



### KM3NeT - INFRADEV - H2020 - 739560

# Report on Art/Science Outreach For KM3NeT

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#### <u>Abstract</u>

In this document we describe the various Art/Science initiatives pursued by the WP3 of the KM3NeT-INFRADEV project.

### I. COPYRIGHT NOTICE

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#### II. DELIVERY SLIP

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#### III. **DOCUMENT LOG**

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4	3/9/20	Final version	P. Coyle, , G. De
			Wasseige

#### IV. APPLICATON AREA

This document is a formal deliverable for the GA of the project, applicable to all members of the KM3NeT INFRADEV project, beneficiaries and third parties, as well as its collaborating projects.





### V. TERMINOLOGY

A complete project glossary is provided:

**ARCA**: Astroparticle Research with Cosmics in the Abyss **ORCA**: Oscillation Research with Cosmics in the Abyss

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#### VII. PROJECT SUMMARY

KM3NeT is a large Research Infrastructure that will consist of a network of deep-sea neutrino telescopes in the Mediterranean Sea with user ports for Earth and Sea sciences. Following the appearance of KM3NeT 2.0 on the ESFRI roadmap 2016 and in line with the recommendations of the Assessment Expert Group in 2013, the KM3NeT-INFRADEV project addresses the Coordination and Support Actions (CSA) to prepare a legal entity and appropriate services for KM3NeT, thereby providing a sustainable solution for the operation of the research infrastructure during ten (or more) years. The KM3NeT-INFRADEV is funded by the European Commission's Horizon 2020 framework and its objectives comprise, amongst others, the development of outreach and Art&Science projects to promote KM3NeT: the science objectives and the detector complexity and location (Work Package 3).

#### VIII. EXECUTIVE SUMMARY

The main goal of WP3 is to grow financial, political and public support for the international KM3NeT project by communicating its value to stakeholders and the general public. The KM3NeT Outreach and Communication Strategic Plan (D3.1) aims at positioning KM3NeT as one of the top scientific and technological projects of the 21<sup>st</sup> century. It is a cooperative effort led by the KM3NeT Outreach and Communication Committee in close collaboration with communication and outreach offices in KM3NeT member countries.

One of the goals of WP3 was to foster Art and Science Collaborations with artists inspired by the science of KM3NeT. Here we summarise the various projects that have been initiated.





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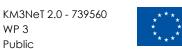
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### Introduction

As stated in the Outreach strategic plan (D3.1) one of the methods adopted to disseminate the KM3NeT project is to support artistic projects inspired by the science of KM3NeT. Such an approach offers a complementary means to increase the public awareness of a population that otherwise may not have been engaged by the more conventional outreach channels. A general strategy that we adopted was to associate KM3NeT scientists to these artistic events with general public presentations taking place in parallel to the 'artistic' event. In the following we describe the various activities undertaken, many of which are still ongoing.





#### 1. Draw me a neutrino

We have launched the drawing contest "Draw me a neutrino" in December 2019. Participants from Ecuador, France, Georgia, Greece, Italy, Morocco, South Africa, and Spain were invited to submit their best interpretation of a neutrino before June 30th 2020. A parallel contest allowed participants from all over the World to enter the challenge.



Figure 1: Logo of the Draw-me-a-neutrino contest.

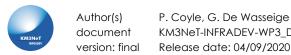
The drawings could be realised using any technique or support (digital included) and are to be judged based on their originality, the creativity demonstrated by the author, and the harmony with the properties and origin of the neutrinos.

There was no age limit to enter the contest and the participants were divided into three different groups:

- Pre-schoolers and primary school students had to imagine what is an electron neutrino
- Teenagers that have already been in contact with physics were in charge of drawing a muon neutrino:
- Adults were invited to tackle the tau neutrino.

Through this contest, we were seeking to familiarize the broad public to the science carried out with KM3NeT. We aimed at:

- Creating awareness of particle physics and astronomy to a young community that may become interested in science in the future;
- Engaging and informing the families and teachers;
- Introducing research and science in schools using an original approach;
- Creating/reinforcing the link between the participating universities and research agencies with the schools and the public;
- Promoting the science carried out by KM3NeT around the World.







