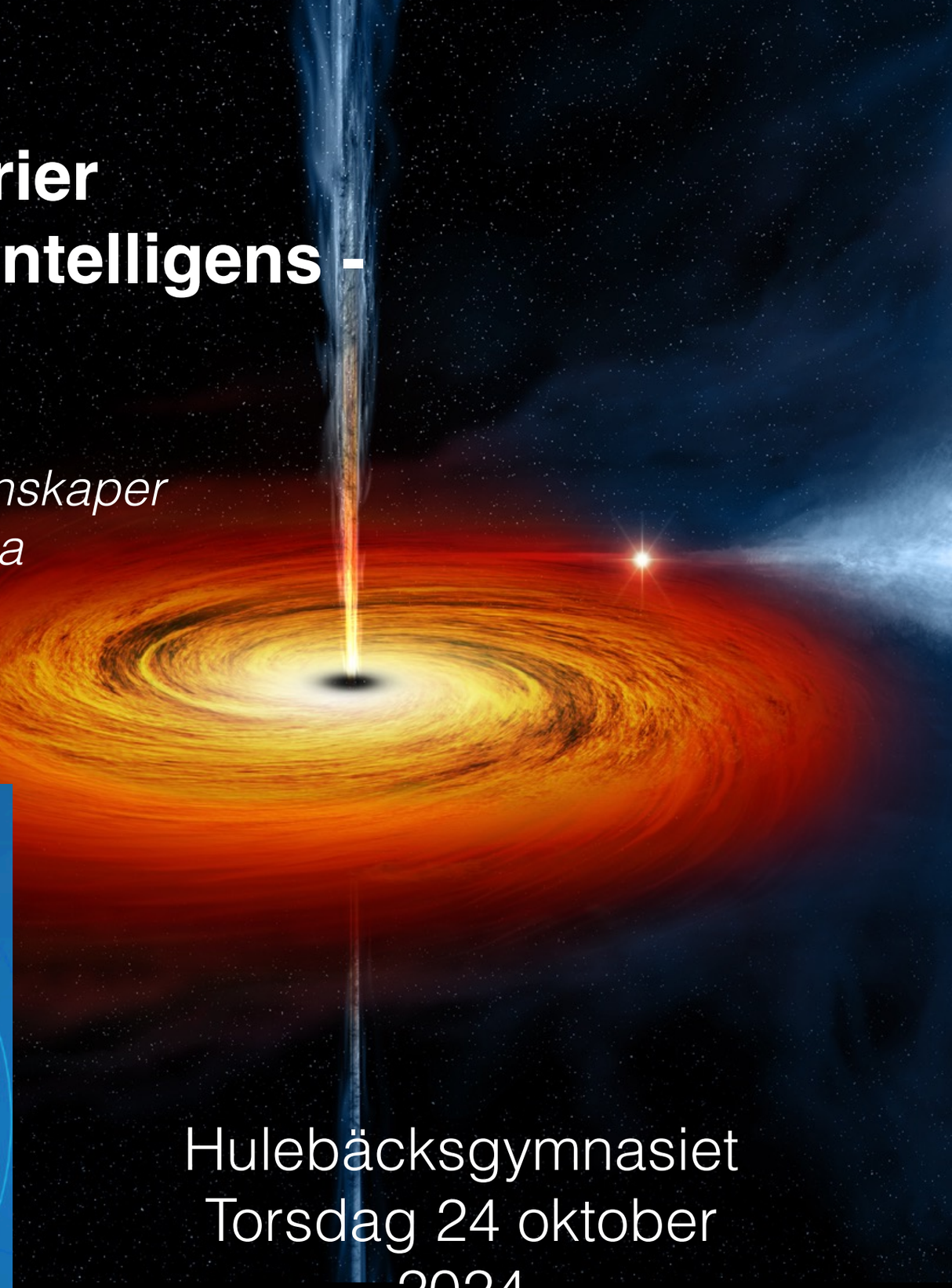
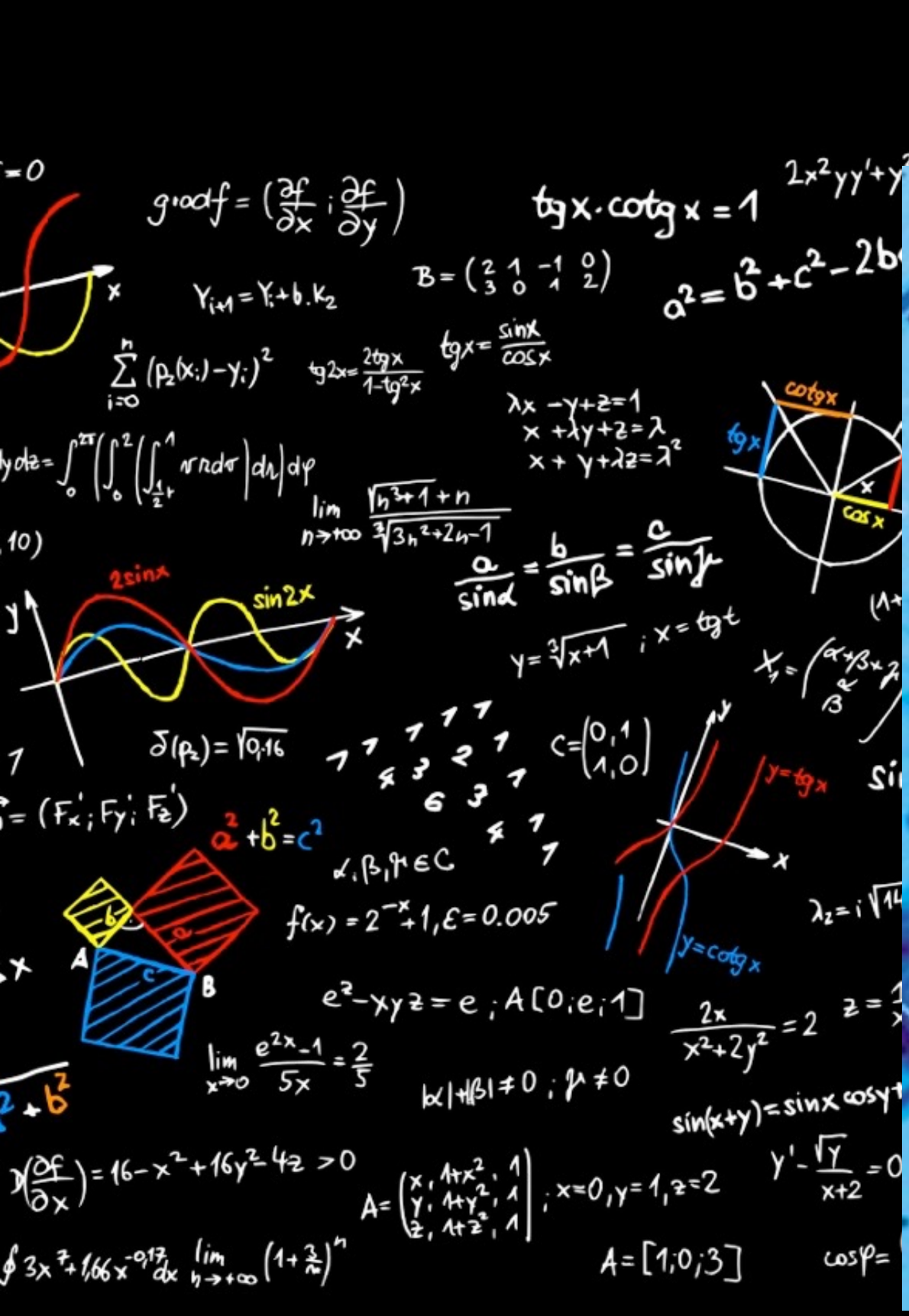
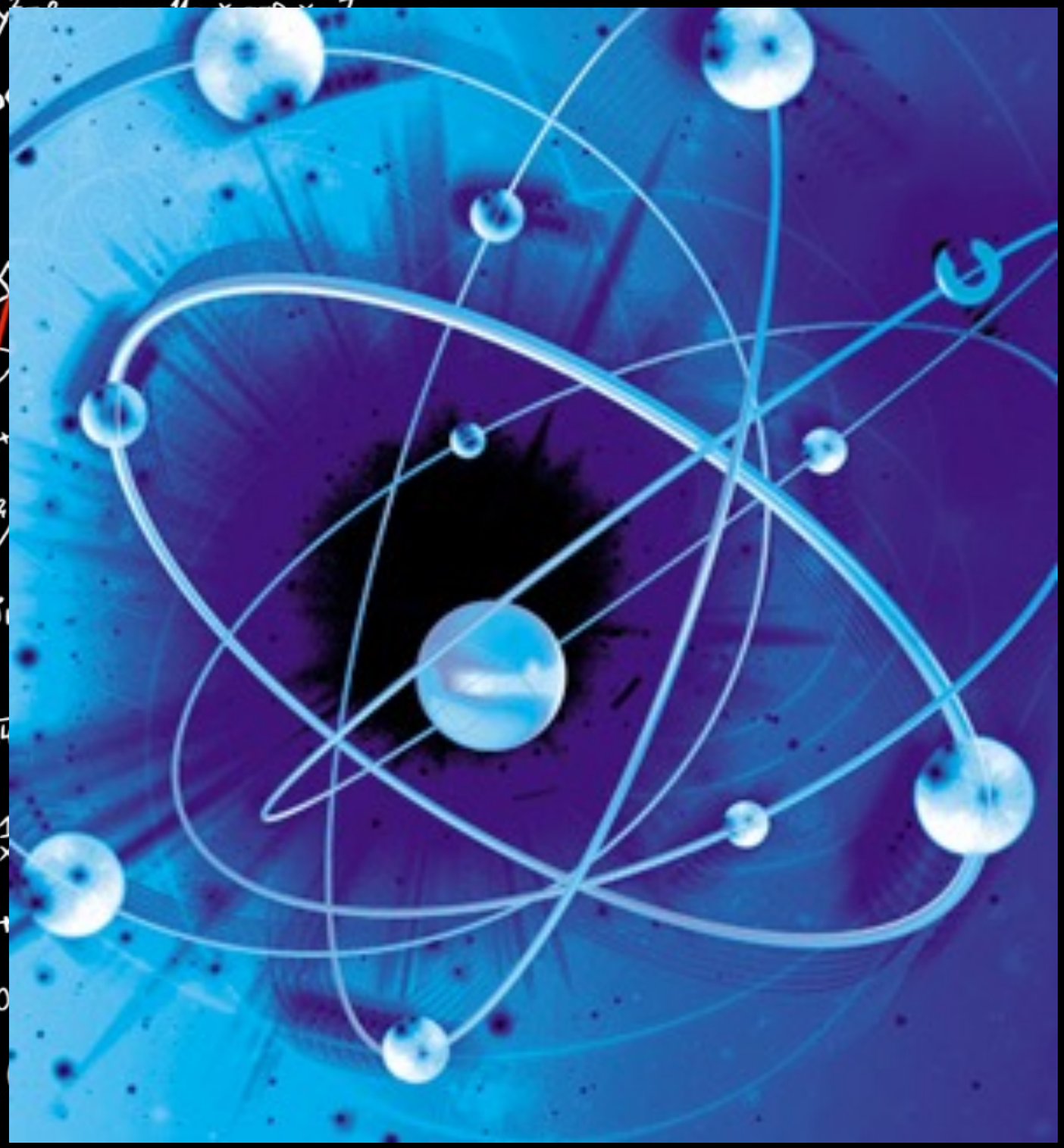
Institutionen för Matematiska Vetenskaper
Chalmers Tekniska Högskola
Göteborgs Universitet



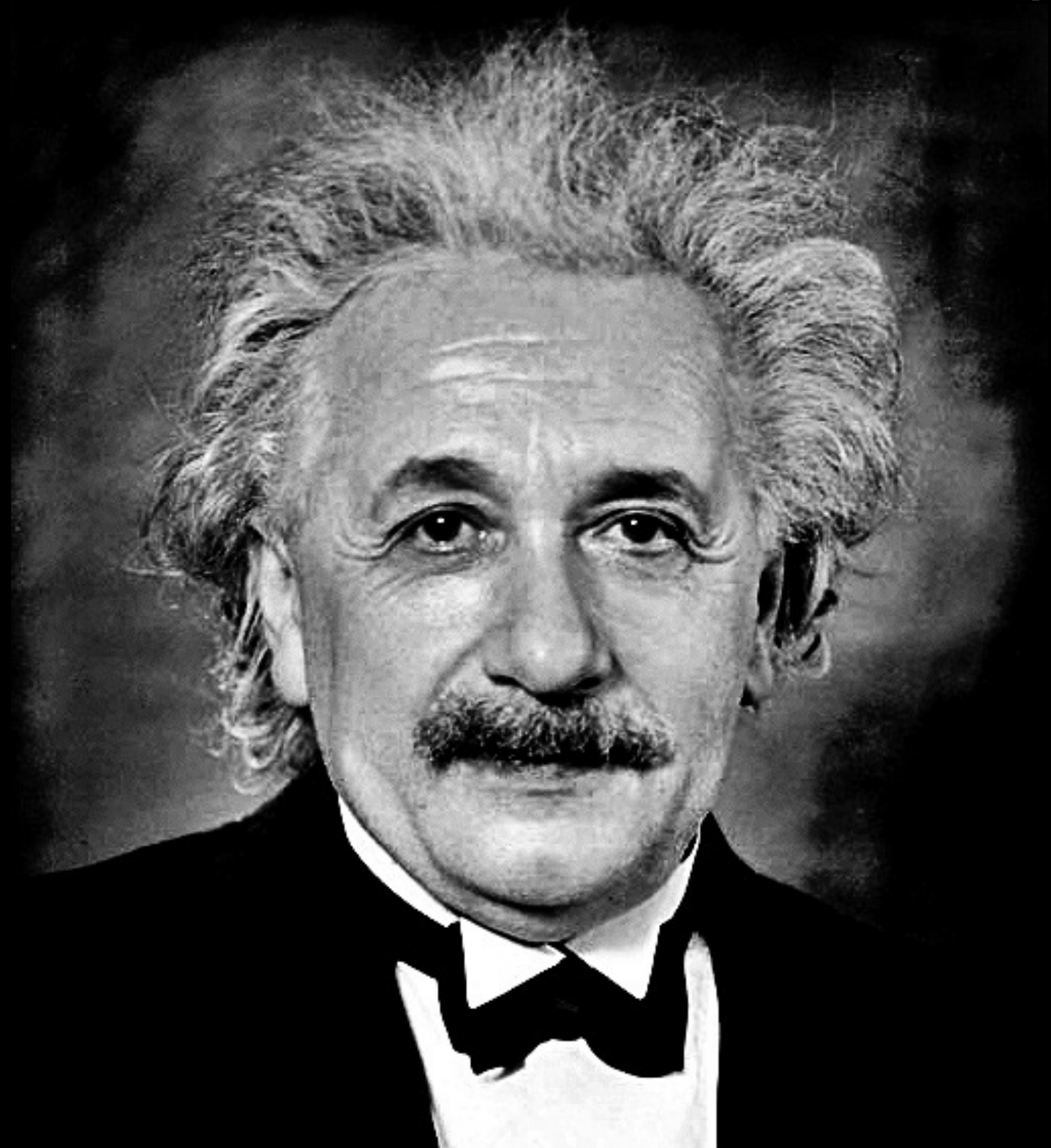
Hulebäcksgymnasiet
Torsdag 24 oktober
2024


grad f = (∂f/∂x ; ∂f/∂y)
tgx · cotgx = 1
B = (2 1 -1 0 / 3 0 1 2)
a² = b² + c² - 2b
Y_{i+1} = Y_i + b.K_2
tgx = sinx / cosx
tg2x = 2tgx / 1-tg²x
λx - y + z = 1
x + λy + z = λ
x + y + λz = λ²
cotgx
tgx
cos x
2sinx
sin2x
y = ∛x+1 ; x = tgt
y = tgx
y = cotgx
a² + b² = c²
α, β, γ ∈ C
f(x) = 2^{-x} + 1, ε = 0.005
e^z - xyz = e ; A[0;e;1]
lim x→0 e^{2x} - 1 / 5x = 2/5
2x / x² + 2y² = 2
sin(x+y) = sinx cosy
A = (x; 1+x²; 1 / y; 1+y²; 1 / z; 1+z²; 1) ; x=0, y=1, z=2
A = [1;0;3]
C = (0,1 / 1,0)
A
B
C

