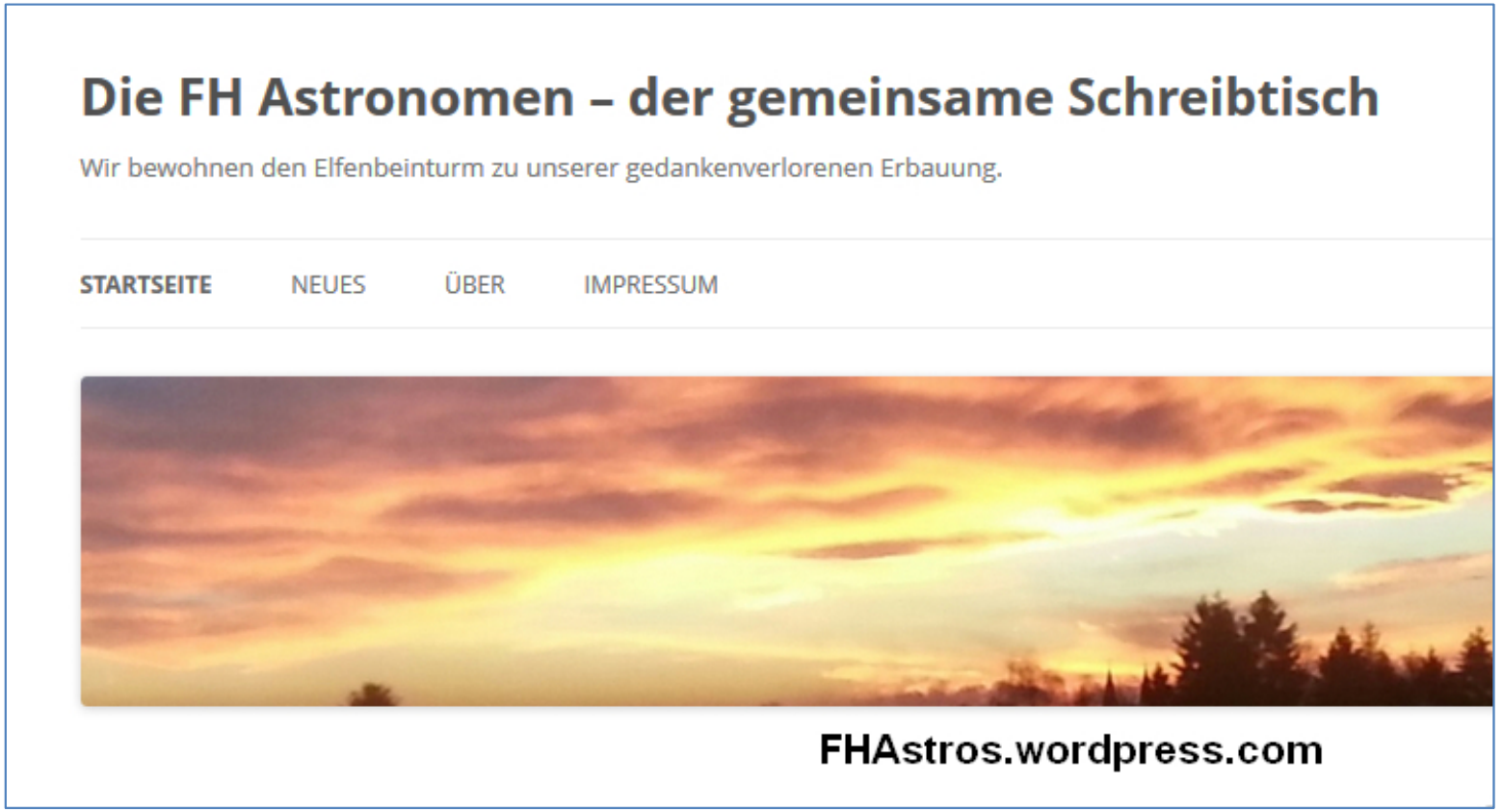
Vorlesungsreihe

ASTRONOMIE

FH Astros

Sommersemester 2017



Kurt.Niel@fh-wels.at - 18.4.2017

Vorlesungsreihe

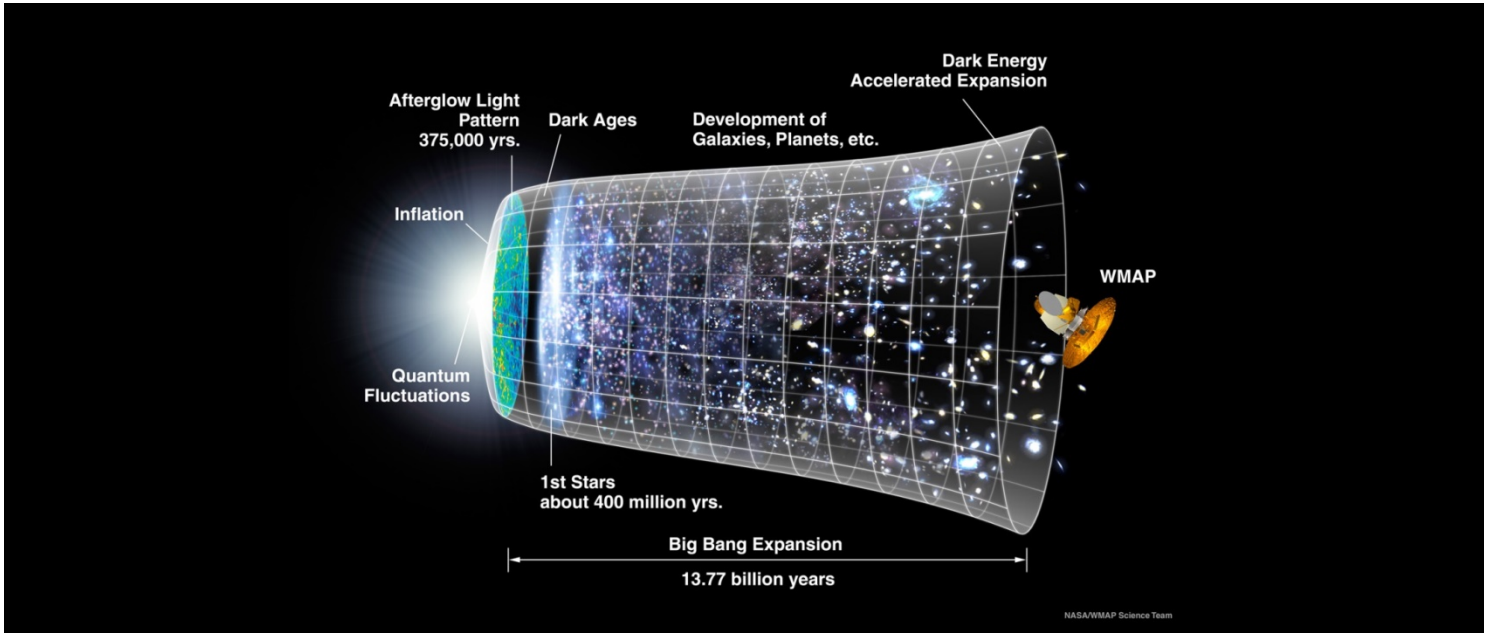
ASTRONOMIE

FH Astros

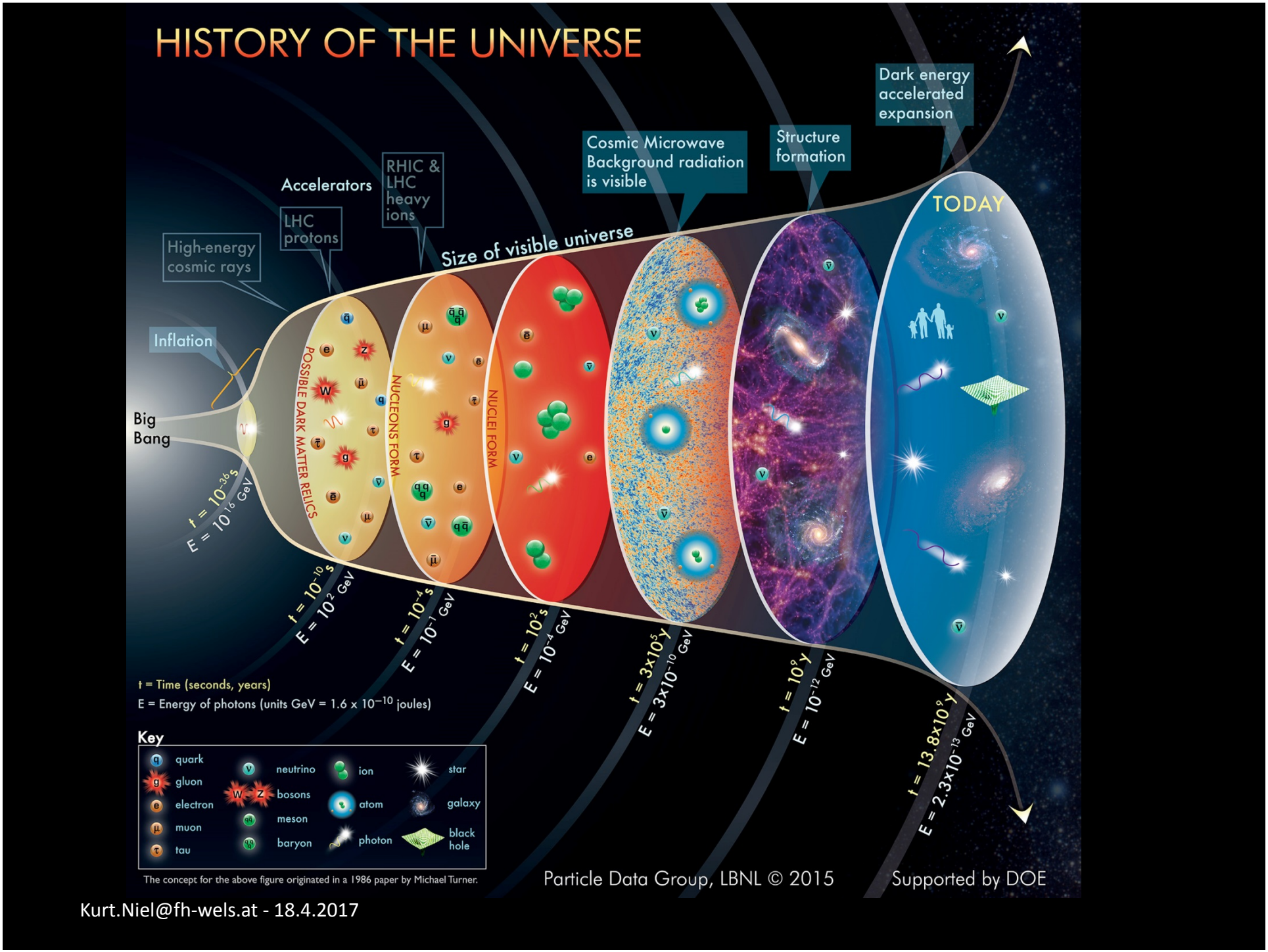
Sommersemester 2017

18. April 2017 – 18:00 Uhr, FH Wels, A2

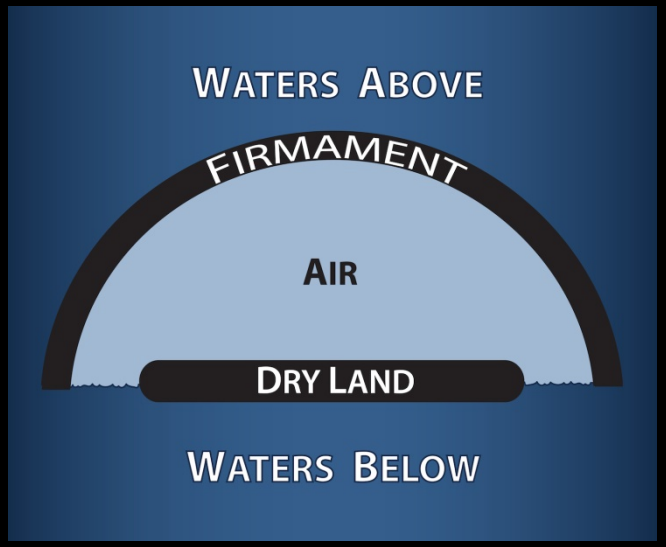
Kosmologie - *Aktueller Stand, Unsicherheiten, Entwicklungen* (Kurt Niel)