A multilingual website gathering information about the neutrino, its nature and origin as well as the detection technique used in KM3NeT has been created: http://wos.ba.infn.it. The informative material has been translated in English, French, Georgian, Greek, Italian, and Spanish. The logo and some examples of infographics prepared for the contest are shown in Fig. 1 and 2, respectively. The website collected 25,000 visits in total, with more than 7,000 in June close to the submission deadline. According to the survey included in the submission form, most of the participants learnt about the contest through school or friends.

In total, we have received 521 drawings (259 (50%) electron neutrinos, 182 (35%) muon neutrinos, and 79 (15%) tau neutrinos) sent from 16 different countries (namely, Australia, Belgium, Bulgaria, Canada, Ecuador, France, Georgia, Greece, India, Italy, Morocco, the Netherlands, Russia, Spain, Switzerland, and the UK.). A substantial fraction of the drawings (68%) comes from countries that are not members of the KM3NeT Collaboration.

A sample of the drawings is shown in Fig. 3. The age distribution of the participants as function of their countries of residence is shown in Fig. 4, together with other statistics related to the contest. We note that 56 % of the participants recognized themselves as women/girls, 42 % as men/boys, 1% as non-binary, and the remaining participants prefer not to say.

In view of assessing the impact of the contest on the participants, the submission form contained a short survey with the following questions: Did you know about KM3NeT before participating to this contest?, Did you know about the neutrino before participating to this contest?, What is, in your opinion, the main characteristic of the neutrino?, What is, in your opinion, the main characteristic of KM3NeT?, How would you describe the neutrino in one word?, How would you describe the KM3Net in one word?, How did you get to know about this contest?. The analysis of the survey results shows that 86% of the participants did not know KM3NeT before the contest and 60% learn about neutrinos for the first time because of the contest. The most common answers to the question How would you describe the neutrino in one word? were: tiny, elusive, invisible, neutral, abundant, particle, fascinating. The most common answers to the question How would you describe the KM3Net in one word? were: innovative, interesting, (powerful) telescope, research, detector, and research infrastructure.

The winners of the contest will be announced during Fall 2020, and the winning drawings will participate to an Art and Science exhibition at the National Archeological Museum in Napoli, Italy during Spring 2021, organised in collaboration with the INFN program Art&Science across Italy [1].

Through this contest, the collaboration has developed several partnerships with organisations specialized in outreach (e.g., SPACE India [2]), European or national projects for science

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education (FRONTIERS [3], Art&Science across Italy [1], LabEx UnivEarthS [4]), as well as local schools in most of the aforementioned countries.

We expect that the biggest impact of this first contest is yet to come as the drawings will now be used for communication on KM3NeT scientific and technical progress. Furthermore, we plan to organise similar contests in the future built on the success of this first edition.

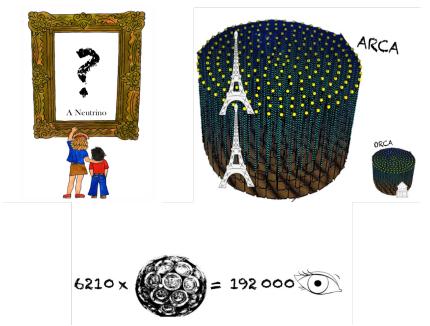


Figure 2: Examples of infographics that have been produced for the drawing contest website.

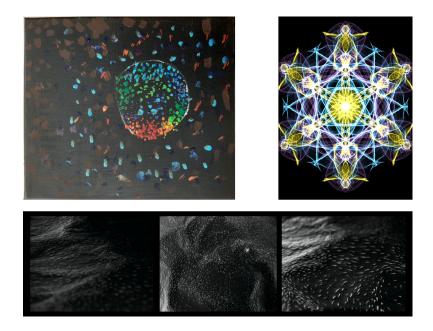


Figure 3: Example of drawing submissions for the electronic (top left, from Spain), muon (top right, from Italy) and tau neutrino (bottom, from France) categories of the contest.





