



Aircraft noise research in DLR - An overview with special focus on noise modeling in airport vicinity

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Content

- German Aerospace Center (DLR)
 - Research Areas
 - Locations and employees
 - Aeronautics Portfolio
- Aircraft noise research in DLR
 - Reduction and Prevention
 - Modeling and Impact
- Expertise for airports, airlines, authorities
 - Participation in expert groups and committees
- Aircraft noise propagation modeling in airport vicinity
 - Development of calculation models for aircraft noise around airports
 - Advanced sound propagation modeling for ground and near ground operations



German Aerospace Center (DLR) Research Areas

- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Space Administration
- Project Management Agency

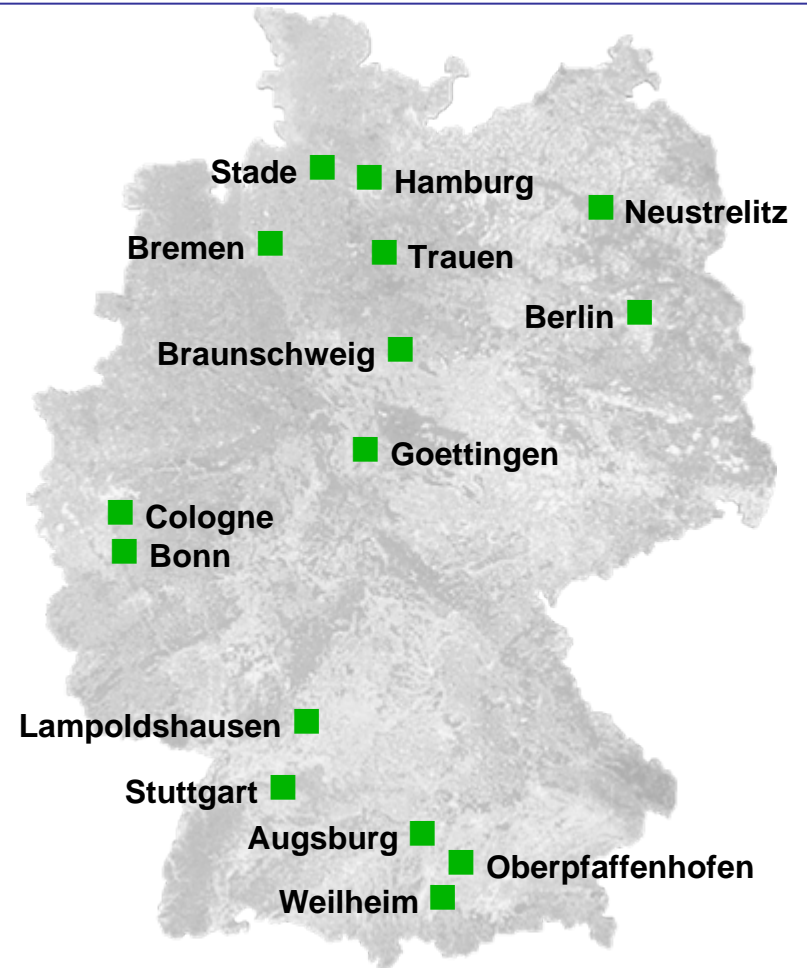


Locations and employees

6900 employees across
33 institutes and facilities at

■ 15 sites.

Offices in Brussels,
Paris and Washington.



Aeronautics Portfolio

Air Transport Systems

System evaluation and optimisation

Aircraft

Concept design/evaluation [Virtual Aircraft (Digital-X)]

Airframe

Materials and structures

Flight physics

Flight mechanics

Systems

Flight systems

Cabins

Human-machine interface

Propulsion

Materials and construction techniques

Turbo machinery

Combustion and emissions

ATM and airport research

Arrivals and departure management

Flight guidance automation

Human factors and safety

Communication and navigation

Weather forecasting and monitoring

Intermodal transport

Strategic Research Agenda

Including:
efficiency
environment
security

Tools and processes

Numerical simulation, experimental simulation, airborne simulation

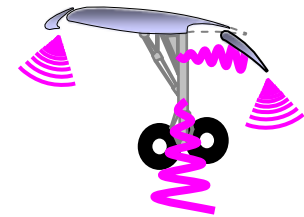
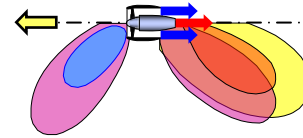