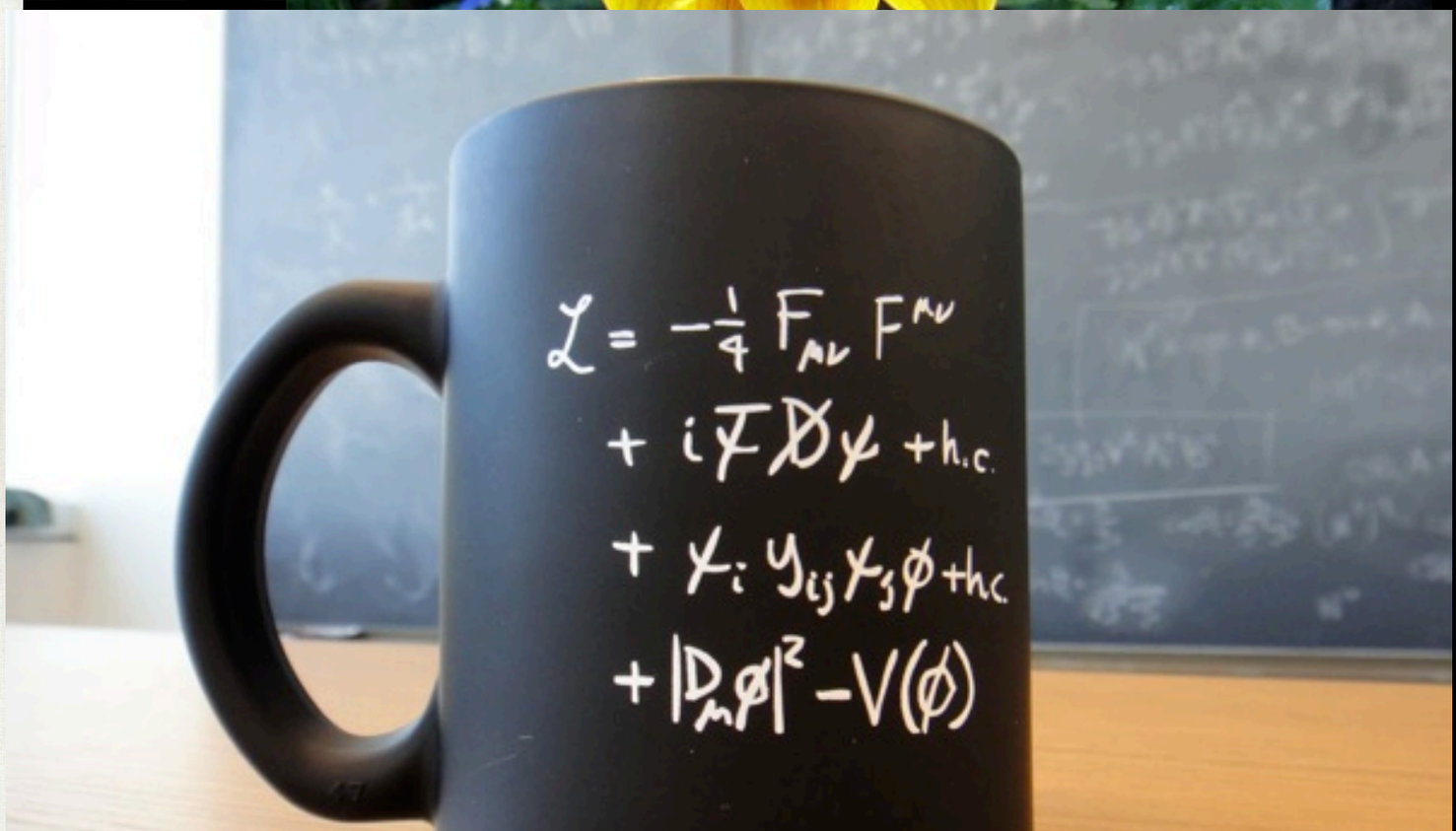


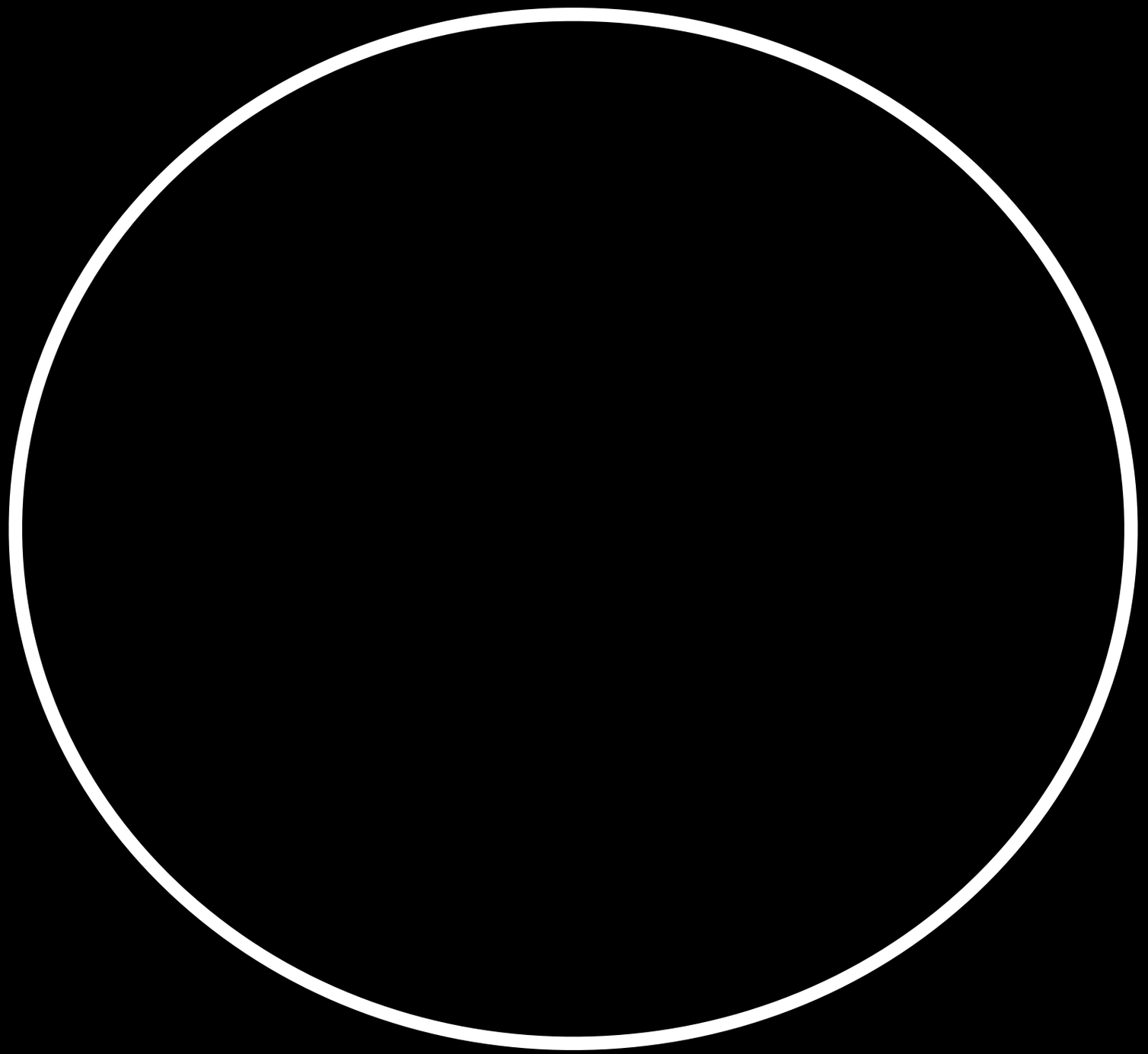
How can it be that mathematics, being after all a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality?

