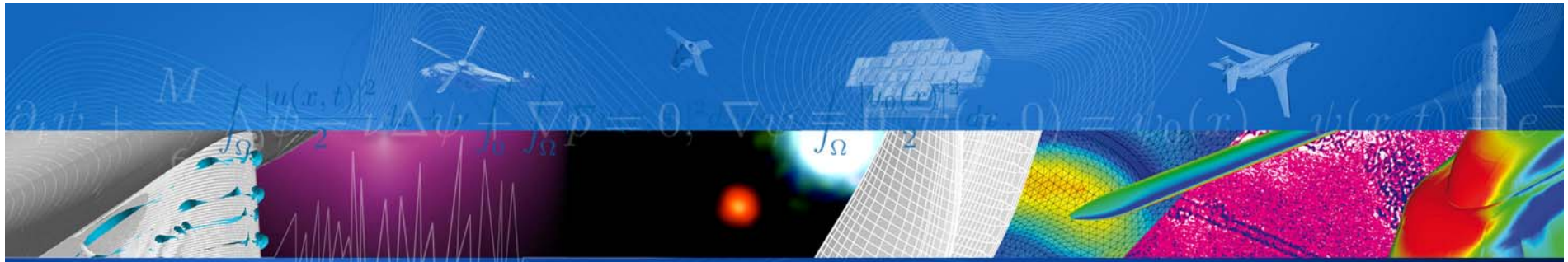

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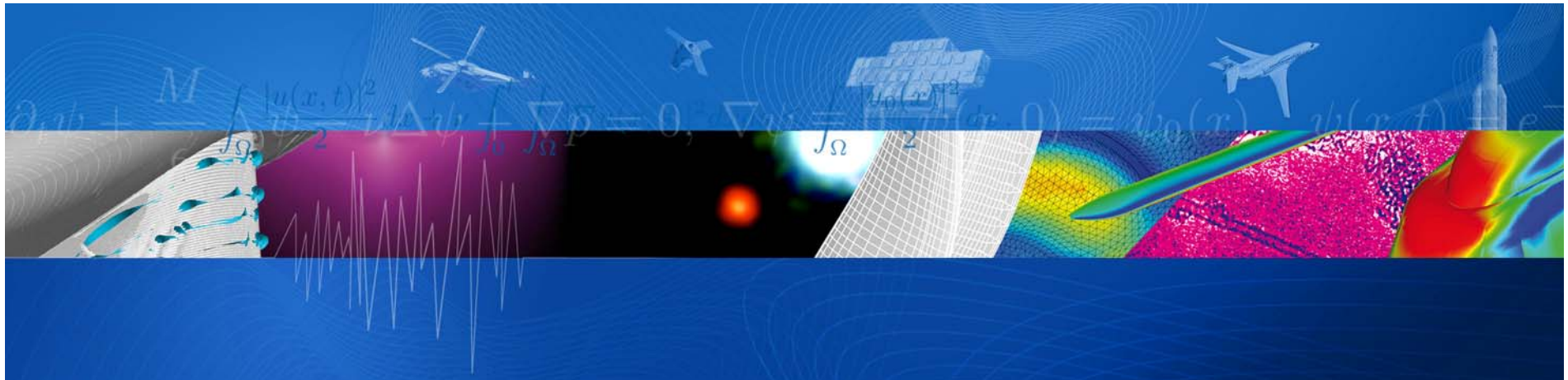

Significant achievements and future research in the field of environmental impact of aeronautics at Onera

Nagoya - October 2012

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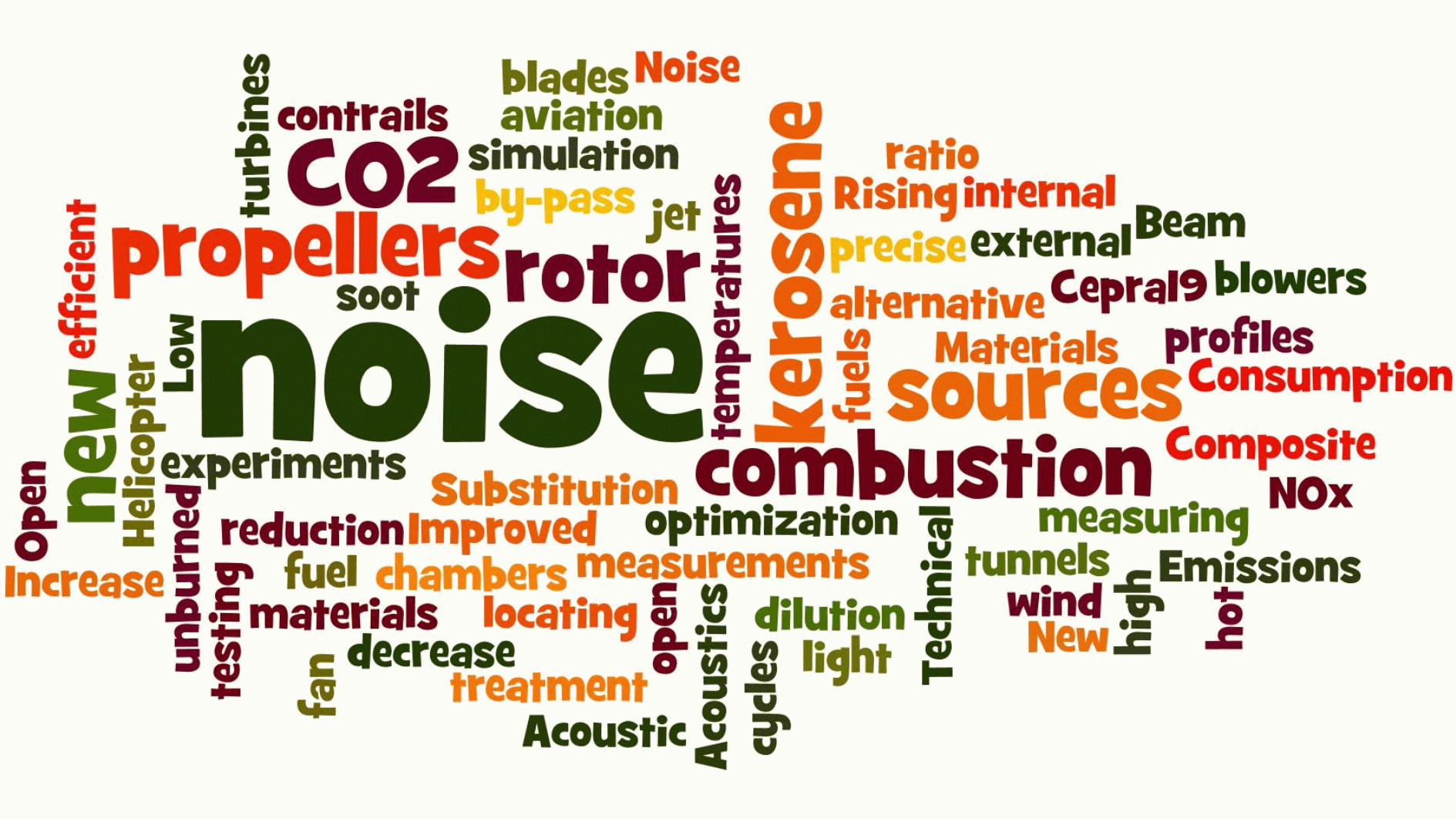
Greener Aviation : a large field for science & technology



