

SmartAnswer – Boundary Control for Noise Transmission attenuation: Local and Advective Strategies.

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Smart Mitigation of flow-induced Acoustic Radiation and Transmission for reduced Aircraft, surface traNSport, Workplaces and wind enERgy noise

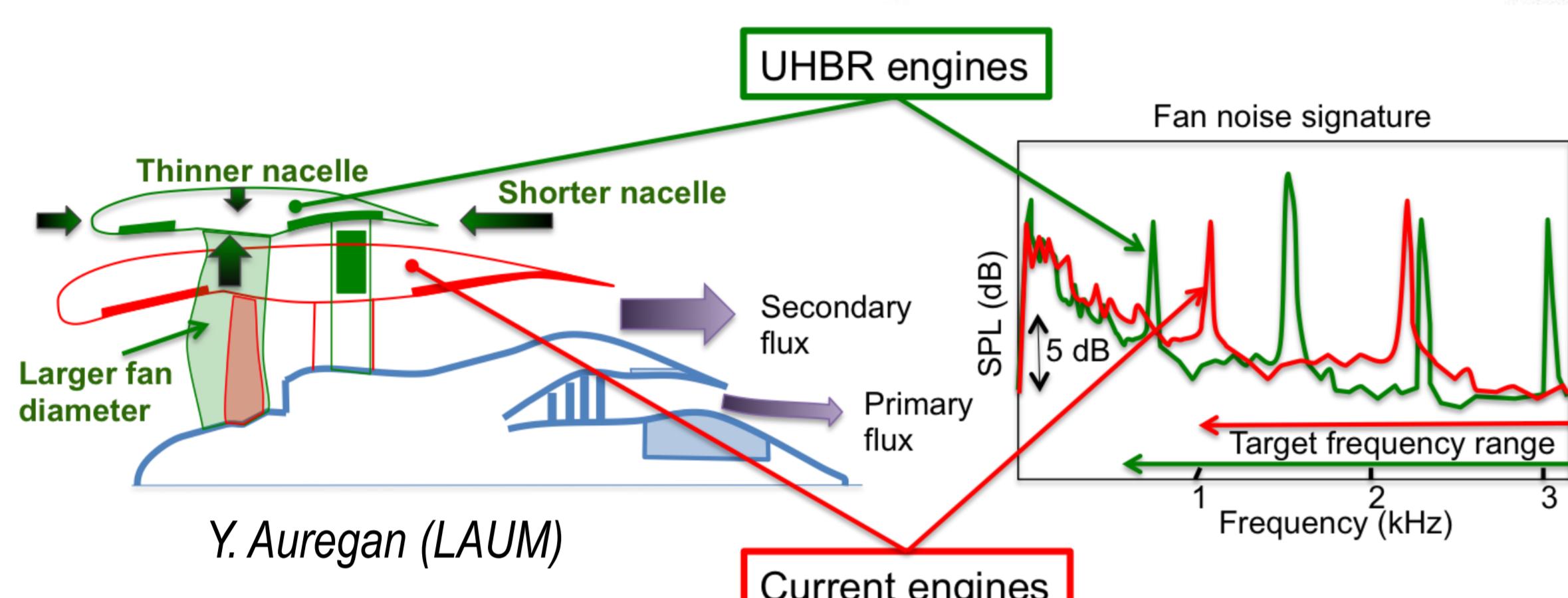
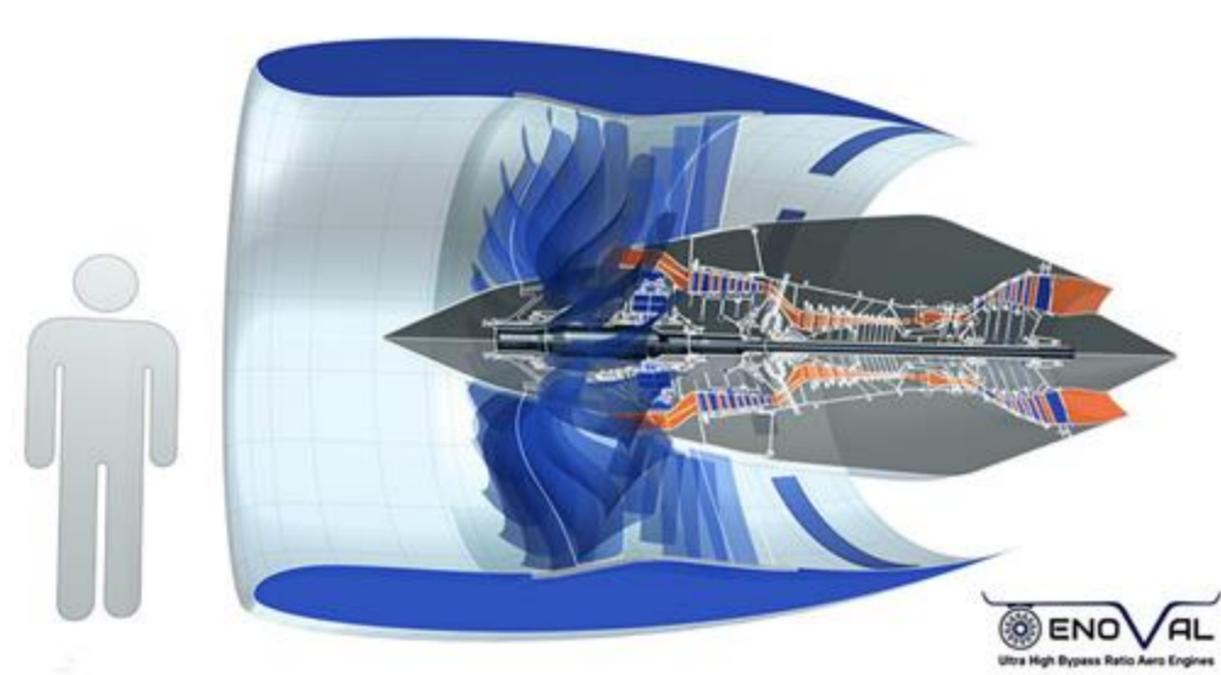


