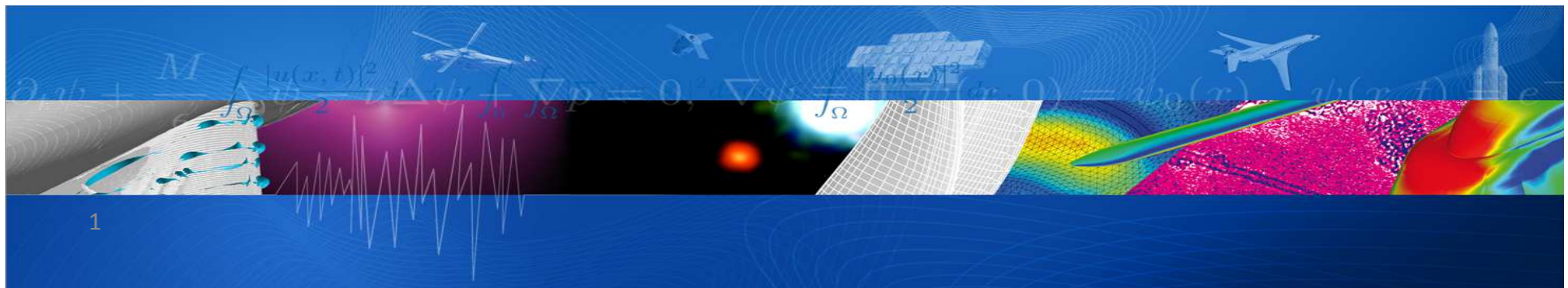


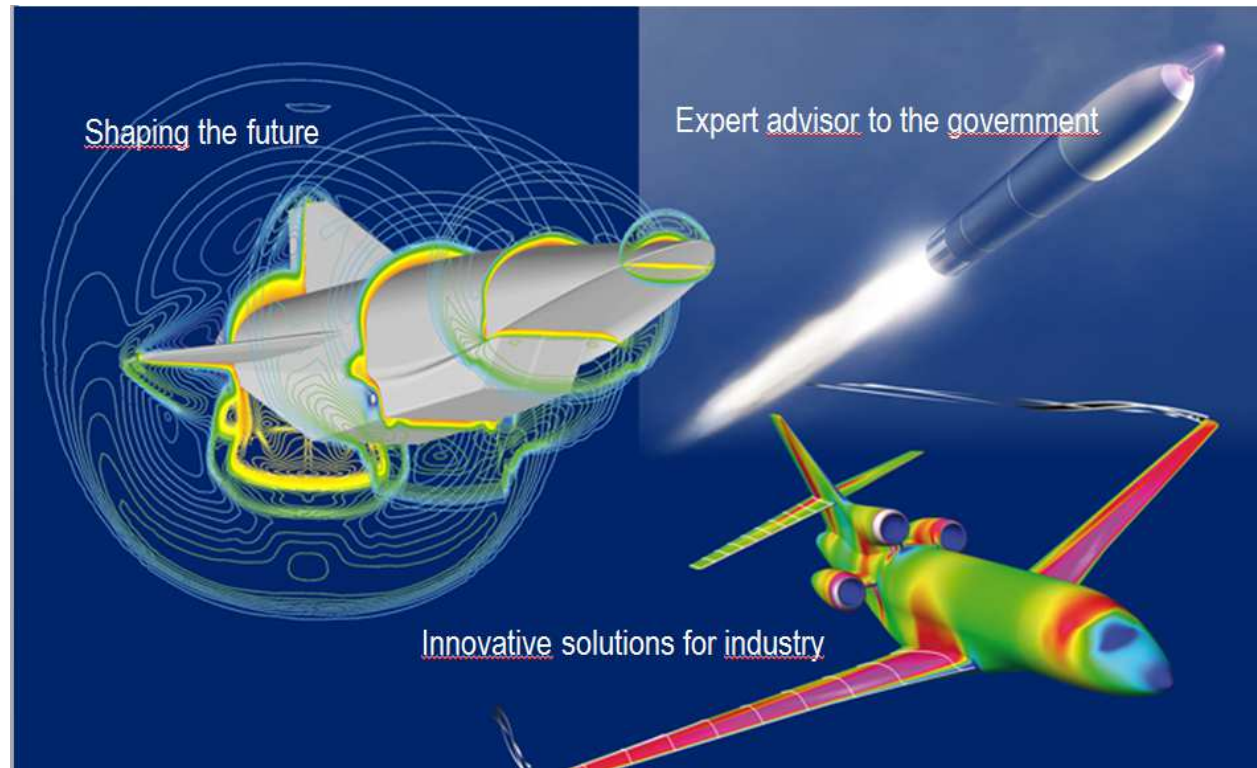
7th European Conference for Aeronautics and Space Sciences

