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Multi-messenger Posters

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Prepared by: EGO

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0.1	28 October 2021	V. Napolano	Added content and editing F. Spagnuolo
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Distribution List	Date	Version
F. Spagnuolo, G. Rossi, S. Katsanevas	28 October 2021	0.1
S. Katsanevas	28 October 2021	0.2

Introduction

Nine posters illustrating the scientific contents, the main lines of research, and the experimental infrastructures involved in Multi-messenger Astronomy, have been designed and realized to reach an audience of students (>13 years old) and the general public.

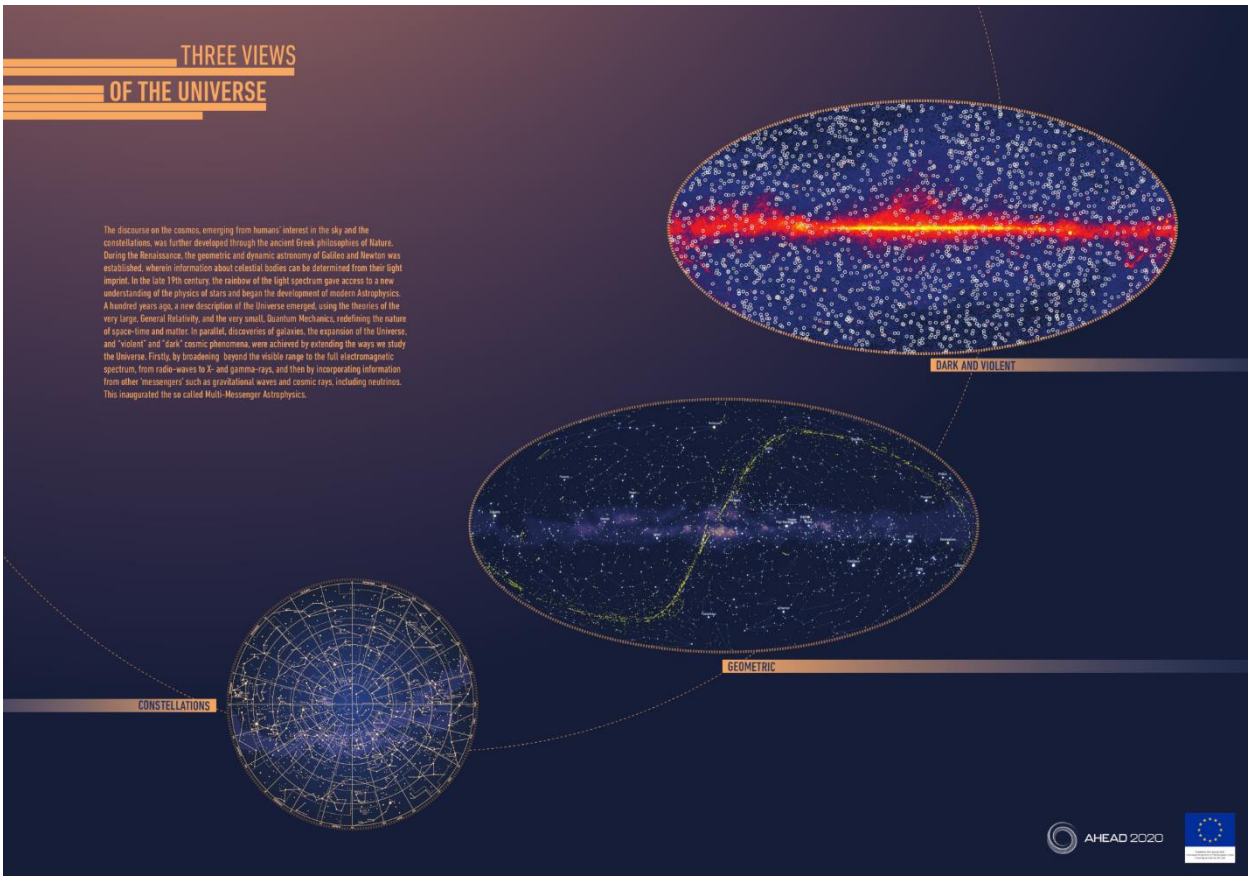
The posters follow the model of the 10 years old APPEC 7 Magnificent posters and aim at representing with attractive images, graphic illustrations and an updated visual language, some of the more complex and recent scientific ideas and results related to contemporary cosmology and Astrophysics, the experimental facilities aimed to detect the different cosmic messengers and the complementarity between the information we get from them.

The difficult, but innovative challenge, was to create clear and, as much as possible, immediate visual syntheses of concepts, ideas and results extremely recent and of which there are few (or no) established visual and graphic references for communication to the general public. For this reason, the time required for the elaboration and revision of content and images was longer than expected. In addition, there was a necessary and frequent exchange and discussion between the designers and the scientific referents, which could only take place remotely and with more difficulty, due to the pandemic.

