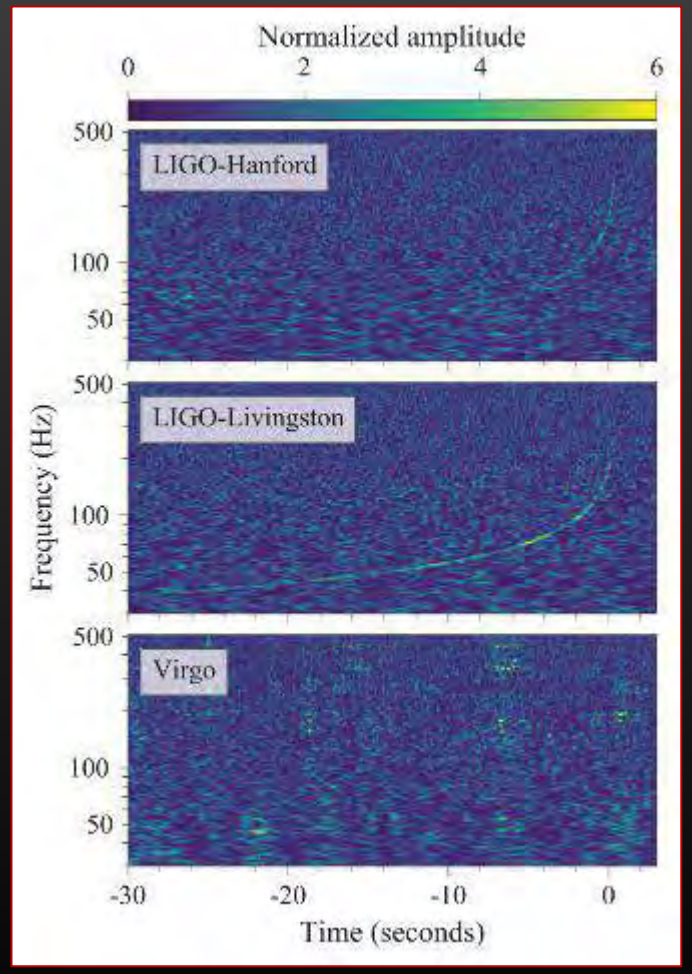
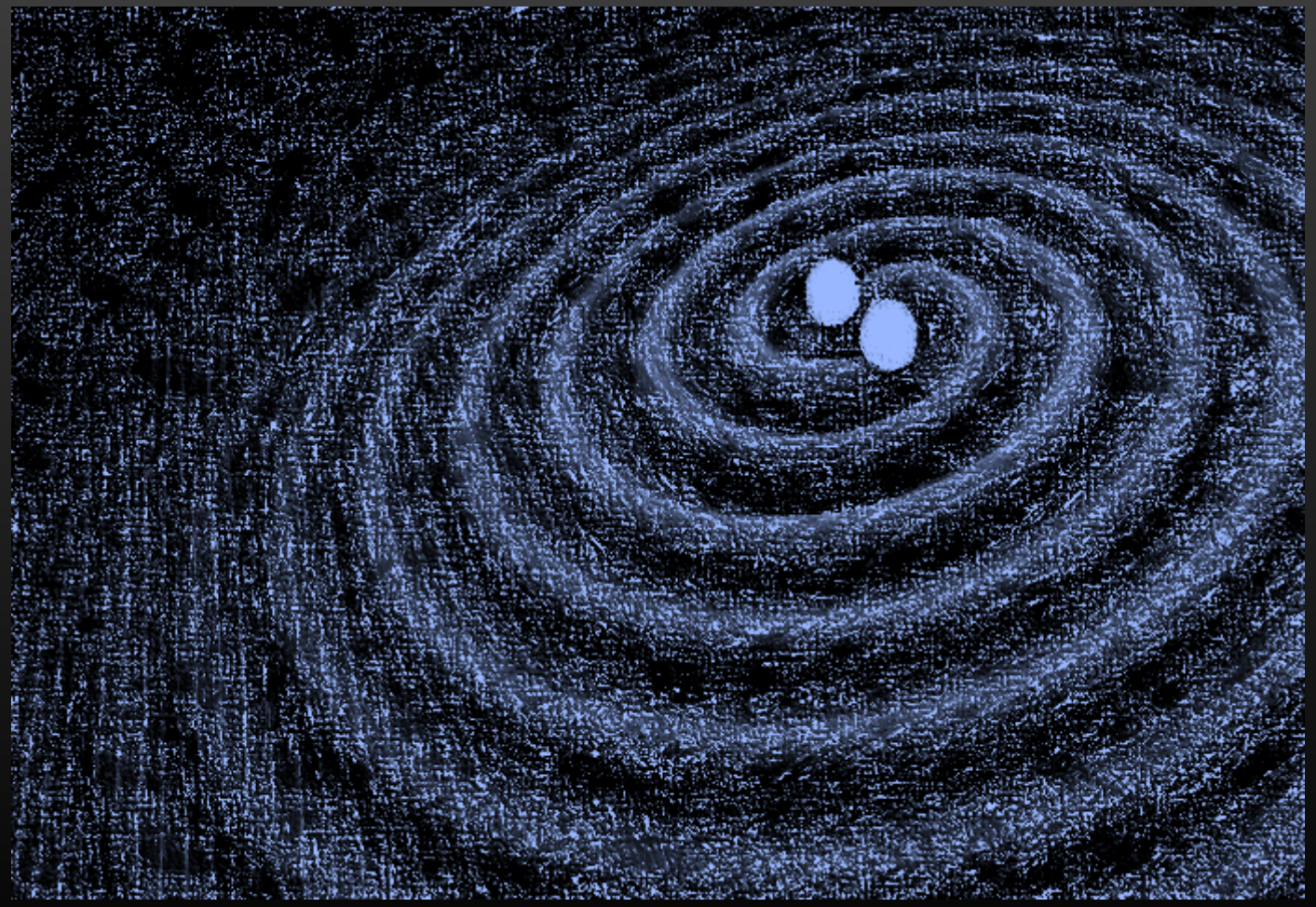
Når Stjerner Kolliderer

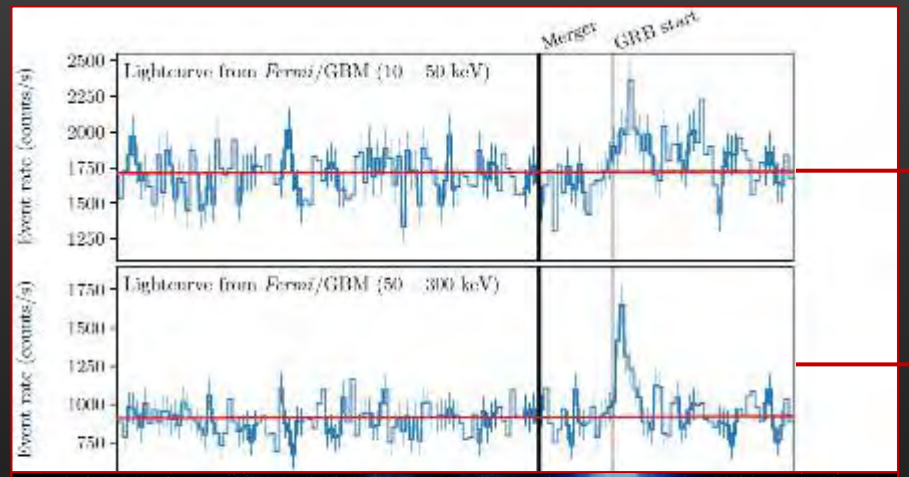
Albert Bjerregård Sneppen

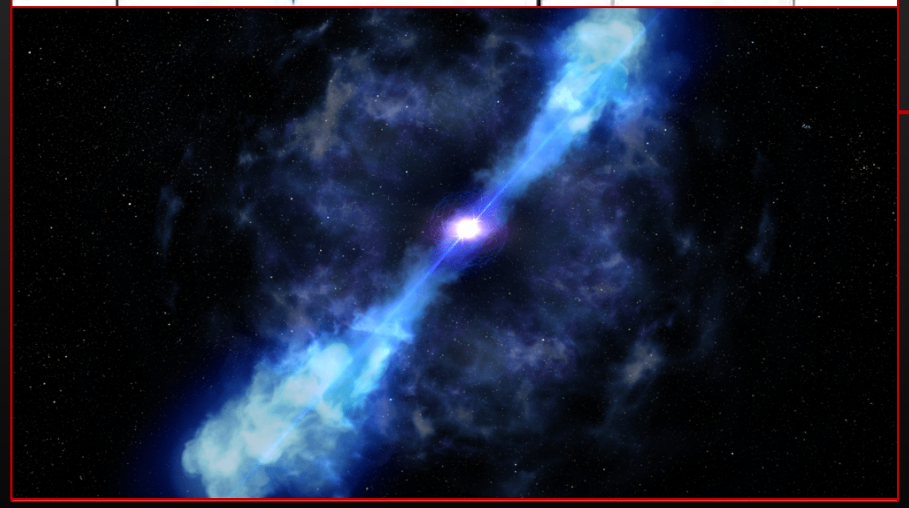
The Niels Bohr Institute & The Cosmic DAWN Center

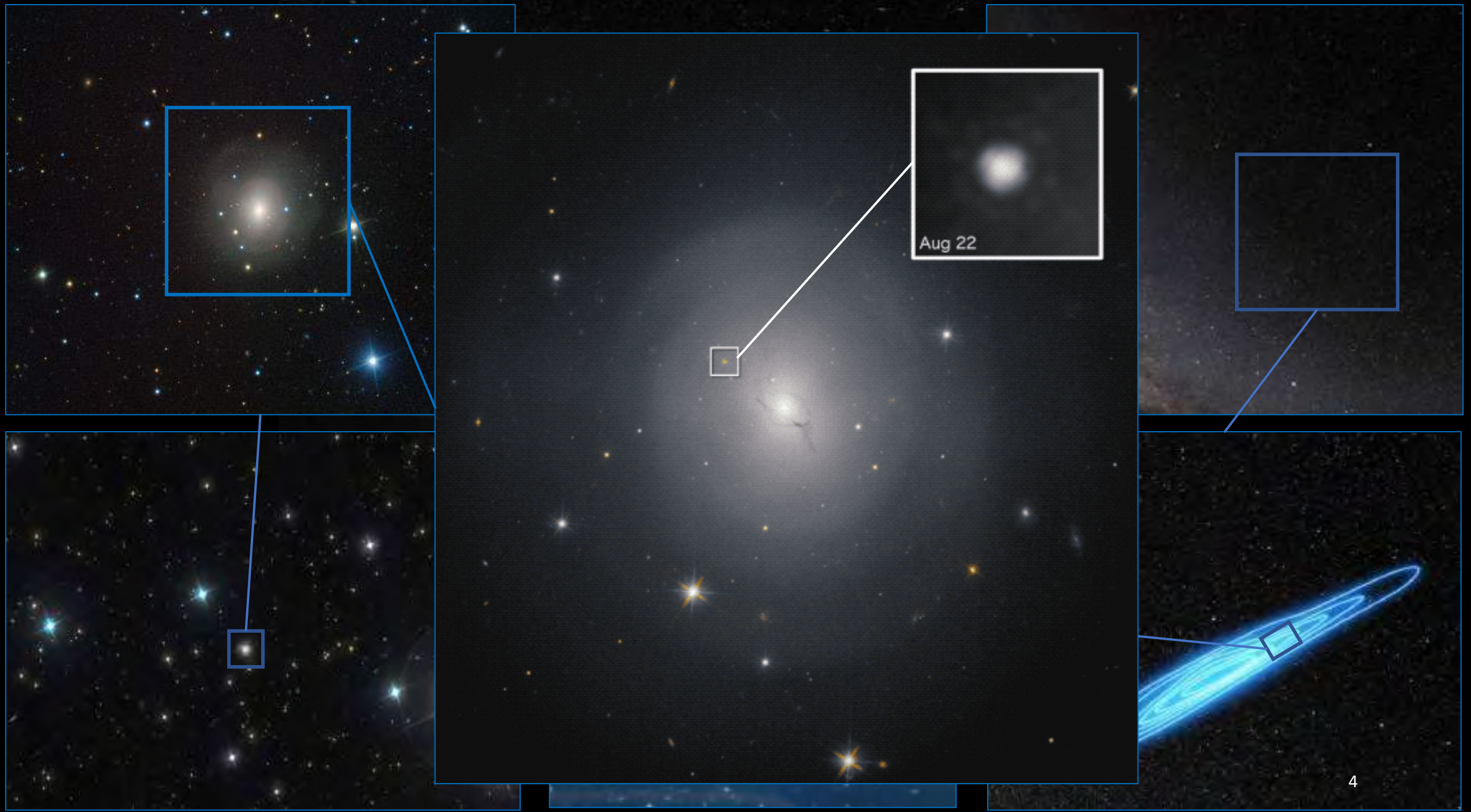
Den 17. August 2017…






Merger
GRB start
Lightcurve from *Fermi*/GBM (10 – 50 keV)
Event rate (counts/s)
2500
2250
2000
1750
1500
1250
Lightcurve from *Fermi*/GBM (50 – 300 keV)
Event rate (counts/s)
1750
1500
1250
1000
750