TRANSDISCIPLINARY RESEARCH POLICY FOR PREPARING THE FUTURE?

Stéphane ANDRIEUX – General Scientific Director
ONERA - France



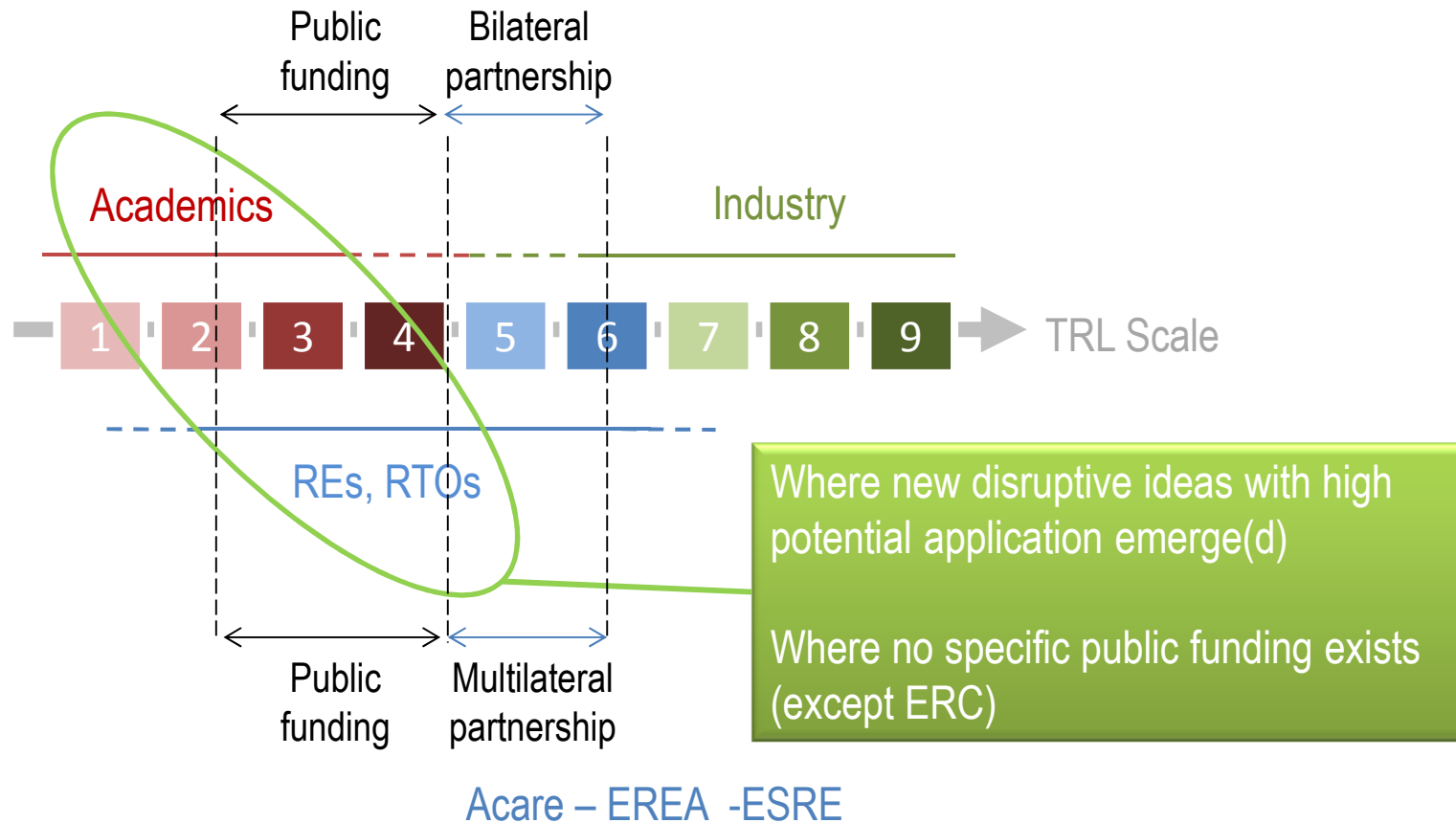
ONERA at a glance



- Public sector entity established in 1946