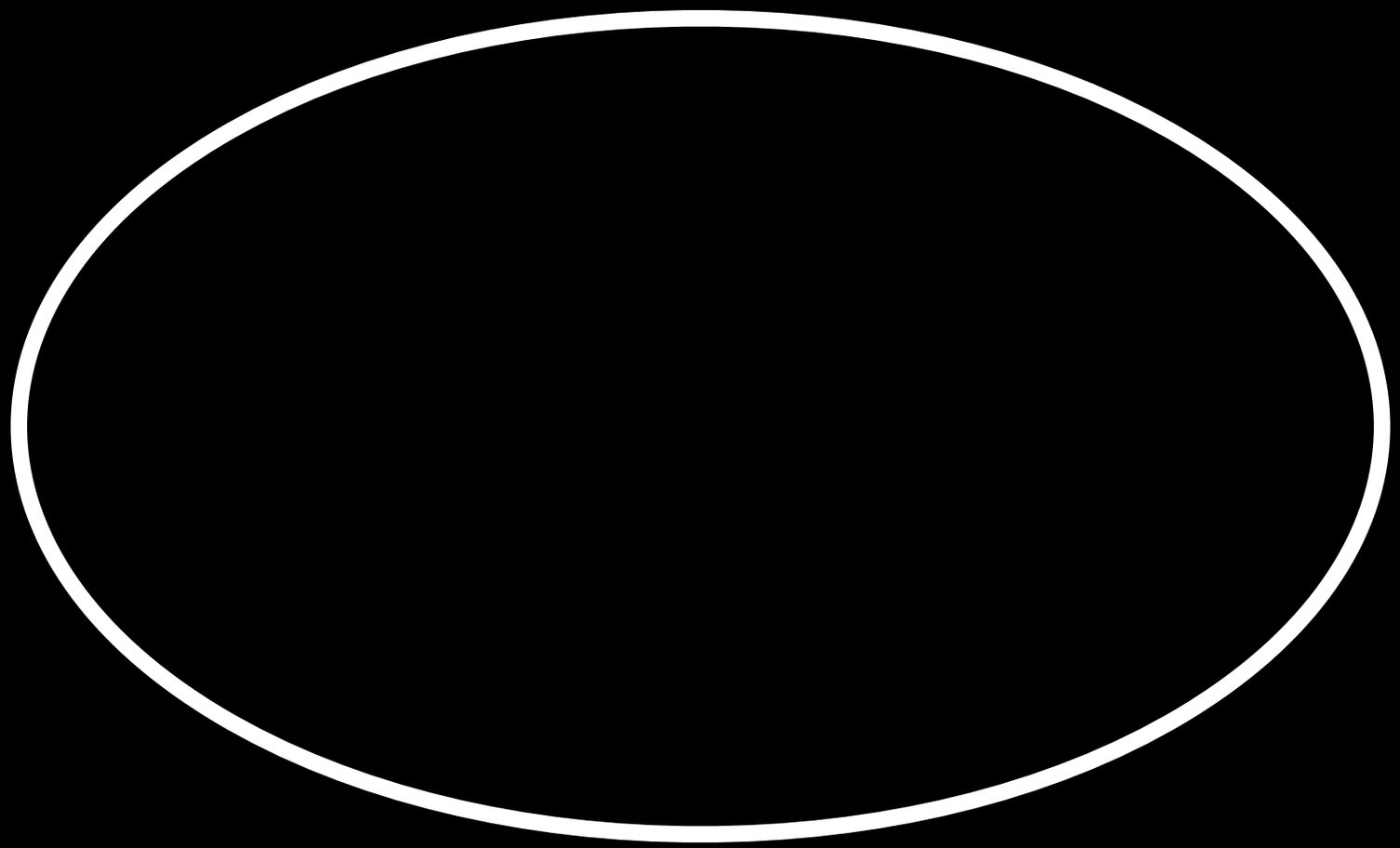
- A. Einstein

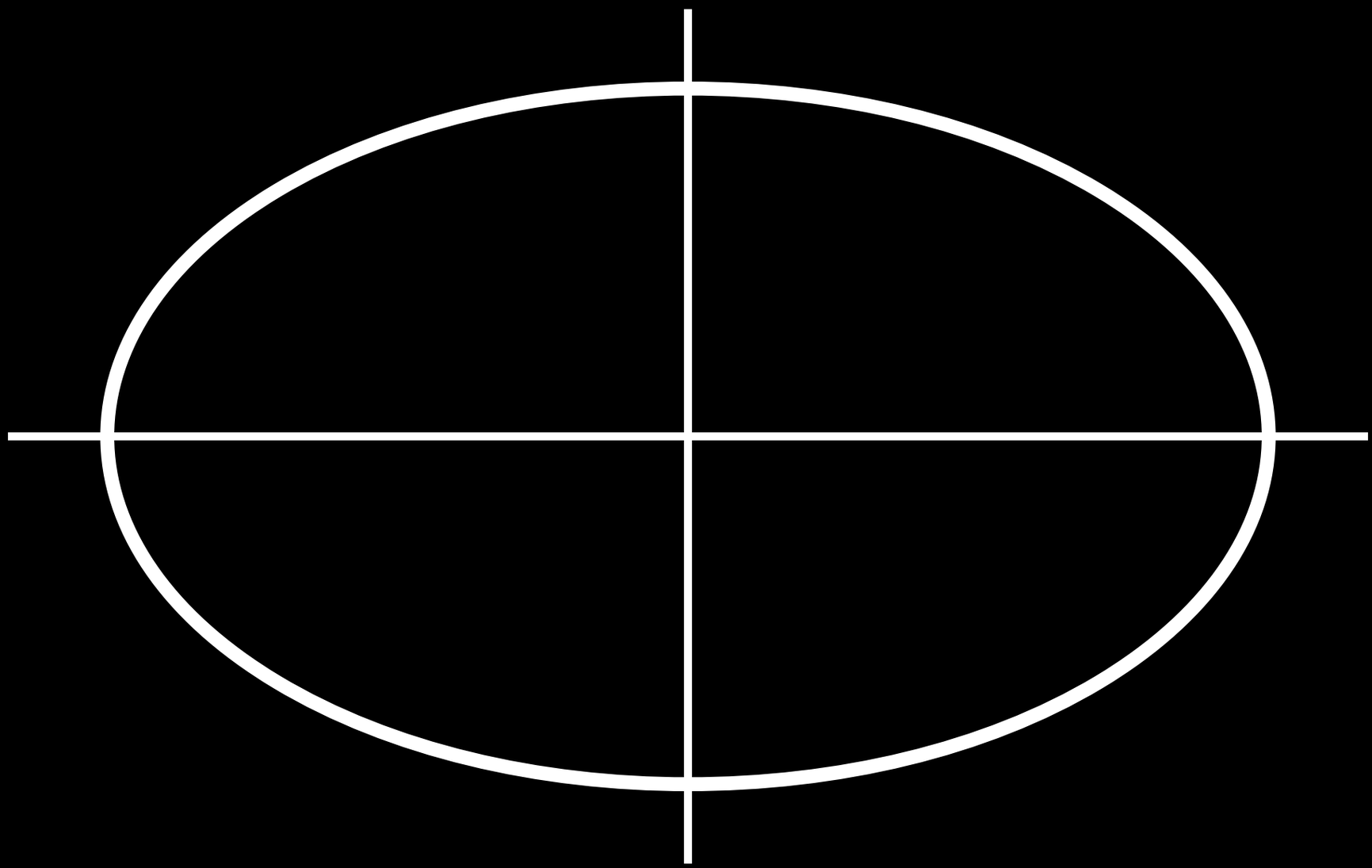


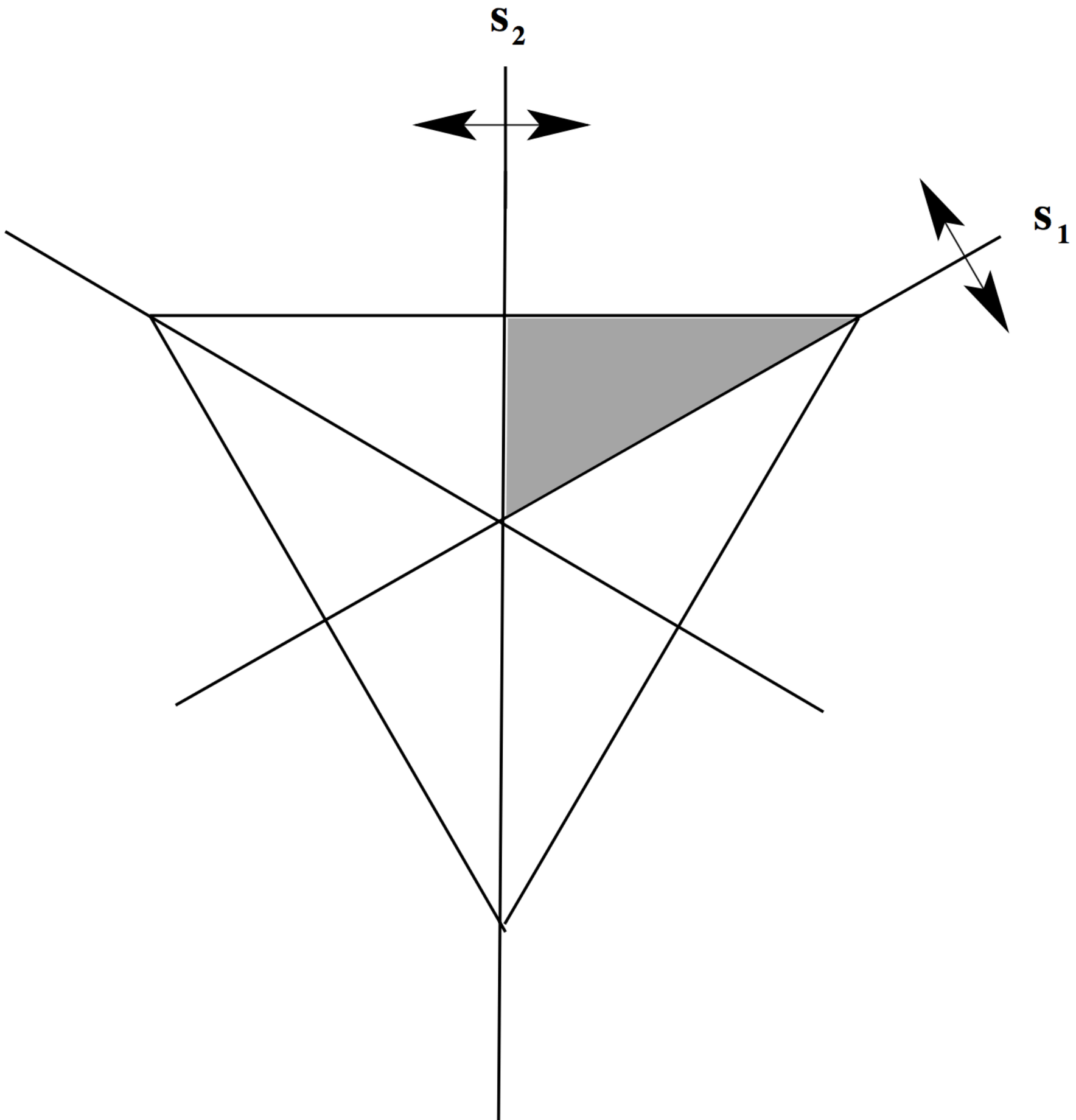
Naturen har inbyggda symmetrier

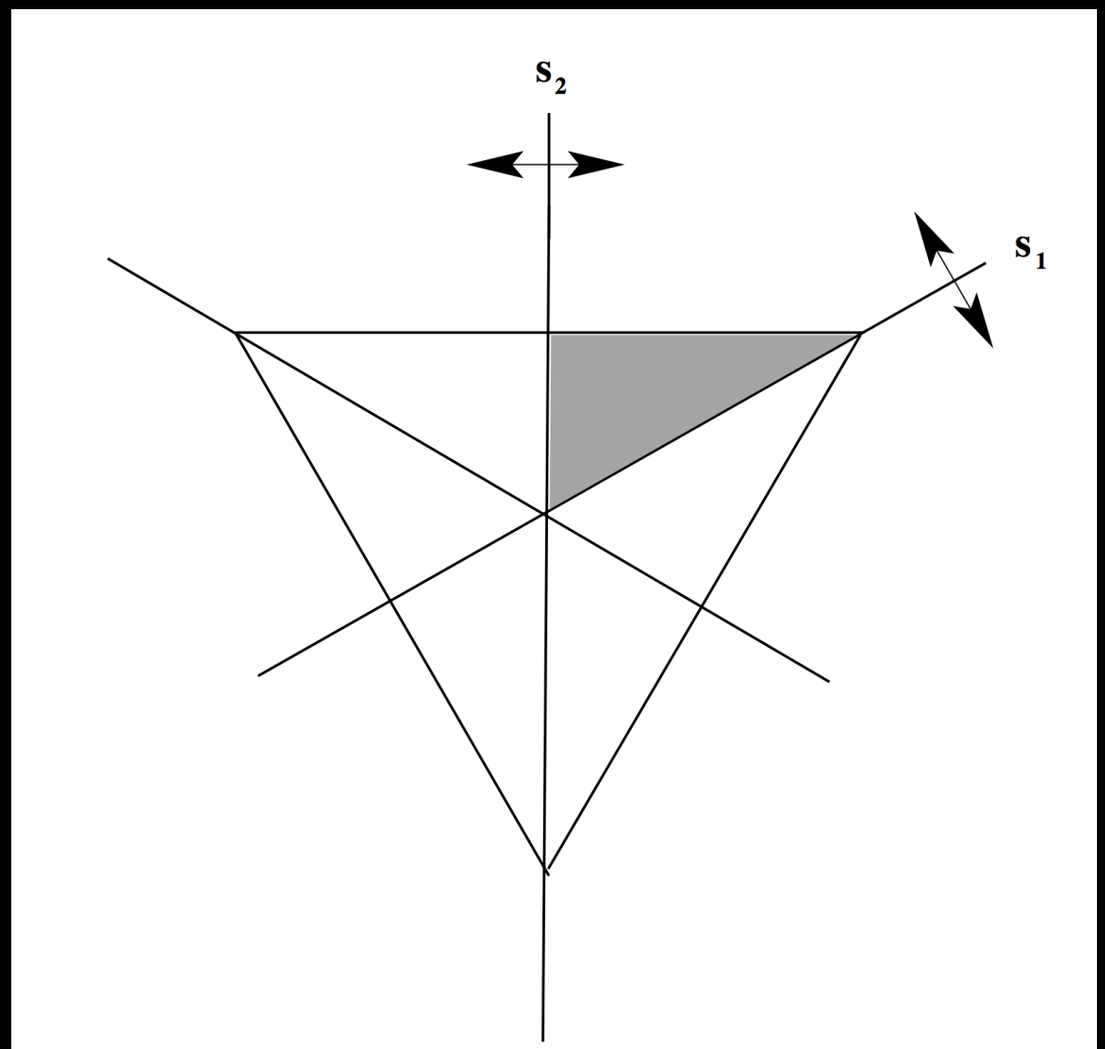









S2
S1



Symmetritransformationer bildar
ett matematisk objekt
som kallas ***grupp***

Kombination av två transformationer
måste också vara en symmetri

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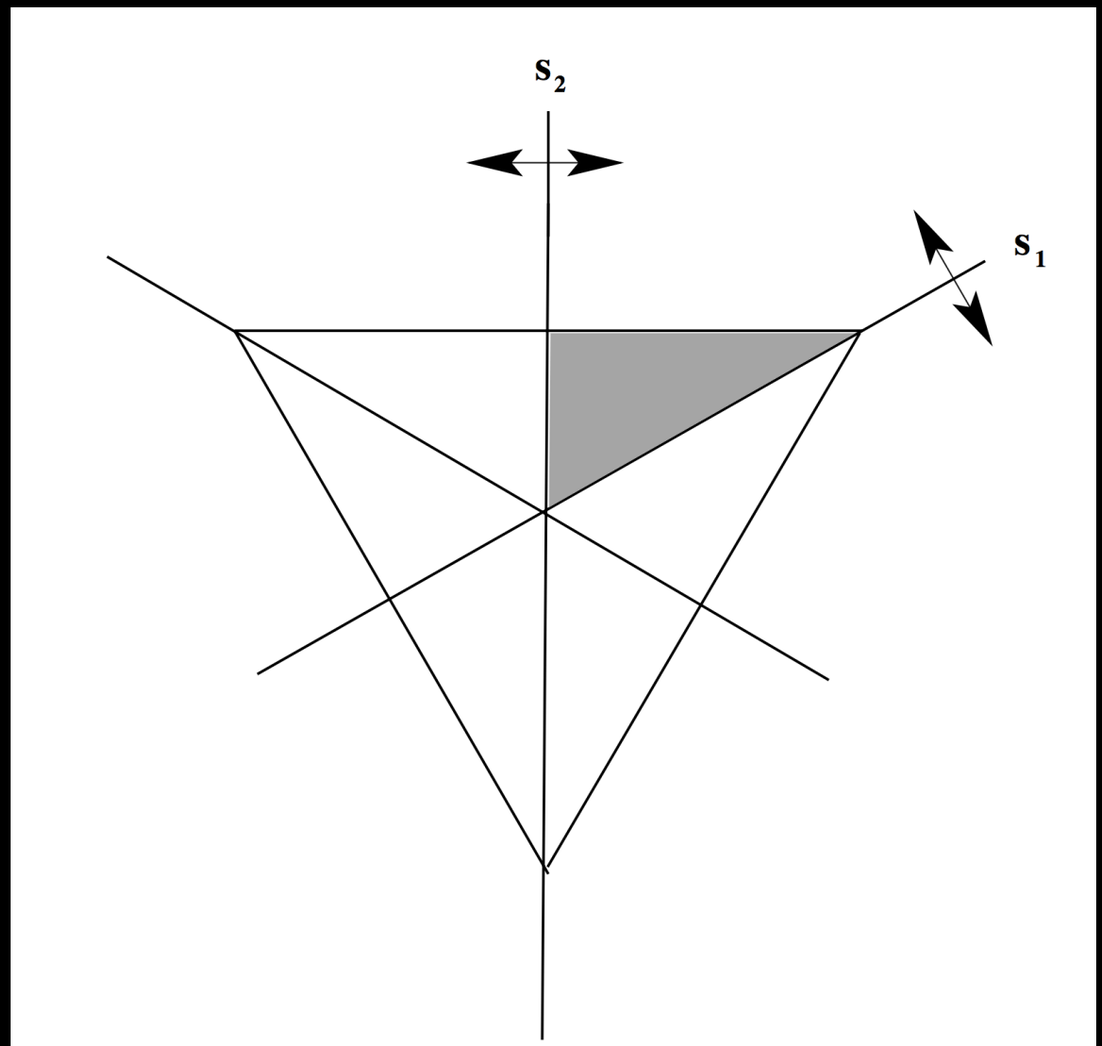
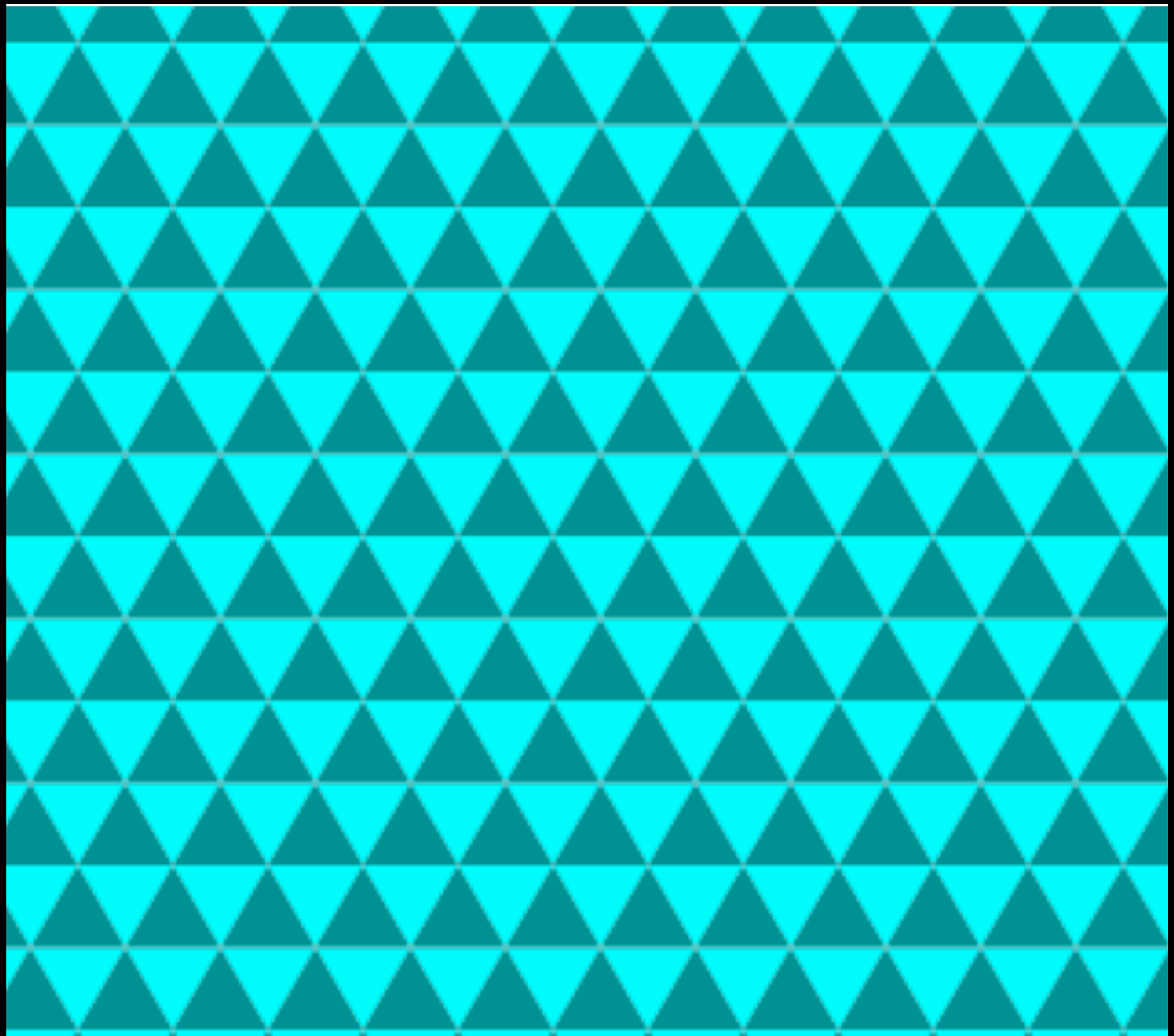
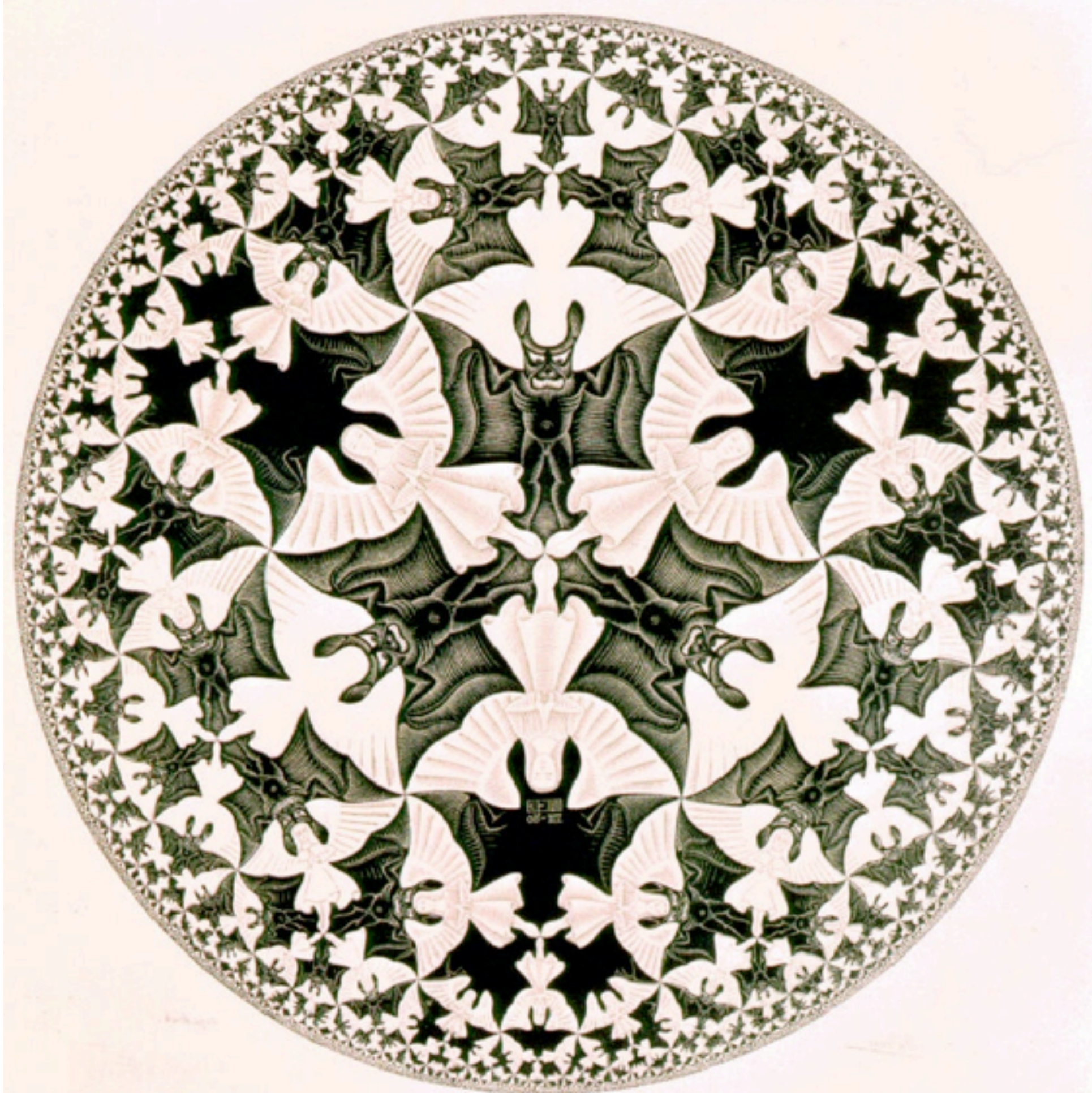


Men vad händer om vi flyttar triangeln?