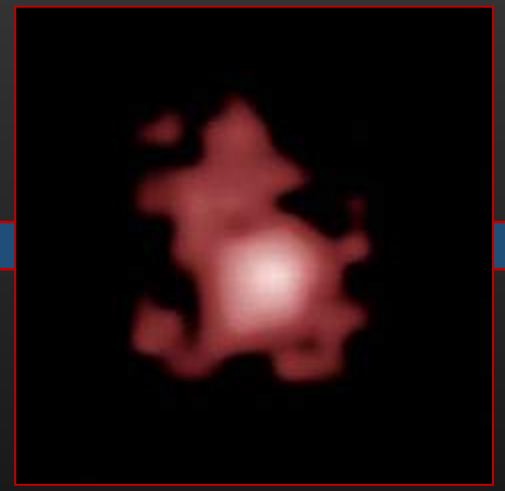



Aug 22

1 second

4 years

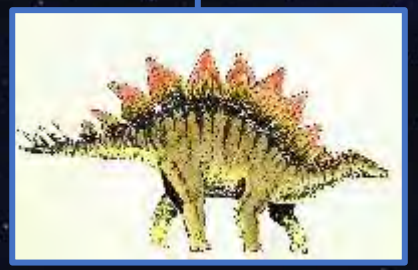
2.500.000 years



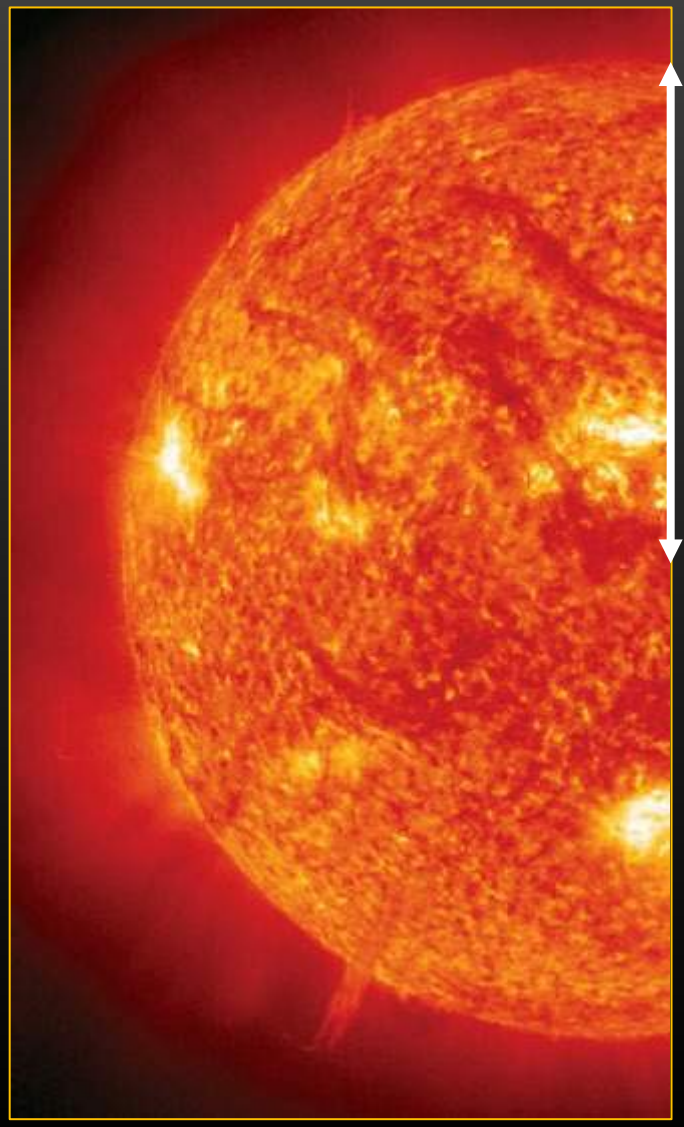
13.400.000.000 years

Ca. 140 millioner lysår

1.320.000.000.000.000.000.000 km



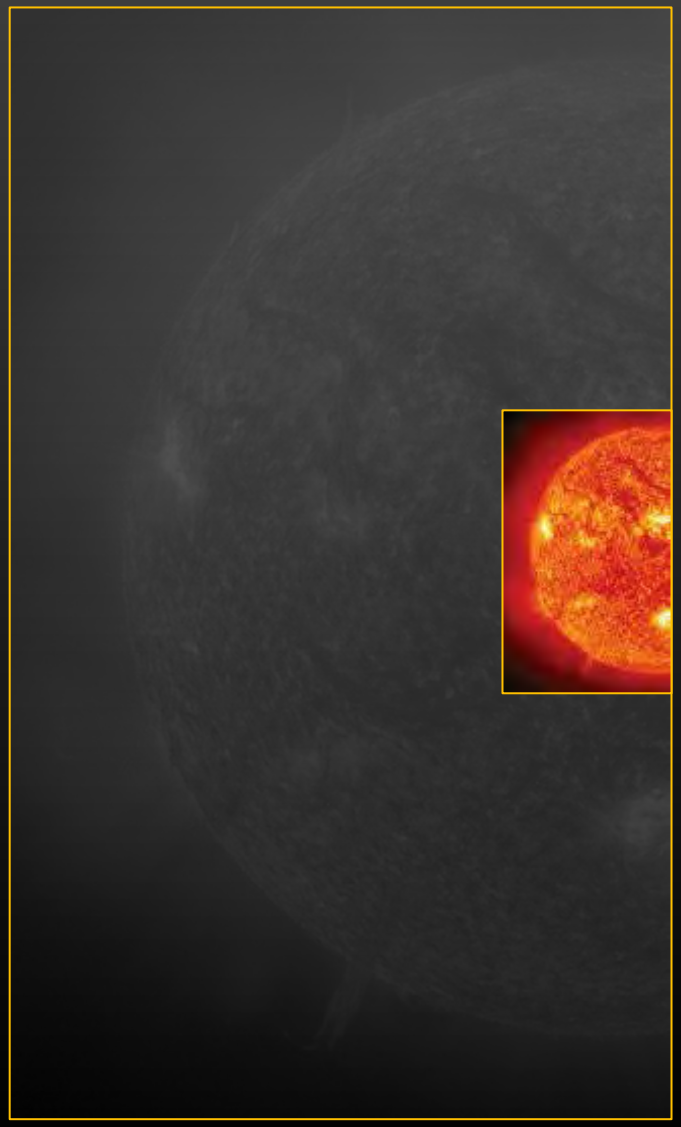
Oprindelsen af Neutron-stjerner



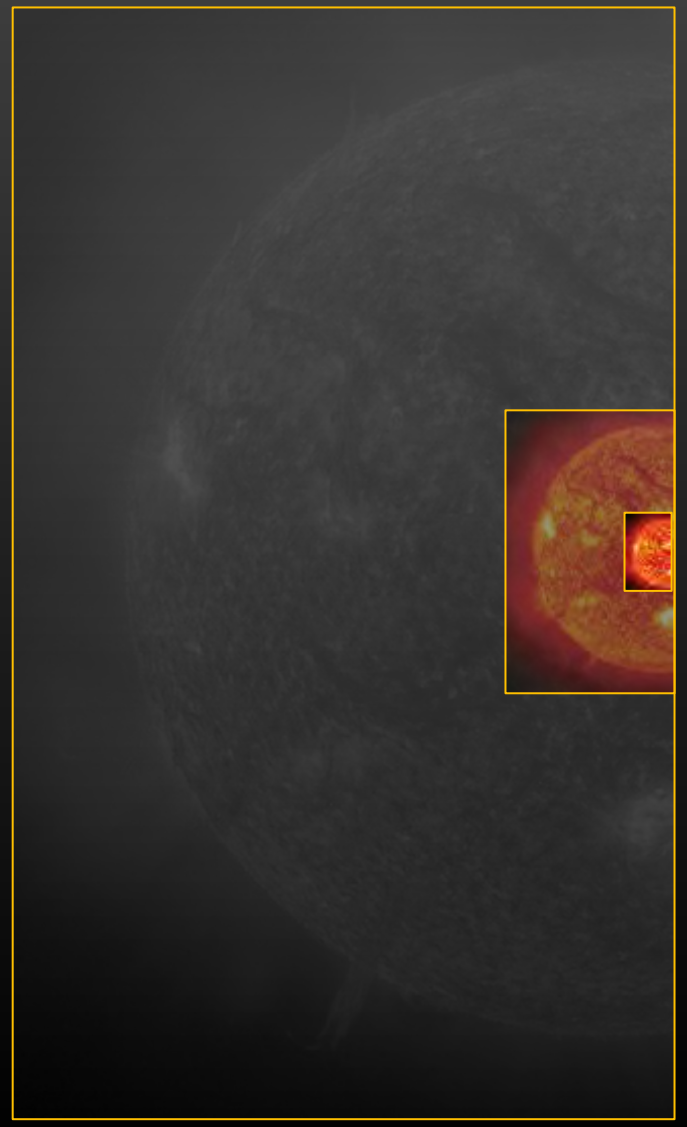
700.000 km

Det ville svare til afstanden man kunne køre på motorvejen 120 km/t, 24 timer i døgnet i 8 måneder!

