INFOVERSUM

the Information Universe in vivo in vitro

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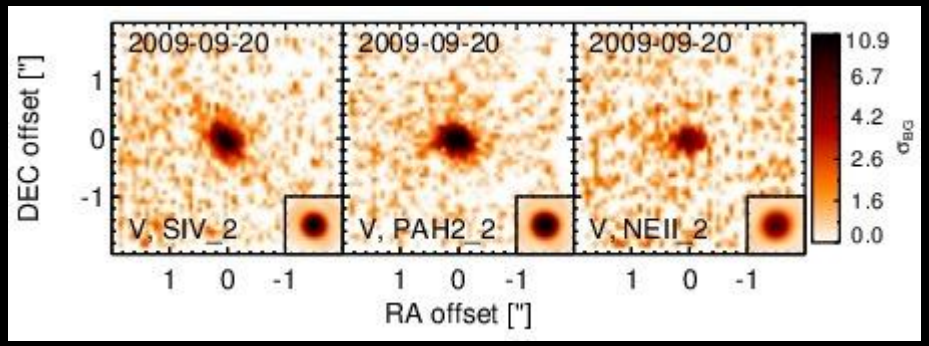
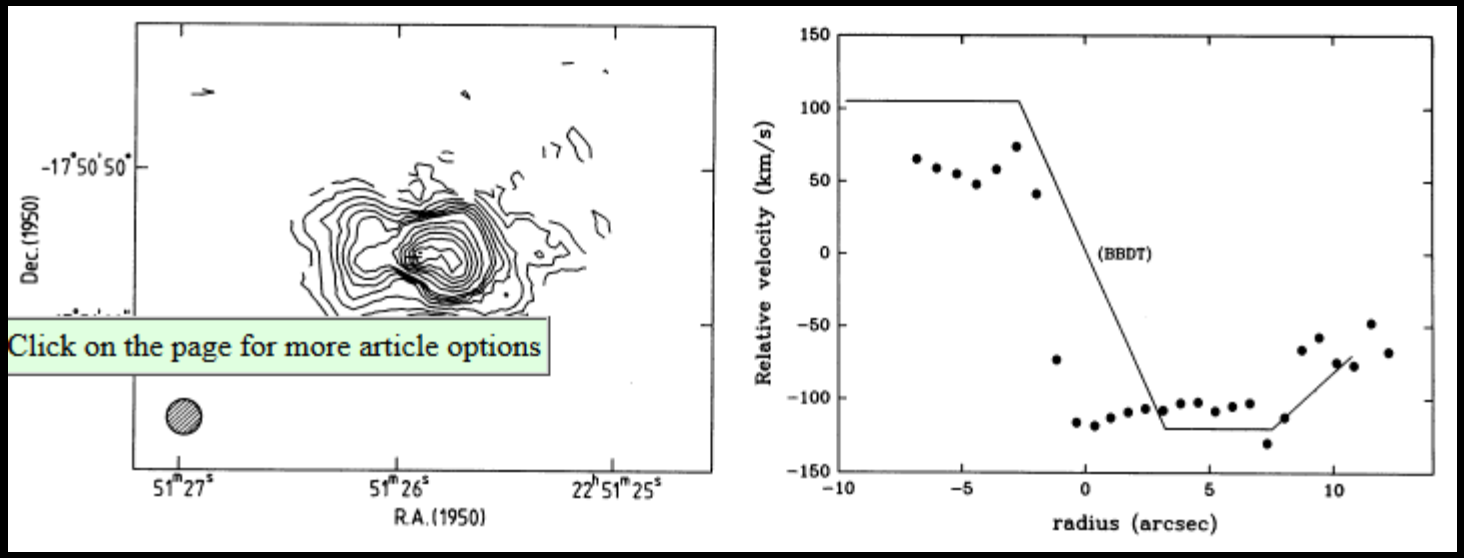
Oktober 2015

- Deep Space
  – Quasar a few dozen photons
  -- Info copied many times- what is the root? qm
- Surveys : Big Data expert
  >2000 Infosystems for Astronomy – Astro-Wise
- Modeling and dealing with Big data makes you wonder- what are we doing?
- is there a more fundamental approach?
- go back to square one
- Internet lives without a physical theory
  we are just doing it ad hoc





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in vivo

- in vivo: in nature - physics and life
- Statistical mechanics - qm

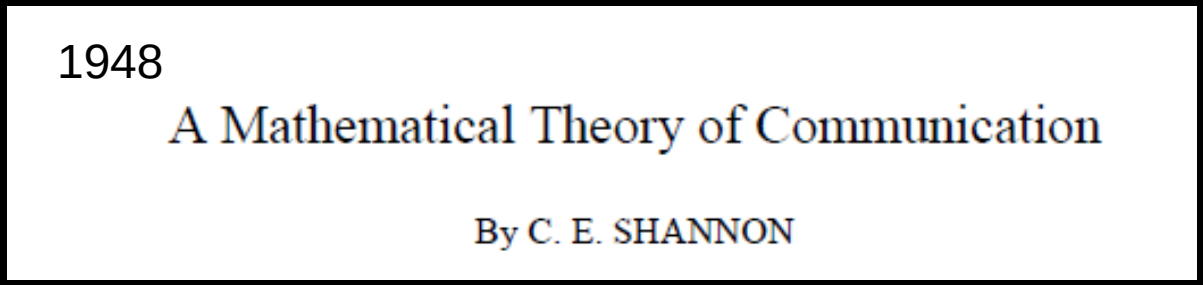
in vitro (in silico)

in the lab

in our computers – internet

Information exists when it is being copied

The basis of Information theory Shannon is:



info is agreements between people

the alphabeth

ASCII

in vivo

In physics Information perceived as entropy

$$S = -k_{\mathrm{B}} \sum_i p_i \ln p_i,$$

in vitro

In Information Theory measures of information:

