# Marie Curie Fellowships: *FLOWAIRS*
# Silent air flows in transport, buildings and power generation

**Laboratoire d'Acoustique de l'Université du Maine, Le Mans, France**

## LAUM open position: Early Stage Researcher (PhD)

We are seeking individuals to join our acoustic research activities. Several research positions are available to young and experienced researchers in the framework of the FP7 European Marie Curie Initial Training Network (ITN) project “FLOWAIRS” (Silent air flows in transport, buildings and power generation), focused on the generation, propagation and reduction of sound in flow ducts for various industrial applications. The research topics address computational aeroacoustics (with a focus on hybrid approaches), acoustic multiport modelling, rotating machines, flow-induced pulsations in pipe discontinuities, boundary layer noise, and noise reduction through innovative silencers. The targeted fields of application encompass ground and air transportation, building ventilation and energy processes (fluid distribution systems).

The candidate will perform most of her/his research activities in the “Laboratoire d'Acoustique de l'Université du Maine”, LAUM, Le Mans (France), and will be called to perform short-term and/or long-term secondments across the FLOWAIRS network to fulfil her/his training and research activities. LAUM is proposing research activities on the **use of metamaterials in duct acoustics**. These activities will be both theoretical and experimental and focused on the practical interest of using such materials in term of additional attenuation in silencers.

The multidisciplinary topics addressed in FLOWAIRS are of high technological and economical relevance, promising interesting career prospects in Research and Development. The candidates are encouraged to carry on their research for the fulfilment of a PhD degree, the present network offering the possibility to obtain a European PhD doctorate. Besides, the practical experience earned at LAUM in a research environment will be extremely valuable for the young researcher in the course of her/his career.

The candidates should hold an Engineering Degree (M.Sc. in Mechanical, Electrical, Physics Engineering, or equivalent), ideally with an experience in acoustics, numerical modelling or experimental methods.

**Conditions:**

The open positions have contract durations of 36 months. The salary is in accordance with the EC FP7 regulations for Marie Curie ITN projects. The FLOWAIRS project is a European Commission FP7 Initial Training Network programme (see http://ec.europa.eu/research/mariecurieactions/index.htm for more details including eligibility criteria). The recruitment procedure does strictly comply with the ethical standards described in the Code of Conduct for Recruitment of Researchers (http://ec.europa.eu/euraxess/index.cfm/rights/codeOfConduct).

**Contact:**

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# PhD Research Project at LAUM in ITN FlowAirS:
# Use of metamaterials in duct acoustics

Air flows are used to transfer heat and mechanical work in a large number of technical processes and systems distributed including household appliances, ventilation systems in vehicles and buildings, cooling systems in laptops and engines, IC-engine, power plants, gas transportation, gas turbine intake/exhaust systems, etc. Frequently there is an associated generation of unsteady flow and pressure which inevitably leads to sound generation and possible noise problems. Sound produced by various air flow systems are responsible for an important part of community noise problems (transportation and energy production) and noise in our homes and at work.

In most flow duct systems, silencers or lined ducts are used to reduce the sound during propagation. Those silencers can use porous materials or other types of dissipative and/or reactive materials. A satisfactory understanding of the acoustic behaviour of homogeneous porous materials has been achieved by models developed at LAUM since 25 years [Lafarge 1997]. These models restrict in severe manner the possible absorption characteristics of materials. In recent years however, the possibility of new acoustic behaviours using heterogeneous materials (for instance with two different micro-scales) was illustrated both theoretically and experimentally and numerically [Groby 2011]. Some recent works gave a pertinent clue to understand and study some of these new acoustic behaviours that appear for complex porous structures [Lafarge 2008]. A new macroscopic acoustics is emerging, which suggests it is possible to conceive new heterogeneous materials having a new kind of macroscopic acoustic properties, thanks to the phenomenon of spatial dispersion. A typical example is a porous material having “cavities” [Nennig 2011]..

Nevertheless, the benefits of those innovative materials on the sound propagation can be masked and even destroyed by the presence of a flow field [Elnady 2009]. The combined effect of wall property and vortex sheet is very often described by the Ingard-Myers boundary condition. Recently, it has become clear [Brambley 2009] that this limit leads to an ill-posed problem in time domain. An improved or modified Ingard-Myers boundary condition is urgently needed. [Renou 2011].

The PhD Student will study the use of metamaterials in silencers (he/she will begin with porous material having “cavities”). He/she benefits from the mathematical background of Technische Universiteit Eindhoven (Netherlands) to model the acoustical behaviour of materials submitted to flow, and from the practical background of Ain Shams University (Egypt). He/she will focus on the practical interest of using such materials in term of additional attenuation. This work will be made in cooperation with various industrials : Airbus, Müller-BBM, Bombardier Transportation and Scania

If you wish to discuss any details of the project informally, please contact Yves Aurégan, LAUM, Email: yves.auregan@univ-lemans.fr Tel: +33 2 43 83 35 09.


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