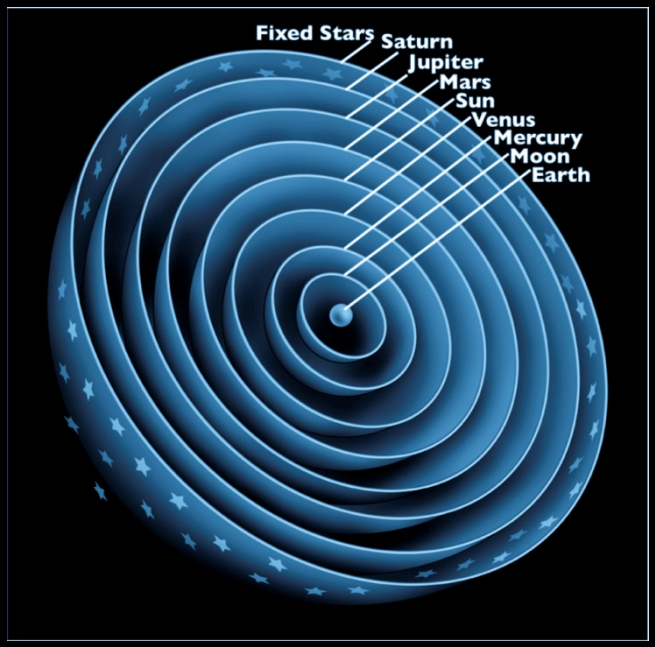
Kurt.Niel@fh-wels.at - 18.4.2017

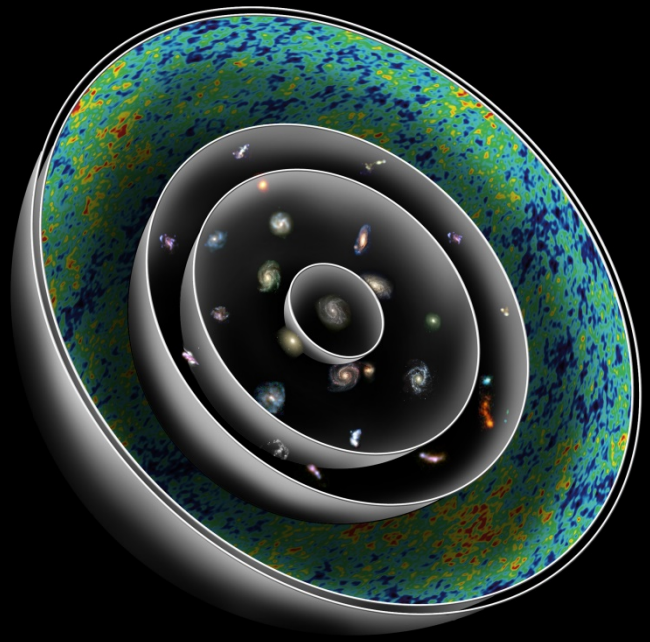


Kurt.Niel@fh-wels.at - 18.4.2017

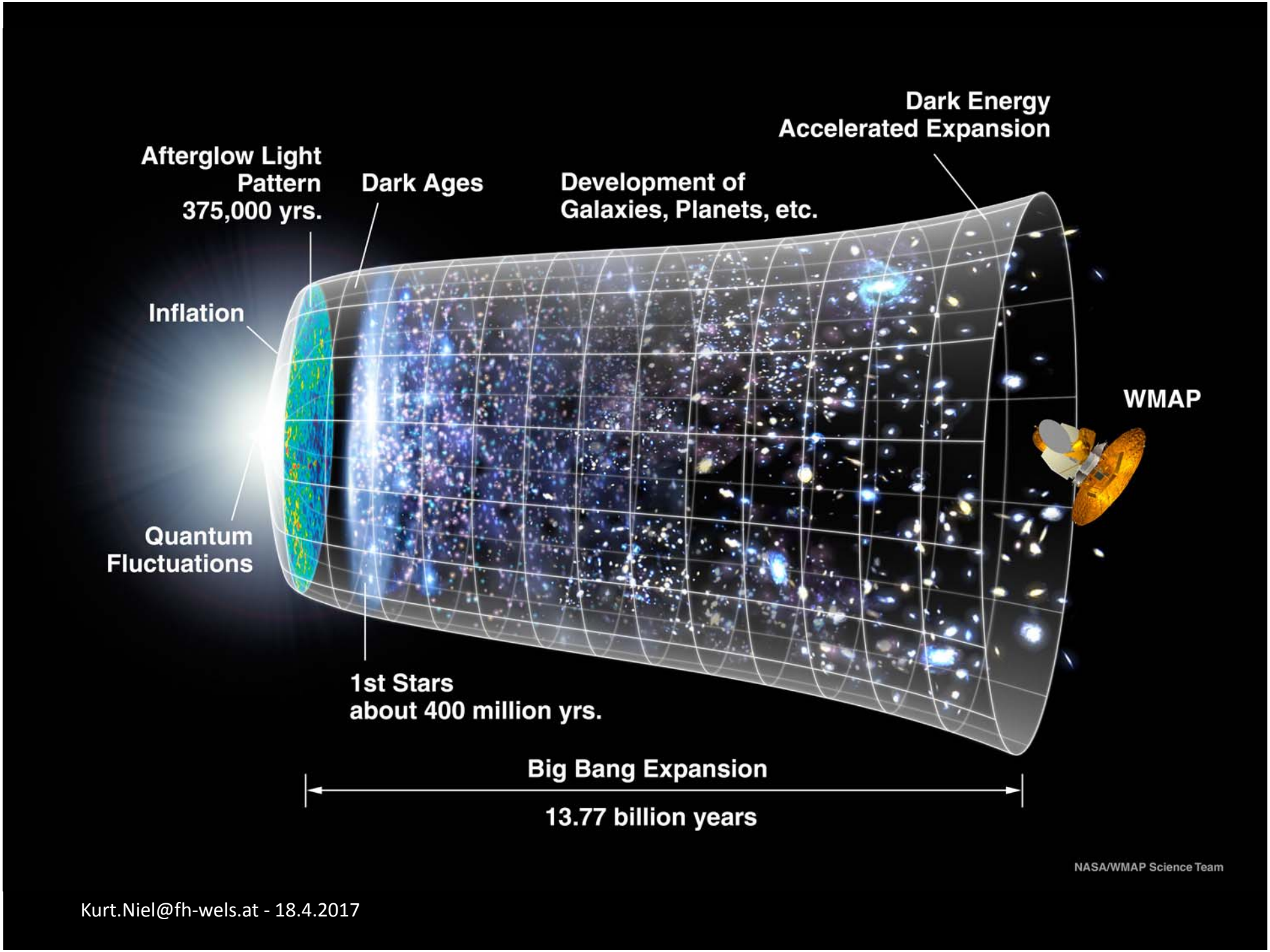


Images: http://new-universe.org Primack/Abrams



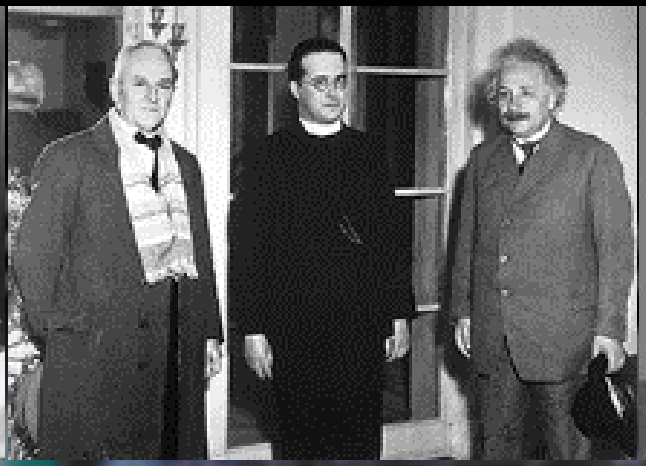


Kurt.Niel@fh-wels.at - 18.4.2017



Kurt.Niel@fh-wels.at - 18.4.2017

Edwin Hubble
1924 Galaxie ex Milchstraße
1929 Expansion Rotverschiebung



Robert Millikan
1910 Öltröpfchen/Elementarladung

George Lemaítre
1927 Expansionsgleichung