Shannon entropy

$$i = -\sum_{k=1}^{n} p_k \ln p_k \ .$$

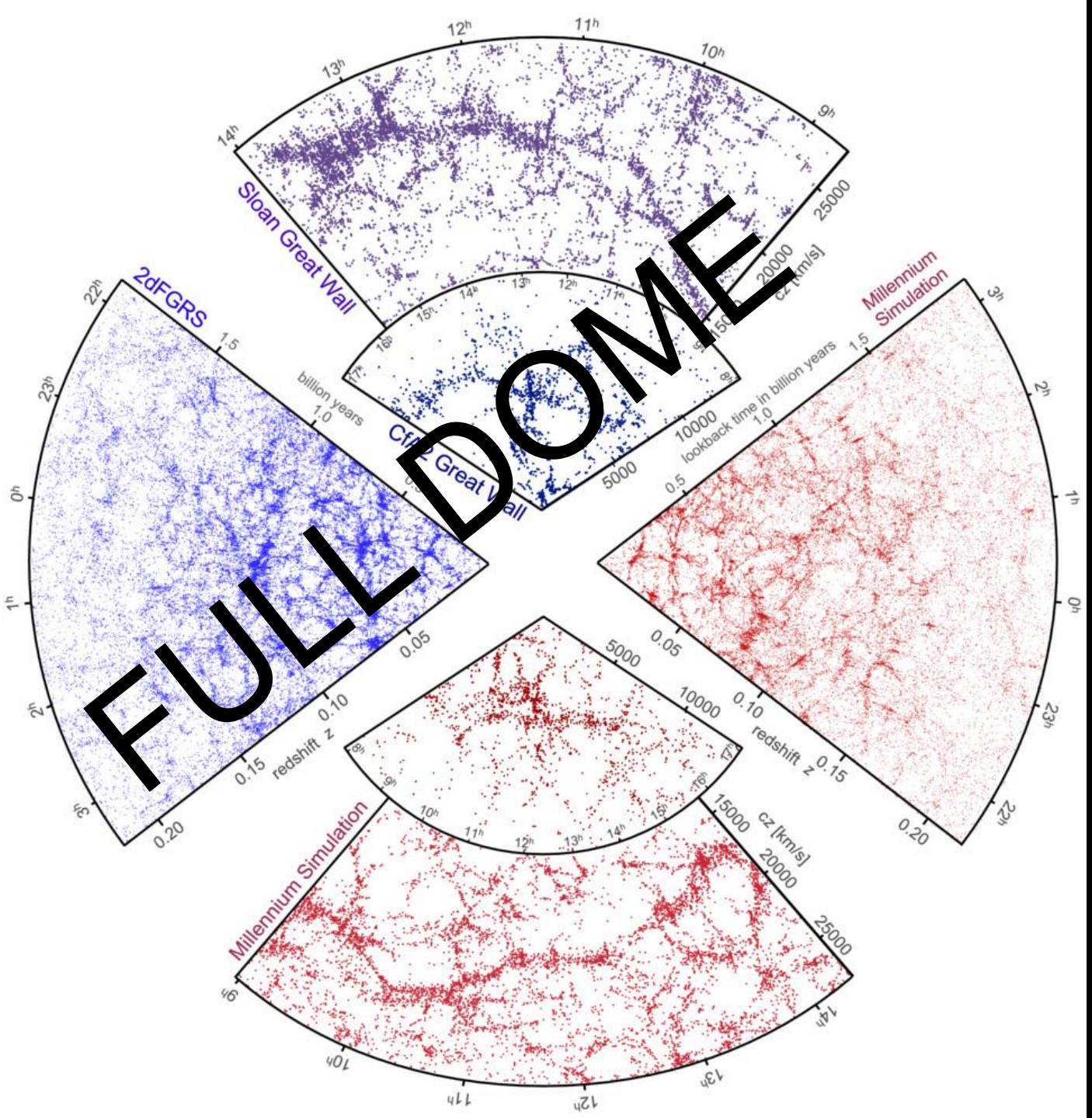
Fisher information

$$\int \left(\frac{\partial}{\partial \theta} \log f(x;\theta) \right)^2 f(x;\theta) \, \mathrm{d}x$$

1956

Information Theory and Statistical Mechanics

E. T. JAYNES
Department of Physics, Stanford University, Stanford, California



In vivo
In vitro

in vivo /in vitro

- observations of vivo
  - brought to in vitro here
- simulations in cpus – in vitro


Tasmani

in vivo /in vitro

- miljons of examples how IT feeds backward and forward into life
- When involvinglong time spans - most impressive
- The power of information

  independent of time and mass

  being copied in space and computers

  but equally in the brains and conscience of the boy


Khandwa
INDIA
Calcutta
Khandwa
Waterfall
Dam
Google

- the place of birth is equal to the information describing it
- EPR - qm teletransportation
- an object is equal to the information describing it

  Fax - DNA (twins) – 3D printer

2-dim surfaces

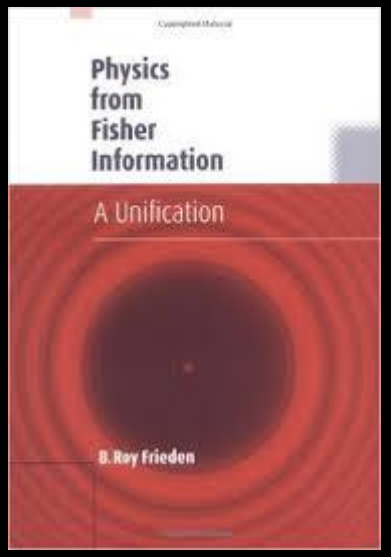
this conference

- Black body radiation:
  - E= hv v = c/l # standing waves- digital per sé
  - Dehesa- n-dim bb radiation derived from Fisher Information, Shannon Entropy
- Black hole paradox
- Hologram - Verlinde

Cross over in vitro in vivo?

- Entropy p log p
- Physics from Fisher information
- Information through 2-dim surfaces

I Physics



Roy Frieden 1998

reality of Kant

- J Noumenon – "Ding an sich" J
- I Phenomenon --"Erscheinung" I - measurement
- Describes physical fluctuations J vs measurement Fisher $I = 1/\sigma^2$

  Cramer – Rao $\sigma^2 I \geq 1$
- Information transfer J→ I
- No ad hoc Lagrangians
- Derives Schrodinger equation
- Unification theory – EPI
- Incorporates the observer into the phenomenon of measurement

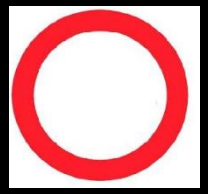
the beginning

- Creation of particle - fields
- Creation of Information
  - God seperated the 1s from the zeros
  - Info as a basic component of our Universe

1 bit

bits	#states	Byte
0	1e+00 1	pre Big Bang
1	2e+00 2	Big Bang

1 or 0



a bit describes the state of a system

1 bit has 2 states: go or no-go

It from bit ?