Finally, the persistence of the pandemic itself has made the printing and presentation of the posters in public events not feasible until now and has pushed us to rethink and expand the use of graphic and visual materials created. The images and graphic content were in fact designed not only to be printed on posters of size 100 X 80 cm, but also to be rescaled and re-paginated for their use on web and social channels. This use has already been planned and will be implemented in parallel with the other public initiatives of the AHEAD2020 project in the coming months. This integration and redirection of content design for this broader use is another reason for the delay in the delivery of the posters.

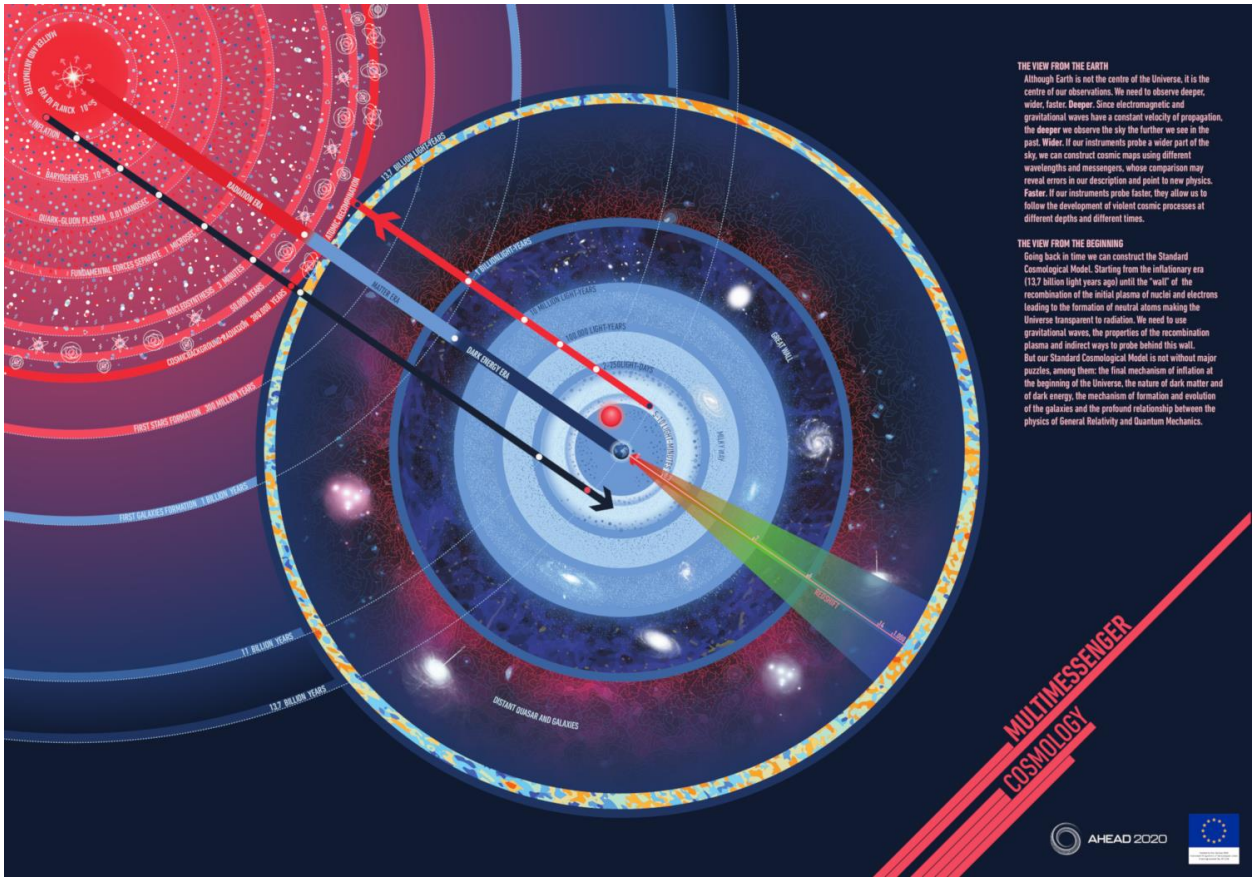
Description of Contents

1. Three Views of the Universe



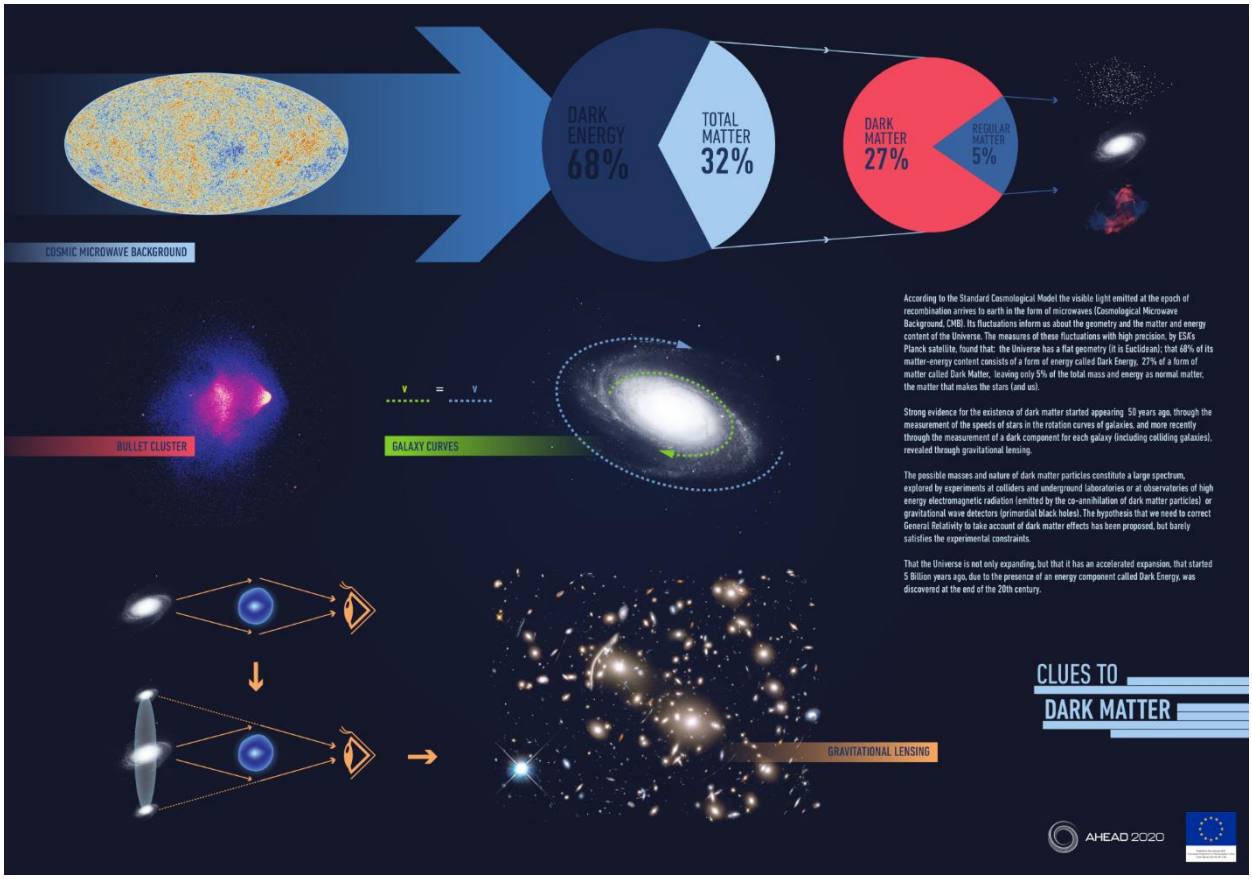
The poster illustrates how our vision of the Universe changed through the centuries and the millennia. It starts from the first humans who looked up to the sky and attempted to map it, using constellations. Then came the era of geometric and dynamic astronomy, of Galileo and Newton and all the scientists who started to analyze the light coming from celestial bodies to identify them. And finally, modern astronomy, which strives to answer questions about the dark and violent universe: black holes, space-time, cosmological issues, dark matter and energy.