- Under the supervision of the Ministry of Defence
- 1 900 people at eight sites (13 % PhD)
- Budget ~225 million €
- 51 % of contract work
- Largest fleet of wind tunnels in Europe



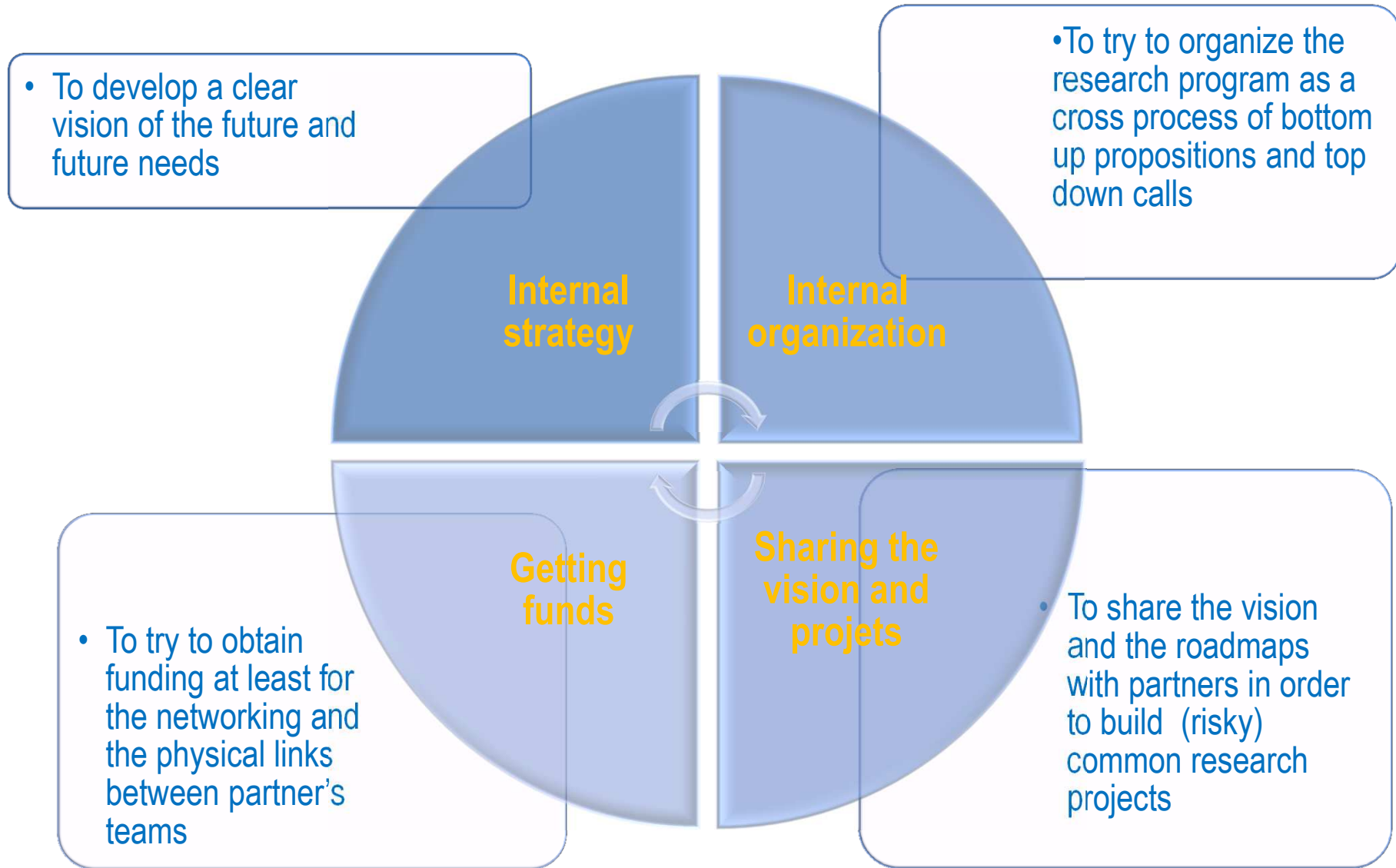
What are we talking about ?