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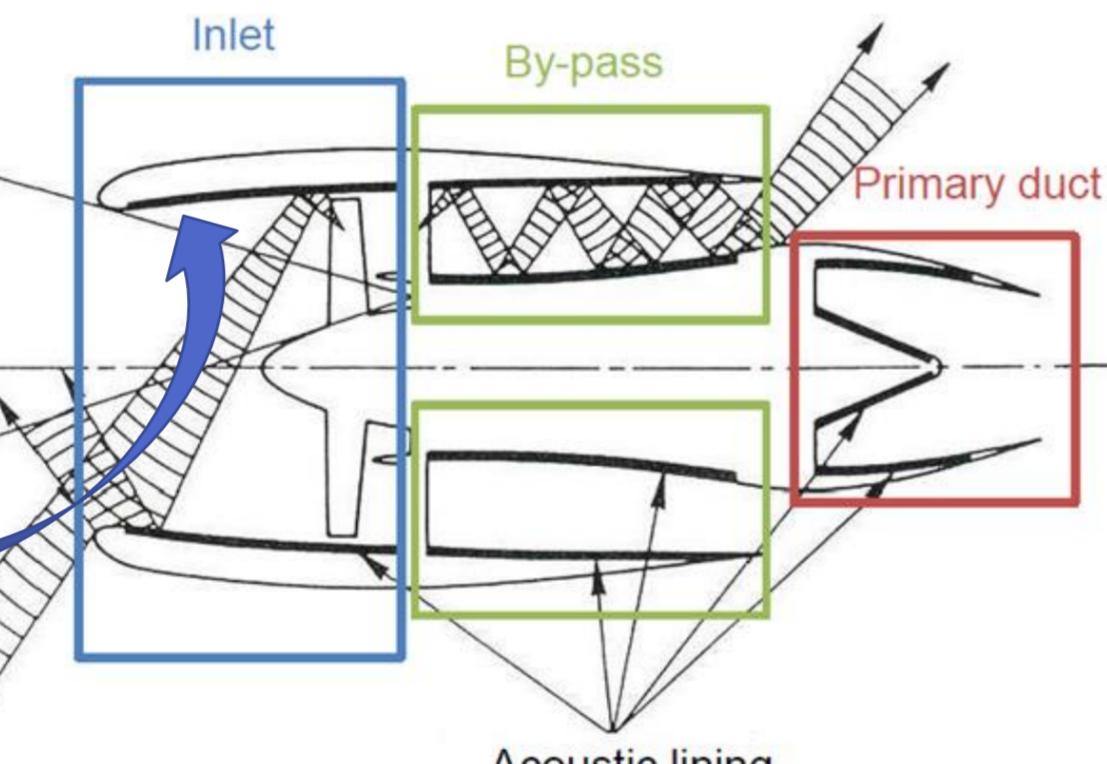
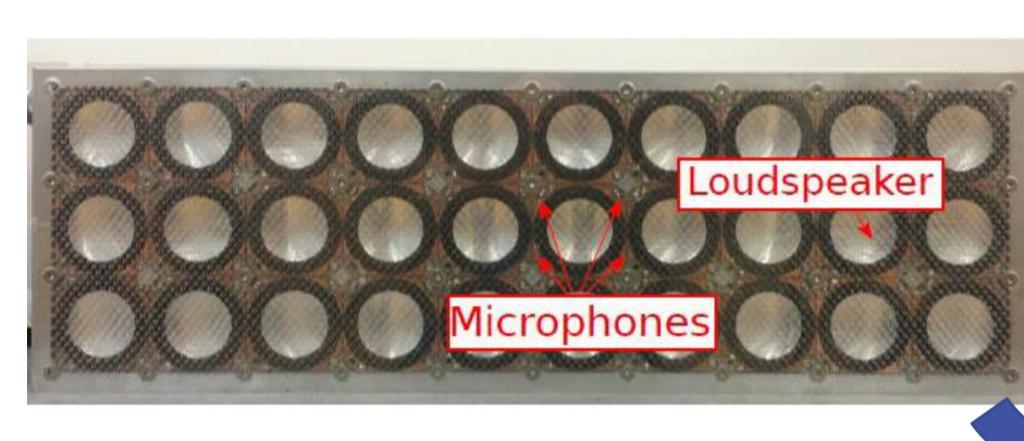
Motivation

