

Les deux infinis Art et Science

In recent years, a large network of observatories has been deployed on remote places in the land, in the sea, underground and in space, to detect the signals coming from the "visible" Universe and even earlier, in the first moments beyond the "recombination wall" when nuclei and electrons formed neutral atoms and the Universe became transparent.

LISTENING TO NEW
COSMIC MESSENGERS

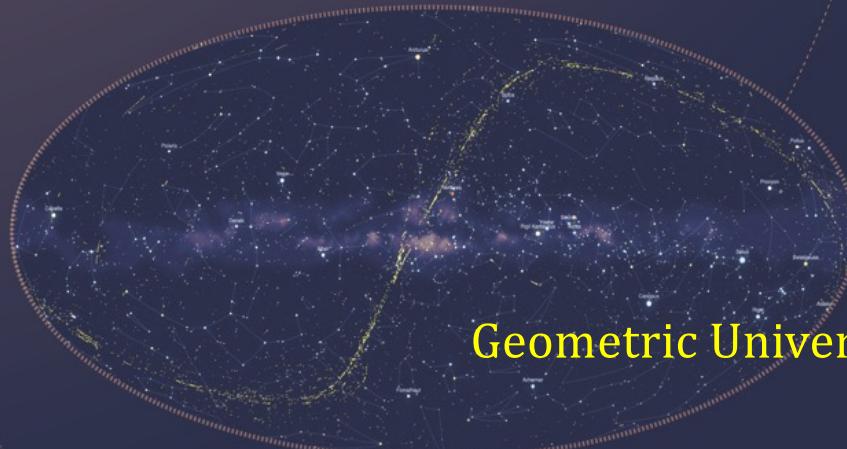
S. Katsanevas



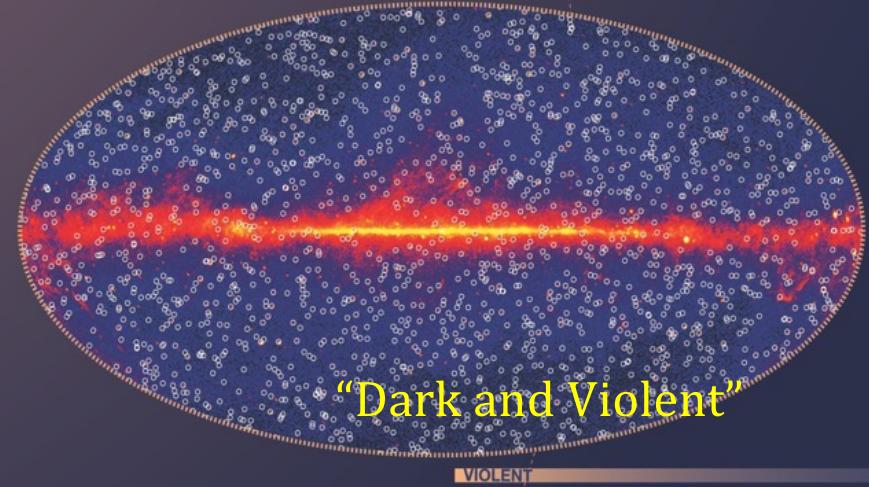
The 3 projections of the Cosmos



Constellations



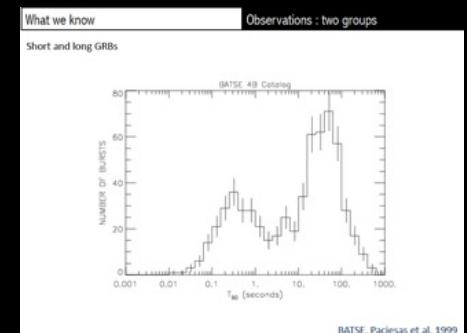
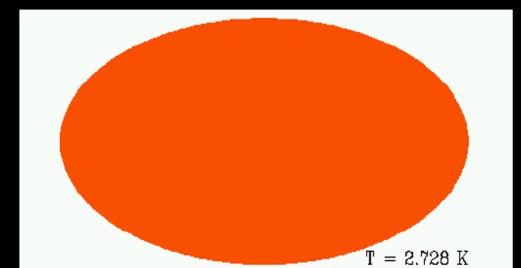
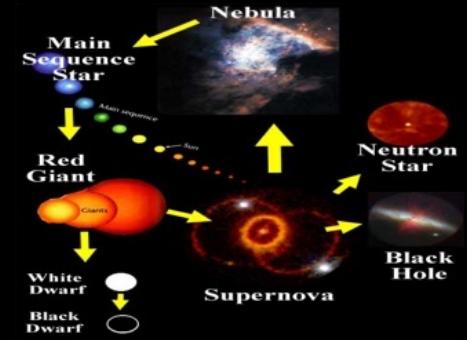
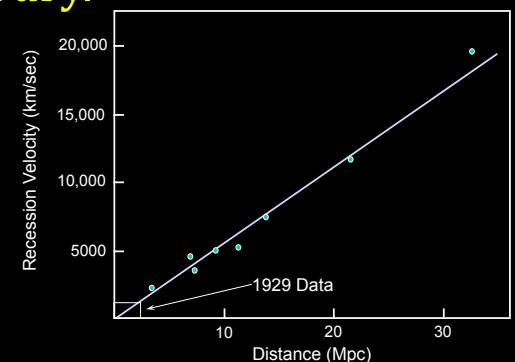
Geometric Universe



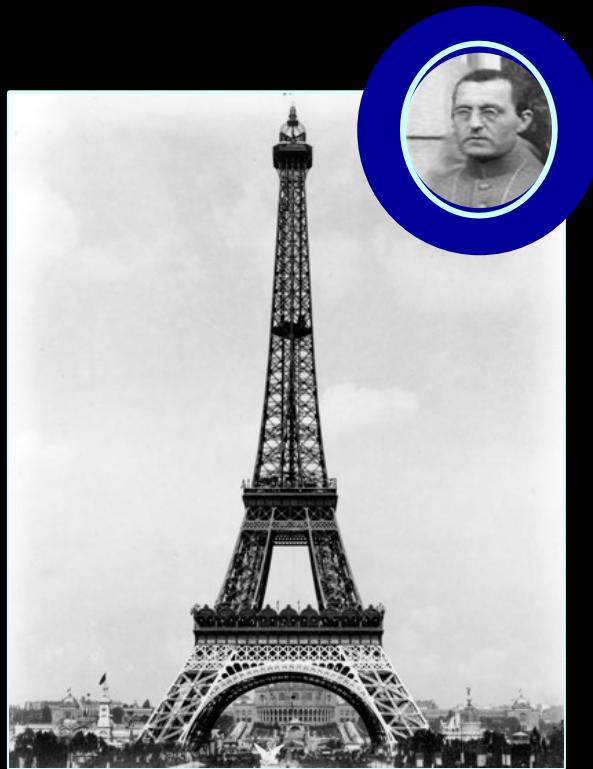
THE THREE
UNIVERSE

Astroparticle physics is a part Astrophysics since the last century.

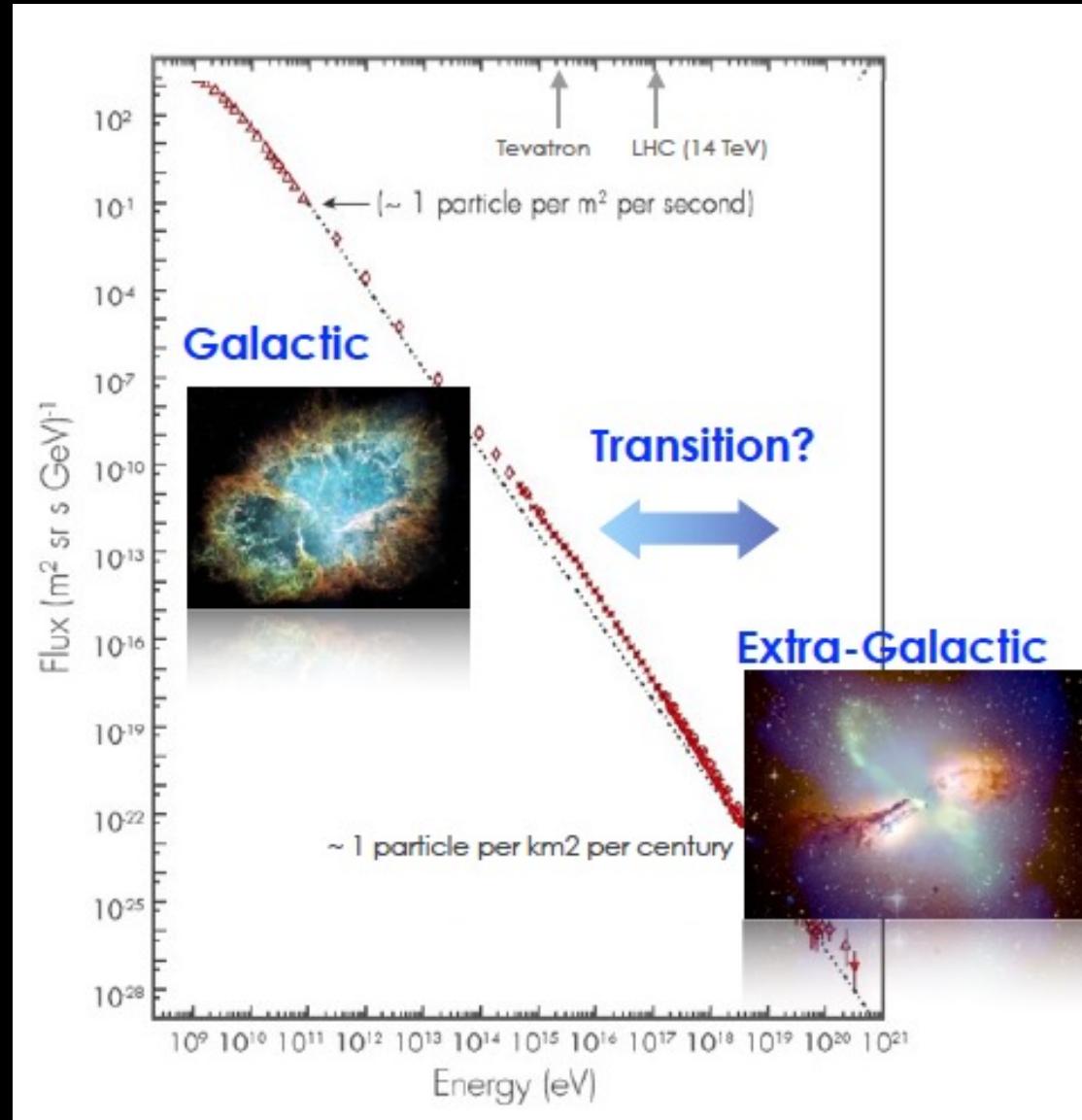
- The Universe and the Atom (1800-1930s) Photography, Photométry, Spectroscopy, Discovery He, Effect Doppler
→ Hubble Univers en expansion
- The Universe and the nucleus(1900-1970s)
Evolution and end of stars , creation of éléments →
Black Holes, Neutrons Stars
- L'Univers and radio waves(1930-) Jansky signal
from galactic centre, Ligne H₂ 21cm, CMB,
Quasars, Pulsars, Pulsars binaries and GW
- The Universe and rays X et γ (1960s-) Cygnus X1,
Scorpius X1, GRBs



A century of studies of cosmic rays



Flux ($\text{m}^2, \text{s}, \text{sterad}$)



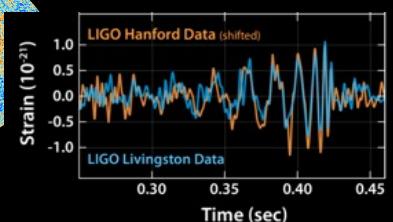
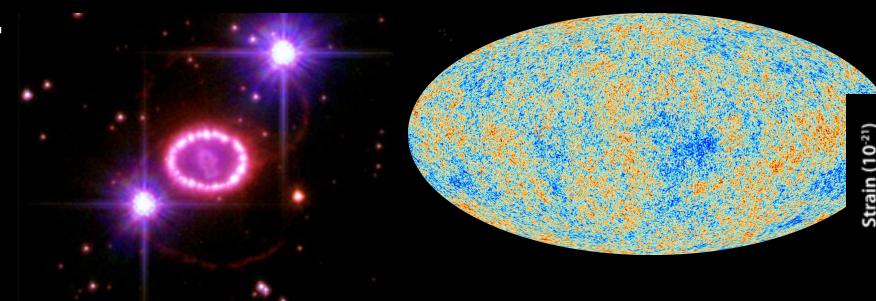
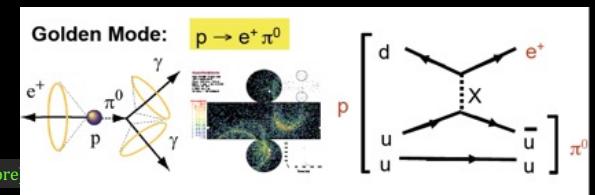
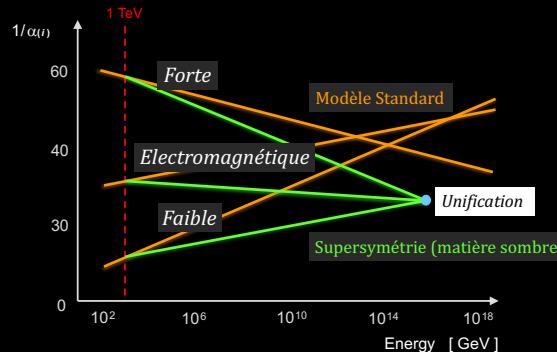
- First measurements
T. Wulff 1909-1910 Eiffel Tour
- V. Hess (balloon) Nobel prize

