THE EUROAVIA FORLÌ-BOLOGNA MAGAZINE

EUROAVIA
Forlì - Bologna

Credit NASA
© Art by Fabio Galuppi

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From the Editor

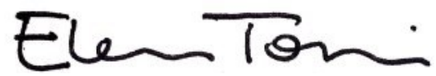
Dear readers,
we hope that you were able to spend a peaceful Christmas with your loved ones and that your exam session went great.

As the new semester approaches, we are back at work at full steam to organise new events for you. New conferences and unprecedented collaborations are going to be revealed soon... Waiting for that moment to come, we are happy to share with you the second issue of our local magazine, which completes the December edition. You will find a new interesting interview, the latest news like NASA's Mars mission, the second part of the journey of Formula 1's safeness and much more.

I would therefore like to thank once more everyone who contributed to the realisation of this magazine, the local Working Groups' members and, naturally, my team: the Local Board. Nevertheless, this time I want to express my greatest gratitude to one person in particular, who introduced me to EUROAVIA, has been my first inspiration and has always been my loyal partner: Chiara. I've hardly known someone who is more hard-working, relentless and utterly devoted to her dreams and passions. Now I can undoubtedly say that she's also one of the strongest people I've ever known. Although life sometimes throws rocks against us and makes our path difficult, people like you, Chiara, will never hold back and face everything bravely.

And that's what I finally wish for all of you, EUROAVIANs: bad moments are part of life, it's how we cope with them that makes the difference.

Best regards,
Elena Tonucci
President of EUROAVIA Forlì-Bologna



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How does EUROAVIA work? - PART II

In the first edition of the Magazine, we presented some of the International Working Groups of EUROAVIA: the Affiliated Societies WG, Business Relations WG, Communication WG, Design WG and, finally, Information Technology WG. Let's find out more about the remaining ones together!

International Events WG

The IE WG is responsible for *monitoring International Events* (IE) held by Local Groups. It also ensures their quality by providing guidance and *support* to the organisation team. Presently, to face the Covid-19 pandemic and the lack of physical IEs, the IE WG has established new bylaws to regulate Online International Events.
It is divided into two subunits:

- Tutors – they guide and *help organisation teams*, collect reports and information from them and represent the bridge between other WGs and the hosting Local Group to provide as much help as it needs in any field;

- Maintenance Crew – they are responsible for the *IEs calendar*, keep track of the events hosted by Local Groups and contact those that would need to host one soon.

Statutes and Bylaws WG

The S&B WG ensures that the official Statutes and Bylaws of EUROAVIA are up to date and in accordance with the needs of the Association. It also deals with the preparation of *Bylaws proposals* before every Congress. Other tasks include *renewing agreements between EUROAVIA and linked associations* making sure that the agreements comply with EUROAVIA's interests. It also often helps the International Board during negotiations with potential partners.

An important subunit is the EU Grants Subunit. As the name suggests, it oversees the *application for European Grants*. It is a difficult and demanding task that requires a lot of experience, attention to detail, organizational skills and writing skills.

Human Resources WG

The HR WG approaches people who would like to be more active in the EUROAVIA network and *provides all the information to make them join the best WG* for their capacities. Then, it prepares the members, delivering training in order to inform them about the structure of EUROAVIA. Moreover, it keeps all the WGs' members highly informed about other WGs and *promotes constant fluent conversation and collaboration between coordinators* (for example through *BoCs*). Lastly, it oversees the *promotion of WGs* and job opportunities for our members by preparing presentations and posting on the Careers section of the website and social media pages.

EUROAVIA Training System WG

The ETS WG aims at *delivering soft skills formation to EUROAVIA members*. Doing so enables EUROAVIA members to develop and join a group of qualified soft skills Trainers. The Trainers' main task is to organise the training activities which can be delivered during any International Event, but the Formation Workshops (*FoWos*) and the Train New Trainers (*TNTs*) are their main events, since they are focused on the *development of soft skills*. Currently, some online training has been organised by the ETS WG, to face the Covid-19 emergency.

Innovation and Development WG

The ID WG's primary goal is the reinforcement and improvement of the EUROAVIA's structure by bringing new visions, *innovative solutions and creative ideas*. It is responsible for developing, analysing, implementing and supervising new ideas that could benefit the development of the Association.

Remember that you can always join an International Working Group if you would like to actively participate in the growth of EUROAVIA.

However, if you don't feel ready to take such a big step, you can start by helping your local community! Join the local Working Groups of EUROAVIA Forlì-Bologna! You can choose between: Communication, Design, Events, Information Technology and Public Relations.

Feel free to contact us to know more about both the International and local Working Groups.

What are you waiting for? Let's start this journey together!

Elena Tonucci

The logo of AS Forlì-Bologna: Icarus

In Greek mythology, Icarus, Daedalus' son, died while trying to escape from Cretan Labyrinth by means of wings that his father constructed from feathers and wax. Artists like Antonio Canova and James Joyce were inspired by the legend of Daedalus and Icarus, and helped keep this myth alive through to the 21st century, as the two figures became the symbols of man's inventiveness and aspiration.

The idea of aviation touched on deep-seated concerns and emotions in the early twentieth century, transcending rational and national boundaries. While fighting, pilots had some control over their fate, which gave them a status above the powerless foot soldiers in the trenches below. One of the most famous of these wartime 'aristocrats' of the air, the legendary Red Baron, Manfred von Richthofen, once said:

"The glorious thing in the flying service is that one feels that one is a perfectly free man and one's own master as soon as one is up in the air."

If you look closely at the logo of EUROAVIA Forlì-Bologna you may see that it represents Icarus, ready to leap off the ground. Now, you may wonder why we decided to design our logo using that specific mythological figure. A momentous marble statue of Icarus celebrates the myth of flight in front of the former College of Military Aeronautics. This was one of Forlì's most important buildings constructed during the rationalistic architectural period. It was dedicated to the training of future pilots and therefore designed to indoctrinate young aviators and engineers being trained there with the ideal of the flying hero, ready to fight. The College of Military Aeronautics, the Forlì airport and the Caproni airplane factory in Predappio were the result of a new "brand" related to the vocation of flying.

Chiara Pennuti

Credit: Luca Massari

"The statue of Icarus has a vigorous,
strapping and perfect body:
it is placed on its feet
with its tendons stretched out
ready to leap off the ground,
embracing its two wings
like two vast aspides,
its face ardently turned
to devour the sky."

Alessandro Spada

Luca Massari

Professional free lance photographer
https://www.lucamassari.it/

A collision of perspectives

Could art and science create a magnificent show? Franchise Freedom is a performative art installation by Studio Drift that explores the relationship between humans, nature and technology.

Whilst it is not unheard of that aeronautics and art can collide, when it happens, the results are definitely extraordinary. This is exactly what happened in July last year during the 50th anniversary of the Moon landing at Kennedy Space Centre. During this event a flock of hundreds of small drones took to the sky and gave a remarkable light show. This seemingly chaotic and mesmerizing manifestation was a splendid example of what happens when a fusion of artistry and engineering is formed.

Credit: Franchise Freedom, Studio Drift, Kennedy Space Center Photographer : Ossip van Duivenbode

For as long as we can think back, birds have been a symbol for freedom. The way they move and the way they can take to the skies has most certainly left a mark, the same mark we see in the "Franchise Freedom". This is a project set up by Studio Drift, in collaboration with a select group of scientists. They managed to artistically visualize the behaviour of a flock of starlings. The algorithm they use creates non pre-programmed flight paths based on starling murmuration. Implementing this unpredictable algorithm into numerous drones supplied with a light source results in wonderful images, each of which is unique.