New challenges for Liners in the new UHBR turbofans:

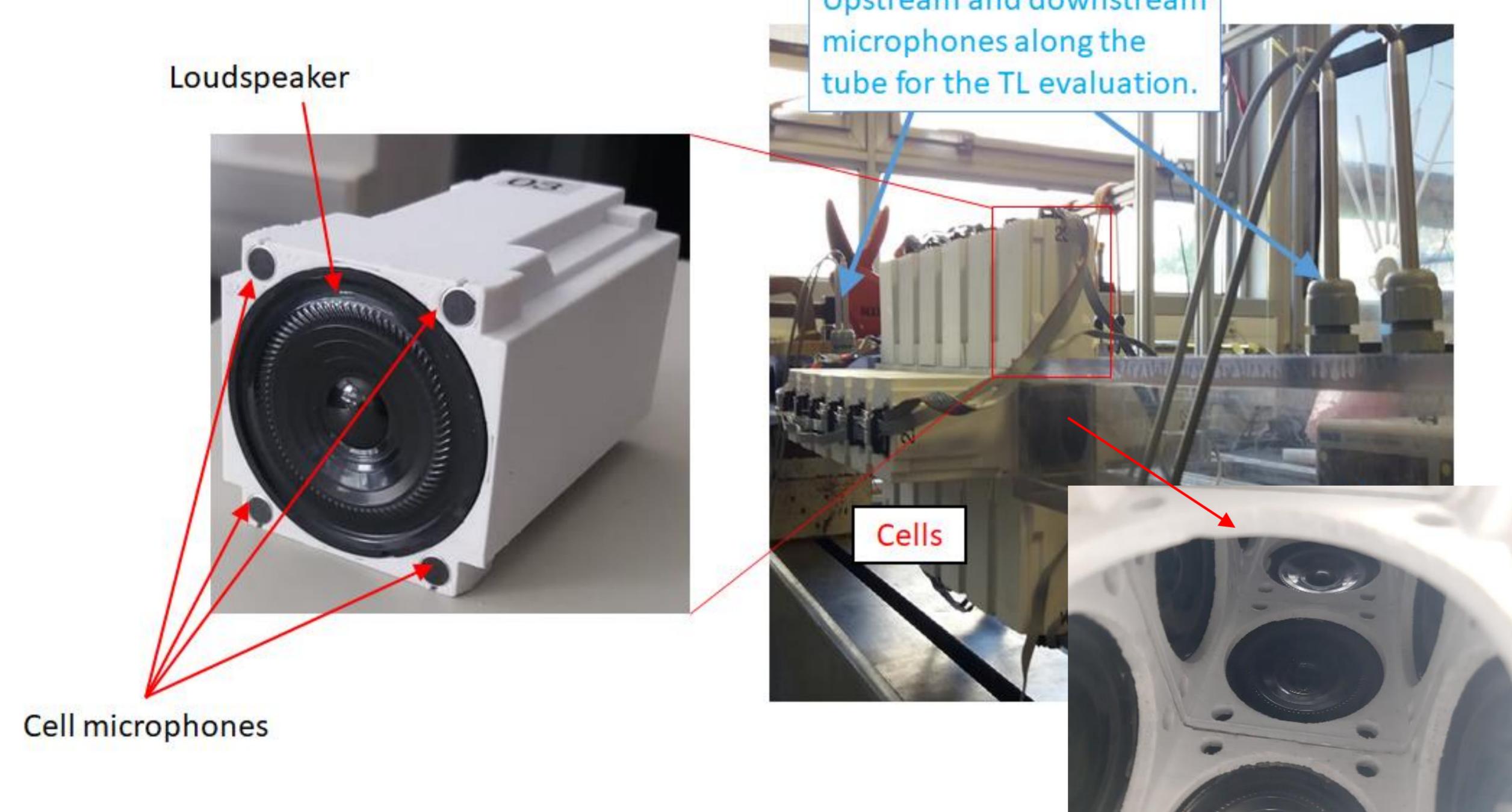
- Target Lower Frequency and Broadband noise.
- Spatial constraints.