Albert Einstein
1917 Relativiät

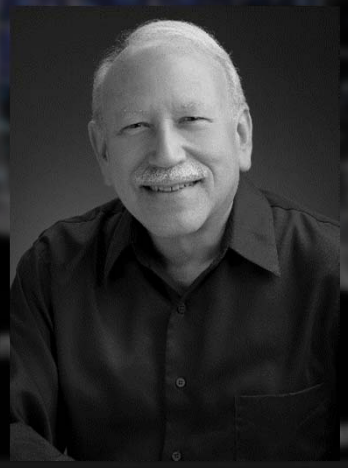
Alexander Friedmann

1927 Expansionsgleichung

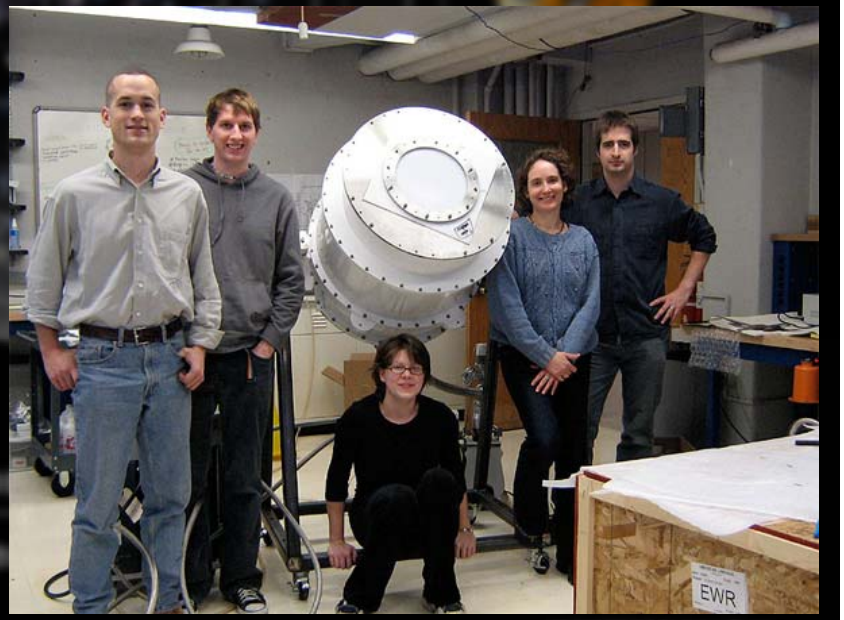
Stephen Hawking
1971 Ereignishorizont Black Hole

Alan Guth
1981 Inflationäres Universum

Roger Penrose
1996 Quantengravitation
2010 CCC



Joel R. Primack
2011 CANDELS,
Bolshoi Simulation



Team QUIET
2011 Messung CMB Polarization

Kurt.Niel@fh-wels.at - 18.4.2017

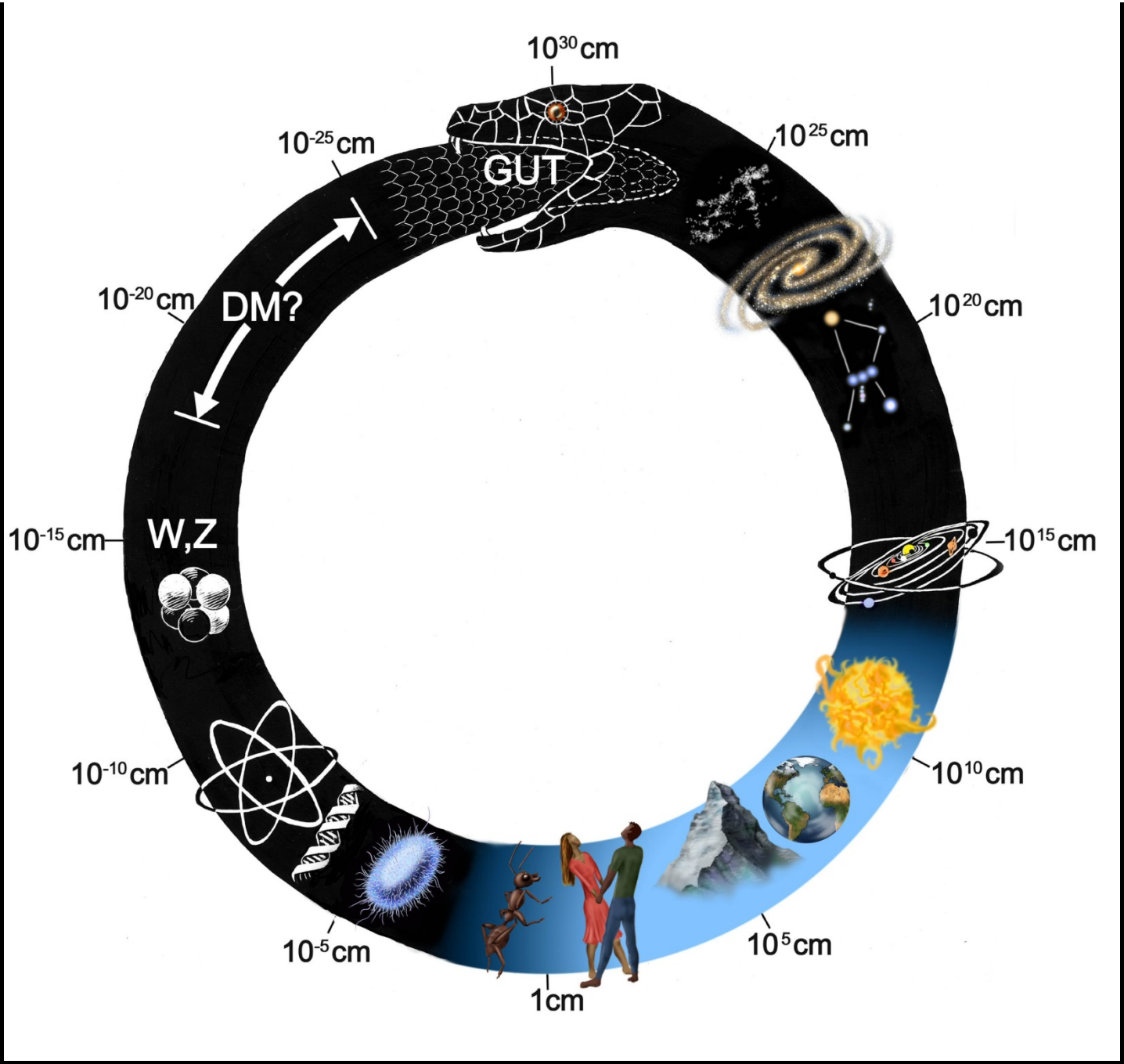
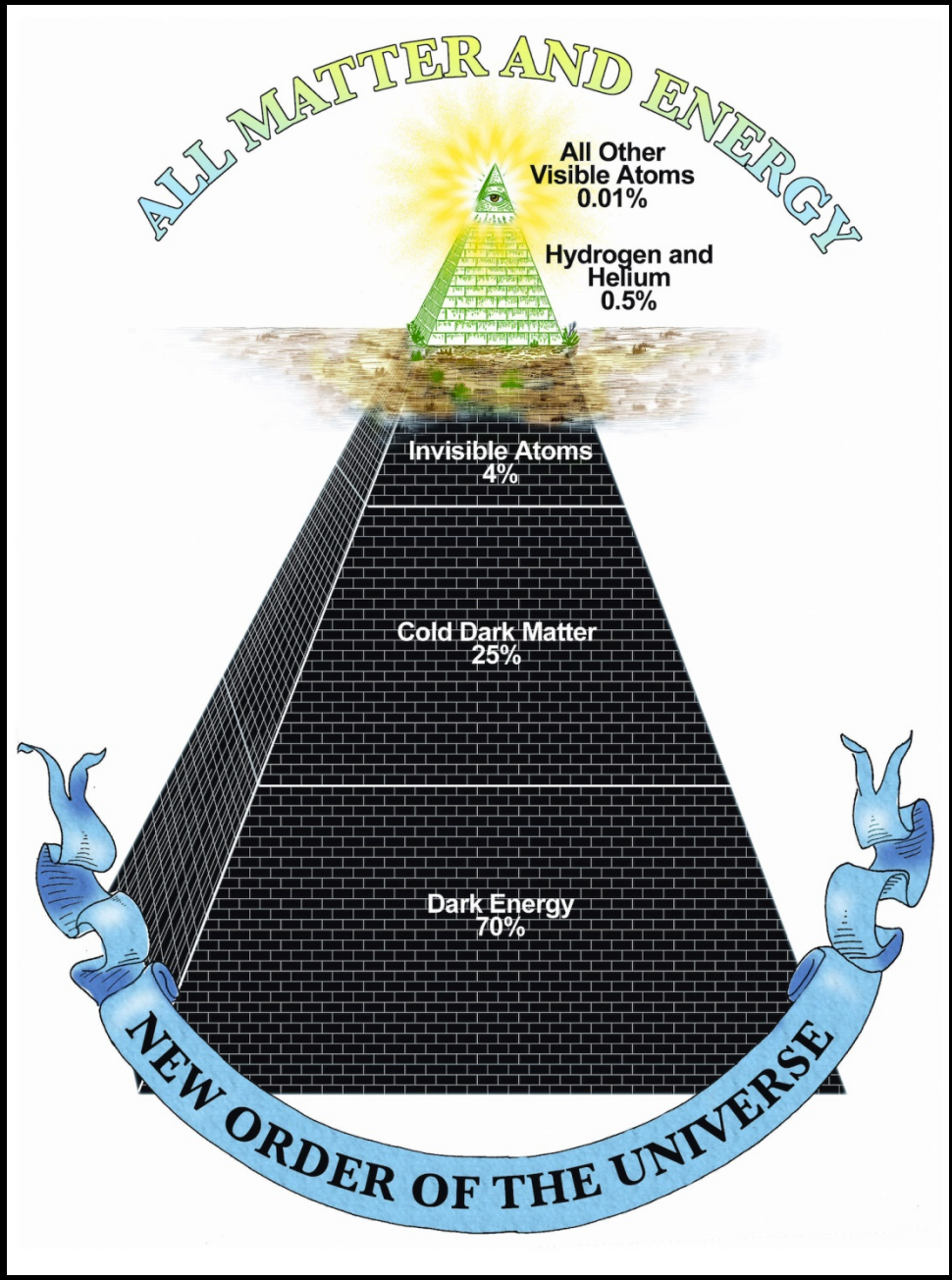