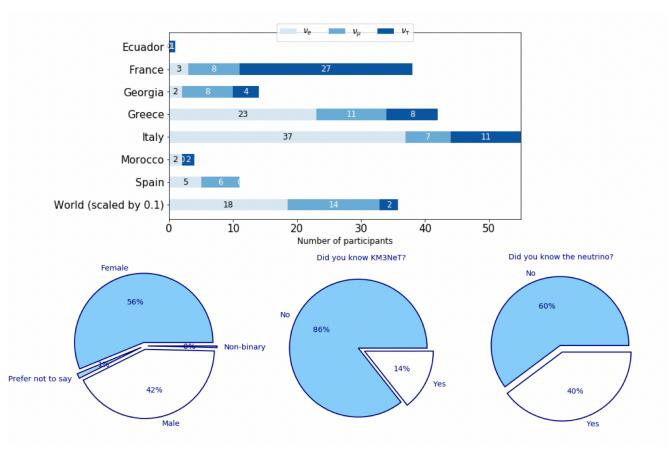


Figure 4: Statistics related to the Draw me a neutrino contest.



### 2. The Bathysphere

We have started a collaboration with Donald Fortescue, Professor of Art and Design at the California College of the Arts (CCA) in San Francisco. Fortescue creates sculptural 'instruments', installations, video, sound works and images which reframe our view of the natural world [5].

One of Fortescue's motivation is revealing energies and events which are beyond our usual perception together with the human experiences and histories which underlie our understanding of the natural world [5].

Fortescue in collaboration with KM3NeT scientists is developing an instrument to be deployed at the surface of one of the KM3NeT detectors in the Mediterranean Sea. This instrument, called Bathysphere schematically represented in Fig. 5, is englobed in a glass sphere identical to those used for the KM3NeT sensors. Within this sphere, Fortescue designed metallic half spheres and clappers that will produce sounds due to wave motion once deployed. The sounds will be recorded with a hydrophone inside the sphere. A first prototype shown in Fig. 6 (left) has been tested in a swimming pool by Fortescue and modifications were added to build the final version shown in Fig. 6 (right). The Bathysphere will be shipped to Marseille, France with a foreseen deployment in Fall 2020.

Another aspect of our collaboration with D. Fortescue is the sonification of KM3NeT data. Sonifying our data will allow a larger fraction of the population to be sensitized to KM3NeT science as the visually-impaired people or anyone more sensitive to sound than to images will be able to 'feel' the data recorded by KM3NeT. The success of this project is guaranteed by the experience Fortescue has previously developed in sonifying high-energy particle data [6].

The Bathysphere data will be superimposed to simultaneous sonified KM3NeT sensor data as well as hydrophone data.

There are several goals associated to this project:

- The Bathysphere highlights the craftsmanship involved in developing, creating and deploying scientific instruments such as KM3NeT sensors;
- Both the Bathysphere data and KM3NeT data will be dominated at trigger level by environmental signatures (wave motion for the Bathysphere, bioluminescence and K40 decays in the deep-sea detected by the KM3NeT light sensors, and sea mammal sounds for the hydrophones). Superimposition of those data may allow potential correlations between surface and deep-sea effects to be identified and highlighted.

Fortescue being a renowned artist and his work taking part in different exhibitions worldwide in addition to being described online [7], the science carried out within KM3NeT will reach a wider audience through this collaboration. This project is partially supported by a Materials-based research grant from the Center for Craft [8].



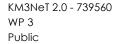






Figure 5: Schematic representation of the Bathysphere as designed by D. Fortescue.





Figure 6: (left) first immersion test of the Bathysphere prototype. (right) final version of the Bathysphere ready for deployment. The glass sphere is identical to those already deployed by KM3NeT.





### 3. Aganta Kairos

Aganta Kairos (Greek for 'seize the moment') is a trans-disciplinary science project initiated by the artist Laurent Mulot. The Aganta Kairos project [9] is inspired by the images captured by the giant neutrino telescopes (ANTARES and KM3NeT), which are located 2,500 m deep in the sea off the island of Porquerolles and detect neutrinos from the deepest reaches of outer space. The precise form of the project has evolved over time, but the constant theme is the idea that neutrinos are messengers that bring information from distant places and can pass that information to human beings.