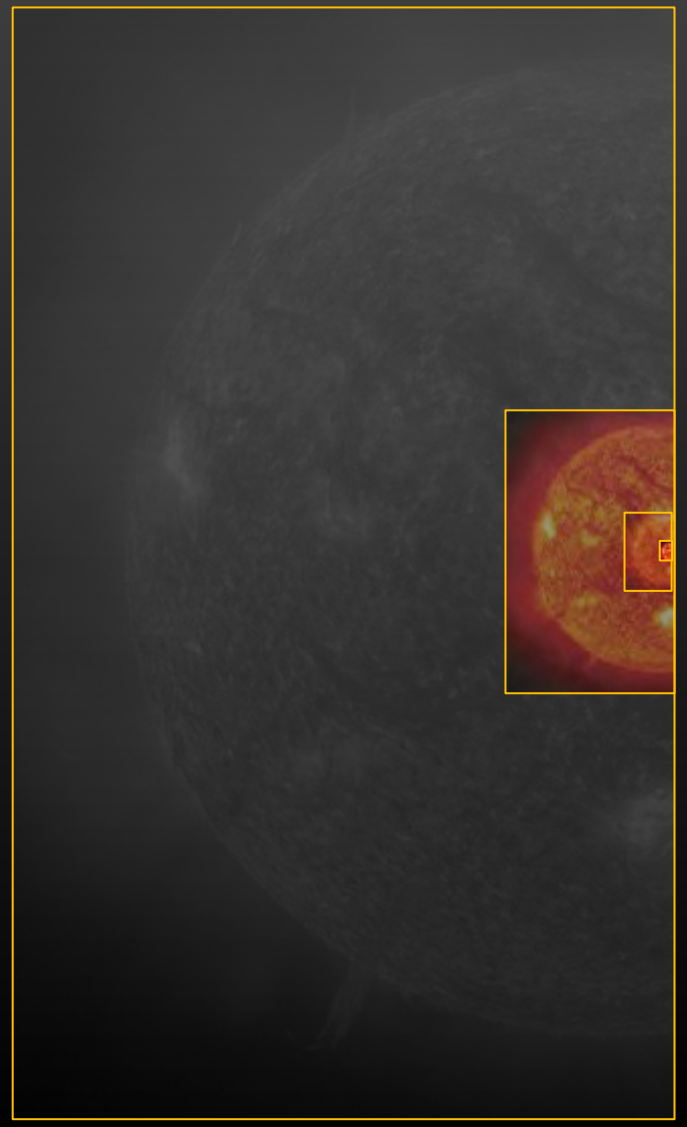
Oprindelsen af Neutron-stjerner



Oprindelsen af Neutron-stjerner

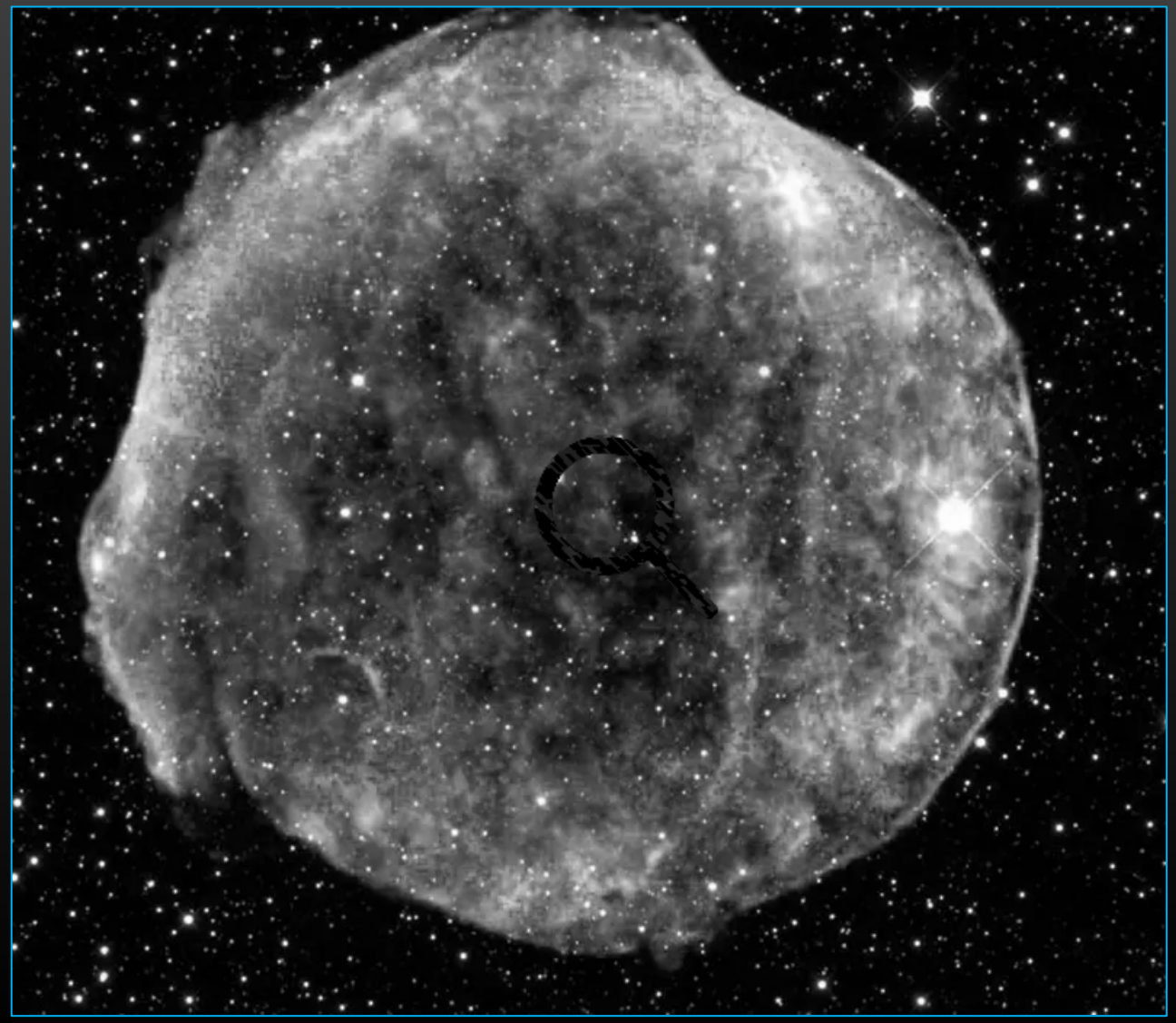


Oprindelsen af Neutron-stjerner

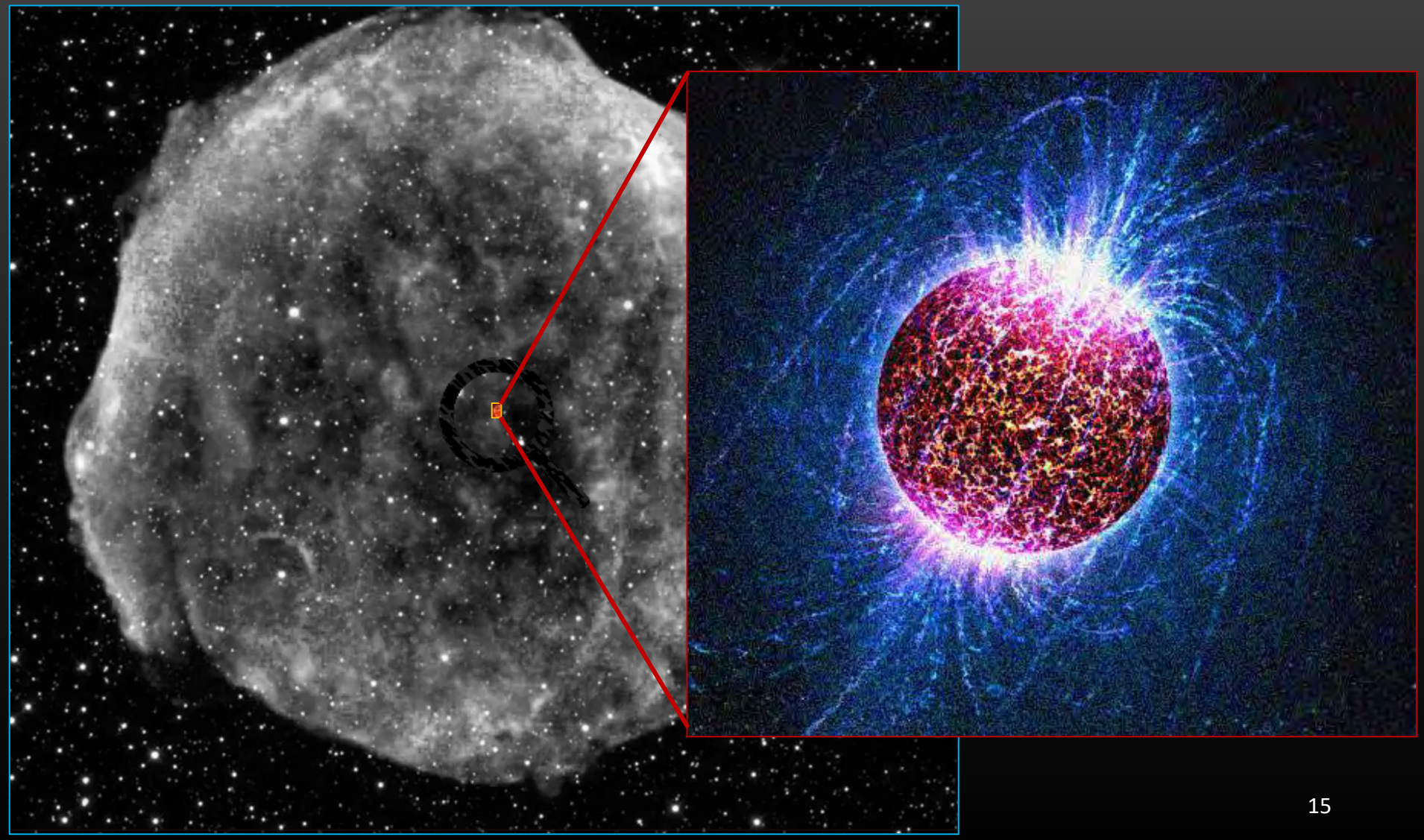


Supernova til neutron-stjerner

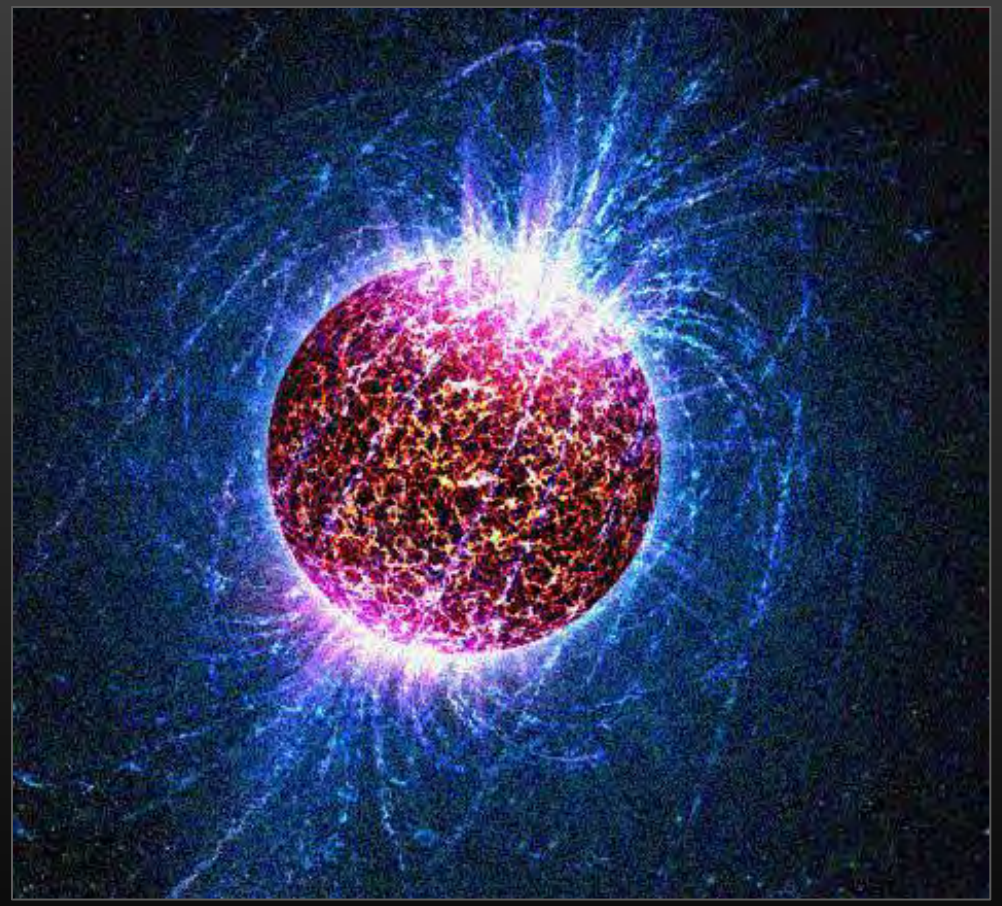
Supernova til neutron-stjerner



Supernova til neutron-stjerner



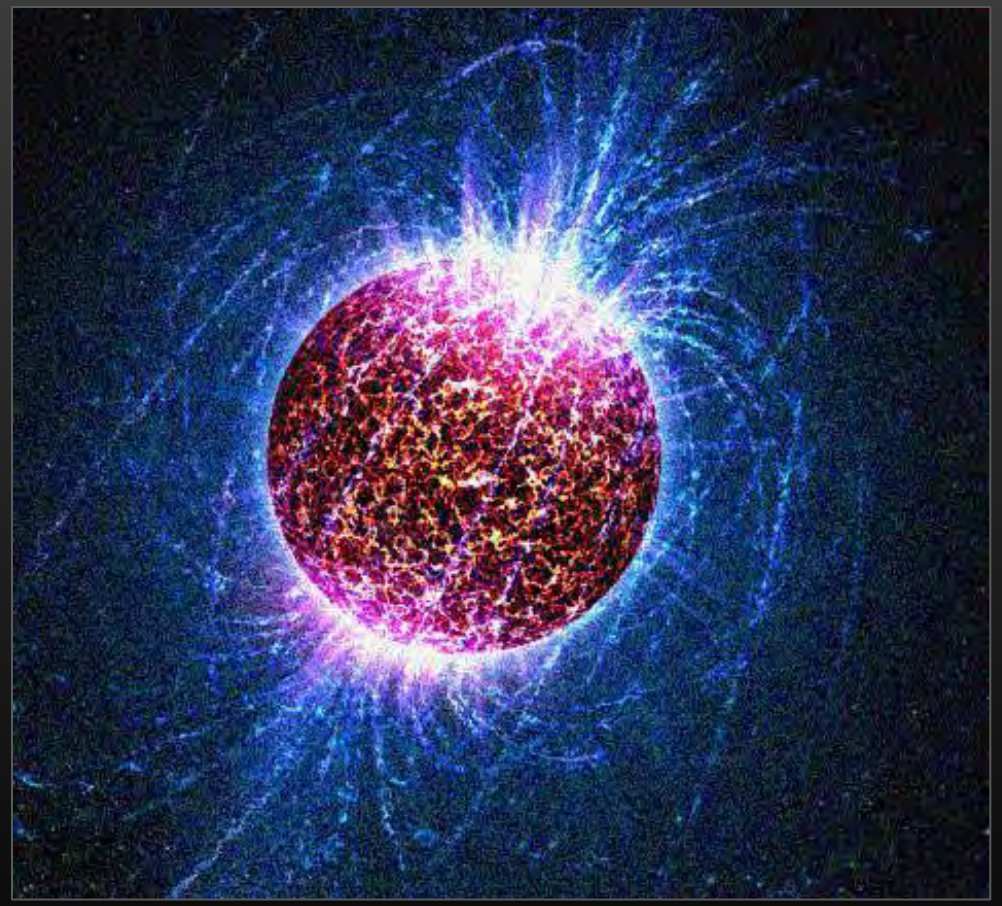
Neutron-stjerner



De tætteste objekter i Universet

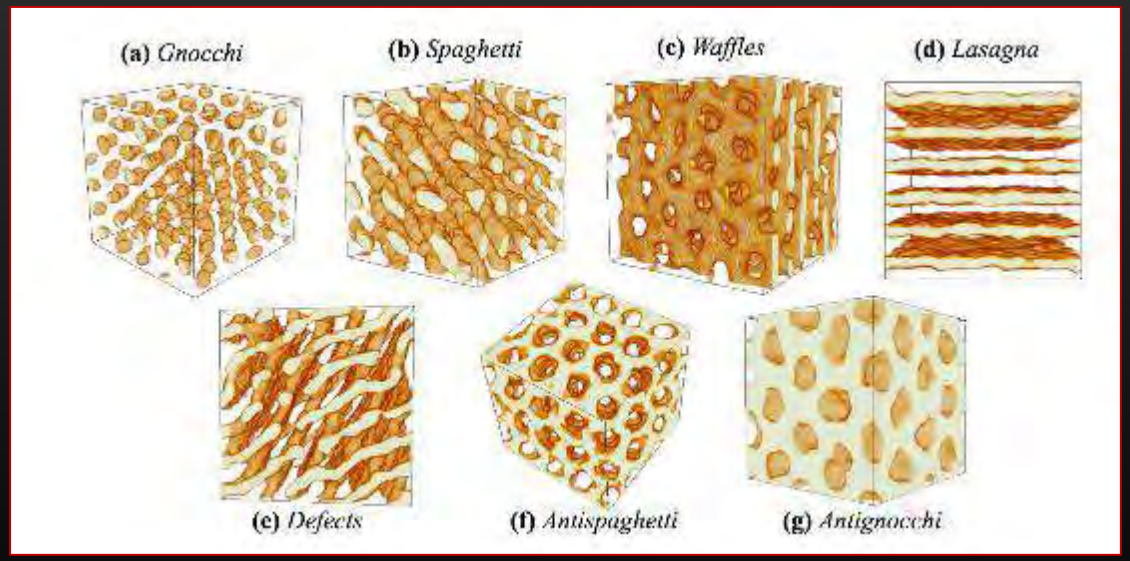
- 100 millioner tons i en centicube
- Ligeså tæt som en atom-kerne

Neutron-stjerner

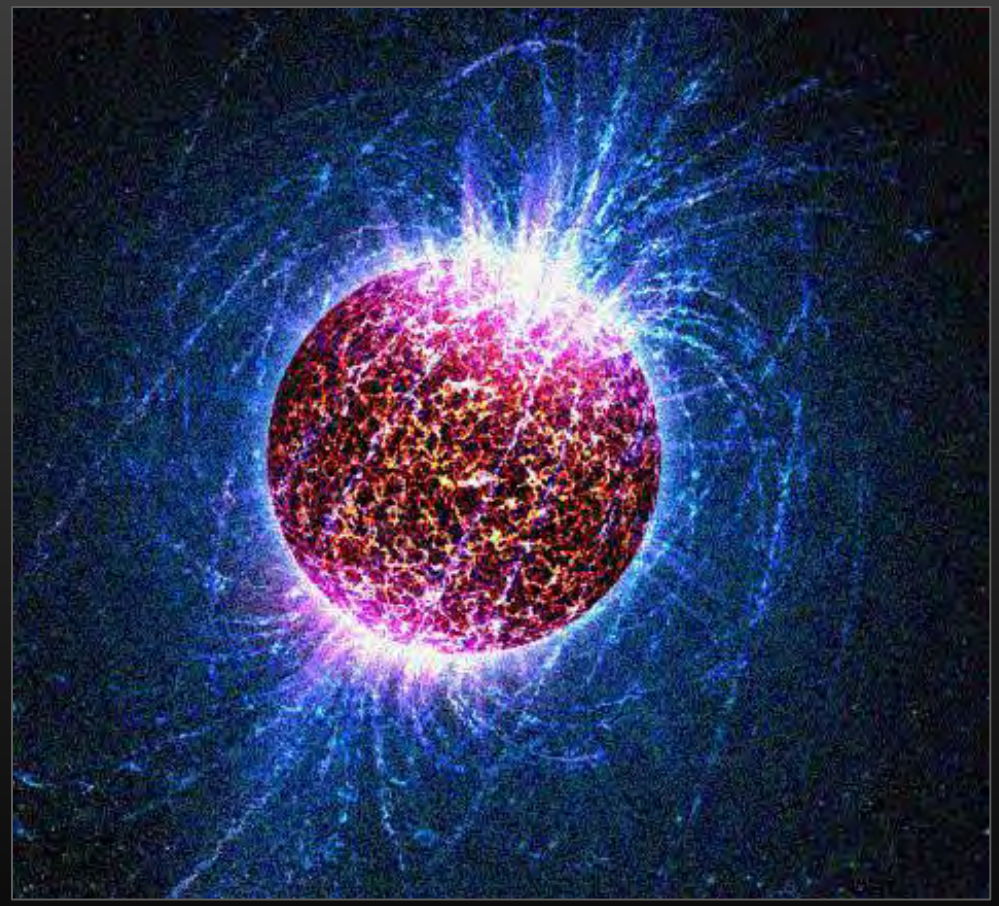


De stærkeste magneter i Universet:

Magnetstyrke op til million millard gange større end på Jorden.