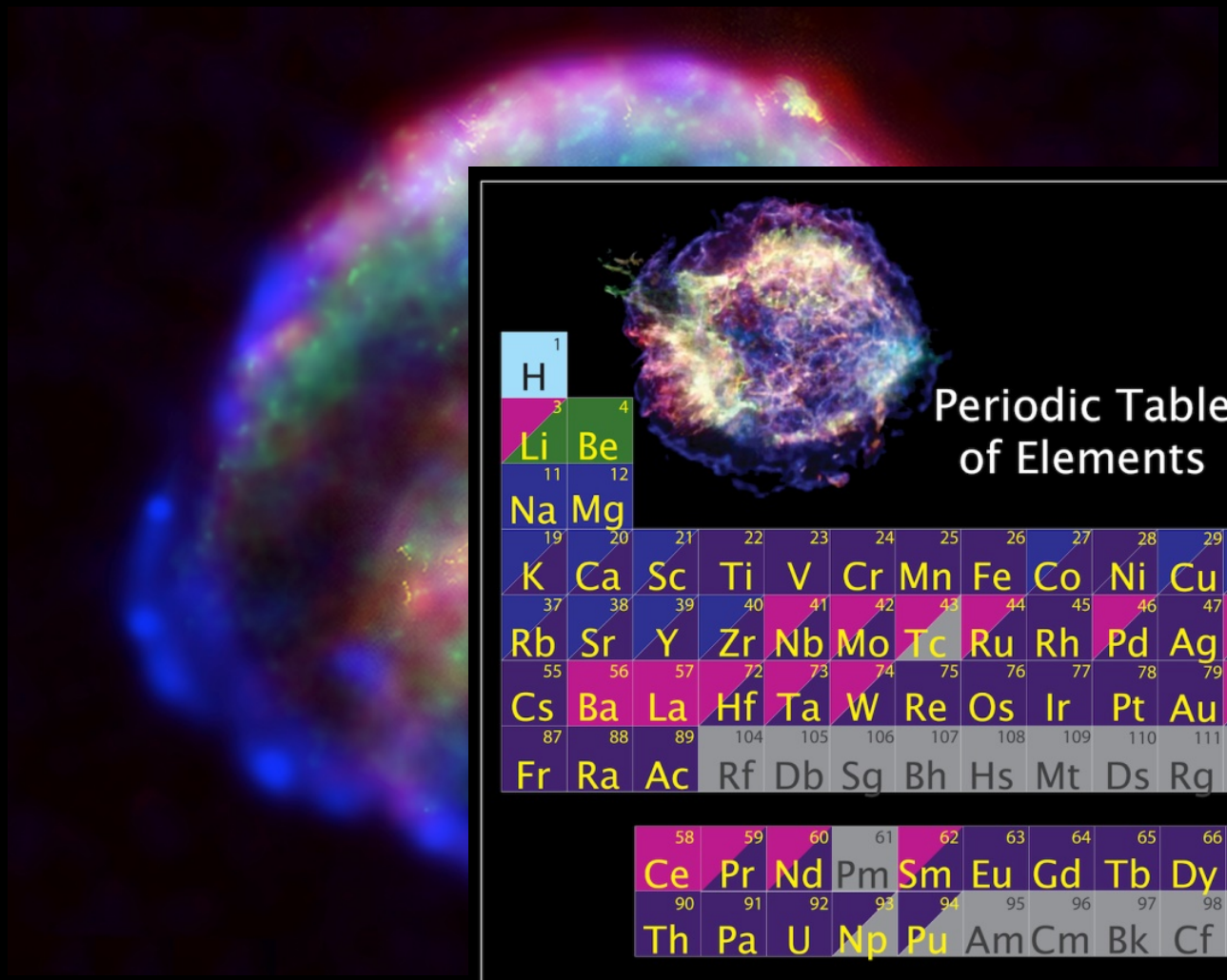
Image: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017



Images: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017



Periodic Table of Elements

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn		114 - -		116 - -		118 - -

