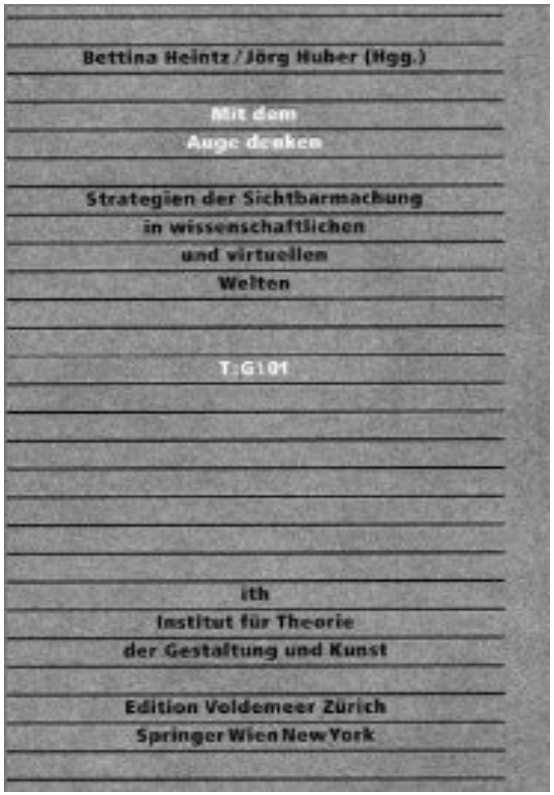
Ernst Peter Fischer

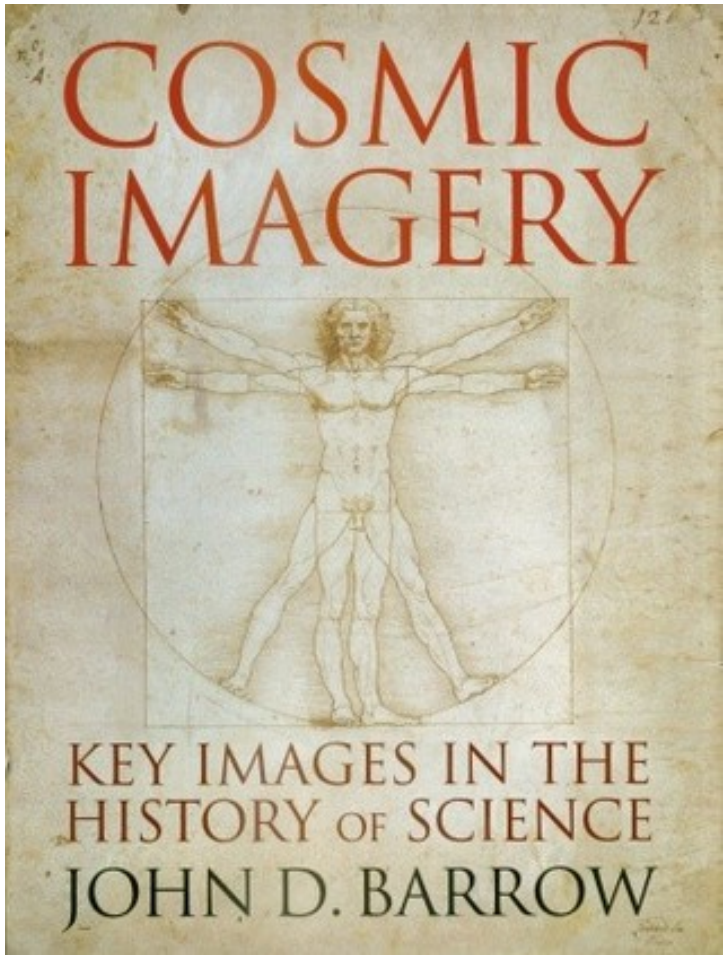
Konstanz, November 2014

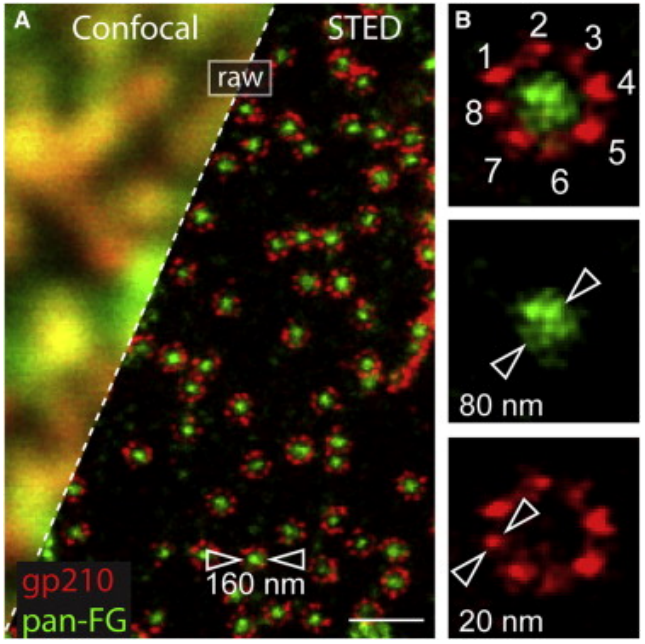
Mit dem Auge denken

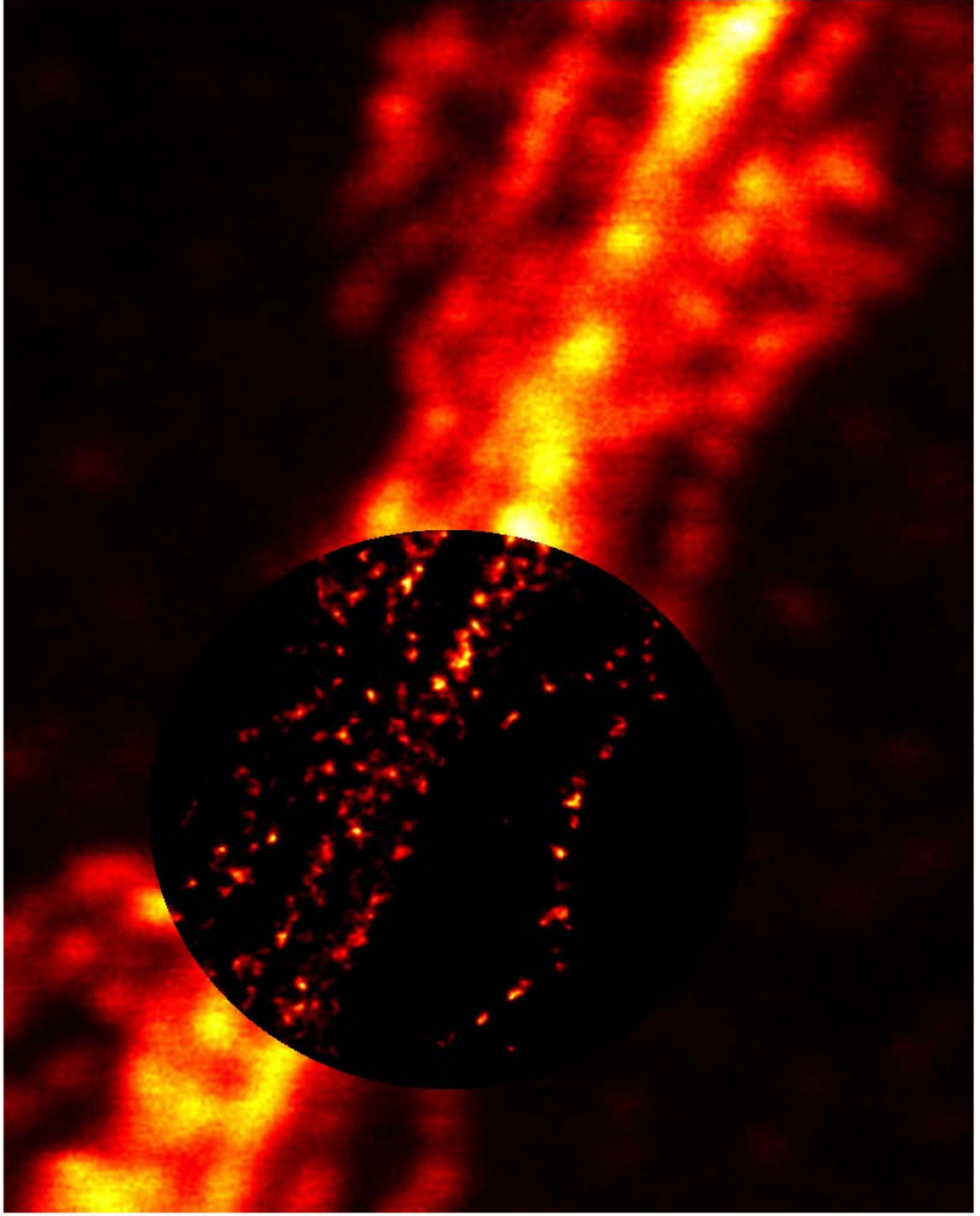
Die Rolle von Bildern in den Naturwissenschaften