Semi-Active Liner



Prototype



Boundary Control Laws



Local Impedance Law:

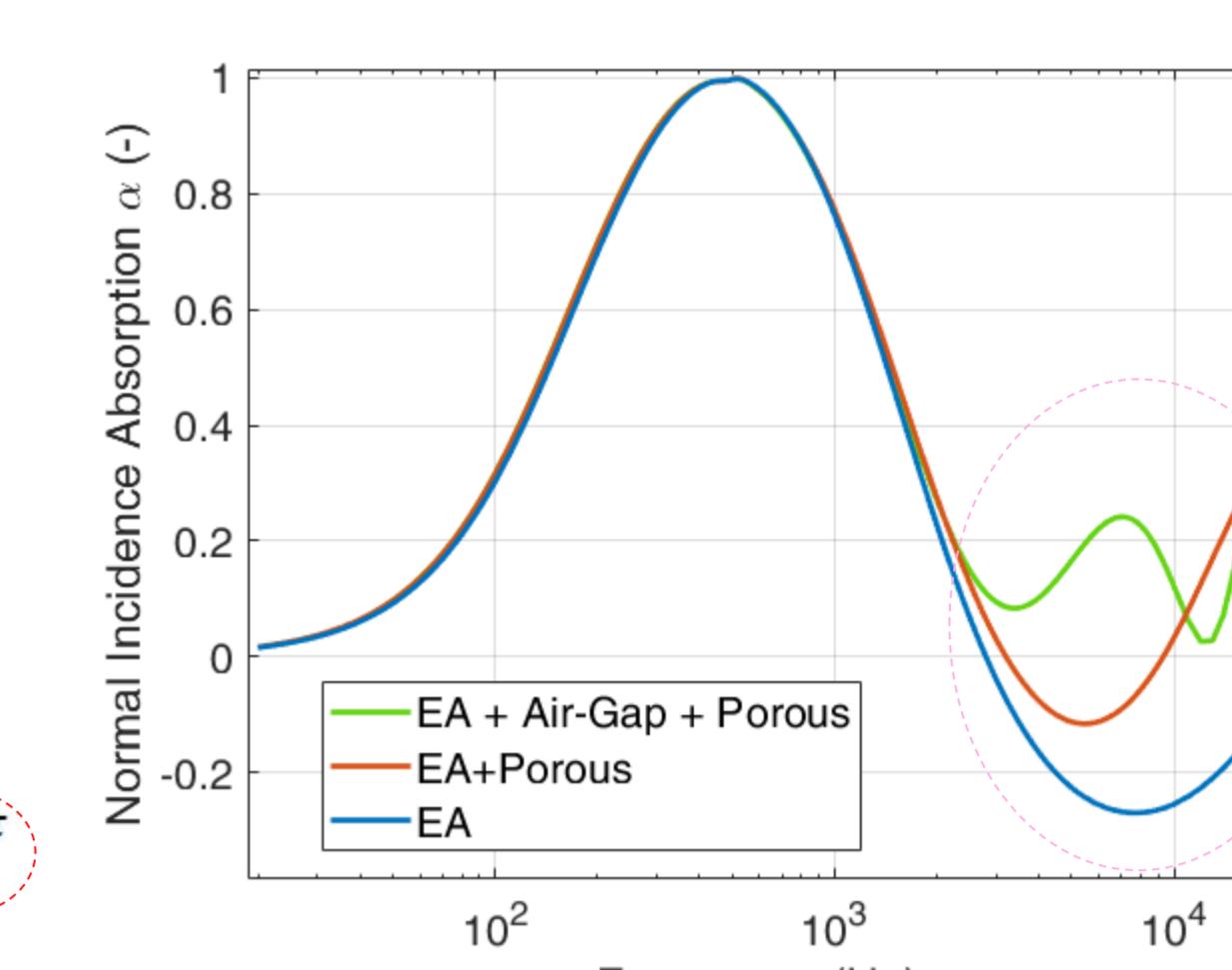
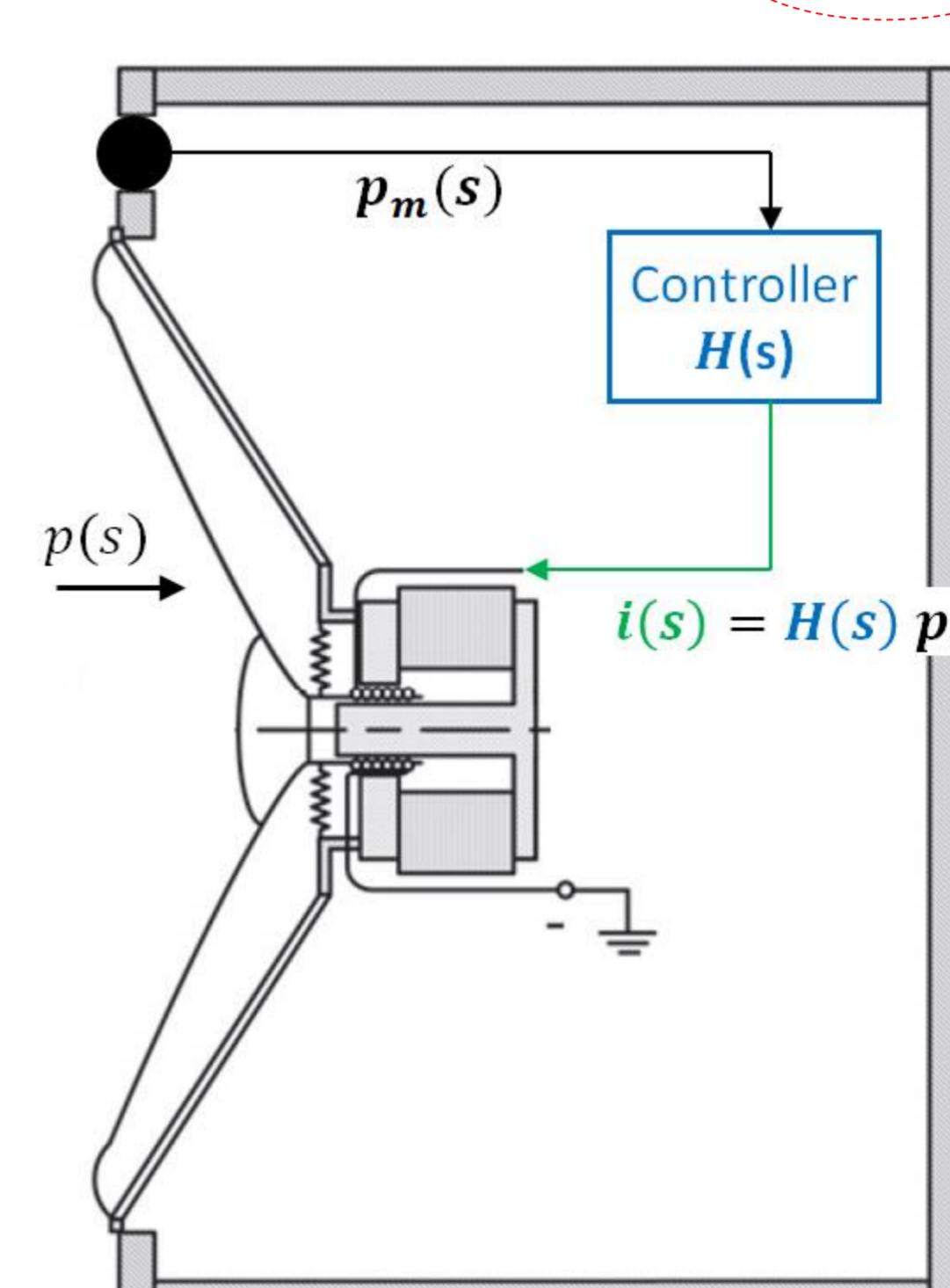
$$Z_{\text{Local}} [a_n] = \frac{\partial p}{\partial t}$$

Advective Boundary Law:

$$Z_{\text{Local}} [a_n] = \frac{\partial p}{\partial t} + c_a \frac{\partial p}{\partial x}$$