2009 Opera Cosmique, Tour Eiffel et finalement Tour Montparnasse

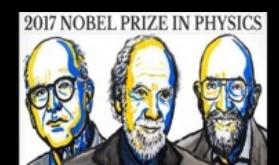
Energy 10^9 eV to 10^{21} eV

Universe and Particle Physics

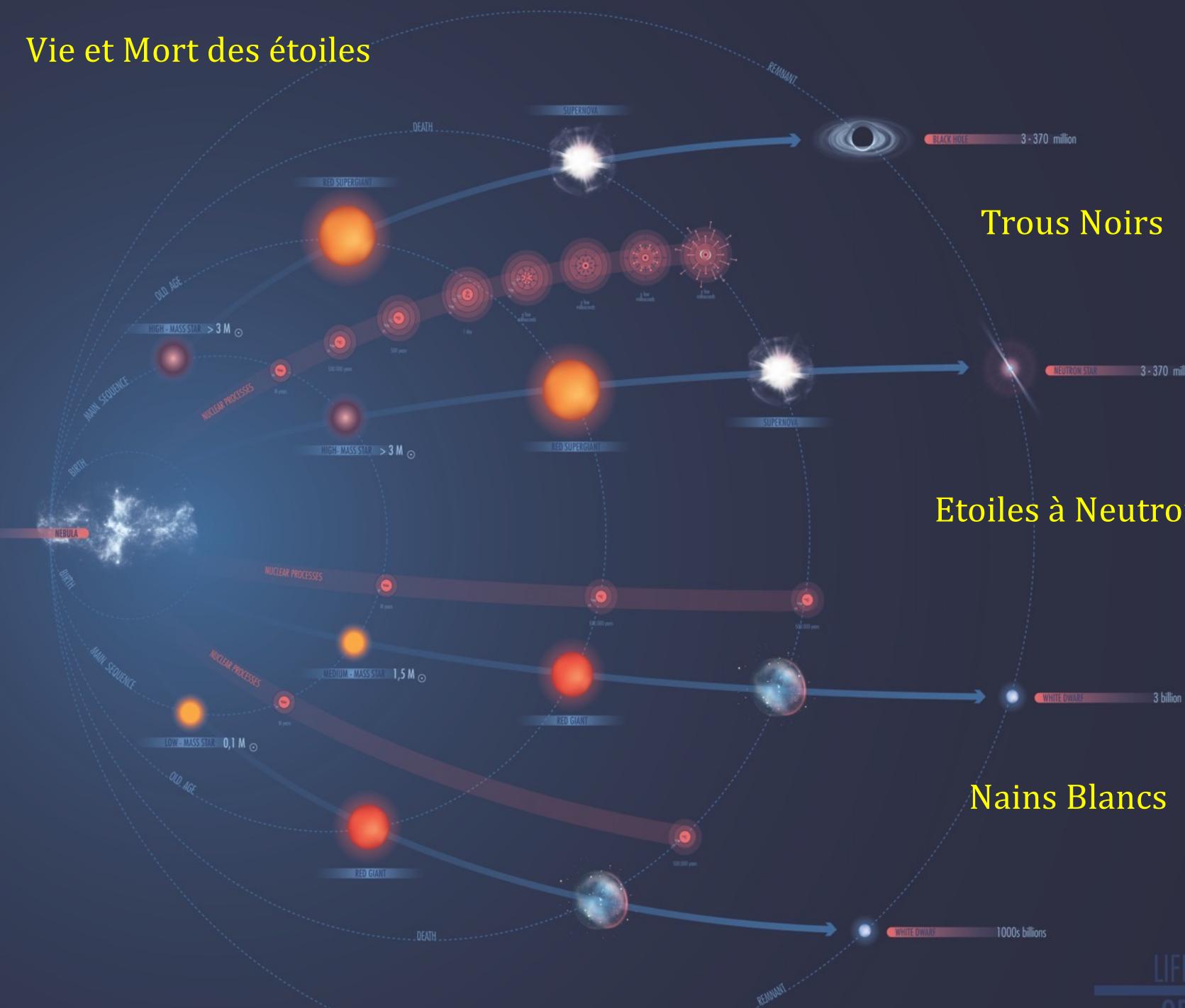
- 1953-1956 detection of ν
- 1960's-2001 Oscillations of solar ν
- 1949-1970's Unification of subnuclear forces prediction
→ lifetime of the proton
- Supernova 1987A in ν



- 1989 TeV γ (T. Weekes)
- 1930's-1970's Dark Matter
- 1990's Fluctuations CMB
- 1999 Dark Energy
- 2015 Detection of GW



Vie et Mort des étoiles



Trous Noirs

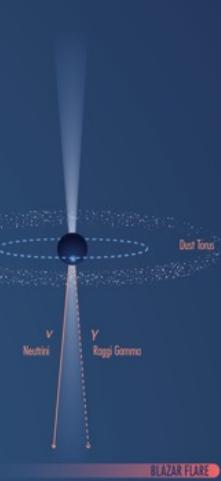
Etoiles à Neutrons

Nains Blancs

LIFE AND DEATH
OF STARS

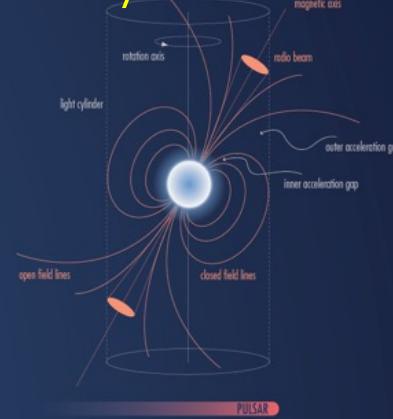
The violent Universe

Tidal disruption events.
Fast Radio Bursts ?

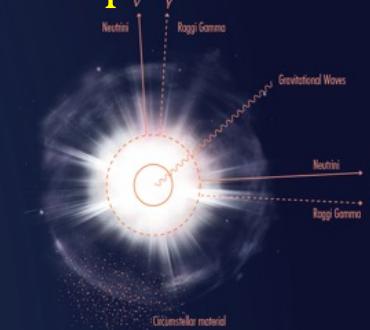


Blazar Flare

EGO/AHEAD2020/APPEC posters



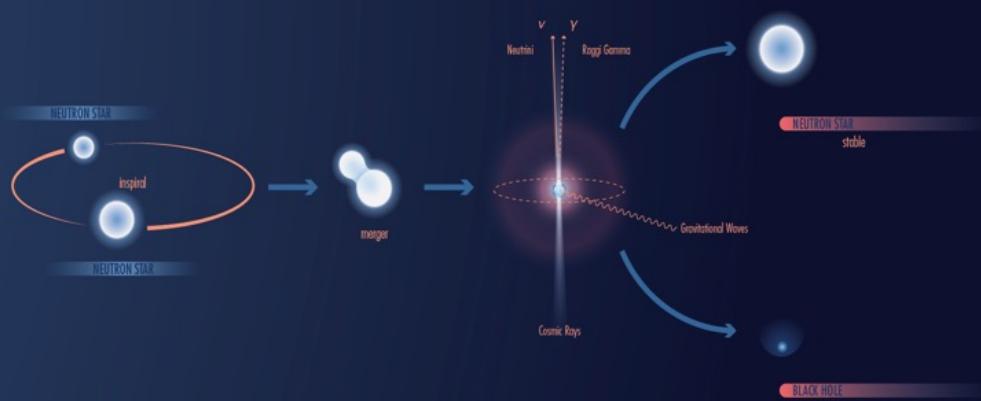
Pulsar, Magnetar



Supernova



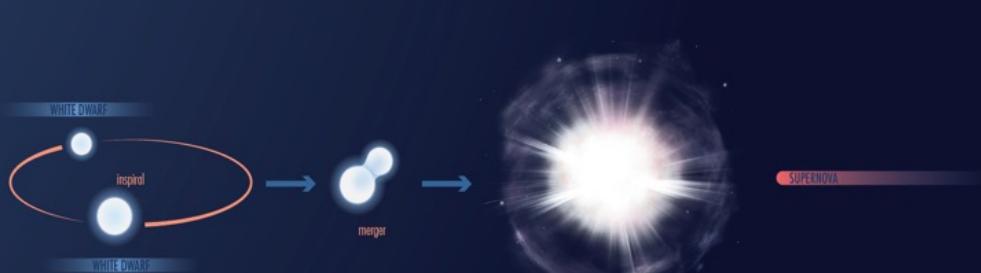
Neutron Star Black Hole merger



Short γ -ray burst double neutron star merger

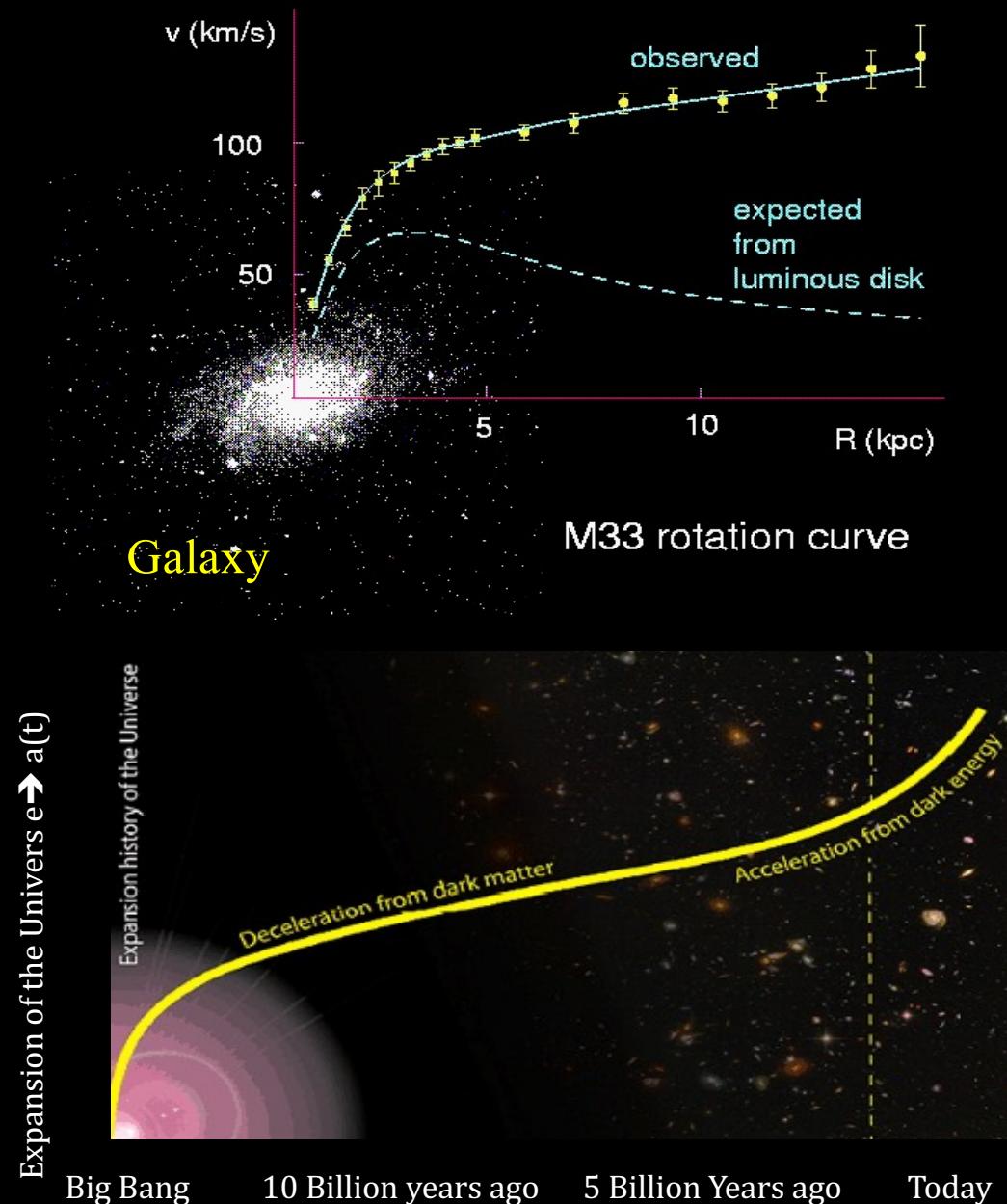


Double Black Hole merger

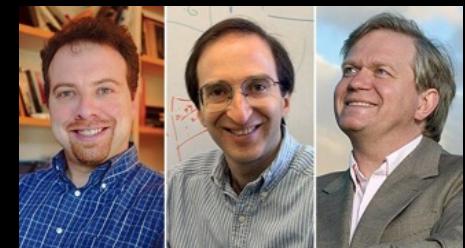


Double White Dwarf merger \Rightarrow SNIa ?