The first incarnation of the project was a photography exhibit for which Laurent visited a number of remote locations at which neutrinos detected by the ANTARES neutrino telescope had passed through. At these locations Laurent interviewed the local inhabitants and a "ceremony" was performed to inaugurate a plaque attesting that they are witnesses of the passage of the invisible neutrino particle (see Fig. 7).





Figure 7: Aganta Kairos plaques erected at the locations of passing neutrinos detected by ANTARES.

Laurent also made a year-long residence at the town of La Seyne sur Mer (the host town for the KM3NeT-ORCA site) and initiated some artistic projects based on neutrinos in the town and at the local school [10] as shown in Fig. 8. These projects included the 'cosmic delivery agency' (the office in the main high street dedicated to the project activities) and the DOMVelo (a rideable tricycle modified to incorporate an optical module). Other activities included 'adoption of an optical module' in which some families in the town were given an optical module to look after for a period of a month. Their 'experiences' face-to-face with such a strange object were documented on film (see Fig. 9). All these activities certainly increased the awareness of the local population, especially the school children, to the presence of the KM3NeT/OCRA control room located in their town and to the unique science it will perform.

In a later step, in collaboration with Thierry Poquet, a stage show was created around the Aganta Kairos project [11]. A poetic journey that brings together age-old mythologies, particle physics and human beings. It explores the links that since the dawn of time have united men and outer space, the sky and the Earth, the living and the dead.







Figure 8: Summary of the Aganta Kairos residence at La Seyne sur Mer.

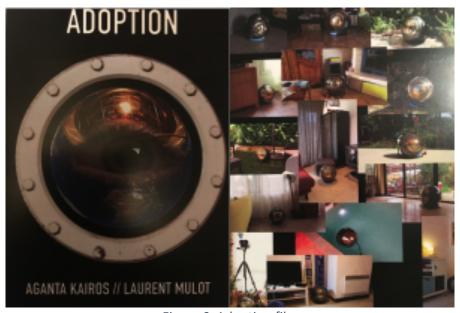


Figure 9: Adoption film

Written for two actors, a choir of eight soloists and an audio-visual installation, this show has been performed twenty times during 2017 across France, in Châteauvallon, Compiègne, Lille, Grenoble, Lyon, Valence, etc. Corollary events that supplement the project's impact were held around the performance: exhibition, media event, works in progress and shootings in high schools and universities, etc., in order to weave together the perspectives of artists, scientists, philosophers, anthropologists and sailors with those of the public and civil society in general,





as connecting islands, with a view to democratizing arts and sciences. Some images of the show are presented in Fig. 10.

As an example, one of the Aganta Kairos events was a presentation at the Garage art centre in Gorky Park, Moscow with the participation of (astro)physicists Paschal Coyle (KM3NeT) and Zhan Dzhikibaev (Baikal) (see Fig. 11).

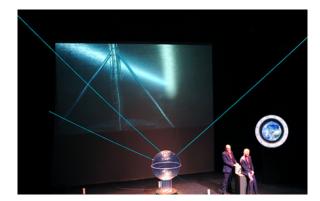




Figure 10: Some images from the Aganta Kairos stage show.

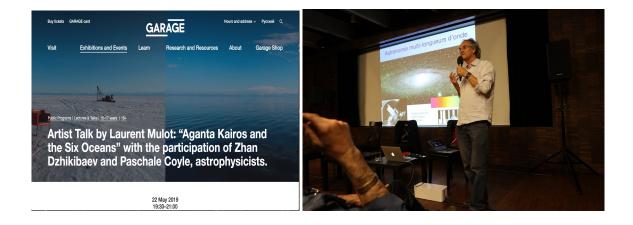


Figure 11: An Aganta Kairos presentation in Moscow Russia.





### 4. Archipelago

Archipelago is an Erasmus+ project [12] mainly funded via the H2020 program and is inspired from the European ANTARES KM3NeT scientific experiments: huge neutrino detectors located in the depths of the Mediterranean Sea, off the coast of La Seyne sur Mer.