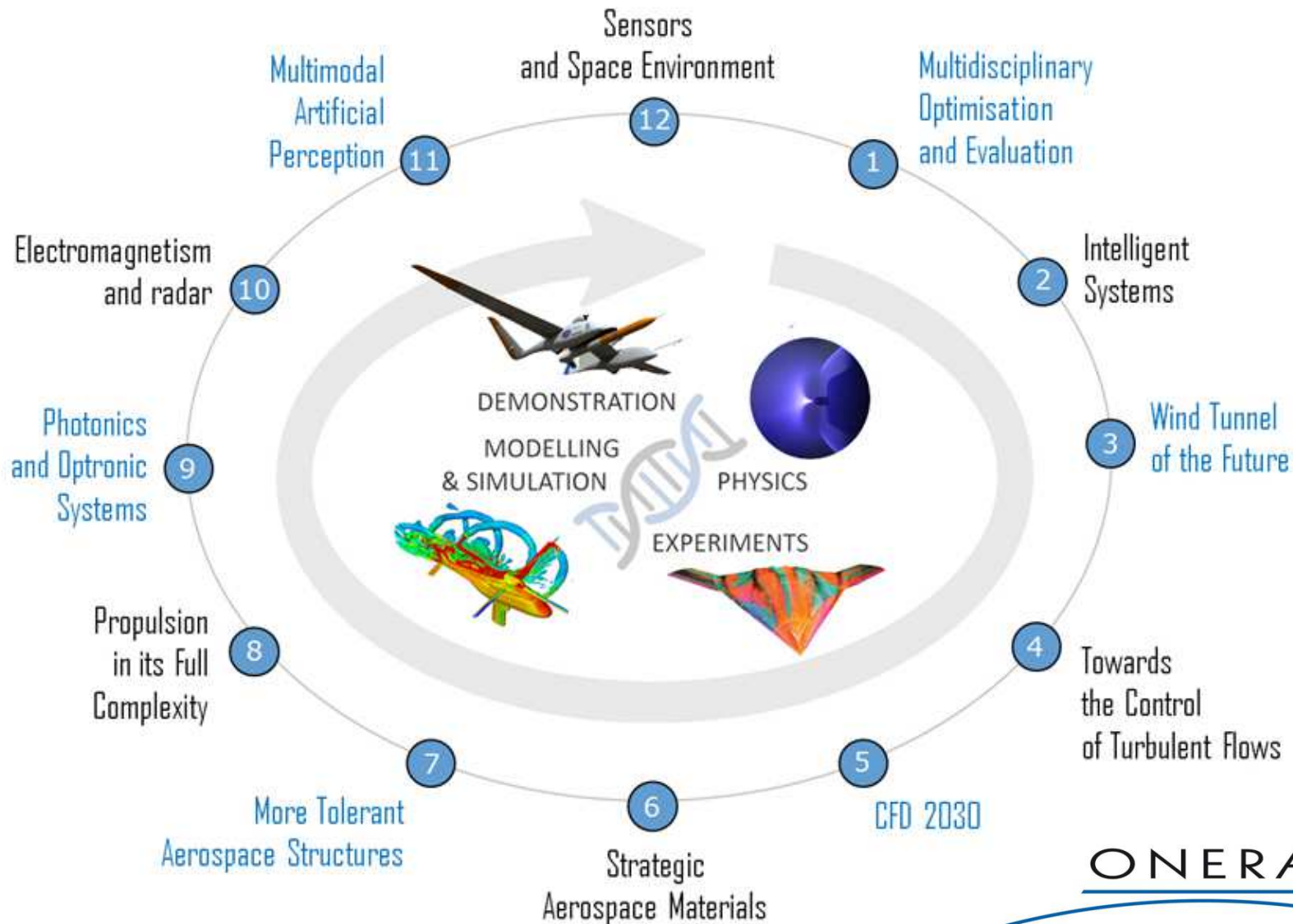
Some (personal) considerations

- The gap between fundamental knowledge and industrial research is bridged by Research Establishments (REs) or Research and Technology Organizations (RTOs).
- **But** time is harder for technically based innovation (compared with services based innovation) because of longer development time cycles and stronger investments (skills, manpower and technical means)
- The key is to fill the TRL2-TRL 4 segment and develop knowledges and elementary bricks to build new concepts of planes (including propulsion, materials, control, systems)
- Taking a look on the past successes, we can see that a lot of them have been grounded on international exchanges and cooperations on risky projects
- We have the responsibility to build a more favorable environment !
- For the young people (and also for those who are young since little longer)