Credit: Studio Drift, Franchise Freedom, rendering at NASA's Rocket Garden at the Kennedy Space Center. Image courtesy of

Franchise Freedom hopes to inspire people into looking at nature once again and learn from it. The artists also invite everyone to ask questions about ourselves as individuals, how our decisions influence society and how the rules and guidelines set by society influence us. Are we free to choose what we want? What is the result when we choose to work outside this safety bubble?

All in all there is more to science than one may read in a book or lecture notes. It is good that during events like these, we are able to see beauty and get a new sense of inventiveness that will help us find new possibilities.

Bob Van Der Wijst

Calm, sensible and filled with laughter, his biggest passion is to discover and create. He loves to travel, cook and do science wherever he goes.

Red Bull Air Race

A competition in air, how was it organised? The Red Bull air race had special rules and requested specific types of aircraft: they had to be manoeuvrable and able to fly at low altitudes.

The Red Bull air race was a competition born in 2003 where pilots fly their planes in an obstacle course, racing against the clock. The season in 2019 however, saw the last race as Red Bull decided not to host any other championships.

The competition took place in different locations around the world, while the course which the pilots had to follow was marked by pylons called "air gates", placed on the ground or on floating surfaces. Planes flew at low altitudes, made rapid turns and acrobatic manoeuvres.

Matthias Dolderer racing over the sea near the city of Chiba in Japan

The pilots had to follow the rules placed, which indicated how the gate must be passed and other variables such as maximum speed or maximum load factor. If not respected, the competitors faced time penalties or even disqualification.

The race usually lasted for 3 or more days: on the first, pilots practiced their skills in the circuit, whereas on qualifying day they raced to set the fastest time, which allowed them to start last on the day of the race. The race day was divided into three sessions: a round of 14, followed by a round of 8 and finally a round of 4. In every round, the slowest pilots were eliminated and could not race in the next session.

The aircraft, engine and propeller used in the competition were standardised to be reliable and to make a fair competition. Thus, teams could only improve with their aerodynamics. The Zivko Edge 540 and the Corvus Racer 540 are examples of planes used in this competition, reaching speeds of up to 400 km/h and bear forces up to 12 Gs. These are highly manoeuvrable aircraft which have a wingspan of less than 7,5 meters and weight less than 700 kilograms. They can climb at a rate of more than 3500 feet per minute and they can roll at more than 420° per second. The six cylinders engine mounted on these planes produced 320 horsepower and it was designed to work at full throttle throughout the various sessions. They also had a special oil valve and an oil separator to make sure that oil supply to the engine was maintained during inverted flight.

Credit: RBAR www.airrace.redbull.com

Nicolas Ivanoff performing a high G action on race day in Grenchen, Switzerland

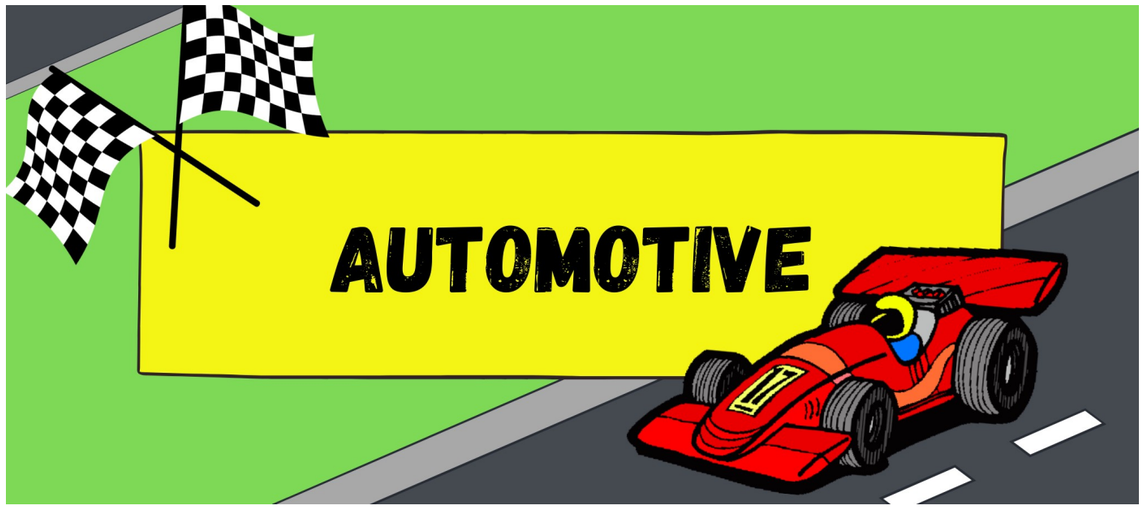
Petr Kopfstein flying over the city of Abu Dhabi

Credit: RBAR www.airrace.redbull.com (both)

Pilots that raced in this competition had to be precise and efficient when driving their vehicle, resist forces up to 10 Gs without fainting or losing control of the plane. The competition must have been a thrill to watch, given all the beautiful stunts that pilots performed and the high level of competition throughout the entire season.

Giovanni Mussoni

He loves watching films and he's a big fan of Scuderia Ferrari. He has other hobbies like mountain biking, gaming and exploring the world of economy and investing.



Formula 1 striving for safety - A journey in drivers' safety, Part II

Having detailed in the previous issue the first 40 years of F1 safety improvements, let us conclude this voyage in time up to day, analysing how Romain Grosjean, Haas F1 Team Driver, could possibly walk away relatively unscarred.

1994, annus horribilis

By the time Formula 1 entered its fifth decade, fatalities began to be a distant memory, only linked to its golden era. Horrific crashes obviously occurred but none resulted in tragedy, due to the great efforts of the FIA and Prof. Watkins. Nevertheless, death was waiting behind the corner and, in 1994, it made its appearance again. At the dreadful San Marino Grand Prix, things took a frightening turn from the beginning of the weekend, on Friday's free practice, when Rubens Barrichello crashed his car and lost consciousness. However, as the Brazilian was safely rescued, other drivers felt a sense of safety; Damon Hill, at the time Williams F1 driver, stated *"We all brushed ourselves off and carried on qualifying, reassured that our cars were tough as tanks and we could be shaken but not hurt"*. But as Saturday came, this sense of safety proved wrong. Twenty minutes into the final qualifying session, Austrian driver Roland Ratzenberger lost control of his car; although the survival cell remained mostly intact, he hit a concrete barrier wall almost head-on and suffered critical head injuries. His death was the first fatality since 1982: everyone was shocked, but the weekend carried on. On Sunday, the 1st of May 1994, Ayrton Senna was leading the race when he lost control of his Williams, crashing against a concrete barrier. The Brazilian was killed instantly by the front suspension wishbone hitting his head. As a recurrent nightmare, death found again its way into the F1 paddock.

Ayrton Senna, McLaren MP4/8, 1993 Monaco Grand Prix

Even if cars were much safer, drivers were still exposed above their shoulders

Credit: The Cahier Archive

https://www.reddit.com/r/formula1/comments/j4n4bs/bmw_sauber_f108_one_of_the_most_beatiful_f1_cars/

Robert Kubica, BMW Sauber F1.08, 2008 Australian Grand Prix

1994 was the "*annus horribilis*" of Formula 1, but what followed can be regarded as the greatest step on safety ever done by the F1's governing body. In the aftermath of Imola, FIA decided to revolutionise its approach to safety, with the goal being to apply science to the problem and research not just on cars, but also on the safety of circuits and the equipment used to protect the drivers. Cars were immediately slowed down in that season with aerodynamic constraints and new low speed corners built in circuit. In the meantime, FIA started to conduct its own tests, aiming to understand how to improve the car's safety criteria: thus, the survival cell was strengthened, and a side impact crash test was introduced; the cockpit's dimensions were enlarged, and its sides risen in order to give both more space to the drivers (previously the steering wheel was very close to their helmet) and to protect their head, the only exposed body part able to suffer deadly injuries. Scientific investigations were also conducted on the circuits' layout, many of which were modified, e.g., the Tamburello curva in which Senna shunted, a fast left hand bend, became slow left-right-left chicane. Moreover, runoff areas were improved again, and tyre barriers underwent a new development, with conveyor belts placed on top; permanent medical centres became mandatory, with a full medical and emergency crew staffing within.