2. Multimessenger Cosmology



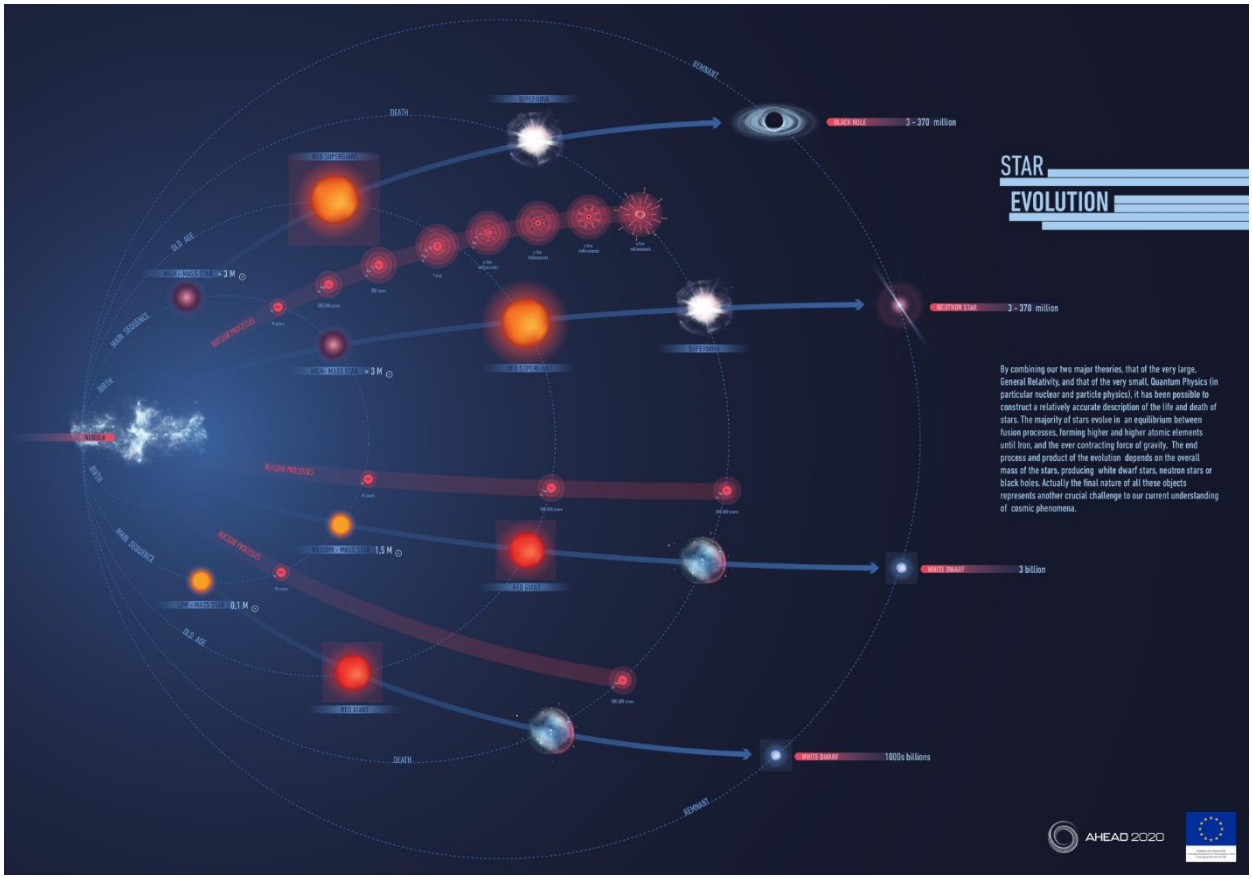
The poster explains how multimessenger astronomy can offer a unique tool to probe the origin of the universe, and thus gain new information about how it was born and how it evolved until now. The image shows how from Earth, just a point in the Universe, we can hope to probe deep into its origin, through tools that penetrate the barriers between the primordial universe and the one we know now.