Men en “tesselering” av planet med trianglar har oändlig symmetri!





Naturens fundamentala lagar bestäms av symmetrier!

gravitation

gravitation

elektromagnetism

starka kärnkraften

gravitation

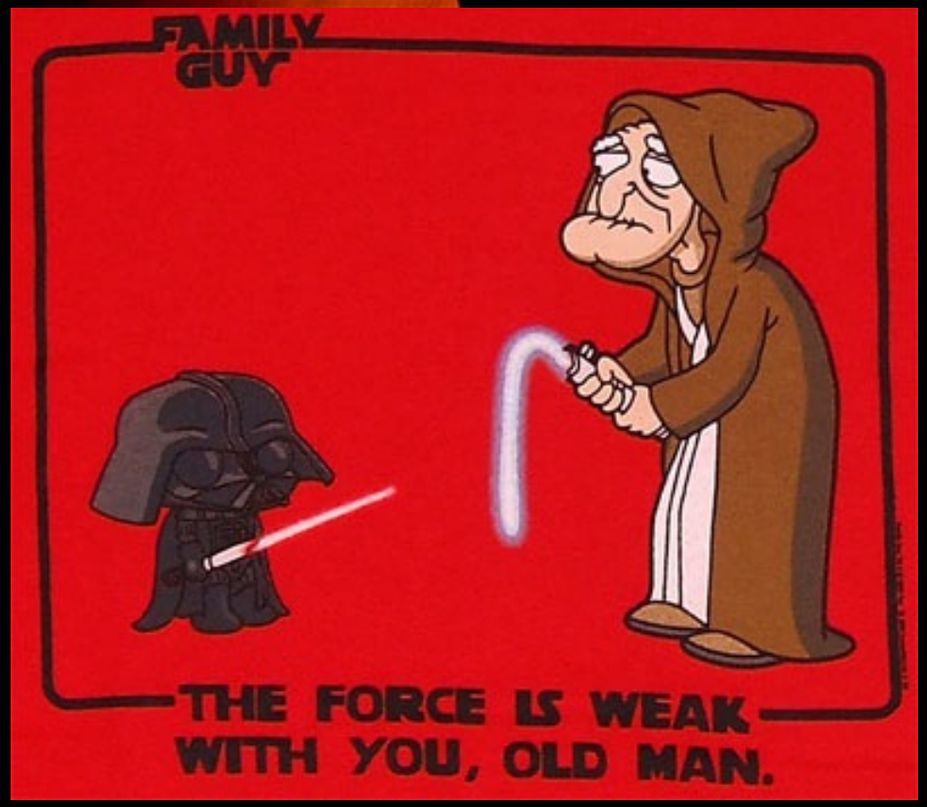
elektromagnetism

starka kärnkraften

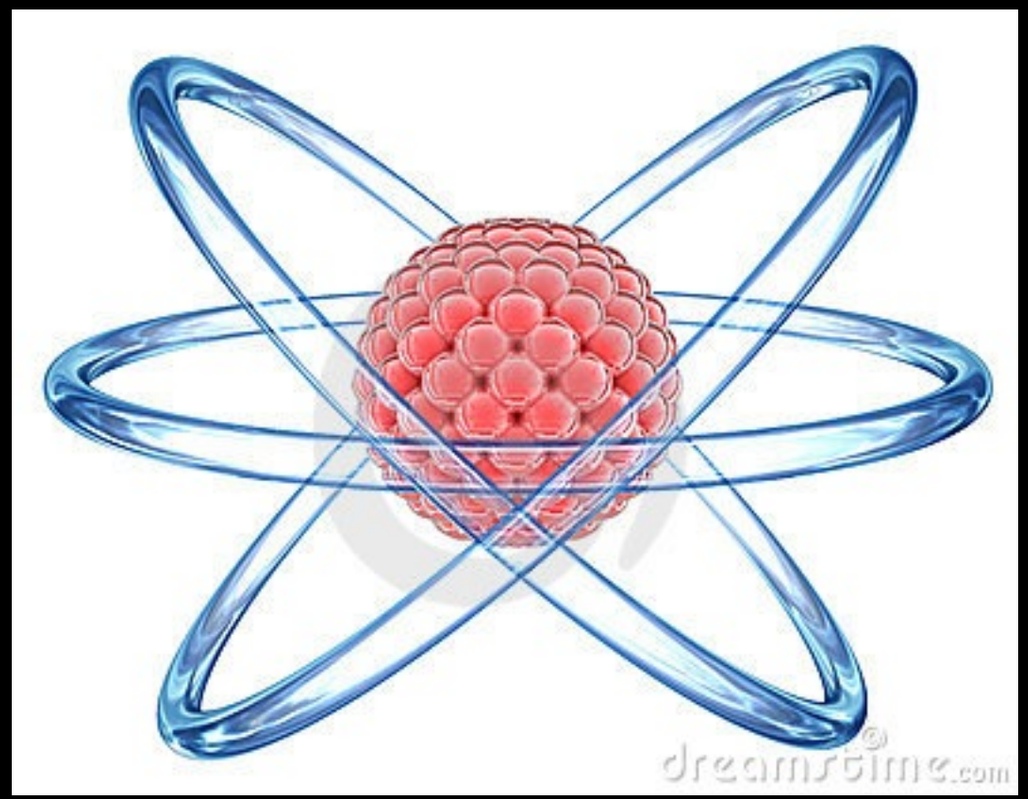
gravitation

elektromagnetism

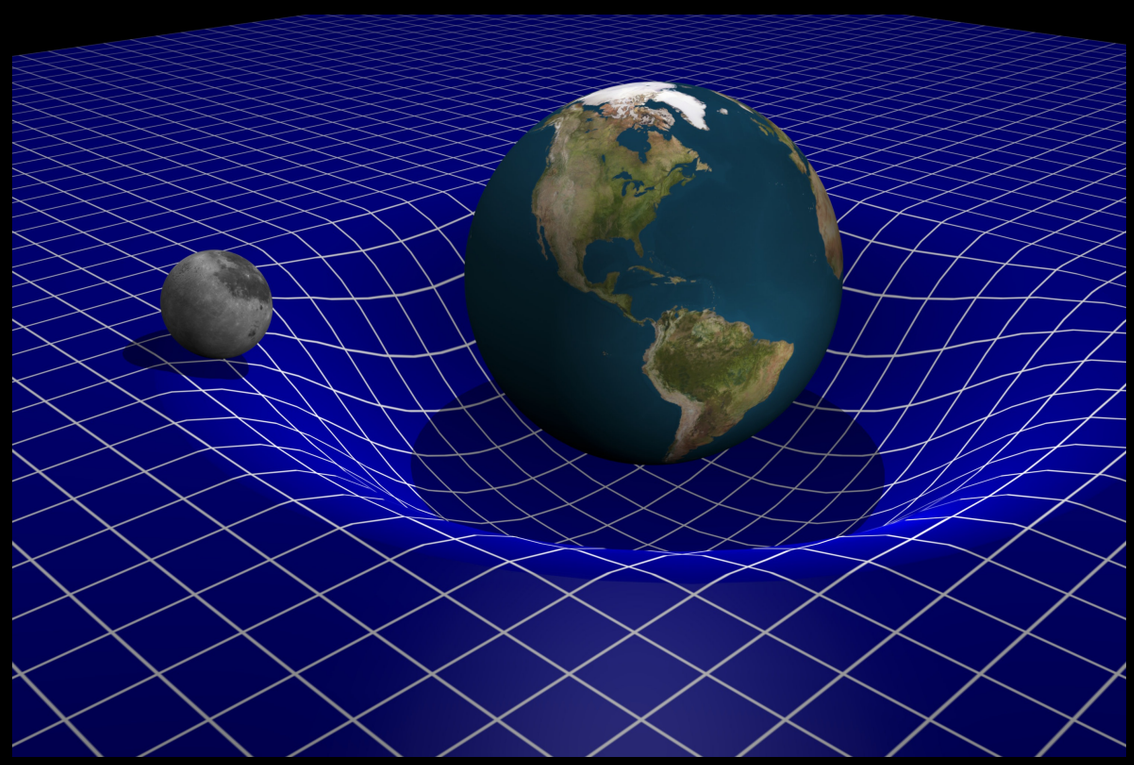
svaga kärnkraften


FAMILY GUY
THE FORCE IS WEAK WITH YOU, OLD MAN.


PLONK
©Lana

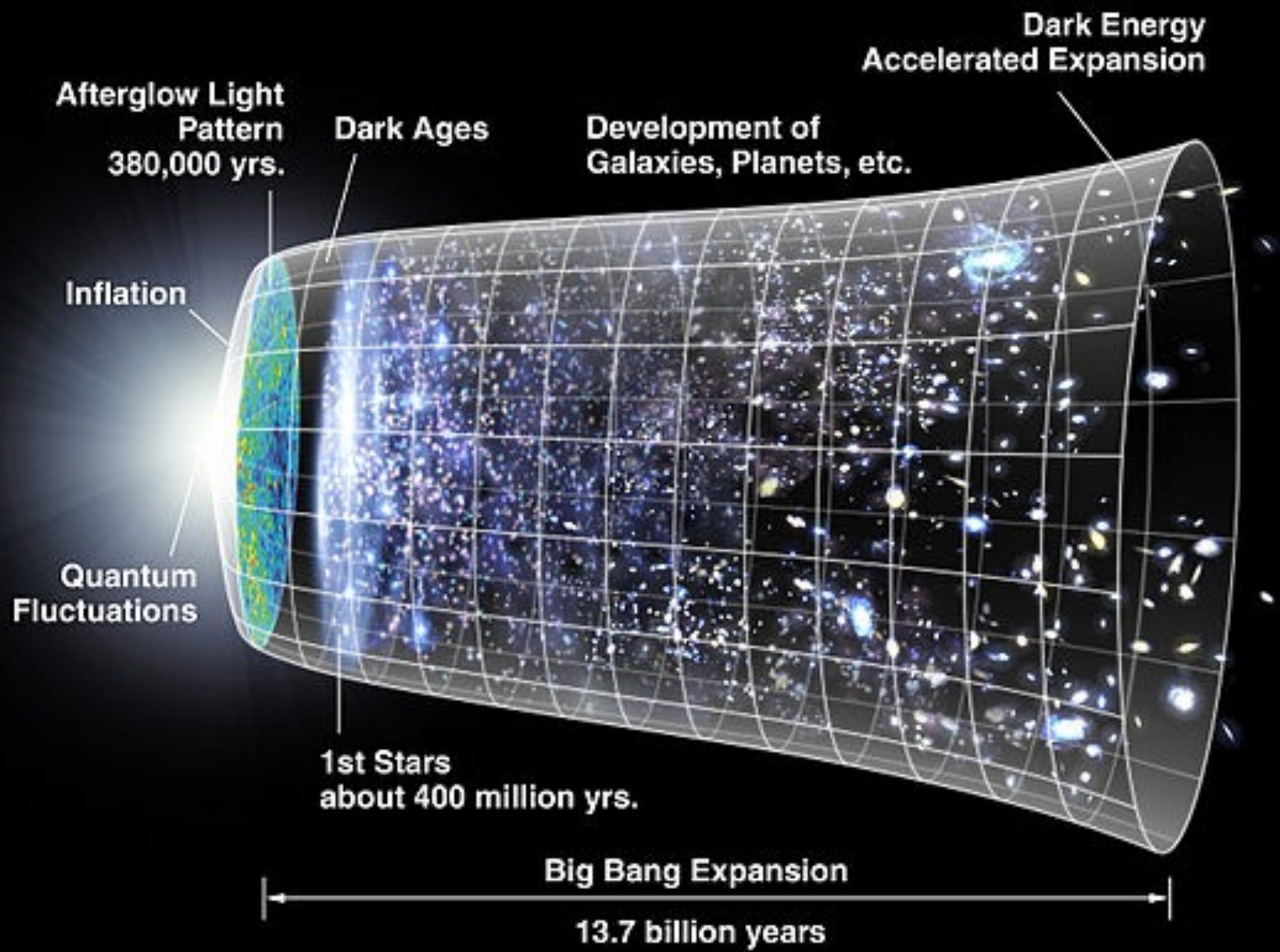


kvantmekanik



allmän relativitetsteori

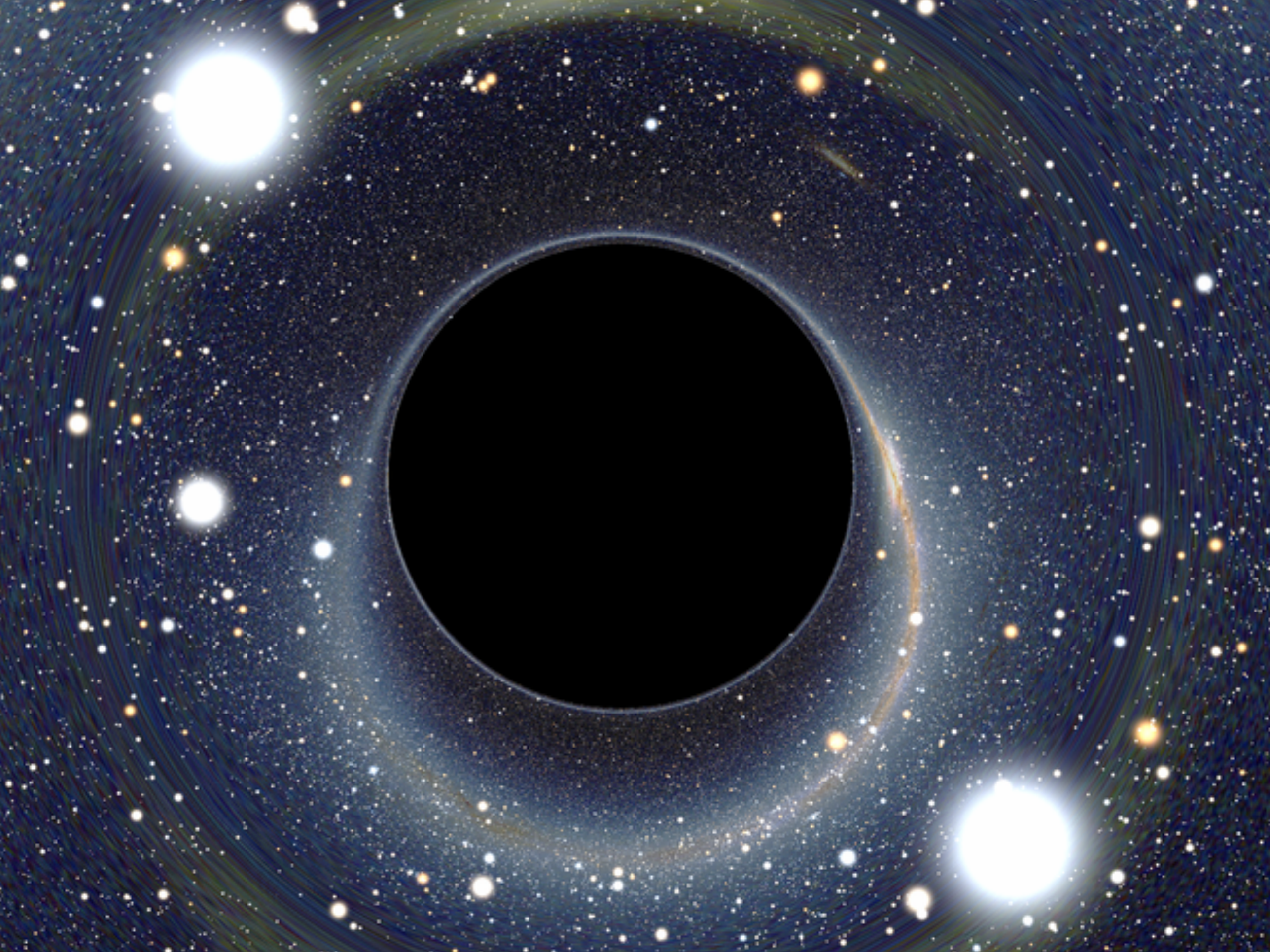
Det finns regioner i universum där kvantmekanik och allmän relativitetsteori måste kombineras