The new millenium

In the following years, many drivers' safety improvements were established. The major ones regarded wheels, for which wheel-tethers were introduced in 1999, and drivers' necks, for which HANS (Head and Neck Support) became compulsory in 2003 to prevent whiplash on collisions. In addition, collapsible steering

columns, deformable crush structures on the nose and gearbox, stronger roll bars, puncture-resistant fuel cells, foam padding within the monocoque and medical warming lights were introduced over the years. At this point, Formula 1 cars had become so strong that a driver could escape with little to no injuries even after the most serious accident. Such was the case of Robert Kubica at the 2007 Canadian Grand Prix when, during the race, he hit the back of another car. The impact forced the Polish driver onto the grass at the edge of the track, where a bump launched his car into and along a concrete wall. After losing three wheels, the nose and suffering major damage to the sidepods in the initial impact, his BMW flipped back across the tarmac and came to rest against the barrier in the run-off area on the other side of the track. Although initial reports said that he had broken his leg, Kubica only suffered a sprained ankle and concussion. It seemed like F1 cars were finally indestructible (at least from the drivers' point of view) and this statement could have been proved by Timo Glock's testimony: *"I feel safe when I am in the car. I don't worry about having any problems if I have an incident; I jump in the car every time with a good, safe feeling."*

Jules Bianchi, 2014 Marussia F1 Team racing driver

Credit: Mark Thompson/Getty Images Europe/Getty Images

Over the next two decades, the 00's and the early 10's this general feeling proved true. A lot of crashes occurred during Formula 1 seasons, but none of them resulted in driver fatality. Again, it seemed that all the efforts carried out by FIA in order to ensure the safety were finally successful. However, much like in 1994, death was just behind the corner. Twenty years after that dreadful weekend, the F1 was struck by the most unexpected circumstances.

The 2014 Japanese Grand Prix was submerged in rain, as the typhoon Phanfone drenched the circuit. With drivers tackled by treacherous weather conditions, car control proved difficult and, on lap 42, Adrian Sutil crashed into the barrier without consequence. As a tractor crane was removing Sutil's car from the runoff area, on the following lap, Jules Bianchi lost control of his car in the same exact corner. In a very unfortunate series of circumstances, the Frenchman collided with the rear of the tractor crane and slid underneath it. Nine months later, he died from sustained injuries.

Formula 1 proved again to be one of the most dangerous motorsports, while the FIA became aware of its Achilles heel: the drivers' head. Jules Bianchi's fatality was a great shock for the paddock and, maybe, it could have been avoided if some form of head protection was adopted previously. Regardless, in 2018 the governing body mandated to adopt the halo on F1 cars: the last piece of our puzzle takes its place in the struggle for safety. The system consists of a titanium bar that surrounds the driver's head and is connected to three points of the vehicle frame. Despite weighing just 7 kilos, the halo is designed to endure massive forces, being capable to withstand the weight of a London double decker bus! The largest load applied to this structure is from above and amounts to 116 kN of force, which must be applied for five seconds without failure to any part of the survival cell or the mountings to guarantee safety. Longitudinal forces of 46 kN and 83 kN must be withstood from the front as well as a lateral load of 93 kN from the side. For comparison, the roll hoop on top of the car has to withstand 50kN laterally, 60kN longitudinally and 90kN from above. It is, without a doubt, a marvellous piece of engineering.

Romain Grosjean, HaasVF-20, 2020 Turkish Grand Prix

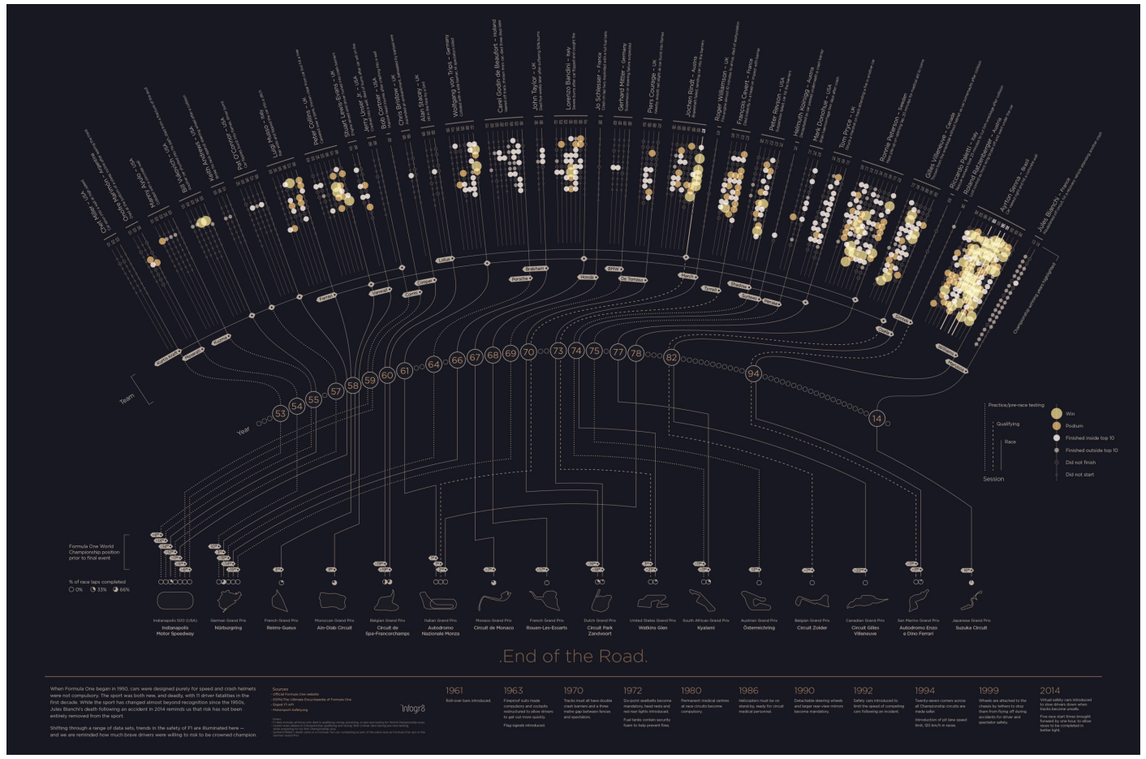
Credit: Icon Sport

Grosjean crash analysis

As we reach the end of our seven decade excursus in understanding how safety criteria were implemented during these years, we look back once more, this time at the recent past: the Bahrain Grand Prix. The race was just getting underway when Romain Grosjean, who started 19th on the grid, moved across the track and collided with Daniil Kvyat's AlphaTauri, sending Grosjean head on into a metal barrier at full speed. The impact split Grosjean's car in half with a massive explosion, and the front tub penetrated the barrier, sliding underneath to the other side while the fire raged around the car. The Frenchman was engulfed by flames in the cockpit for nearly 30 seconds before being able to scramble out of it, to the waiting arms of the medical delegate, who, inside the F1 Medical Car, was following the pack on the first lap. So, let us dig out how all the safety measures, introduced by FIA over the course of Formula 1's history, were crucial in the salvation of Grosjean.