3. Clues to Dark Matter



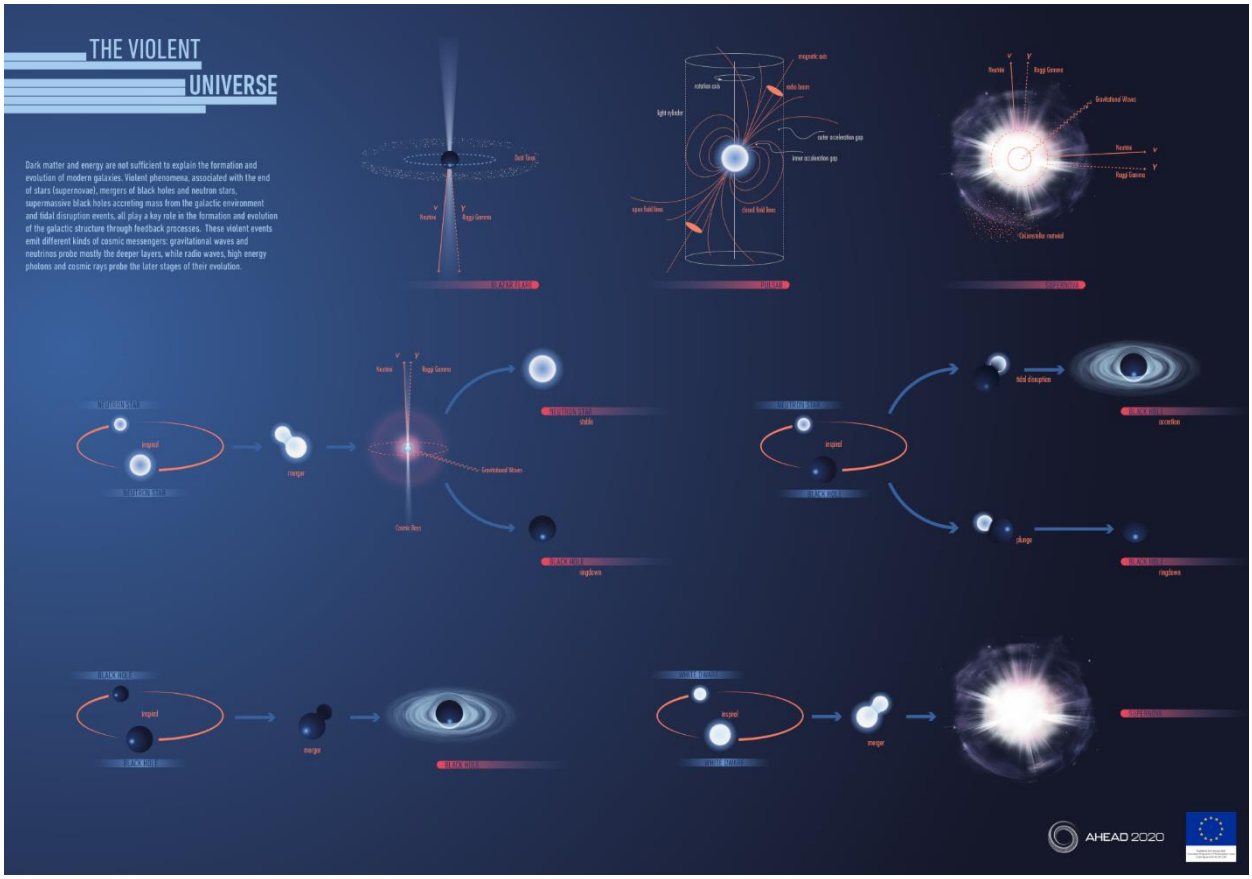
The poster sums up some of the clues of the existence of dark matter that astronomy has collected over the past few decades, from the Cosmic Microwave Background to the rotation curves of galaxies that couldn't be explained with ordinary matter only. It also illustrates some of the theories surrounding what dark matter could be, and introduces the existence of dark energy, another mysterious component of the universe that we haven't directly observed yet.

4. Star Evolution



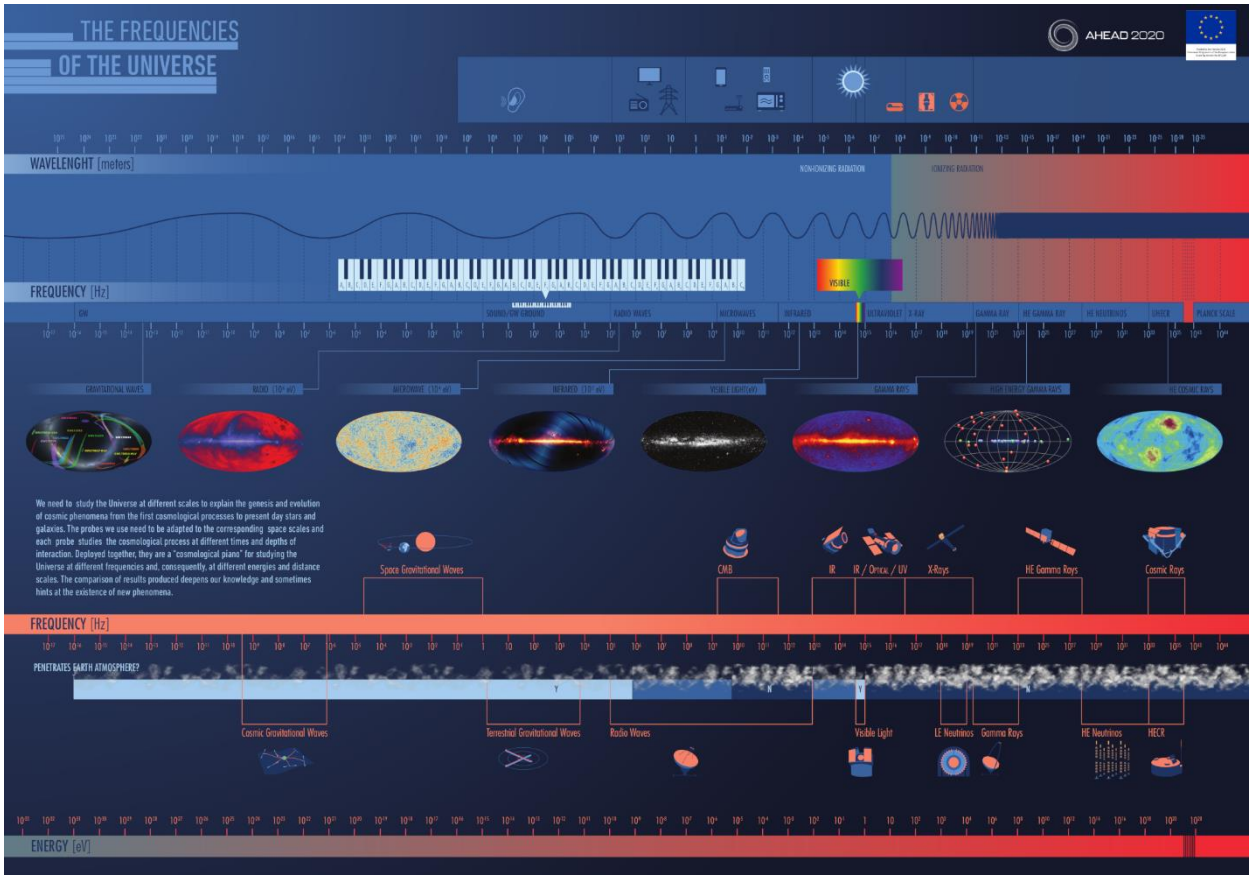
The poster illustrates the present knowledge of stellar evolution, showing which phases a star goes through depending on its initial mass, and what remnants it leaves behind after its death, a white dwarf, a neutron star or, for the most massive stars, a black hole. A theory that has been made possible by combining physics of the very small, like particle and nuclear physics, with that of the very large, general relativity.