Passivity of digitally-implemented Impedance Control

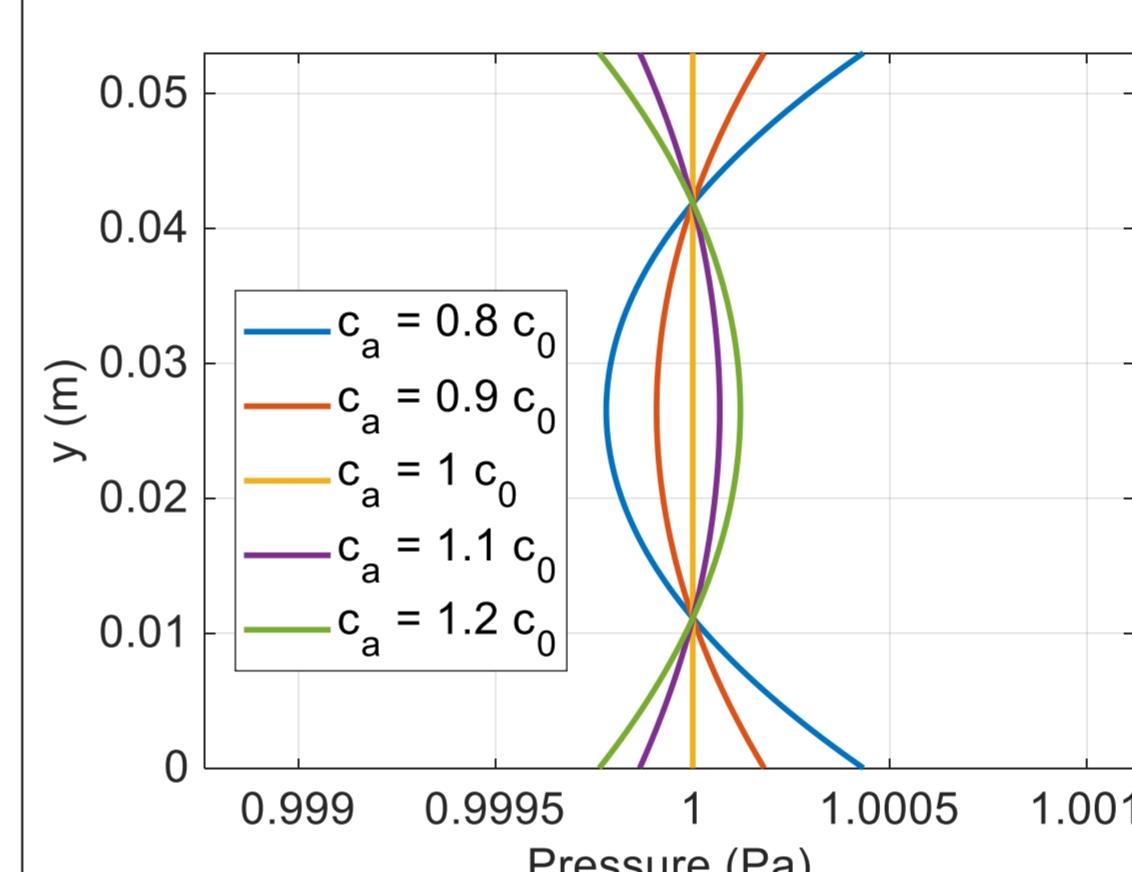
Digital implementation \Rightarrow Time Delay