From the data collected from the crash, the FIA stated that the impact took place at an approximate speed of 221 km/h with an estimated deceleration of more than 50 Gs: considering modern F1 cars

weigh at least 745 kg, there was an awful lot of energy to get rid of. The first part to hit the barrier was the nose cone, which in the aftermath photos seems to have vanished; however, that is exactly its purpose, as it is engineered to absorb peak forces up to 337.5 kN, allowing it to be crushed. Then, the unexpected happened: the Haas penetrated the metal railing. This was something really uncommon to see in modern days because the barriers' development is such to guarantee maximum energy absorption. Unfortunately, these are usually the tyre barriers, or their evolution, and, in his run towards the trackside, there laid just a plain three-piece guardrail awaiting the Frenchman. However, what in the olden days would have been certain death (we just remember Jochen Rindt, but this was a common fate during F1's golden era), here the halo widened the passage between the two lower rails, saving Grosjean's life. Nevertheless, fire broke out, endangering Romain's life once more. As luck would have it, and despite the previous misfortune, the Frenchman found a way to escape the inferno which surrounded his car with only minor burns. Finally, in the expert hands of medical delegates, we can conclude this double episode article, wishing a fast recovery to Romain and hoping to see him in Abu Dhabi for the last race of the season and next year in another motorsport category, as he rightfully deserves (his path in Formula 1 ended this year, but I am sure he is not done racing yet!).



The end of the road, infographic anaylisis by infogr8

Credit: Infogr8

https://www.espn.com/f1/story/_/id/14278880/kate-walker-f1-blog-end-road

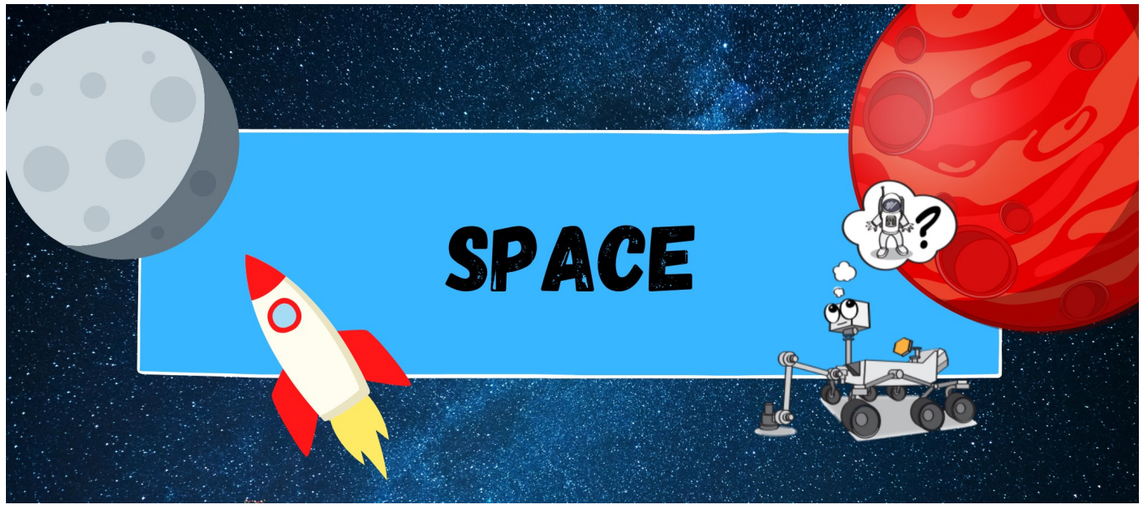
However, we stated some paragraphs ago that the great menace of fire was a matter which the FIA had dealt with; well, almost. Over the decades, fire made its come back once in a while, sometimes injuring some drivers or mechanics, but never claiming lives. This is due to the great efforts of the governing body on this matter; over the years, fuel tanks have been made more and more resistant, almost to a military level, pumps have been mandated in order to prevent flow reversal and refuelling has been banned once again in 2010 (it was previously banned between 1984 and 1994). Hence, before concluding, we have to ask ourselves: how could a fire that massive erupt? To answer this question, we must first clarify a rule. Since refuelling is not permitted, cars have to start with all the fuel needed to endure the 300 km of race: by regulation teams are allowed to fill the car up to 110 kg of fuel. So, when Grosjean crashed against the barrier his tank was almost full. In the tremendous shunt, there is evidence showing that the tank had been greatly compressed and, the fuel being an incompressible fluid, the enormous pressure increment inside it resulted in the yielding of the refuelling cap and in the horrific explosion that everyone saw on live tv.

On that very Sunday of the race weekend, FIA race director Michael Masi said that the investigation had begun almost immediately, while on Thursday the governing body had explained how the process will work. "As with all serious accidents, we will analyse every aspect of this crash and collaborate with all parties involved. [...] With so much data available in Formula 1, it allows us to accurately determine every element of what occurred, and this work has already begun," said FIA Safety Director Adam Baker. "We take this research very seriously and will follow a rigorous process to find out exactly what happened before proposing potential improvements." FIA has stated to release findings of its investigation within eight weeks, when possibly the dynamics of this crash will be unfolded. Whilst we wait, we can at least wish a speedy recovery to Grosjean.

Giacomo Semprini Cesari

Amend: at the time this article was written Romain Grosjean had already been discharged from the hospital and resigned from racing in Abu Dhabi to not compromise the recovery of his hands. He is now competing in Indycar Series.

From the data visualization done by *infogr8*, the fatalities' trend which affected Formula 1 in its early decades is clearly visible. In the first 30 year's span, 28 drivers died, while "only" five had the same fate in the last 38 years. However, this work has some limits, as it only includes those F1 drivers who died in practice, qualifying, or while racing in a Formula One event. As a result, Jim Clark, who died during a F2 event held at Hockenheim in 1968, and Elio De Angelis, who died during a private test session at Paul Ricard in 1986, are some notable omissions from the analysis.

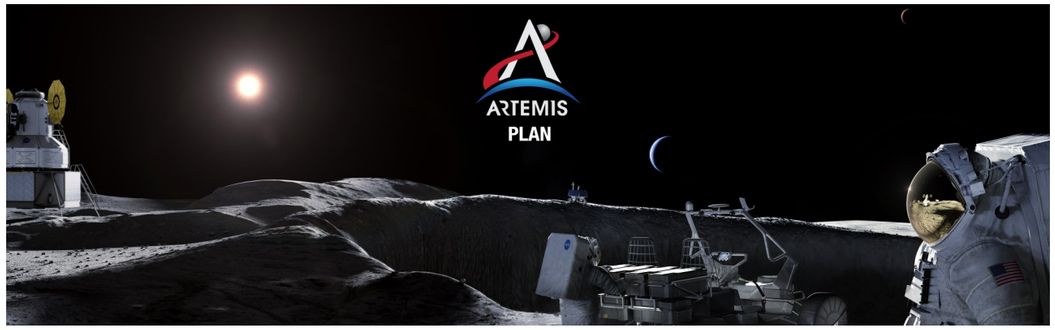


We are going back to the Moon!

NASA is planning to take humans back to the Moon by 2024 through the Artemis program. The Apollo missions brought humans to the surface of the Moon for the first time in 1969. Now, we will see humans land on the moon again, but this time with a special difference: the first woman will step on the Moon.

The Artemis program is divided into several phases, before any human steps on the moon, two phases will occur: Artemis -I, a rocket and spacecraft testing mission to validate all system performance; Artemis-II, a test flight that will carry a human crew to validate the communication, navigation and life support systems of the spacecraft. If these two test phases are validated, Artemis-III will be launched.