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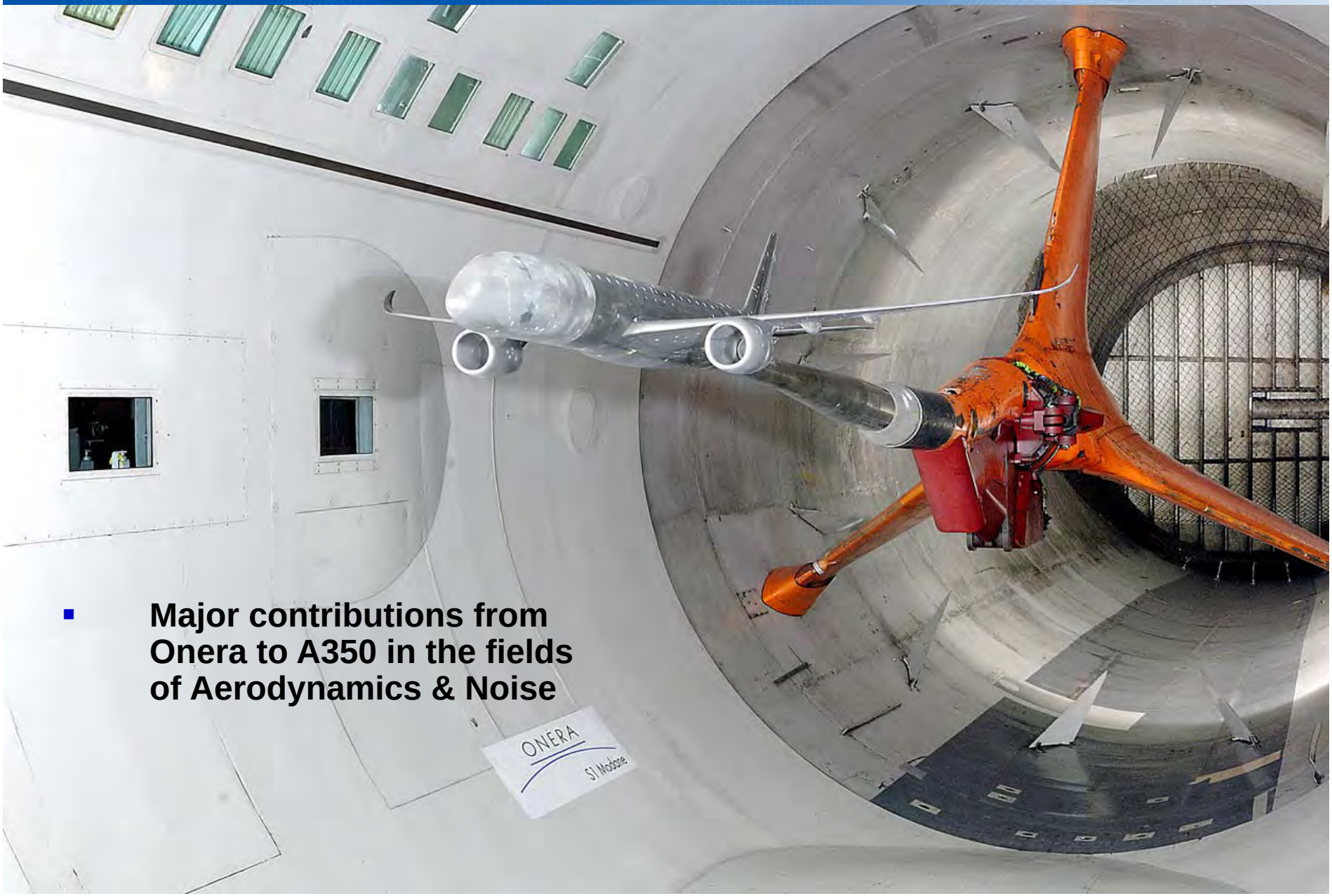
A 380 large model in the Onera S1MA and F1 wind tunnels

- **Major contributions from Onera to A380 in the fields of Aerodynamics & Noise**

