

A.I.D.A.A. News #5

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1 AIDAA to Bid for IAC2023 and ICAS2024

During 2020, AIDAA is going to compete to let Italy host two leading international congresses. In October 2020, Dubai, AIDAA will present the candidature of Milan as the host city of the 74th International Astronautical Congress (IAC) to be held in October 2023. The Milano Convention Centre (MICO) is the proposed venue, and various academic and non-academic institutions granted support for this bid, including the Italian Space Agency (ASI), Thales Alenia Space, and Leonardo. IAC2023 will gather some 6000 delegates and 100 exhibitors, amounting to 200 scientific sessions and 5000 sqm of exposition. IAC2023 would be the fifth edition held in Italy after Rome (1956 and 1981), Turin (1997), and Naples (2012).

In May 2020, Paris, AIDAA will present the candidature of Florence for the 34th Congress of the International Council of the Aeronautical Sciences (ICAS) to be held in September 2024. Palazzo dei Congressi is the designated venue to host some 2000 delegates and 100 scientific sessions. ICAS2024 would be the third edition in Italy, after Rome (1970) and Sorrento (1996).

For both events, AIDAA calls for support, sponsorship, and volunteering. More info can be found on www.aidaa.it/iac2023.htm and www.aidaa.it/icas2024.htm (Fig. 1).

2 DEMEASS 2020: An AIDAA Centenary Event

The 10th edition of the international conference on “Design Modelling and Experiments of Advanced Structures and Systems” (DEMEASS 2020) will be held in Sicily (3–6 May 2020), in one of the most suggestive fishing villages of the island named “Scopello”. It represents one of the scientific centenary events of the AIDAA organized by Prof. Erasmo Carrera, the General Chairman of the Conference, and by Prof. Alberto Milazzo and Prof. Andrea Alaimo, representing the Sicilian AIDAA section.

The topics of the conference are Advanced Structures and Intelligent Systems in its various aspects, and the spirit of the conference is to collect international expertise and to promote intensive and fruitful discussions among the participants in a very reserved and confidential context.

For the interested researcher, the full information on the conference can be found at the official website <http://www.mul2.polito.it/demeass2020/>.

3 Italian Contribution to H2020 Project MAHEPA on Hybrid-Electric Aviation

The FMSlab (Flight Mechanics and Flight Systems Laboratory) research group of the Dept. of Aerospace Science and Technology of Politecnico di Milano, coordinated by Lorenzo Trainelli, is involved in the analysis and design of innovative aircraft within the EU-funded projects MAHEPA (www.mahepa.eu) and UNIFIER19 (www.unifier19.eu), both concerning electric aircraft developments.

MAHEPA (Modular Approach to Hybrid-Electric Propulsion Architecture) represents a major attempt to push habilitating technologies for hybrid-electric (HE) aircraft, with the advancement to TRL6 of two HE airplane models: the Pipistrel Panthera Hybrid (Fig. 2, left), a four-seater featuring a reciprocating engine for electric power generation, and the Hy4 (Fig. 2, right), a new incarnation of the award-winning Pipistrel Taurus G4 twin-fuselage motor glider, driven by batteries and hydrogen fuel cells. The corresponding powertrains have been designed, developed, and integrated on board, and the two aircraft are ready to be thoroughly flight-tested, starting in Spring 2020. The FMSlab is involved in flight testing and flight-data-based modelling, as well as in the investigation of HE aircraft design methodologies, powertrain model scalability, and environmental impact prediction. Furthermore, FMSlab is responsible for a visionary study on the implementation of HE architectures towards a future systemic implementation from General Aviation to regional air transportation.

4 Dr. Francesco Topputo's Research into Self-driving Interplanetary CubeSat Awarded an ERC Consolidator Grant

A grant worth €2 M has been assigned to EXTREMA (Engineering Extremely Rare Events in Astrodynamics for Deep-Space Missions in Autonomy), a research project led by Francesco Topputo, an Associate Professor with Politecnico di Milano's Department of Aerospace Science and Technology. The project has been awarded the ERC Consolidator Grant, a prestigious award given by the European Research

Council to top scientists to pursue frontier research projects. EXTREMA introduces "self-driving interplanetary CubeSats": miniaturized probes able to drive themselves during the cruise, without requiring any contact with ground.

The project can potentially lower the entry level to the outer space, so making it more accessible by small institutions that cannot afford a conventional mission, which in turn could lead to more missions, and, thus, an overall improved knowledge of the solar system (Fig. 3).

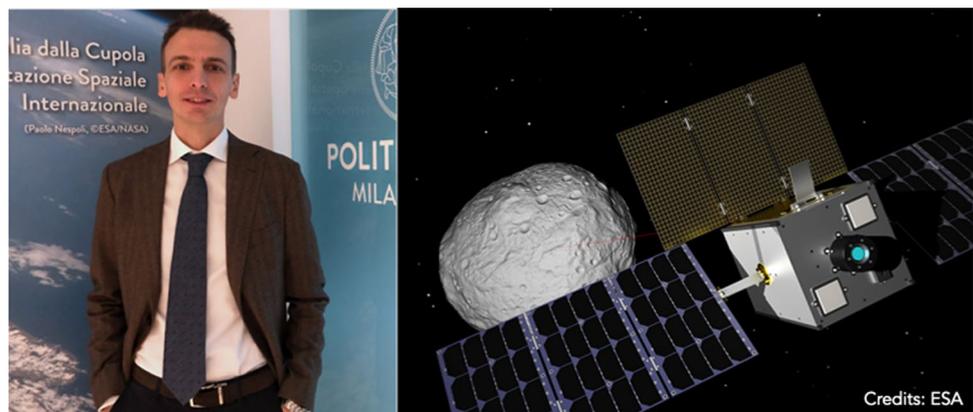


Fig. 1 AIDAA is founding member of the International Astronautical Foundation (IAF) and member of the International Council of the Aeronautical Sciences (ICAS)



Fig. 2 The two hybrid-electric aircraft models currently under development within the MAHEPA project, the Pipistrel Panthera Hybrid (left) and the Hy4 (right)

Fig. 3 Dr. Francesco Topputo, PI of the EXTREMA project (left) and an artistic representation of the CubeSat MARGO (right), a stand-alone CubeSat currently under development by ESA for deep-space exploration missions



5 Airships: the Transatlantics of Sky

Inside the AIDAA celebration of centenary from the foundation, dated July 2nd 1920, many events will be organized to remember this event during the whole year.