Artemis-III will take humans back to the Moon and will consist of a week-long expedition to the Moon with a 4-person crew. Here the astronauts will collect a variety of samples to take back to Earth to study: planetary processes, lunar volatile cycles and in-situ resource utilization, materials from the impact history of the earth-moon system and experimental science in the lunar environment.



Credit: NASA www.nasa.gov (both)

The United States wants Artemis to be a preparation for human exploration of Mars, but how?

After the landing of Artemis-III, more missions will follow to test several systems, operations, and infrastructures. One of the key elements is the Artemis Base Camp, which will be built in the south pole of the Moon. The camp will be a base of operations for trips lasting 1-2 months, hopefully proving the capability of building infrastructure which is able to sustain humans on a surface different from that of Earth. This camp will have communication systems, power systems, radiation shielding, a landing path, waste disposal systems and storage planning.

The American author Andy Weir (author of The Martian), wrote the fiction novel Artemis, which describes life of humans in a lunar city (check it out!).

Artemis is the next big step towards a human inclusive space exploration!

Johan Birnie

He is a mechanical engineer who, one day, was driving in the chaotic Guatemalan traffic and, the next, was discovering Italy.

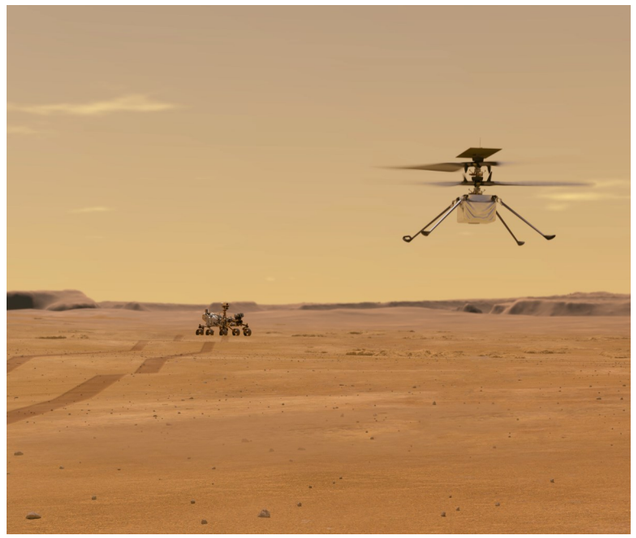
Ingenuity

NASA's rover Perseverance and its strange passenger, the helicopter drone named Ingenuity, finally landed on Mars. Their goal is to realise a completely new scientific demonstration.

This year a helicopter will fly on Mars.

You've read it well dear EUROAVIANs: in the upcoming spring there will be an aircraft flying on another planet and its name is Ingenuity. Ingenuity is a part of the Mars 2020 mission, the same mission that includes the new NASA rover Perseverance.

Mars 2020 lifted off from Cape Carnival, in Florida, on the 30th July 2020 on board the Atlas V rocket of the United Launch Alliance and successfully landed on Mars on the 18th of February 2021. The spectacular landing procedure included the use of a sky crane, just as it was done with the last NASA rover, Curiosity, in 2012.



Helicopter Above Perseverance on Mars (Artist's Concept)

Credit: NASA/JPL-Caltech

Ingenuity has been completely designed by the Jet Propulsion Laboratory, separately from the Perseverance rover. Its main task won't be related to Perseverances' scientific research but it will be a technological demonstration for future missions. Nevertheless, it will be used to take high-resolution pictures of the Martian surface and help to choose the most effective path for the Perseverance rover to follow, allowing it to spare a lot of time.

Flying an aircraft on Mars is not at all easy. The atmospheric density is about 1% that of Earth. This means that in order to achieve the same thrust, the blades of the helicopter's rotor have to spin much faster. On the other hand, an object on the surface of Mars weighs about one third of that on Earth, due to the lower gravitational acceleration. The JPL engineers designed a very light drone, only weighing 1.8kg. The rotor is made up of 2 carbon fiber counter-rotating blades, each with a span of 1.2m, and weighing only 56g.

You may be wondering how they simulated the Martian atmosphere and gravity here on Earth while testing the helicopter.

Inspecting NASA's Mars Helicopter

Credit: NASA /Cory Huston

Well, they used a vacuum chamber to simulate the atmosphere and hung the drone using a lightweight tether to relieve part of its weight.

The helicopter would be impossible to control in real-time from Earth since a signal takes 10 minutes to arrive on Mars, not to mention the feedback signal that must be sent back. For this reason, engineers will send the positional information to be computed to the onboard controller, which applies it whilst also taking into account what its sensors detect.

The average flight duration of Ingenuity will be about 90 minutes, the rest of which will be spent to maintain its systems warm enough to resist the -80°C temperature of Mars during the night. The minimum mission objective is to have 5 Ingenuity flights within 30 days.

Ingenuity will be the pioneer in new ways to explore other planets. In fact, the path will be followed by NASA quadcopter Dragon-Fly, as it is expected to fly on Titan, the largest moon of Saturn, in 2036.

Andrea Curatolo

Space passionate, he wants to contribute to make humanity an multi-planetary species.
In his free time he practices sports and reads books.

In the past few months we organised a new cycle of online conference calls. Our hard work was rewarded by kind feedback of the participants, which we'd like to thank once again. To remember our journey, we want to share with you the reports of the last three conferences, reminding you that you can read about the first two in the first edition of the Magazine.

Conference Call on Signal Analysis in Orbit Determination

1st December 2020

This semester's fourth conference was held by a member of the Local Board and PhD Student at the University of Bologna, Andrea Togni.

By working at the Radio Science and Planetary Exploration Laboratory of the university, Andrea was able to talk about the science and technology involved in projects he is currently involved in, like the characterization of ground stations for deep space orbit determination and time frequency analysis of signals from the Jovian system.

Credit: ESA—http://www.esa.int/ESA_Multimedia/Images/2013/01/Network_map

The conference aimed at giving the audience an introduction to the complex topic of orbit determination, by introducing the systems and mathematical methods involved in the process.

First, the ground segment employed in space missions was described; this way, the EUROAVIAns attending the conference were able to understand why the antennas used by the space agencies need to be so big, as well as what this means from an electromagnetic point of view.

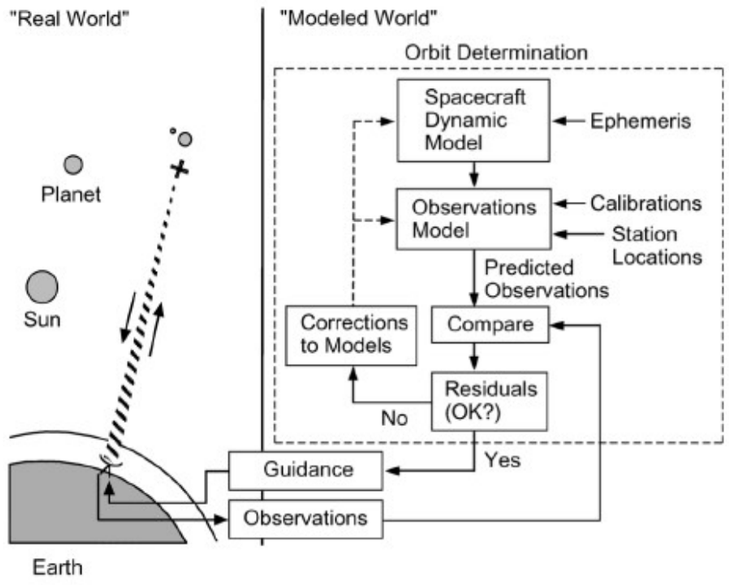
Secondly, Andrea presented the modern navigation process and explained why accurate orbit determination requires numerical iterations, as orbital models are compared to the information content of signals transmitted from space probes to understand if there is any mismodeling in the computed dynamic model.