2 bit 4 states

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
2	4e+00	4	

- A billion years ago Unicellar systems evolved into Multicellar
- Cells started to exchange (copy) information
- Complex life started with multi cells exchanging info

7 bit

LYNDON B. JOHNSON

XXXVI *President of the United States: 1963-1969*

127 - Memorandum Approving the Adoption by the Federal Government of a Standard Code for Information Interchange.

March 11, 1968

7 bit ASCII

bits	#states	Byte
0	1e+00 1	pre Big Bang
1	2e+00 2	Big Bang
7	1e+02 128	ASCII

7 bits: 0110110

- Our in vitro Information Universe is fully due to agreements between people
  - 7 bit ASCII
  - standards -bitstreams

ASCII character code

Dec	Oct	Hex	Binair	Code	Betekenis
97	141	61	1100001	a	Letter a
98	142	62	1100010	b	Letter b
99	143	63	1100011	c	Letter c
100	144	64	1100100	d	Letter d
101	145	65	1100101	e	Letter e
102	146	66	1100110	f	Letter f
103	147	67	1100111	g	Letter g
104	150	68	1101000	h	Letter h
105	151	69	1101001	i	Letter i
106	152	6A	1101010	j	Letter j
107	153	6B	1101011	k	Letter k
108	154	6C	1101100	l	Letter l
109	155	6D	1101101	m	Letter m
110	156	6E	1101110	n	Letter n
111	157	6F	1101111	o	Letter o
112	160	70	1110000	p	Letter p
113	161	71	1110001	q	Letter q
114	162	72	1110010	r	Letter r
115	163	73	1110011	s	Letter s
116	164	74	1110100	t	Letter t
117	165	75	1110101	u	Letter u
118	166	76	1110110	v	Letter v
119	167	77	1110111	w	Letter w
120	170	78	1111000	x	Letter x
121	171	79	1111001	y	Letter y
122	172	7A	1111010	z	Letter z