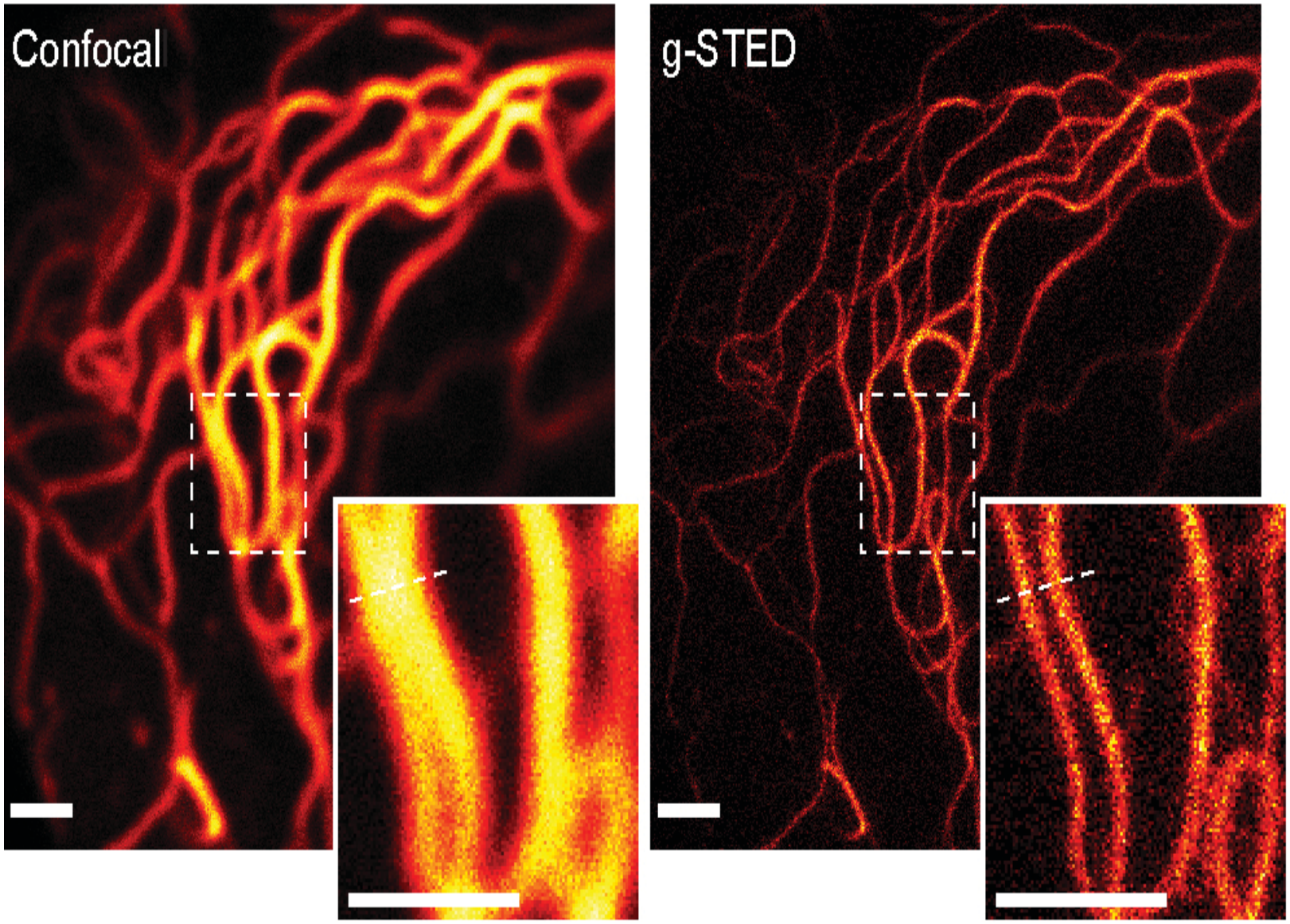
Bücher zu den Bildern






A
Confocal
STED
raw
160 nm
gp210
pan-FG
B
1
2
3
4
5
6
7
8
80 nm
20 nm



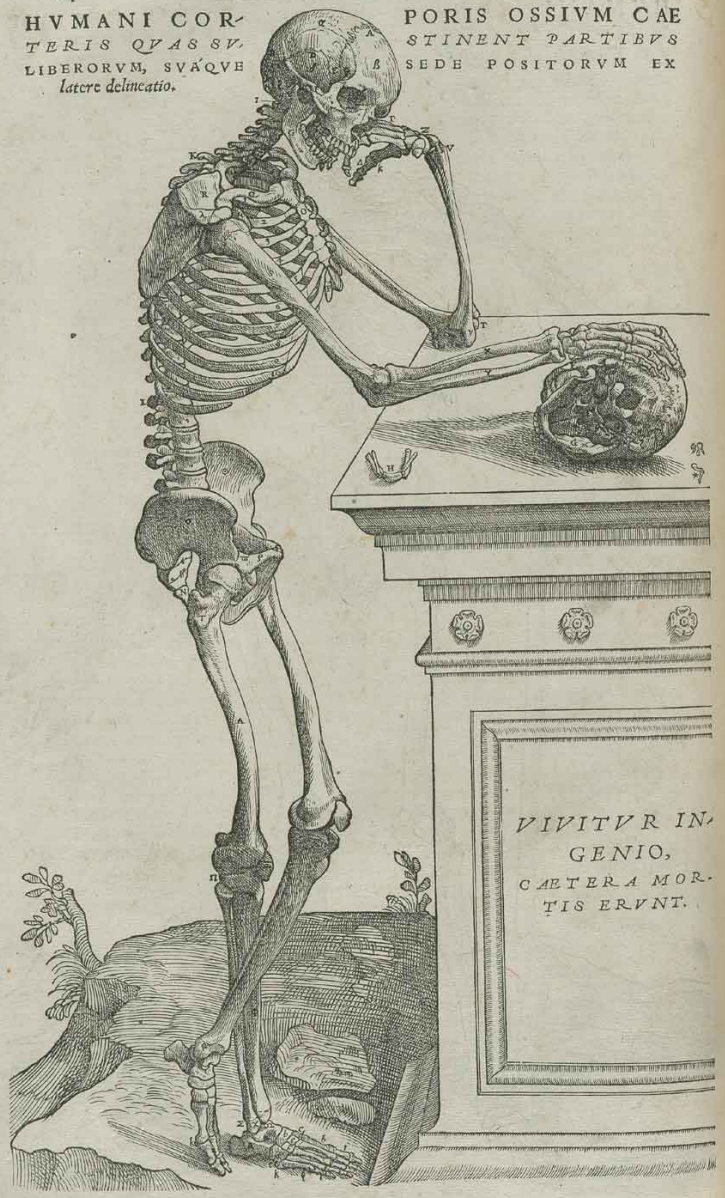

Confocal
g-STED

net, in quo terram cum orbe lunari tanquam epicyclo contineri diximus. Quinto loco Venus nono mense reducitur. Sextum deniq; locum Mercurius tenet, octuaginta dierum spacio circũ currens. In medio uero omnium residet Sol. Quis enim in hoc

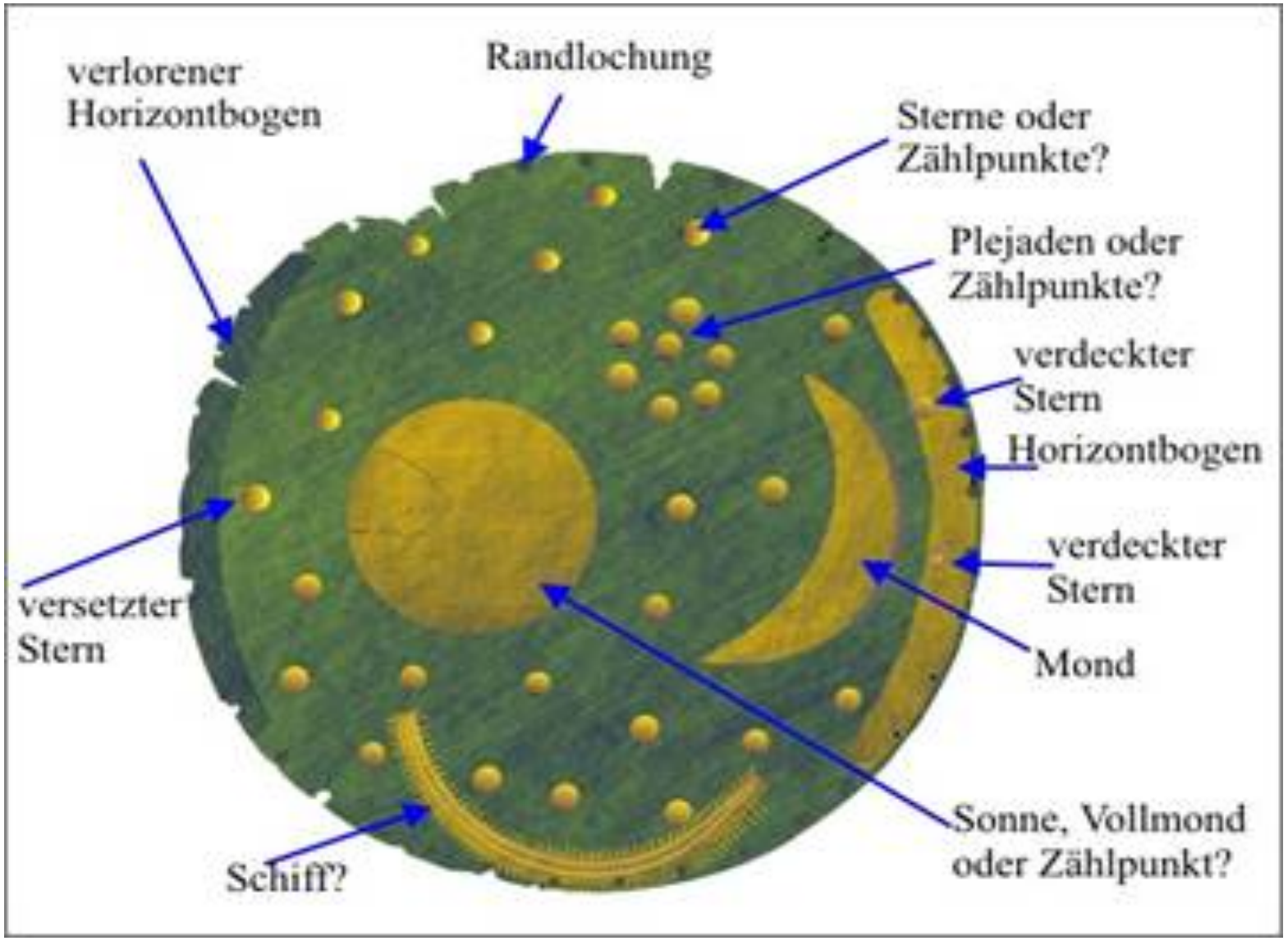
pulcherimo templo lampadem hanc in alio uel meliori loco poneret, quàm unde totum simul possit illuminare? Siquidem non inepte quidam lucernam mundi, alij mentem, alij rectorem uocant. Trimegistus uisibilem Deum, Sophoclis Electra intuentẽ omnia. Ita profecto tanquam in solio regali Sol residens circumagentem gubernat Astrorum familiam. Tellus quoq; minime fraudatur lunari ministerio, sed ut Aristoteles de animalibus ait, maximã Luna cũ terra cognationẽ habet. Concipit interea à Sole terra, & impregnatur annuo partu. Inuenimus igitur sub

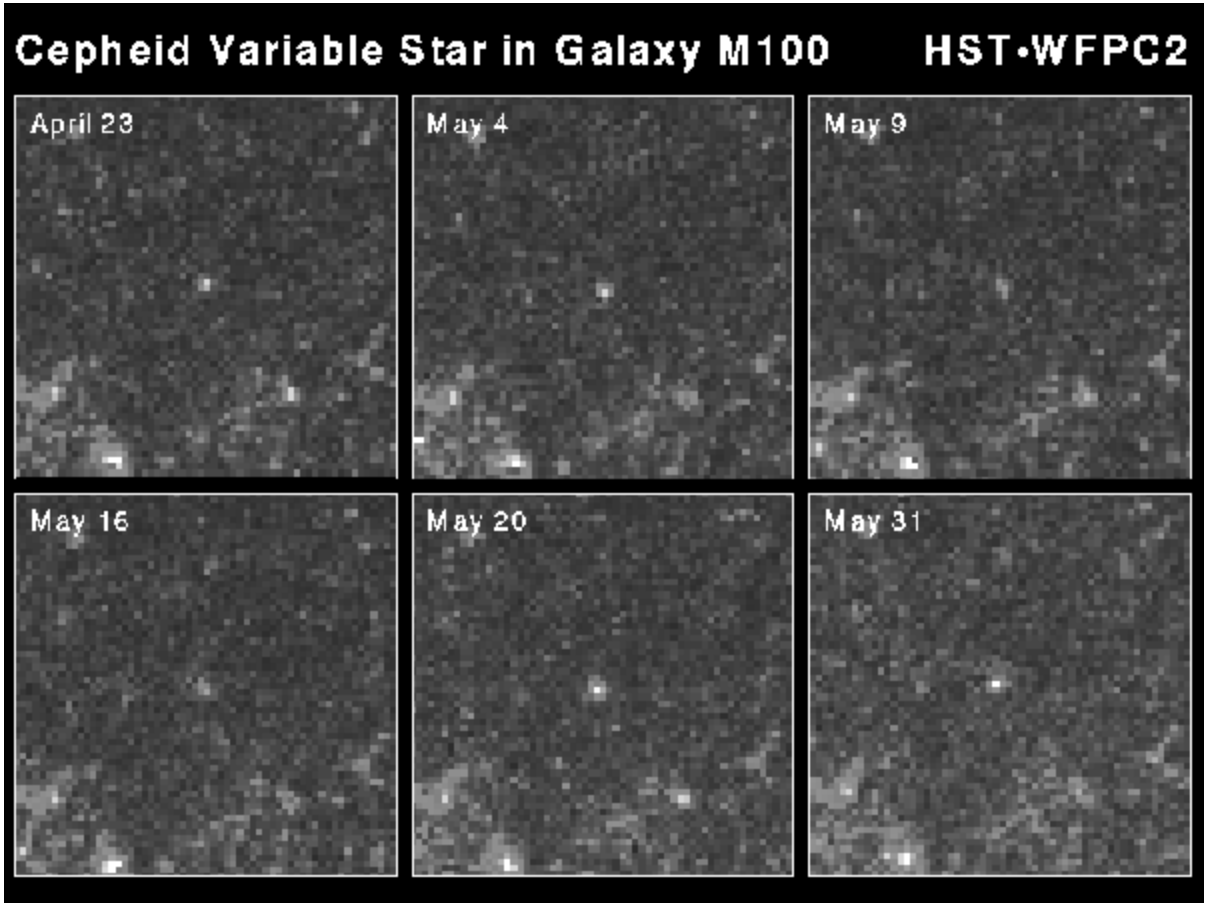
hac

HVMANI CORPORIS OSSIVM CAETERIS QVAS SVSTINENT PARTIBVS LIBERORVM, SVAQVE SEDE POSITORVM EX latere delineatio.