Before concluding the presentation, Andrea presented some figures of merit, so as to give the participants a practical sense of what kind of results are obtained by current Deep Space missions, as well as introduced some examples of Radio Science Experiments that are being carried out in the outer Solar System.

During question time, some EUROAVIAns asked him about the projects he's currently involved in, and more information on how satellites are operated and what role the frequencies of signals have in different mission scenarios.

Starting from this event, we collected feedback from attendees about our events. While most people only gave a brief positive feedback, some also added that they were satisfied with the presentation "given the short time to cover all the points", or that they found the conference to treat a "very interesting topic".

Andrea Togni

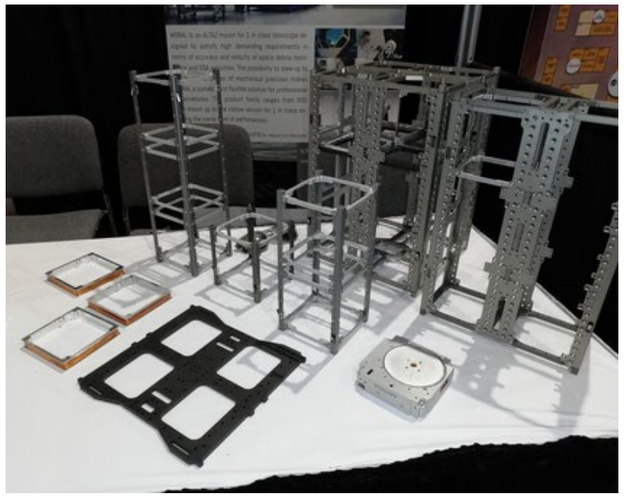


Credit: Radiometric Tracking Techniques for Deep-Space Navigation—Catherine L. Thorton, James S. Border

Conference Call on CubeSats and Space Debris

17th November 2020

After the brief digression in the previous conference, we come back to the main topic: space! For the third conference, the speaker was Niccolò Bellini, an aerospace engineer who is currently working at NPC Spacemind, the aerospace division of New Production Concept (NPC). NPC is focused on research and development of products dedicated to the space sector. Their goal is to become a solutions provider for nano satellites, CubeSats and other similar space related applications, offering a complete package solution and allowing the application of scientific research to a commercial industrialized product and service.



This conference differed from usual at the organisational level for two reasons. One, it was divided into two parts: the first was a theoretical presentation held by Niccolò; the second was a virtual visit of the company's laboratories. Two, the guide during the visit was a very special guest, Paolo Matteoni, an aerospace engineer of our age and friend of ours. He carried out his internship and thesis project in the company while he was graduating at the University of Bologna. Back then, Paolo was a member of our association and actively helped our local IT WG. He is now studying his master's degree at the Politecnico of Milan and works at NPC Spacemind.

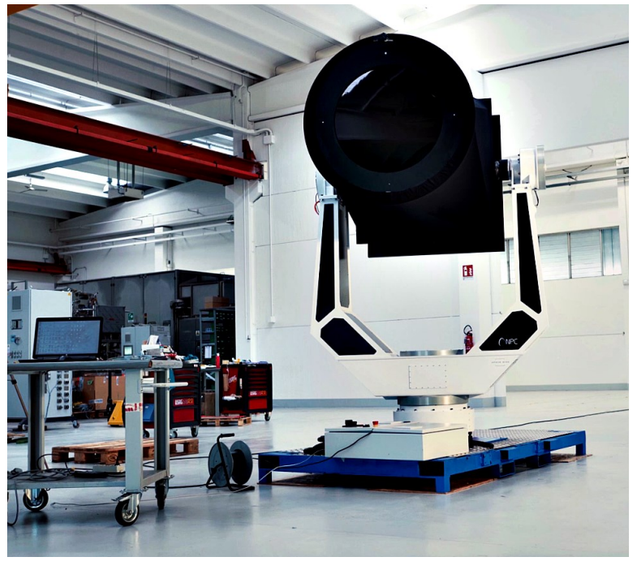
CubeSats overview

During his presentation, Niccolò first spoke about CubeSats, emphasizing how this new technology simplifies the design and construction of a satellite. In fact, nowadays, everyone can purchase CubeSat components directly on the internet, as if they were clothes or shoes. Moreover, thanks to their light weights, they are easier to transport to space, so people in the sector are talking about thousands and thousands of CubeSats that will be launched in the future.

Nevertheless, there is a huge problem: the presence of too many objects in space. Hence, Niccolò moved to the examination of the problem of space debris, giving the main solutions designed so far, and the philosophy of the company.

Watch out for waste!

CubeSats are scheduled to have a short lifetime (1-3 years). Although this may be an advantage for replacing a satellite with a technologically updated one, their disposal becomes a serious problem. Their inevitable death is mainly due to the degradation of solar panels and batteries. To avoid one day having to deal with too much "space trash", NPC Spacemind is specialising in the realization of CubeSats products with a focus on deorbiting devices and space debris related systems, like advanced ground stations for debris tracking and defence.



Credit: NPC Spacemind www.npcspacemind.com (both)

Virtual company visit with a special guest

During the guided visit through the company laboratories, Paolo showed some of the space components that were previously explained to the participants, like some CubeSat prototypes, their physical structures and solar panels.

Paolo's presence was very appreciated by the participants, who could identify with him, being young engineers. Cesare from PAS Stockholm says: "Great presentation and very interesting feedback from a student point of view".

Here are some other opinions given by the participants:

Jules from AS Bordeaux says: "Very interesting, it was nice to learn more about space debris, which is definitely a tough issue, and to have a tour and a showcase of the components: it gave a totally different dimension to the conference!".

"It was amazing to interact closely with a space company and to understand their products related to important topics such as CubeSats and space debris", Edoardo from AS Forlì-Bologna asserts.

Alessia from our AS had no doubts: "The conference was really interesting and both the speakers were really prepared. Learning about the future of such important topics in the aerospace sector has increased my knowledge and has pushed me to carry out my own research. Thank you EUROAVIA!".

Elena Tonucci

Conference Call on Orbital Transportation

in collaboration with D-Orbit

15th December 2020

The fifth and final conference this semester, wherein space was definitely the overall theme, was hosted by D-Orbit, a young Italian space company that provides solutions that cover the entire lifecycle of a space mission. The speaker, Marco Bevilacqua, an aerospace and systems engineer at D-Orbit, shared his experience inside the company, from both personal and technical perspectives, and spoke about the most unexpected sides and challenges within a space mission.

Being part of D-Orbit since 2015, Marco experienced several accomplishments, the most recent of which was The Origin Mission. It involved the launch of the ION mark1 platform, for which he was responsible for almost every single iteration, starting from the design process, through the verification and ultimately being in charge of the operation.

Vega rocket lifting-off from the launchpad at Guiana Space Center in Kourou. ION mark1 was part of the 53 satellites carried by SSMS mission

Credit: ESA

A revolutionary idea

The ION (In Orbit NOW) platform, is a revolutionary payload deployment system for small satellites. Historically, these objects are usually joined to larger satellites, but their displacement in orbit is typically non-coherent, ending in months of waiting time for these to be spread well. D-Orbit, with its ION carrier, has reshaped this concept, providing a new effective solution for the last mile of orbital transportations. Their device, hosting up to 64U (1U = 1cubesat's units), fills this gap by controlling the spread, in space and time, for a satellites' constellation or multiple independent satellites. By doing so, the waiting time for satellites to be fully operative is reduced to only a few weeks. Moreover, the attitude control is easier because they are evenly distributed in space.