The Dark Universe

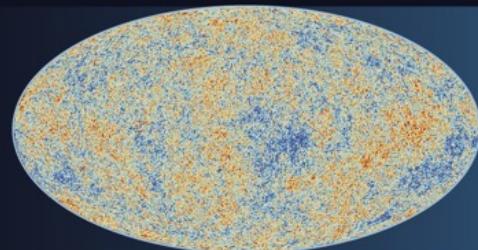


Visible matter is not the totality of the mass of the Universe; there is dark matter



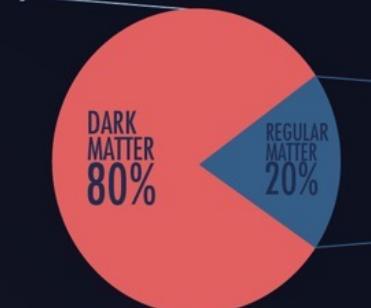
Universe is not only in expansion but in accelerated expansion due to dark energy,

The Dark Universe

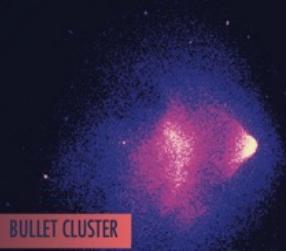


LOREM IPSUM DOLOR SIT AMET, CONSECTETUR ADIPISCING ELIT, SED DO EIUSMOD TEMPOR INCIDUNT UT LABORE ET DOLORE MAGNA ALIQUA. UT ENIM AD MINIM VENIAM, QUIS NOSTRUD EXERTIONATIONE ULTIMO LABORIS NISI UT ALIQUIP EX EO COMMODO CONSEQUAT. DULS AUTEM IURE DOLOR IN REPREHENDERENT IN VOLUNTATE VELETT ESSE CILUM DOLORE EU FUGIAT NULLA PARITAT.

Titolo ?



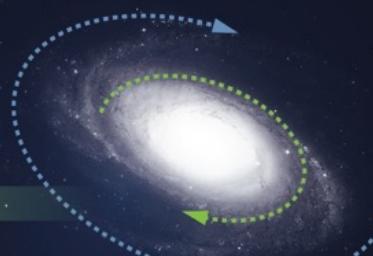
But also why matter dominated antimatter ?



BULLET CLUSTER

$$v_{\text{dotted}} = v_{\text{dashed}}$$

GALAXY CURVES

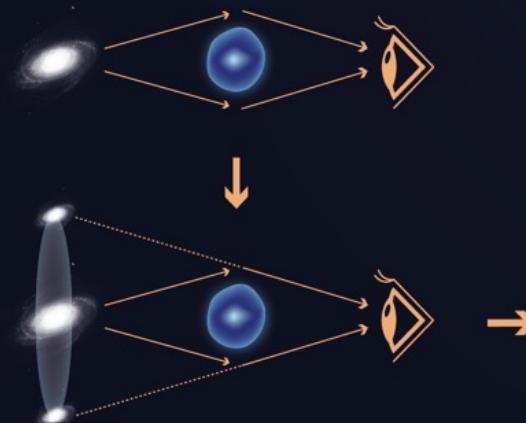


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In the 2020's we know with very high precision, what we do not know....

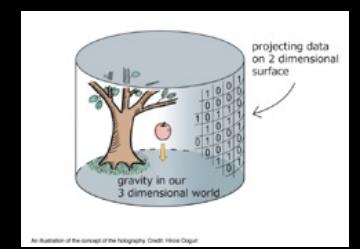
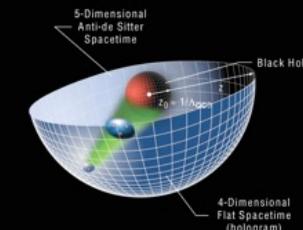
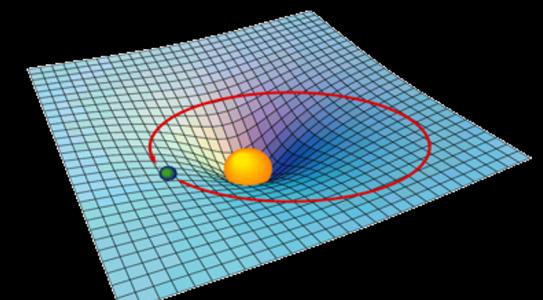
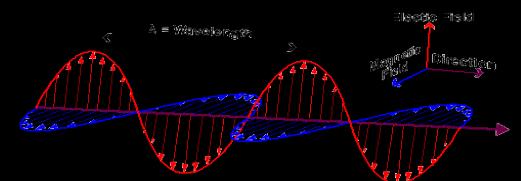
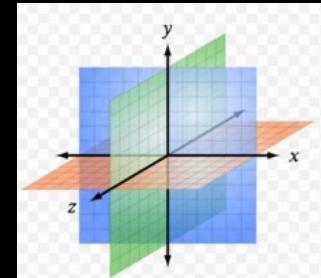


GRAVITATIONAL LENSING

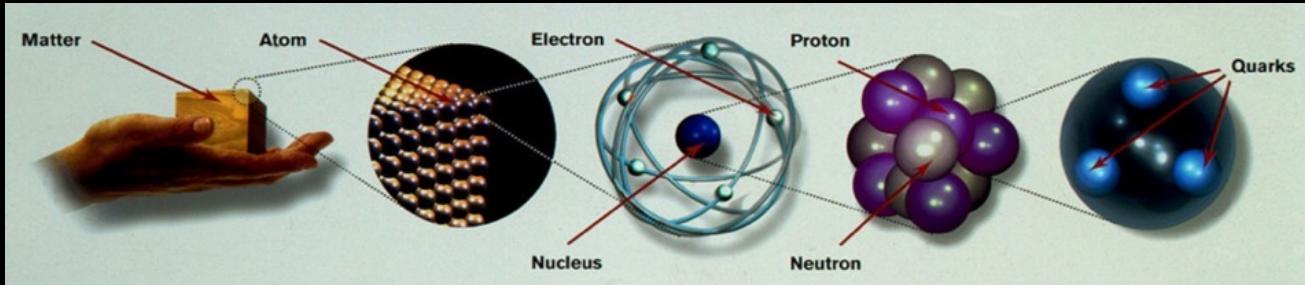
CLUES TO
DARK MATTER

3 concepts of space-time

1. **Newton** Space and time a fixed eternal frame(Sensorium dei). “*It is inconceivable that inanimate brute matter should without the mediation of something else which is not material, operate upon and affect other matter without mutual contact*”; *Hypotheses non-fingo.* **Maxwell** Electric and magnetic forces are a function of a single field: the electromagnetic field taking different values at each point in space-time.
2. **Einstein** Space-time is a deformable medium. Mass and Energy deform space-time around them and inversely they follow the deformed paths inside it (the metaphor of the swimmer of Deleuze). Space and time depend on the M/E context. Gravitational Waves can be produced by violent phenomena
1. Quantum Mechanics, Quantum Filed Theory, Strings,Holography, Entanglemenet. Space-time is an “emmergent” product of the relation. (Also Leibnitz)



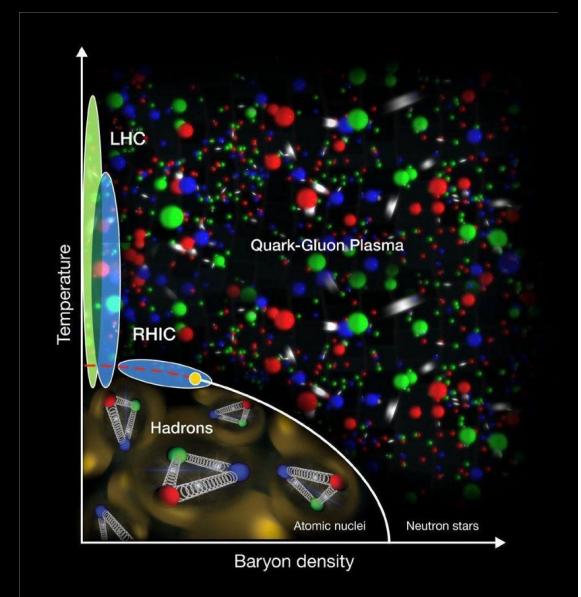
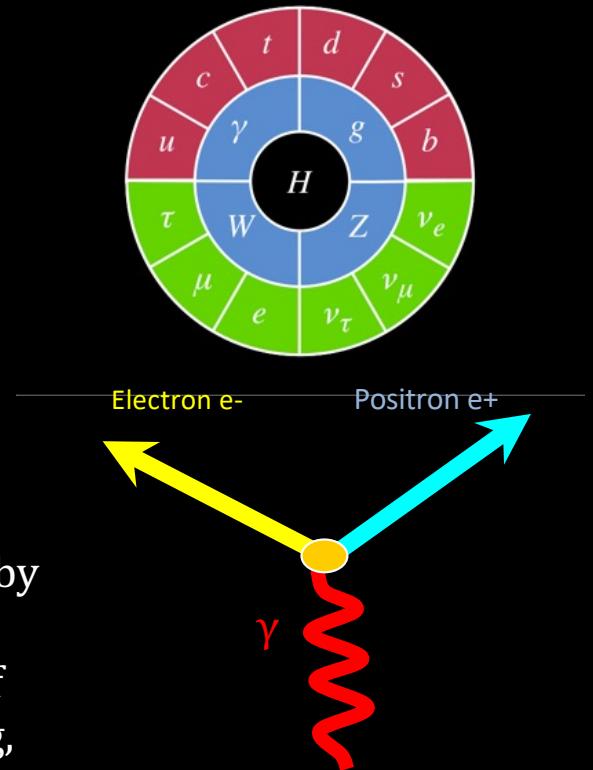
Matter: The infinitely small (QM, QFT, Strings...)



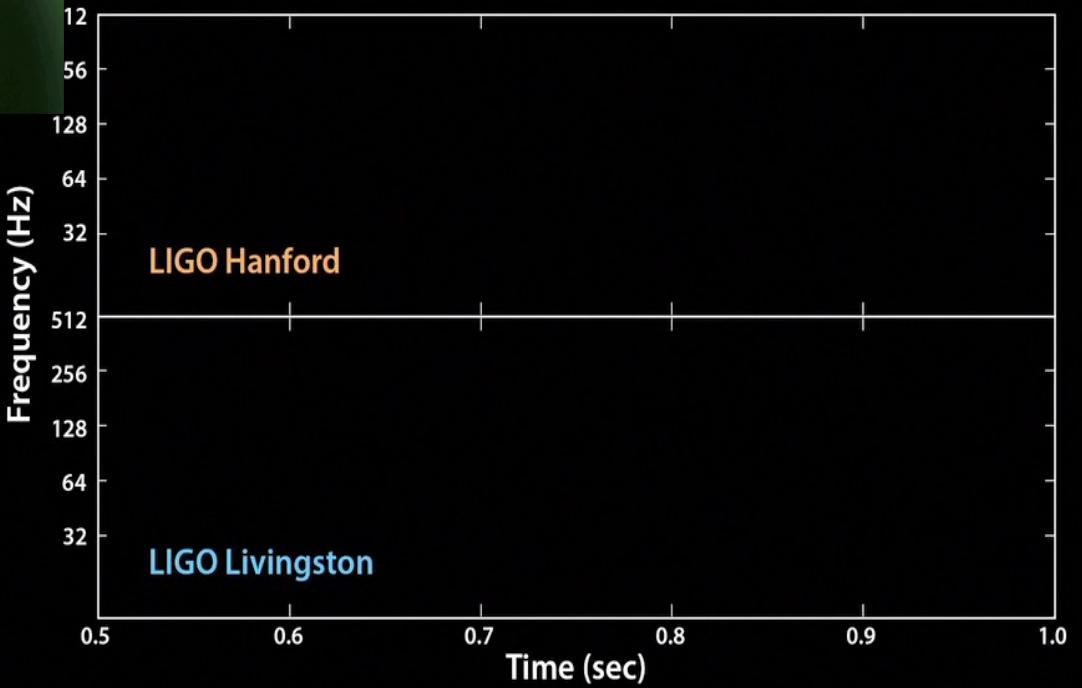
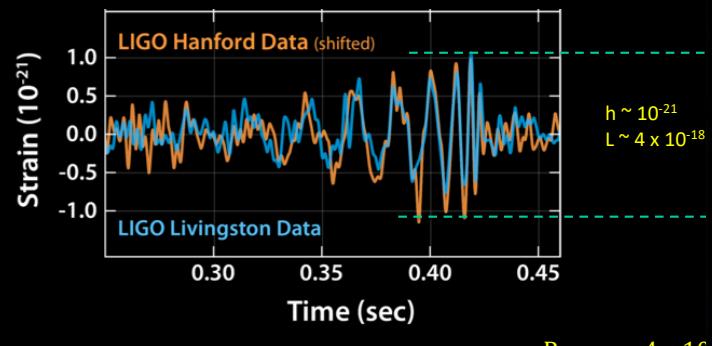
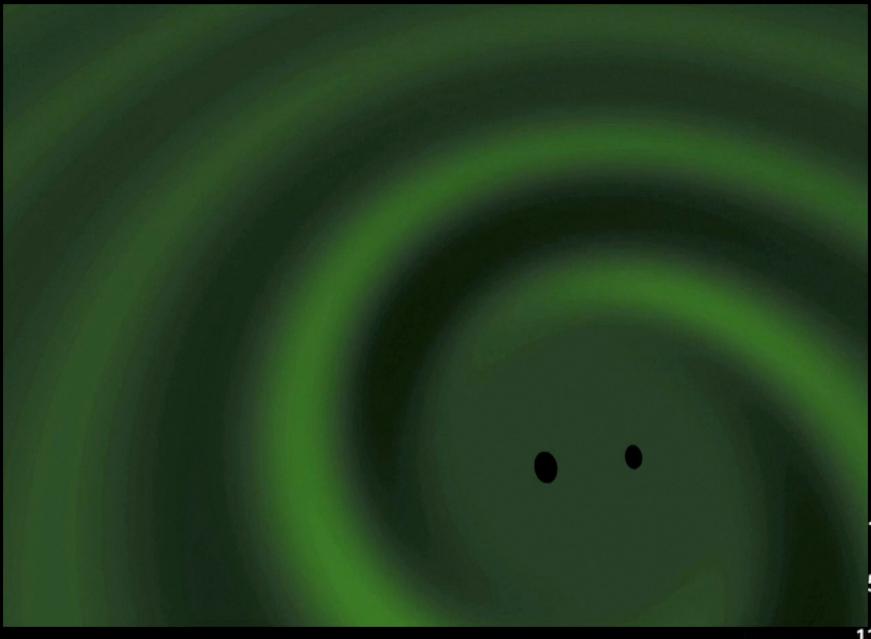
1. **Mass:** The Higgs field determines the mass of leptons and quarks
2. **Antiparticles:** particles with the same mass but opposite charge.
3. **Energy:** conservation of energy can be violated for a short enough time (Heisenberg Principle). Particle -antiparticle pairs can “virtually” emerge from the vacuum for a time interval permitted by the HP.
4. **Interaction between two elementary particles** is due to exchange of virtual quanta (bosons): photons/ electromagnetic, gluons/strong, W-Z/ weak forces
5. **The virtual creation of particles/antiparticles** by bosons permits the creation of the Universe, through the mechanism of Inflation