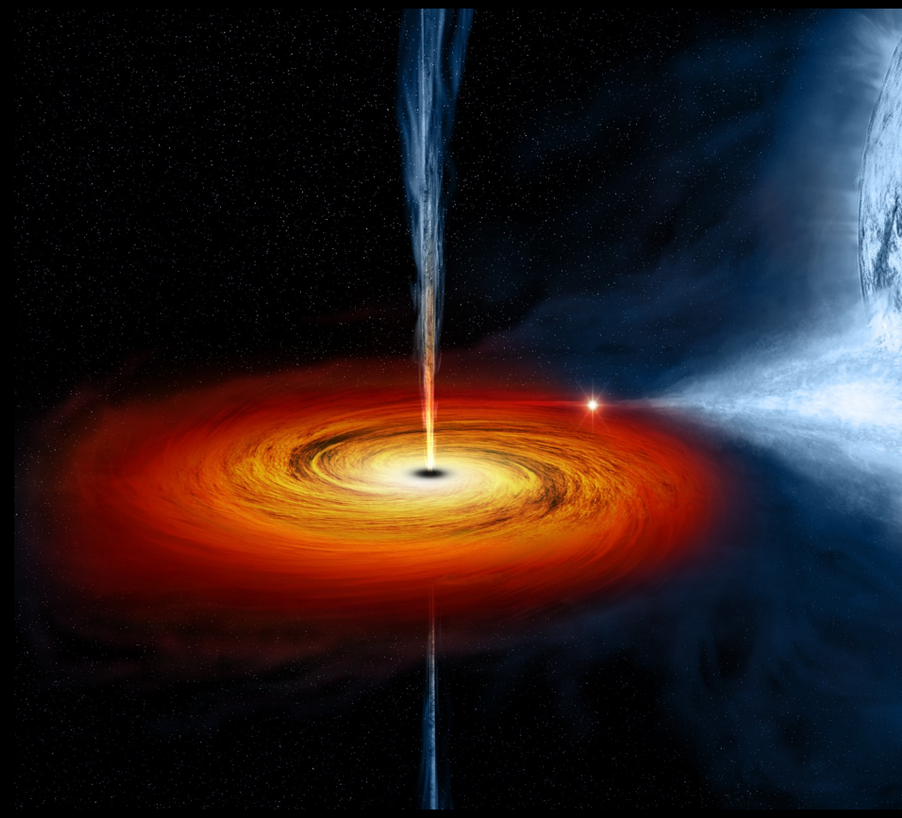
The Milky Way

DIGITAL IMAGE OF THE MILKY WAY BY PIKAIA IMAGING (WWW.PIKAIA-IMAGING.CO.UK)

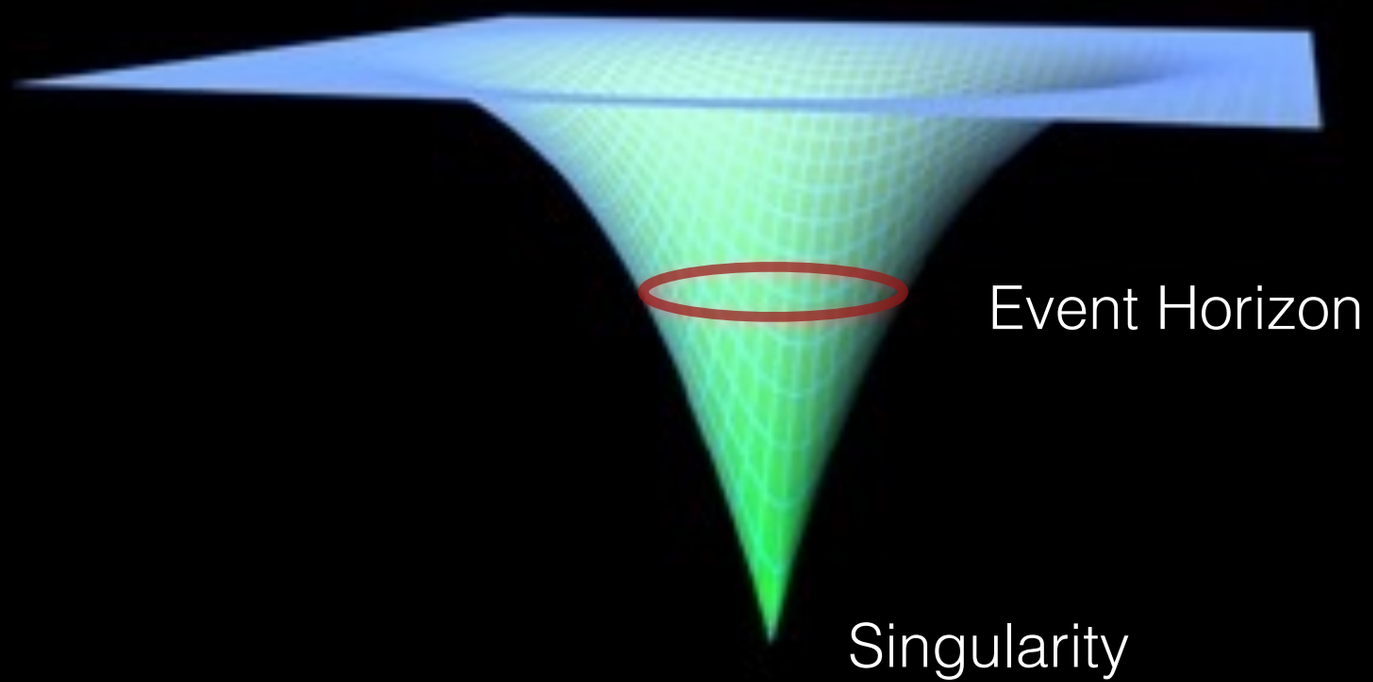
NewScientist



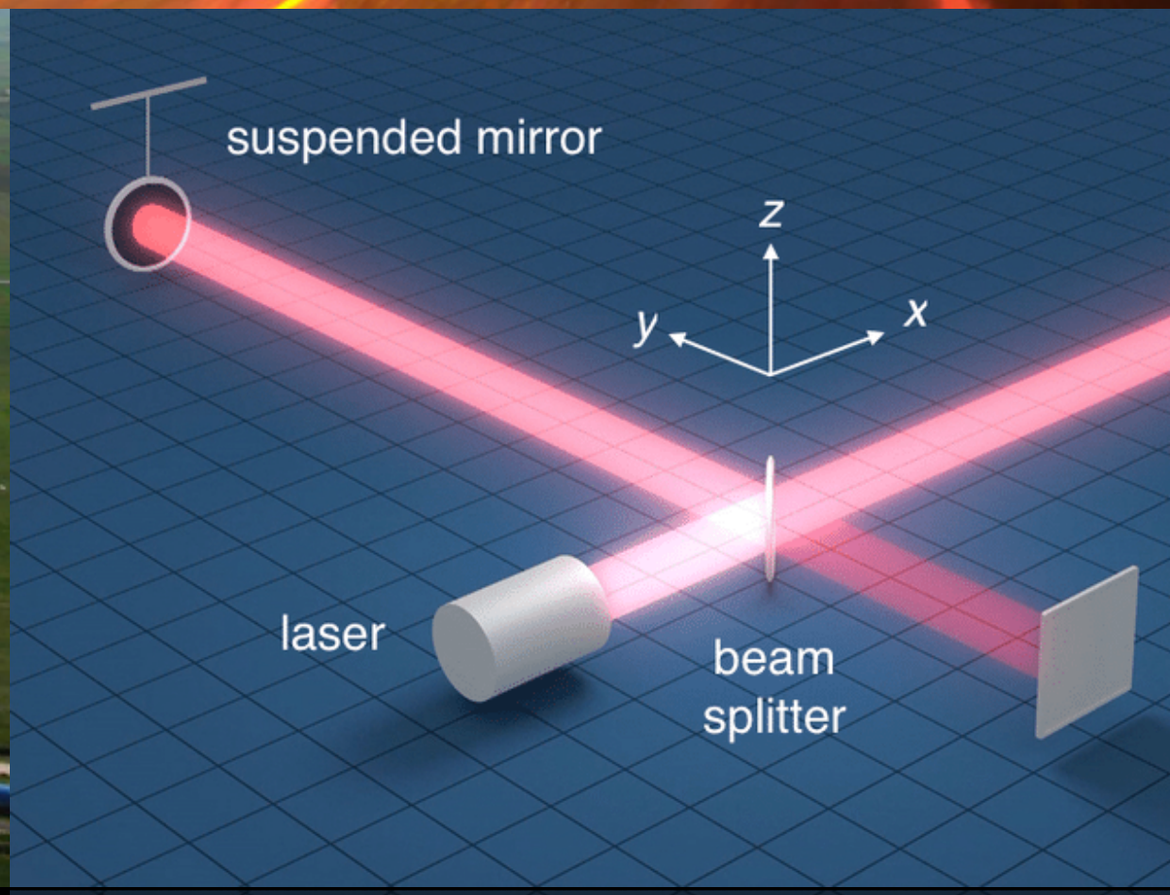
Ett svart hål bildas när en tillräckligt stor stjärna kollapsar och dör



I mitten av ett svart hål bryts rumtiden sönder



Vad händer inuti ett svart hål?


suspended mirror
z
y
x
laser
beam
splitter

Vad har allt detta med AI att göra?

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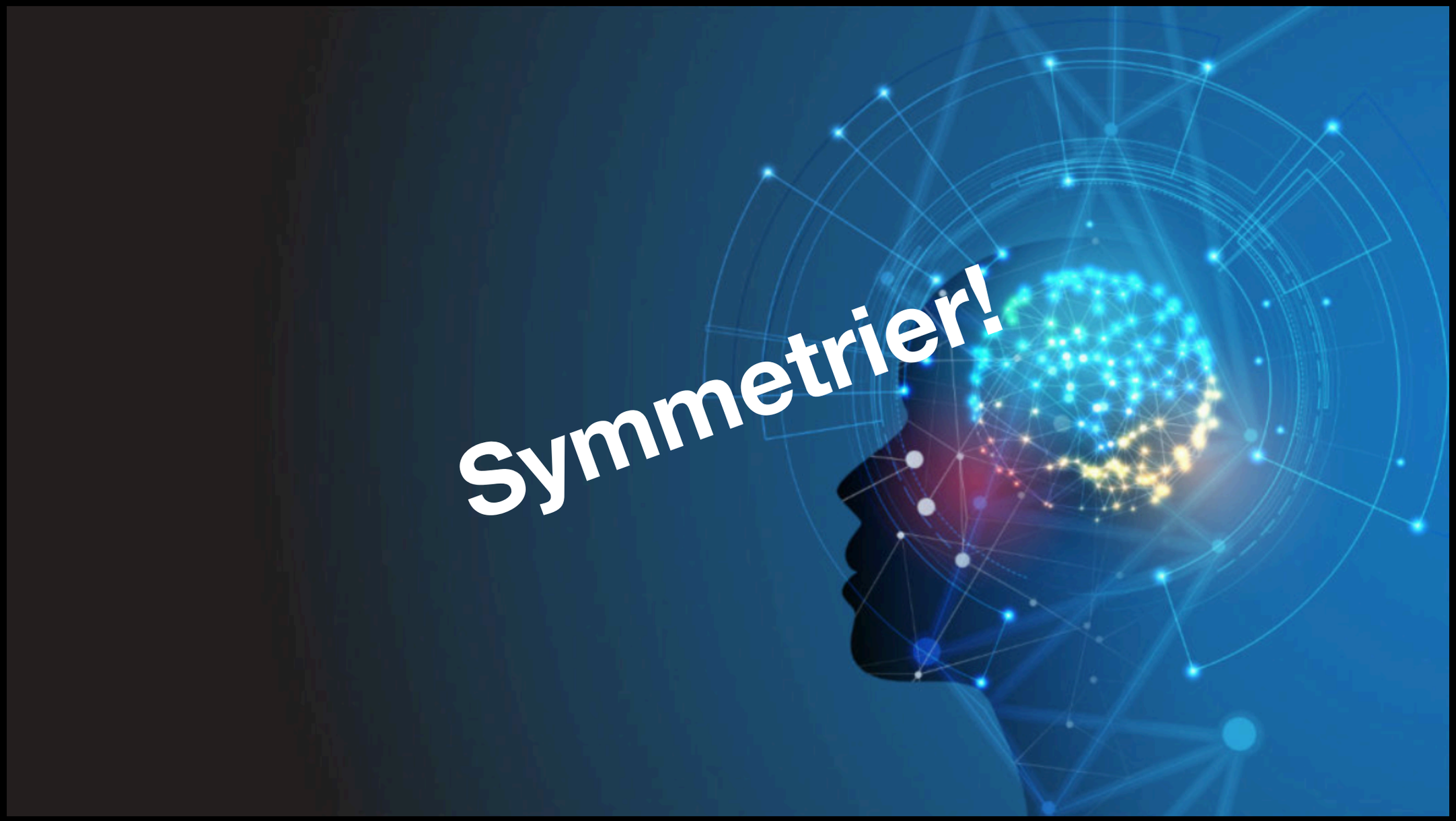
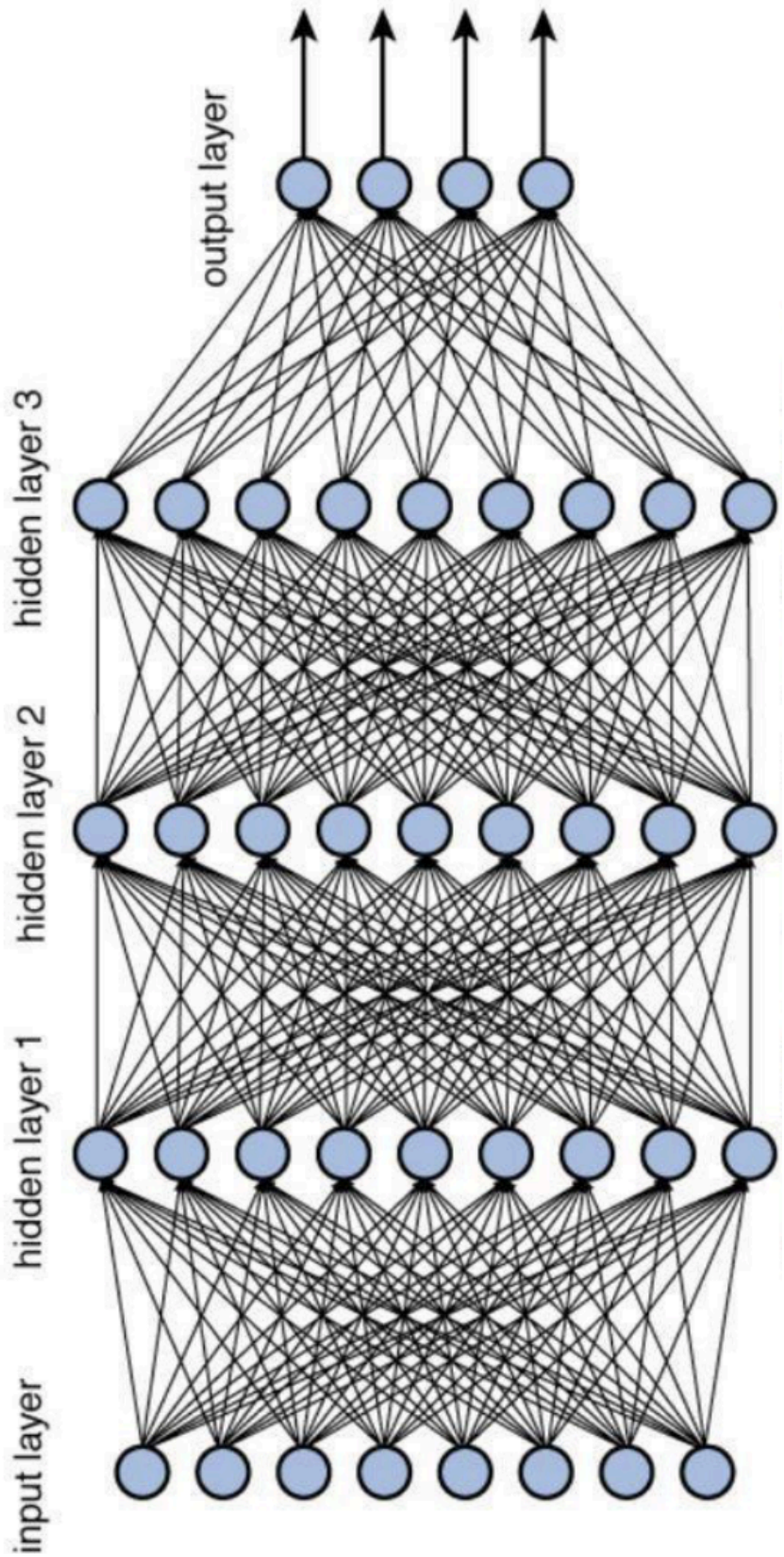
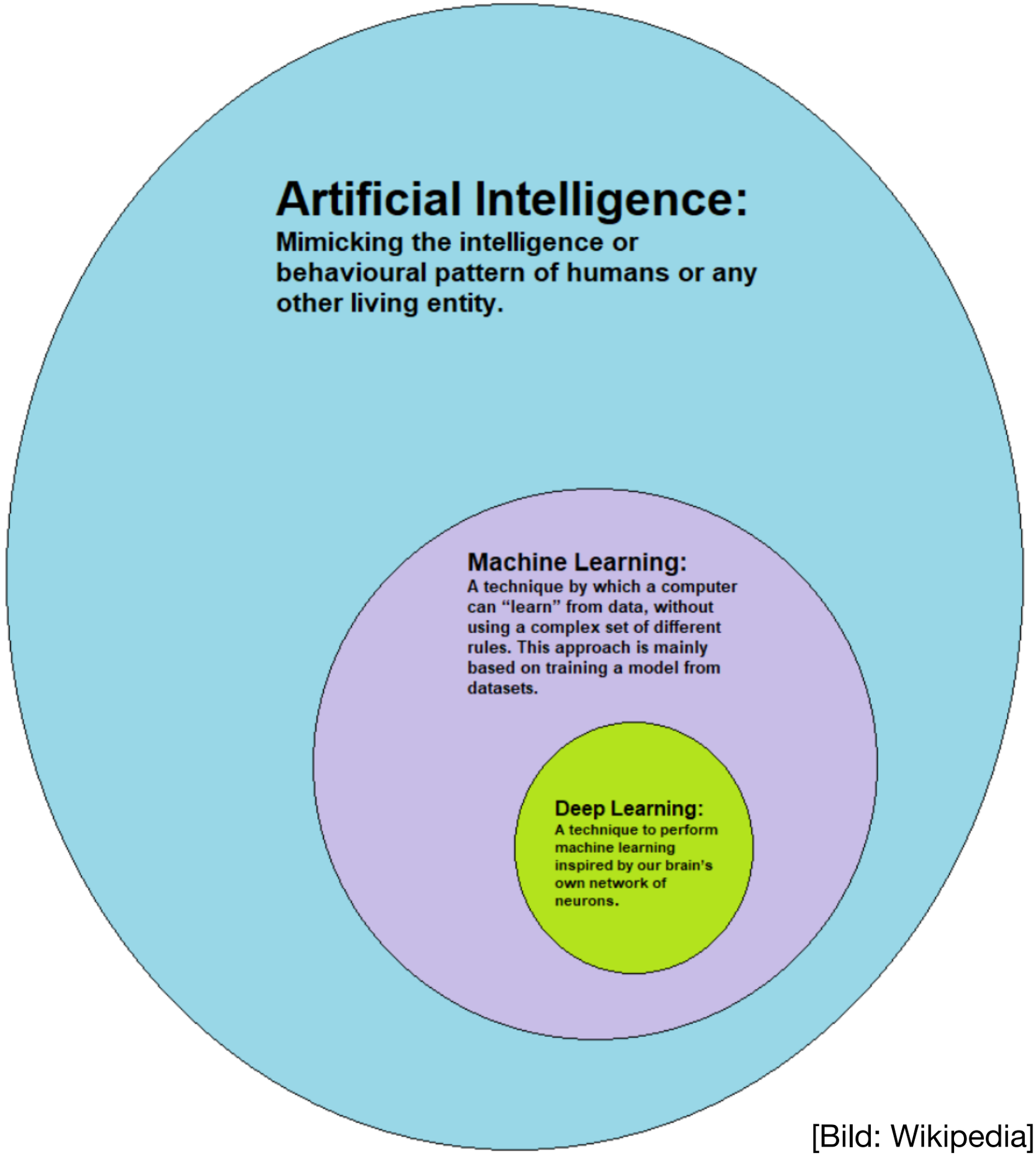
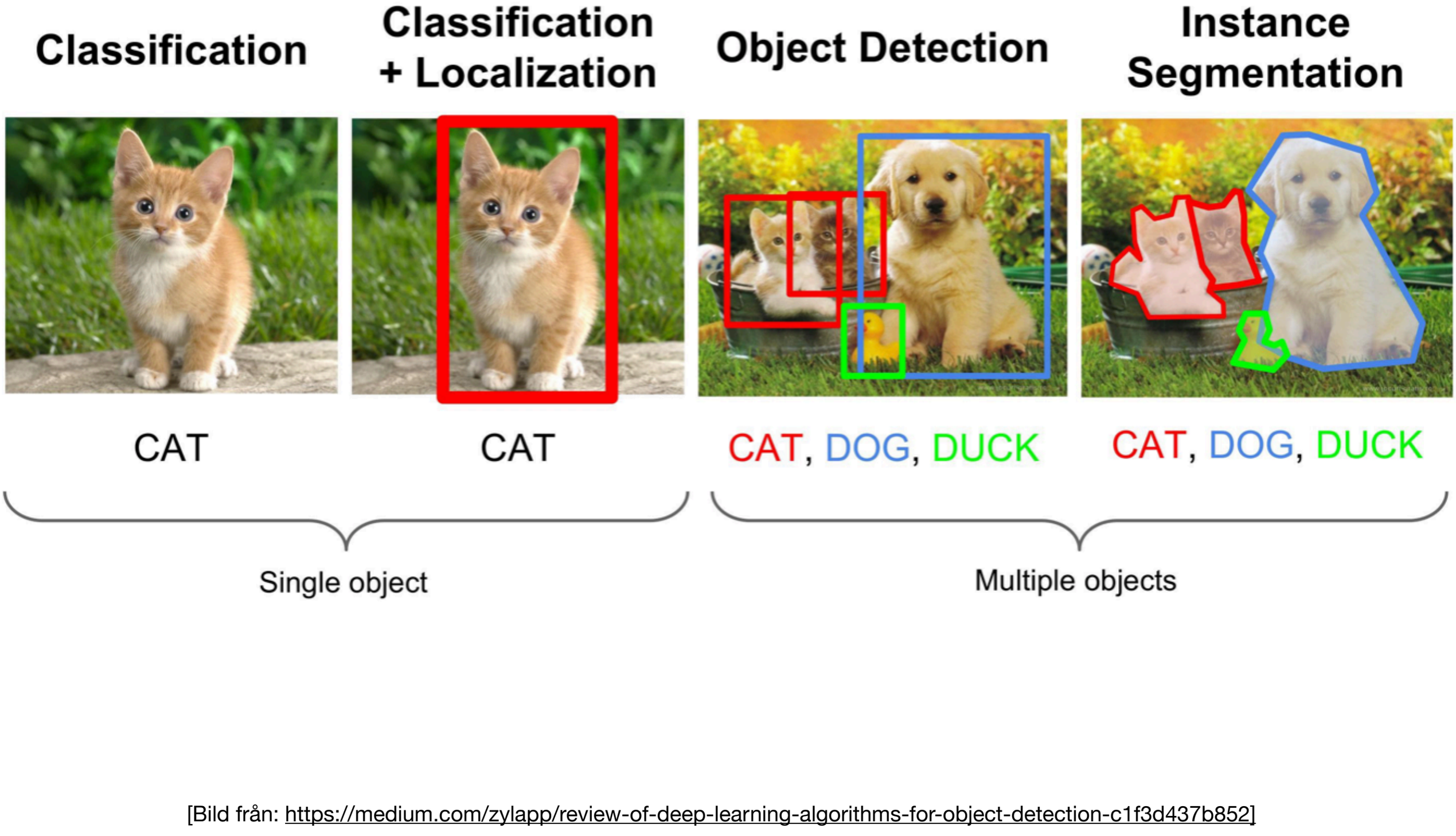