VIVITVR INGENIO, CAETERA MORTIS ERVNT.


verlorener Horizontbogen
Randlochung
Sterne oder Zählpunkte?
Plejaden oder Zählpunkte?
verdeckter Stern
Horizontbogen
verdeckter Stern
versetzter Stern
Mond
Sonne, Vollmond oder Zählpunkt?
Schiff?


Cepheid Variable Star in Galaxy M100
HST•WFPC2
April 23
May 4
May 9
May 16
May 20
May 31

N
VAR!
N
6-Oct
1923
N

The Spitzer Infrared Nearby Galaxies Survey (SINGS) Hubble Tuning-Fork

The Spitzer Space Telescope observed 75 galaxies as part of its SINGS (Spitzer Infrared Nearby Galaxies Survey) Legacy Program. The galaxies are presented here in a Hubble Tuning-Fork diagram, which groups galaxies according to the morphology of their nuclei and spiral arms. The designation of these galaxies and their placement in the diagram is based on their visible-light appearance. The main goal of the SINGS program is to characterize the infrared properties of a wide range of galaxy types. The images of the galaxies are composites created from data taken by IRAC (the Infrared Array Camera) at 3.6 and 8.0 μm, and MIPS (the Multiband Imaging Photometer for Spitzer) at 24 μm.

The infrared range probed by these and other observations taken for the SINGS project allows for the detailed study of star formation, dust emission, and the distribution of stars in each galaxy. Light from old stars appears as blue in the images, while the lumpy knots of green and red light are produced by dust clouds surrounding newly born stars. The elliptical galaxies on the left are almost entirely made of old stars, while spiral galaxies like our own Milky Way are rich in young stars and the raw materials for future star formation.

More information can be found at:
http://sings.stsci.edu/

Unbarred Spirals

Weak Bulge

Strong Bulge

Intermediate Spirals

Strong Bulge

Ellipticals

Irregulars

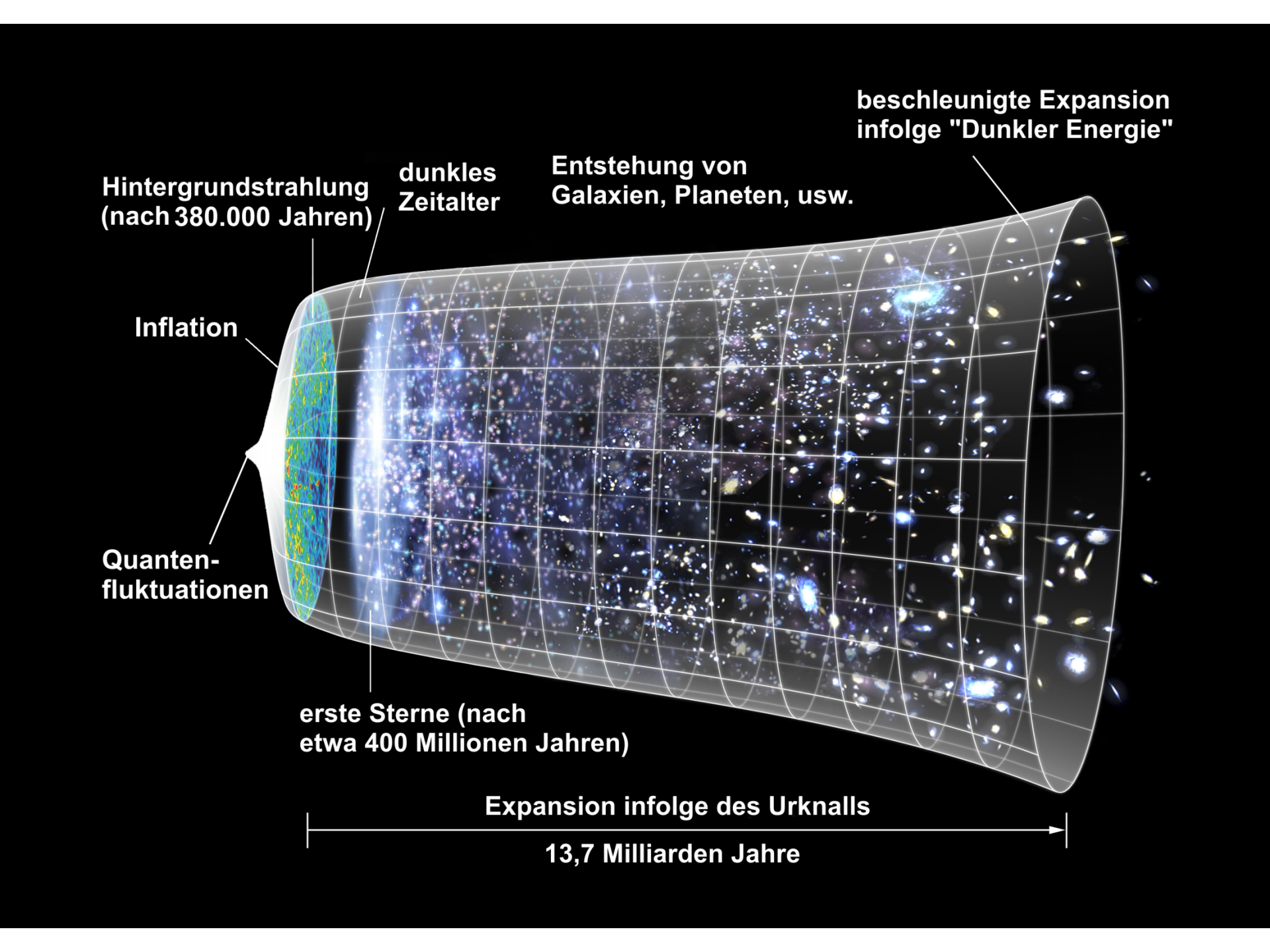
Weak Bulge

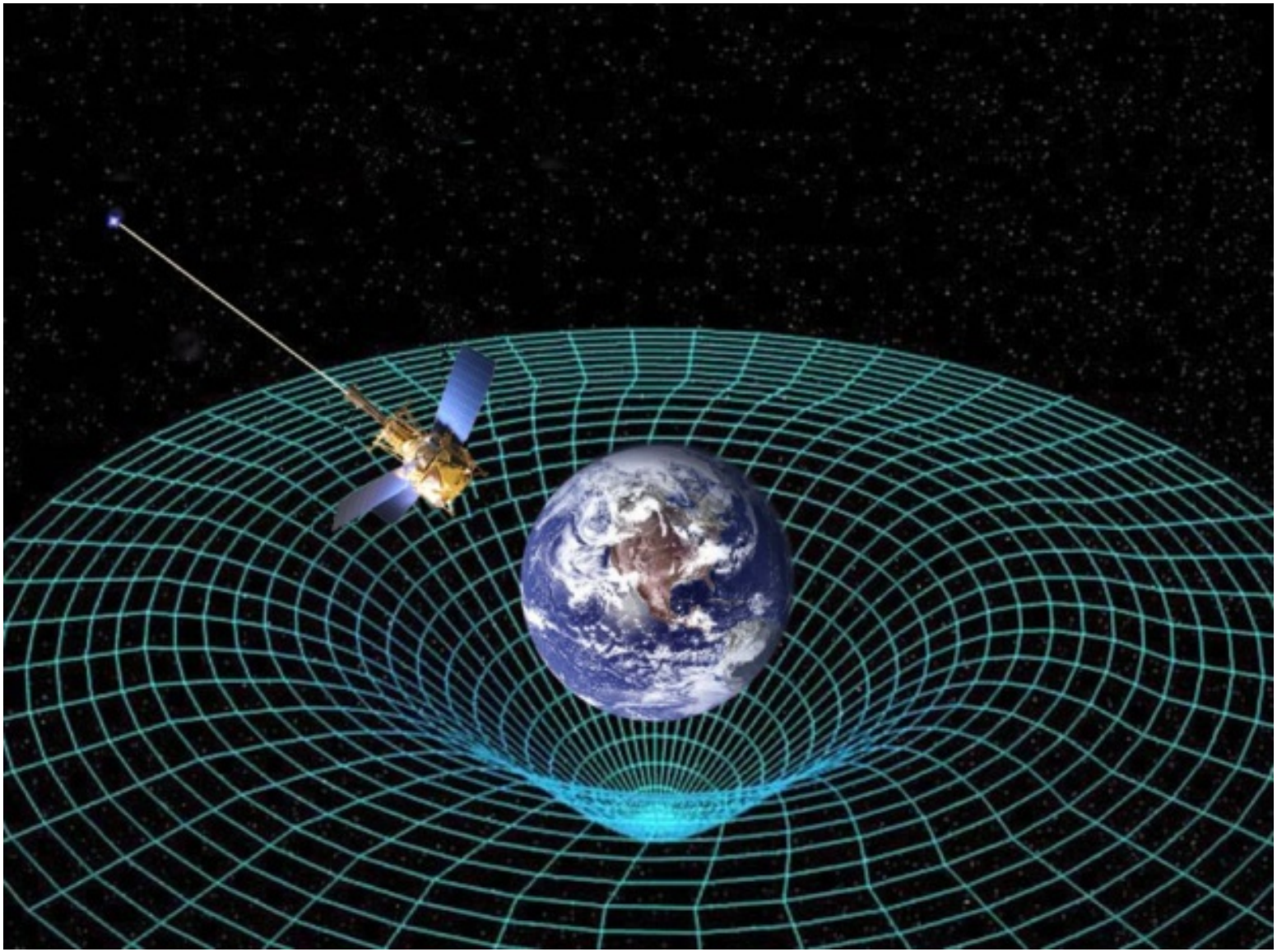
Barred Spirals

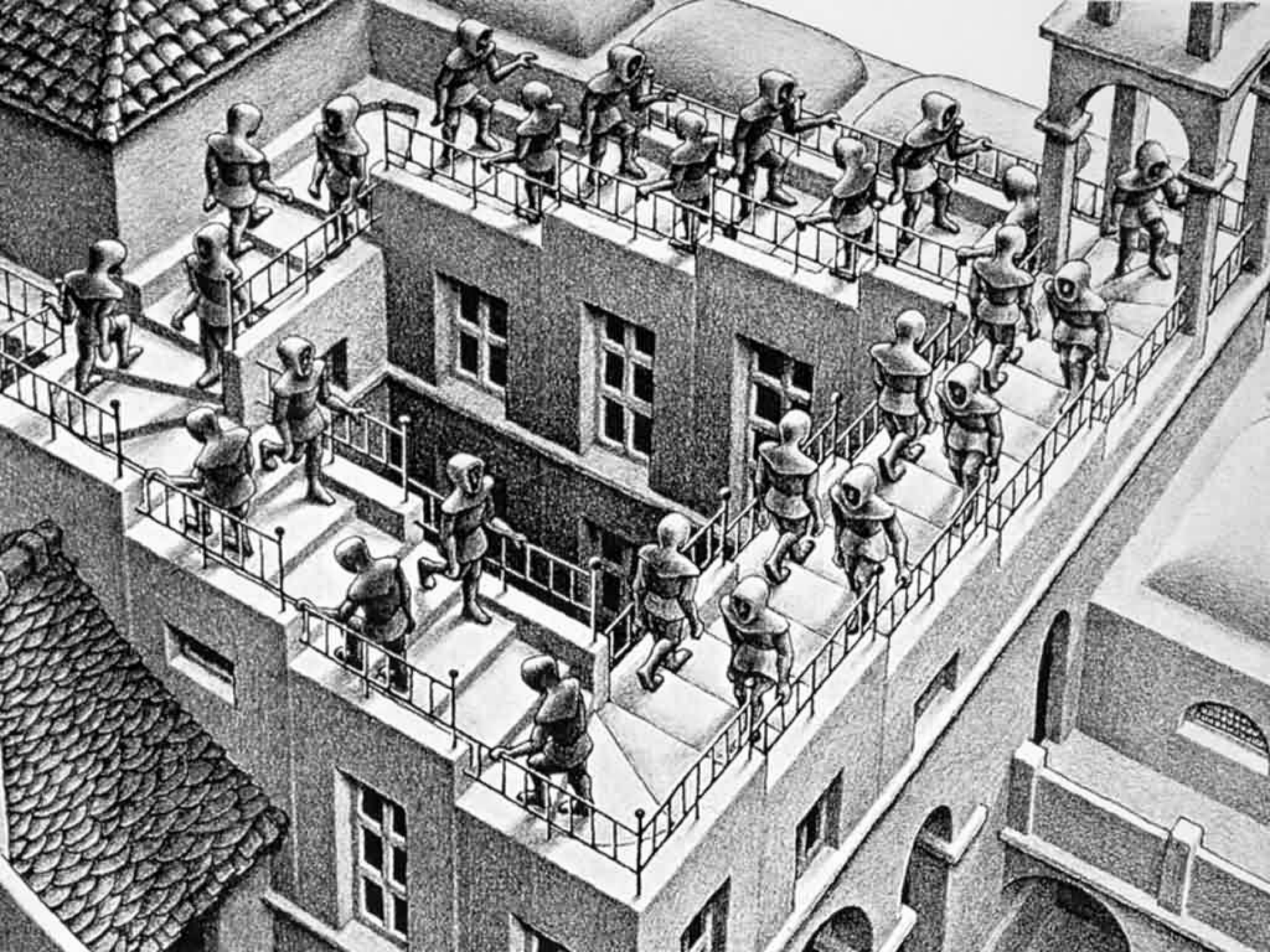
Poster and composite images created from SINGS observations by Karl D. Gordon (Oct 2007)
Blue=IRAC 3.6μm (stars)
Green=IRAC 8μm
(aromatic features from dust grains/molecules)
Red=MIPS 24μm (warm dust)