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Light blue - Big Bang

Pink - Small Stars

Purple - Supernovae

Green - Cosmic Rays

Blue - Large Stars

Dull gray - Made in Lab

Images: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017

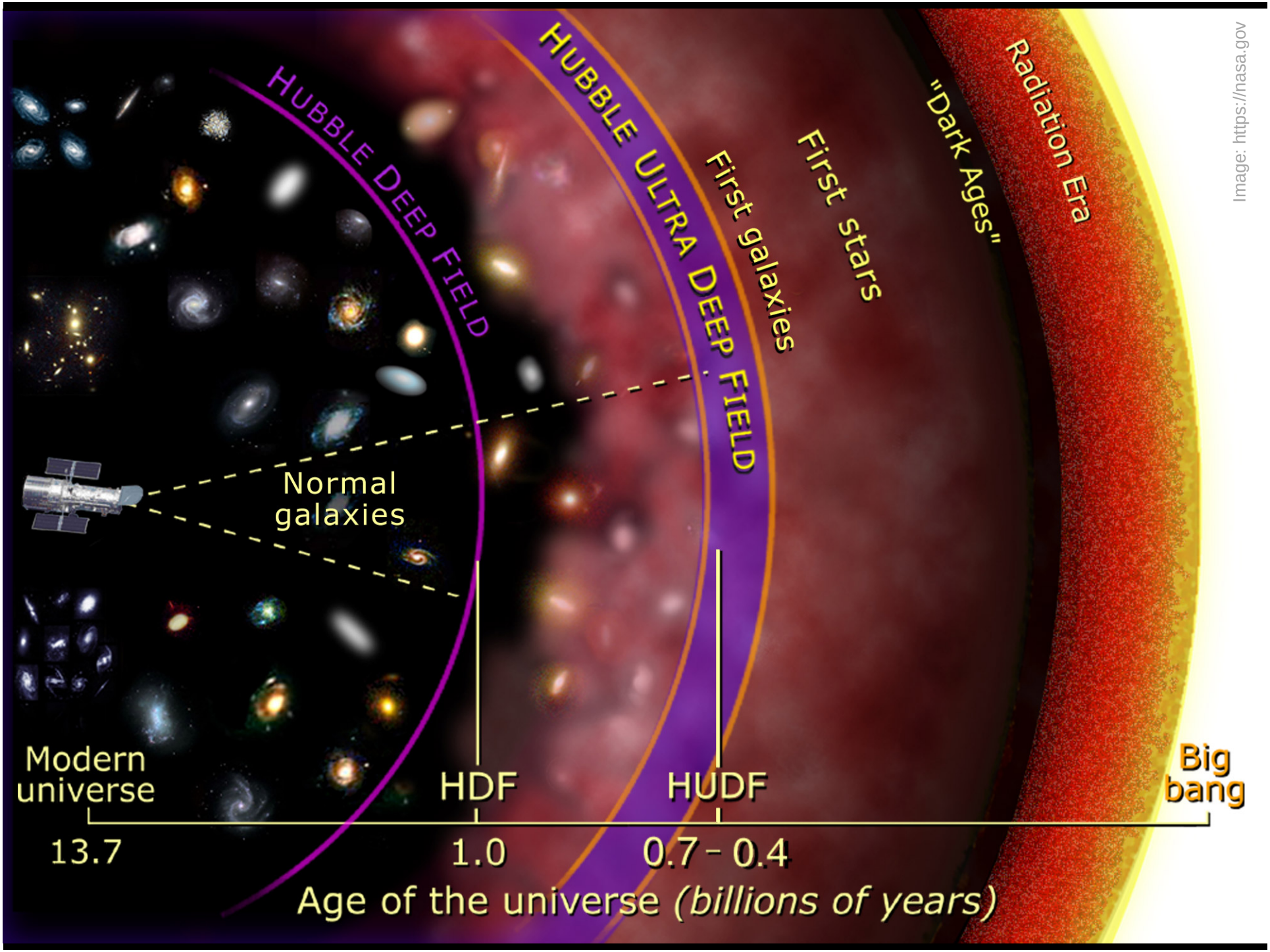
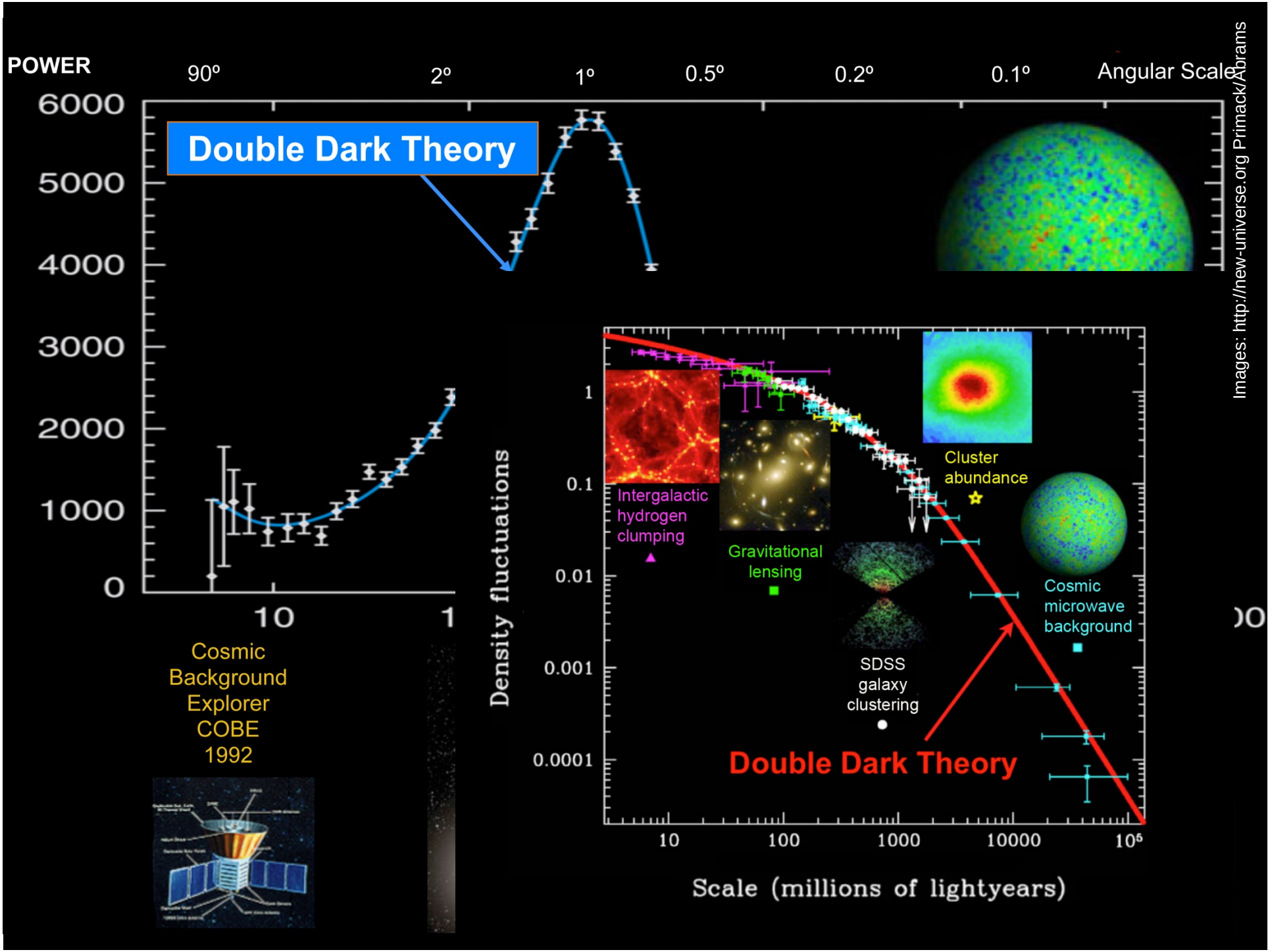
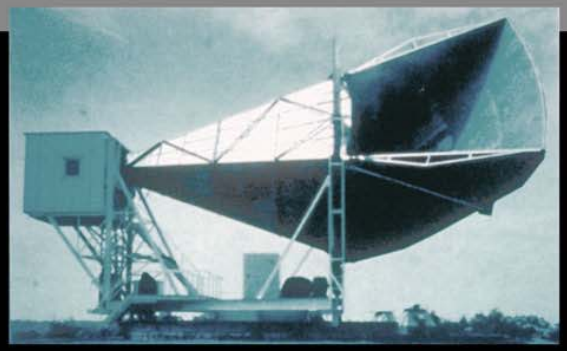

Hubble Deep Field
Hubble Ultra Deep Field
First galaxies
First stars
"Dark Ages"
Radiation Era
Normal galaxies
Modern universe
HDF
HUDF
Big bang
13.7
1.0
0.7 - 0.4
Age of the universe (billions of years)
Image: https://nasa.gov

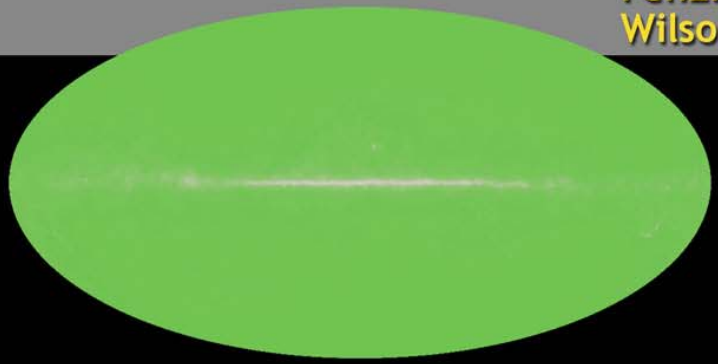

Image: http://new-universe.org Primack/Abrams


POWER
90º
2º
1º
0.5º
0.2º
0.1º
Angular Scale
6000
5000
4000
3000
2000
1000
0
Double Dark Theory
10
1
Cosmic
Background
Explorer
COBE
1992
Density fluctuations
1
0.1
0.01
0.001
0.0001
Intergalactic
hydrogen
clumping
Gravitational
lensing
Cluster
abundance
Cosmic
microwave
background
SDSS
galaxy
clustering
Double Dark Theory
10
100
1000
10000
10⁵
Scale (millions of lightyears)
Images: http://new-universe.org Primack/Abrams