Neutron-stjerner



De tætteste objekter i Universet

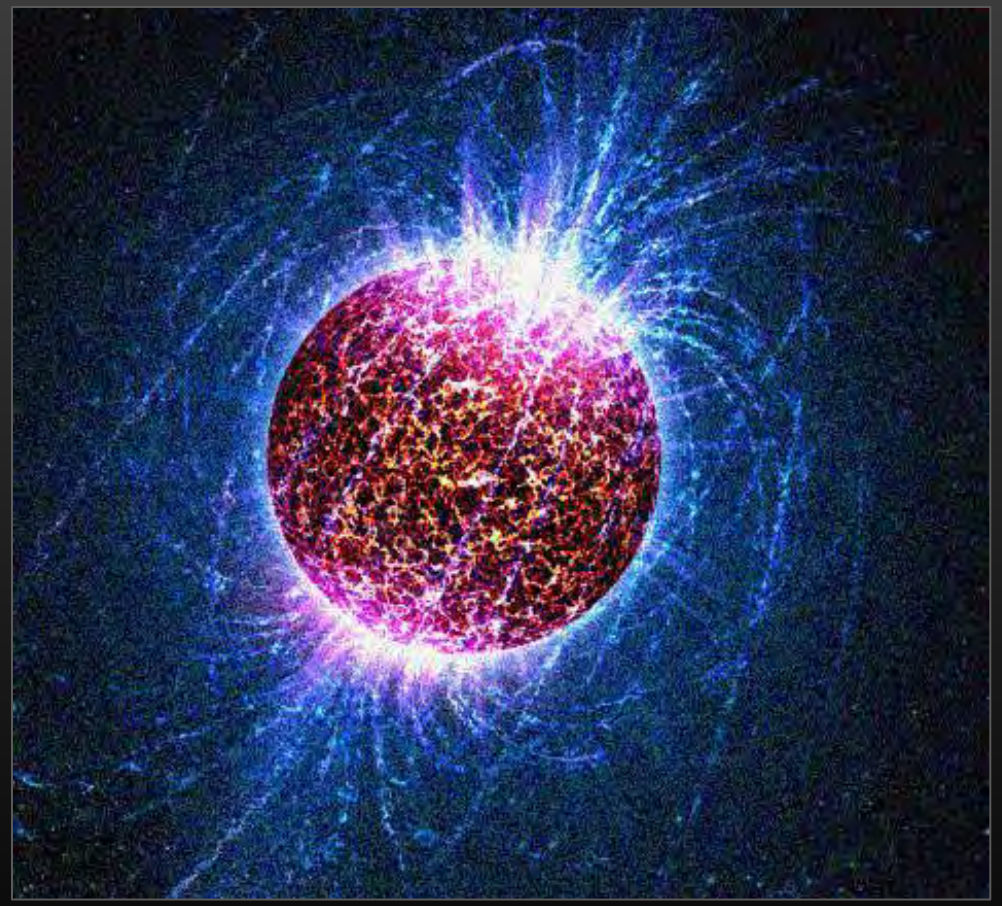
De stærkeste magneter i Universet

De mest præcise ur i Universet

De mindste bjerge i Universet

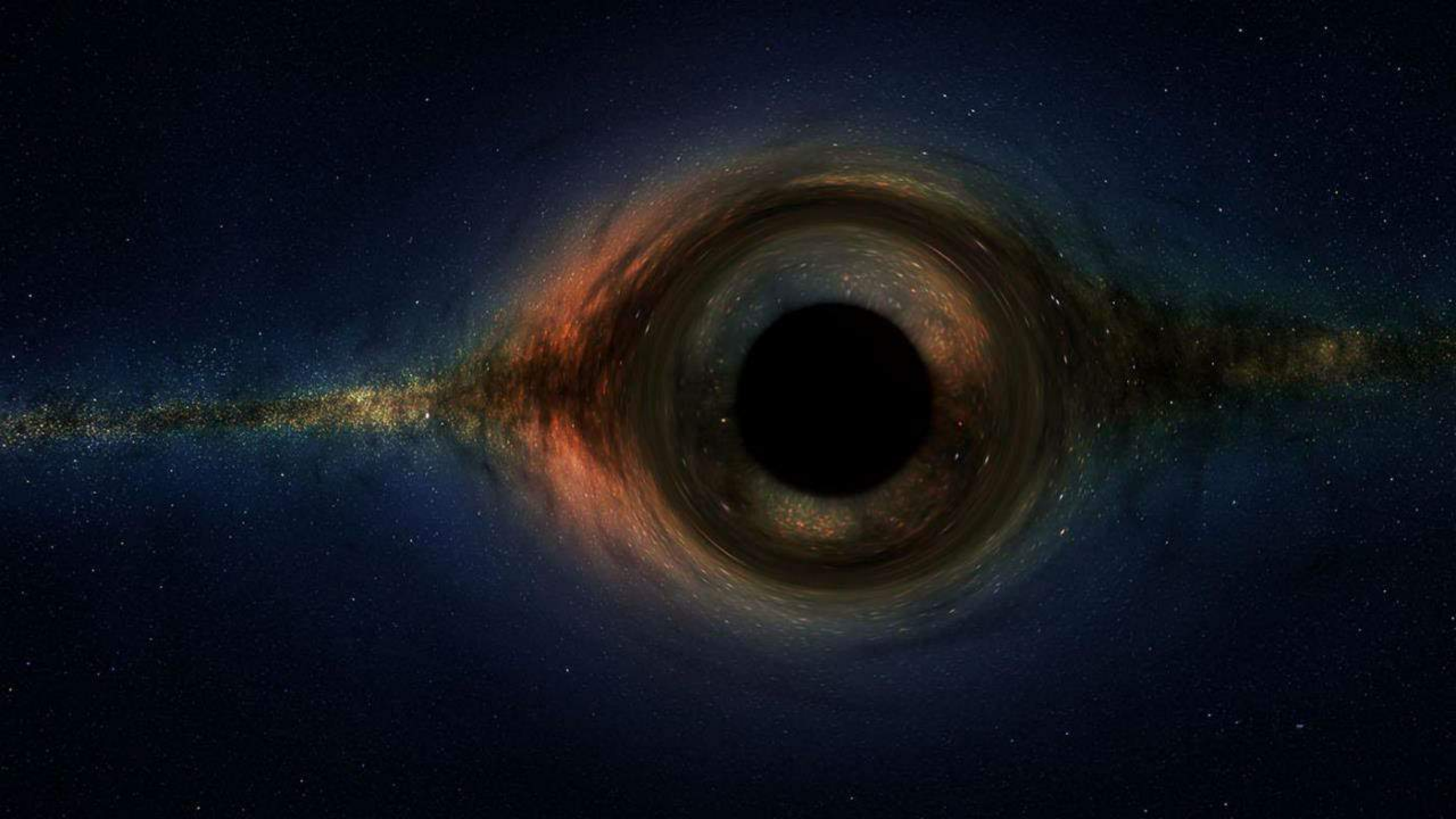
Nær den gravitationelle grænse af Sorte Huller
(bagsiden af en neutron-stjerne…)

Neutron-stjerne



Kilonova


Sort Huls Fødsel



Atomernes oprindelse

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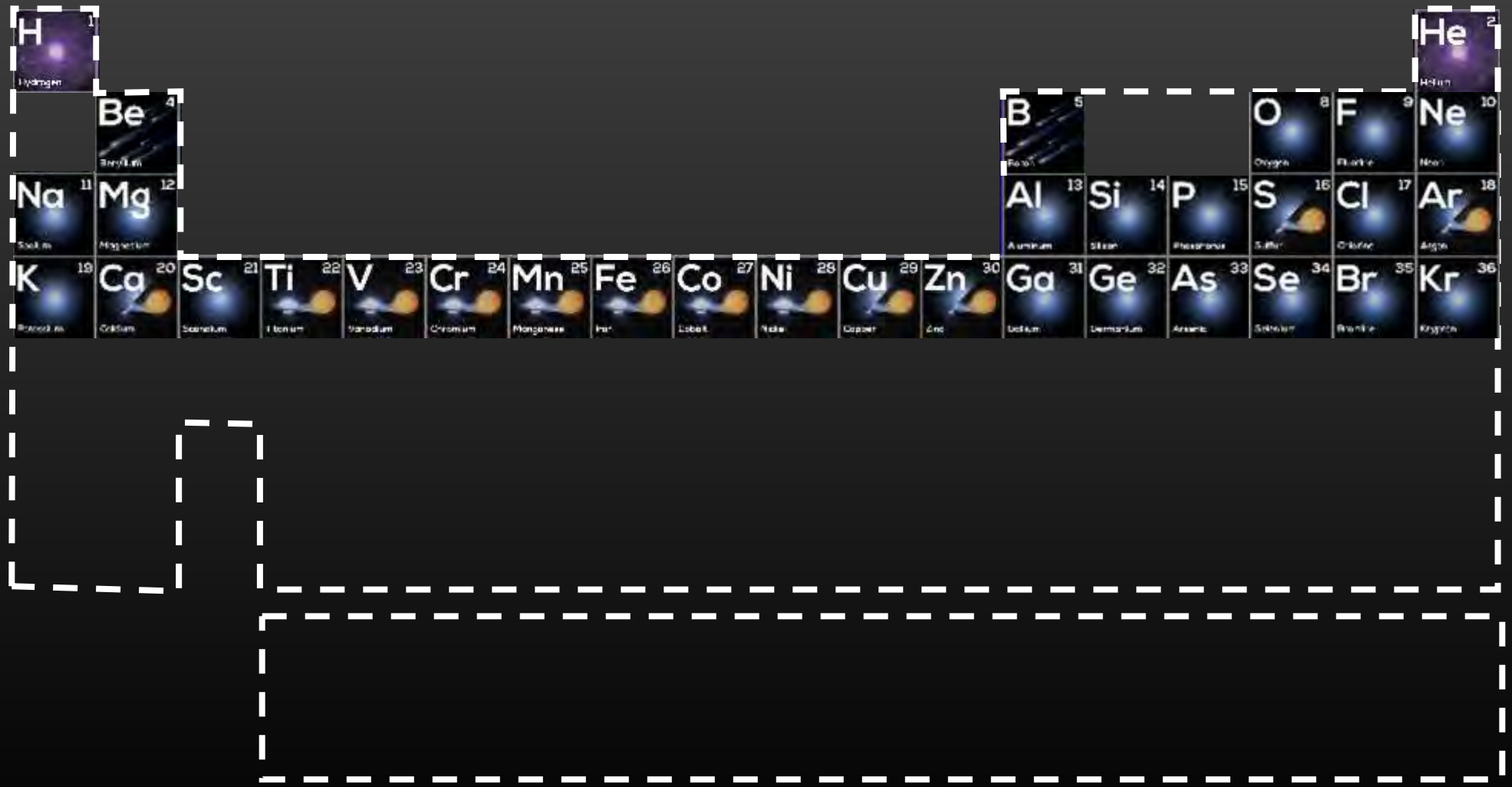

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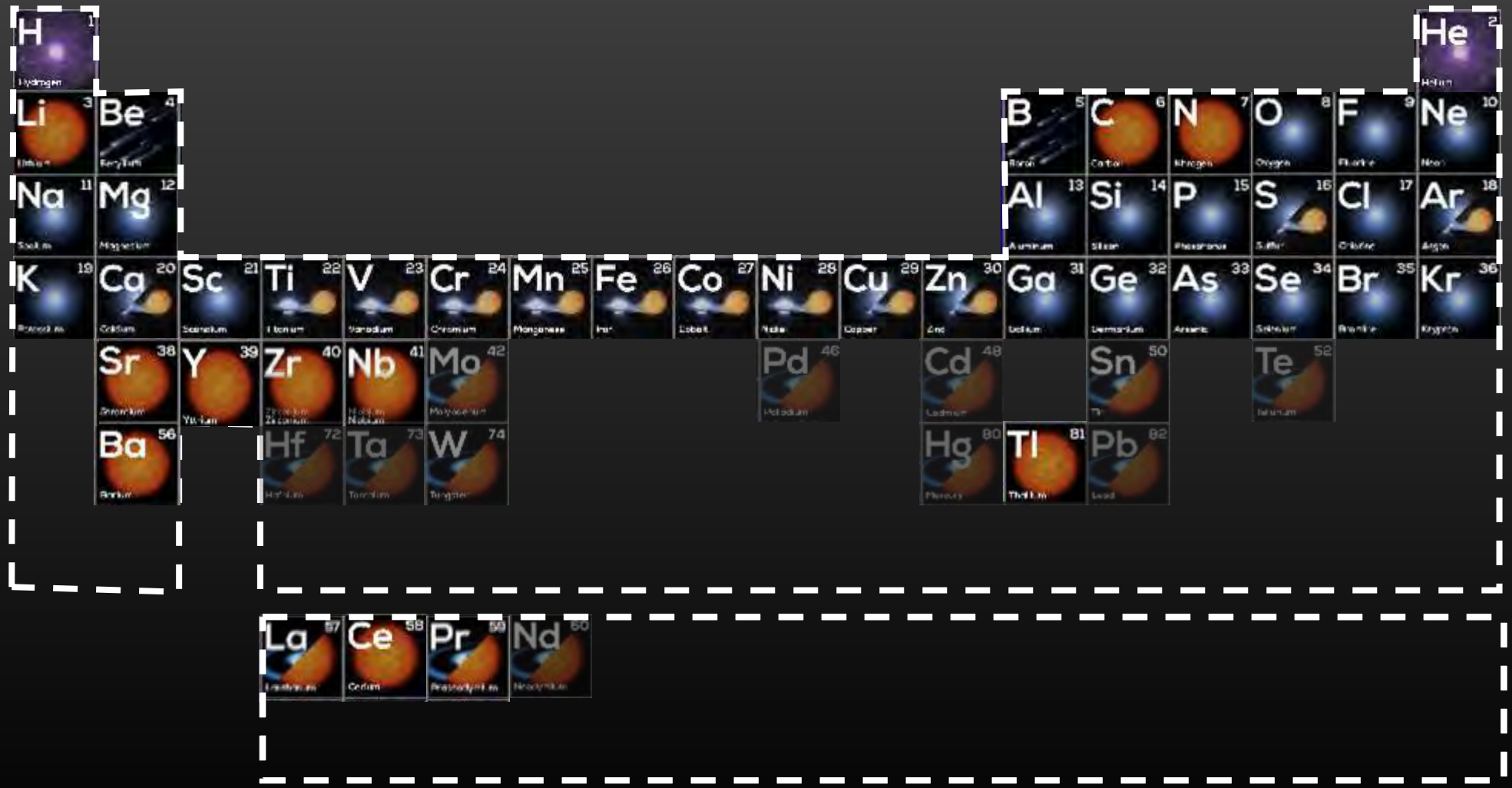