SINGS Team

Robert Kennicutt, Jr. (Principle Investigator), Daniela Calzetti (Deputy Principle Investigator), Charles Engelbracht (Technical Contact), Lee Armus, George Bendo, Caroline Bot, Brent Buckalew, John Cannon, Daniel Dale, Bruce Draine, Karl Gordon, Albert Grauer, David Hollenbach, Tom Jarrett, Lisa Kewley, Claus Leitherer, Aigen Li, Sangeeta Malhotra, Martin Meyer, John Moustakas, Eric Murphy, Michael Regan, George Rieke, Marcia Rieke, Helene Roussel, Kartik Sheth, J.D. Smith, Michele Thornley, Fabian Walter & George Helou


beschleunigte Expansion
infolge "Dunkler Energie"
Hintergrundstrahlung
(nach 380.000 Jahren)
dunkles
Zeitalter
Entstehung von
Galaxien, Planeten, usw.
Inflation
Quanten-
fluktuationen
erste Sterne (nach
etwa 400 Millionen Jahren)
Expansion infolge des Urknalls
13,7 Milliarden Jahre

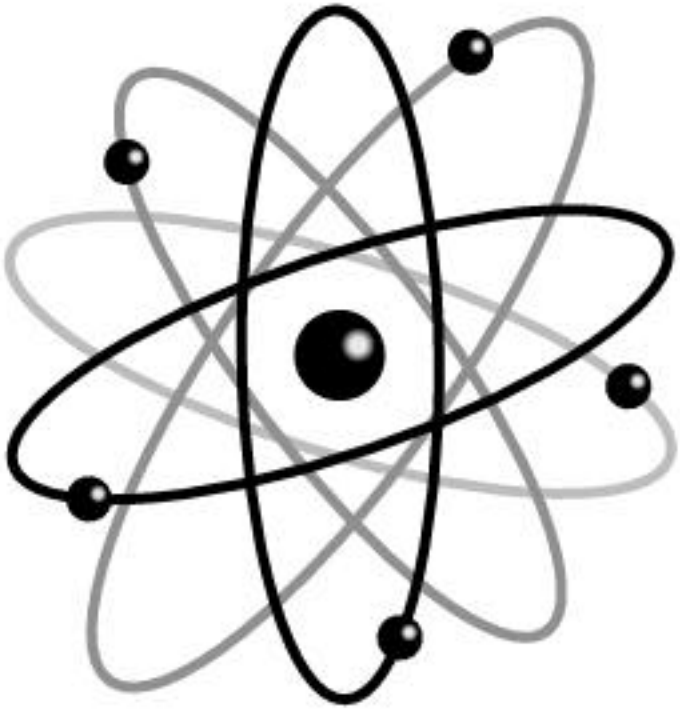


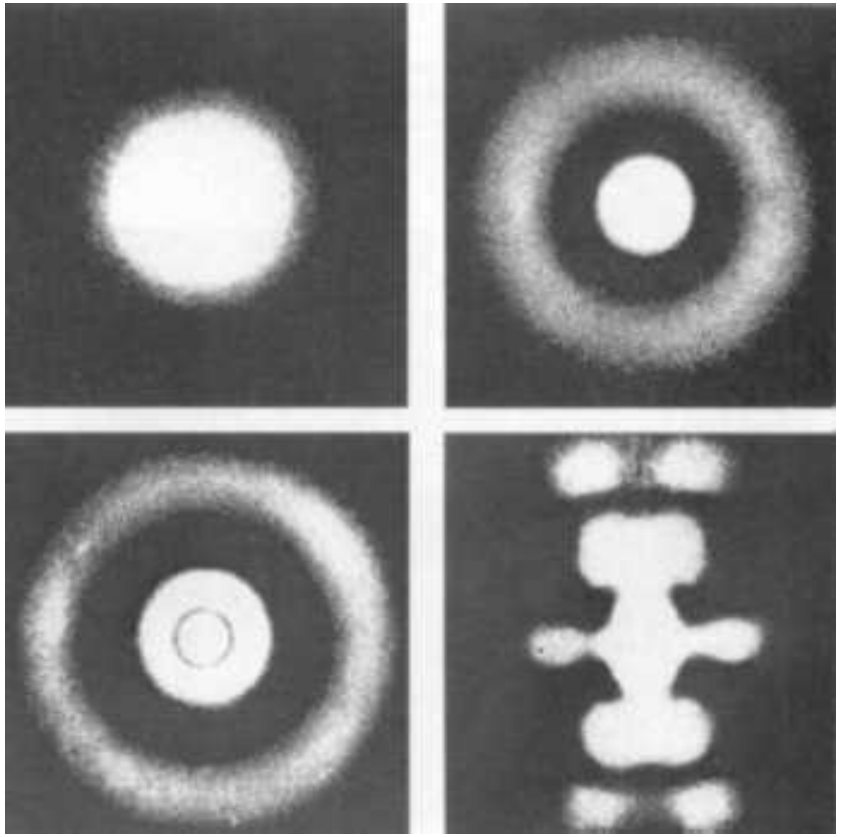


Les Demoiselles d´Avignon (1907)