1965

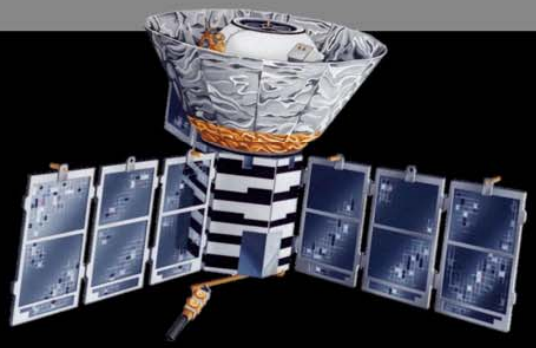
Penzias and Wilson

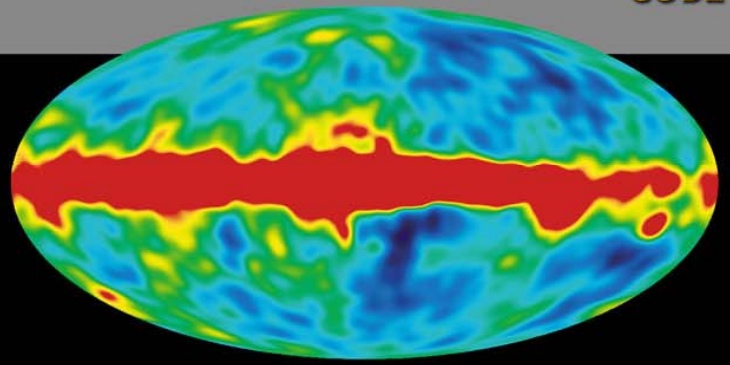




1992

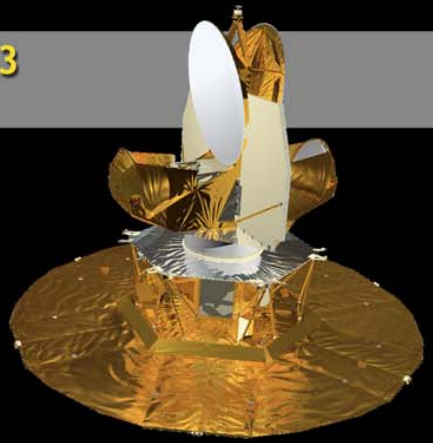
COBE

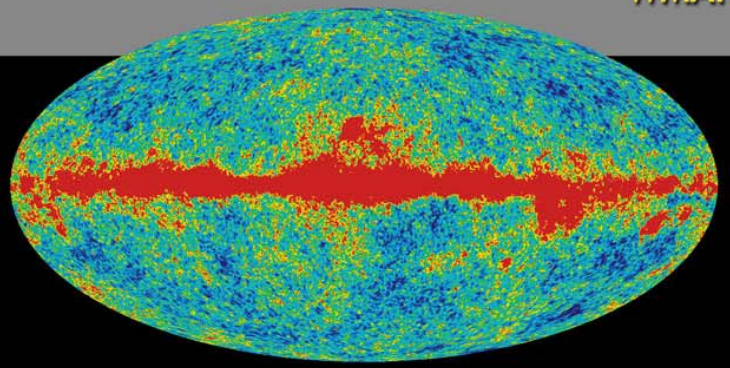




2003

WMAP

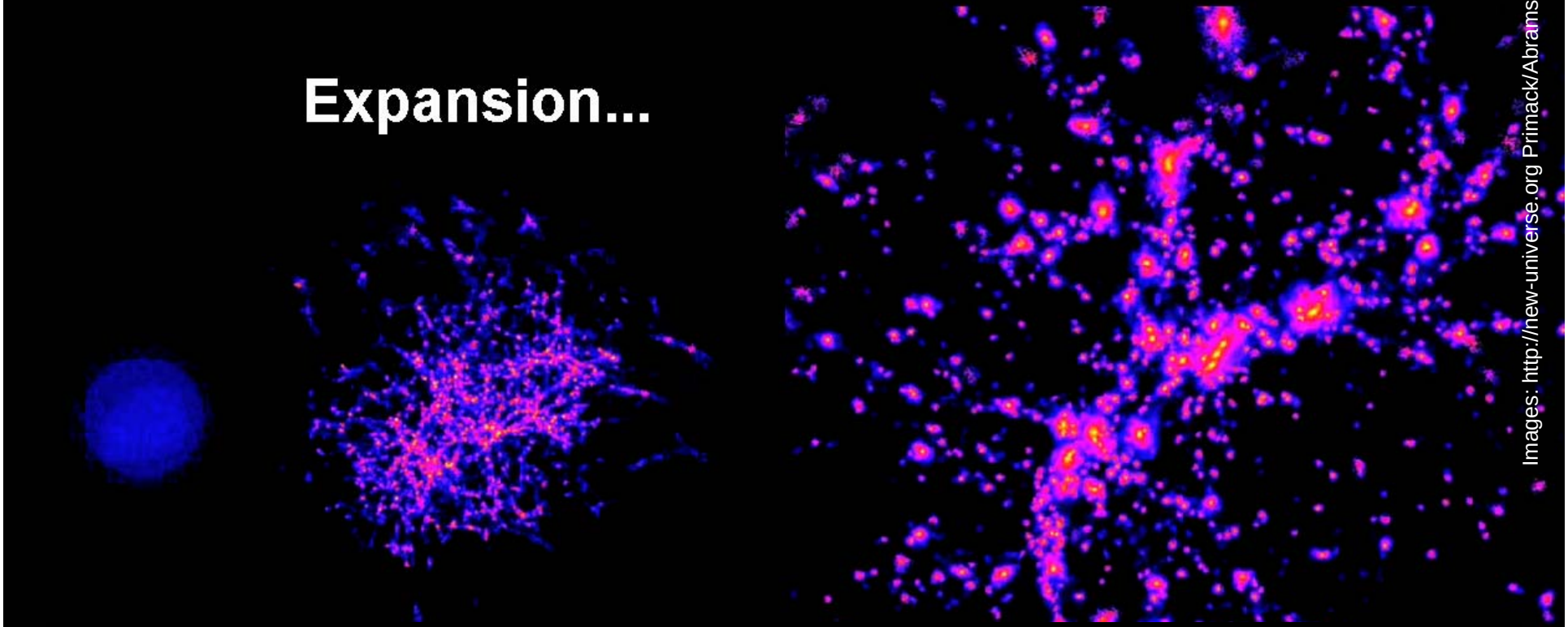


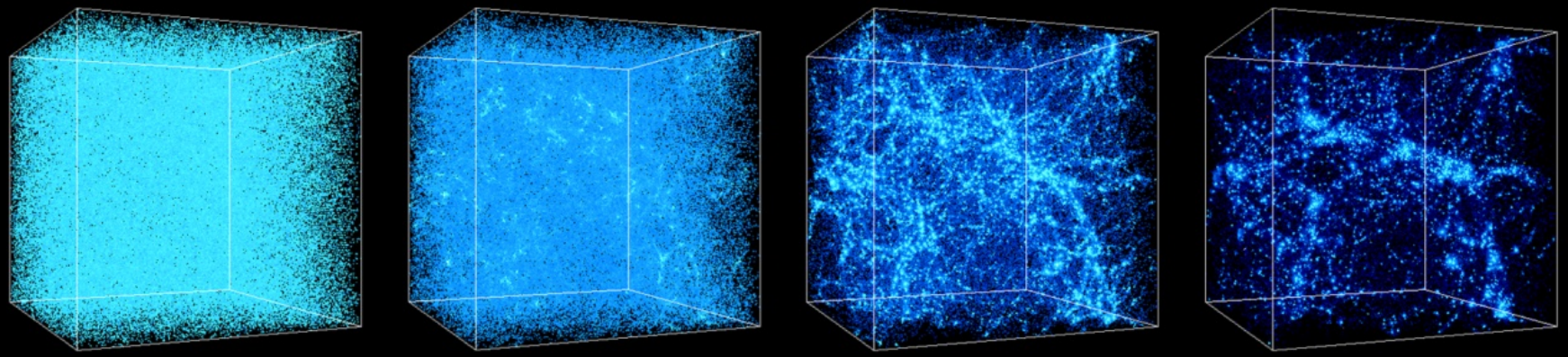


Images: https://wmap.gsfc.nasa.gov

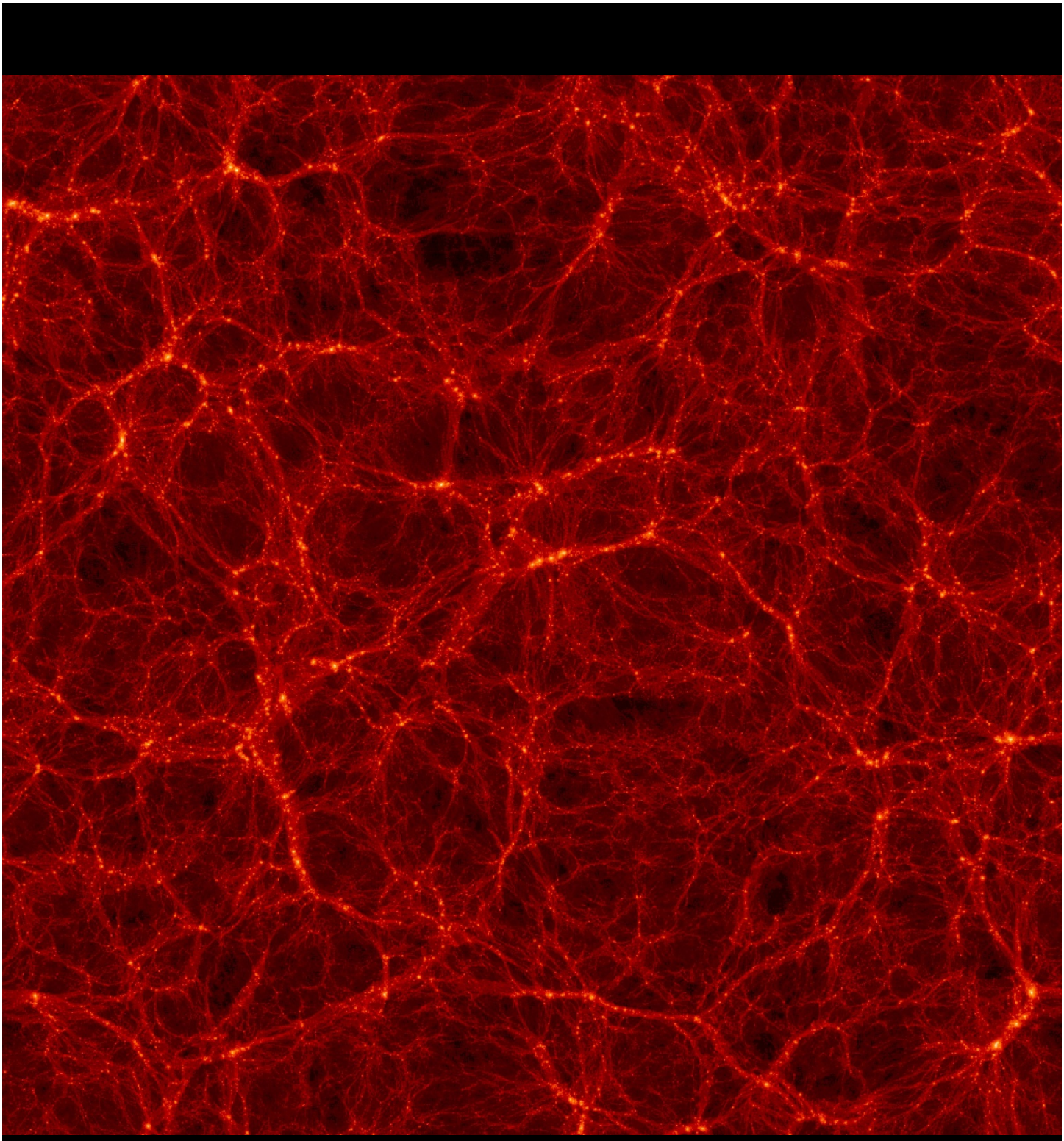
Kurt.Niel@fh-wels.at - 18.4.2017

Expansion...