Aircraft noise research in DLR

➤ Reduction at the source

➤ engine noise

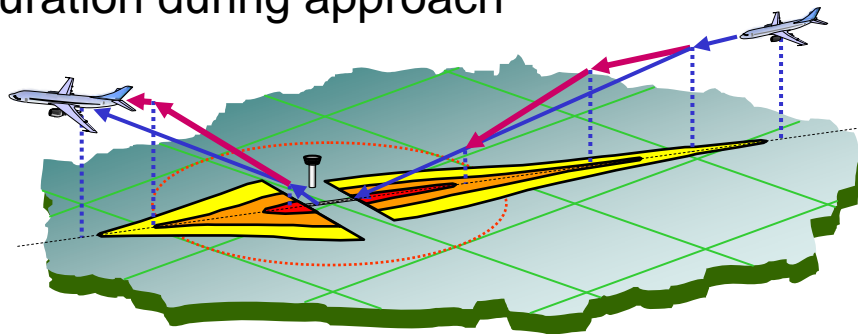
➤ aerodynamic noise (airframe, flaps, gear)



➤ Prevention / minimization

➤ new procedures in the extended terminal maneuvering area (E-TMA)

➤ new aircraft configuration during approach

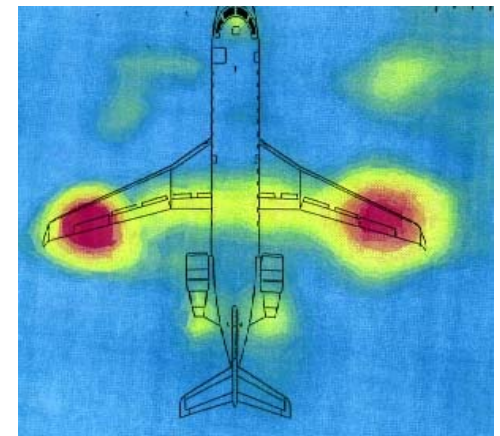


Aircraft noise research in DLR

- Impact on humans
 - sleep, health, welfare and performance



- Propagation modeling in airport vicinity
 - partial sound source model (SIMUL)
 - advanced sound propagation modeling



DLR aircraft noise activities in expert groups

Member of expert groups on aircraft noise, e.g.

- DIN Committee „Aircraft Noise“ (development of new noise standard DIN 45689 „Calculation of Aircraft Noise around Airports“)
- ECAC/ANCAT working group AIRMOD (development of ECAC Doc.29)
- CNOSSOS-EU (development of harmonized European calculation methods for environmental noise)
- CEAS, member of Aeronautics Group

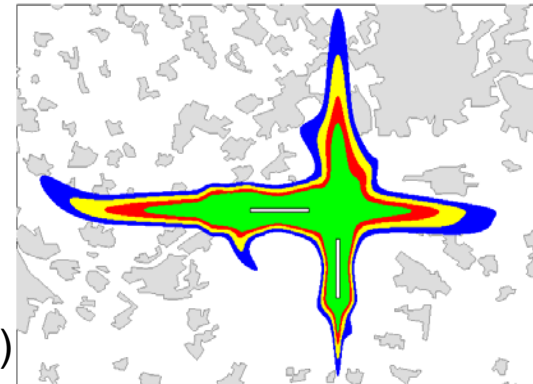
Development of calculation models for aircraft noise around airports - Models in use

Conventional noise models

- **INM** (FAA`s Integrated Noise Model, experiences since 1983)
- **AzB** (official German model, own development & commercial version)
- **AzB+** (DIN 45689 prototype currently under development)
 - moving point source
 - source description by spectral directivity functions
 - performance model compatible to Doc.29 / INM

SIMUL (scientific noise model, limited data base)

- moving point source
- partial sound source description (jet, fan, airframe noise)
- propagation model based on wind and meteorological stability
- interface to flight simulator / flight data recorder