4 steps for the revival of TRL 2→4 transdisciplinary research in REs



The 12 challenges of the ONERA Scientific Strategic Plan (2015-2025)



The structure of in-house research projects at ONERA

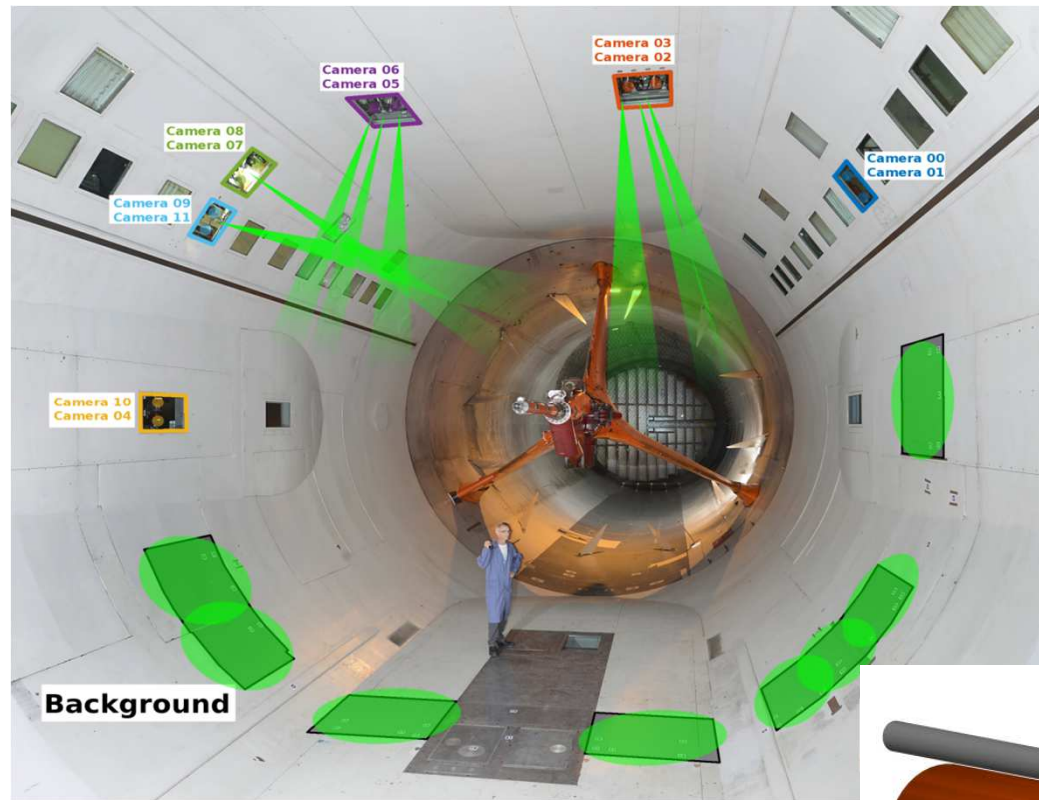
	Now running
• Federative Research Projects	27
• 4 years projects, multidisciplinary research	
• Federative Research Actions or networks	15
• 3 years transverse disciplinary actions or networks	
• Research Projects	55
• 3 years monodisiplinary projects	
• Exploratory Research Actions	8
• International Exploratory Research Actions (new)	1
• Fully hired PhDs	50
• One year Post-Docs	20
• In-kind contribution to collaborative projects (public)	
• In-kind contribution to programs of common interest with industry	
• PhDs with industry	
• Self-elaborated projects granted by State Agencies	