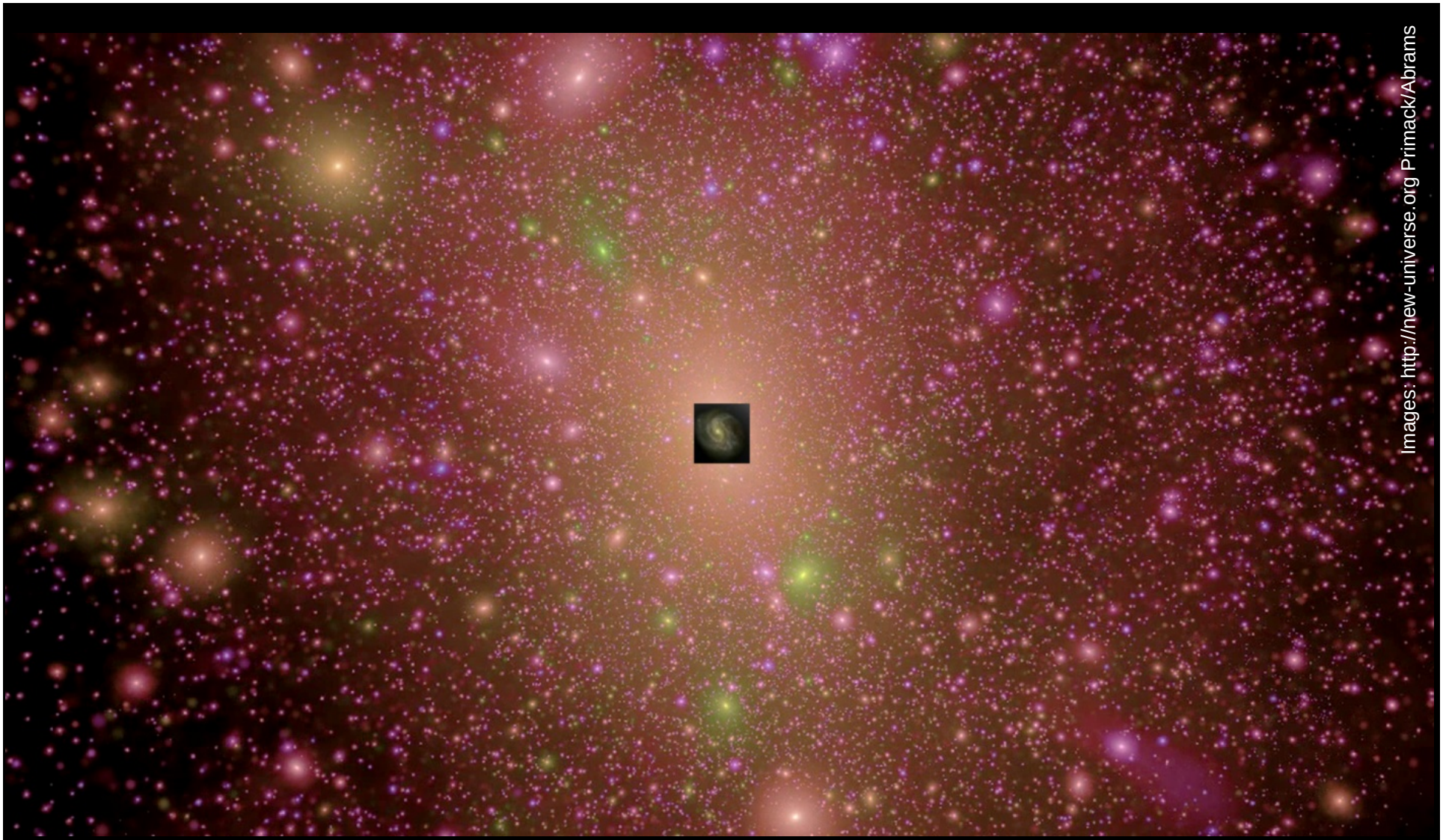




Images: http://new-universe.org Primack/Abrams



Images: http://new-universe.org Primack/Abrams



Images: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017

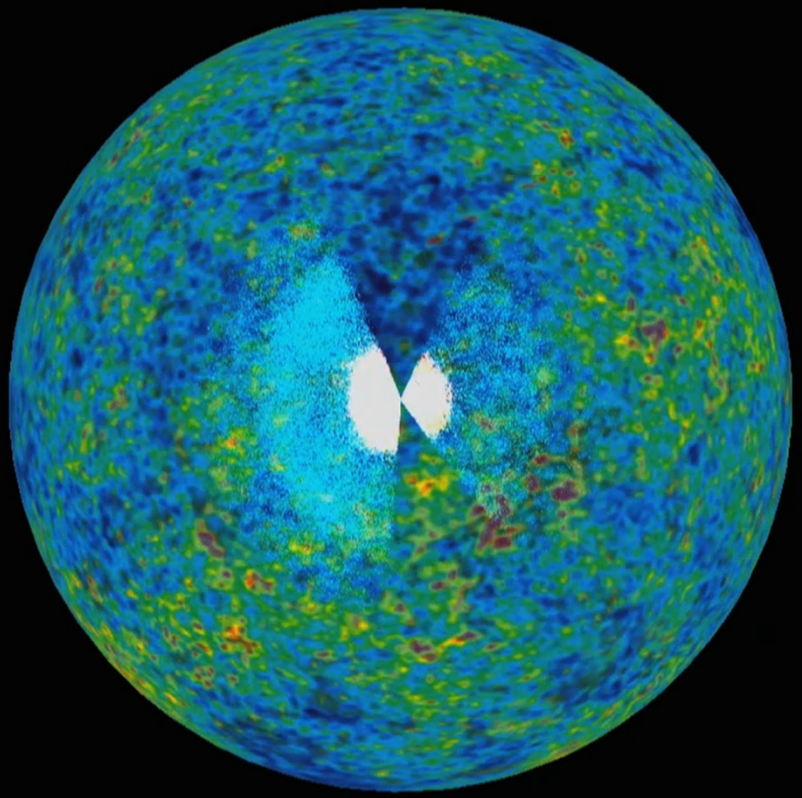
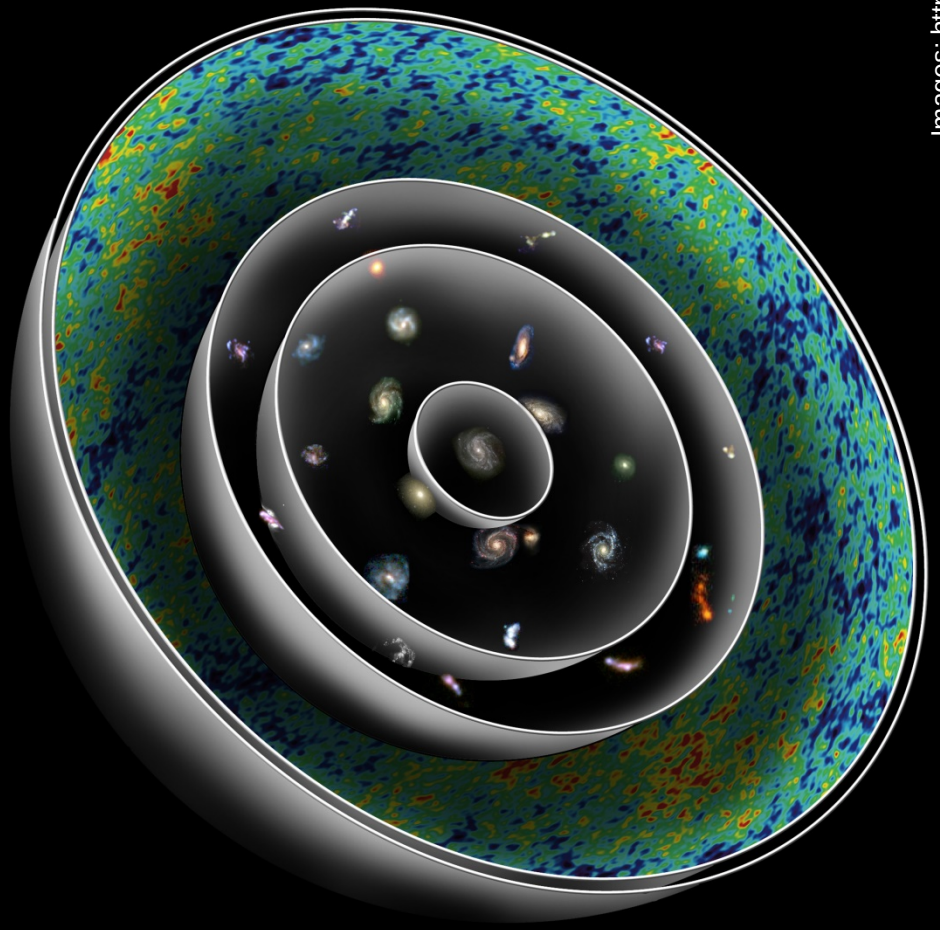
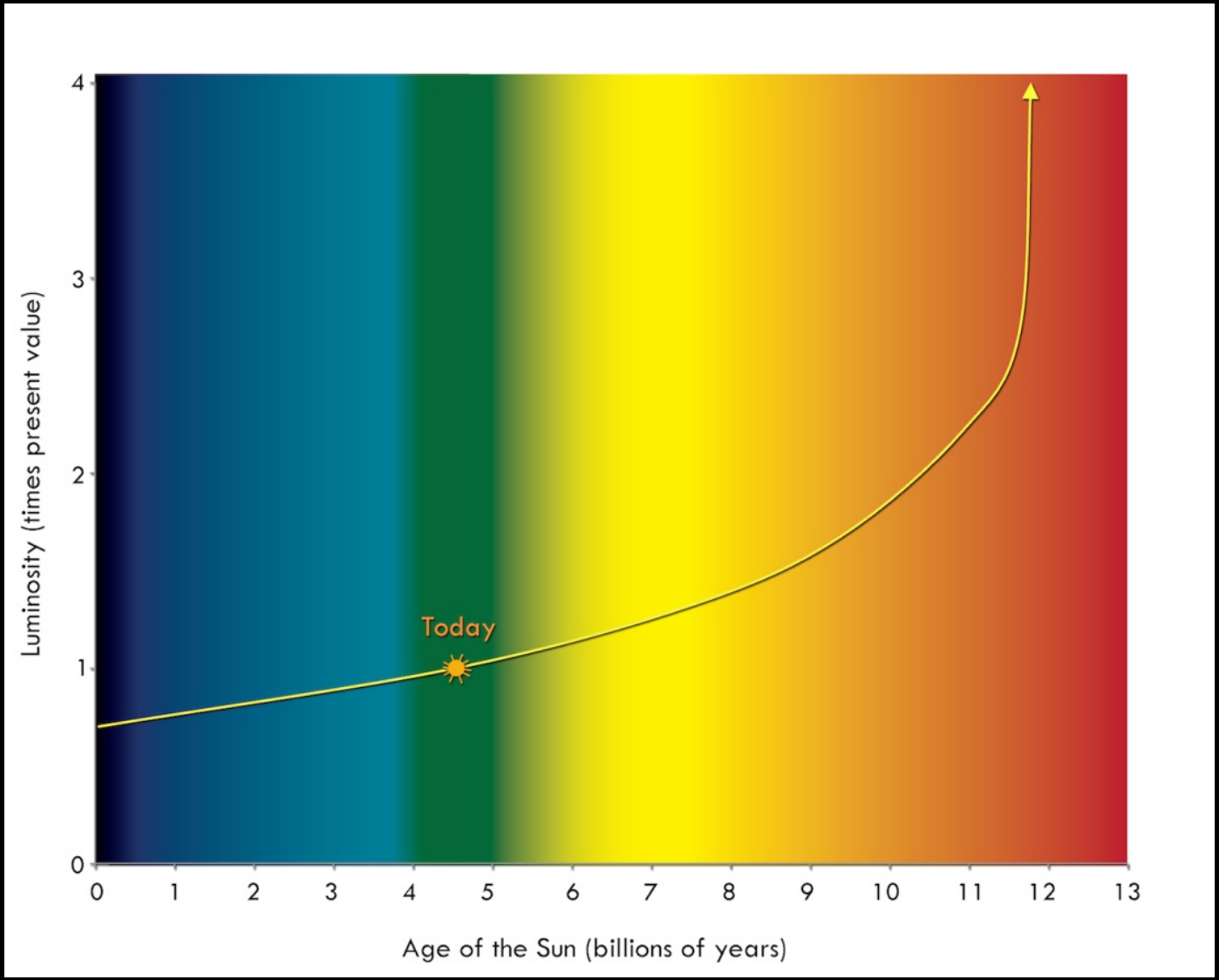


Bild des gesamten Universums
aus Messdaten (keine Simulation!)



Images: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017



Images: http://new-universe.org Primack/Abrams

Kurt.Niel@fh-wels.at - 18.4.2017


Images: http://new-universe.org Primack/Abrams

Unsicherheiten

- Noch kein direkter Nachweis Dunkle Materie (Axion?)
- Dunkle Energie als Feldskalar des Raumes angesetzt – ohne Erklärung

Alternativen

MOND – Modified Newtonian Dynamics 1987 e.g. Erik Verlinde
https://www.wired.com/2017/01/case-dark-matter/
Erklärt Galaxiedrehung ohne Dunkle Materie

Raum und Zeit sowie Länge und Masse ineinader wandelbar - 2010 Wun-Yi Shu
Während sich Universum ausdehnt wird laufend Zeit in Raum und Masse in Länge - Lichtgeschwindigkeit und Gravitationskonstante nicht konstant
“The Geometry of the Universe”
https://arxiv.org/abs/1007.1750

QUELLEN

Standardmodell - Spektrum.de
http://www.spektrum.de/lexikon/physik/standardmodell-der-kosmologie/13743

Bolshoi Cosmological Simulation
http://hipacc.ucsc.edu/Bolshoi/

Aquarius Simulation
https://www.eso.org/public/germany/videos/aquarius_springel/

Joel R. Primack / Nancy Ellen Abrams
http://viewfromthecenter.com/
http://new-universe.org/index.html

Vorlesungsreihe

ASTRONOMIE

FH Astros

Sommersemester 2017

18. April 2017 – 18:00 Uhr, FH Wels, A2