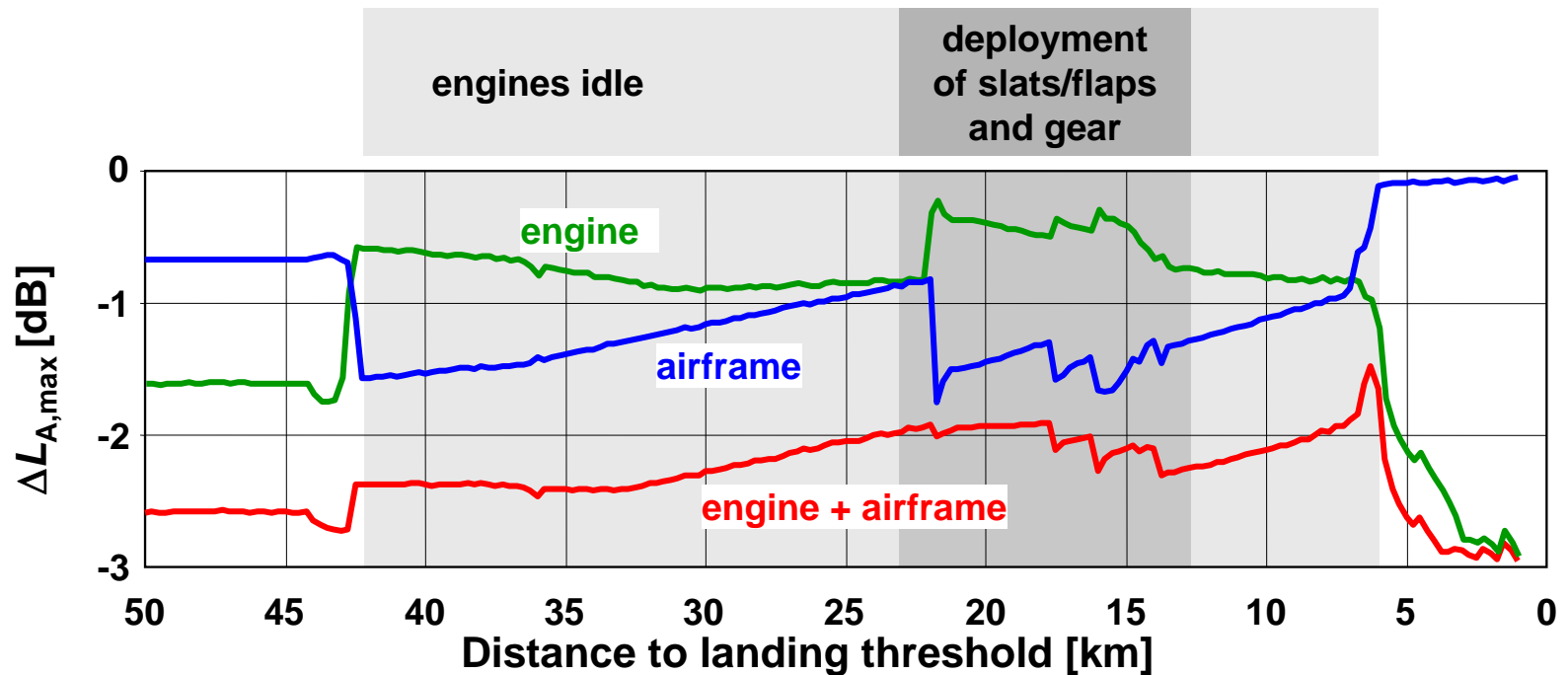


Used for special investigations and improvement of conventional models

Advantage of a partial sound source model

Retrofit effect modeling with SIMUL

Approach A319, maximum sound level decrease $\Delta L_{A,max}$ under flight path)



Assumed effects of retrofit:

jet :	- 2 dB	gear :	- 2.5 dB
fan:	- 3 dB	slats/flaps :	up to - 2 dB

Advanced sound propagation modeling at DLR

- Finite-Difference Time-Domain (FDTD) model
- Ray-based sound particle model

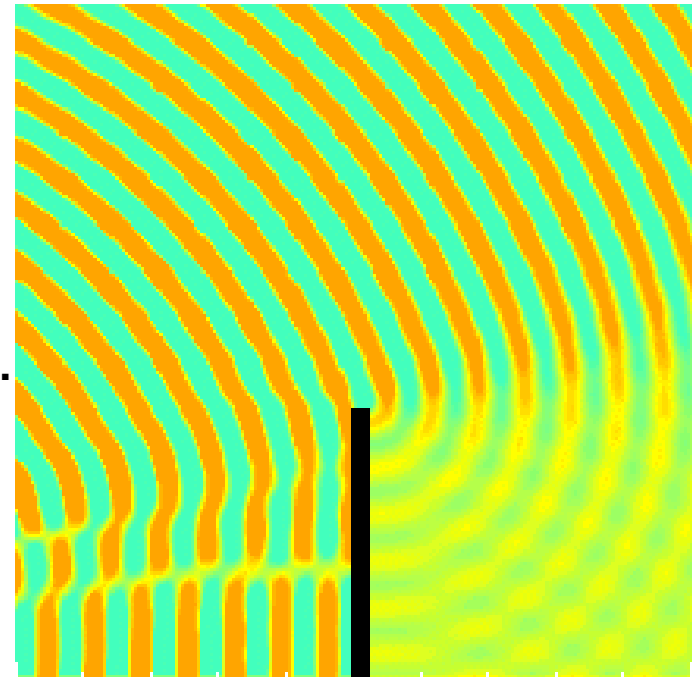
Consideration of ...

- meteorological effects
- terrain effects
- ground effects
- buildings and barriers
- vegetation

... in 2- and 3-dimensional applications aiming at ...

- optimization of noise protection measures
- identification of critical meteorological situations
- avoiding of exceedences

for ground and near ground aircraft operations



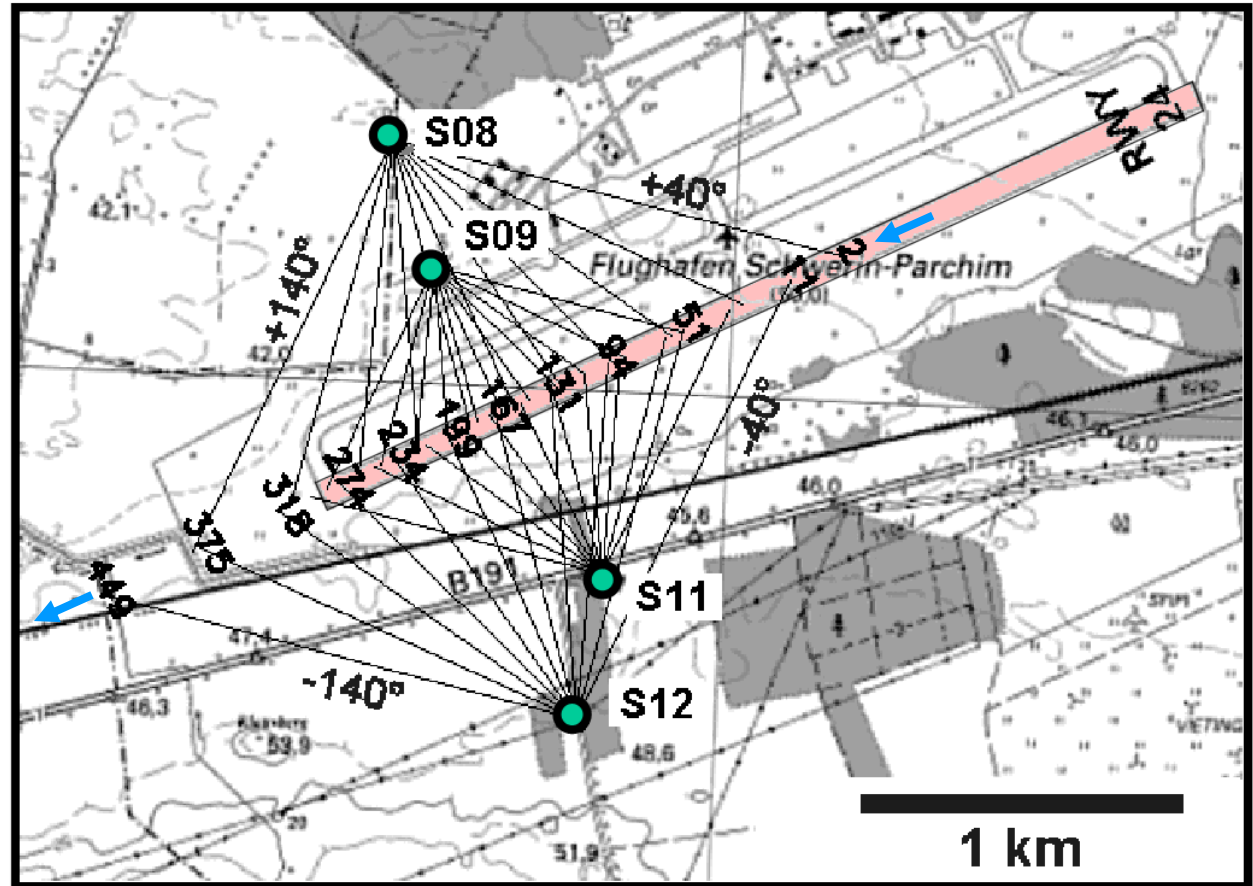
LAnAb measurement campaign on 03 Oct 2006

