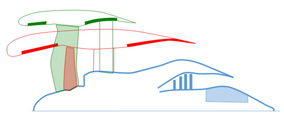
Aeroacoustics of new engine architectures in aeronautics

ARENA – Industrial chair ANR – Safran Aircraft Engines (ANR-18-CHIN-0004-01)

Future large engines (Ultra-High Bypass Ratio, UHBR) beyond 2025

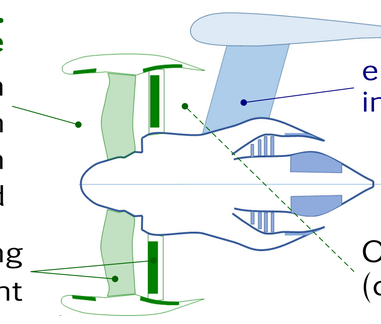


UHBR engine vs **current engine:**
shorter and thinner nacelle,
larger fan diameter
(UHBR, BPR ≤ 15)

More integrated config.
ultra compact nacelle

fan design
high distortion pattern
fan inlet interaction
reduced fan rotation speed

reduced fan/OGV spacing
fan/OGV reduced count



engine/wing/aircraft
integration & interaction

OGV & flowpath design
(downstream distortion)

New ways to install the engines

Semi-buried engine with BLI (Boundary Layer Ingestion)

(NextGen ONERA Versatile Aircraft - NOVA)

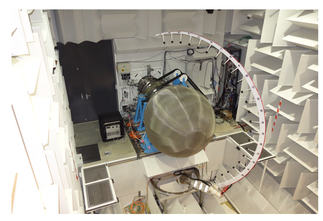
High-mean flow distortion, and strong inhomogeneous turbulence ingestion

Architecture: modified aerial excitation to the cabin, modified radiation to the ground, additional struts

Objectives of ARENA

- Understanding and modelling of **noise sources** in new engine architectures (UHBR and BLI). Investigations will primarily concern all key fan stage areas of noise generation mechanisms but other emerging sources will also be explored
- Understanding and modelling of the effect of the engine installation on engine **noise propagation** and radiation to the fuselage and to the ground in the far-field propagation
- Development of advanced **measurements** and analysis methods for investigating fan noise. A strong asset in the ARENA Chair proposal is the wealth of unique experimental facilities available at ECL

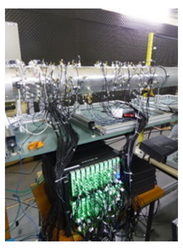
LEAP-1B engine

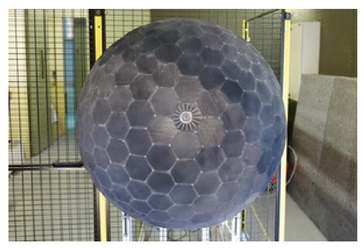


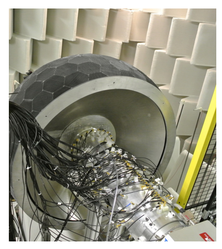
Phare2 facility (ECL), 1/3 scale of a real engine for fan noise

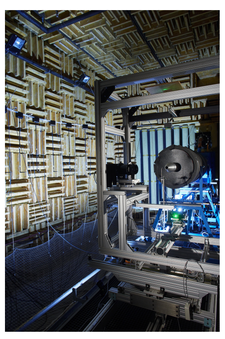
Experimental facilities

LP3 bench – modular installation (rotor/stator, inflow conditions) to develop research work in laboratory, e.g. advanced in-duct modal detection using hundred pressure sensors with the aim of finally implementing these analysis tools in the Phare-2 facility





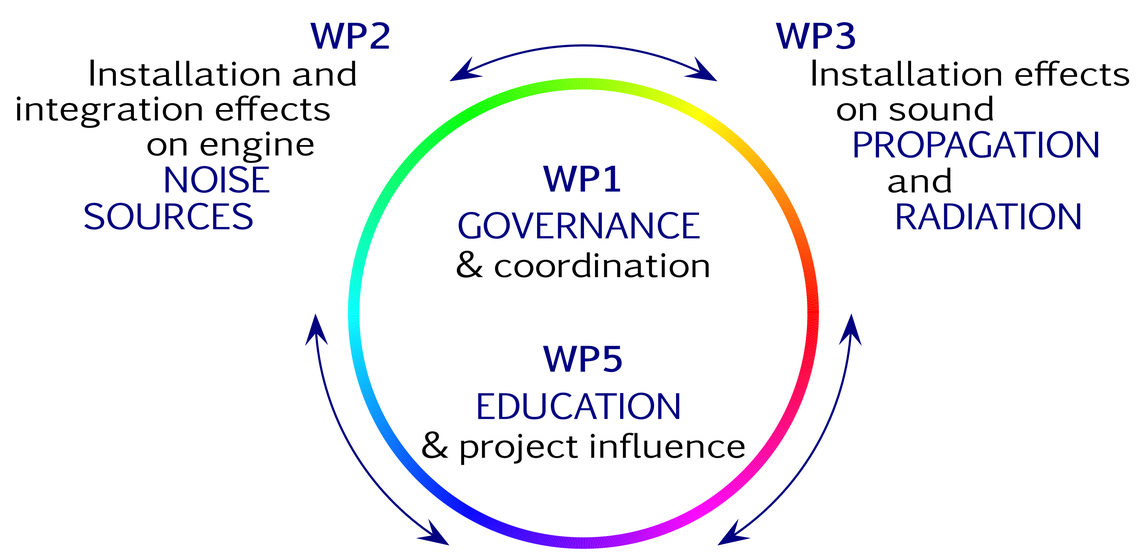




Subsonic and supersonic anechoic wind tunnel of the Center for Acoustics (LMFA, ECL)

Subsonic stream: $M = 0.5$ in a 30 cm×40 cm cross-section for investigating airfoil noise, and $M = 0.8$ in a secondary nozzle diameter $D = 20$ cm, for the simulation of flight effect on jet noise • Supersonic stream: fully expanded Mach number M_j ranges up to 1.59 (NPR of about 4.17)

Project organization



WP4 Advanced MEASUREMENT and signal processing methods for INDUCT AEROACOUSTICS

Contacts

Christophe Bailly (Pr, ECL), christophe.bailly@ec-lyon.fr
http://acoustique.ec-lyon.fr

Hélène de Laborderie (Safran Aircraft Engines)
helene.de-laborderie@safrangroup.com