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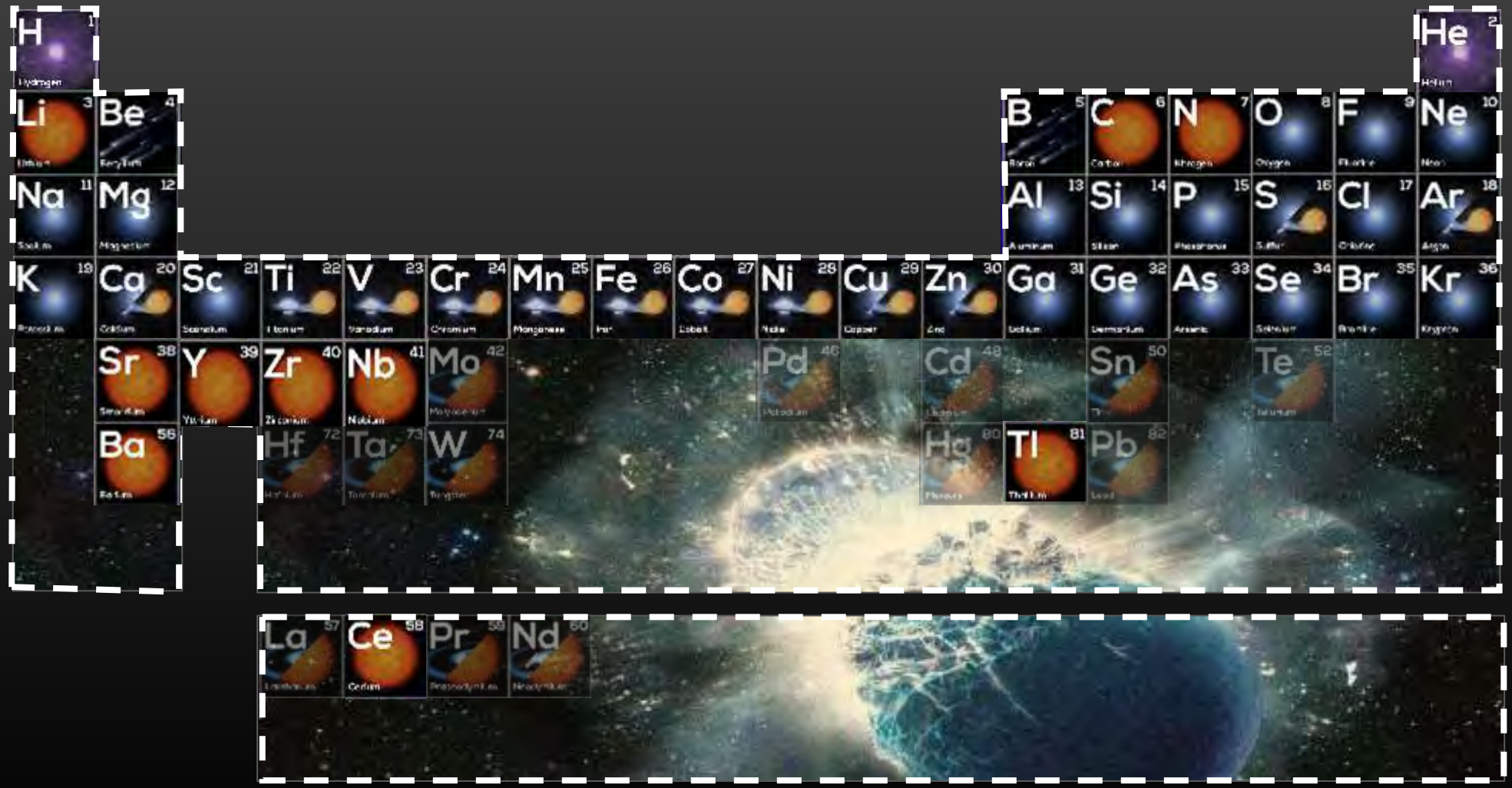
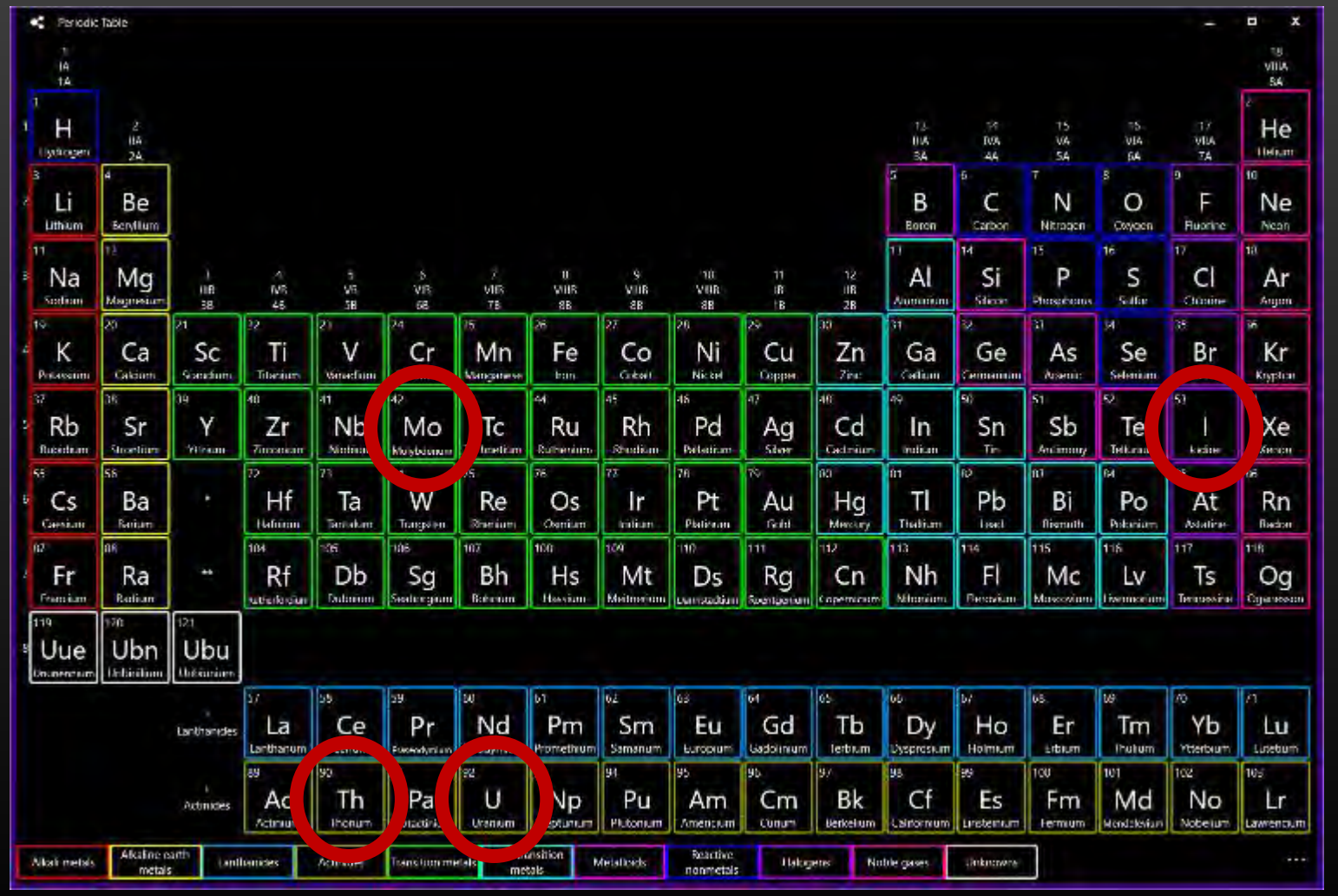
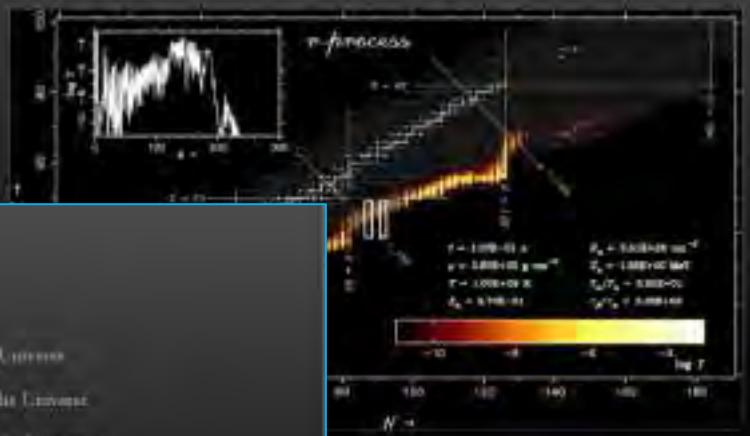


Oprindelsen af (*tunge*) grundstoffer



The Origin of the (*heavy*) Elements



Neutron Stars

Densest objects in the Universe

Strongest magnets in the Universe

Most precise clocks in the Universe

Can be the hottest stars in the Universe

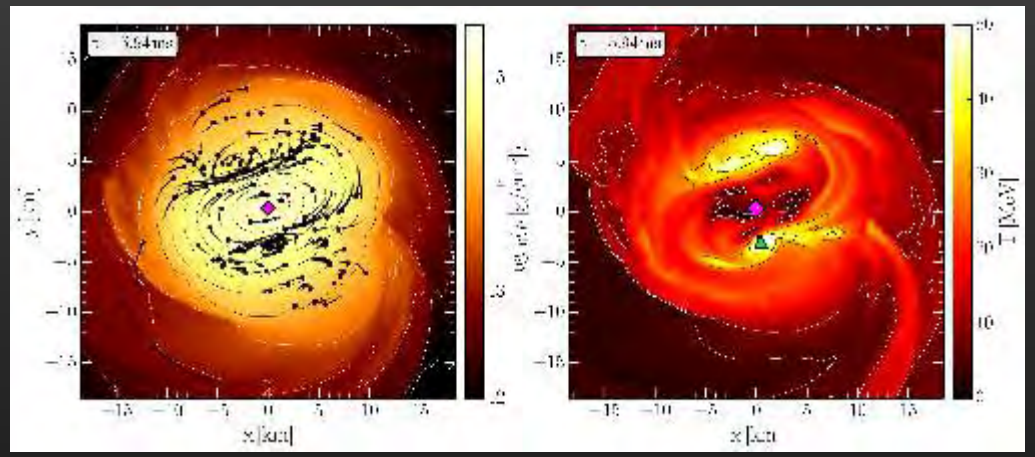
Smallest mountains in the Universe

At the gravitational limit of black holes
(you can see the back of a neutron star)

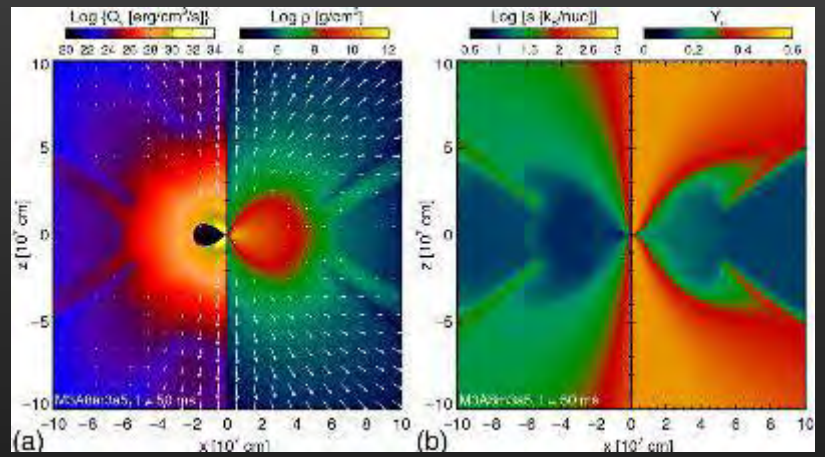
Black Hole Formation

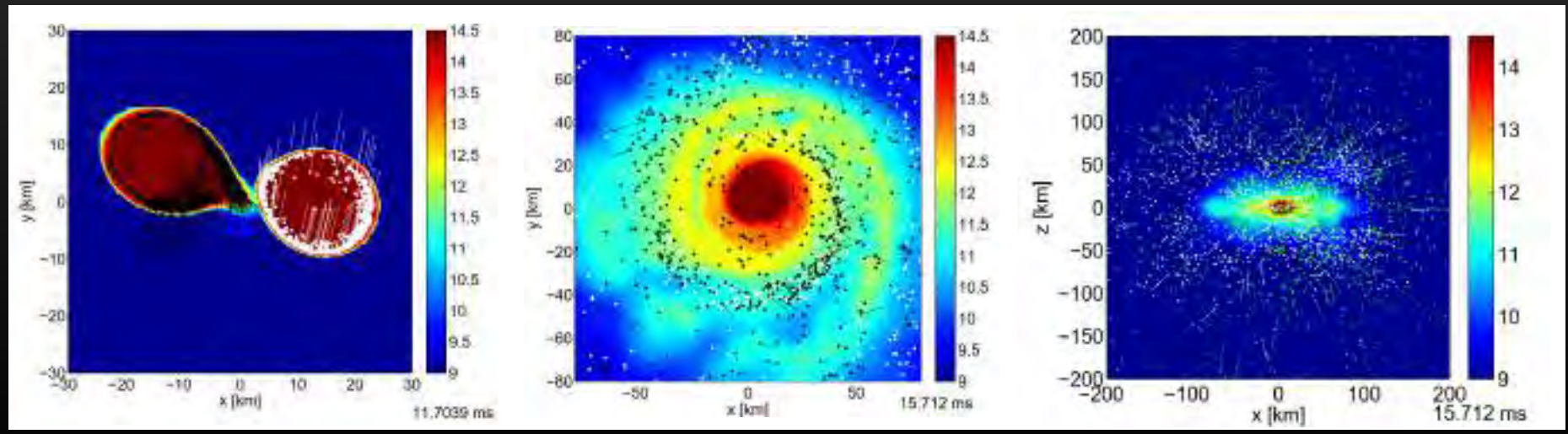
Eksplosionens form

Hanauske 2019



Just 2015

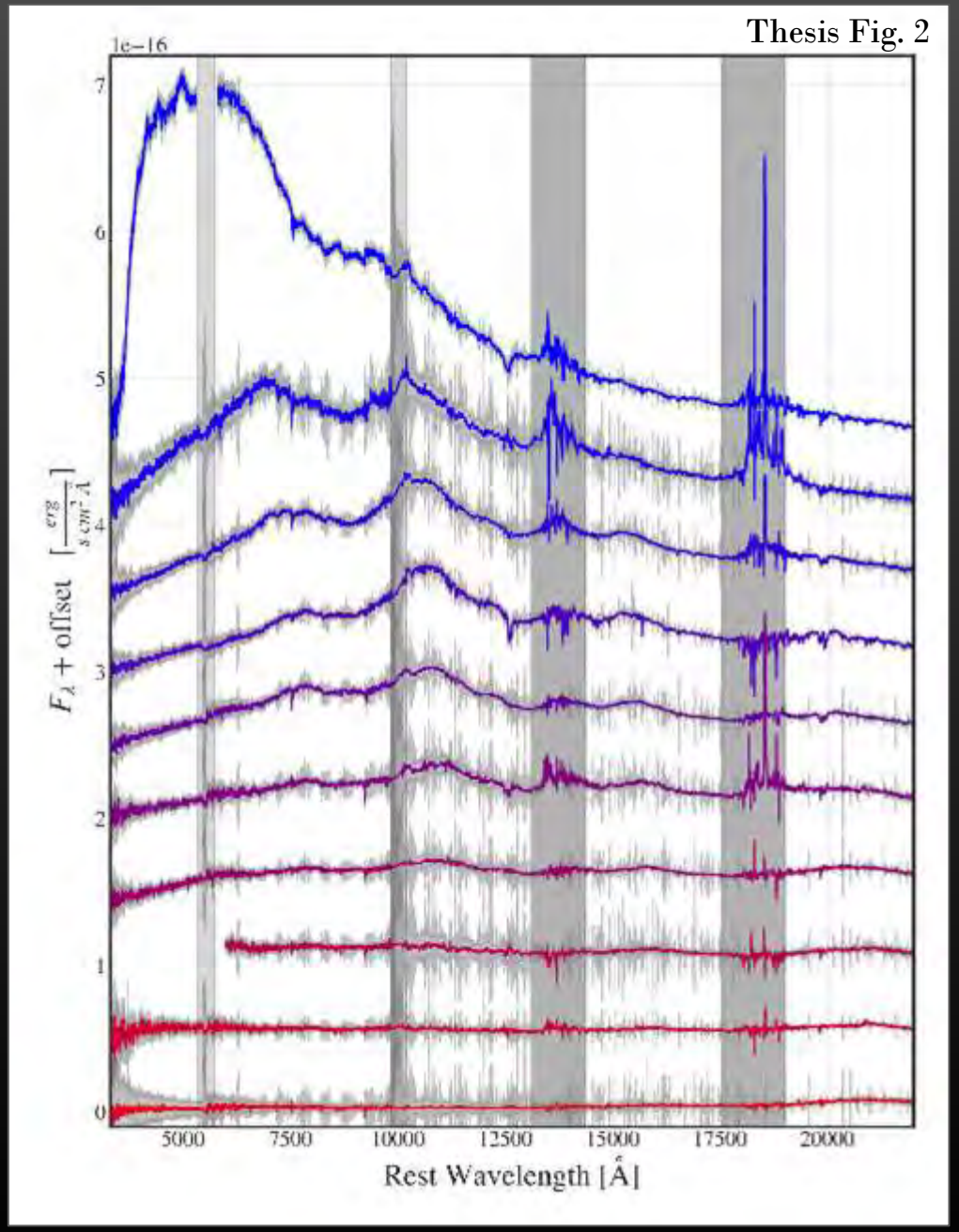




Bauswein 2013

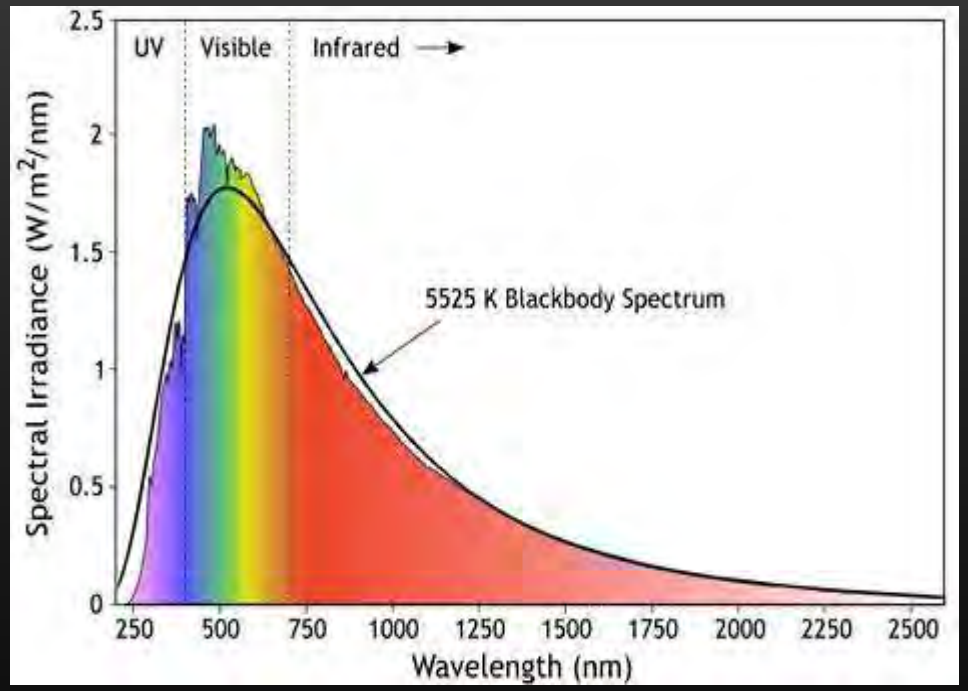
Transient astrofysisk objekt med lysstyrken, $10^9 L_\odot$,