5. The Violent Universe



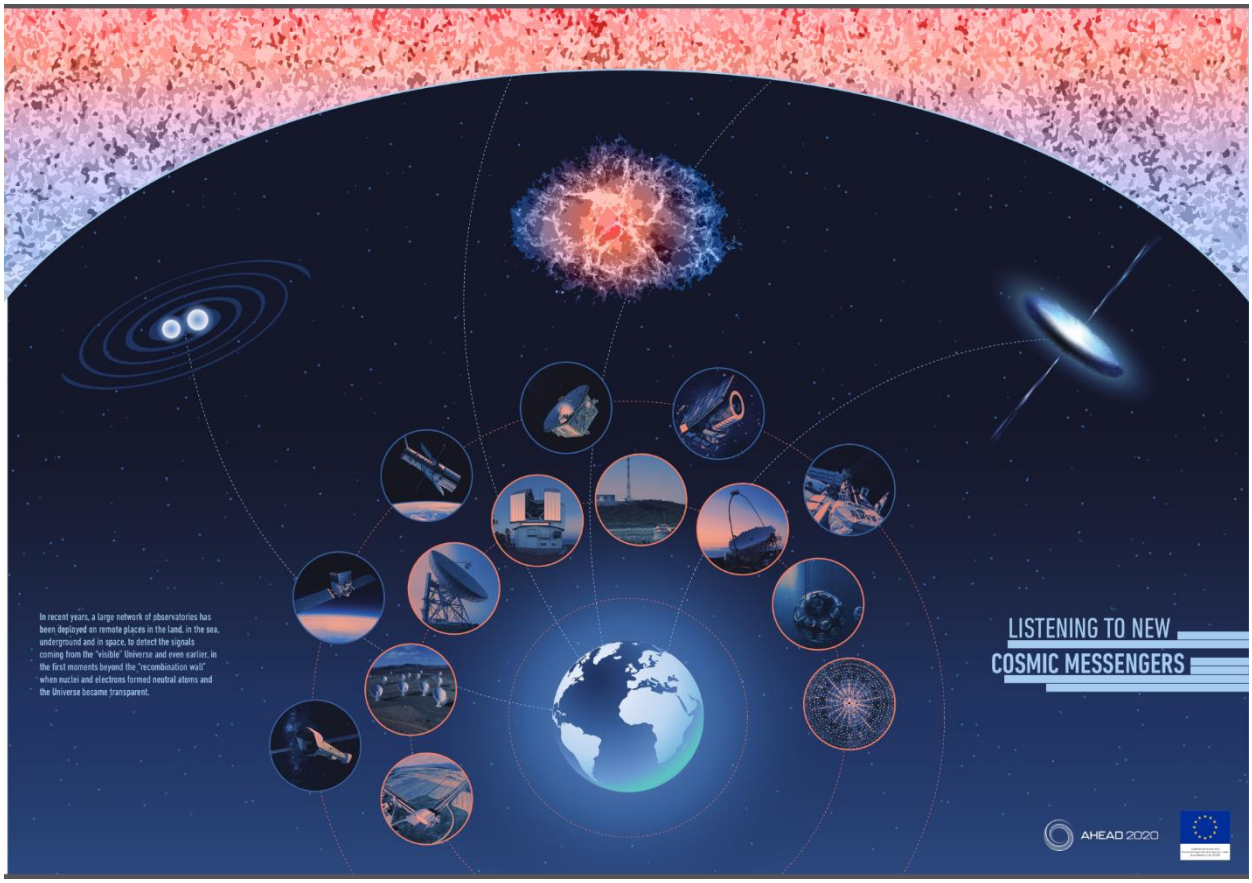
The poster shows a collection of events included in what is called “The violent Universe”: blazars, pulsars, supernovae, mergers of black holes or neutron stars. These objects and events are very special for astrophysics because they involve very high energies, thus emitting particles and signals that wouldn’t be produced in any other way, and pushing physics to extremes that would be impossible to replicate on Earth, allowing us to study both the physics of the very large and the very small.