baltic airport
SCHWERIN-PARCHIM



← Airbus A318
take-off on RWY 24
(altitude in m GND)

● noise measurement
stations



LAS during take-off phase



simulations without meteo and ground effects

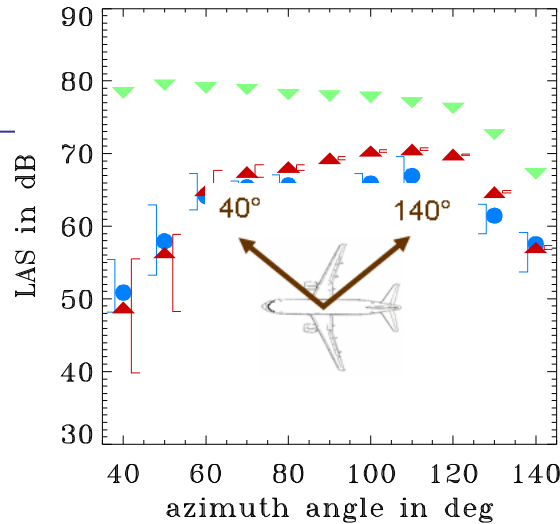


simulations with meteo and ground effects

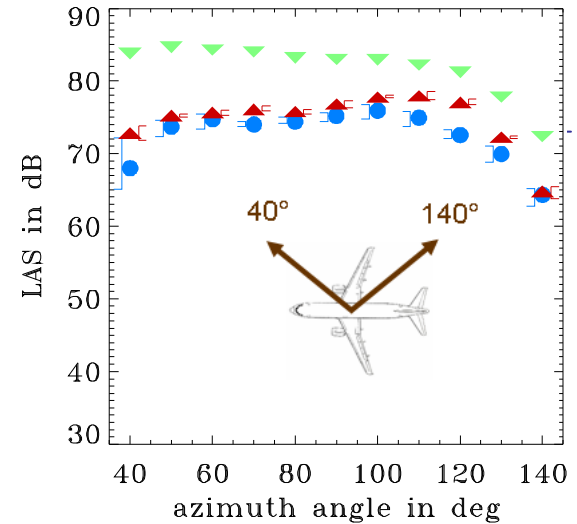


Measurements
1.5 m over ground

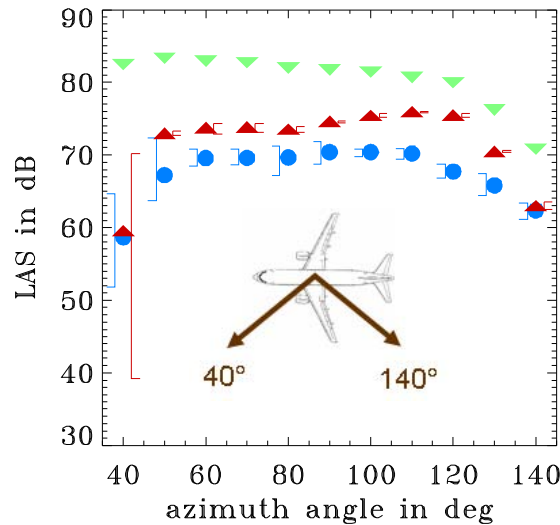
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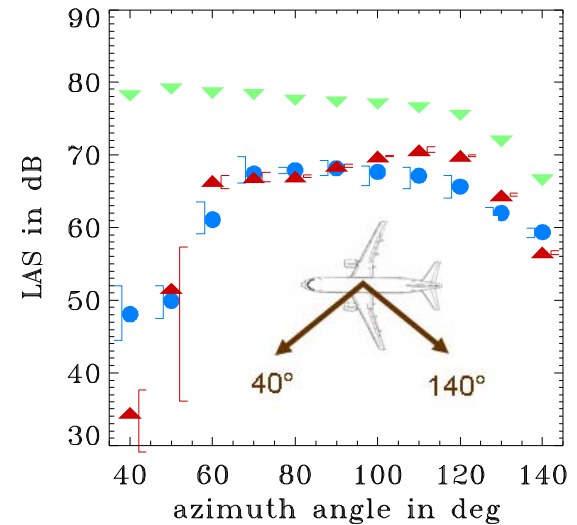
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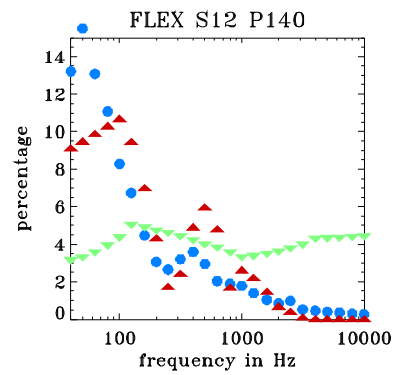