8 bit

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu

The Intiwatana stone

- about 8 sides on-off

--> 256 states

one of the first man made hard disks

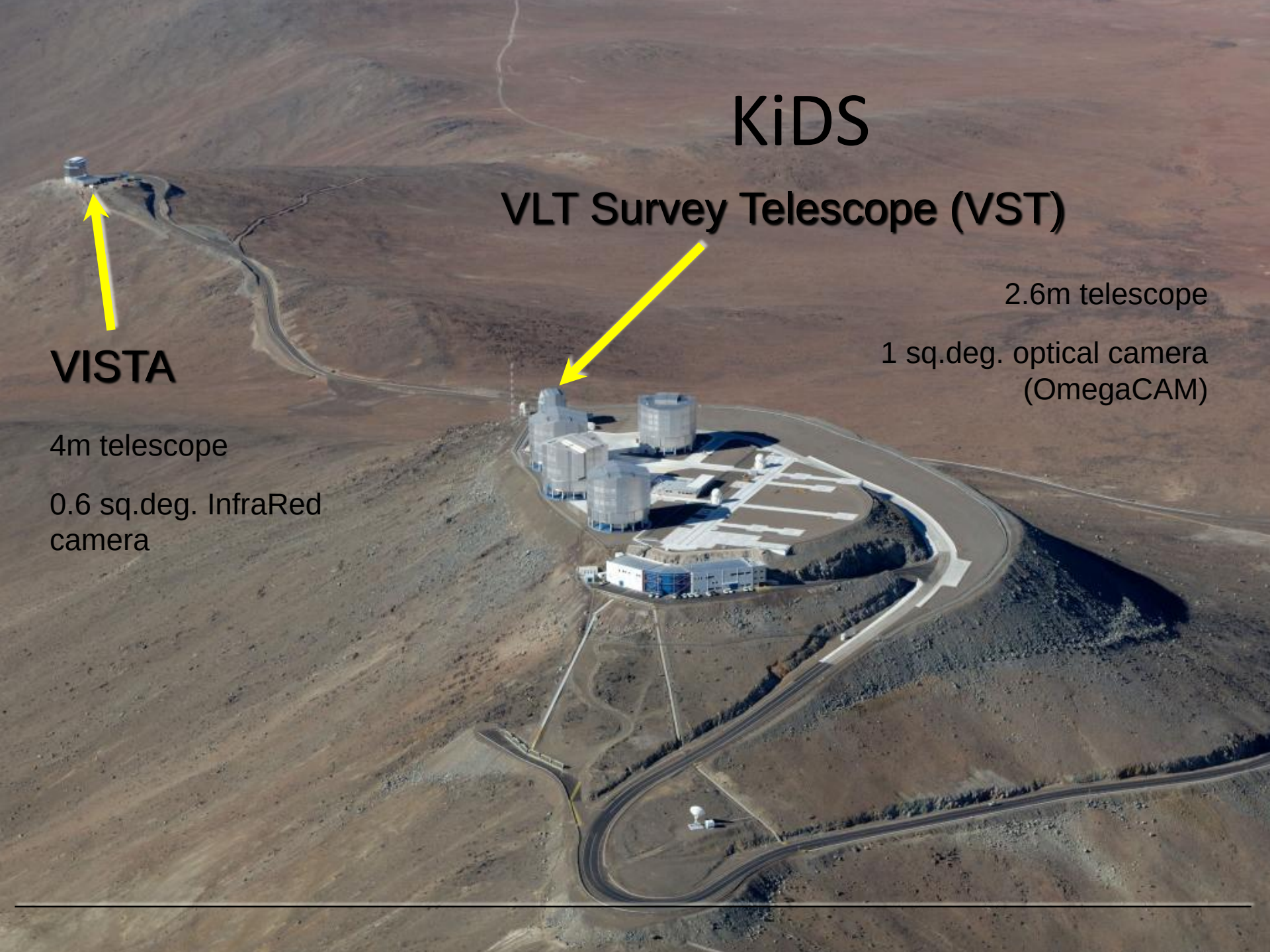
IBM
5 Mbyte
harddisk
1956

16 -24 bit -> kilo Mega

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega

16 bits

0110110101101101

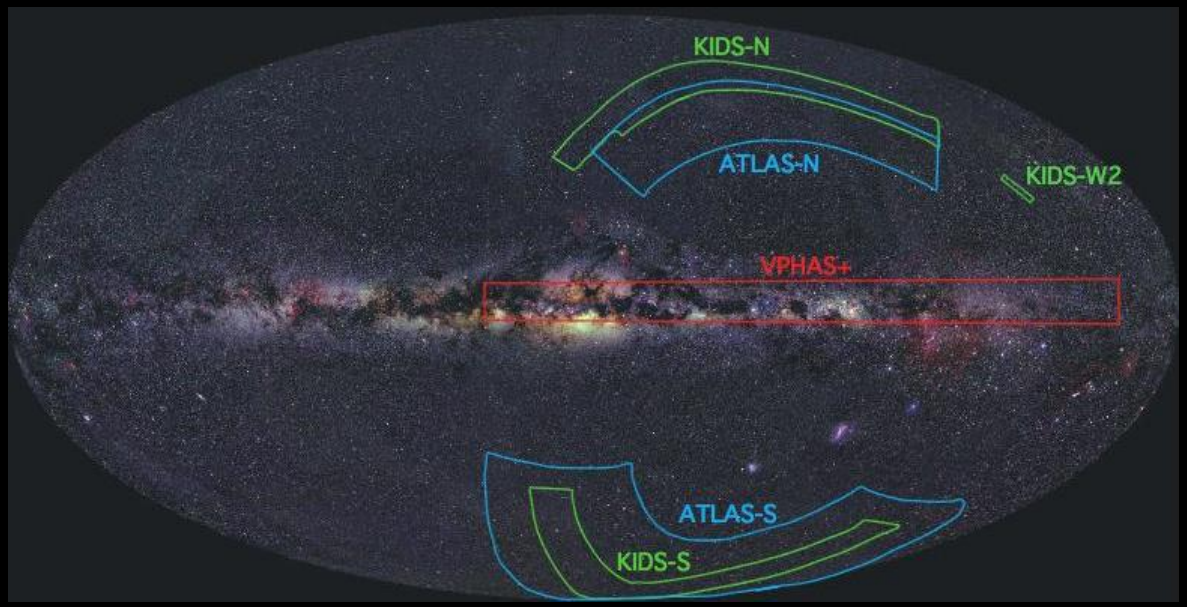

KiDS
VLT Survey Telescope (VST)
2.6m telescope
1 sq.deg. optical camera
(OmegaCAM)
VISTA
4m telescope
0.6 sq.deg. InfraRed
camera

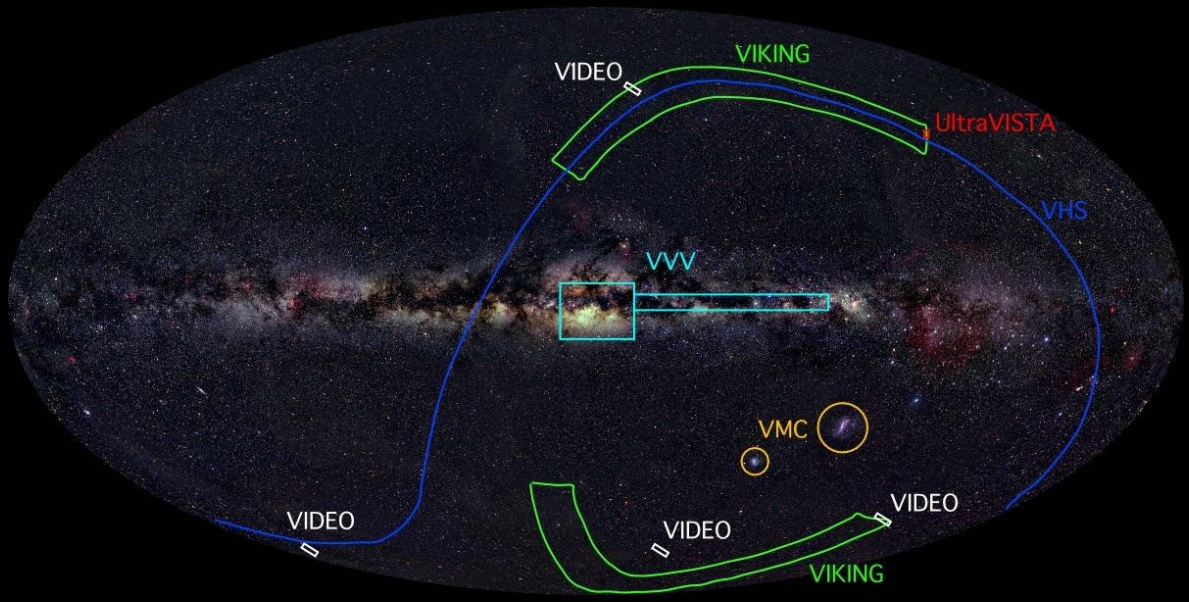
Giga - Tera

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega
32	4e+09	4294967296	Giga
40	1e+12	1099511627776	Tera

ESO public surveys

- VST:
- ATLAS
- VPHAS+
- KiDS
- VISTA:
- VHS
- VIKING
- VIDEO
- UltraVISTA
- VIDEO
- VVV






FULL DOME

Peta -100 Peta

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega
32	4e+09	4294967296	Giga
40	1e+12	1099511627776	Tera
48	3e+14	281474976710656	
56	7e+16	72057594037927936	Peta
64	2e+19	18446744073709551616	100 Peta

Data about Big Data

Peta -100 Peta

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega
32	4e+09	4294967296	Giga
40	1e+12	1099511627776	Tera
48	3e+14	281474976710656	
56	7e+16	72057594037927936	Peta
64	2e+19	18446744073709551616	100 Peta