A 350 large model in the Onera-S1MA wind tunnel

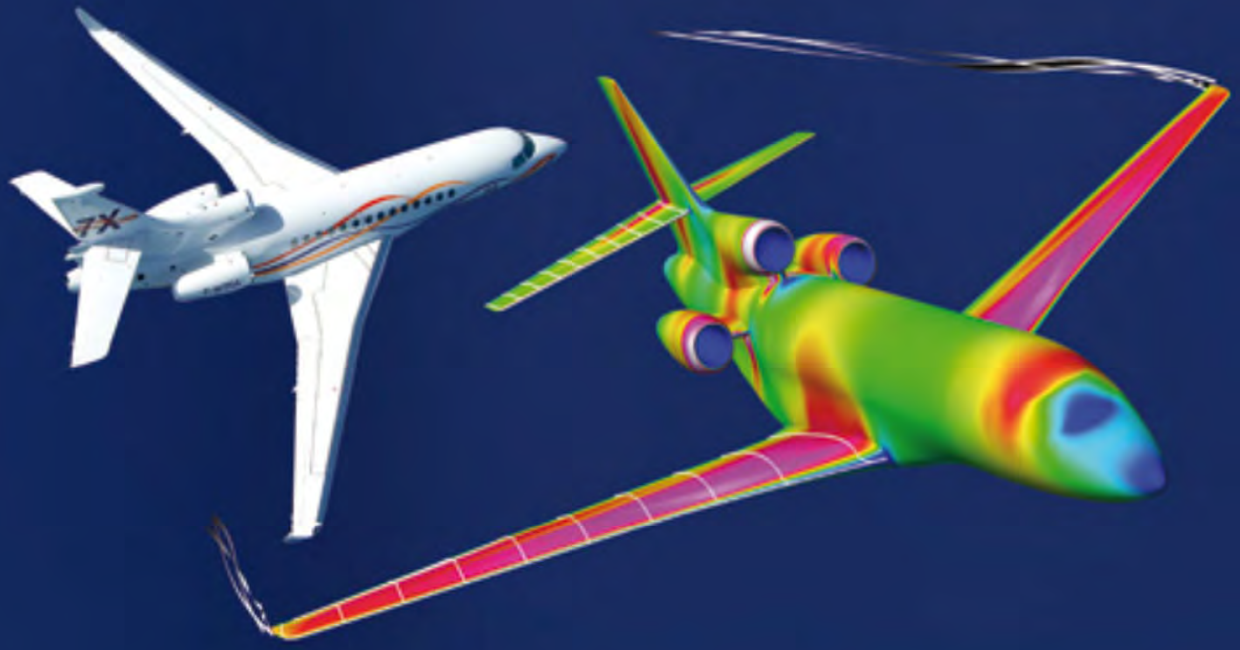


- **Major contributions from Onera to A350 in the fields of Aerodynamics & Noise**

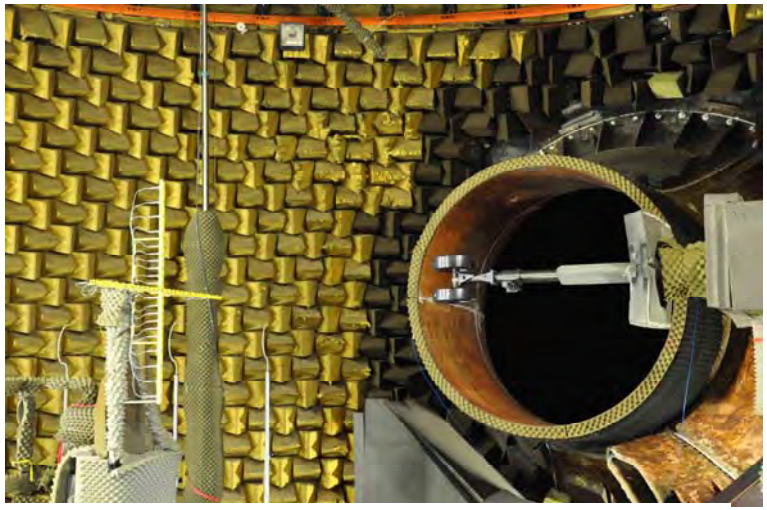
Winglets

An additional « device », with a high potential for performance improvement of the aircraft (consumption, range)

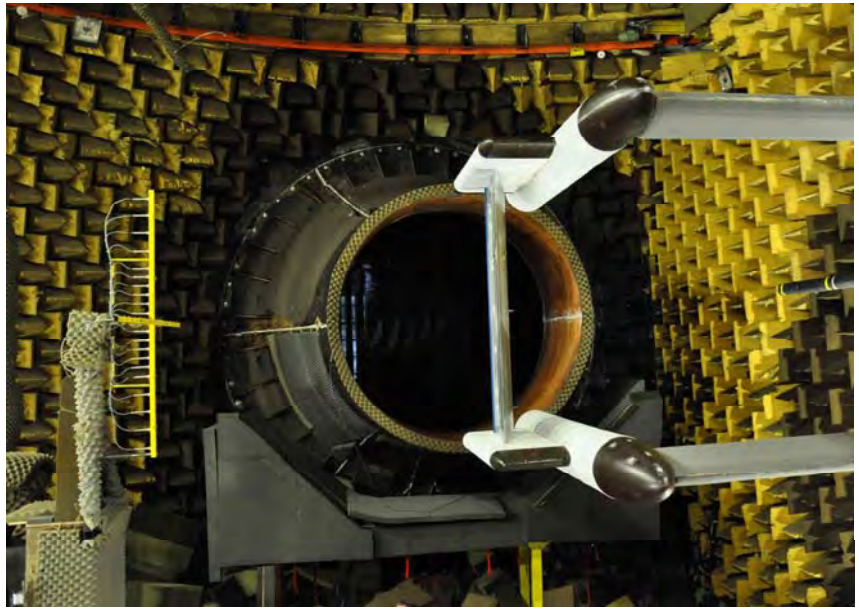
Wind tunnels were major contributors to the assessment



Illustrations of recent activities in CEPRA19 : Aerodynamic Noise



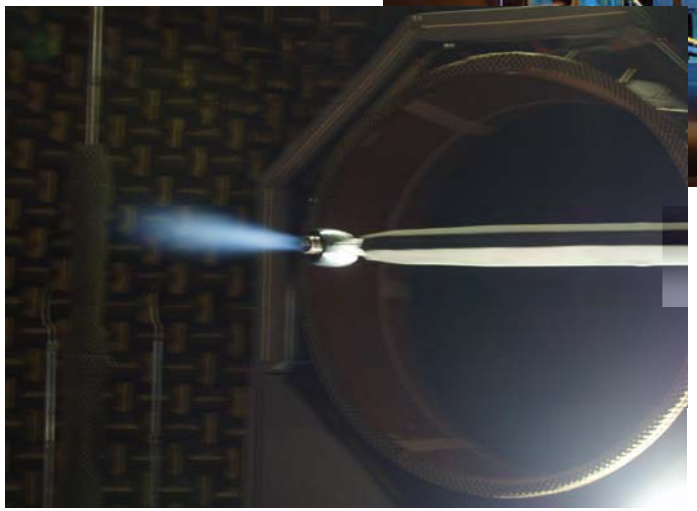
LAGOON (Airbus - DLR - ONERA)
Generic undercarriage leg