Open issues (LHC+ and neutrino detectors)

1. The detailed nature of Higgs field (also revealing the possible existence of other particles through virtual exchange)
2. The origin of neutrino very small mass most probably not emerging from a Higgs interaction, the true mechanism (see-saw) may be at the origin of the dominance of matter over antimatter in the Universe
3. The understanding of the transition of quarks to gluons and the equation of state of dense matter (e.g. neutron stars)

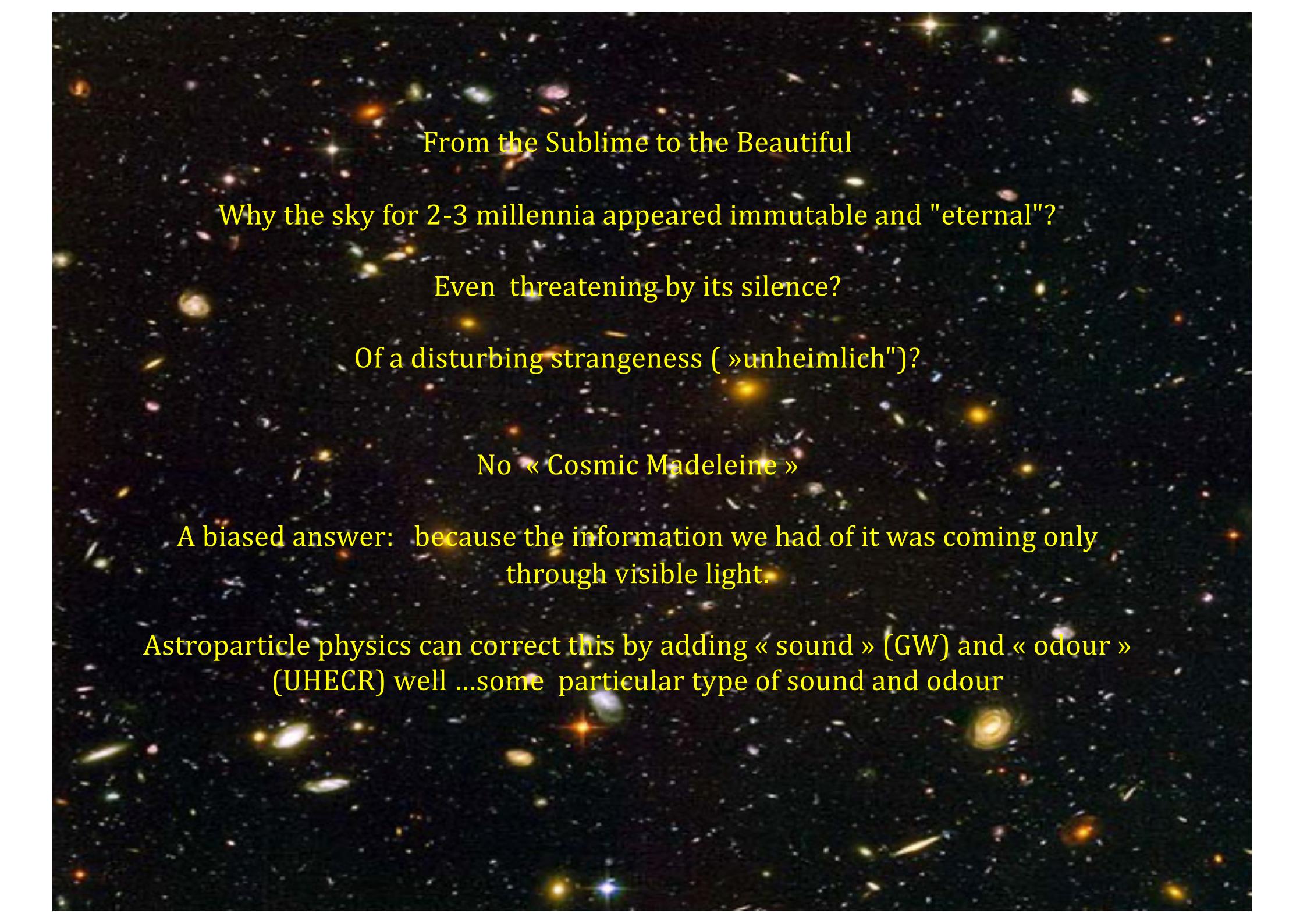


Gravitational Wave detection



The frequencies of the deformation in the “acoustic bandwidth” (20Hz -20 KHz)

Dear Blaise do not be frightened anymore: the eternal silence is broken



From the Sublime to the Beautiful

Why the sky for 2-3 millennia appeared immutable and "eternal"?

Even threatening by its silence?

Of a disturbing strangeness (»unheimlich")?

No « Cosmic Madeleine »

A biased answer: because the information we had of it was coming only through visible light.

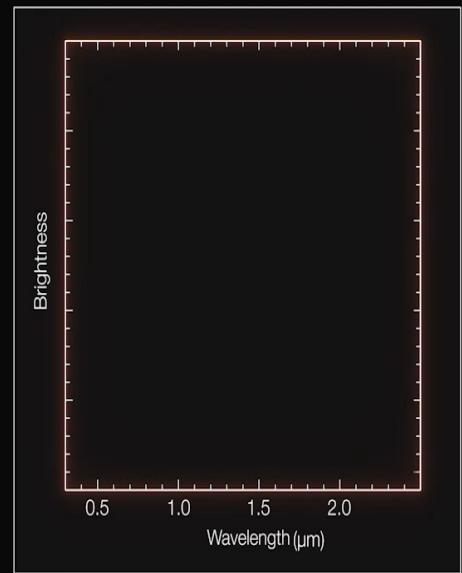
Astroparticle physics can correct this by adding « sound » (GW) and « odour » (UHECR) well ...some particular type of sound and odour

GW from a Binary Neutron Star (BNS) merger

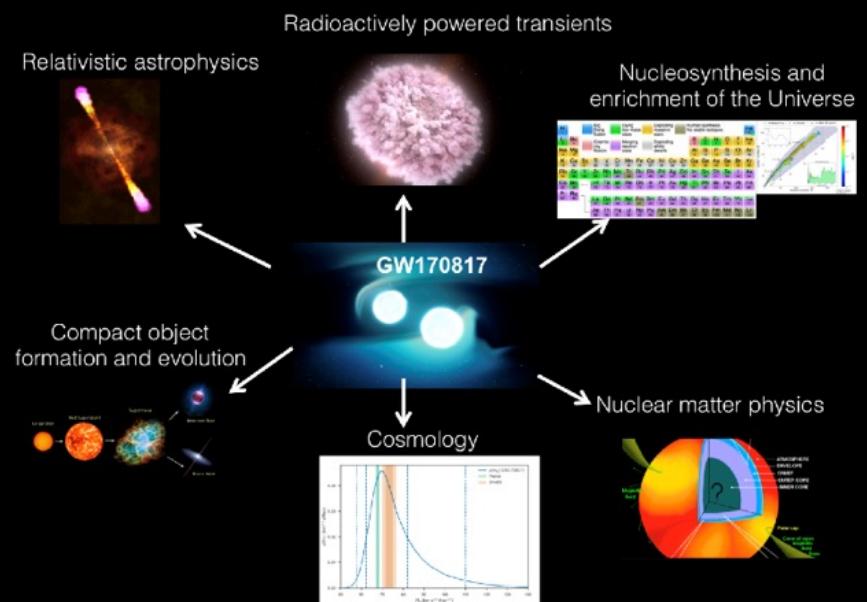
Start of Multimessenger Astronomy.

17 August 2017

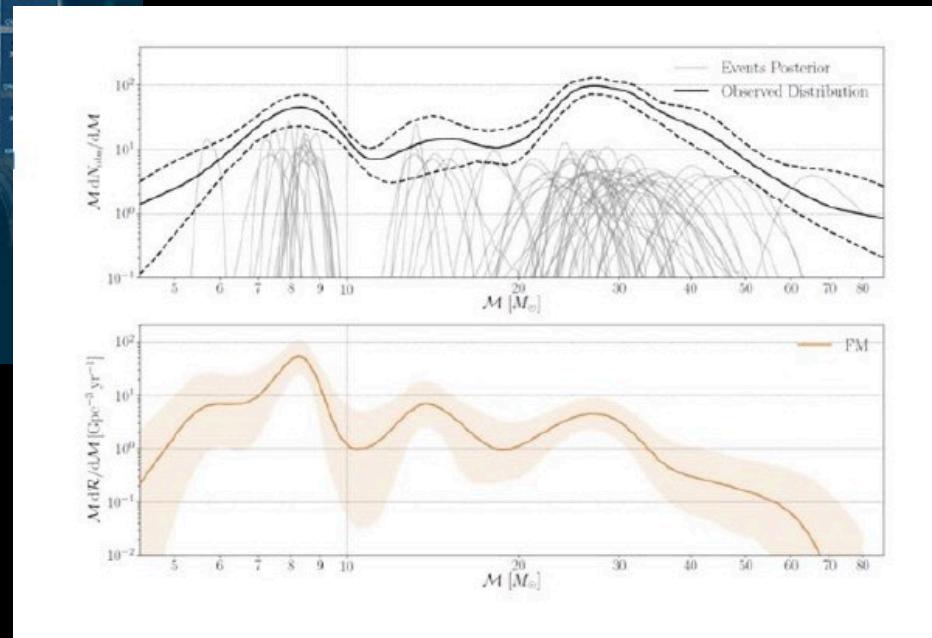
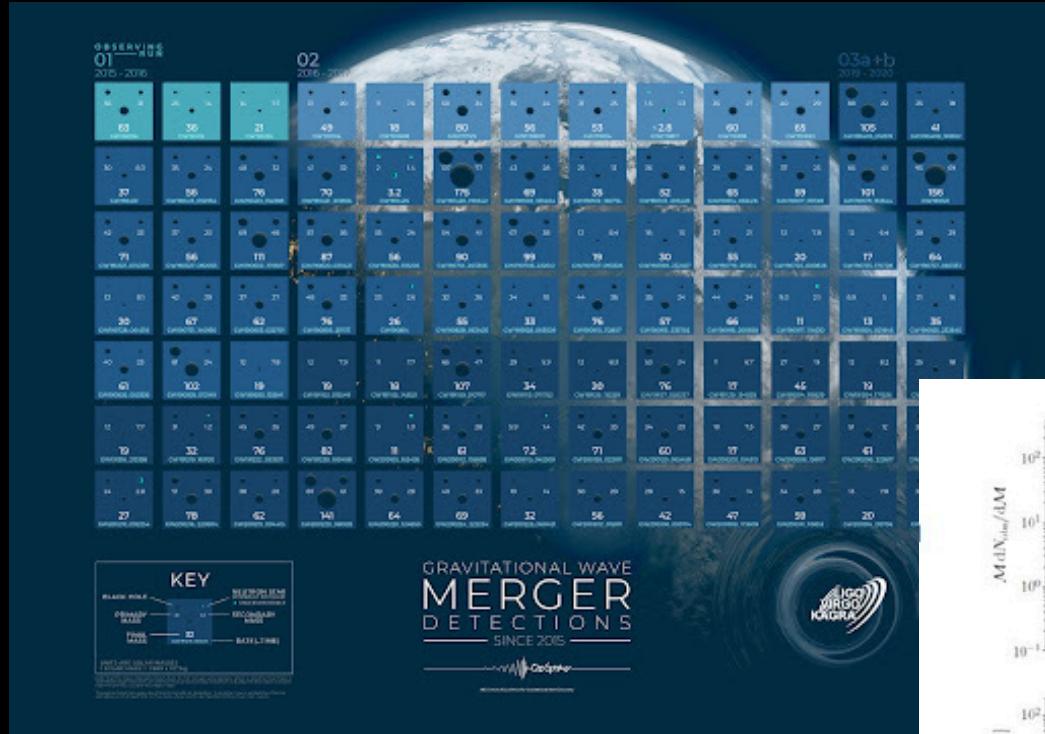
GW170817 a BNS @ 120 Mly: observed by about 70 observatories around the world