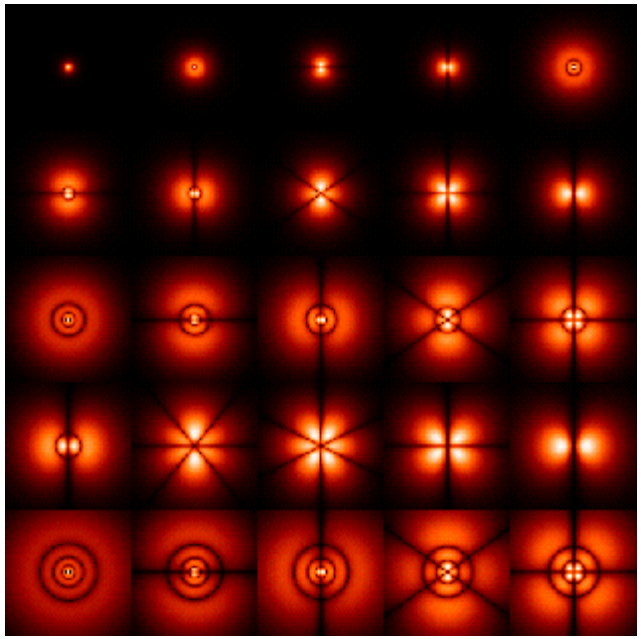

E=mc²
E=mb²
S. Harris

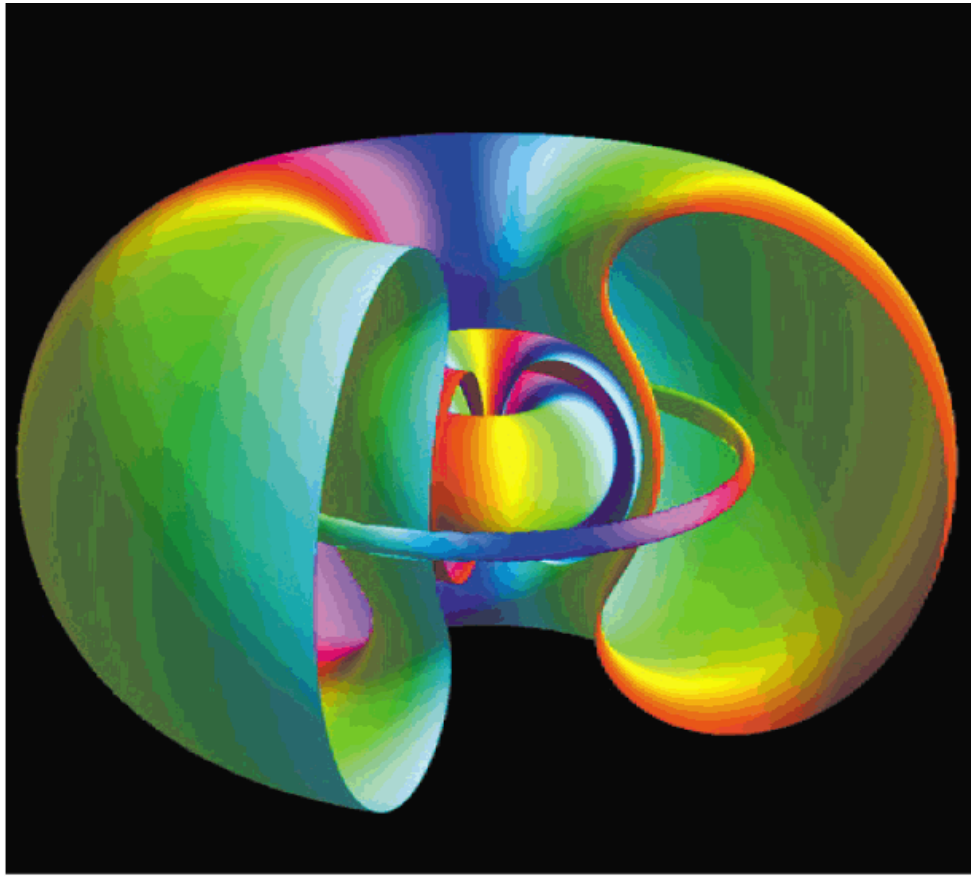
Das Bild der Atome

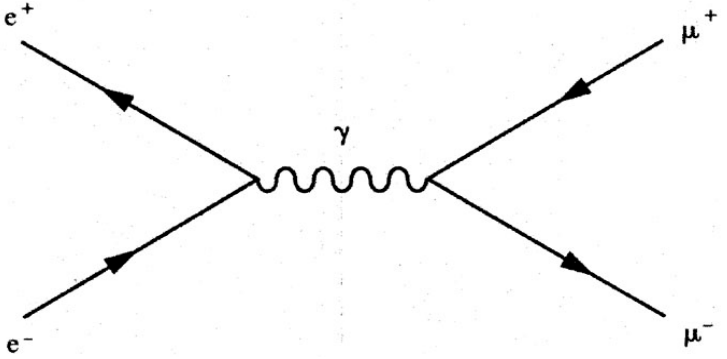


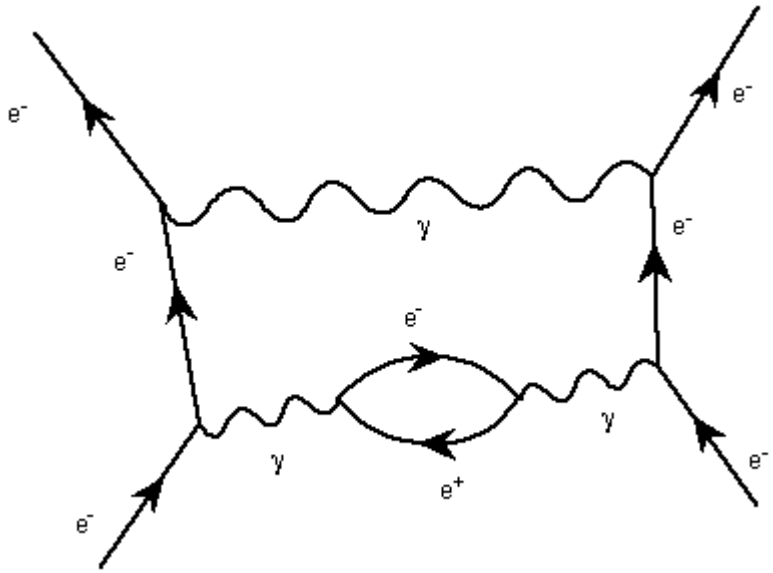


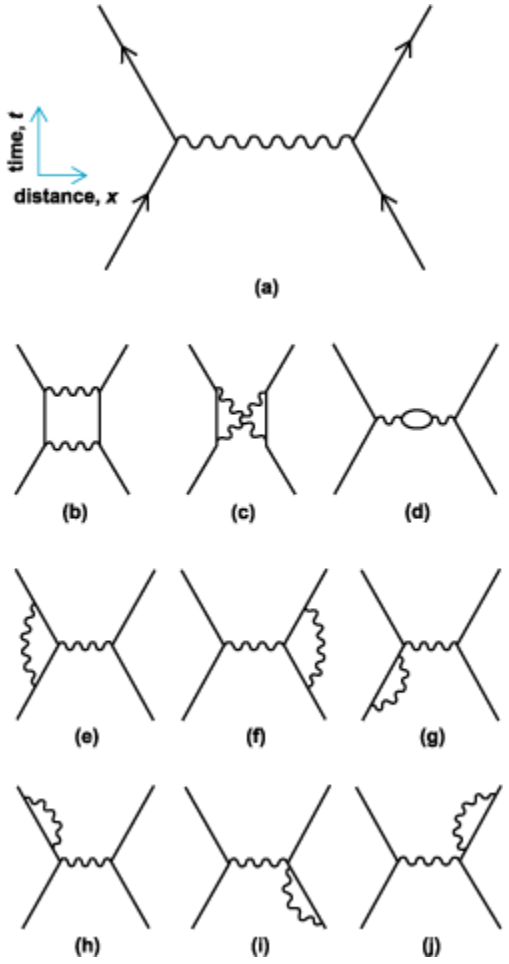
Atomphysik (20. Jahrhundert) – Mathematik als Kunst

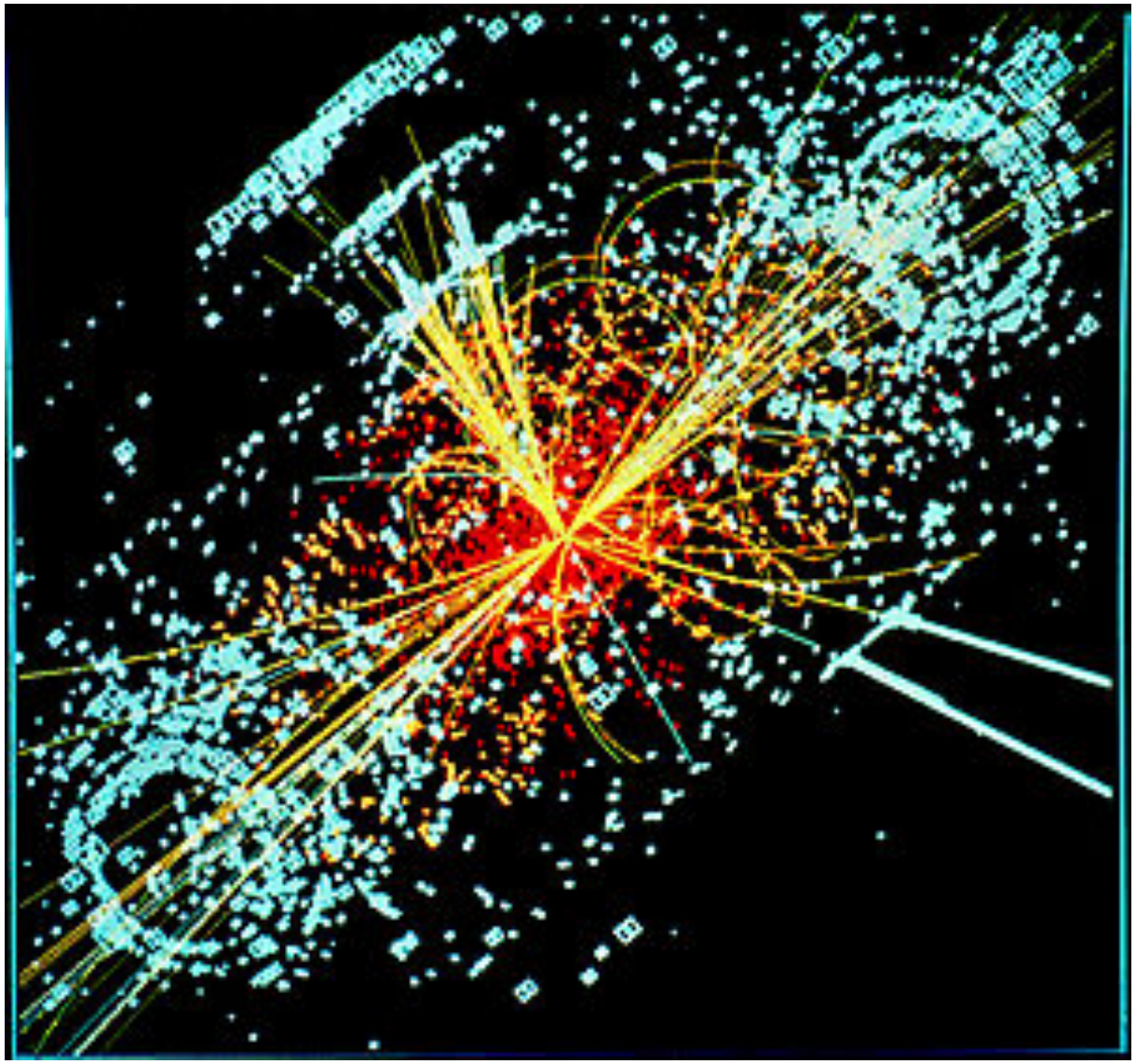


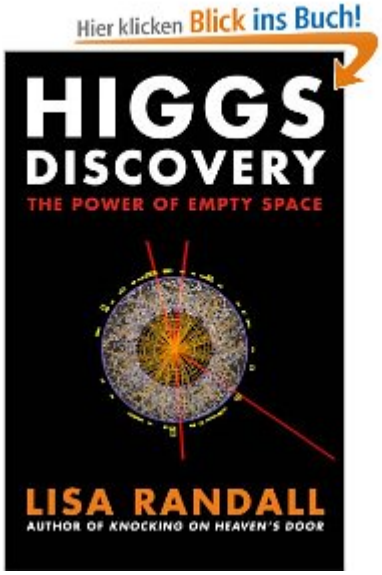


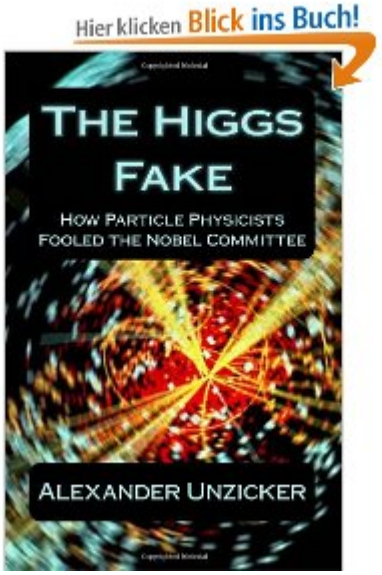

e+
μ+
γ
e−
μ−

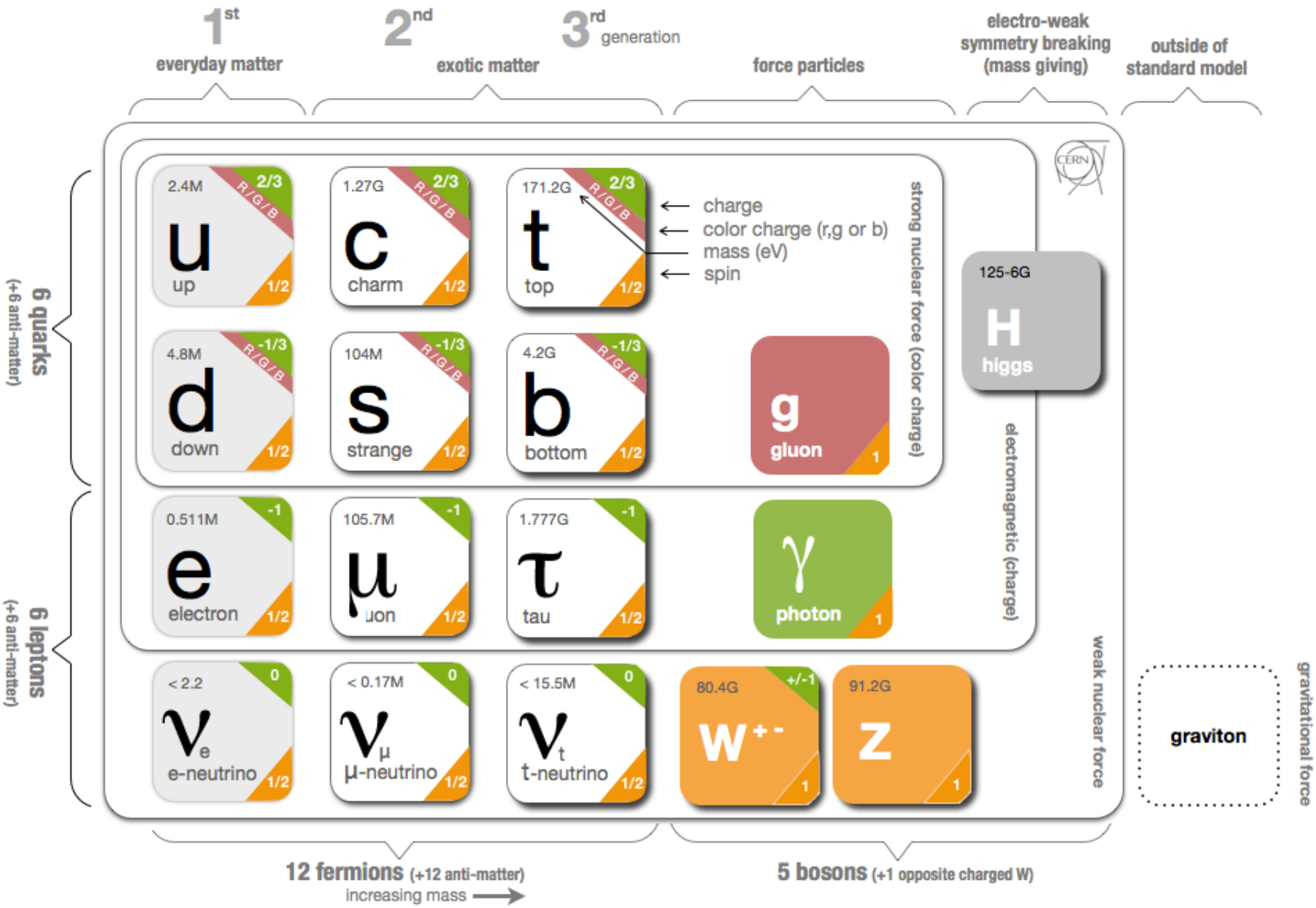

e-
e-
γ
e-
e-
e-
γ
γ
e+
e-


time, t
distance, x
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)