Data about Big Data

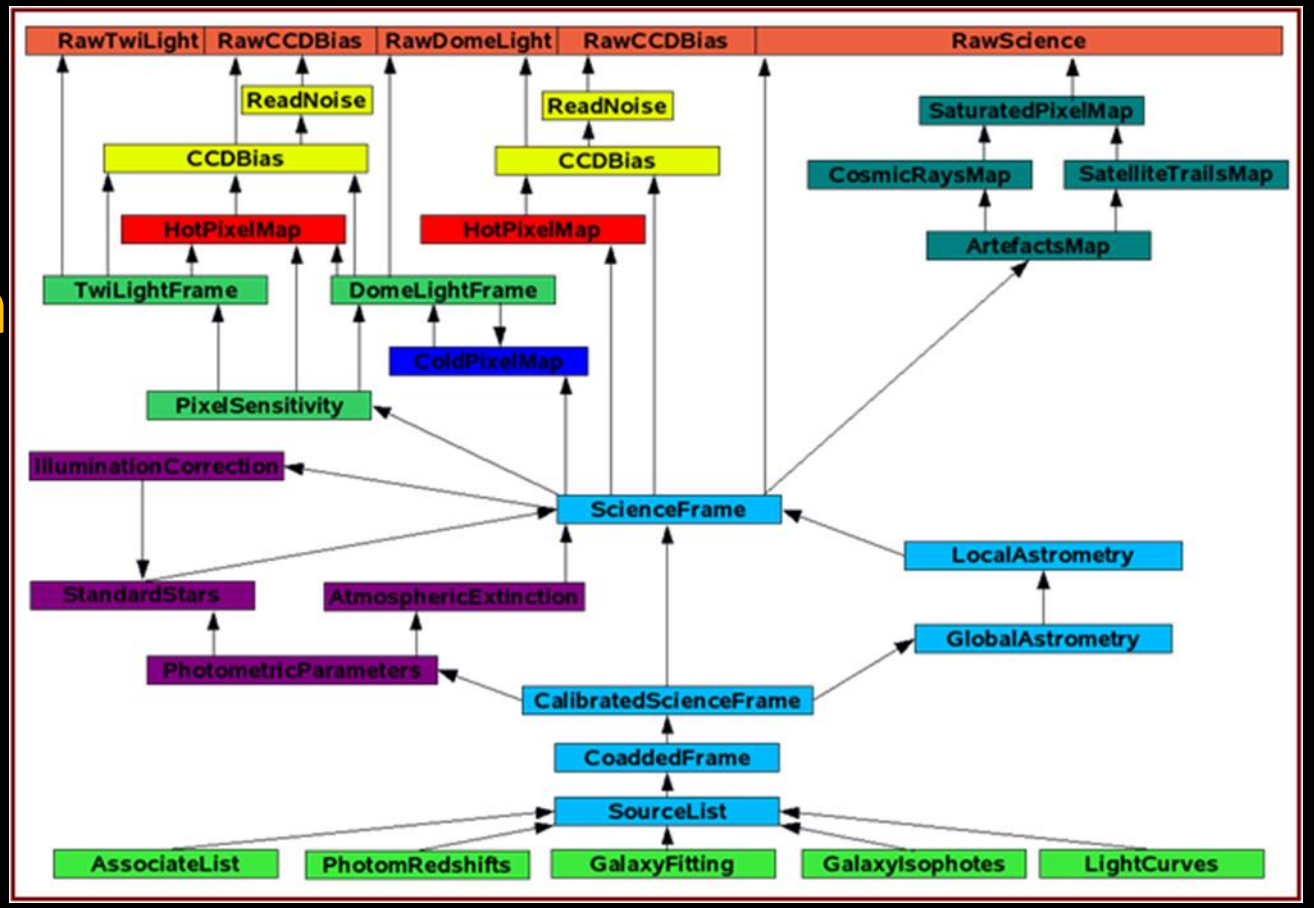

FULL DOME
facebook
December 2010

The universe as a spreadsheet

- Backwards chaining

  Links bit to It

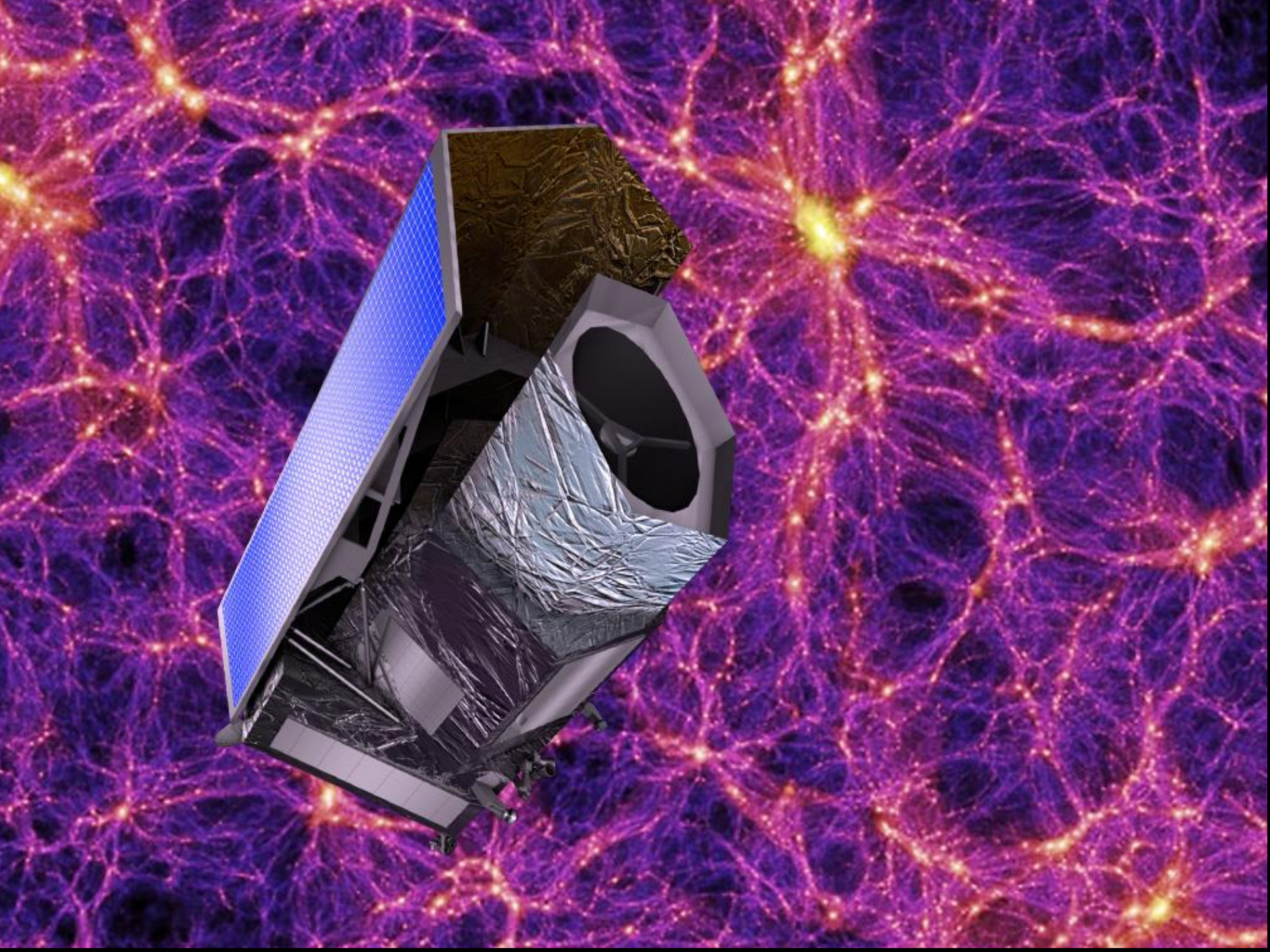
  I to J
- Target diagram
- ++
- Datamodelling
- AstroWISE
- Euclid