men som forsvandt i løbet af nogle dage…

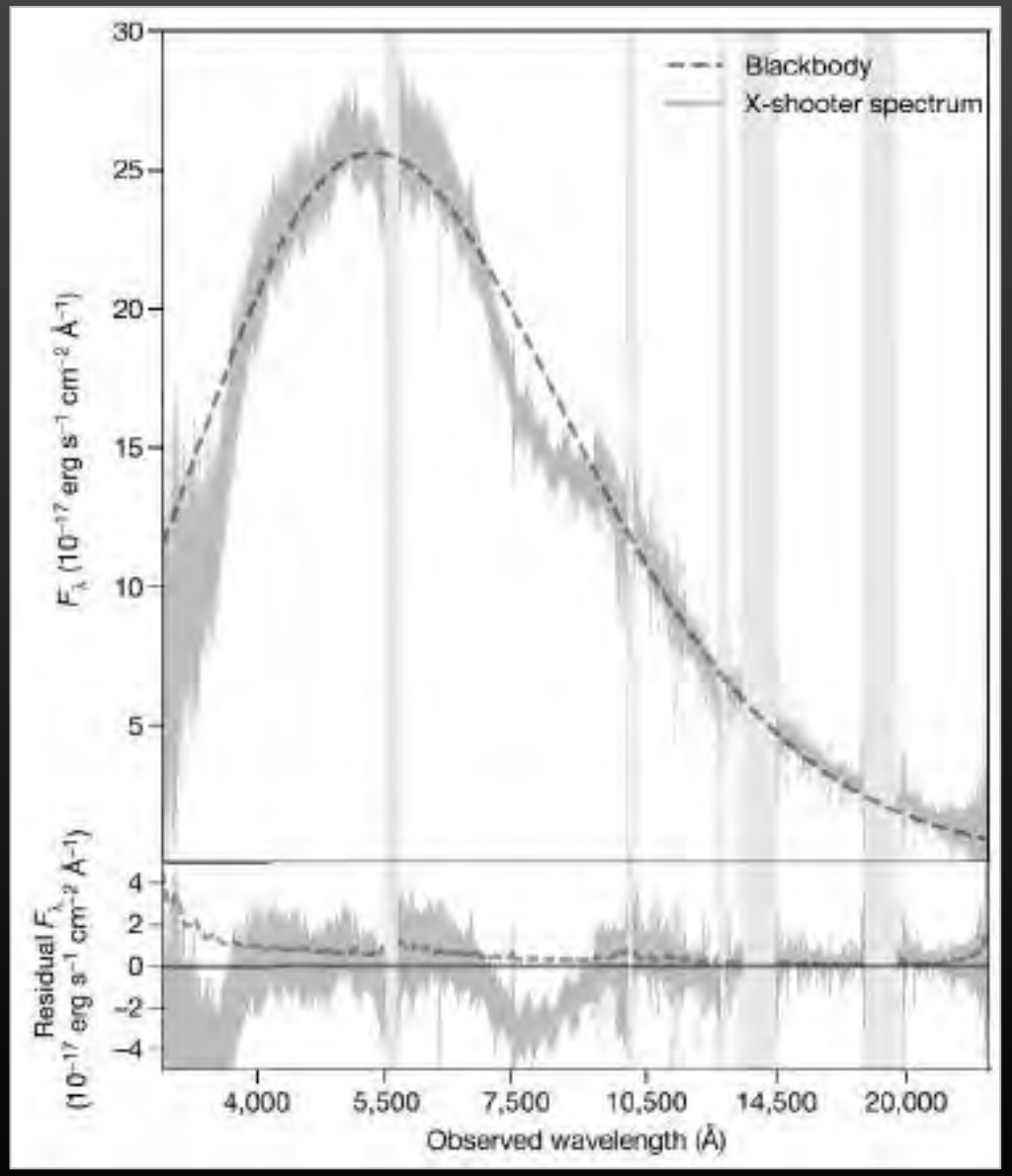


AT2017gfo

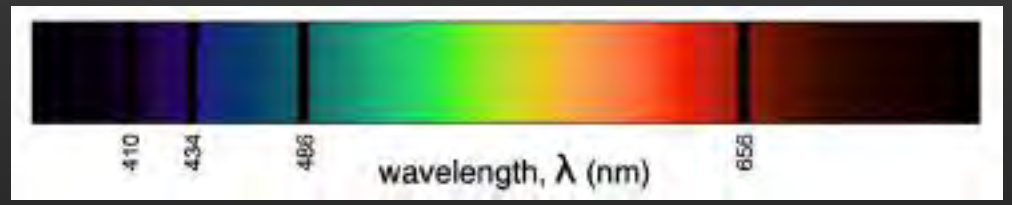
Solens farver

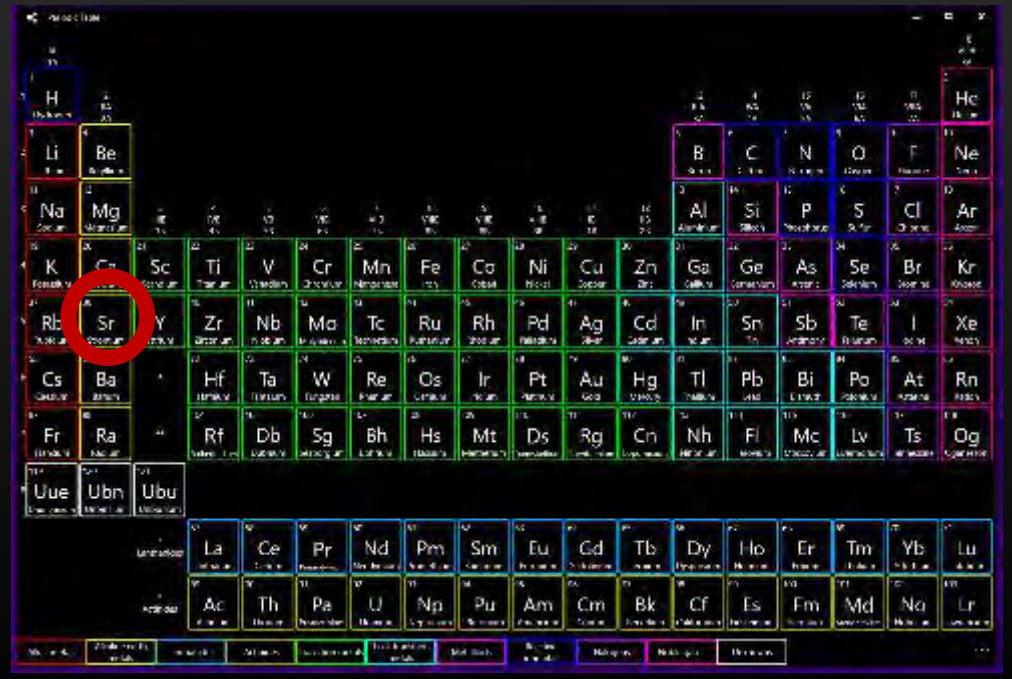


Watson et al. (2019)