Time: -1225 days

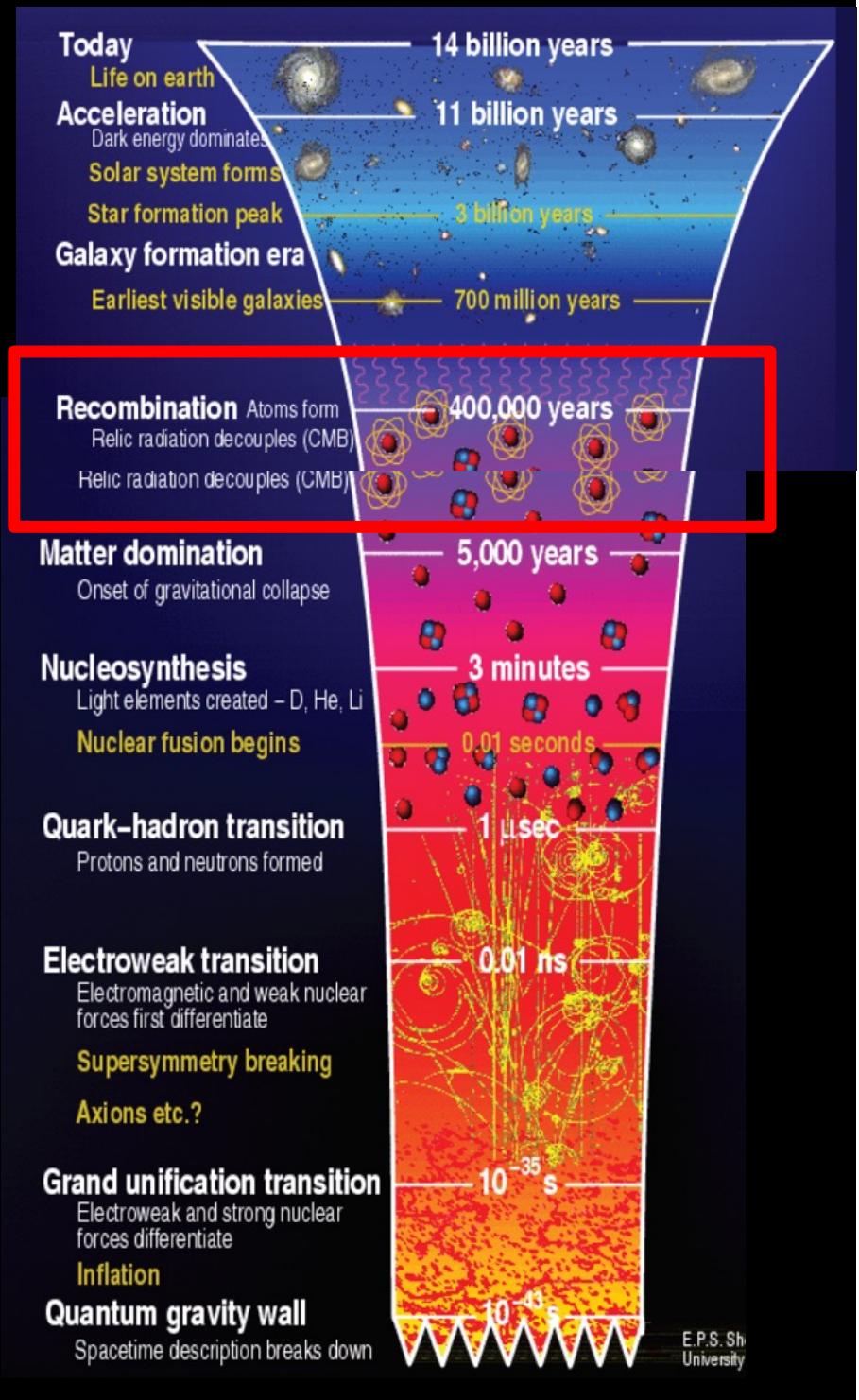


Today: 90 events till now: detection one event per week



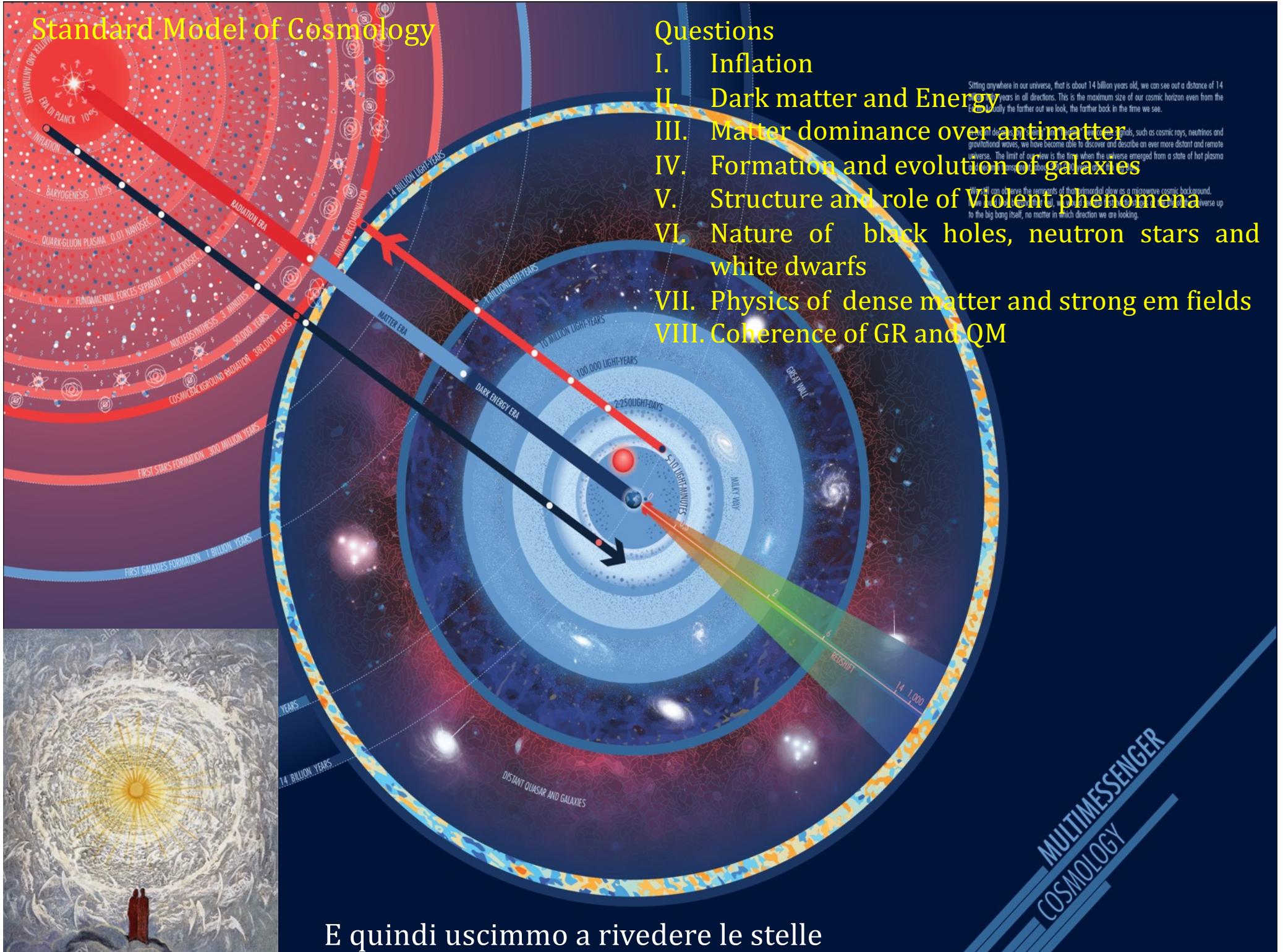
- Cartography of “dead stars”
- To compare with this of the living stars as a door to new physics
- How can one make the history of the Universe without counting the dead ?

- Inflation and Grand Unification Transition:** Electroweak and Strong interaction differentiate
- Dominance of Matter over Antimatter**
- Electroweak Transition** weak and strong forces separate (Higgs)
- Quark-hadron Transition:** Protons and Neutrons form
- Nucleosynthesis Transition :** Light elements (D,He, Li) form. nuclear fusion starts
- Matter Domination Transition:** Onset of gravitational collapse
- Recombination Transition:** Atoms form, Universe becomes transparent relic radiation decouples and travels to earth (CMB)
- Era of formation of first stars and galaxies** (Population III, primordial black holes?)
0,4Myr t 1 0,7Bly.
- Formation and evolution of “modern” stars and Galaxies** 0,7Bly- 11 Bly
- Expansion of acceleration** 11Bly-14Bly

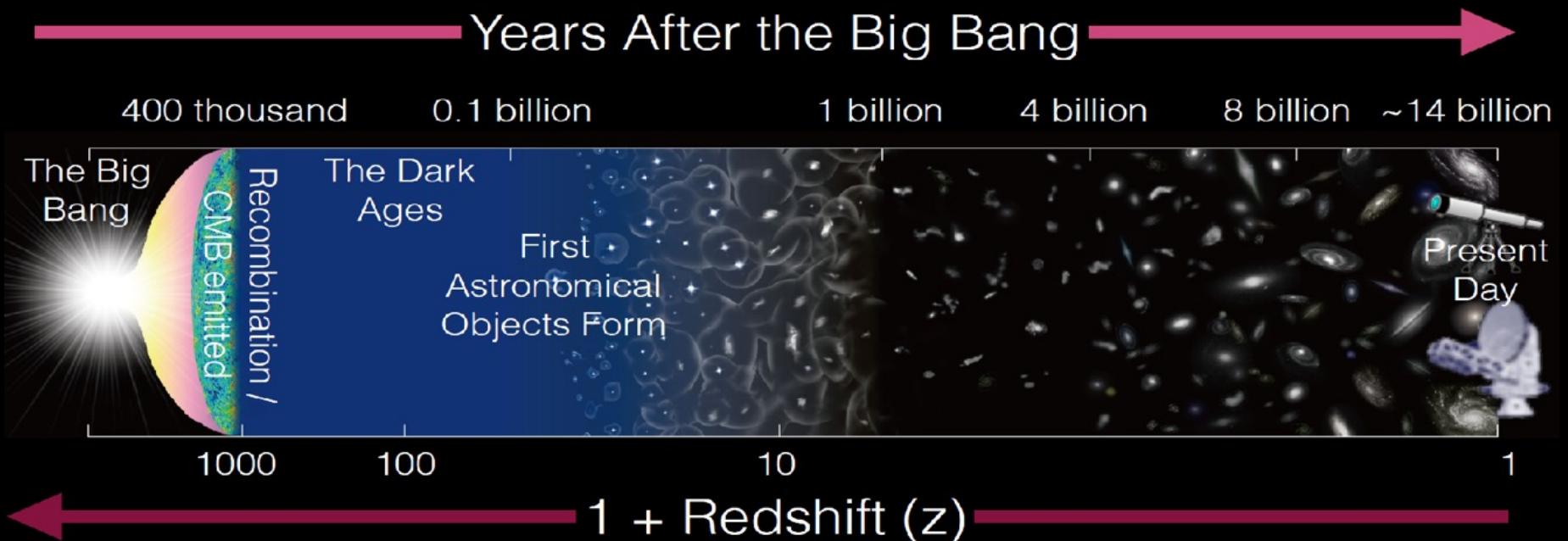


GW a dominant probe

Standard Model of Cosmology



GW a universal probe



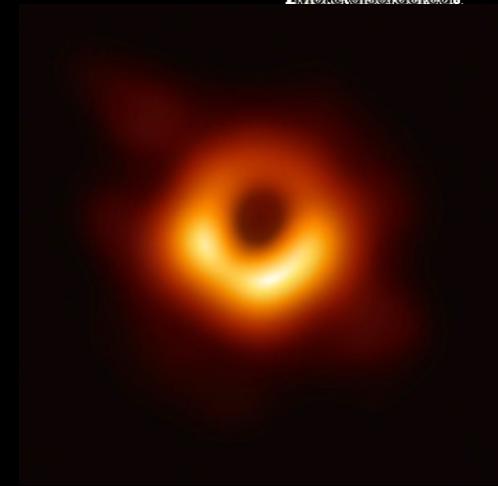
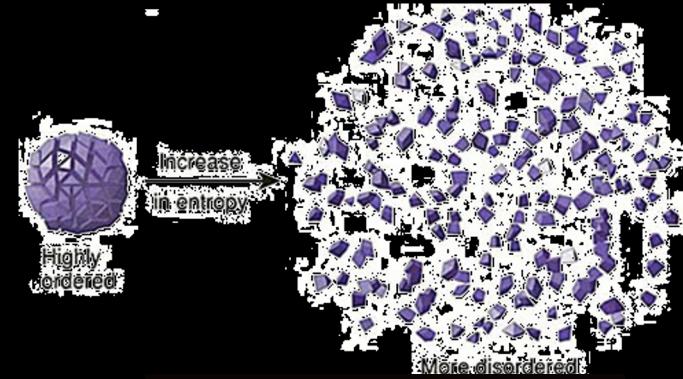
GW will address the following issues

1. **Astrophysics.** Visible Universe cartography of the “dead stars” up to Recombination wall, measure the expansion rate of the Universe, dark energy and dark matter
2. **Nuclear Physics.** Probe extreme nuclear matter conditions in the ringdown of the fusion, clouds around it...
3. **Particle Physics.** “Listen” behind the Recombination wall all phase transitions... (GU, Higgs, Leptogenesis, ...)