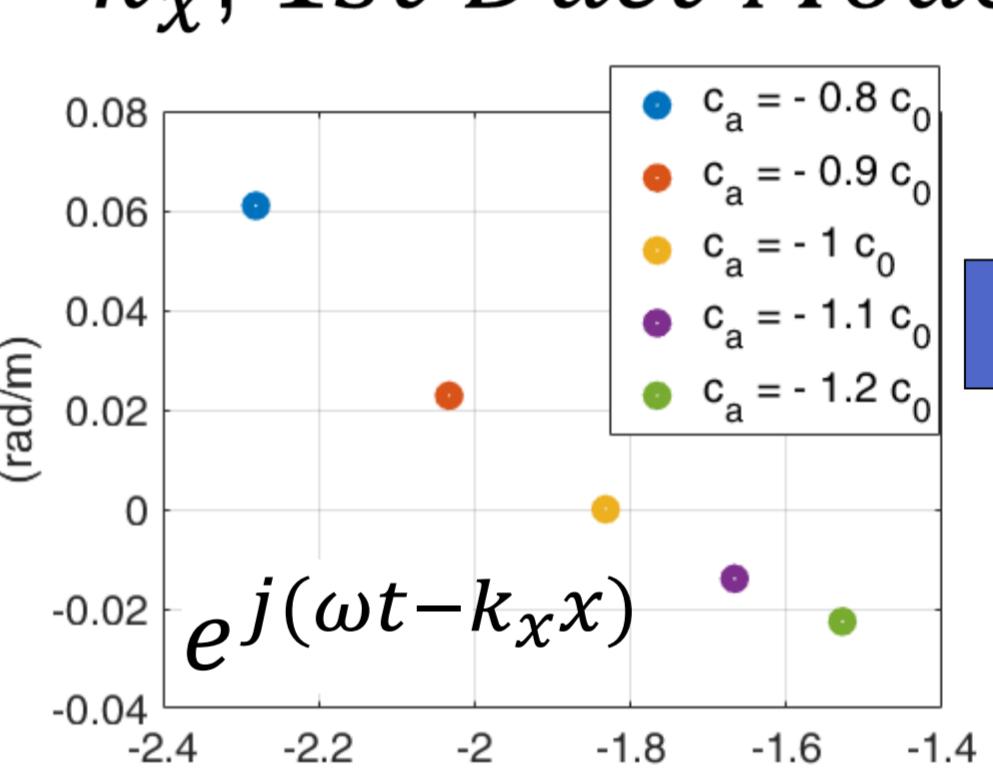
Passivity of Advective Boundary

Boundary Solution: $p_b(\bar{t}, x) = p_b(0, x - c_a \bar{t}) + \int_0^{\bar{t}} Z_{\text{Local}} [a_n(t, x - c_a (\bar{t} - t))] dt$