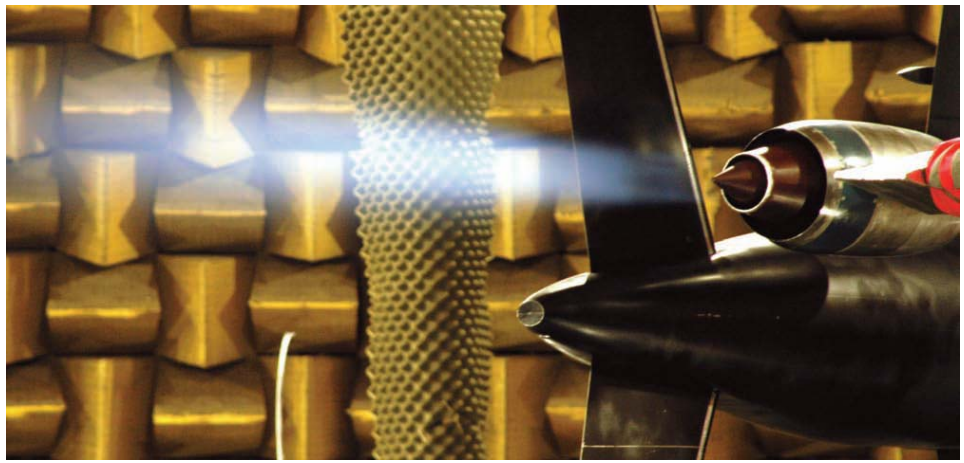


TIMPAN (Airbus)
Wing section with High-Lift Devices
and mesh across the slat gap

DTP BAF (Dassault)
Business jet

Illustrations of recent activities in CEPRA19 : Fan Noise

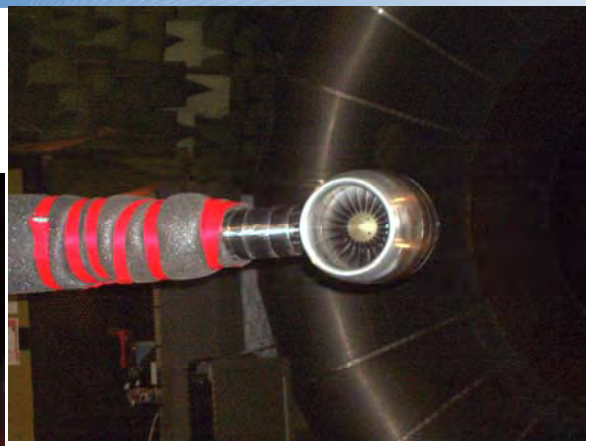




NACRE (Airbus/Snecma/RR)

Fan noise in isolated and installed configurations

CEPRA19 – recent activities



- **Nacre : look on the configurations**

elsA as a « Key Green Enabler »

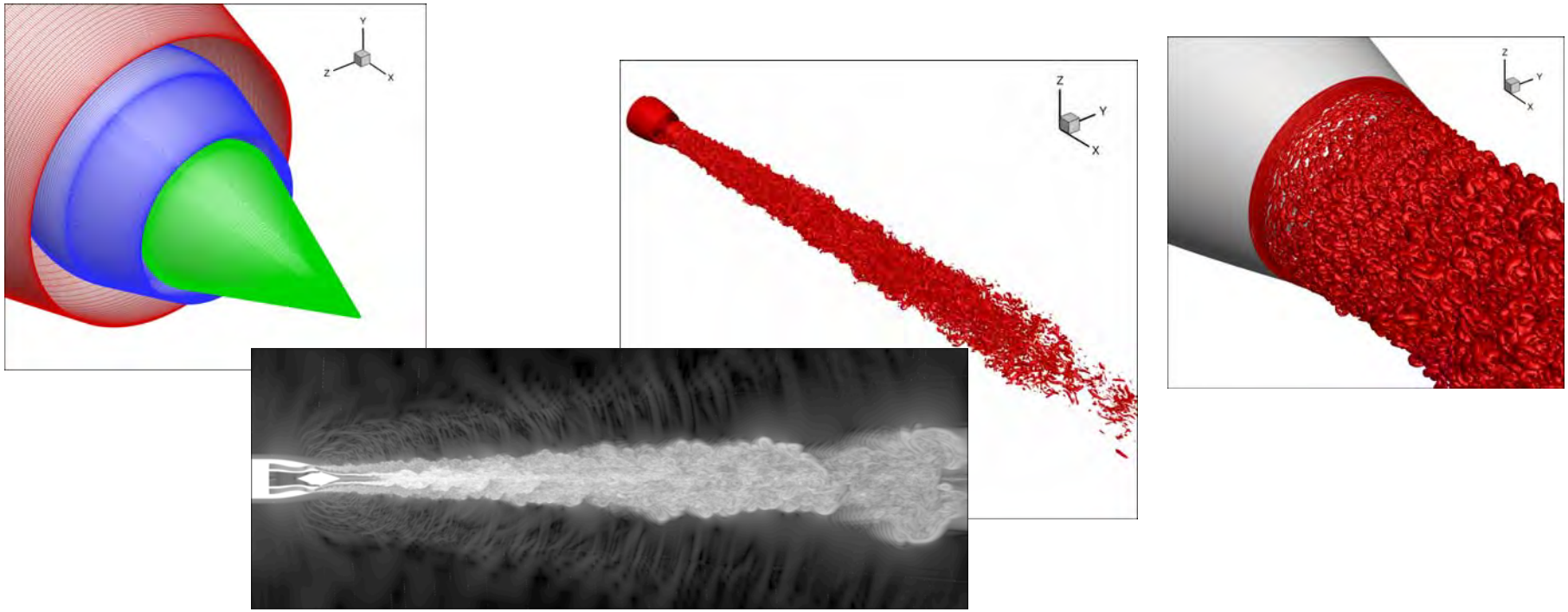
elsA is the ONERA software for complex external and internal flow simulations and for multi-disciplinary applications involving aerodynamics. That includes the following disciplines or topics:

- **Aerodynamics, aeroelasticity, aerothermics coupling, aeroacoustics coupling;**
- **Aircrafts, helicopters, turbomachinery, missiles, launchers, air intakes, nozzles, propulsive jets;**
- **Research and industrial applications;**
- **Euler, RANS, URANS, DES, LES simulations;**
- **Mono-species perfect gas assumption with a user-given value of the specific heat ratio (equilibrium real gas assumption in development);**
- **Calculation of sensitivities for optimum design.**

The objectives of the elsA project aim at providing a software that is : a federative support for research on physical and numerical modelling; RANS, URANS, DES, LES simulations;