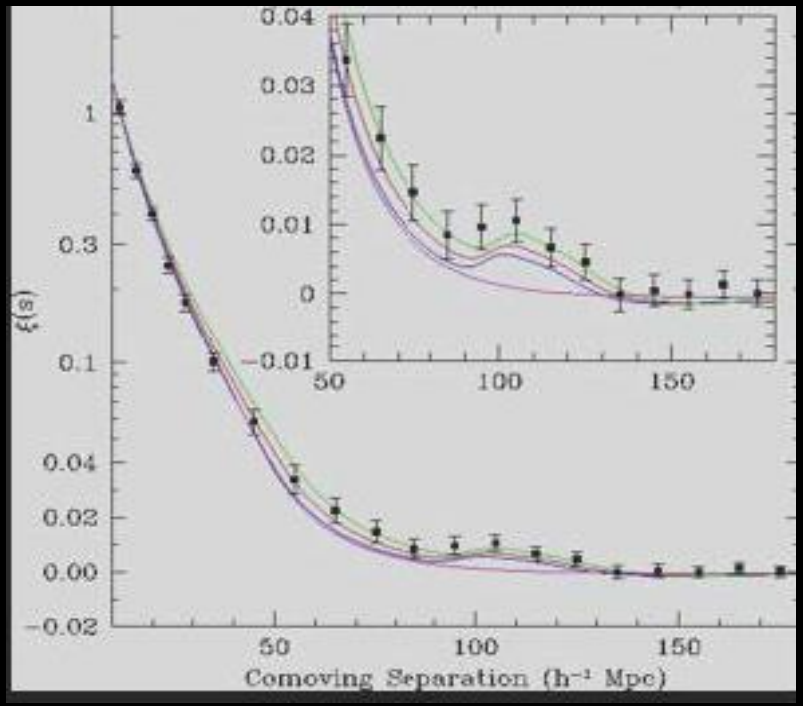
Lineage as a whole

- Data lineage
- Evolutionary lineage / micro biology
- Both lineages follow same track, copying of information (genes -> inheritance of info)

- But biological evolution. Information is added all the time, leading to more and more complex systems



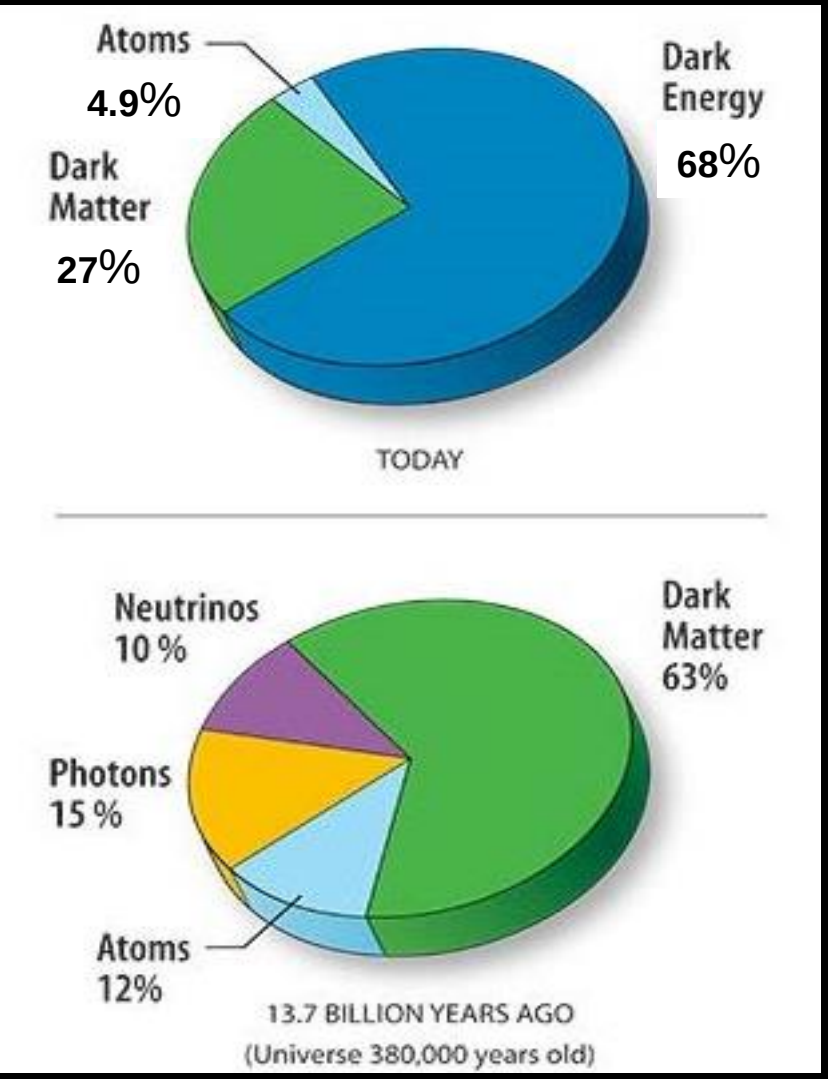
Probing Dark Energy



power spectrum galaxies

- Structure growth as function of z
- 140 Mpc bump as funtion of z
- high z cluster mass function

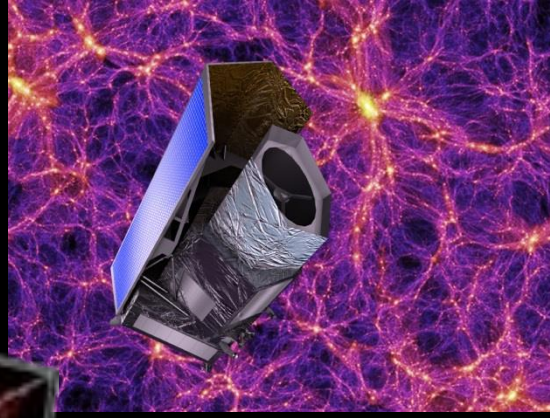
Weak gravitational lensing as probe of dark matter