Figure 12: the students rehearsing the show in Valencia. (https://lepetitjournal.com/valence/communaute/projet-archipelago-au-lfv-relier-sciences-et-arts-sur-scene-255117)

Archipelago federates three communities: scientific, artistic and educational around a creative process undergone and fuelled by 25 students from 4 countries: France, Greece, Turkey and Spain in five cities (Lille, La Seyne, Athens, Samsun, Valencia). This process is facilitated by an artistic and international collaboration led by the theatre company Eolie Songe. The students and the teachers attended research, art workshops, international meetings, and participated to rehearsals and shows in each partner city.

Archipelago's final goal is to produce a collaborative artwork mixing dance and theatre. Archipelago is especially focused on flows: tidal flows (the 5 cities are attached to an important port), streams of elementary particles (like the neutrino that crosses the Earth at the speed of light without deviating from its trajectory), flows of goods, human flows and migration phenomena.

Using their own words, enhanced by the writing of the Scottish playwright Iain Finlay MacLeod, with their bodies, set in motion by the Spanish choreographers Inma Garcia and Meritxell Barbera, and the French director Thierry Poquet assisted by Marc Duport as actors director, these young people approach current research in particle astrophysics, in particular by valuing the neutrino as a metaphor for the link between peoples. They portray the anthropology of the living linking humans, animals and plants; they





foreshadow the ecological shift to come; and formulate wishes for their generation and their children's.



Figure 13: Archipelagos Rehearsals featured in Turkey newspaper.





#### 5. On Air

'On Air' was a 'Carte Blanche' exhibit by Tomas Saraceno at the Palais Tokyo, Paris from 17 Oct 2018-6 Jan 2019 [13]. Some posters prepared for the exhibit are shown in Fig. 14.

Tomas Saraceno is a renown conceptual artist whose work is informed by the worlds of art, architecture, natural sciences, astrophysics and engineering. His floating sculptures, community projects and interactive installations propose and explore new, sustainable ways of inhabiting and sensing the environment.







Figure 14: Posters for the 'ON AIR' exhibit of Tomas Saraceno at the Palais Tokyo, Paris.

This large exhibit included a 'multi-messenger room' installation (see Fig. 15) in which 'messages' from gravitational wave experiments, neutrino telescopes (ANTARES, KM3NeT, IceCube), cosmic rays (Auger), bioluminescence signals (KM3NeT) and acoustic signals (KM3NeT, Fig. 16) came together to form a 'cosmic jam' - an intra-cosmic communication.

The exhibition attracted 221,075 visitors during the 12 weeks of opening.



Figure 15: The 'multi-messenger room'.



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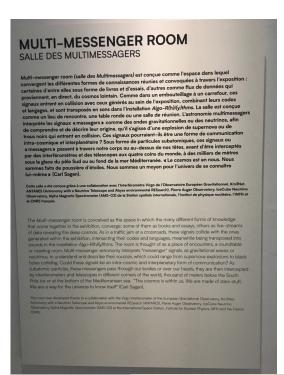






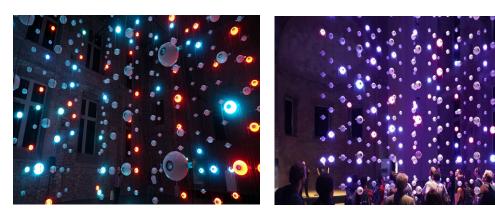
Figure 16: Information panels and the KM3NeT real-time acoustic feed.



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### 6. AIS3: Acoustic Immersive Synthesizer<sup>3</sup>

The AIS3 installation is a giant sound and light synthesizer realised by the artist Tim Otto Roth [14]. It illustrates astroparticle research in the form of a walk-in light- and sound installation. A total of 516 plastic spheres, each 10 cm in diameter, mimic the optical modules of neutrino telescopes like IceCube and KM3NeT. The spheres are arranged in strings, covering a volume of 10×10×10 metres as illustrated in Fig. 17. Each sphere contains 2 loudspeakers and several LEDs. Experimental data from KM3NeT can be transformed to musical tones and flashes of colour. Such a walkable, immersive space of sound and colour, where sinusoidal tones mix to form complex sounds, opens an intuitive access to science without *a priori* knowledge of the scientific details.