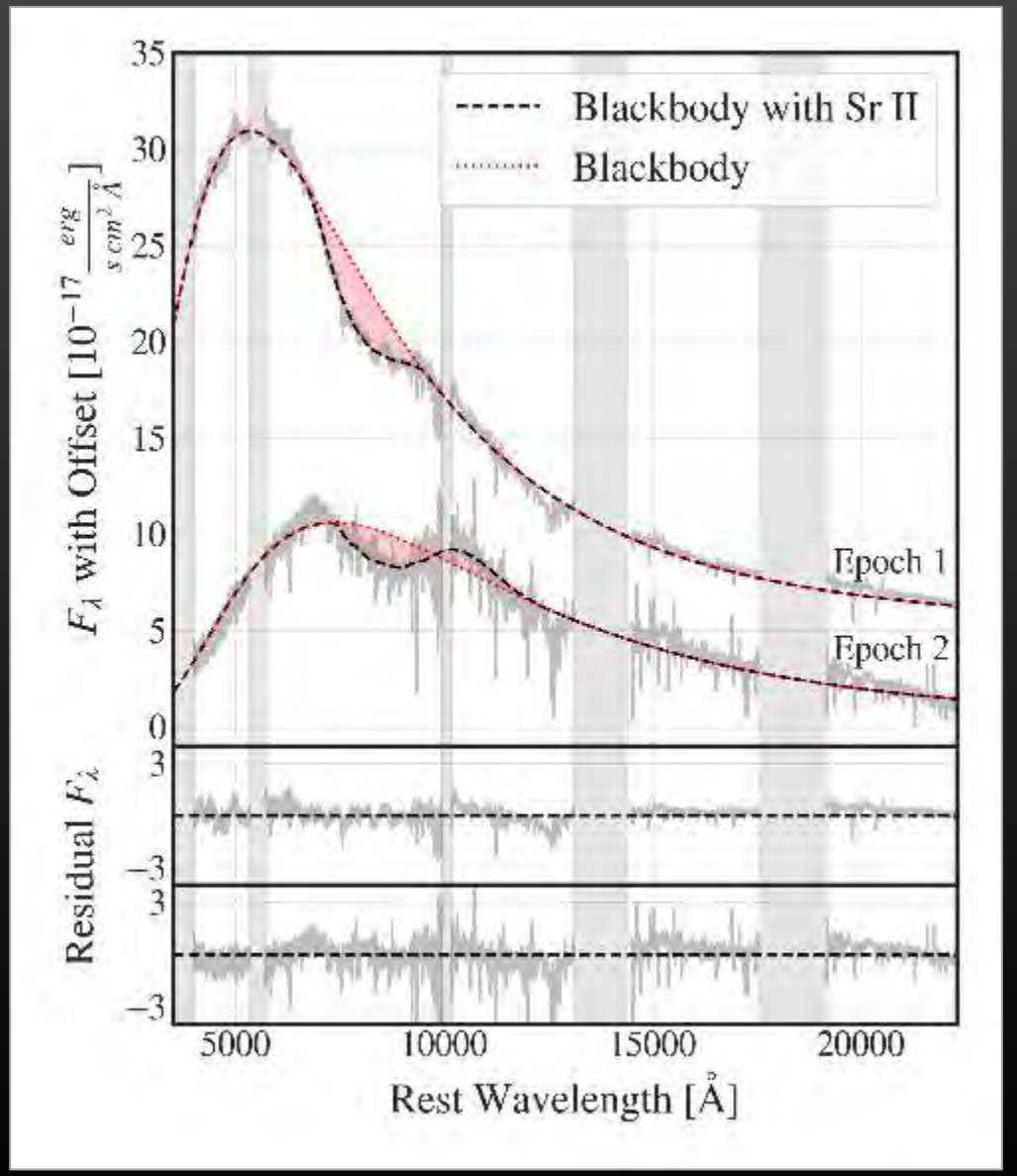


AT2017gfo

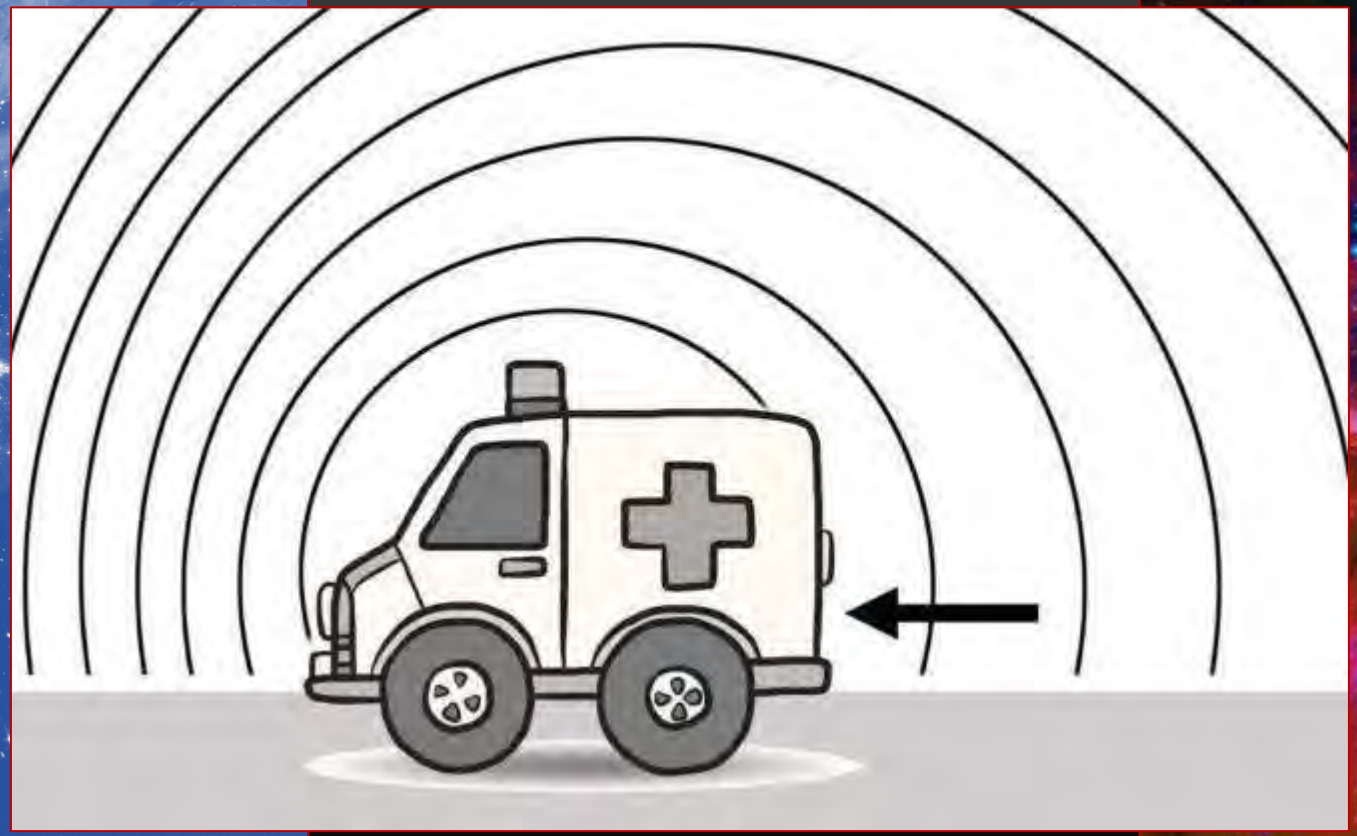




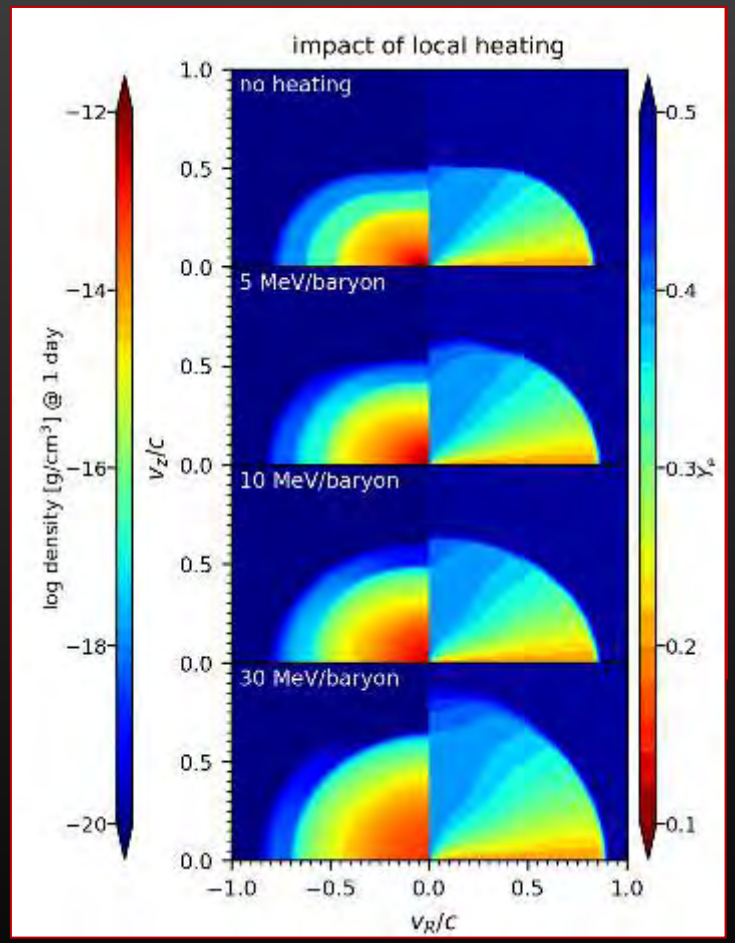
X-shooter spectrum epoch 1+2

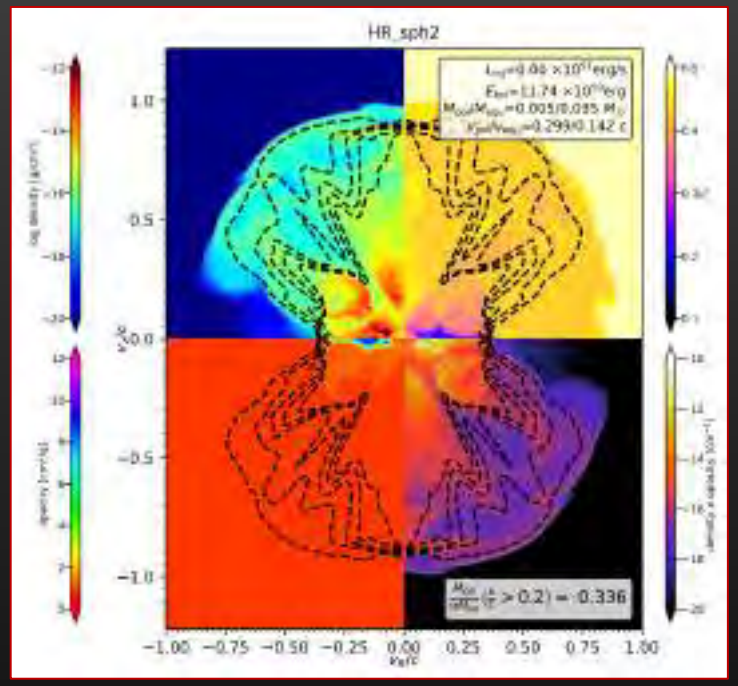


Doppler-effekten

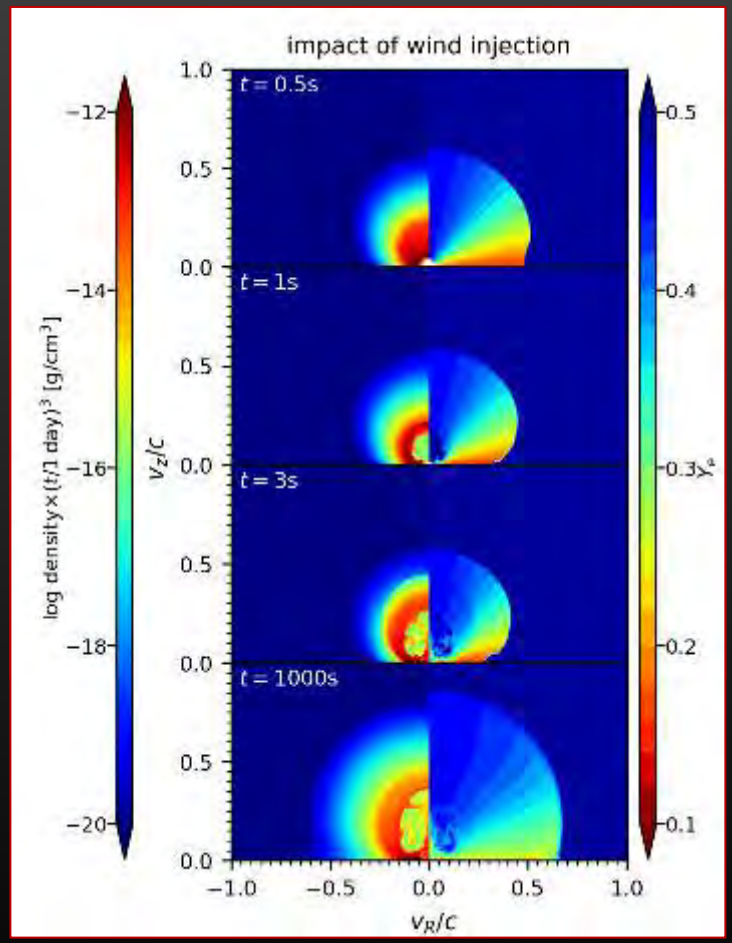


Mysteriet i eksplosionens kerne





Produceret af Oliver Just



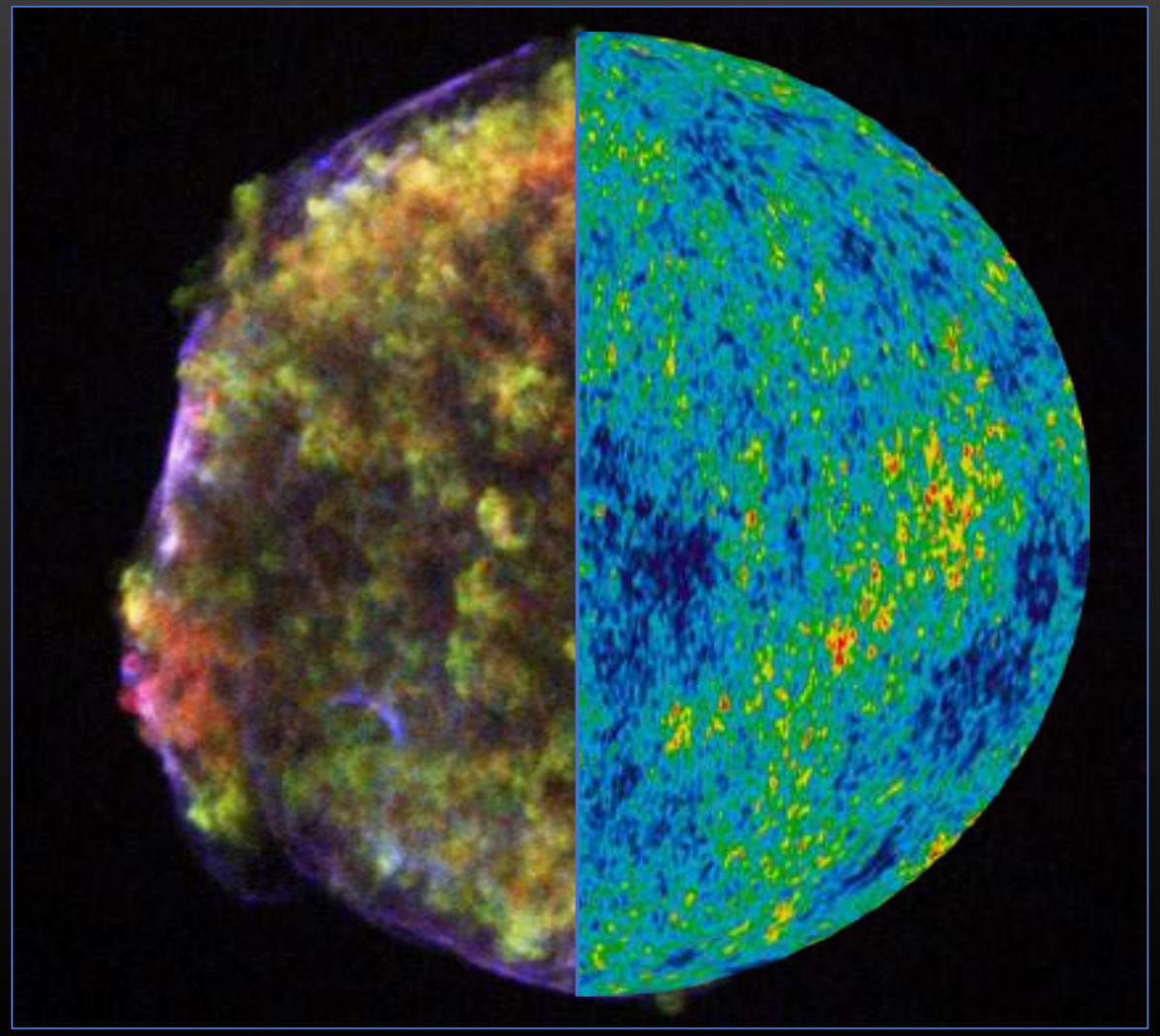
Universets alder

Universets alder

Lokale Målinger

$$H_0 = 74.0 \pm 1.0 \ \frac{km}{s \cdot Mpc}$$

12.8 Milliarder År Gammelt



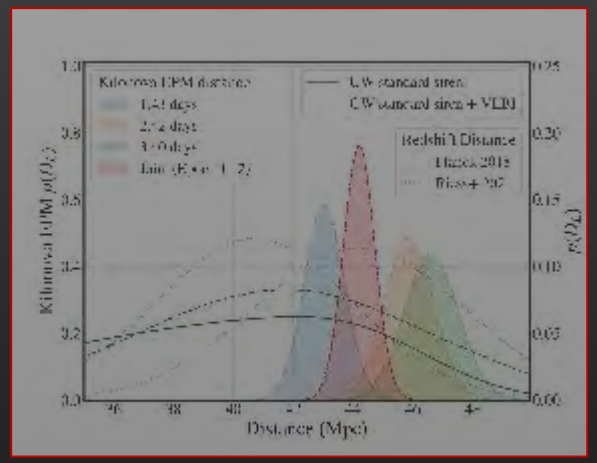
Det Tidlige Univers

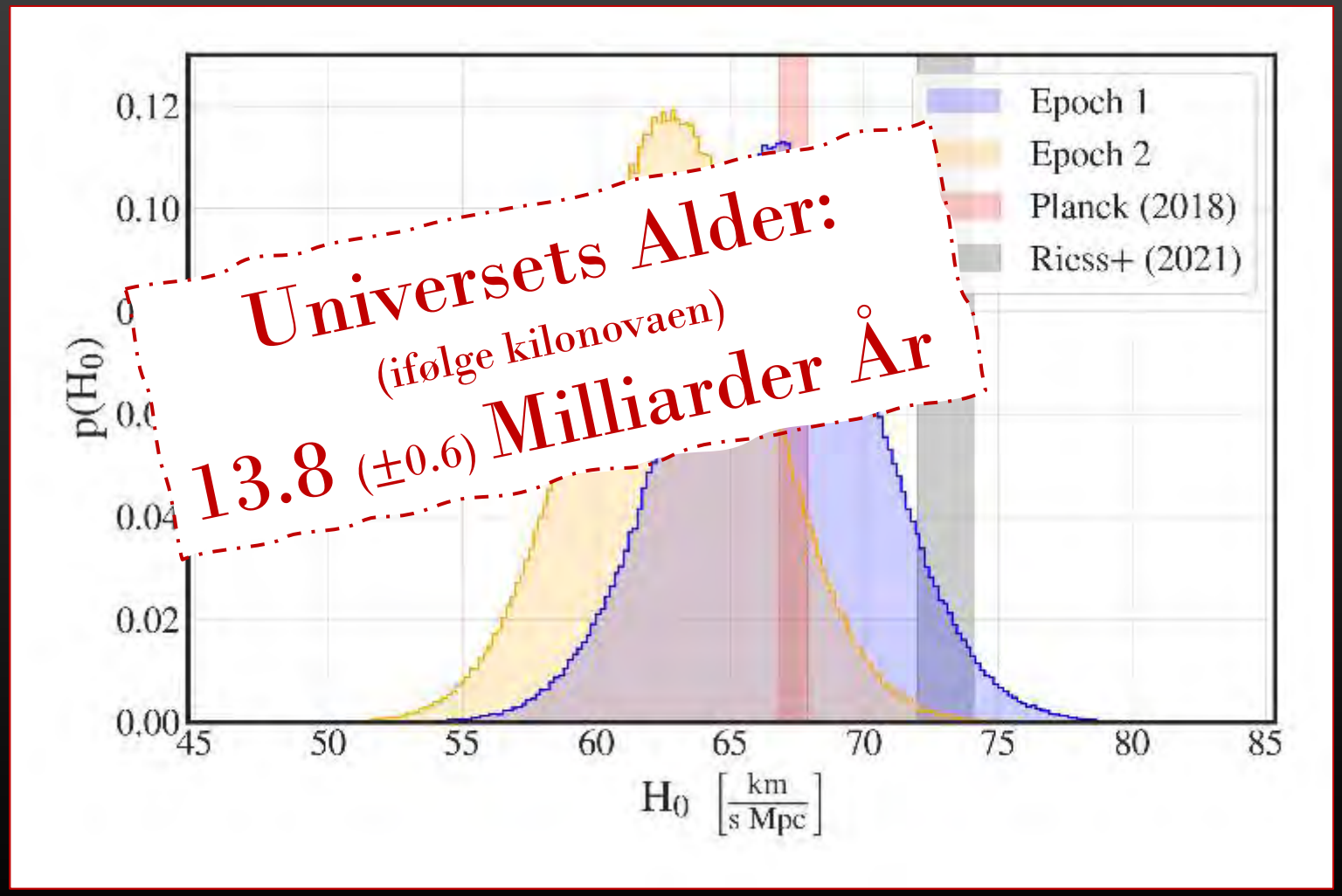
$$H_0 = 67.5 \pm 0.5 \frac{km}{s \cdot Mpc}$$

13.8 Milliarder År Gammelt

Universets alder er stadig ukendt!