- Les points de rencontre, les confins entre les deux infinis, sont aussi des lieux d'incertitude mais aussi de portes vers des nouvelles théories. Imaginarium.
- Les horizons, l'origine, les points singuliers, posent des limites à nos théories et/ou visions mais deviennent aussi des portes vers l'invention.
 1. Le passage du temps, augmentant l'incertitude de correspondance entre des états macroscopiques et les états microscopiques dans la Mécanique Classique, ce qu'on nomme **entropie**;
 2. Les difficultés conceptuelles de définition de **l'espace du temps dans la Mécanique Quantique**
 3. **La perte d'information d'un trou noir**, ou à l'époque Planck, points de rencontre du Classique et du Quantique

Peuvent se comparer à des approches artistiques de présentation de l'horizon et des points singuliers ou plus généralement de notre compréhension affective/artistique de l'espace et du temps.
Voir Exhibition en cours “L'Incertezza” à Rome



In this beginning of the 21st century, our knowledge of the Universe can be compared to the knowledge of the gases at the beginning of the 20th. We know with great precision the overall parameters and relations of macroscopic variables: in short its macrophysics, but we still lack the full knowledge of its elementary constituents: its microphysics G. Smoot (Nobel of Physics 2006)



G. Smoot in M. Curie's Office, Paris, December 2006

Les relations art et science

Toutes les grandes révolutions scientifiques (et nous traversons une) sont synchrones avec des révolutions artistiques

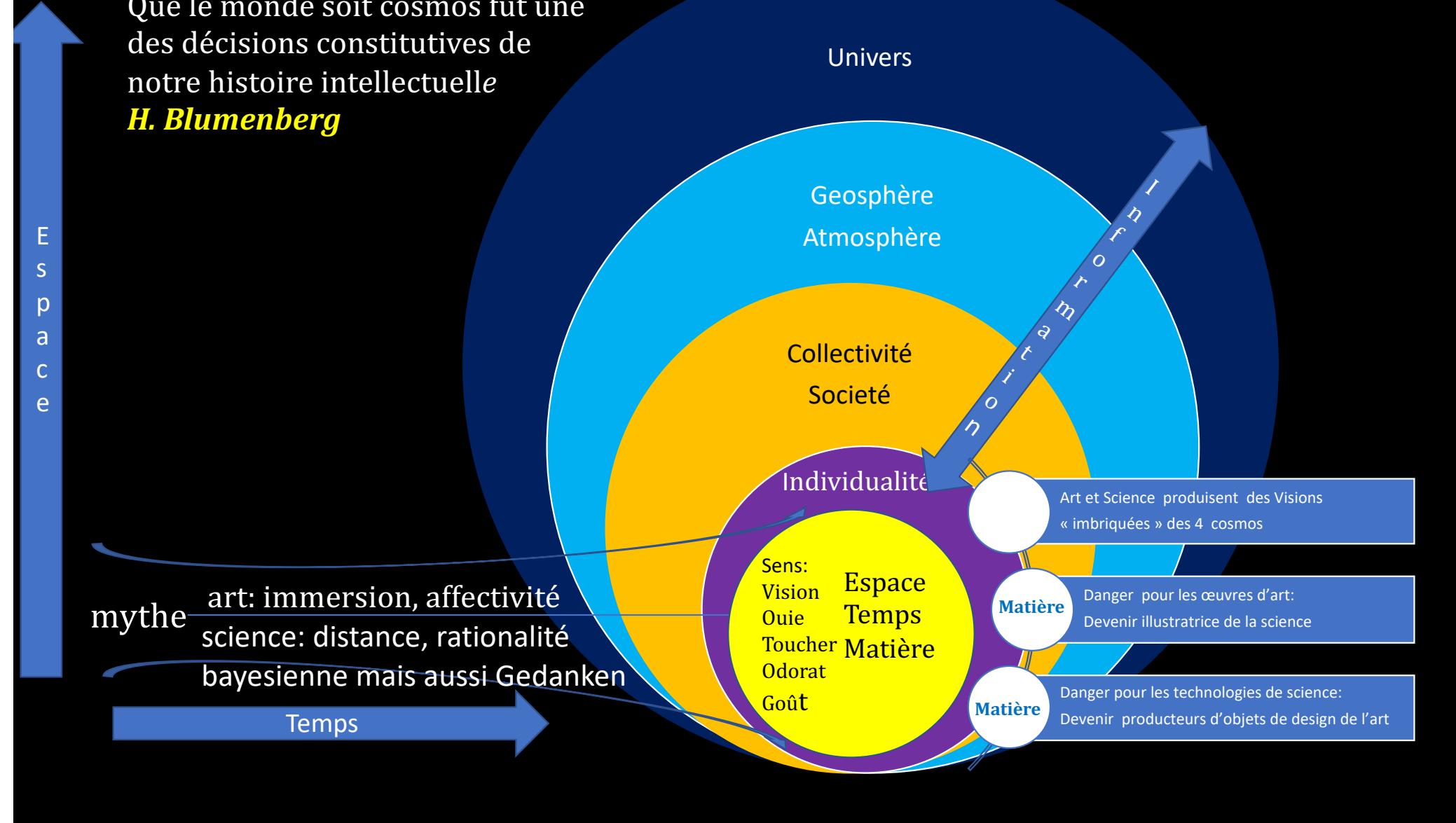
1. **Le moment Galiléen Cartesien et Newtonien.** (invention du telescope et du microscope) Au delà du modèle ptolémaïque, Uniformité géométrique de l'Univers, Trajectoires et pas des rythmes, le rôle du tennis, Art Renaissance, la sortie de la Bodega (Artisanat) vers le génie individuel, Leonardo "les artistes doivent créer leurs images et pas illustrer la foi". La philosophie cherche des stabilités et une logique de l'identité au milieu des guerres de religion, cogito, deisme.
2. **Le moment Einsteinien.** Discussions philosophiques de Bergson à Cassirer. Duchamp, les Surrealistes, Kandinsky, Linda Darlymple. Breton (Surrealist manifesto): the spontaneous clairvoyant insolent connection established under certain conditions between two things whose conjunction could not be permitted by common sense.
3. **Aujourd'hui ? Quelques éléments**
 1. La conscience environnementale
 2. Du multi-messager au multi-sensoriel, les qualités premières et secondaires à repenser ? L'espace et les sens ?
 3. Nouvelle relation entre l'éducation et la science. Thorpe and Blandford " After the pandemic we need to rethink the link between research and education"
 4. Art et science

Ainsi cosmos, en Antiquité, signifie-t-il en même temps **parure** et toute **splendeur** en général; univers ou totalité des êtres et **constitution politique** fondée sur la loi; **principe d'ordre et d'harmonie** qui règle aussi bien les rapports entre les êtres qu'entre les éléments de chaque être; **vertu** ou bien immanents à chaque être et lui permettant de devenir ce qu'il est et de se maintenir tel qu'il est

K. Papaioannou

Que le monde soit cosmos fut une des décisions constitutives de notre histoire intellectuelle

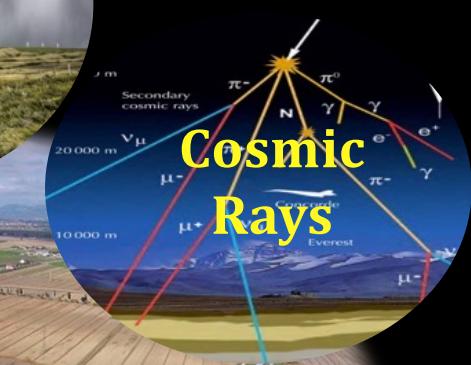
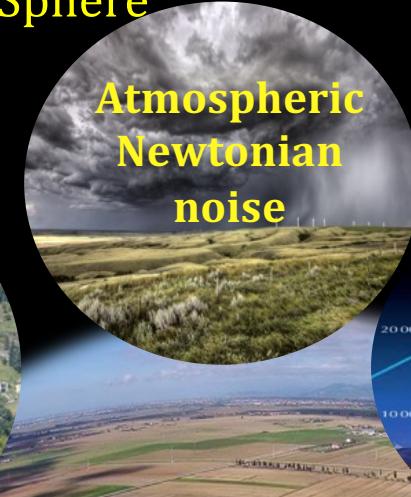
H. Blumenberg



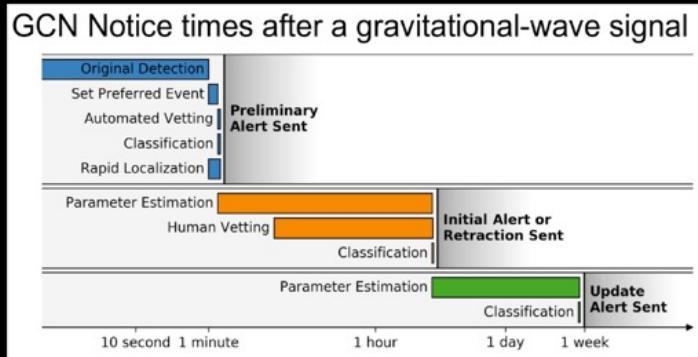


D'Ouranos à Gaia

Astroparticle and GW detectors deeply imbedded in Geo and Atmo Sphere



O3 LIGO-Virgo PUBLIC alerts



- One needs first to understand the environmental “noise” before declaring a signal of cosmic origin
- Low latency alerts Can be of societal impact, early warning for natural catastrophies (tornado's , fires, ...)

• EU proposal APOGEIA



Du Multimessager à
multisensoriel

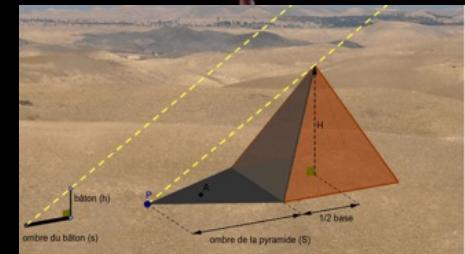
A short story of Messengers and Sensing

- Myth : Zeus: Hermes, Dawn, Lightning and Rainbow



- The presocratics trying to sense the Universe

- Thales: Visible: Light/Shadow

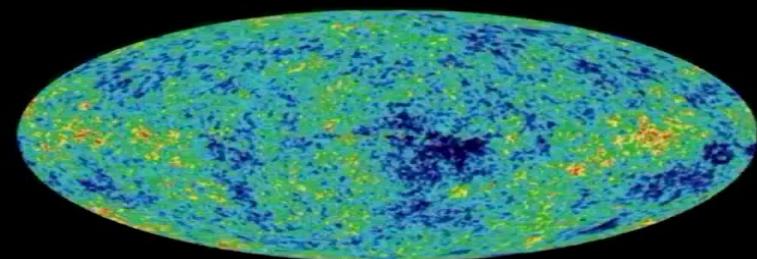
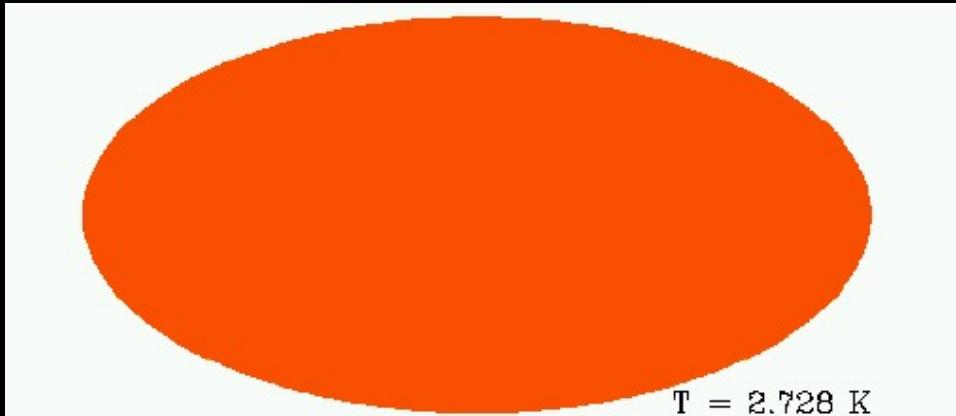


- Pythagoras Acoustic Rhythme/Harmony

- Democritus Touch: Atoms/Vacuum , “symploke” of trajectories (H. Wismann)



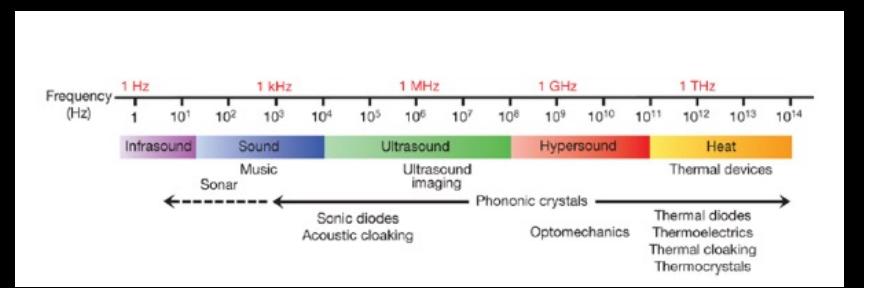
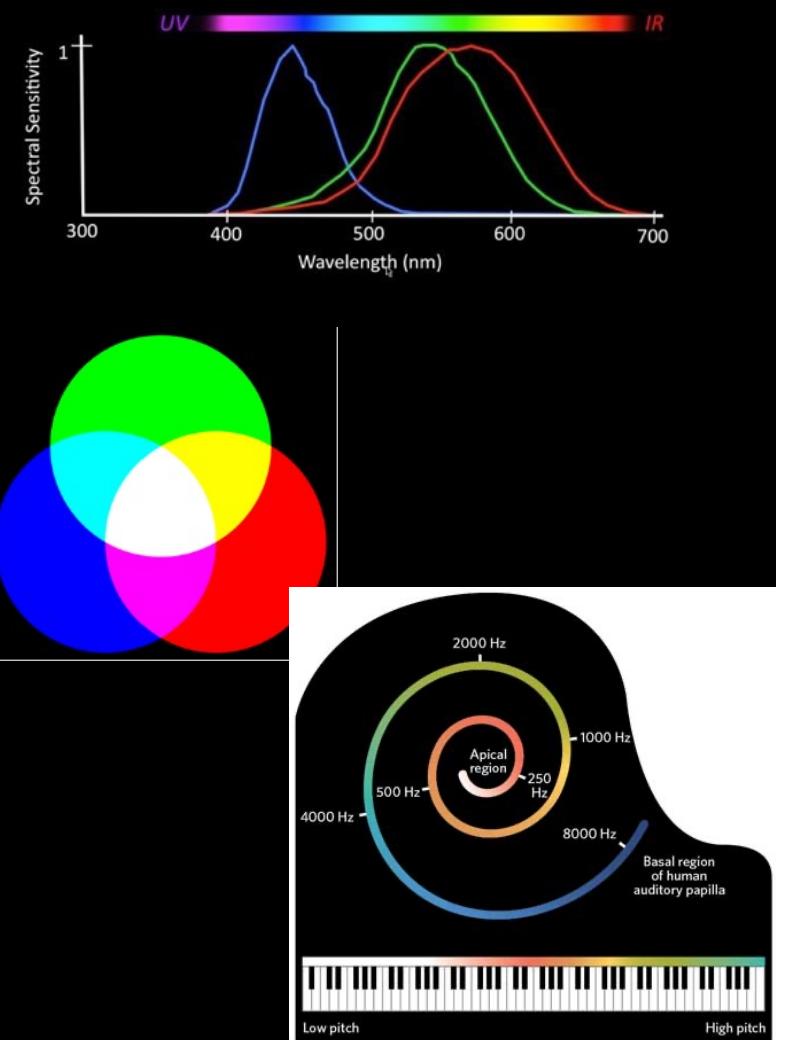
The Cosmic Microwave Background Back to Pythagoras ?