- tomography >10^9 redshifts
- light rays deflected ~3’ by Large Scale Structure

gravitational shear vs distance

- reconstruct 3D gravity field
- KiDS: < 100 10^6 redshifts



128 bit

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega
32	4e+09	4294967296	Giga
40	1e+12	1099511627776	Tera
48	3e+14	281474976710656	
56	7e+16	72057594037927936	Peta
64	2e+19	18446744073709551616	100 Peta
128	3e+38	340282366920938463463374607431768211456	

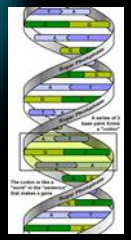
GPUs

The Universe – 256 bit

bits	#states		Byte
0	1e+00	1	pre Big Bang
1	2e+00	2	Big Bang
8	3e+02	256	Machu Pichu
16	7e+04	65536	
24	2e+07	16777216	Mega
32	4e+09	4294967296	Giga
40	1e+12	1099511627776	Tera
48	3e+14	281474976710656	
56	7e+16	72057594037927936	Peta
64	2e+19	18446744073709551616	100 Peta
128	3e+38	340282366920938463463374607431768211456	
256	1e+77	115792089237316195423570985008687907853269984665640564039457584007913129639936	

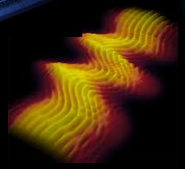
Planck one-year all-sky survey

esa

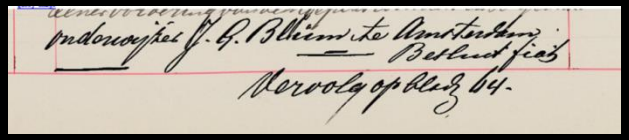


10^{-10} m

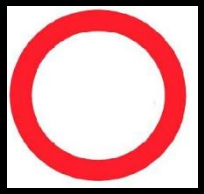
10^{-9} m nanom

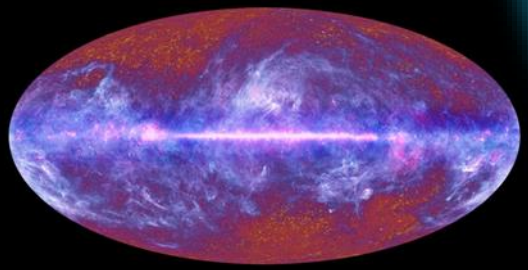


10^{-6} m micron



10^{-3} m mm



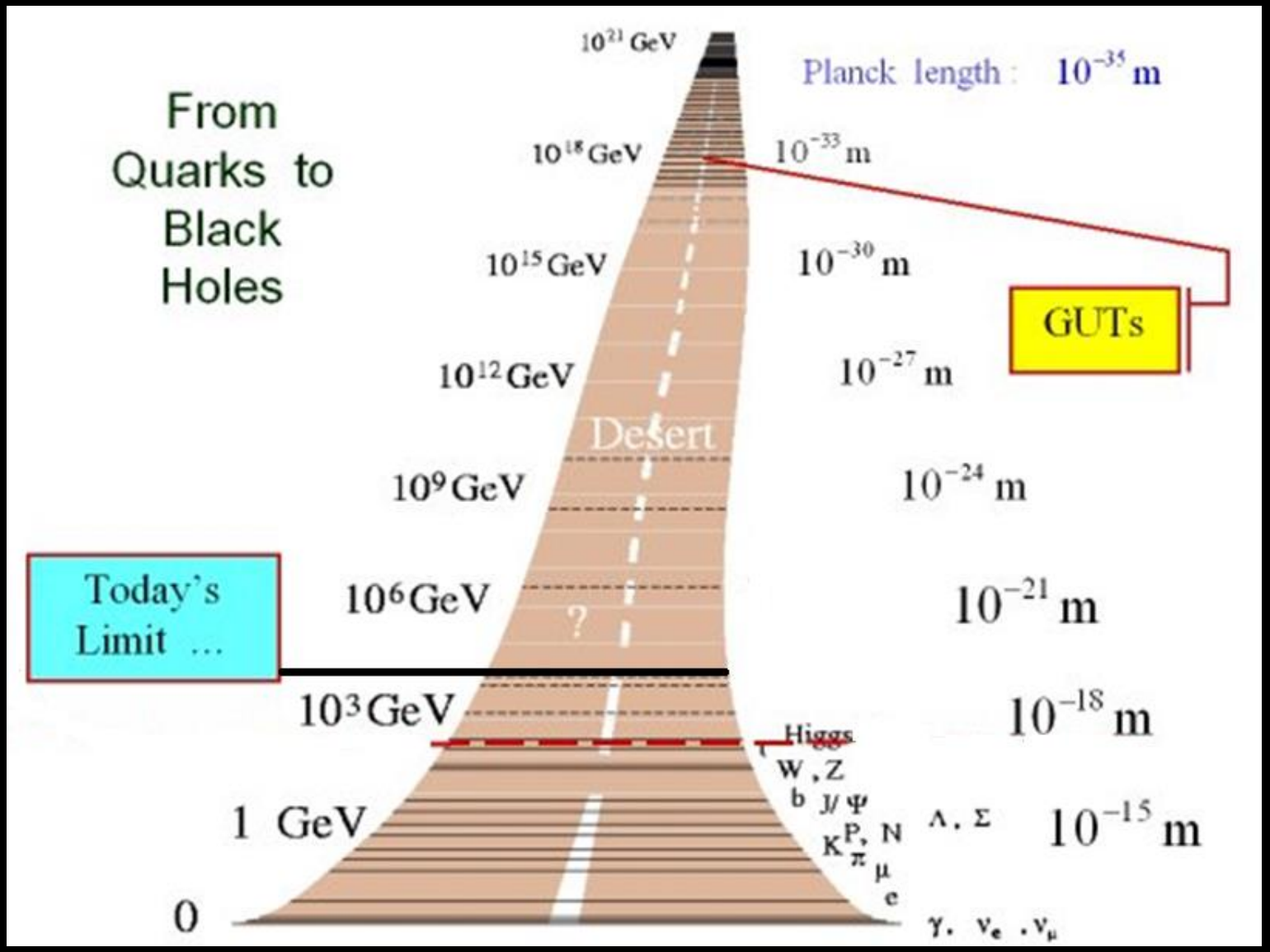


10^{-1} m

I-density of units in m/bit scalelength

The Universe-matter	5	10^{-1}	Baryons ΛCDM
Traffic sign	5	10^{-1}	50 cm
Printed text		10^{-3}	1 mm