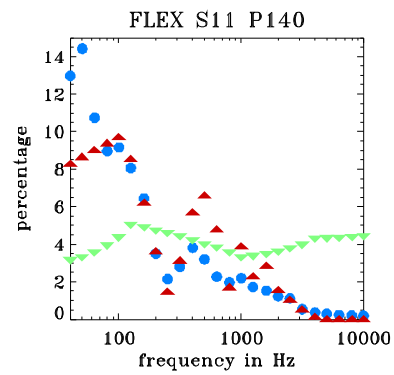
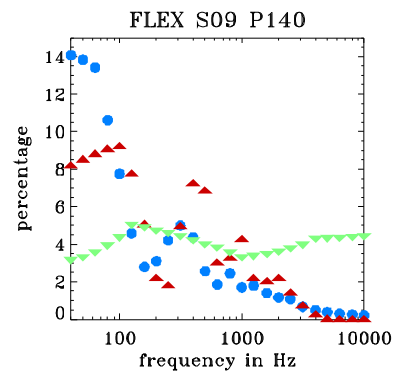
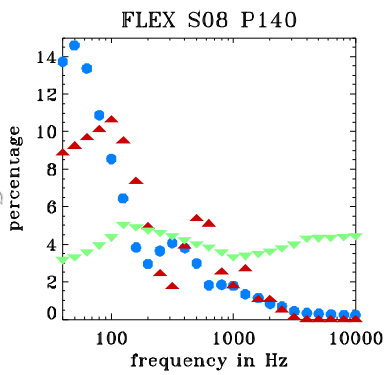
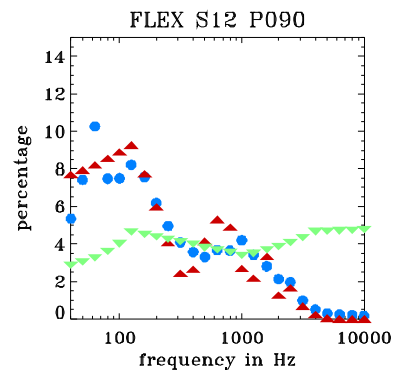
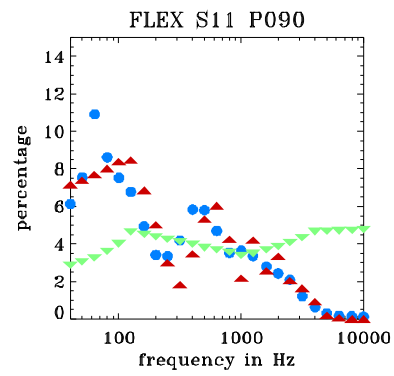
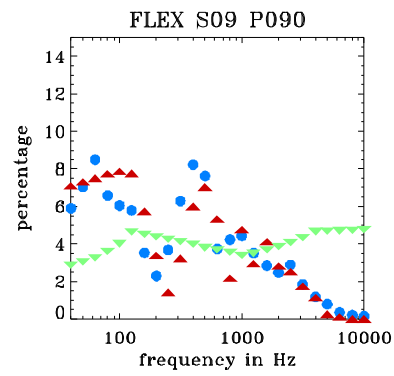
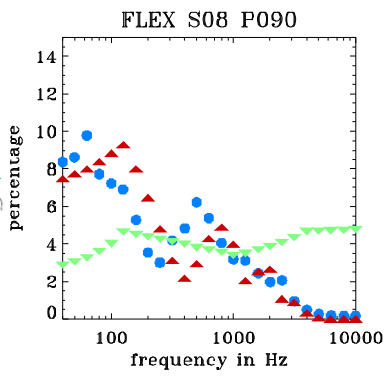
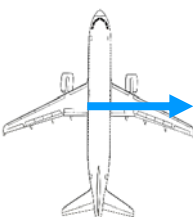
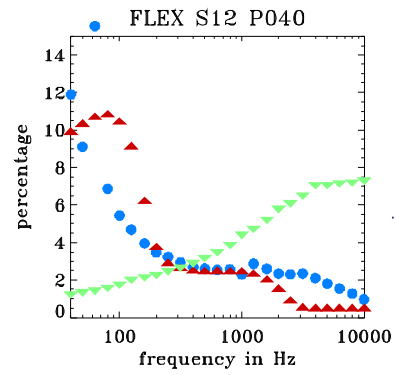
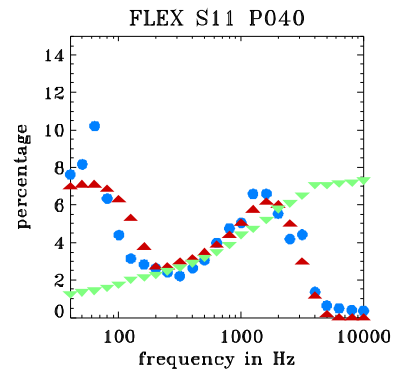
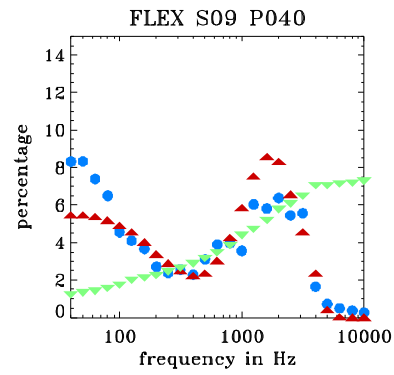
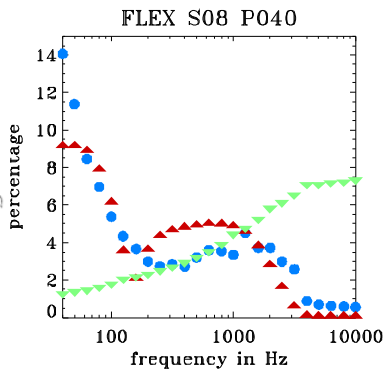
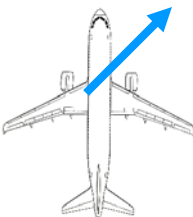