Hier klicken Blick ins Buch!
HIGGS
DISCOVERY
THE POWER OF EMPTY SPACE
LISA RANDALL
AUTHOR OF KNOCKING ON HEAVEN'S DOOR


Hier klicken Blick ins Buch!
THE HIGGS
FAKE
HOW PARTICLE PHYSICISTS
FOOLED THE NOBEL COMMITTEE
ALEXANDER UNZICKER


1st
everyday matter
2nd
exotic matter
3rd generation
force particles
electro-weak symmetry breaking (mass giving)
outside of standard model
6 quarks
(+6 anti-matter)
6 leptons
(+6 anti-matter)
2.4M
2/3
R/G/B
u
up
1/2
1.27G
2/3
R/G/B
c
charm
1/2
171.2G
2/3
R/G/B
t
top
1/2
charge
color charge (r,g or b)
mass (eV)
spin
4.8M
-1/3
R/G/B
d
down
1/2
104M
-1/3
R/G/B
s
strange
1/2
4.2G
-1/3
R/G/B
b
bottom
1/2
g
gluon
1
strong nuclear force (color charge)
125-6G
H
higgs
0.511M
-1
e
electron
1/2
105.7M
-1
μ
uon
1/2
1.777G
-1
τ
tau
1/2
γ
photon
1
electromagnetic (charge)
< 2.2
0
νe
e-neutrino
1/2
< 0.17M
0
νμ
μ-neutrino
1/2
< 15.5M
0
νt
t-neutrino
1/2
80.4G
+/-1
W+-
1
91.2G
Z
1
weak nuclear force
graviton
gravitational force
12 fermions (+12 anti-matter)
increasing mass
5 bosons (+1 opposite charged W)

$$\mathcal{L}_{GWS} = \sum_f (\bar{\Psi}_f (i\gamma^\mu \partial\mu - m_f)\Psi_f - eQ_f \bar{\Psi}_f \gamma^\mu \Psi_f A_\mu) +$$

$$+ \frac{g}{\sqrt{2}} \sum_i (\bar{a}_L^i \gamma^\mu b_L^i W_\mu^+ + \bar{b}_L^i \gamma^\mu a_L^i W_\mu^-) + \frac{g}{2c_w} \sum_f \bar{\Psi}_f \gamma^\mu (I_f^3 - 2s_w^2 Q_f - I_f^3 \gamma_5) \Psi_f Z_\mu +$$

$$-\frac{1}{4}|\partial_\mu A_\nu - \partial_\nu A_\mu - ie(W_\mu^- W_\nu^+ - W_\mu^+ W_\nu^-)|^2 - \frac{1}{2}|\partial_\mu W_\nu^+ - \partial_\nu W_\mu^+ +$$

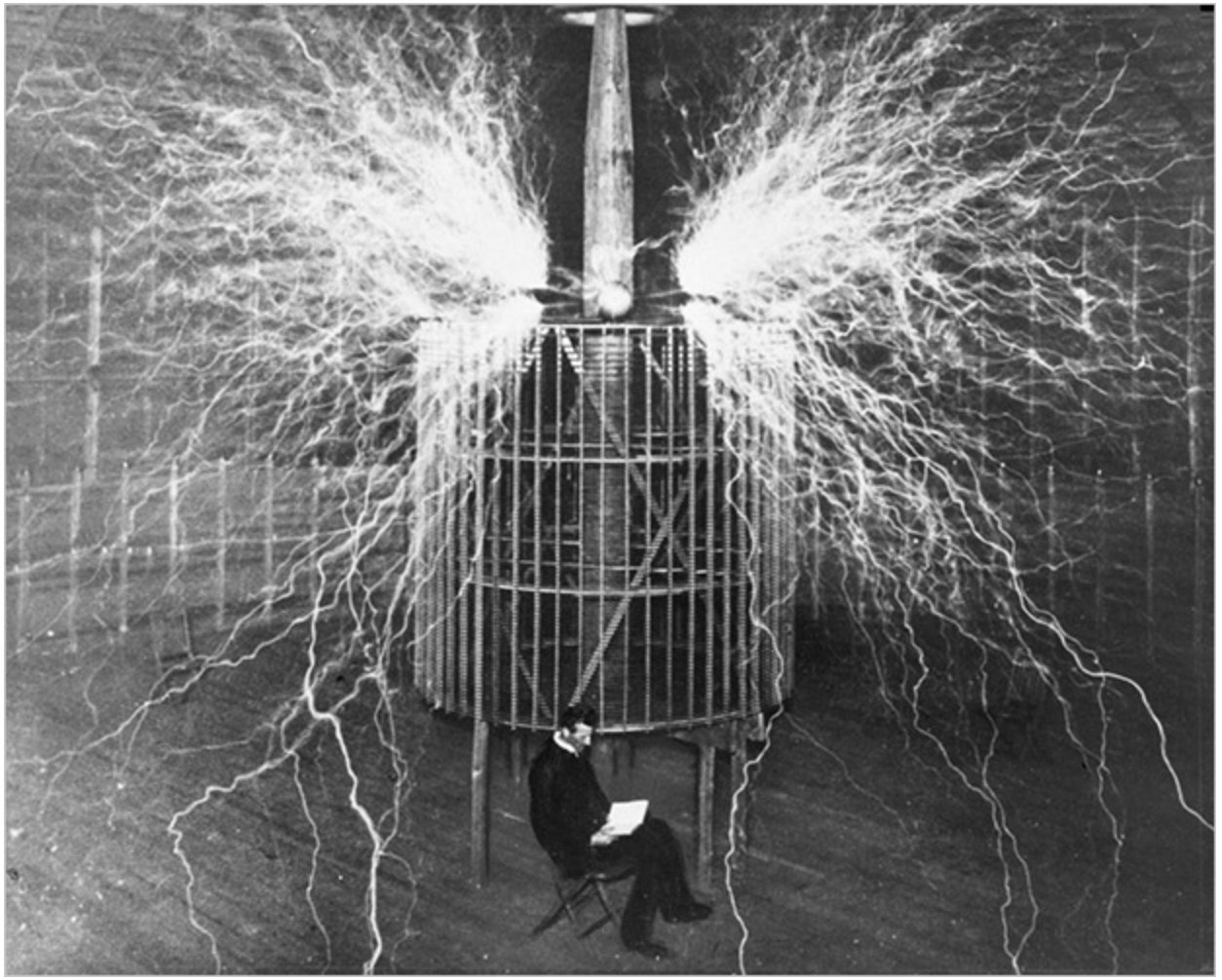
$$-ie(W_\mu^+ A_\nu - W_\nu^+ A_\mu) + ig' c_w (W_\mu^+ Z_\nu - W_\nu^+ Z_\mu|^2 +$$

$$-\frac{1}{4}|\partial_\mu Z_\nu - \partial_\nu Z_\mu + ig' c_w (W_\mu^- W_\nu^+ - W_\mu^+ W_\nu^-)|^2 +$$

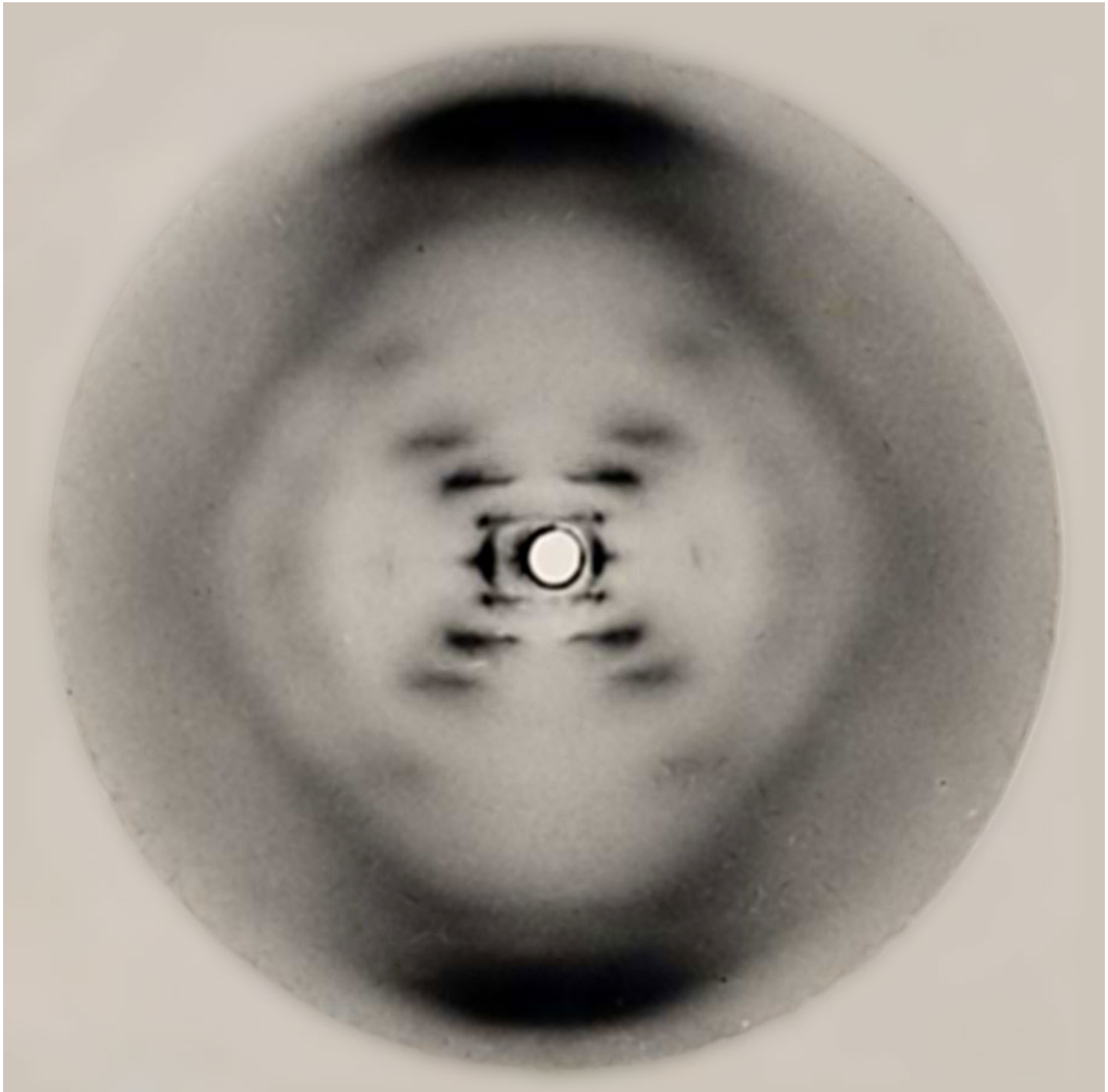
$$-\frac{1}{2} M_\eta^2 \eta^2 - \frac{g M_\eta^2}{8 M_W} \eta^3 - \frac{g'^2 M_\eta^2}{32 M_W} \eta^4 + |M_W W_\mu^+ + \frac{g}{2} \eta W_\mu^+|^2 +$$

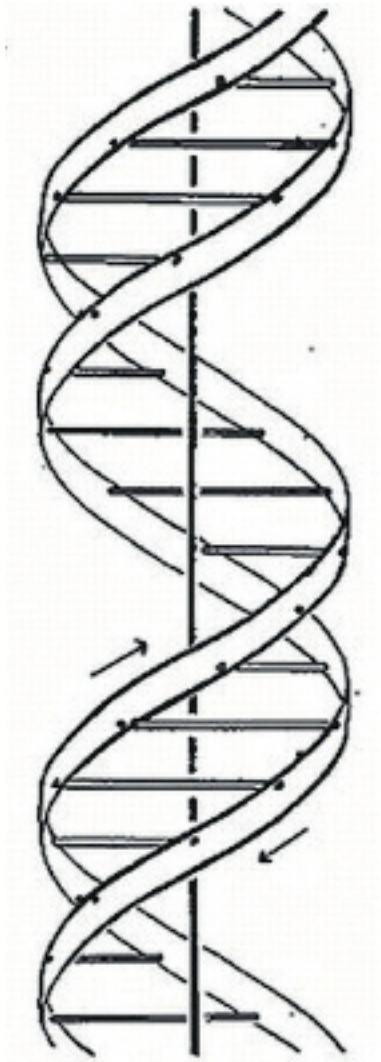
$$+\frac{1}{2}|\partial_\mu \eta + i M_Z Z_\mu + \frac{ig}{2c_w} \eta Z_\mu|^2 - \sum_f \frac{g}{2} \frac{m_f}{M_W} \bar{\Psi}_f \Psi_f \eta$$