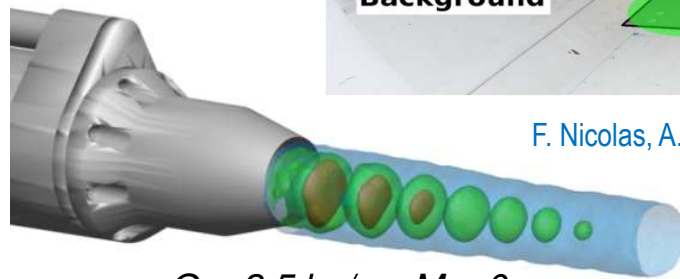
Development of the instrumentation in large industrial wind-tunnels

BOS-3D for instantaneous density field measurement

PIV-3D for time-resolved dynamic fields

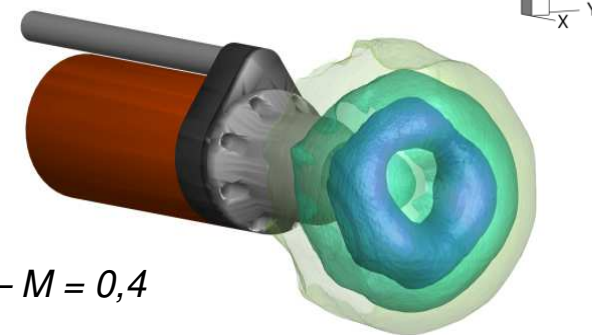


BOS-3D Jet studies in the wind-tunnel S1 ONERA Modane



$$Q = 2,5 \text{ kg/s} - M = 0$$

F. Nicolas, A. Plyer, et al. (Fluvisu & MOTAR 2017)



$$Q = 1 \text{ kg/s} - M = 0,4$$

PIV Particle Image Velocimetry BOS Background Oriented Schlieren

The 2016 ONERA-TSAGI Price for young researcher's 2 years projects

Topology Optimization Methods for Searching of Advanced MetaMaterials and Pro-Composite Layouts

Main objective of TOPSAMPI

- Revisit aircraft structures design **from global layout to material** by combining the two aspects : matter and material



With

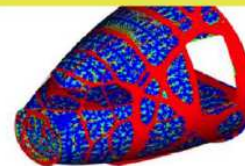
- topology optimization and parametric/shape optimization
- composite and extreme materials/structures
- additive manufacturing



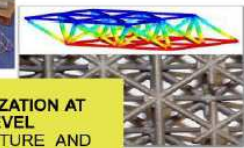
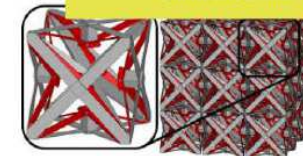
Print of an auxetic material
Negative Poisson's ratio



TOPOLOGY OPTIMIZATION AT AIRCRAFT LEVEL
OPTIMAL LAYOUT AND MECHANICAL PROPERTIES (E^* and ν^*)



TOPOLOGY OPTIMIZATION AT MATERIAL LEVEL
OPTIMAL ARCHITECTURE AND METAMATERIAL



Bettebghor et al. ONERA, TSAGI



As a conclusion ... for discussion

By asking some questions

How do new ideas emerge ?

How can we support this emergence ?

What are the means we can use for passing from the crude idea to preliminary results that can be the starting point of funded projects ?