Marco's perspective

As the person responsible for the Origin mission, Marco spoke about the main challenges and the solution taken by his team during the development of this project. He recalled four major solutions, both from an engineering and a new-born company's point of view. However, the most critical point was obviously the realisation of such a project, from sketches to flight, and proving that "*it works not only on paper, but in space*". Proving this statement has not been easy, but towards the end we glimpsed pride in Marco's words; in a mere three years they have not only created a new solution for orbital deployment of small satellites, but they have proven it to be cost -effective and reliable. The next generation of ION carriers will raise the bar further, by applying propulsive manoeuvres in order to displace several satellites in different orbits.

During question time, we asked Marco to recall his switch from university to working life and what his main criteria were which allowed him to enter D-Orbit. At the time, whilst evaluating the offers he received, Marco chose D-Orbit for the freedom they were giving him for being on the edge, with "*no people between me and issues*" and, therefore, "*nobody between me and the success of a mission*". In this way, he could learn a lot through testing and trying anything he wanted by applying his ideas to the company's current projects.

Credit: D-Orbit SpA www.dorbit.space

Our statistics show that you enjoyed this conference quite a lot, with some reviews being pretty ecstatic. We would like to share one which nicely wraps up the general gist of the feedback given, by Gregorio Marchesini, member of EUROAVIA Forlì-Bologna for the past two years and now member of PAS Stockholm: "I think what you are doing is a great opportunity for young students to concretely understand what is going on outside the small and protected environment of the University. The world is running fast and urges us, as students, to bring innovation and enthusiasm to every field of science and technology. The experience shared by Marco was a perfect example. Starting a project from zero requires courage, patience and tough decisions that will mark your work. However, it is the passion for what you are doing that makes you keep going even if the result will be evident only in the long run. Lectures like the one given today help share all these values. Thank you EUROAVIA. Continue to lift students' passions to the sky!"

Giacomo Semprini Cesari

Interview with Luis Gomez Casajus

Q: Dear interviewee, please introduce yourself.

A:Hi Andrea, thank you for having me. I am Luis Gomez Casajus, Ph.D. in Aerospace Engineering with five years experience in orbit determination and processing of radio tracking data for interplanetary missions.

Q: What is your current position? What projects are you currently working on?

A: At the moment I am a postdoc researcher in the radio science and planetary exploration lab at the University of Bologna. The lab, based in Forlì, is involved in several NASA and ESA space missions.
Mainly, I am working on gas giant missions just as Galileo, who studied the Jovian system for 8 years or Cassini, that analogously studied, during most of the 13 years of its mission, the natural satellites of Saturn and paying specific attention to Titan, the only moon of the solar system with a thick atmosphere. In addition, I am also involved in other missions like Europa Clipper or JUICE.

Q: What do you find most interesting/exciting about these? And, on the other hand, what are the biggest challenges you face?

A: During the last two decades, unmanned probes allowed the study of gas giant satellite systems. The three most relevant spacecraft for their study have been Galileo, Cassini and Juno. Working with real data from these probes, and reconstructing their orbit during the different flybys, is as amazing as it is challenging. You have to take into account a lot of effects that may not be evident or that not have not been taken into account in the past because, at that time, they were not known.

Q: Are you particularly proud of any recent achievements as a researcher? What implications did your findings create for your field of work?

A: One of the objectives of my PhD was to fit the Cassini radio-tracking data acquired during the Titan gravity flybys and reconstruct the orbit of Titan during for the time-span of the Cassini mission. We managed to do this, and we found something unexpected, a large orbital expansion for Titan. This fact suggests that the moon was formed significantly closer to Saturn and that it has migrated by a substantial amount over the lifetime of the solar system. This evidence motivates a revision of the evolutionary history of Saturn's moon system and has recently been published in Nature Astronomy.

Q: Do you cooperate with many people from other agencies? Or mostly people from your laboratory?

A:Yes, we collaborate with many people from different Space agencies such as NASA, ESA, ASI and several universities and research institutions, but also with the people from our laboratory every day. I believe that collaboration in science is mandatory to obtain successful results.

Q: What was your academic path to reach your current position? What do you think were the winning choices in your years as a student to reach your current position?

A: My academic path started with Aeronautics engineering in Madrid, in the UPM. During the last year of the master's degree I had the opportunity to do an internship at the Radio Science Laboratory. After that I decided to invest 3 more years of my career in doing a PhD. The winning choice was, of course, the PhD program in the laboratory, that opened the doors to my stay in the JPL within the Radio science group, were I had the opportunity to experience the work dynamics of a space agency.

Q: Have you always dreamed of doing research in your field, or did you "find it by chance"?

A: Well, when I was a kid, I always loved the space. I have always seen space as something fascinating, mysterious and unexplored that makes you dream about it. By that time, I did not know that Radio science existed, but I wanted to work in something related to space. Somehow, this passion went dormant during my first years of the university and only resurged when I had the opportunity to do an internship in the laboratory and work on a space project, developing a tool to simulate one-way atmospheric occultations of Titan.
So, I guess that we can say that I always

dreamed to work in a space related job but at the very end I found it by chance.

Q: Give us your expert opinion on the Jovian system: do you think it is possible we will find some forms of life?

A: The Jovian system is complex, unique and amazing. It has the biggest planet of the solar system, Jupiter. It contains the only moon with volcanic activity, Io, and the biggest moon of the entire solar system, Ganymede and there is evidence of the presence of an ocean in some of the moons like Europa. In the near future, two missions will study the system almost simultaneously: Europa Clipper and Juice. Who knows what these missions will find? So far, there is evidence for the presence of an ocean in the interior of some of the moons, so we can say that the Jovian system is a good place to look for it.

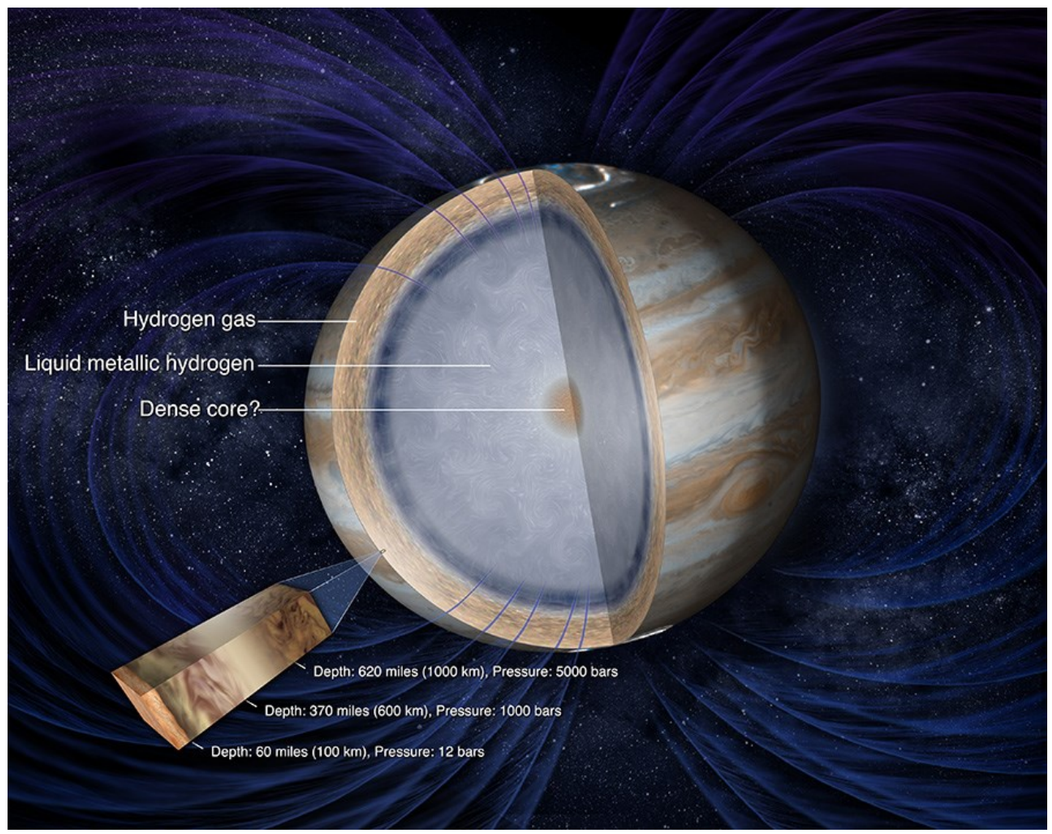
Q: What advice would you give to younger students that wish to work in the space sector?