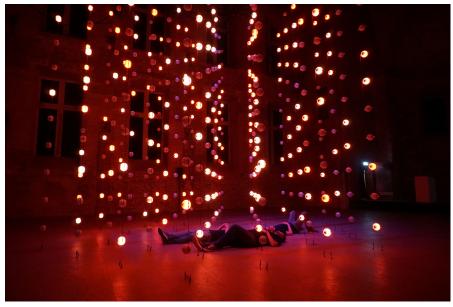


Figure 17: Images of the AIS3 installation.





The installation has been presented in Aachen, Berlin, and Munich. The exact attendance is not known as the structure was sometimes placed in public space. As an indication of the participation, the Munich exhibition that lasted two days gathered 1500 people.

It was originally planned to install the AIS3 at the Vasarely Foundation, Aix-en-Provence (see Fig. 18) in March 2020 and to be open to the general public for a couple of months. Around the event, it was planned that the researchers of CPPM and KM3NeT would organize a variety of outreach activities to explain the fascinating science addressed by the KM3NeT neutrino telescope. Unfortunately, due to the Corona virus situation, we were obliged to cancel the event at the last minute. We are hoping to reschedule the event sometime in 2021.

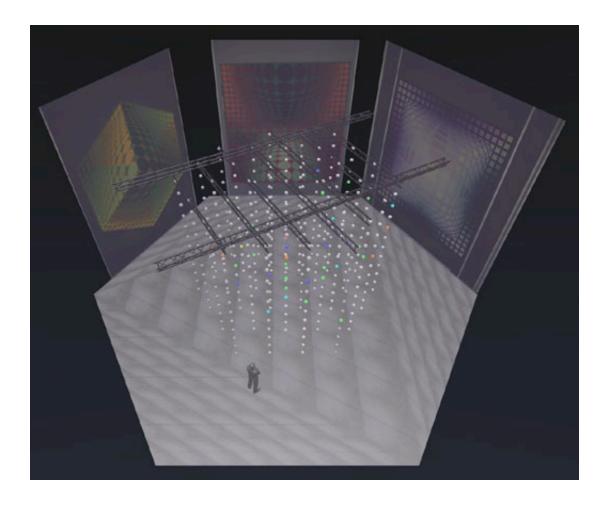


Figure 18: The planned installation at the Vasarely Foundation, Aix-en-Provence.





### 7. Concluding Remarks

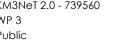
As part of the outreach work package of KM3NeT INFRADEV, we have developed several projects that combine art and sciences. Five of them involved close collaborations with renowned international artists and have gathered thousands of visitors/participants in the related exhibitions. The 6<sup>th</sup> one, a drawing contest whose principal organizer was the KM3NeT Collaboration, has collected more than 500 drawings from 16 different countries.

These activities represent an alternative, easy-accessible, and more personality-friendly path to introduce the science and engineering carried out in KM3NeT. The above-mentioned activities have served as a proof-of-concept and the success of each of them motivates the KM3NeT Collaboration to pursue the organization of such events as part of its long-term outreach program.



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#### IX. References

- [1] https://artandscience.infn.it
- [2] https://www.space-india.com
- [3] http://www.frontiers-project.eu
- [4] http://www.univearths.fr/en/home/
- [5] http://www.donaldfortescue.com/about
- [6] https://pos.sissa.it/358/887/pdf
- [7] http://www.donaldfortescue.com/projects#/bathysphere/
- [8] https://www.centerforcraft.org/recipient/2019-materials-based-research-grant-donaldfortescue-gwenhael-de-wasseige
- [9] https://www.institutfrancais.com/en/portfolio/aganta-kairos-by-laurent-mulot
- [10] https://www.leseynois.fr/la-residence-aganta-kairos-presentee-au-chapiteau-de-lamer-le-9-octobre/
- [11] <a href="http://lyon.aujourdhui.fr/etudiant/sortie/aganta-kairos-laurent-mulot-thierry-poquet-l-">http://lyon.aujourdhui.fr/etudiant/sortie/aganta-kairos-laurent-mulot-thierry-poquet-l-</a> hexagone-meylan.html
- [12] http://archipelago-erasmus.eu/
- [13] https://studiotomassaraceno.org/on-air/
- [14] http://www.imachination.net/about