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FLEX S12







emission spectrum
 
simulated spectrum
 
measured spectrum

DLR contact

Website <http://www.dlr.de/en/desktopdefault.aspx>

DLR institutes involved in interdisciplinary aircraft noise research:

- DLR Institute of Propulsion Technology, Cologne
- DLR Institute of Aerodynamics and Flow Technology, Braunschweig and Goettingen
- DLR Institute of Atmospheric Physics, Oberpfaffenhofen
- DLR Institute of Flight Guidance, Braunschweig
- DLR Institute of Flight Systems, Braunschweig
- DLR Institute of Aerospace Medicine, Cologne and Hamburg

Additional contact for aircraft noise modeling in airport vicinity:

Advanced Sound Propagation Modeling

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Partial Sound Source Model (SIMUL)

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Summary

Aircraft noise research in DLR includes

- Reduction at the source (engine, airframe)
- Avoid by new arrival and departure procedures
- Minimize by new aircraft configuration during approach
- Development of calculation models for aircraft noise around airports and for ground and near ground operations
- Impact on humans (sleep, health, welfare, performance)
- Participation in national and international expert groups and committees
- Provide independent expertise for airports, airlines, authorities



**Thank you
for your attention**



**Deutsches Zentrum
für Luft- und Raumfahrt e.V.**
in der Helmholtz-Gemeinschaft

Aviation Noise Impacts Roadmap Annual Meeting, April 19-20, 2011, Washington, DC