The Universe-Photons	1.4 10-3		2.7K CMB
CCD sensor	4	10^{-6}	15 mm
Human brains	2	$10^{-5\ -7}$	$10^{10\text{-}11}$ /volume
Visual photon	5	10^{-7}	5000 A
CPU / SSD	2	10^{-8}	20 nm
Human DNA	2.5	10^{-10}	6 10^{9}/3m
Electron in LEP	6	10^{-15}	45 GeV
Proton in LHC	1.2	10^{-19}	13 TeV (2015)
Planck length		10^{-35}	10^{19} GeV

The desert


From Quarks to Black Holes
10^{21} GeV
Planck length : 10^{-35} m
10^{18} GeV
10^{-33} m
10^{15} GeV
10^{-30} m
GUTs
10^{12} GeV
10^{-27} m
Desert
10^{9} GeV
10^{-24} m
Today's Limit ...
10^{6} GeV
?
10^{-21} m
10^{3} GeV
10^{-18} m
Higgs
W , Z
b J/Ψ
1 GeV
K P, N Λ , Σ
π
μ
e
10^{-15} m
0
γ , ν_e , ν_μ

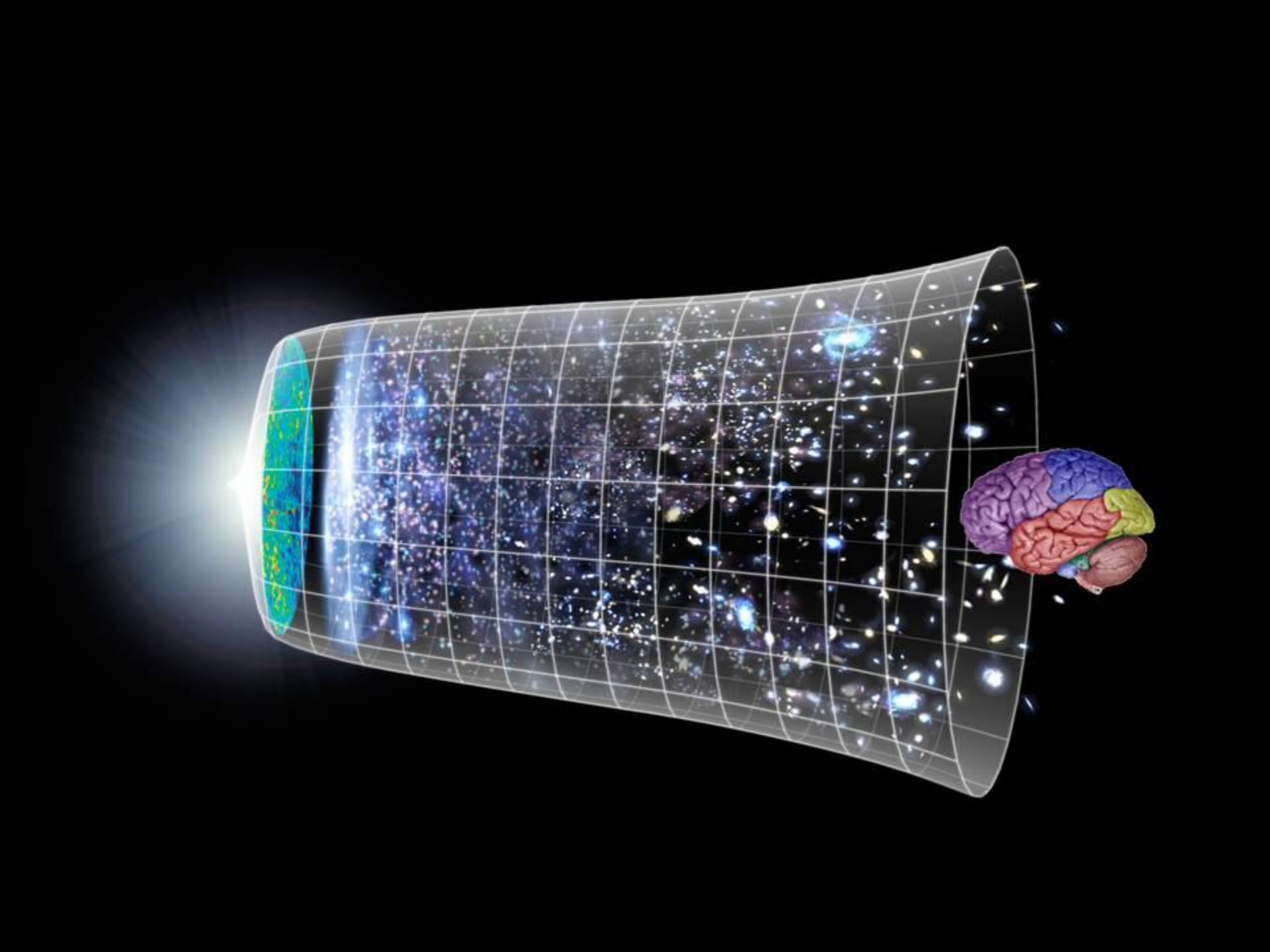
back to the moment of creation

bits	#states	Byte
0	1e+00 1	pre Big Bang
1	2e+00 2	Big Bang

1 bit has two states

0 bit has 1 state

the ultimate vacuum out of which the universe was created



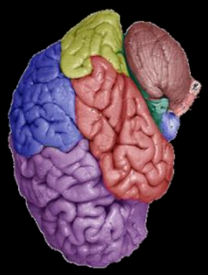
Vicky: born blind

– in surgery room after car accident

-- sees visual images of herself

(while never experienced any images befor)

"it felt like the place where all knowledge is"



Information

- Information exists when it is being copied
- info is agreements
- an object is equal to the information describing it
- It’s nearly all-in the CMB
- In vivo in vitro are close to identical
- Noumenon (J) – phenomenon (I) approach very succesful in Big Data