- **a long-term facility for capitalizing research results;**
- **Calculation of sensitivities**
- **a tool helping to investigate and understand flow physics;**
- **a powerful and user-friendly multi-purpose tool for applied CFD and multi-physics;**
- **a medium from research to industry;**
- **a tool open to co-operative work.**

elsA for aérodynamic of jets

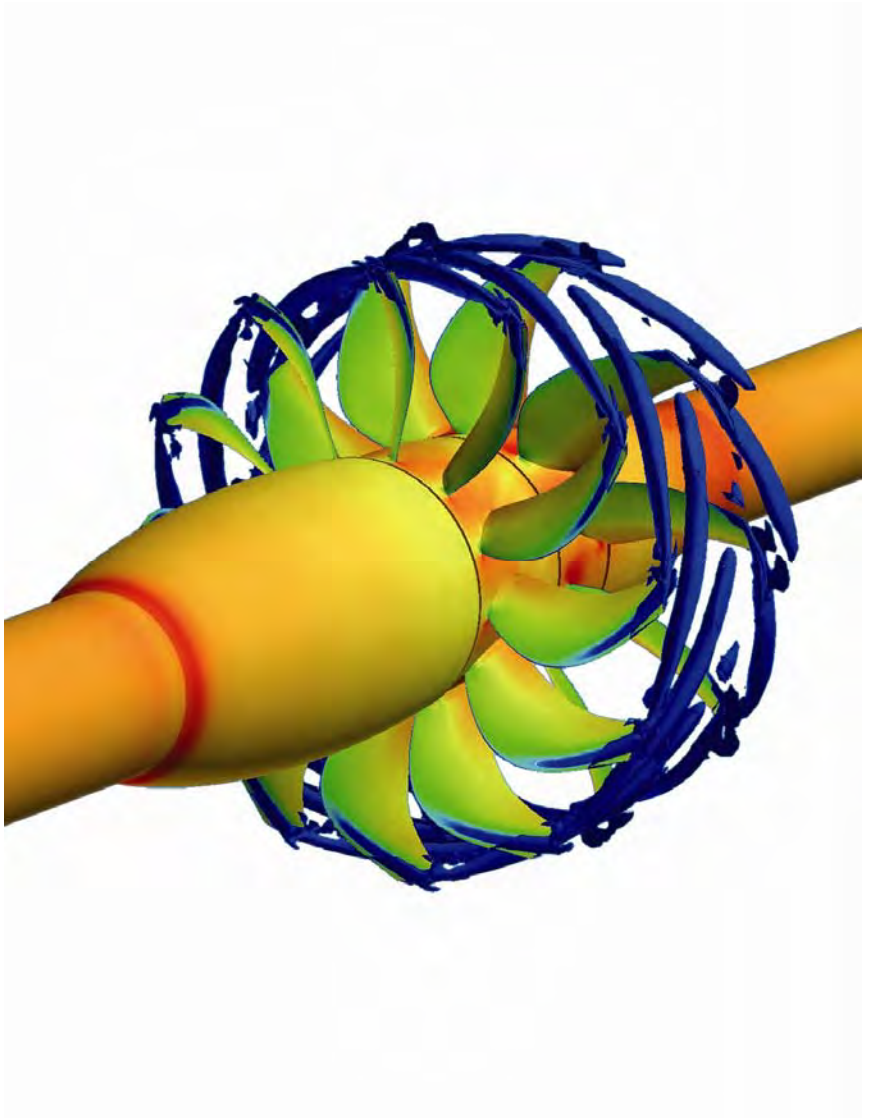


- ZDES computation
- 290 millions pts
- 500 000 h CPU

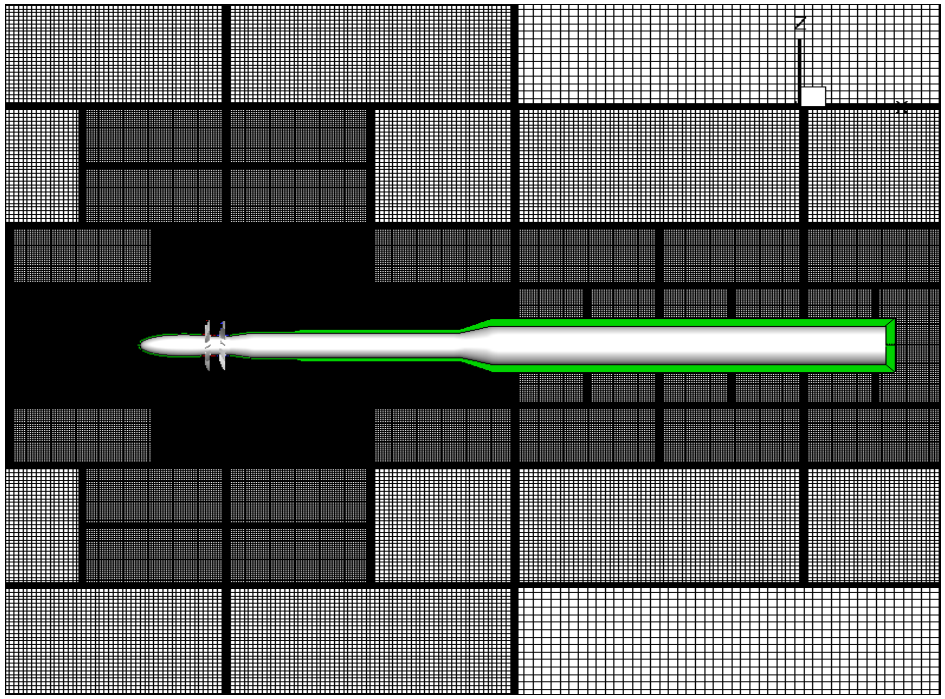
CROR in Onera : a long story

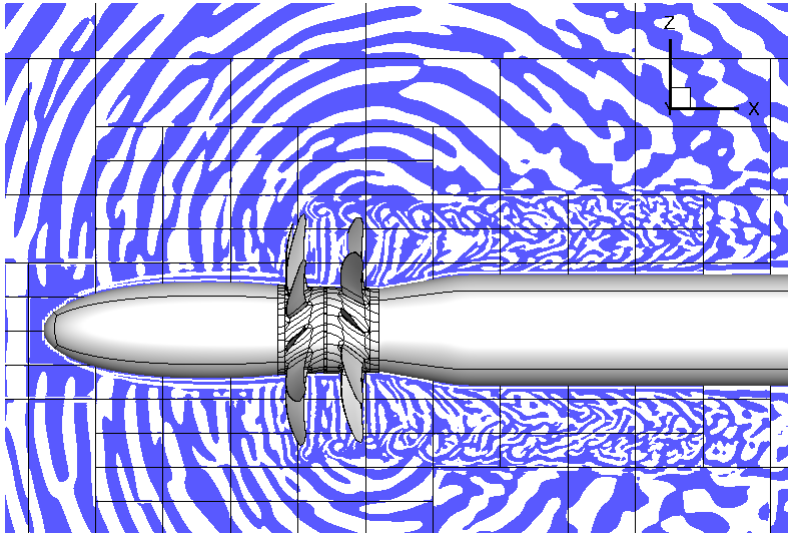
Strong expertise in that field

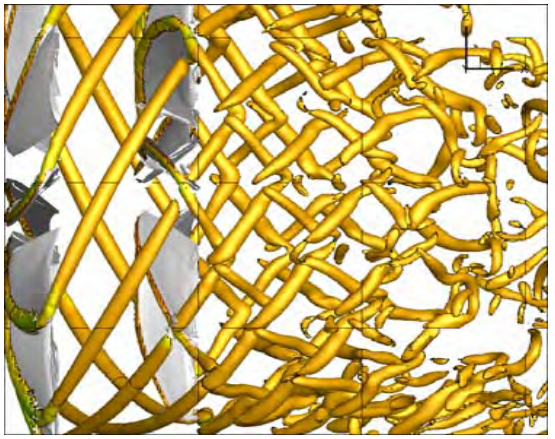
- **comparison simulations / tests**
- **interactions wake/rotor**
- **CROR demonstrators in windtunnel S1 Modane**



elsA for CROR

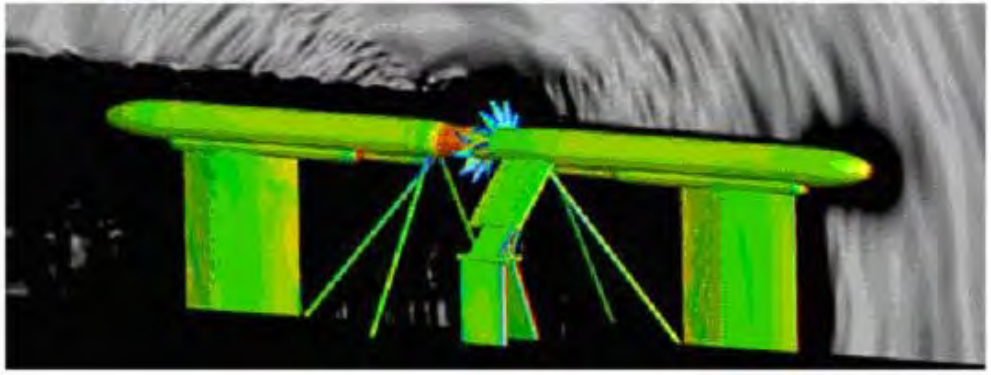






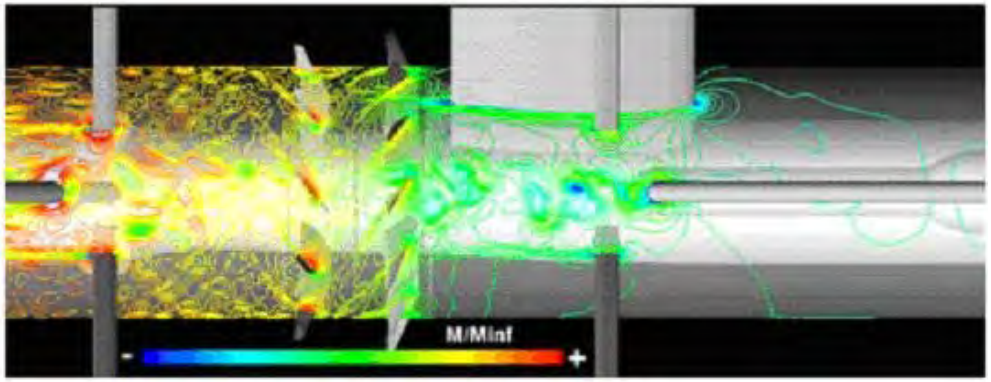
- elsA computation, approach « Chimère-Cartesian »
- 138 millions pts +480 millions pts
- 250 000 h CPU
- Following studies with pylon

CROR : Test vs simulation



Comparison between tests and CFD

- **match Onera (URANS) TsAGI (tests)**
- **Far field acoustic visualisation**
- **2 elsA-based computations on Stelvio (Onera supercomputer)**
- **220 millions pts + Chimère technics - 600 000 h CPU**
- **2 publications (AIAA + AAAF 2012).**



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CROR : Pylon

Aerodynamics – interaction wake/OR

- **key point for noise**
- **URANS technics needed**
- **comparison of differents solutions**
- **42nd AIAA Flow Control Conference : "Blowing Strategies of Pylon-Propeller Configuration for Noise Reduction Using Numerical Approach" 25-28 juin 2012, New-Orleans.**
- **further studies on new concepts for aeroacoustics**