I'VE DONE IT– I'VE FOUND THE MOST BASIC PARTICLE!
I'VE FOUND THE PARTICLE THAT MAKES UP THAT BASIC PARTICLE!
I'VE FOUND THE PARTICLES THAT MAKE UP THE PARTICLES
J. Harris




Chas Addams

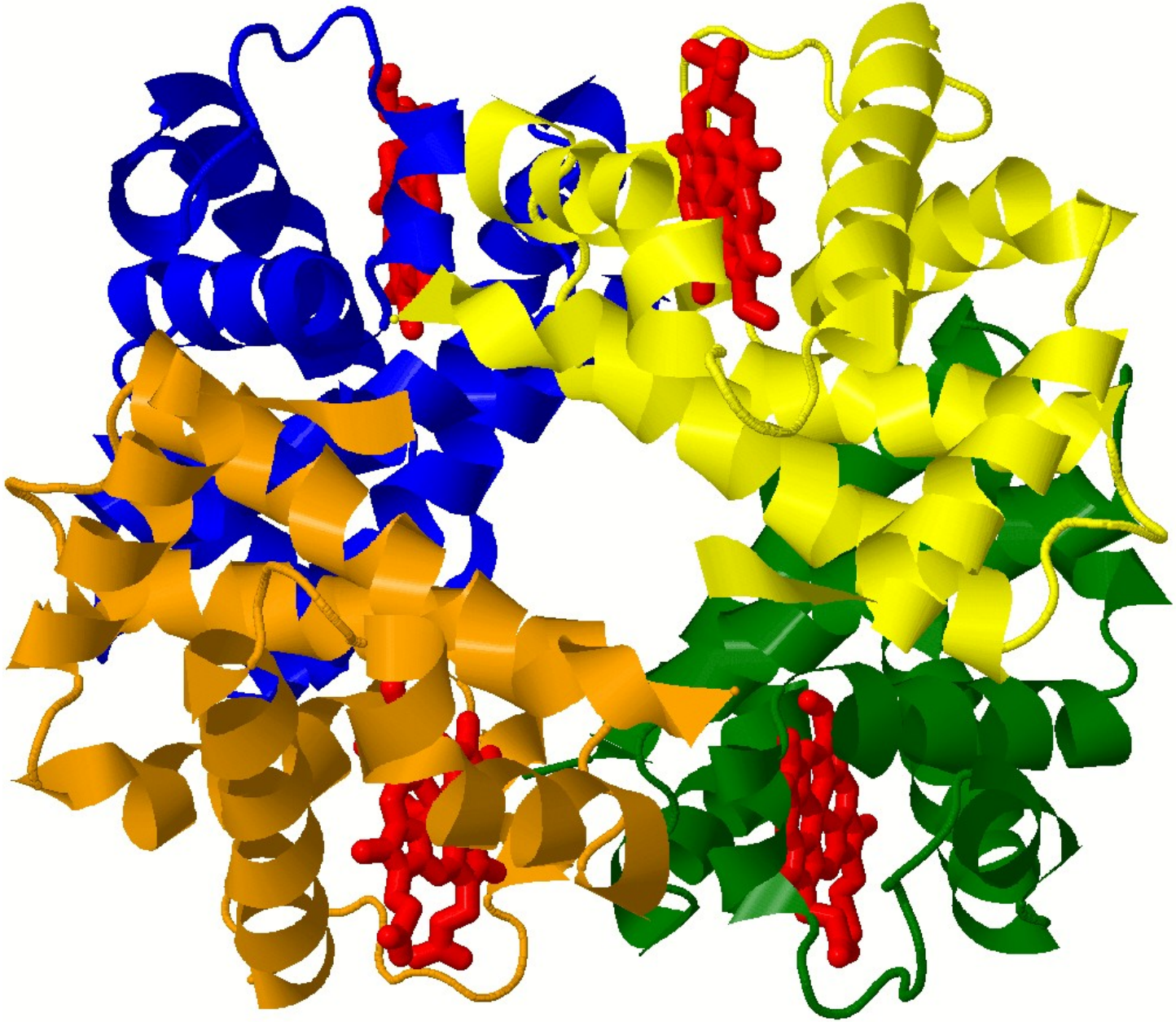


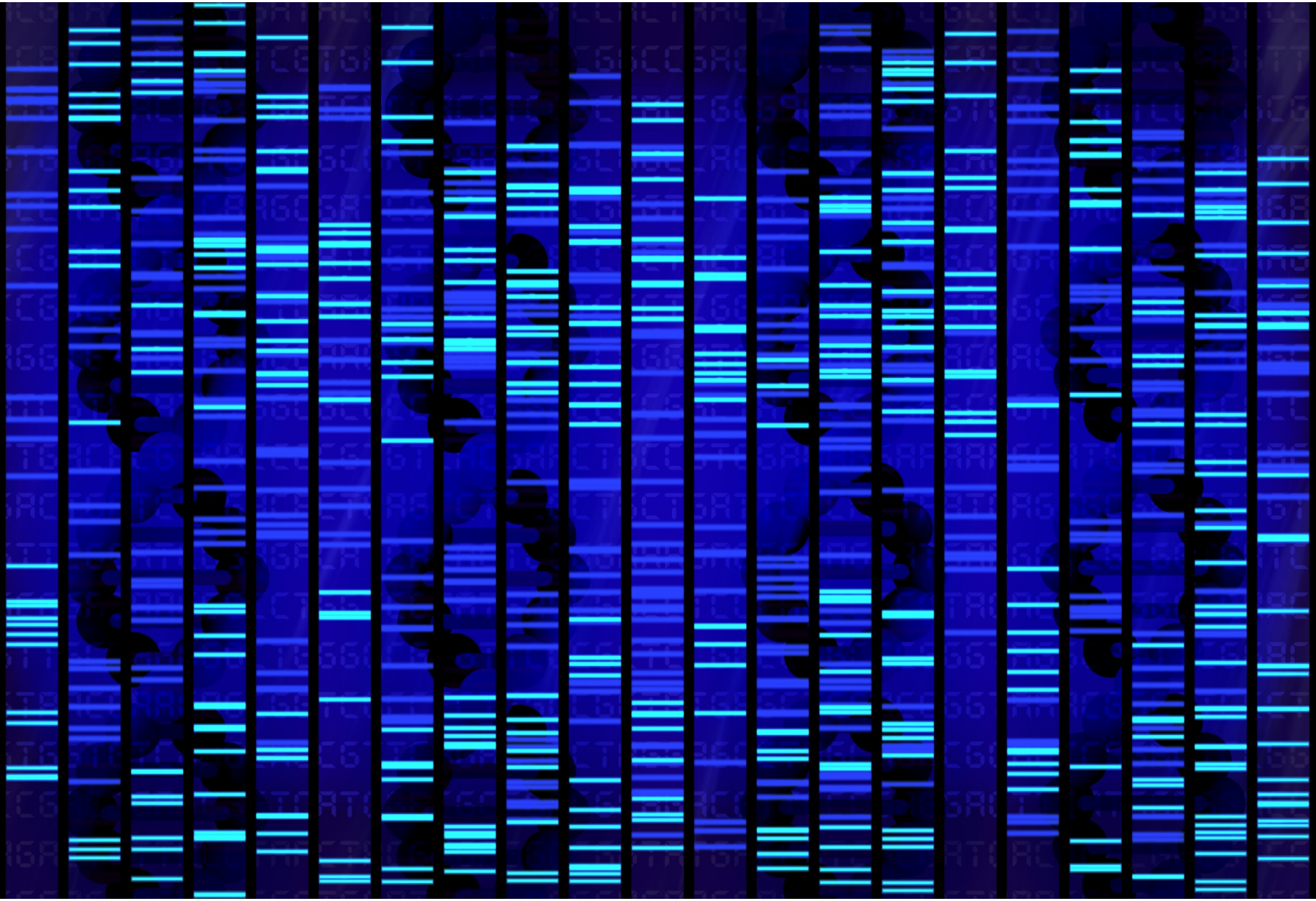


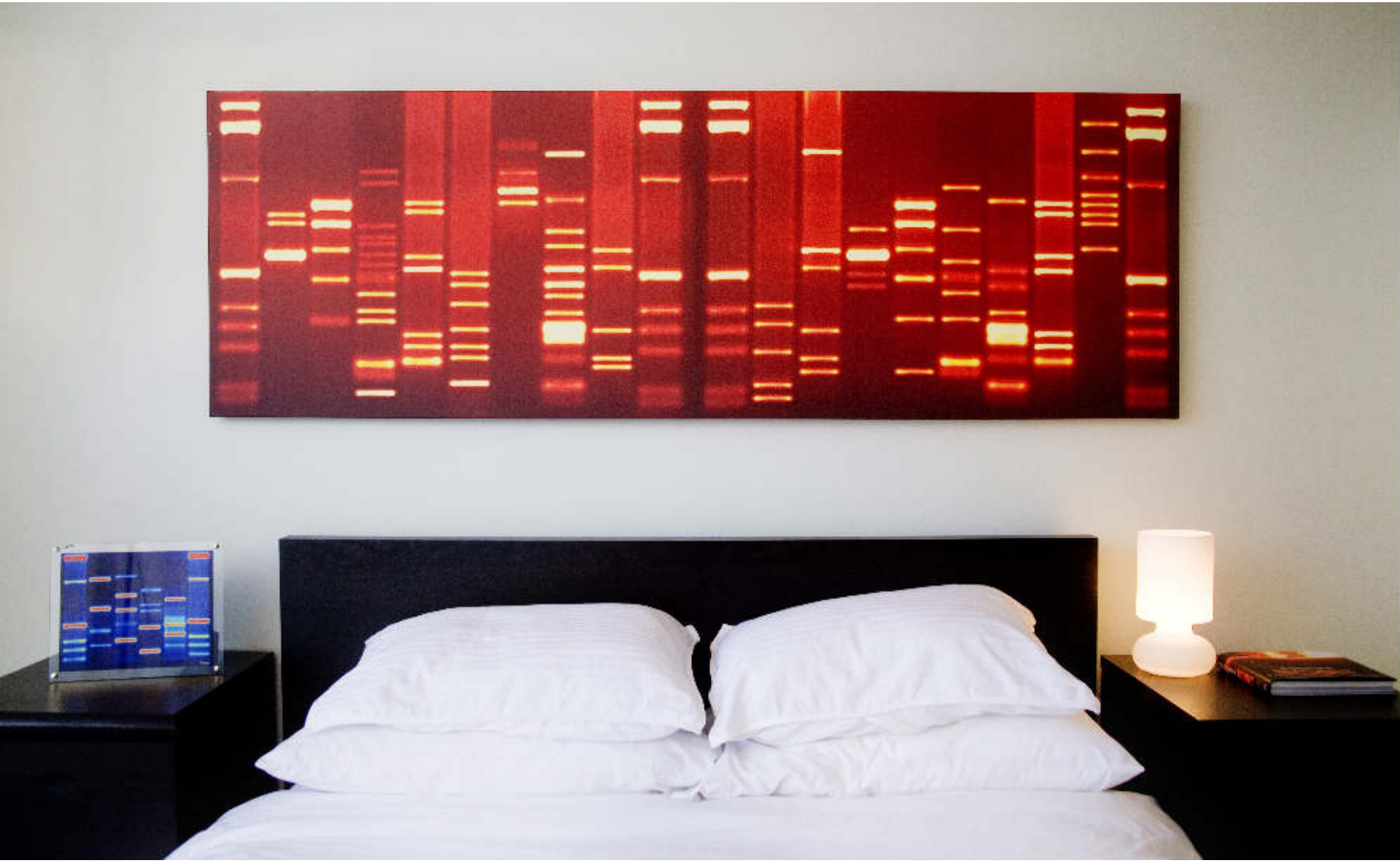
C
G
A
T

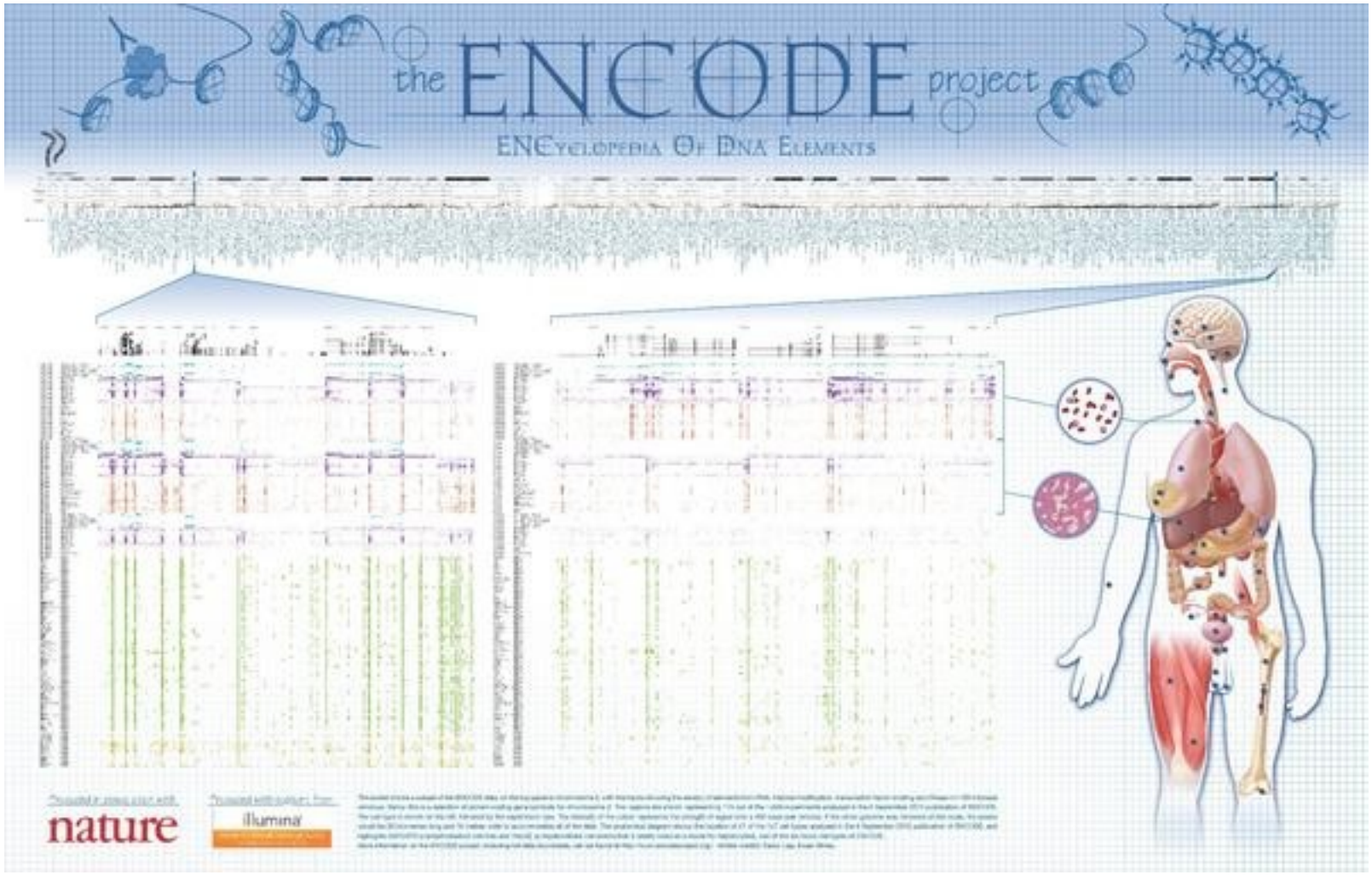
© R.G. Steane

Primase
DNA-Ligase
RNA-Primer
DNA-Polymerase (Polα)
3'
Folge-
strang
5'
Okazaki-Fragment