Vores Nye Målinger af Universets alder





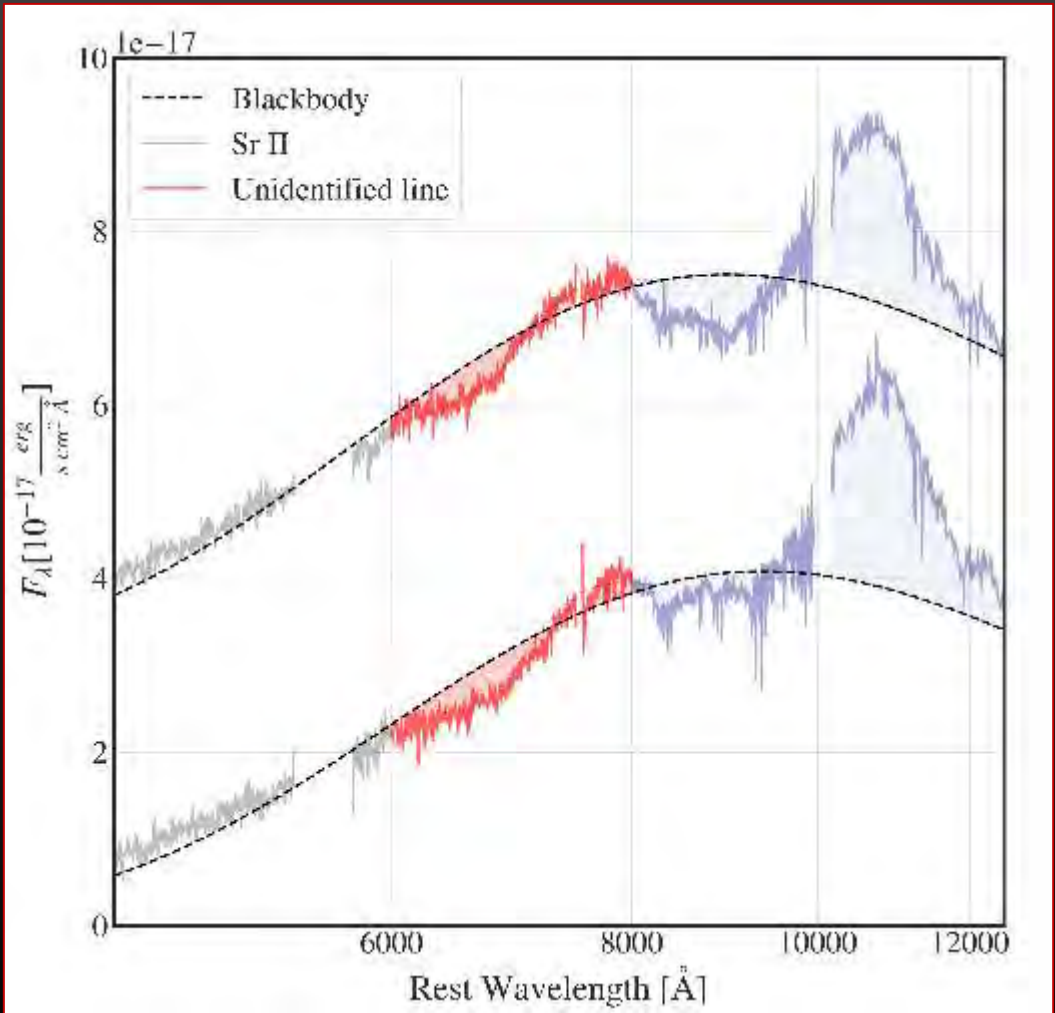
Universets Alder:

(ifølge kilonovaen)

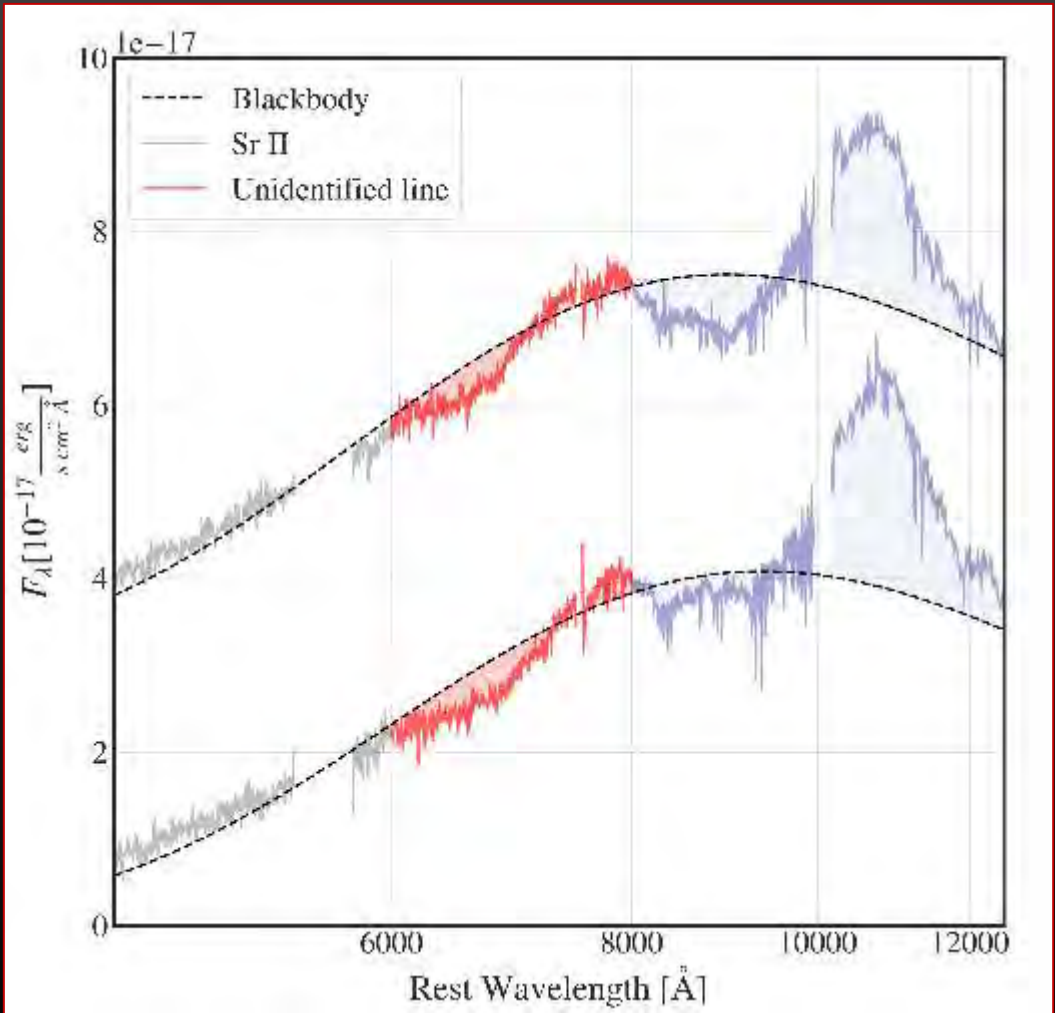
13.8 (±0.6) Milliarder År

Sneppen et al., in prep, (2023)

Ny Atom-linje



Yttrium!


1e−17
Blackbody
Sr II
Unidentified line
$F_\lambda[10^{-17}\ \frac{erg}{s\ cm^2\ \AA}]$
0
2
4
6
8
10
6000
8000
10000
12000
Rest Wavelength [Å]


H
He
Li
Be
B
C
N
O
F
Ne
Na
Mg
Al
Si
P
S
Cl
Ar
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Kr
Rb
Sr
Y
Zr
Nb
Mo
Tc
Ru
Rh
Pd
Ag
Cd
In
Sn
Sb
Te
I
Xe
Cs
Ba
La
Hf
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Re
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Ir
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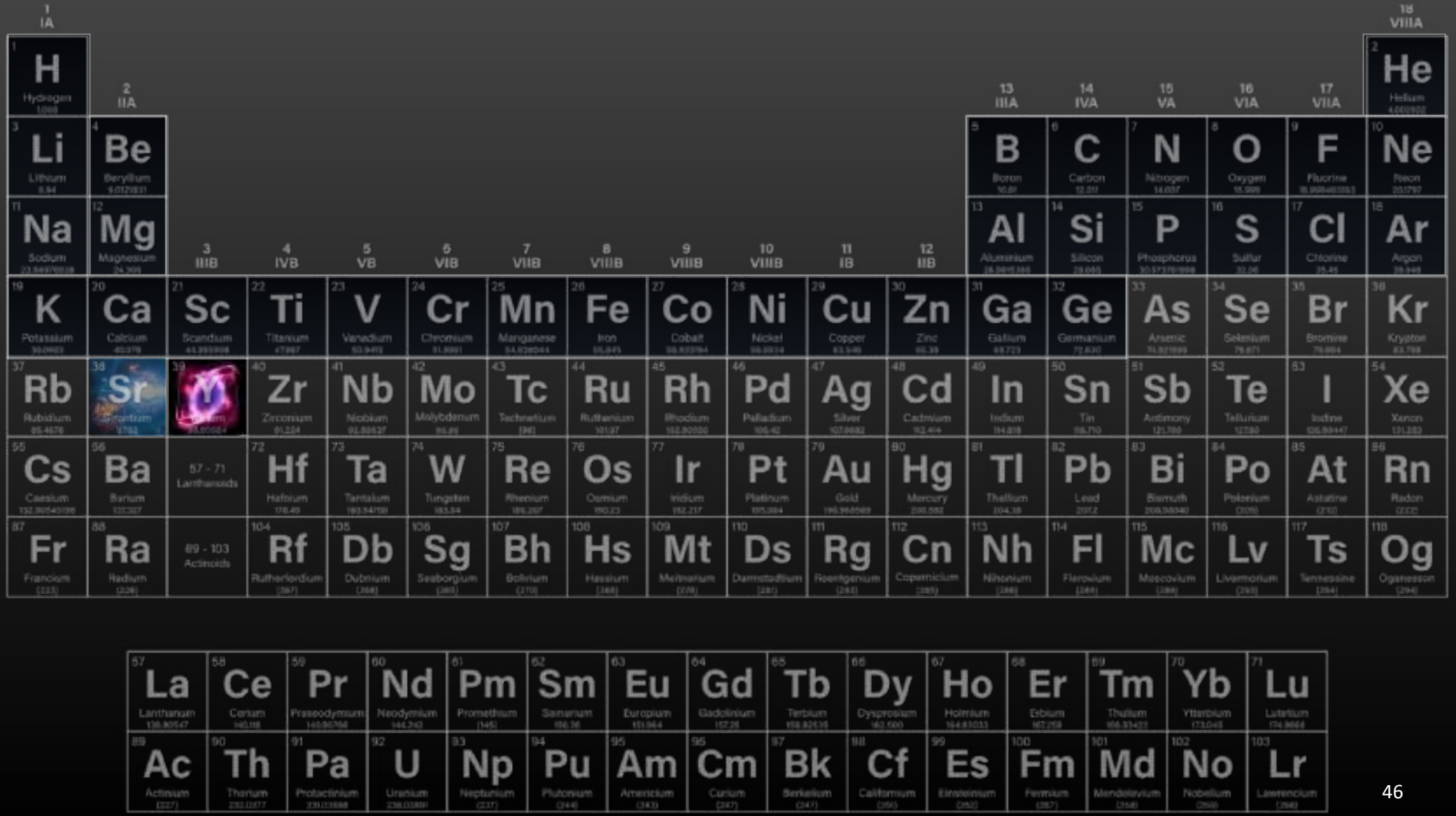
Fm
Md
No
Lr


1 IA
18 VIIIA
1 H Hydrogen
2 He Helium
2 IIA
13 IIIA
14 IVA
15 VA
16 VIA
17 VIIA
3 Li Lithium
4 Be Beryllium
5 B Boron
6 C Carbon
7 N Nitrogen
8 O Oxygen
9 F Fluorine
10 Ne Neon
11 Na Sodium
12 Mg Magnesium
3 IIIB
4 IVB
5 VB
6 VIB
7 VIIB
8 VIIIB
9 VIIIB
10 VIIIB
11 IB
12 IIB
13 Al Aluminium
14 Si Silicon
15 P Phosphorus
16 S Sulfur
17 Cl Chlorine
18 Ar Argon
19 K Potassium
20 Ca Calcium
21 Sc Scandium
22 Ti Titanium
23 V Vanadium
24 Cr Chromium
25 Mn Manganese
26 Fe Iron
27 Co Cobalt
28 Ni Nickel
29 Cu Copper
30 Zn Zinc
31 Ga Gallium
32 Ge Germanium
33 As Arsenic
34 Se Selenium
35 Br Bromine
36 Kr Krypton
37 Rb Rubidium
38 Sr Strontium
39 Y Yttrium
40 Zr Zirconium
41 Nb Niobium
42 Mo Molybdenum
43 Tc Technetium
44 Ru Ruthenium
45 Rh Rhodium
46 Pd Palladium
47 Ag Silver
48 Cd Cadmium
49 In Indium
50 Sn Tin
51 Sb Antimony
52 Te Tellurium
53 I Iodine
54 Xe Xenon
55 Cs Caesium
56 Ba Barium
57 - 71 Lanthanoids
72 Hf Hafnium
73 Ta Tantalum
74 W Tungsten
75 Re Rhenium
76 Os Osmium
77 Ir Iridium
78 Pt Platinum
79 Au Gold
80 Hg Mercury
81 Tl Thallium
82 Pb Lead
83 Bi Bismuth
84 Po Polonium
85 At Astatine
86 Rn Radon
87 Fr Francium
88 Ra Radium
89 - 103 Actinoids
104 Rf Rutherfordium
105 Db Dubnium
106 Sg Seaborgium
107 Bh Bohrium
108 Hs Hassium
109 Mt Meitnerium
110 Ds Darmstadtium
111 Rg Roentgenium
112 Cn Copernicium
113 Nh Nihonium
114 Fl Flerovium
115 Mc Moscovium
116 Lv Livermorium
117 Ts Tennessine
118 Og Oganesson
57 La Lanthanum
58 Ce Cerium
59 Pr Praseodymium
60 Nd Neodymium
61 Pm Promethium
62 Sm Samarium
63 Eu Europium
64 Gd Gadolinium
65 Tb Terbium
66 Dy Dysprosium
67 Ho Holmium
68 Er Erbium
69 Tm Thulium
70 Yb Ytterbium
71 Lu Lutetium
89 Ac Actinium
90 Th Thorium
91 Pa Protactinium
92 U Uranium
93 Np Neptunium
94 Pu Plutonium
95 Am Americium
96 Cm Curium
97 Bk Berkelium
98 Cf Californium
99 Es Einsteinium
100 Fm Fermium
101 Md Mendelevium
102 No Nobelium
103 Lr Lawrencium


Instagram: Sneppen et Albert