6. The Frequencies of the Universe



Both light and gravitational waves can be put on a spectrum of frequencies, which represents the frequencies at which we are able to observe the universe. Each part of this spectrum allows to see a different component of the signals emitted by objects in the cosmos, thus allowing the universe to be observed under a different lens. These images, all significant for different reasons, can then be put together to obtain a more complete picture and gain a deeper understanding of what the universe truly looks like.

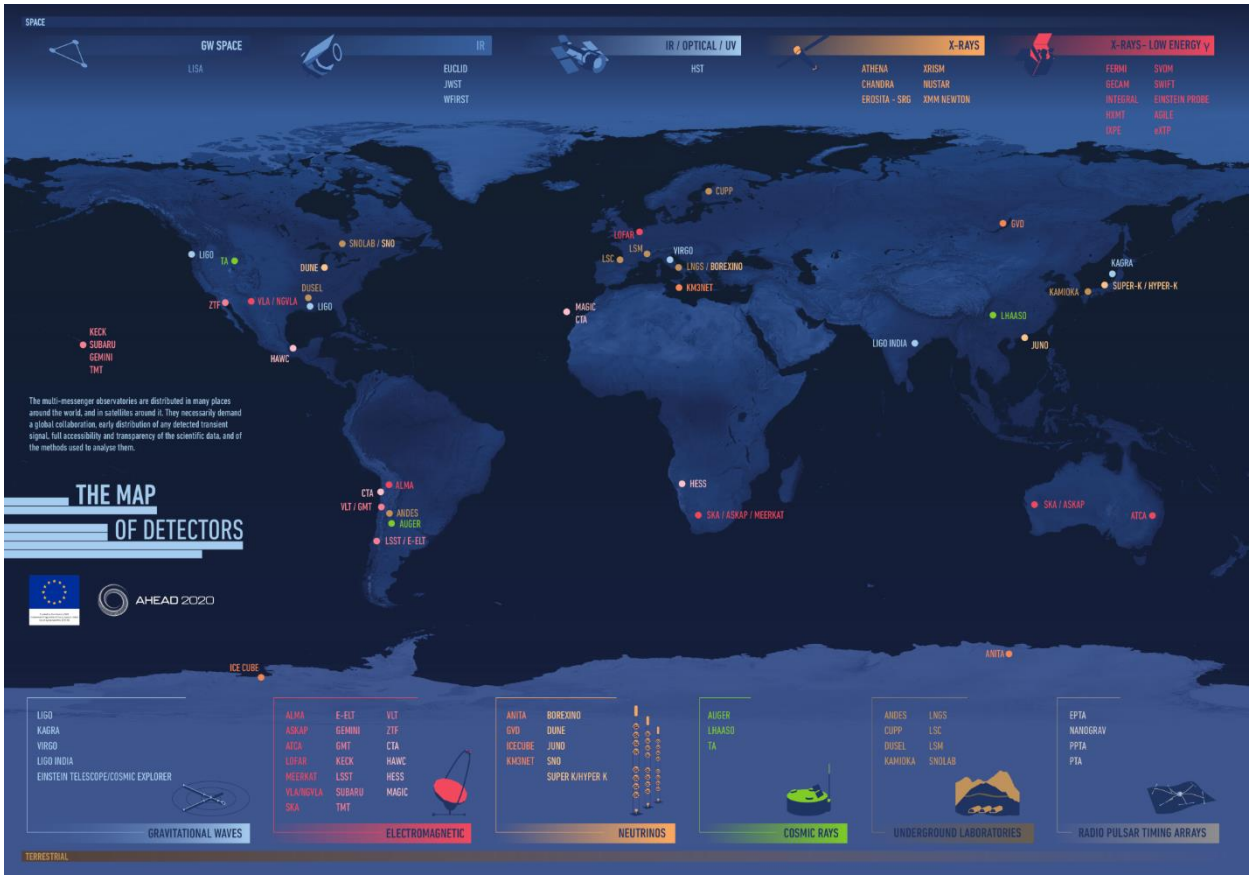
7. Listening to new cosmic messengers



The distribution of different types of detectors all over the planet, on remote places in the earth, in the sea, underground, and in Space, aims at capturing different types of messengers in order to build an ever more complete picture of our knowledge about the Universe.