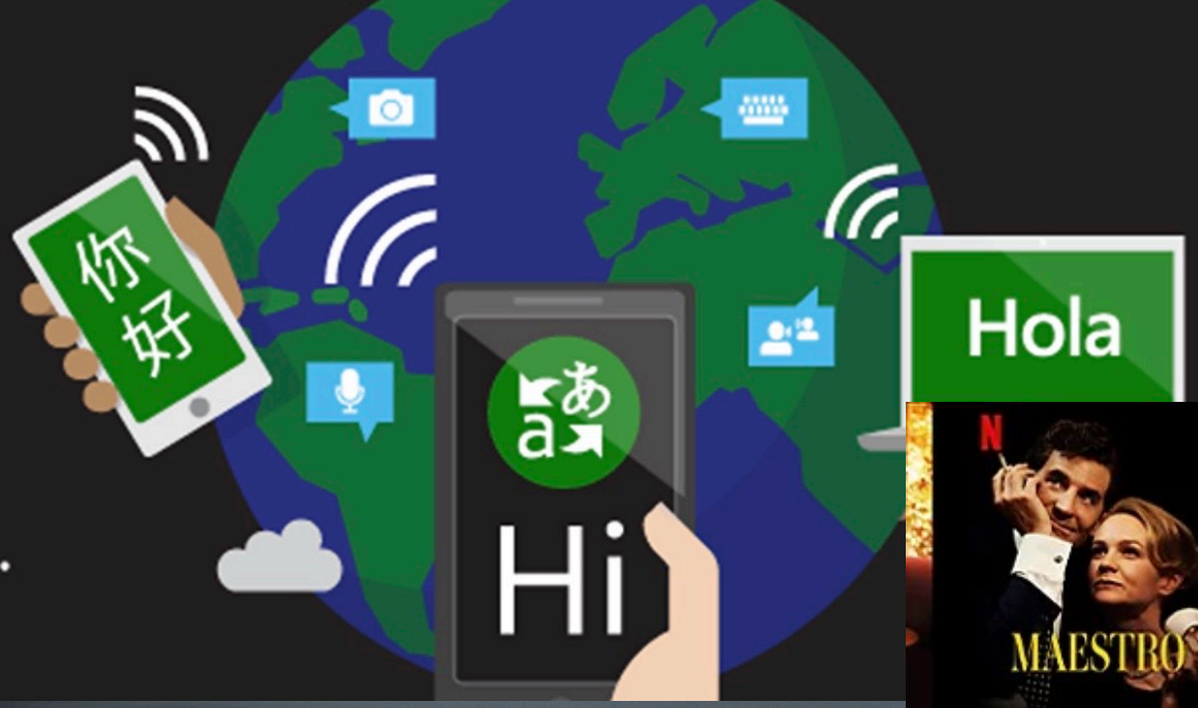


[Bild: Wikipedia]



[Bild från: https://medium.com/zylapp/review-of-deep-learning-algorithms-for-object-detection-c1f3d437b852]

[Bild från thispersondoesnotexist.com]


你好
Hola
Hi


/Autonomous
/Sensing
/Communication
/Battery
/Navigation
/Mirrorless
/Ecology
100m
48
mph

MAESTRO


BEEF


THE CROWN


players


QUEER EYE
more than a makeover


RMULA 1
TO SURVIVE


DAMSEL


THE LAST AIRBENDER


LOVE


DIPLOMAT

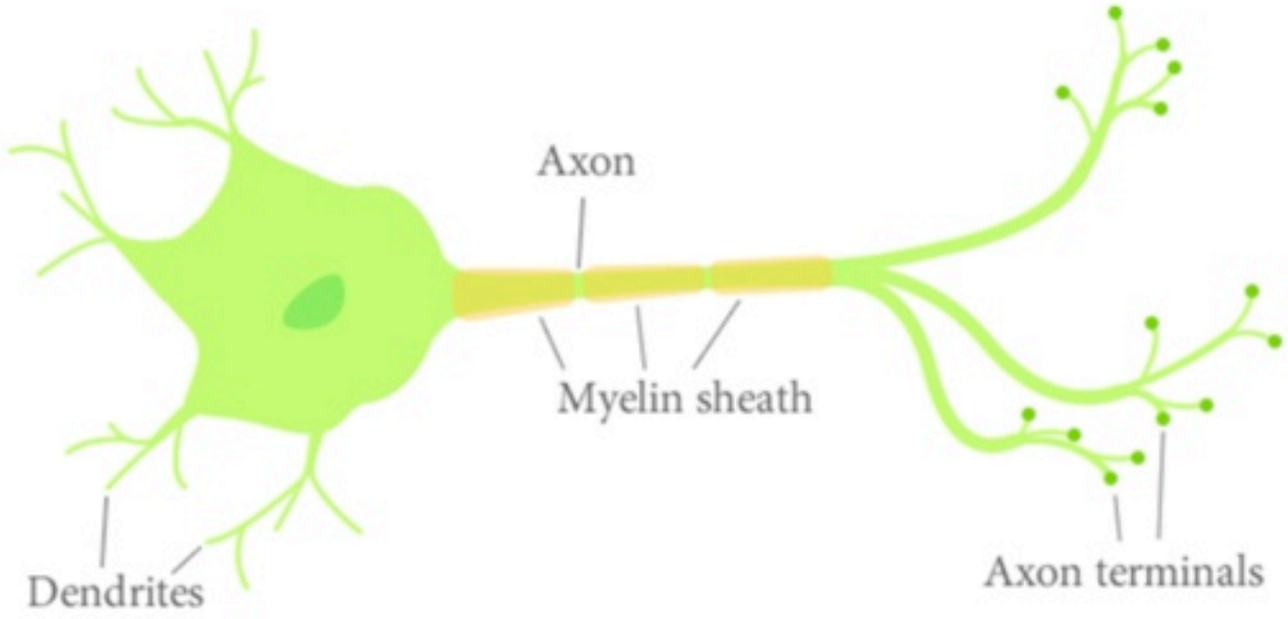

MONEY HEIST
BERLIN


IRISH WISH


SELLING SUNSET


ONE DAY

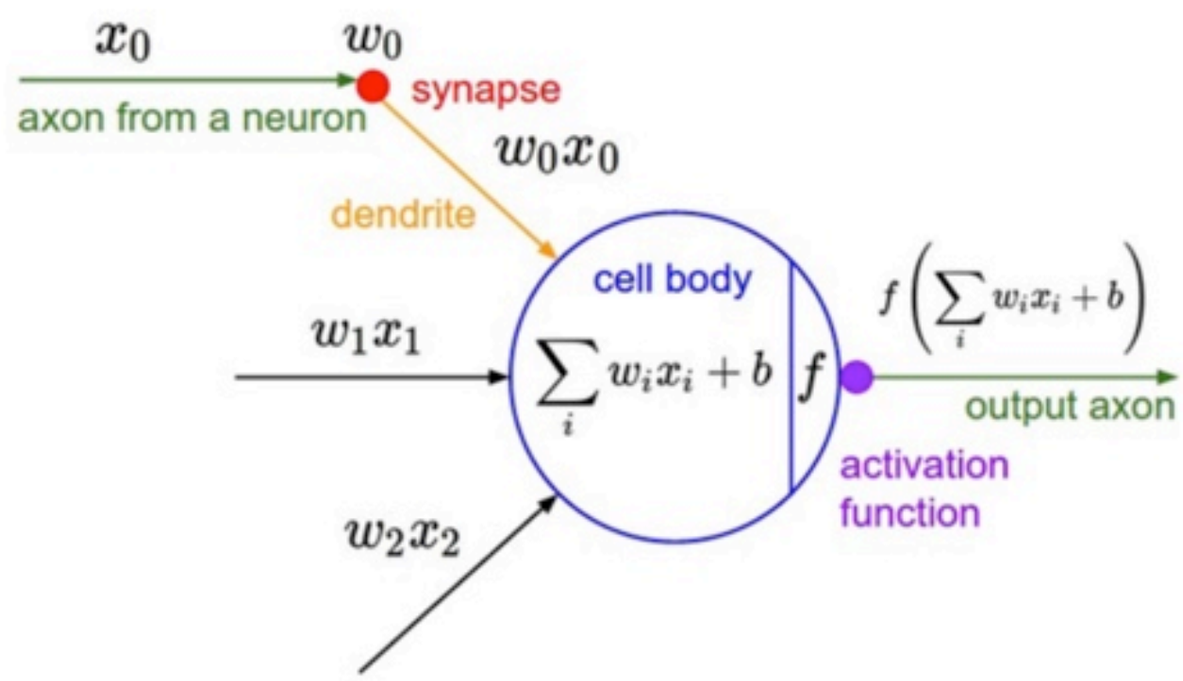
Real Neuron



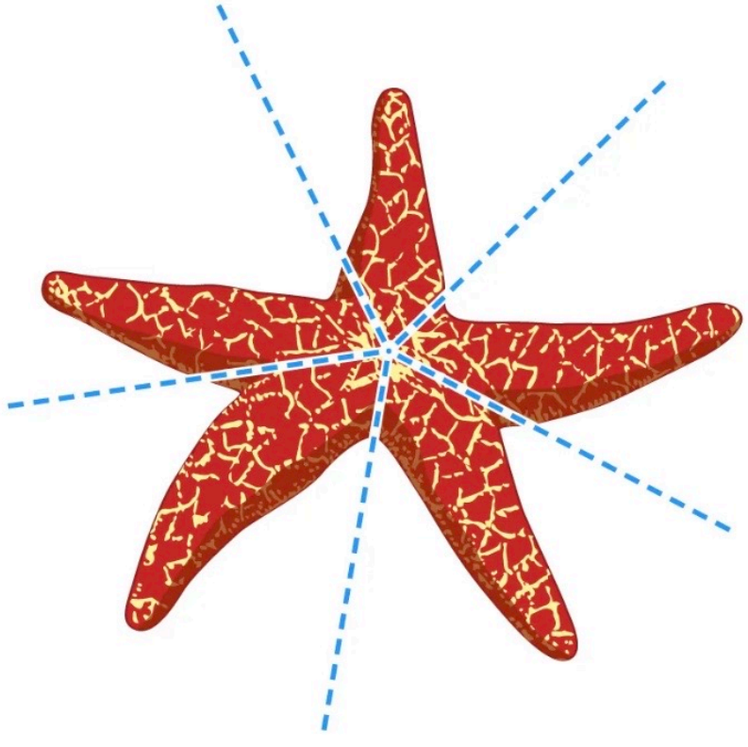
Artificiell neuron:

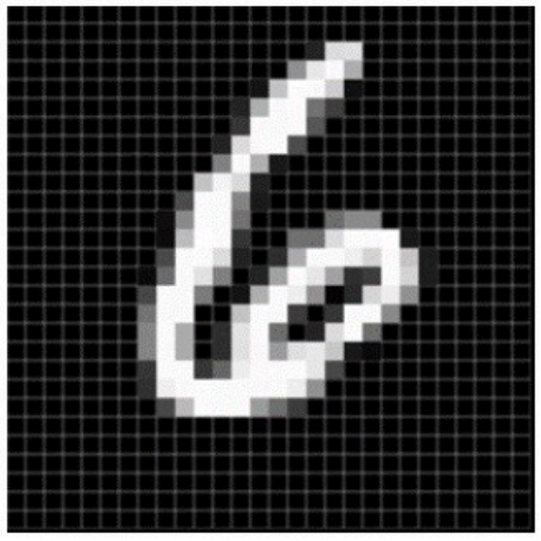
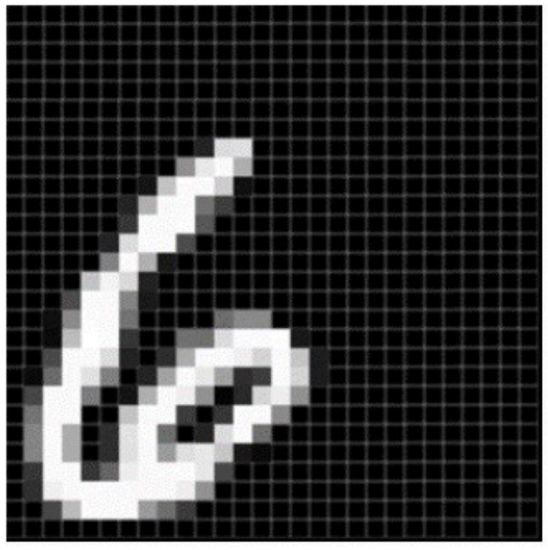
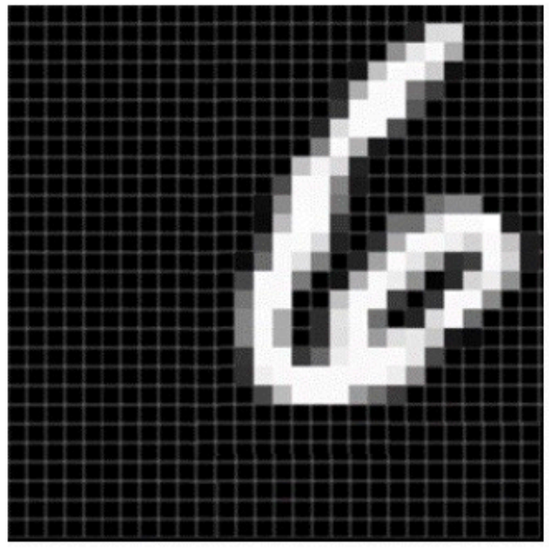
1. Input lager
2. Dolda lager
3. Output lager

Artificial Neuron

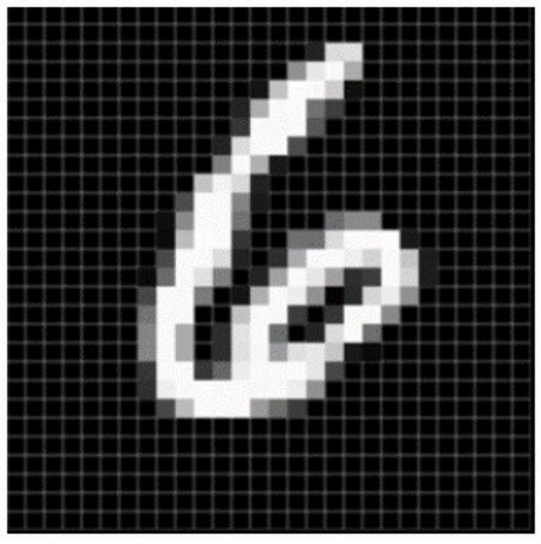
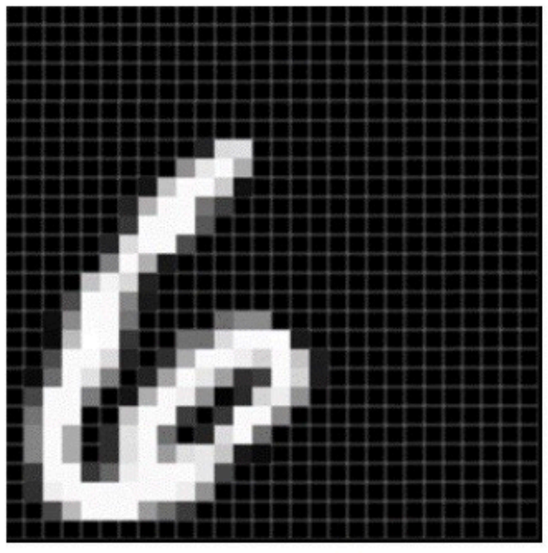
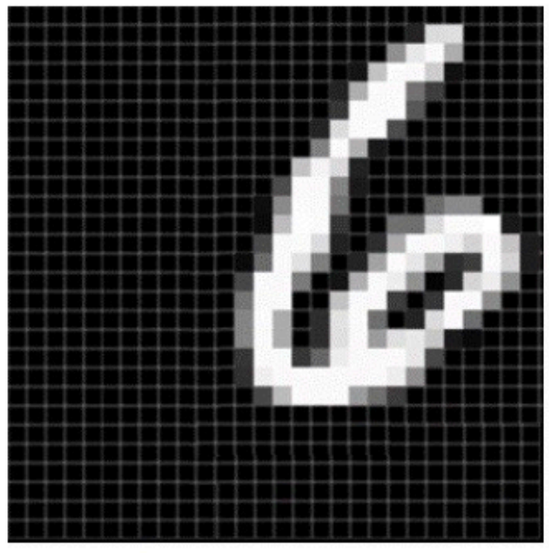


Bilder kan ha symmetrier!



Vi känner igen siffran 6 oavsett var den befinner sig

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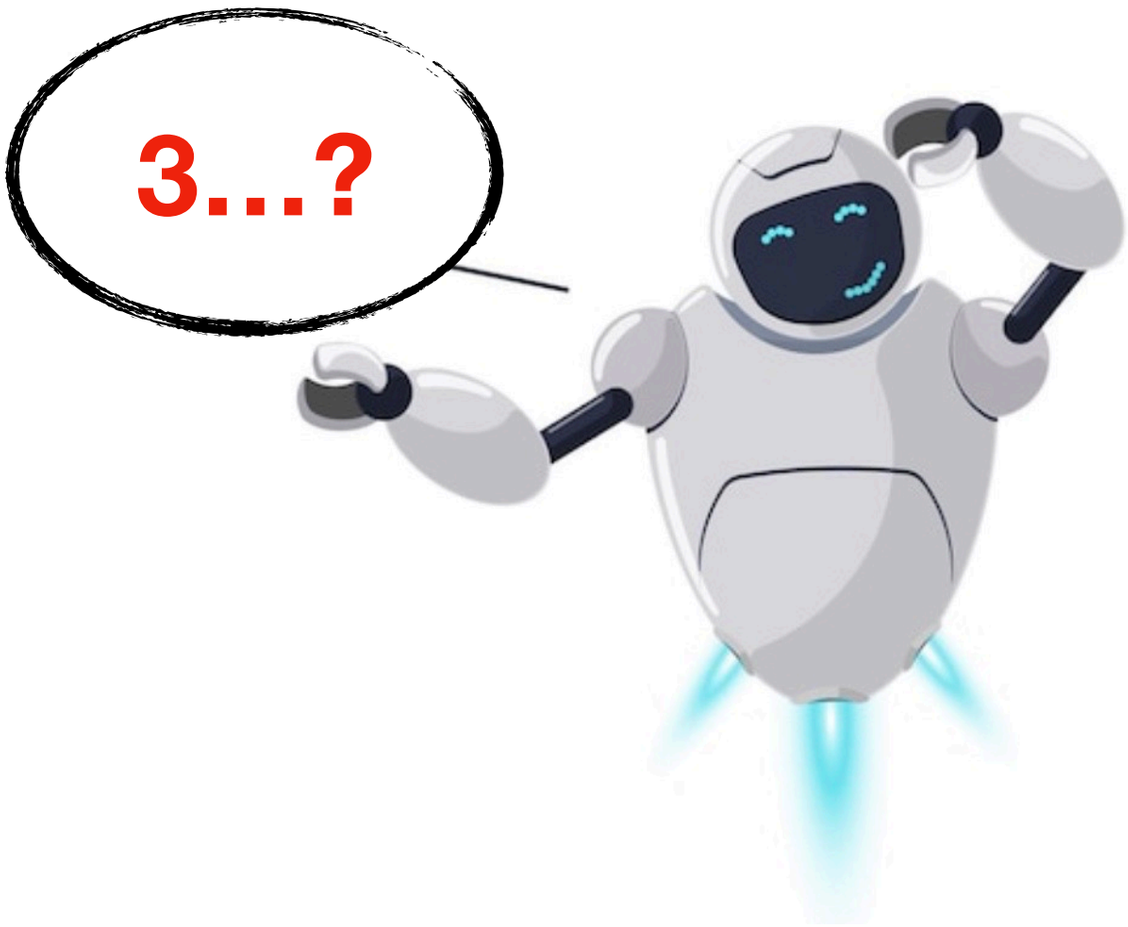
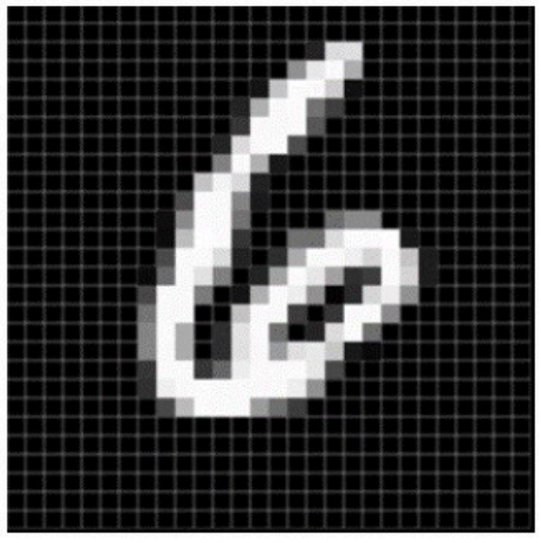
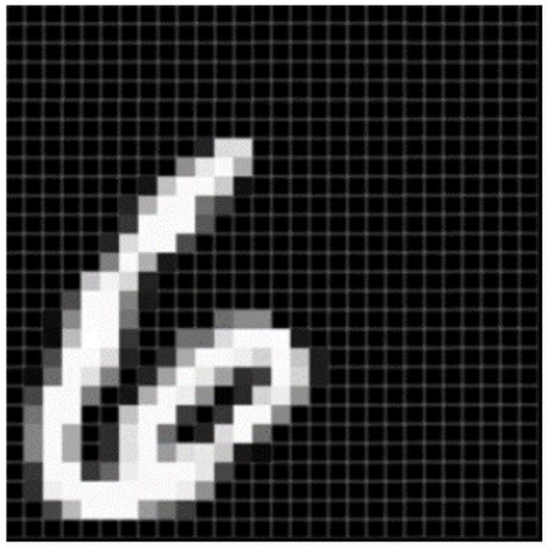
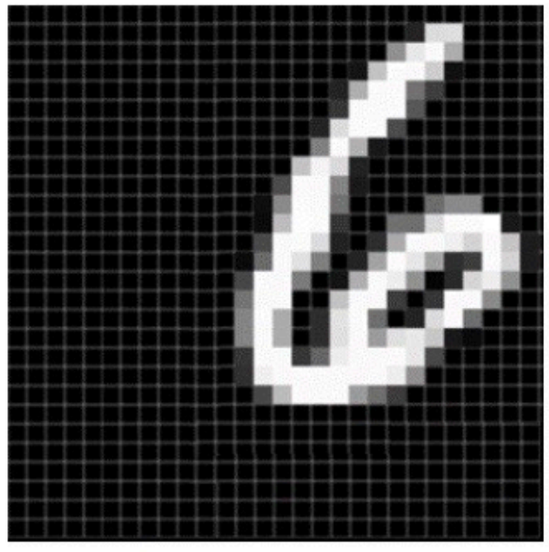


Men en AI kan bli förvirrad….