On March 24th, Prof. M. Pinucci, ISIA Florence, one of the major worldwide experts on airships, will give the first conference of the centenary, named “Airships, the transatlantics of sky”.

The conference will take place in the historical “Aula Magna” of the School of Engineering of Pisa University; it will regard the origins of the airships, the famous airships before the second war and, furthermore, the new perspectives for transport and touristic applications (Fig. 4).

6 PARSIFAL Project

The project PARSIFAL (“Prandtlplane ARchitecture for the Sustainable Improvement of Future AirPLanes) has been funded by the European Union under the Horizon 2020 Programme. The project consortium has been coordinated by University of Pisa (Italy), whereas the partners are ONERA (France), TUD (Netherlands), ENSAM (France), DLR (Germany), and SkyBox Engineering (Italy). In addition, an external Advisory Board composed of expert coming from aircraft manufactures (Leonardo, Airbus), airport management companies (Milan and Tuscany airports), and airlines (KLM) has supported the research activities.

The project has been focused on the improvement of air traffic sustainability over short-to-medium ranges (< 4000 km), where most of the aircraft in service today

belong to the ICAO Aerodrome Reference Code “C” category. Since this category will play a major role in the future air traffic increment, with growth factors up to $2 \times$ in next 20 years, PARSIFAL has faced the challenge of designing a disruptive box-wing aircraft, called “PrandtlPlane”, assessing the feasibility of its entry into service through the analysis of the benefits in terms of fuel consumption, environmental impact, and direct operating costs reduction.

The main results achieved within PARSIFAL are: the design and performance analysis of a PrandtlPlane aircraft with up to 308 seats, same overall dimensions of competitors such as A320/B737 family aircraft, same turnaround time of competitor aircraft, reduction of CO₂ and other pollutants per passenger-kilometre, and reduction of direct operating costs. In addition, the project has investigated the adoption of innovative design tools and procedures for the PrandtlPlane design, the integration of engines with ultra-high bypass ratio (18 and above), landing gears, and built-in air stairs. Among the novel features of the PrandtlPlane, it is worth citing the double-aisles cabin which allows accommodating more than one luggage per passenger, a longer cargo bay capable of embarking more containers in comparison to competitor aircraft and provided with a front and a rear door, for simultaneous loading and unloading operations.

The project has achieved all the results expected, overperforming in terms of achieved TRL, since flight tests on a radio-controlled 1:38 scaled model have been carried out to assess the flight behaviour at low-speed conditions. The final TRL achieved is above 4.

The main FlightPath2050 goals that the project has contributed to obtain can be summarised as follows:

Fig. 4 Poster for announcing the event

The poster is a horizontal layout with a dark background featuring a large airship silhouette. At the top left, it reads: "Celebrazioni del centenario della fondazione della Associazione Italiana di Aeronautica e Astronautica (AIDAA)". Below this, it specifies the location: "Aula Magna Facoltà di Ingegneria Largo L. Lazzarino 2 Pisa" and the date: "24 marzo, ore 16". At the bottom left, it notes: "La conferenza è basata sul libro 'Airships | 100 anni di dirigibili (Max Pinucci e AA.VV)'. The top center features the AIDAA logo (ASSOCIAZIONE ITALIANA DI AERONAUTICA E ASTRONAUTICA) and the logo of the Dipartimento di Ingegneria Civile e Industriale, Sezione Aerospaziale, Università di Pisa. The top right shows the logo of the Istituto Nazionale di Fisica Nucleare (INFN) with the number 7343. The main title "DIRIGIBILI AIRSHIPS I TRANSATLANTICI DEL CIELO" is prominently displayed in white and red text, with "U.S. NAVY" written on the airship's side. Below the title, it says "A CURA DI MAX PINUCCI". At the bottom center, the word "AIRSHIPS" is written in a large, stylized font, with "DESIGNED FOR GREATNESS. THE ILLUSTRATED HISTORY" underneath. On the right side, there is a vertical text block: "Un omaggio ad una storia dimenticata: l'epopea dei grandi dirigibili, navi nate per solcare i cieli. Avventure, esplorazioni, nuove frontiere, nuovi progetti, lussuosi viaggi, economici cargo." The MB Vision logo is in the bottom right corner.



Fig. 5 PrandtlPlane configuration

- a reduction of fuel consumption of more than 15% per passenger-kilometre compared the competitor aircraft such as A320/B737 family aircraft;
- reduction of the direct operating costs (DOCs) not less than 10%;
- more than 15% reduction of CO₂ and other pollutants per passenger-kilometre;
- full compatibility with present ICAO reference C airports;

- same turnaround time of the single isle aircraft with about 190 passengers.

These benefits are the results of the aerodynamic advantages due to the PrandtlPlane configuration adopted, which minimizes the induced drag among for given wingspan and total lift. All the additional advantages coming from lighter materials, greener propulsion systems, more electric solutions, etc. have not been taken into account in such analysis; therefore, further improvement can be obtained by combining the PrandtlPlane technology with the other innovations (Fig. 5).

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