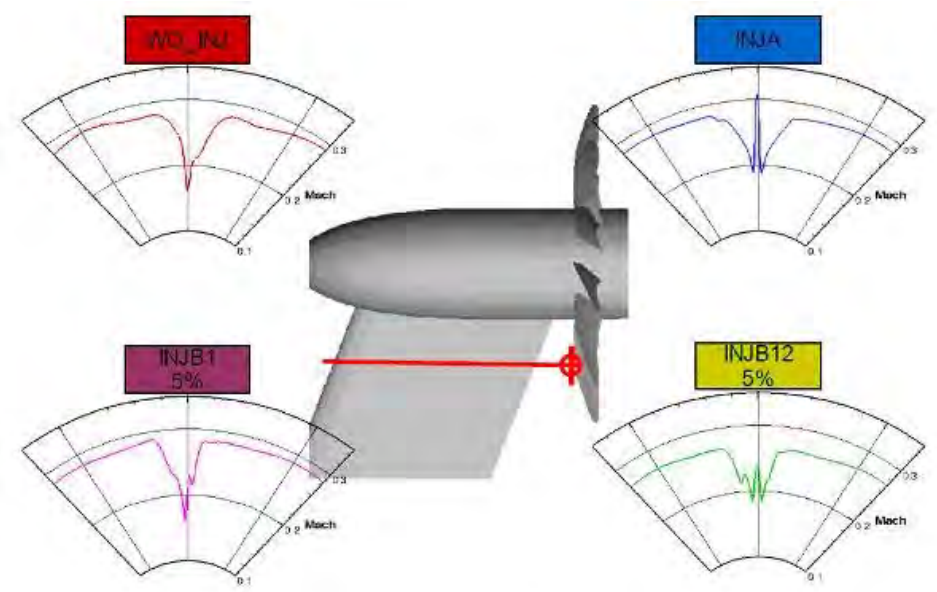
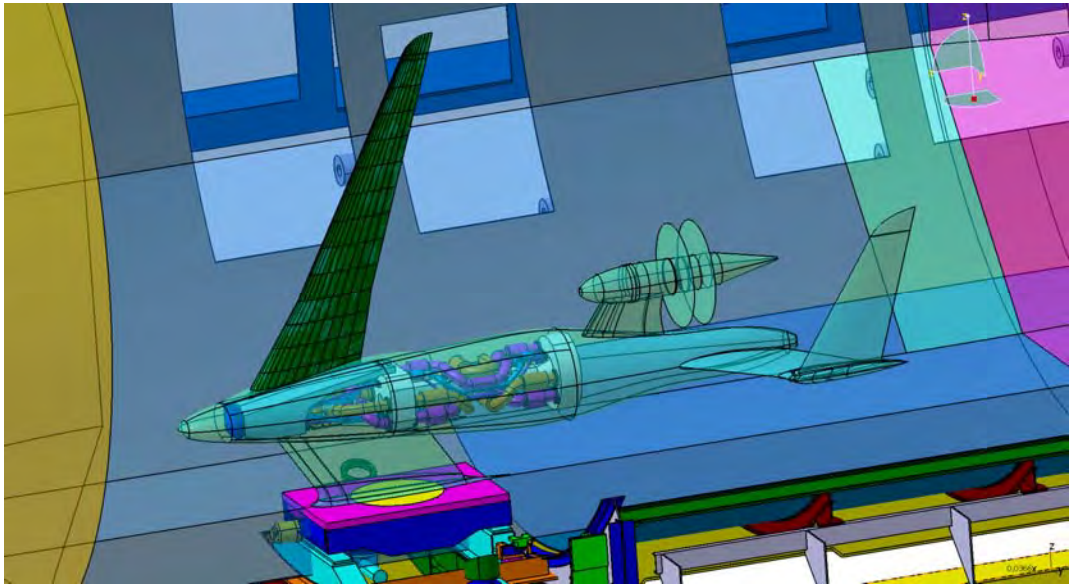
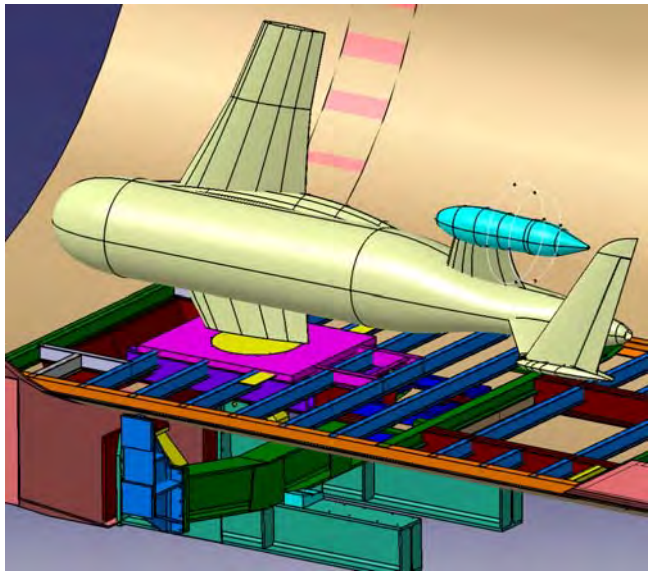


Fig 7. Wake visualization between the pylon trailing edge and the propeller leading edge at r/R = 50 %.

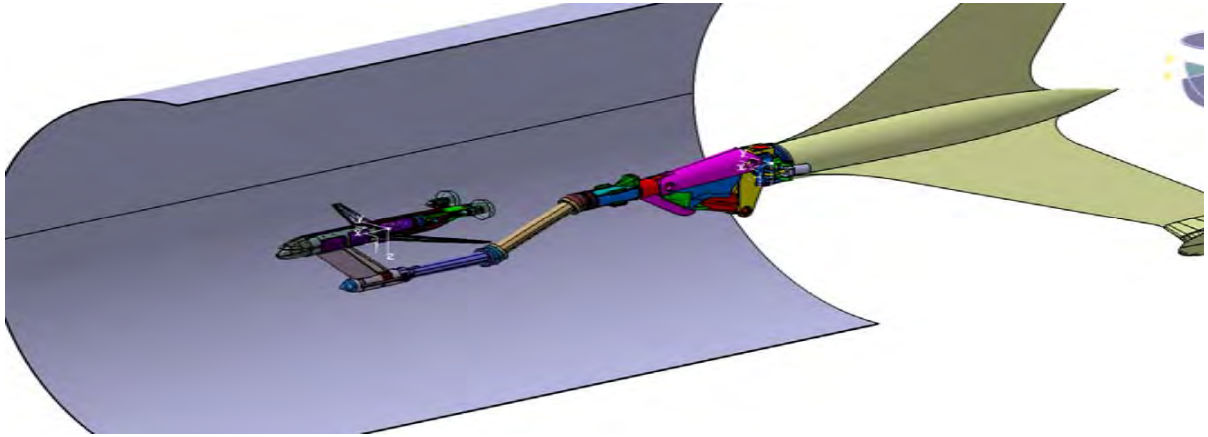
Onera WTs to support development of CROR concept