So you have heard the Big Bang ? Isaac-Bashevitz-Singer to Penzias and Wilson

Reconstructing the cosmos through our senses

- **VISION:** Light is made of electromagnetic waves of frequency between 430 and 770 Thz (400-700 nm). At this frequency we have a good spatial resolution but bad in time
- Sensor side: "opsines" have different sensitivity curves, blue / red / green
- The colour of an object is a point in an "interior" space of colour to 3D (Newton vs Goethe)
- **HEARING:** sound of pressure waves / frequency density 20 Hz to 20 KhZ (17 mm-17m). At this frequency, we have a good temporal resolution but not a spatial one.
- Sensor side: The cochlea is like an inverse piano where sounds control the keys
- The perceived sounds are a Fourier (harmonic) analysis of the incident signal
- **Sensor networks:**
- **TOUCH:** Pressure and particles, **SMELL** and **TASTE** Detection of particles by chemoreceptors.



THE FREQUENCIES OF THE UNIVERSE

A cosmic wavelength piano



$10^{25} \quad 10^{24} \quad 10^{23} \quad 10^{22} \quad 10^{21} \quad 10^{20} \quad 10^{19} \quad 10^{18} \quad 10^{17} \quad 10^{16} \quad 10^{15} \quad 10^{14} \quad 10^{13} \quad 10^9 \quad 10^8 \quad 10^7 \quad 10^6 \quad 10^5 \quad 10^4 \quad 10^3 \quad 10^2 \quad 10 \quad 1 \quad 10^{-1} \quad 10^{-2} \quad 10^{-3} \quad 10^{-4} \quad 10^{-5} \quad 10^{-6} \quad 10^{-7} \quad 10^{-8} \quad 10^{-9} \quad 10^{-10} \quad 10^{-11} \quad 10^{-12} \quad 10^{-13} \quad 10^{-14} \quad 10^{-15} \quad 10^{-16} \quad 10^{-17} \quad 10^{-18} \quad 10^{-19} \quad 10^{-20} \quad 10^{-21} \quad 10^{-22} \quad 10^{-23} \quad 10^{-24} \quad 10^{-25}$

WAVELENGTH [meters]

NON-IONIZING RADIATION

IONIZING RADIATION

FREQUENCY [Hz]

VISIBLE

GW $10^{17} \quad 10^{16} \quad 10^{15} \quad 10^{14} \quad 10^{13} \quad 10^{12} \quad 10^{11} \quad 10^{10} \quad 10^9 \quad 10^8 \quad 10^7 \quad 10^6 \quad 10^5 \quad 10^4 \quad 10^3 \quad 10^2 \quad 10^1 \quad 1 \quad 10 \quad 10^2 \quad 10^3 \quad 10^4 \quad 10^5 \quad 10^6 \quad 10^7 \quad 10^8 \quad 10^9 \quad 10^{10} \quad 10^{11} \quad 10^{12} \quad 10^{13} \quad 10^{14} \quad 10^{15} \quad 10^{16} \quad 10^{17} \quad 10^{18} \quad 10^{19} \quad 10^{20} \quad 10^{21} \quad 10^{22} \quad 10^{23} \quad 10^{24} \quad 10^{25}$

GRAVITATIONAL WAVES

RADIO (10^4 eV)

MICROWAVE (10^4 eV)

INFRARED (10^2 eV)

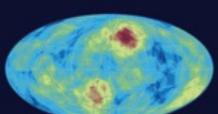
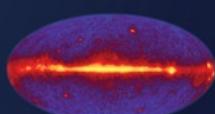
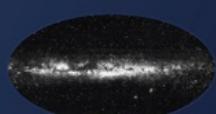
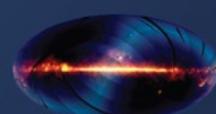
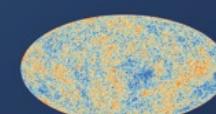
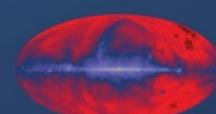
VISIBLE LIGHT(eV)

GAMMA RAYS

HIGH ENERGY GAMMA RAYS

HE COSMIC RAYS

PLANCK SCALE



Space Gravitational Waves



CMB

IR

X-Rays

HE Gamma Rays

Cosmic Rays

FREQUENCY [Hz]

$10^{17} \quad 10^{16} \quad 10^{15} \quad 10^{14} \quad 10^{13} \quad 10^{12} \quad 10^{11} \quad 10^{10} \quad 10^9 \quad 10^8 \quad 10^7 \quad 10^6 \quad 10^5 \quad 10^4 \quad 10^3 \quad 10^2 \quad 10^1 \quad 1 \quad 10 \quad 10^2 \quad 10^3 \quad 10^4 \quad 10^5 \quad 10^6 \quad 10^7 \quad 10^8 \quad 10^9 \quad 10^{10} \quad 10^{11} \quad 10^{12} \quad 10^{13} \quad 10^{14} \quad 10^{15} \quad 10^{16} \quad 10^{17} \quad 10^{18} \quad 10^{19} \quad 10^{20} \quad 10^{21} \quad 10^{22} \quad 10^{23} \quad 10^{24} \quad 10^{25} \quad 10^{26} \quad 10^{27} \quad 10^{28} \quad 10^{29} \quad 10^{30} \quad 10^{31} \quad 10^{32} \quad 10^{33} \quad 10^{34} \quad 10^{35}$

PENETRATES EARTH ATMOSPHERE?



ENERGY [eV]

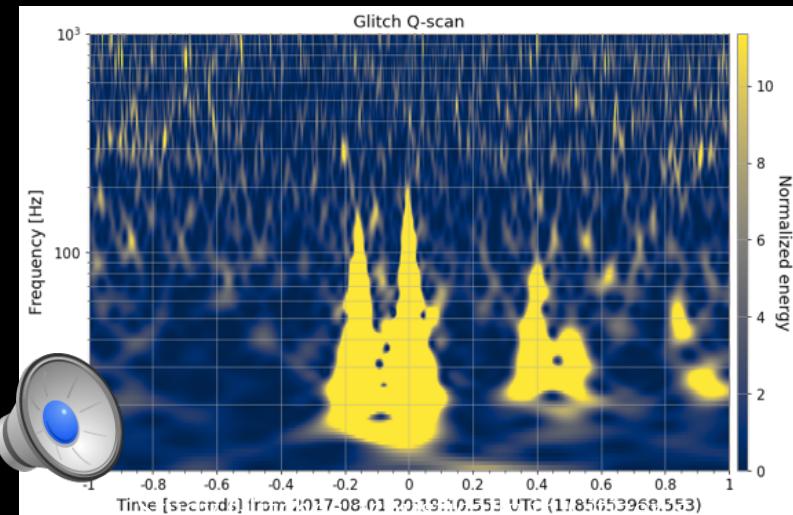
$10^{10} \quad 10^{11} \quad 10^{12} \quad 10^{13} \quad 10^{14} \quad 10^{15} \quad 10^{16} \quad 10^{17} \quad 10^{18} \quad 10^{19} \quad 10^{20} \quad 10^{21} \quad 10^{22} \quad 10^{23} \quad 10^{24} \quad 10^{25} \quad 10^{26} \quad 10^{27} \quad 10^{28} \quad 10^{29} \quad 10^{30} \quad 10^{31} \quad 10^{32} \quad 10^{33} \quad 10^{34} \quad 10^{35}$



Inclusion for augmenting humanities perception capabilities from Multi-Messenger to Multi-sensorial

Wanda Daz Merced

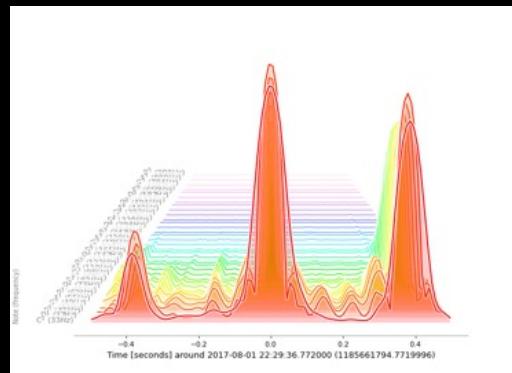
- From multi-messenger to multisensorial apprehension of reality
- Not only increasing inclusion . Also increasing the researchers discrimination power of signal over background through the use of sound.