A: To be passionate and motivated, to be curious, proactive and to give their best in every opportunity that they will have.

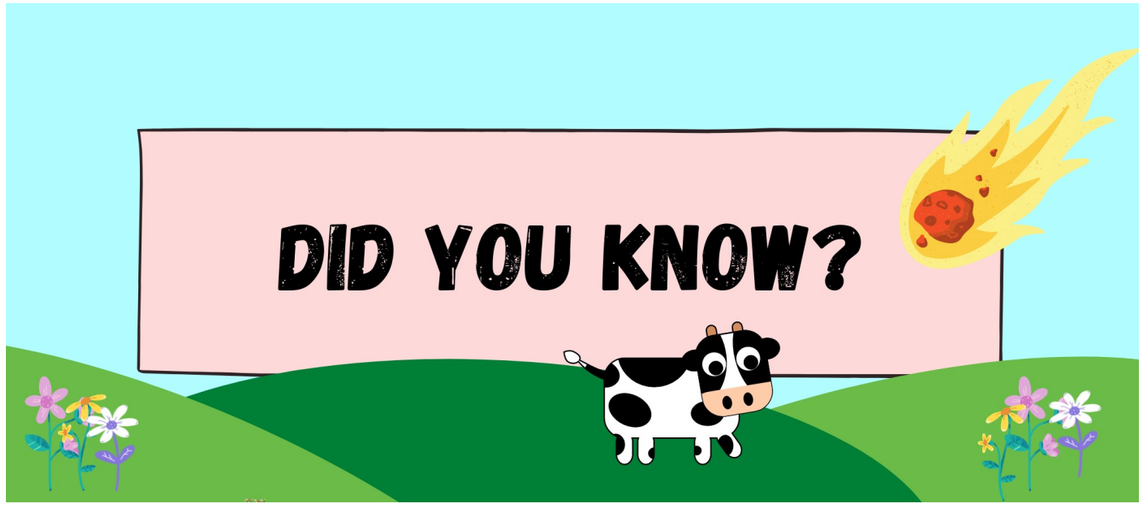
Q: Thank you very much for your time.

A: It was a pleasure and thank you for having me.

Andrea Togni



Credit: JPL, NASA



Rufina cow

"Cause of death? A rain of metal junk!"

November 30, 1960.
Rufina, a solitary cow, is grazing in a meadow in the south of Cuba. On the other side of the Caribbean Sea, the sky is clear in Florida and on the launch pad at Cape Canaveral there's great excitement as the American Thor-Able-Star rocket is ready for lift-off.
Thor flies over Florida, passing Miami beach and over Cuba. Everything is perfect. However, at some point, something goes wrong. On the way to the stratosphere, Thor explodes unexpectedly. While the engineers in Florida are trying to figure out the real cause of the disaster[1], Rufina is unaware of her ugly fate. Indeed, a few moments later, a spatial debris hits her and, unfortunately, she loses her life.

But don't worry, Rufina's death did not go unnoticed. In the following days many of her sisters protested in the streets of Havana, in front of the American embassy. The whole world became aware of the dangers of space debris and Rufina became the most expensive cow in history, as the American government gave the Cubans 2 million dollars compensation.

Credit: https://www.mapfreglobalrisks.com/risks/images/Seguros_de_satelites_ENU_tcm1366-435032.pdf

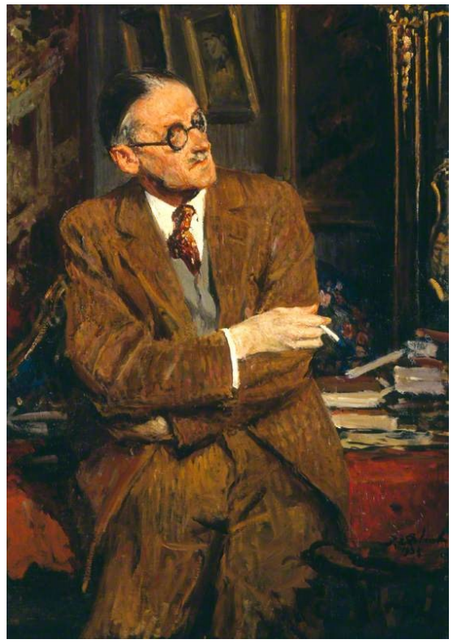
Notes:
[1]Rocket malfunction at the second stage.

Chiara Pennuti

Where does the term ‘quark’ come from?

If you think that the choice of the term ‘quark’ is due to scientific reasons or it comes from an anecdote related to its discovery (like Newton’s apple, for example), then you are way off the… *mark*.

The term comes from a completely different field: 20th century Irish literature.
Have you ever heard of “Finnegans Wake” by James Joyce? Joyce wrote this book with the purpose of keeping translators and literary critics busy for years. He surely succeeded in doing that, if we consider that, nowadays, after decades from its publication back in 1939, we have only translated a few chapters and most of the text remains obscure and full of hidden meanings in its original English version.



In fact, Joyce invented a unique polyglot-language, also called ‘idioglossia’, solely for the purpose of this work. This language is composed of composite words from some seventy world languages, combined to form puns and phrases intended to convey several layers of meaning at once.

At page 383 of Finnegans Wake we can read:
“Three quarks for Muster Mark!
Sure he hasn't got much of a bark
And sure any he has it's all beside the mark.”

From this passage, the American physicist and Nobel laureate Murray Gell-Mann assigned in 1963 the name "quark" to the fundamental constituents of the nucleon. Actually, a quark is ‘the cry of a gull’ and Gell-Mann chose it while reading Finnegans Wake because it reminded him of a German word of Slavic origin that stands for ‘dairy product’ or ‘rubbish’, colloquially. This juxtaposition of languages generated an intense debate on how to pronounce the word quark when it is referred to the physical particle: is it ‘kwork’ or ‘kwark’? But this is another story.

In any case, the number *three* in the passage fits perfectly the way quarks occur in nature, so that’s why Gell-Mann chose this word while bringing a blast of Irish literature to the scientific world.

Elena Tonucci

Credit: National Portrait Gallery, London

Enola Gay Bomber

Credit: US Dept. Of Defense

Enola Gay was the name of the B-29 Superfortress bomber that dropped the atomic bomb “Little boy” on Hiroshima on the sixth of august 1945. This aircraft was named after Enola Gay Tibbets, the mother of the pilot Paul Tibbets. For this mission the pilot was awarded the second highest military award and gained fame as one of the heroes of the war against Japan. This plane is also part of the song “Enola Gay” of the band “Orchestral Manoeuvres in the Dark” a famous song in the 1980s.

Giovanni Mussoni

“Enola Gay
Is mother proud of little boy
today
Ah-ha this kiss you give
It's never ever going to fade
away”

EUROAVIA

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