Kosmologie - *Aktueller Stand, Unsicherheiten, Entwicklungen* (Kurt Niel)

6. Juni 2017 – 18:00 Uhr, FH Wels, A2

Entwicklungen von Messinstrumenten für den Raumflug -

Funktionell, autark, strahlungsresistent, langlebig, irreparabel

(Dr. Manfred Steller, Institut für Weltraumforschung, Österreichische Akademie der Wissenschaften)

29. Mai 2017 – 18:00 Uhr, FH Wels, A2

noch offen

26. Juni 2016 – ggf. Exkursion

noch offen

Kurt.Niel@fh-wels.at - 18.4.2017

Kosmologische Ära

- Planck-Ära
  $< 10^{-43}$ Sekunden
  alle vier Kräfte noch vereint
- GUT-Ära (Grand Unified Theory)
  $< 10^{-33}$ bis 10^{-30} s
  Inflation, Expansion 10^{30} und 10^{50}
- Quark-Ära (Elektroweak)
  $< 10^{-7}$ s
  Quarks, Leptonen, Photonen; Ungleichgewicht Materie/Antimaterie
  Baryogenese
- Hadronen-Ära
  $< 10^{-4}$ s
  Protonen, Neutronen deren Antiteilchen; Myonen, e-, e+, Neutrinos, Photonen
- Lepton-Ära
  < 10 s
  Myonen zerfallen, e- e+ annihilieren (erzeugen Photonen)
- Promordiale Nukleosynthese
  < 3 min
  H, He, Li entstehen
- Stahlungs-Ära
  < 300 000 j
  Universum undurchsichtig; Sichtbarkeitsgrenze CMB (Cosmic Microwave Background)
- Materie-Ära
  bis heute
  Universum wird durchsichtig, Galaxien entstehen.

Technische Spezifikation Universum

- Alter: 13,77 Mrd Jahre
- Ausdehnung: 100 Mrd Lj (10^{30} cm)
- Volumen: 10^{87} cm^3
- Anzahl Galaxien: 100 Mrd, je 100 Mrd Sterne, je 10^{58} Protonen
- Dichte Protonen: 10^{-7} je cm^3 oder 1 je 10 m^3
- Dichte Photonen: 400 je cm^3 (aus Planck & $T_{Hintergrundstrahlung}$)
- Dichte Moleküle Luft: 2,55 10^{19} je cm^3

Physikalische Grenzen – Planck

- Zeit: 10^{-43} s
- Länge: 10^{-35} m