science



Wanda joined Ego March 2021



Antares a bioluminescent discussion

*



Une nouvelle relation
education
et
recherche



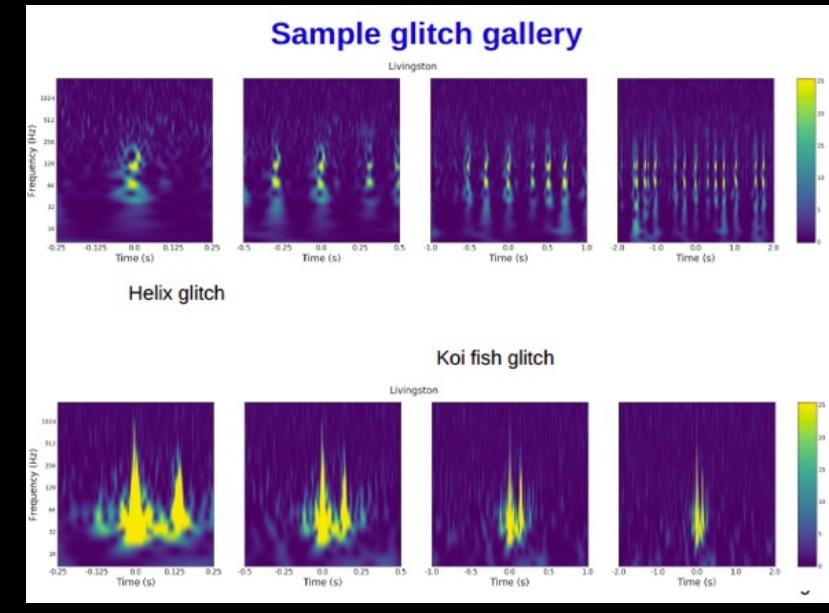
Citizen's Science

REINFORCE and GW

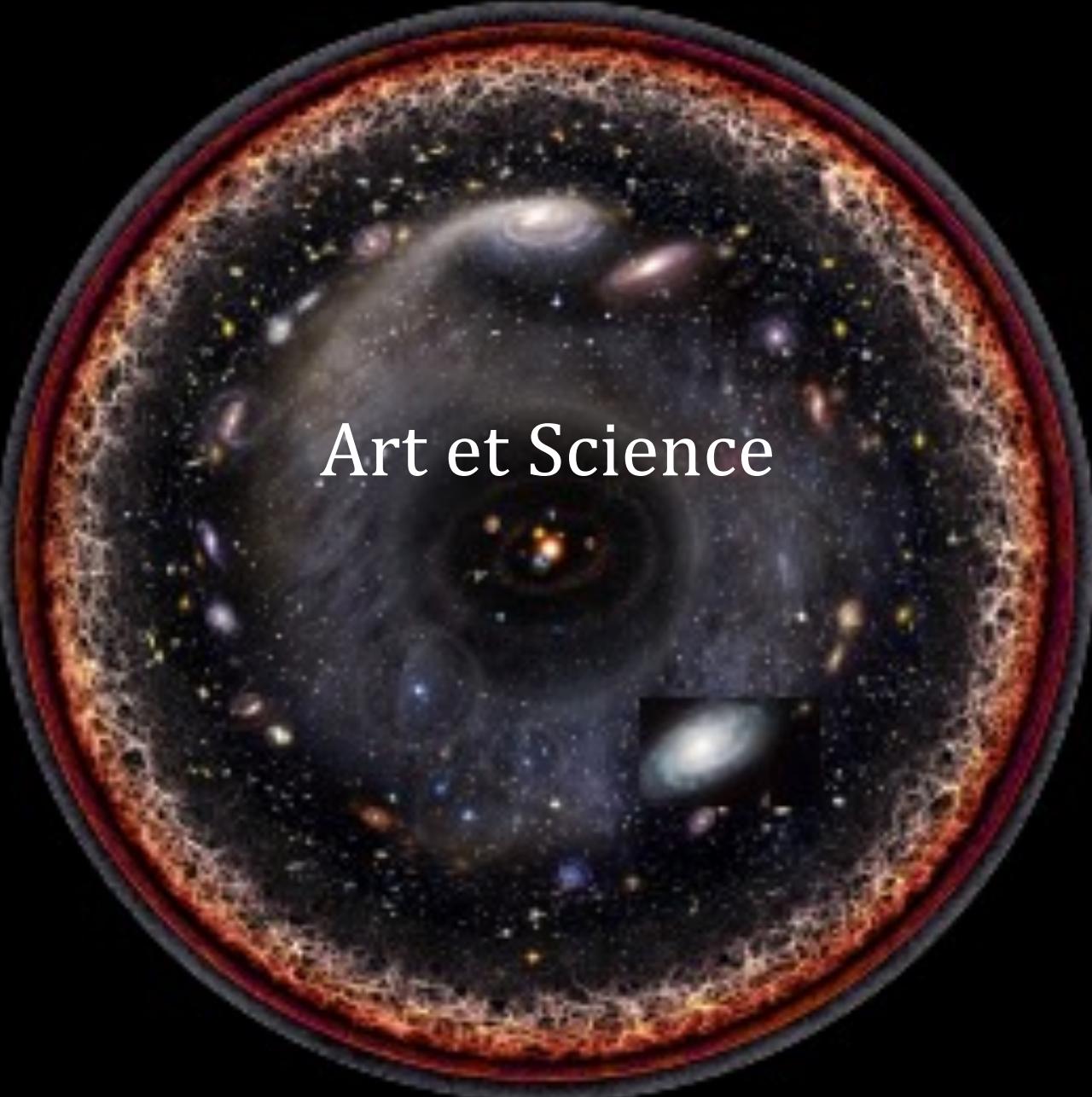
- REINFORCE is focused on 4 projects (aka "demonstrators")
- The GW one is focused on noise studies
- Benefit from GravitySpy long experience and interactions with its team

GW Work Package
Institutions:
Unipi, EGO, EA, Conicet, OU, UXF

- Demonstrators developed on Zooniverse, the leading platform for citizen science
- Our goal: engaging citizens as active participants, not only as "classifiers"
- Output used to train machine learning models,



- The citizen's scientists are participation in classification but also correlations between glitches. Avoid GAFA practices.
- Also participating in the near future to Critical Thinking courses: *in a world of media inflation and digital connectivity. Formulate hypotheses, estimate proper biases, manage uncertainty, collective versus herd thinking, following the model of Saul Perlmutter et al course: " Sense & Sensibility & Science*
- *An IN2P3-INSHS Art and Science Critical Thinking Course ?*



A circular image depicting a dense cluster of galaxies against a dark background. A prominent, multi-colored ring of light surrounds the central cluster, transitioning from red to orange and yellow. The central region is filled with numerous galaxies of various sizes and colors, including several spiral galaxies and smaller elliptical ones. In the lower-left quadrant of the circle, the words "Art et Science" are written in a white, sans-serif font.

Art et Science

On Air , Palais de Tokyo

L'expo plus visitée du Palais depuis son commencement



Tomas Saraceno, funambule entre l'art et la science



An exhibition on Art and Science
Rythm of Space (EGO)
Museo della Grafica Pisa, 12 October- 8 December 2019

A series of multisensorial artits and scientists T. Saraceno, L. Lijn, A. Csorgo, B.Lamarche, R. Dellaporta, G. Alda/A. Ortiz...



..urgently questioning again the nature and texture of space-time and matter, the notions of origin and horizon, the role of representation, information and transformational activity, artistic or scientific, the questions of individuality... S.K

Light : How to entangle the Universe in a spider web
<https://www.youtube.com/watch?v=79Dws6K9SPE&list=PLRQChI0vpMP7PnFaGoiqUzv3PDQY0o-N8&index=5>

Sound : Cosmic levitation
<https://www.youtube.com/watch?v=1D5vEFTq51Q&list=PLRQChI0vpMP7PnFaGoiqUzv3PDQY0o-N8&index=11>

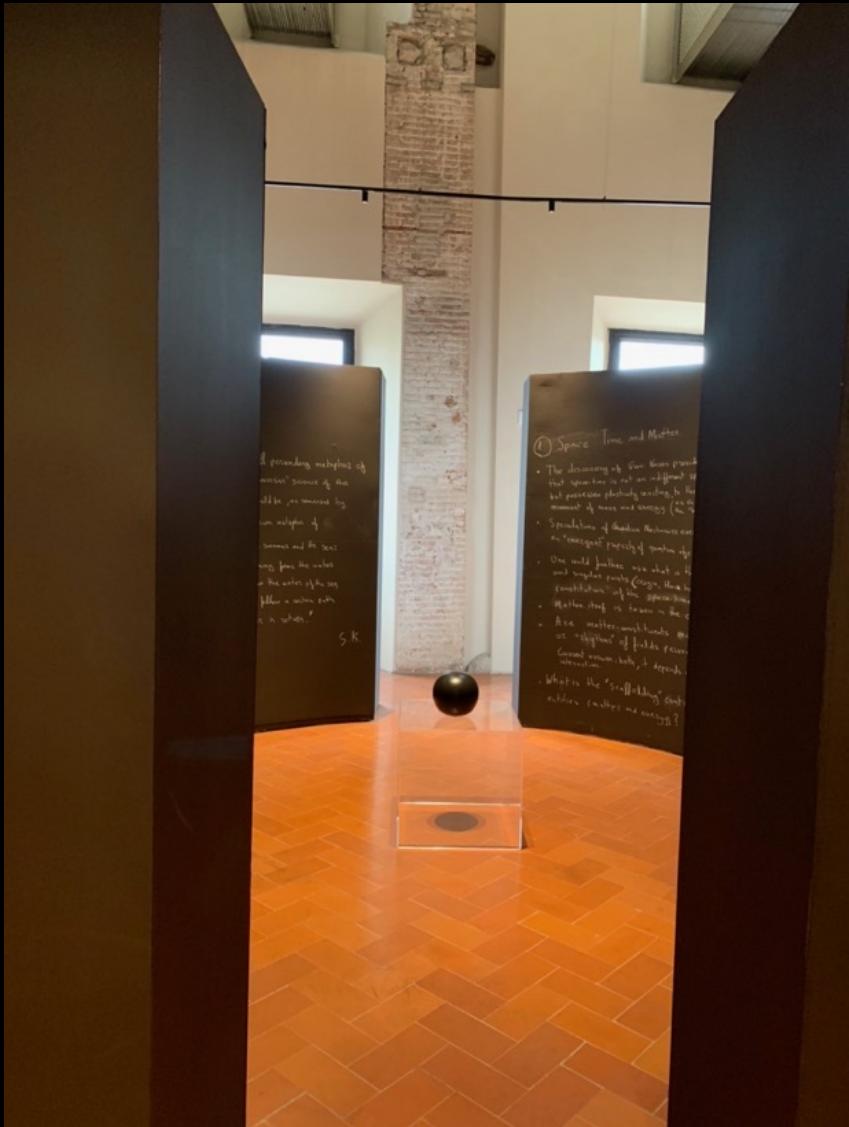
Metaphores de l'information:

- Bob et Alice (Adam et Eve) échange d'un projectile,
- L'arbre de la connaissance
- Le net d'araignée (cosmic web)

Sound and Gravitational waves: From the exhibition « Il Ritmo dello spazio »



Le côté affectif



A poem by AIMA people seeing a work of art on black holes :

Riflessione:

Nucleo sferico, globo, forma.

Nero. Terra notturna illuminata dalla luna.

Abisso.

Pieno o vuoto...
...liscio!

Mistero esoterico.

Ragione. Emozione.

Inquietudine. Oppressione.

....freddo!

Pupilla di Polifemo.

"If the predictability of the Universe breaks down with black holes, it can break down in other situations, even worse if the information is lost, we cannot be sure of the past history either. The history books and our memories could just be illusions. It is the past that tells us who we are, without it we loose our identity". S. Hawking

Fiesta di Capodanno 2021 à Rome, distribuée par RAI



<https://arachnophilia.net/romeconcert2020-3>

Cosmic Ouroboros

10^{-30-33} cm

ν mass, proton decay, inflation

10^{28} cm event horizon (5 Gpc)
Cosmology, Dark Energy/matter,
GRB,cosmological markers

10^{-24-27} cm

UHECR, HE ν , DM

10^{-15} cm

10^{-21} cm LHC,DM

10^{-15-18} cm

Nucleosynthesis
Primordial/Star

10^{-20} cm

10^{26} cm GZK horizon (100 Mpc) CR, HE γ , ν , GW

10^{-19} cm

10^{22} cm Galaxy (10 kpc)
(supernova, CR, HE γ , ν
quasars)

10^{-5} cm

10^{-18} cm

10^{15} cm solar system
(solar neutrinos)

10^{10} cm

Plato

Astroparticle infrastructures help study ocean floor biodiversity

Astroparticle heps us understand our origins

Astroparticle uses the geosphere as detecting medium

Conclusions

- Le mariage de "stasis" et du "flux", ou le mariage de la tradition et de la nouveauté sont au centre tant de la pensée artistique que scientifique (Relativité Générale et Mécaniques Quantique).
- L'Imaginarium artistico-scientifique, si bien décrite par Kierkegaard "*Quand une araignée se précipite à partir d'un point fixe, en accord avec sa nature, elle ne voit devant elle qu'un espace vide où elle ne peut trouver aucun appui, l'espace est au-delà de ses possibilités d'étalement. Et c'est la même chose avec moi : toujours devant moi un espace vide ; ce qui me pousse vers l'avant est la cohérence qui se trouve derrière moi*".
- Un nouveau "Paragone" ou Comparaison des arts/sciences et des sens , imitant l'approche du "Traité de Peinture" de Da Vinci, incluant tant les arts (peinture, sculpture, architecture mais aussi poésie, musique, théâtre) que les sciences, serait une tache à poursuivre.

- Avec l'avènement de la science moderne, l'unité médiévale du savoir (*universitas*) éclate et se réorganise autour de deux pôles distincts : les réalités physiques créées par Dieu (la nature) et les réalisations historiques dues à l'homme (la culture). Cette séparation ontologique des domaines de la connaissance s'est maintenue, au travers des évaluations divergentes de leur pertinence respective (p.e. Vico contre Descartes), jusqu'au 19^{ème} siècle. A la suite du rejet de toute ontologisation des objets de l'expérience par Kant, elle prend alors chez les Néokantiens une tournure strictement méthodologique. C'est le traitement réservé aux données qui décide de leur inscription dans l'un ou l'autre ordre de la connaissance. Ainsi les sciences de la nature se constituent par la subsomption de phénomènes particuliers sous des règles générales, tandis que les sciences de la culture se caractérisent par l'intégration d'éléments divers dans des ensembles individuels (Windelband, Rickert). Grâce à cette approche formelle, il devient possible de rendre compte de la complexité de certaines disciplines, qui combinent parfois les deux démarches, comme la biologie et la sociologie, sans effacer pour autant la différence de leur identité scientifique.
- Cependant, la polarité traditionnelle des sciences de la nature et des sciences de la culture incite à oublier que la science en tant que telle est un fait culturel. C'est pourquoi Ernst Cassirer introduit un concept élargi de culture, qui couvre l'intégralité des modes de production du sens, dont le principe relève de la fonction symbolique du langage. En écartant la notion d'espace absolu comme ultime avatar ontologique, battu en brèche par l'essor des géométries non-euclidiennes (voir *Substance et fonction*, paru en 1910), la Philosophie des formes symboliques reprend à nouveaux frais l'Esthétique transcendantale, pour déployer via des configurations successives la synthèse de la réceptivité et de la spontanéité empruntée à Kant.
- Aux projections mythiques se superposent les représentations analogiques, que relaient les significations mathématiques, constituant des modalités distinctes d'appréhension du réel. La forme symbolique de l'Art s'intercale entre ces trois formes fondamentales au fil de leur émergence historique. Son rôle consiste à créer, lors du passage de l'une à l'autre, des correspondances qui, à rebours de l'abstraction croissante des univers de sens, préservent la cohérence de notre rapport au monde. Ainsi les rimes et allitérations poétiques recréent, au sein même du discours de la représentation, l'atmosphère fusionnelle du mythe, quand les peintures cubistes visent à figurer l'espace multidimensionnel des géomètres au moyen d'un équivalent représentable.
- Le risque qui guette ces procédés artistiques est d'osciller entre l'illustration pure et simple du progrès des connaissances et l'évocation régressive d'un passé idéalisé, au lieu d'élargir l'horizon de l'intelligence commune. Une confrontation rigoureuse entre les deux types de recherche, scientifique et artistique, devrait nous permettre d'y voir plus clair.

Anaxagoras: the “first philosophical fragment” surprisingly modern

Anaximander of Miletos, son of Praxiades, a fellow-citizen and associate of Thales, said that the material cause and first element of things was the *apeiron* (infinite or formless), he being the first to introduce this name for the material cause.

He says it is neither water nor any other of the so-called elements, but a substance different from them, which is *apeiros*, from which arise all the heavens and the different cosmos within them. And into that from which things take their rise they pass away once more, "as is ordained; for they make reparation and satisfaction to one another for their injustice according to the appointed time," as he says in these somewhat poetical terms. —Phys. Op. fr. 2 (R. P. 16).