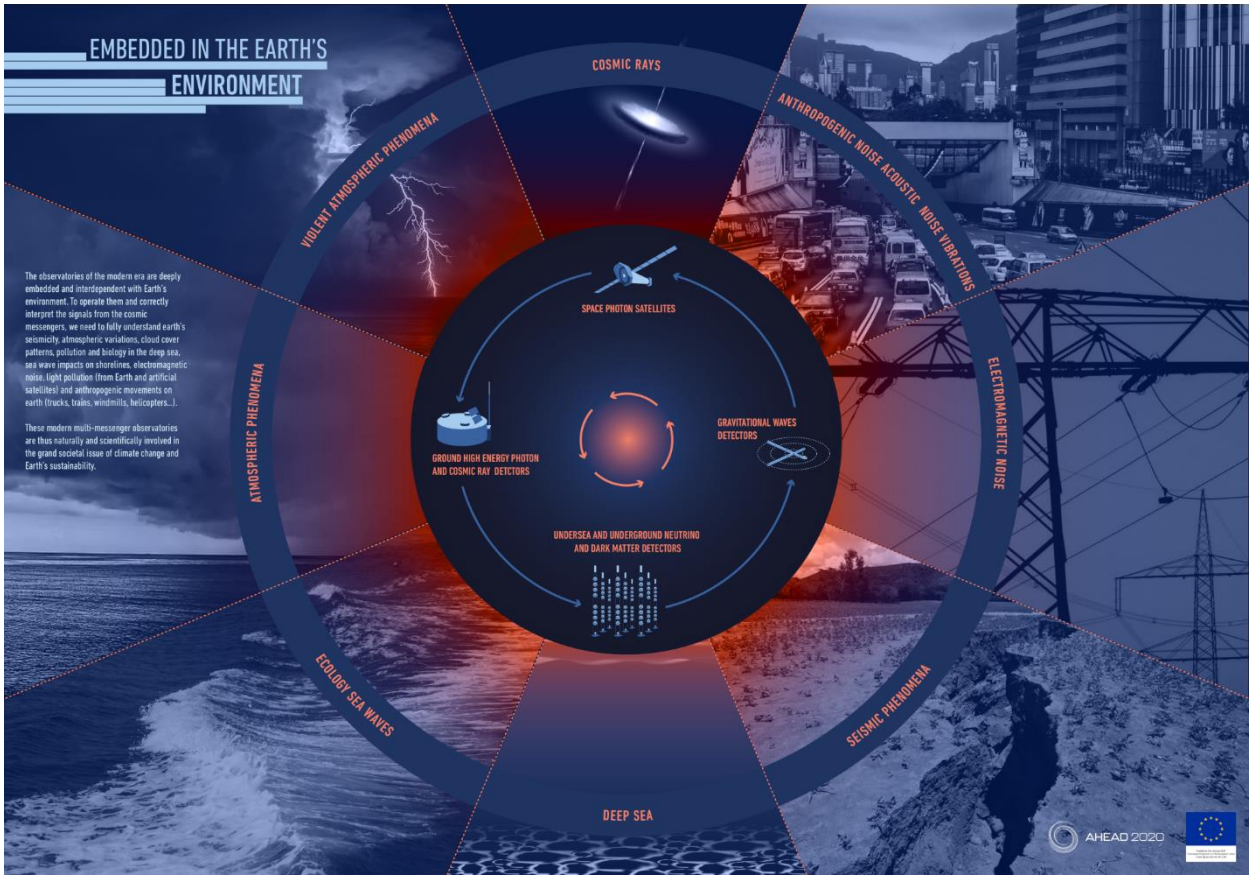
This knowledge integrates information from signals coming from the "visible" Universe and even earlier, in the first moments beyond the "wall of recombination" when nuclei and electrons formed neutral atoms and the Universe became transparent.

8. The Map of Detectors



A comprehensive map of all the facilities, experiments, and satellites that coordinate in the Multi-messenger Astronomy effort is impressive. Multi-messenger observatories are distributed across continents and on satellites around the Earth and necessarily require global collaboration, timely distribution of any transient signals detected, and full accessibility and transparency of scientific data and the methods used to analyze them.

9. Embedded in the Earth's Environment



The observatories of the modern era are deeply embedded and interdependent with Earth's environment. To operate them and correctly interpret the signals from the cosmic messengers, we need to fully understand earth's seismicity, atmospheric variations, cloud cover patterns, pollution and biology in the deep sea, sea wave impacts on shorelines, electromagnetic noise, light pollution (from Earth and artificial satellites) and anthropogenic movements on earth (trucks, trains, windmills, helicopters…). These modern multi-messenger observatories are thus naturally and scientifically involved in the grand societal issue of climate change and Earth's sustainability.