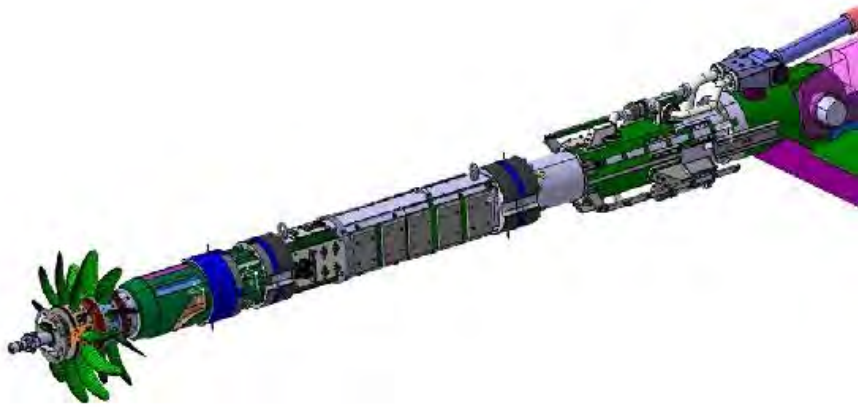


Test rigs are being developped for experiments in S1MA : objectives are

performances and acoustics

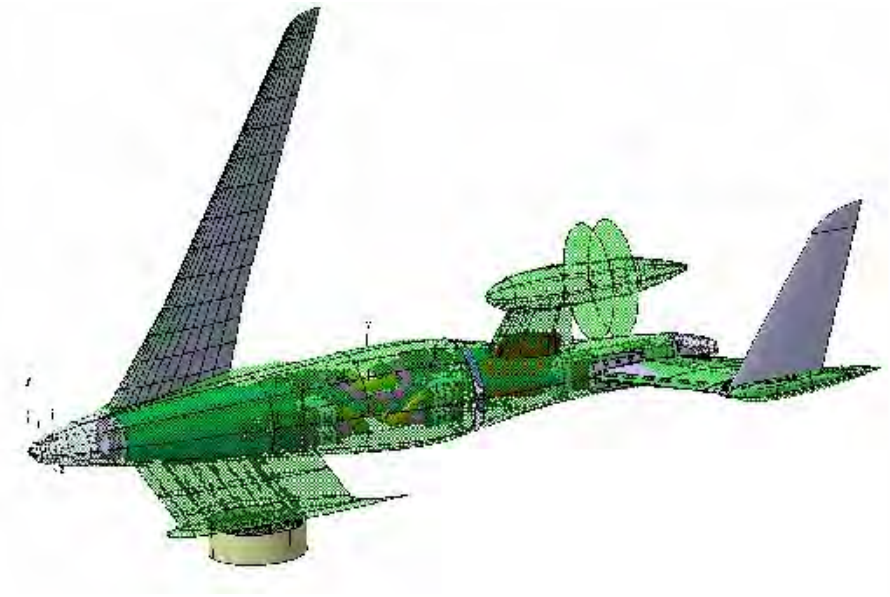


CROR : Z49



Z49, scale 1/5

- **Design : Onera**
- **Configuration Z49 alone**
- **Configuration Z49 with installation**
- **Specific technics (made in Onera) for blade deformations**



CROR & experimentations

Onera as a key player :

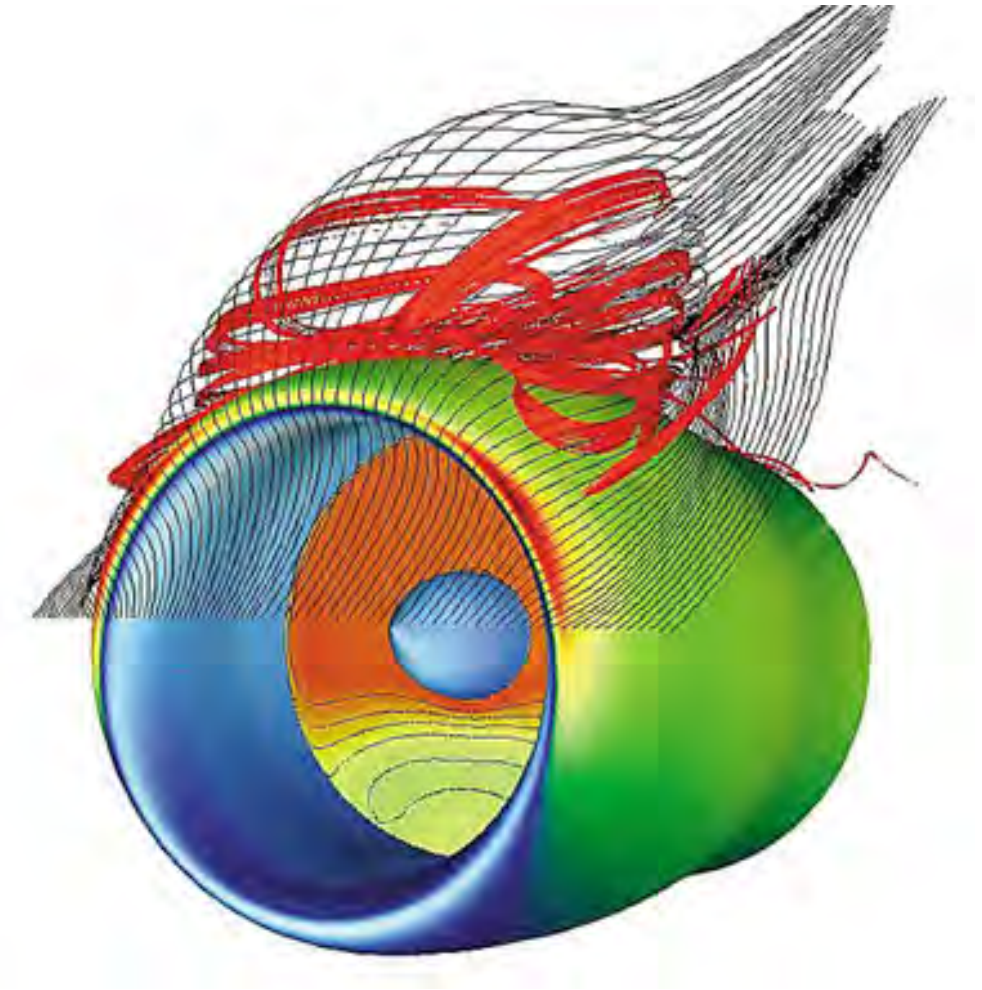
- **HERA in S1MA**
- **Z10 scale 1/10**

Open-Rotor testing in the Onera S1MA large transonic wind tunnel

challenges

engine to wing and fuselage integration

- **drag reduction**
- **BD2 testbed for tuyeres,**
- **S4B tesbed for TPS & fuselage integration**
- **New tools for design**



Challenges

natural or hybrid laminar flow on wings :

- **drag reduction**
- **old story but new ideas**
- **large model needed**

Onera : travelling together to our future – a lot to do !

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Thank You !
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