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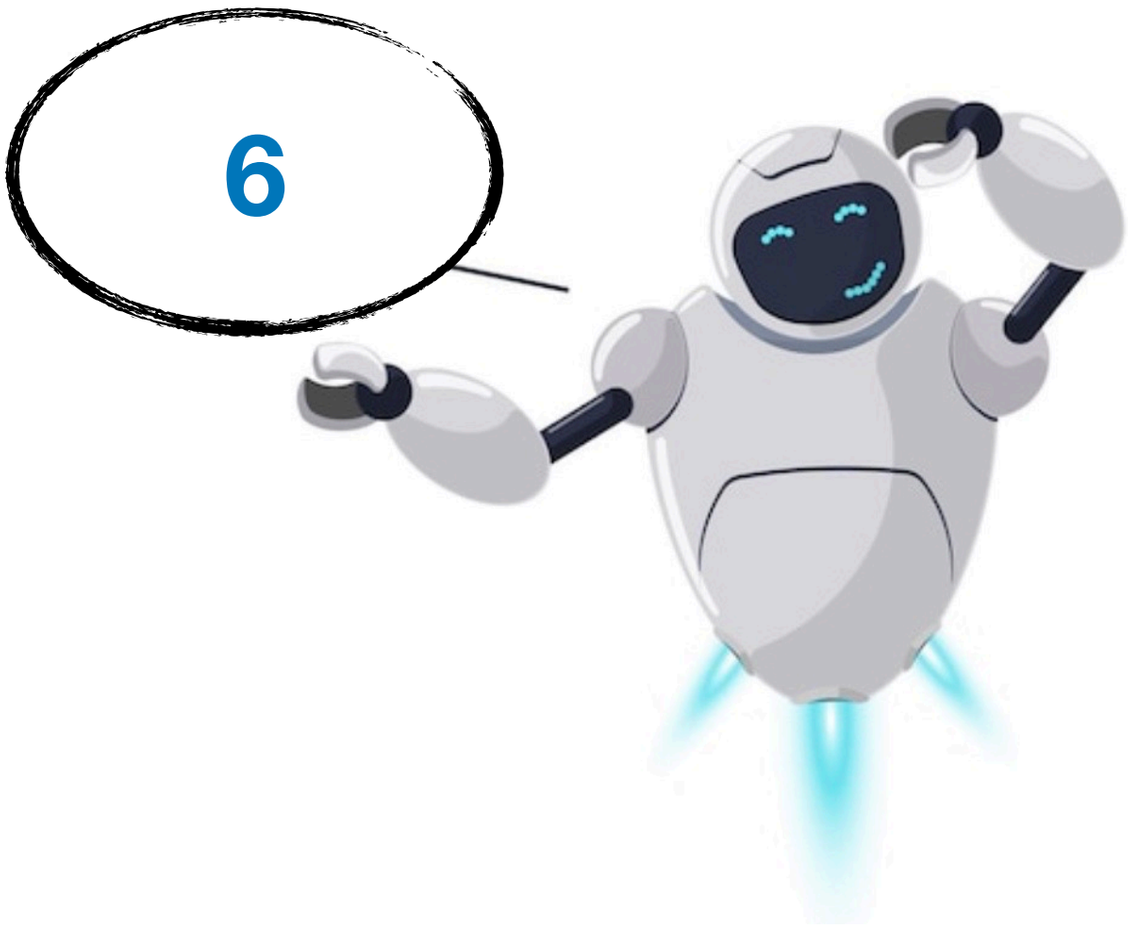
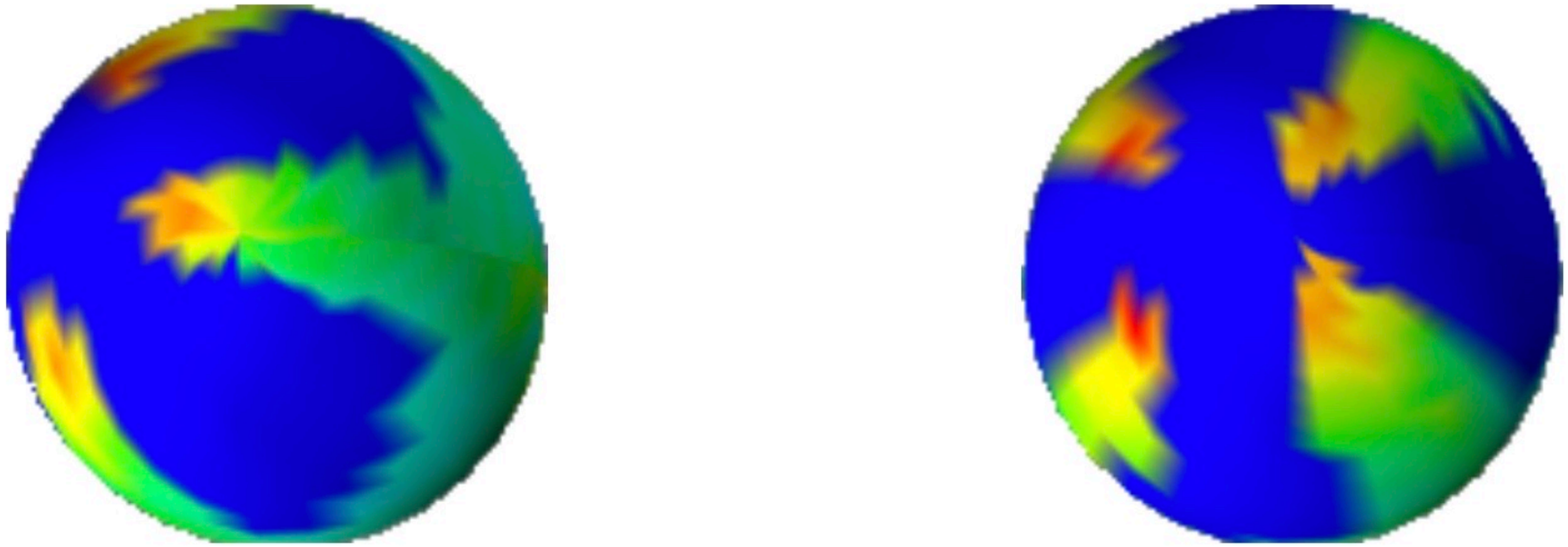
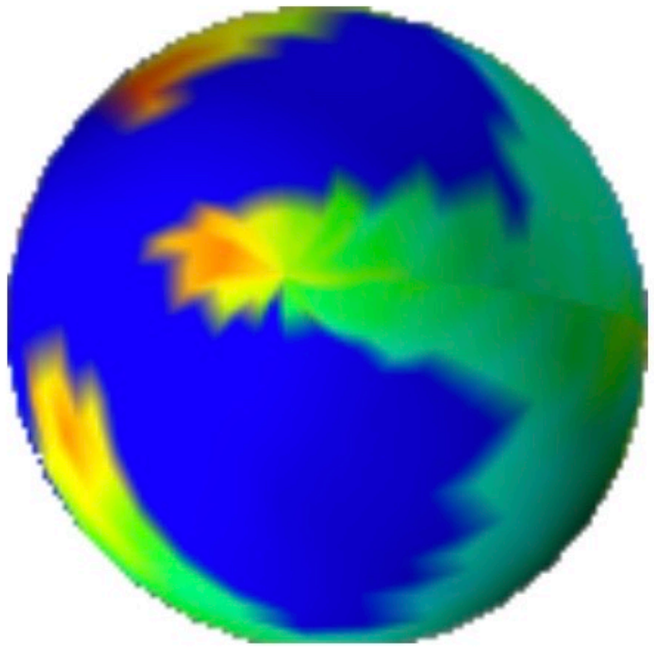
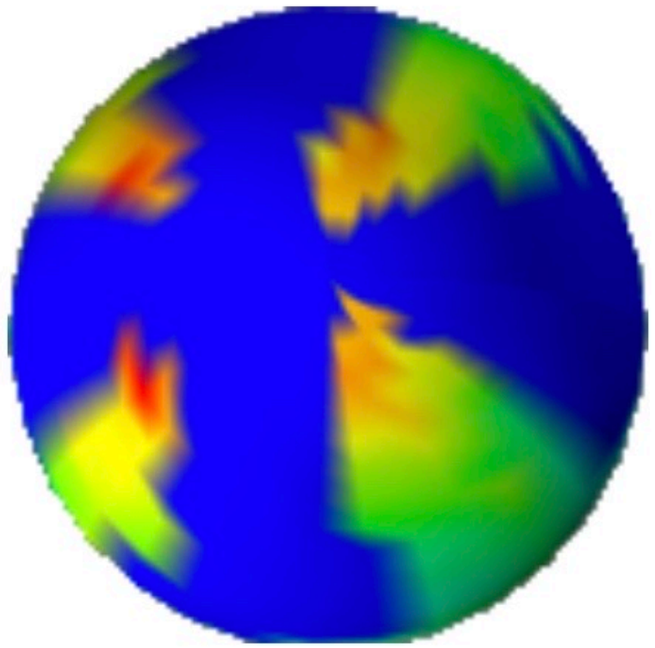


Vill ha en AI med inbyggd

TRANSLATIONSSYMMETRI





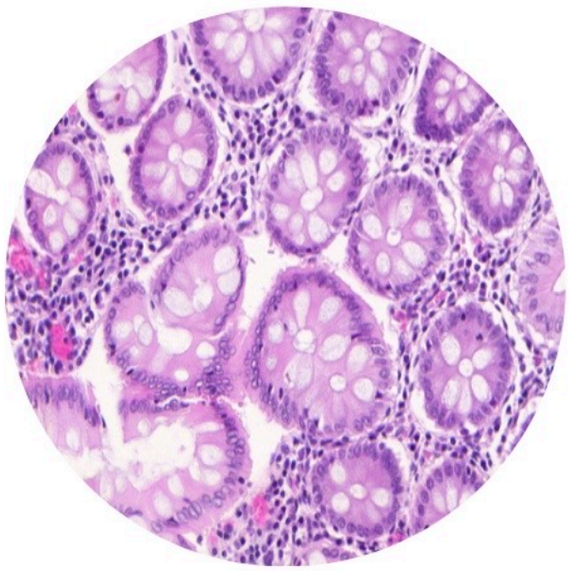


Vill ha en AI med inbyggd

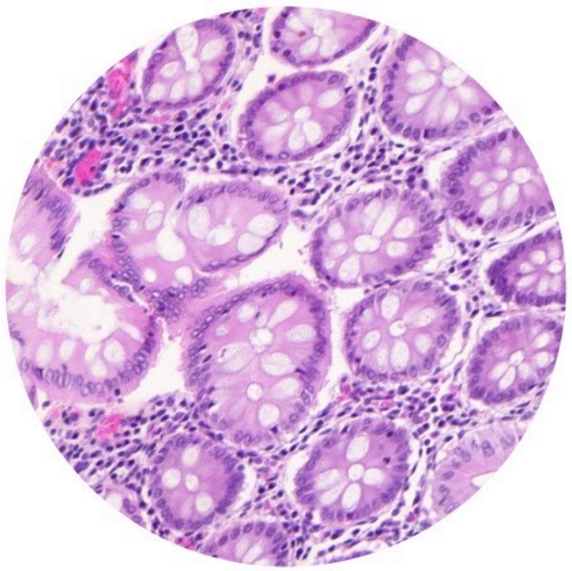
ROTATIONSSYMMETRI

[Bild från dataset Woodscape, projicerad på en sfär]

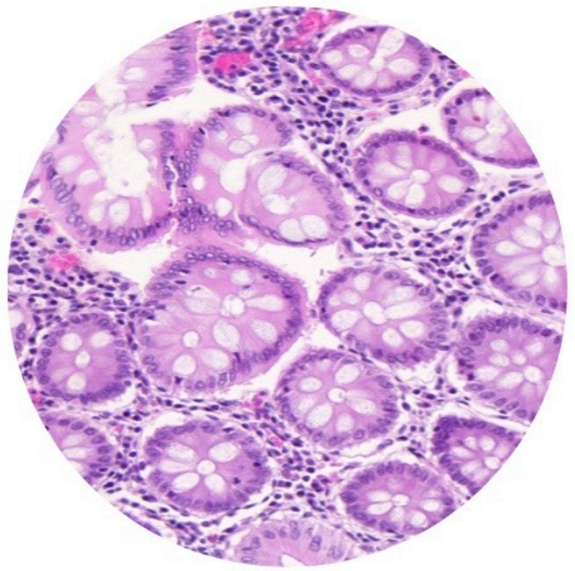
Medicinska bilder - cancertumörer



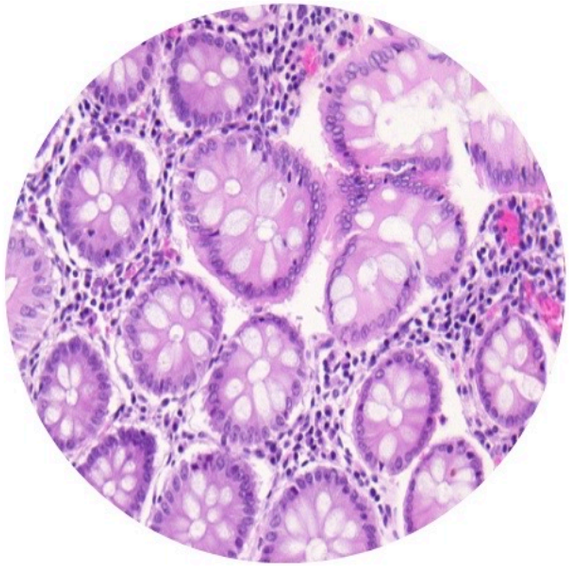
Original



45° rotation

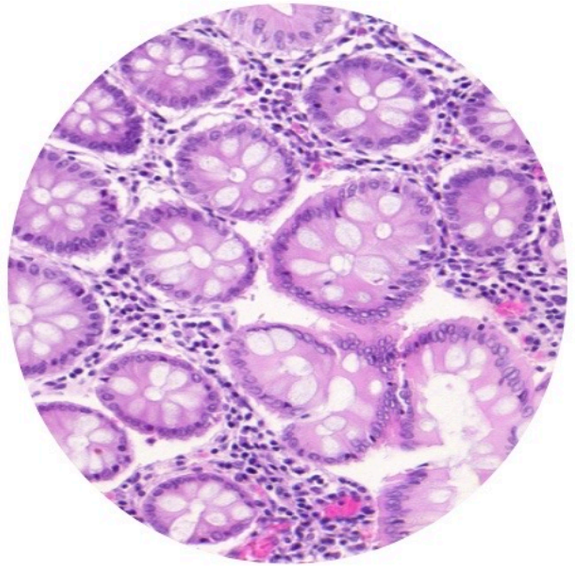


90° rotation



180° rotation

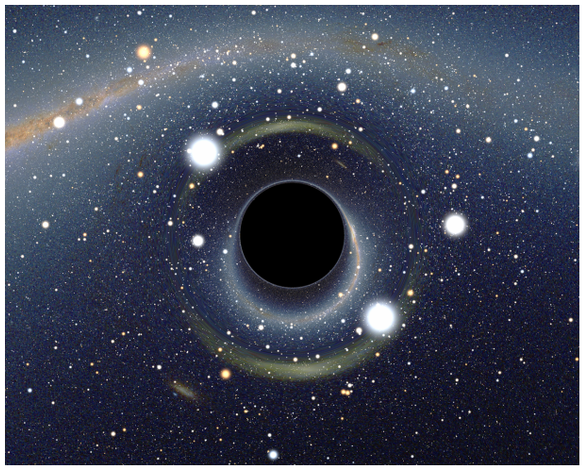
225° rotation



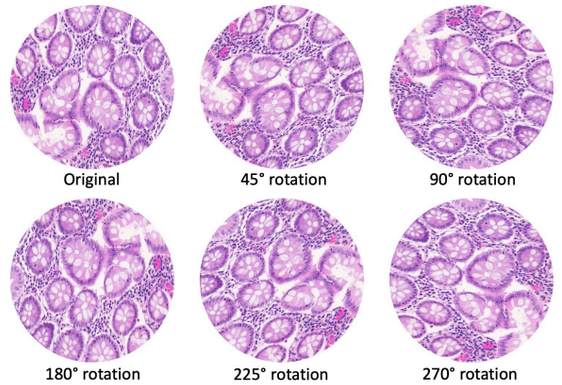
270° rotation

[Bild från Graham, Epstein, Rajpoot, 2020]

Fysik



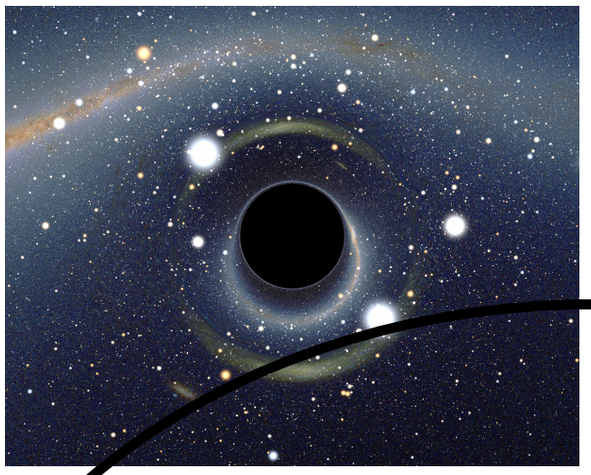
AI



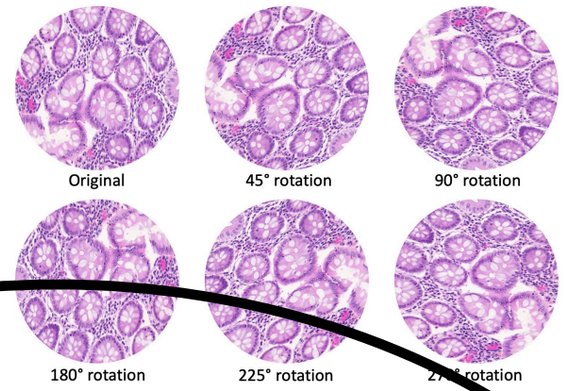
$$R_{\mu\nu}(g) - \frac{1}{2} g_{\mu\nu} R(g) = T_{\mu\nu}(g, F, \dots)$$

Matematik

Fysik



AI

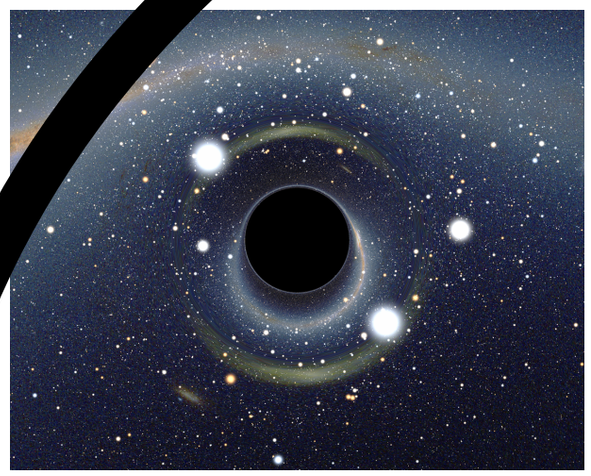


$$R_{\mu\nu}(g) - \frac{1}{2}g_{\mu\nu}R(g) = T_{\mu\nu}(g, F, \dots)$$

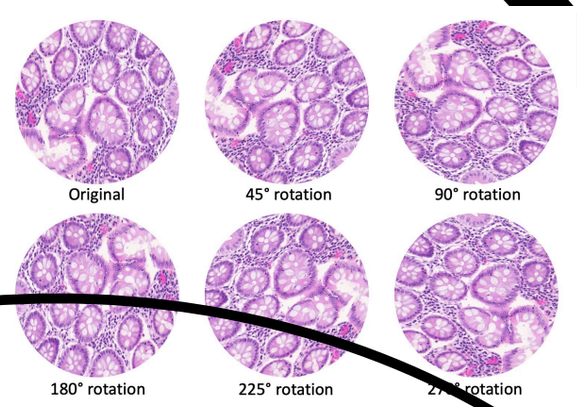
Matematik

Biologi/Kemi

Fysik



AI



Matematik

$$R_{\mu\nu}(g) - \frac{1}{2}g_{\mu\nu}R(g) = T_{\mu\nu}(g, F, \dots)$$

Biologi/Kemi

Tack!