5'
Leit-
strang
3'
3'
5'
Topoisomerase
DNA-Polymerase (Polδ)
Helicase
Einzelstrang-
bindendes Protein

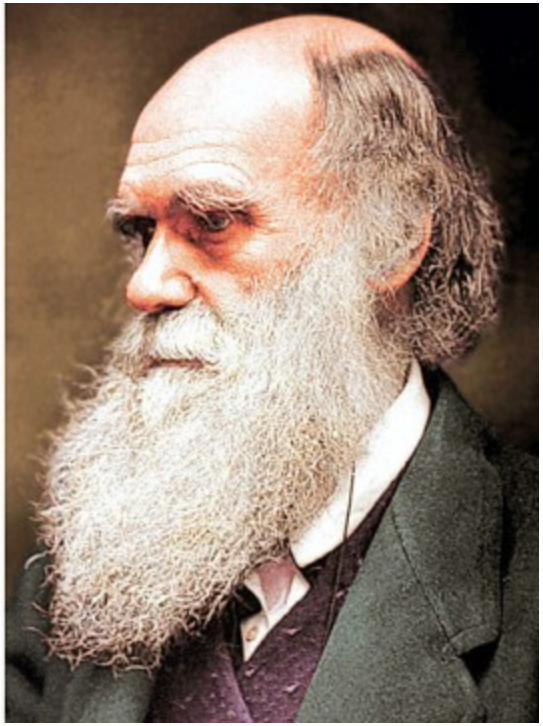




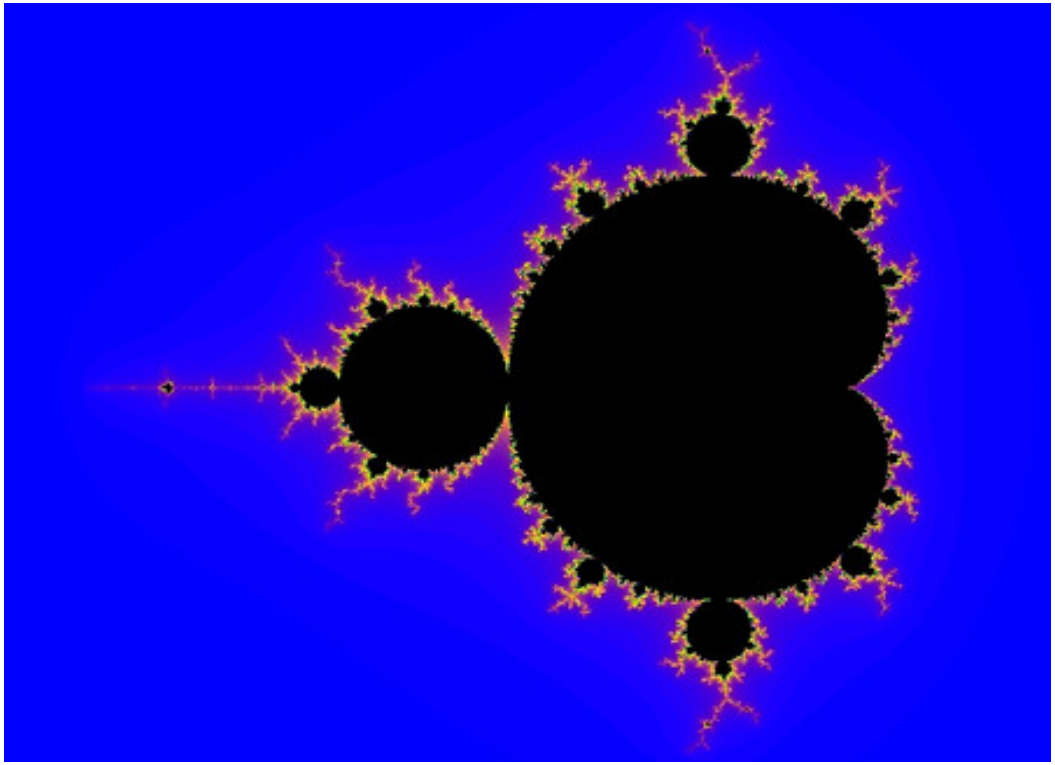



the ENCODE project
ENCyclopedia Of DNA Elements
nature
illumina

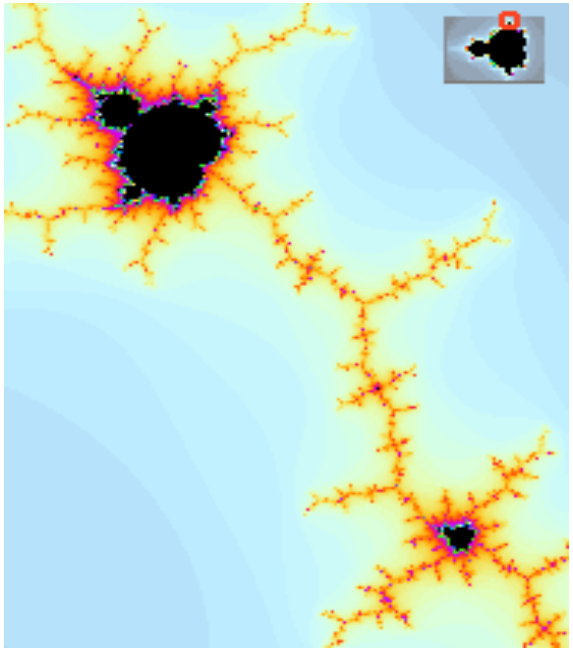

I think
B
D
C
A



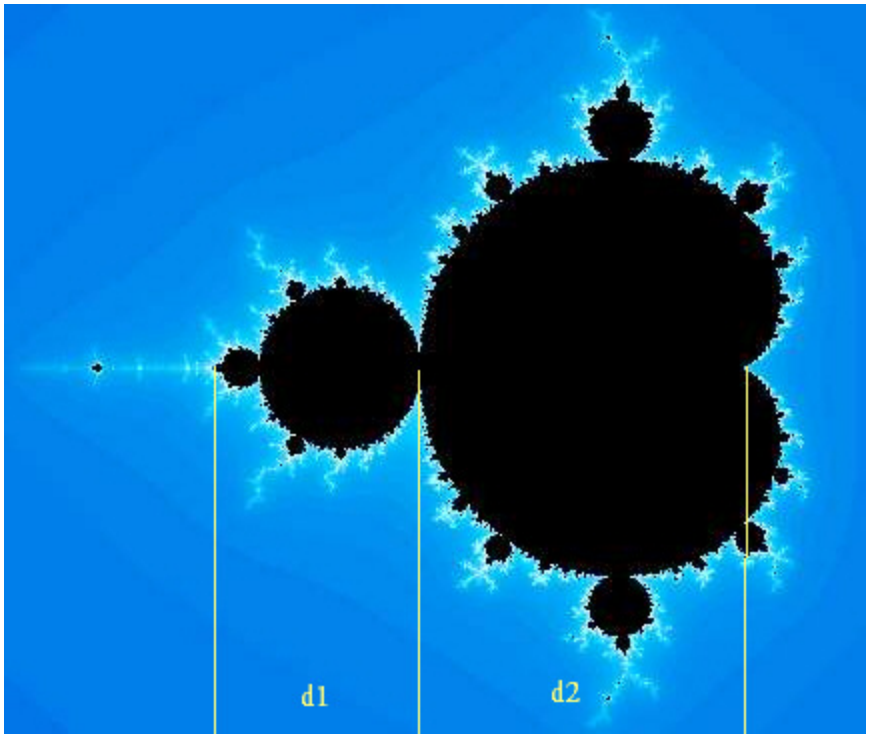
Benoit Mandelbrot



Ausschnitte des Mandelbrotfraktals



Mandelbrots Geigenkasten



Fraktale Figuren