1st Duct Mode

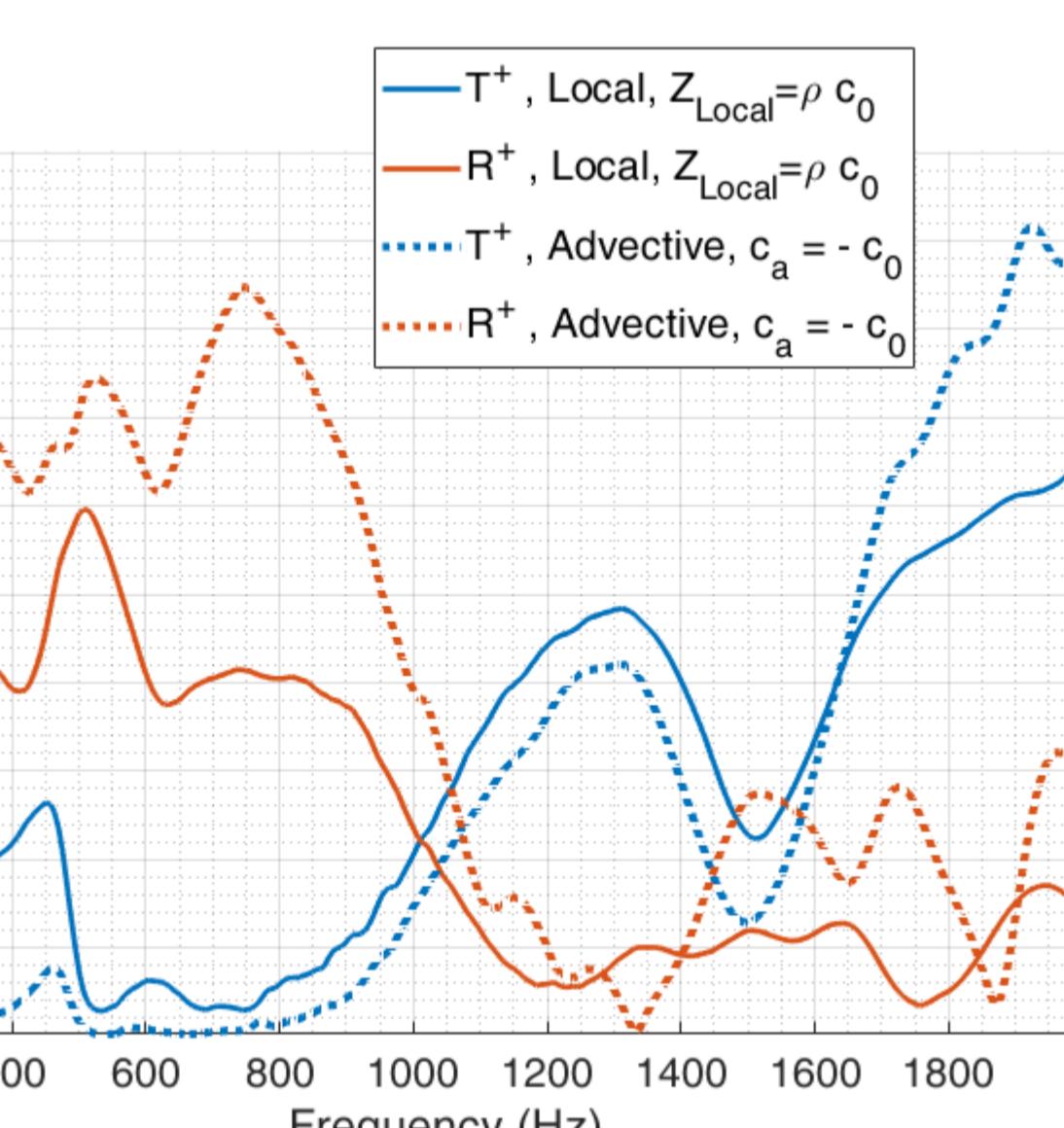
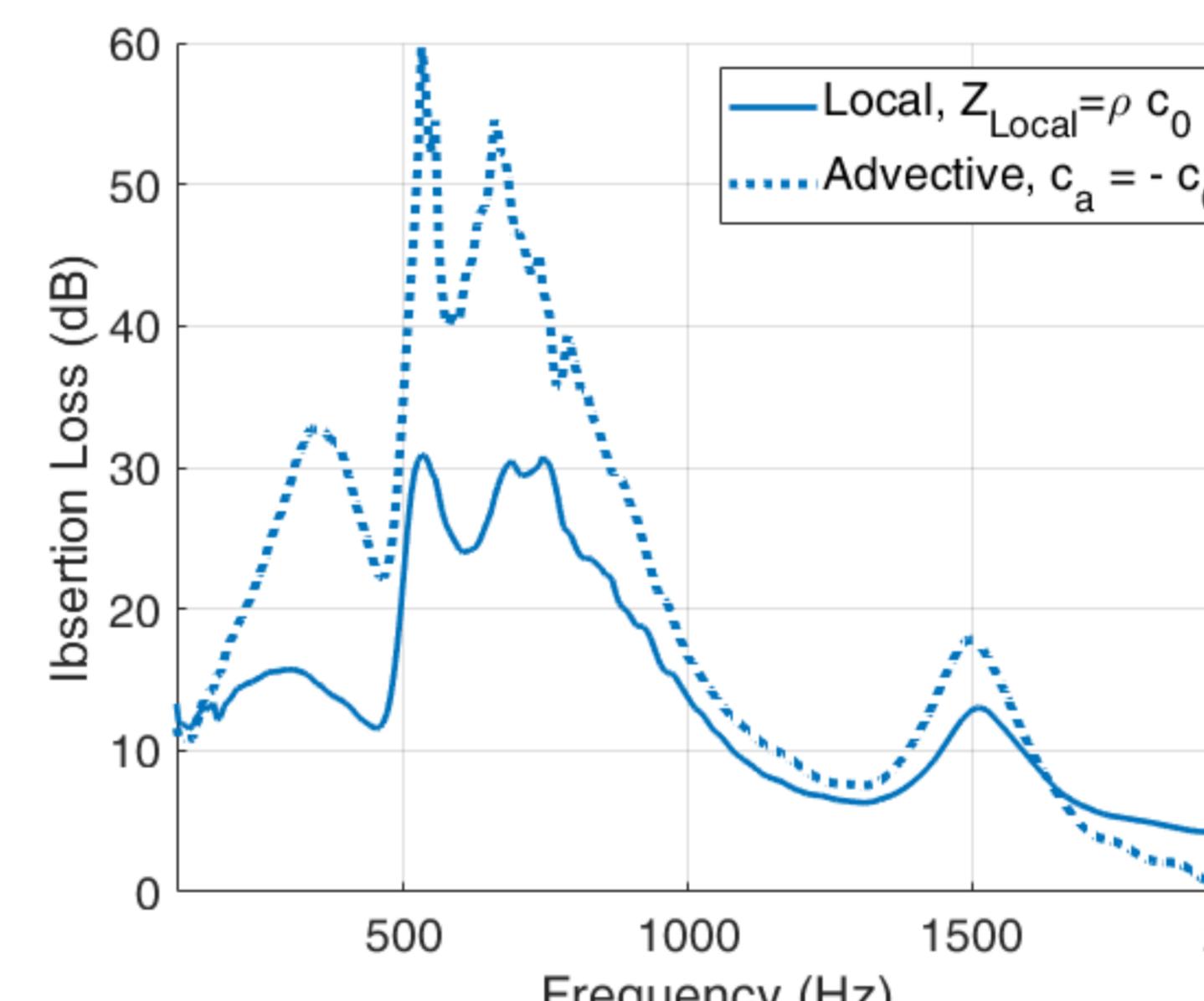


k_x , 1st Duct Mode

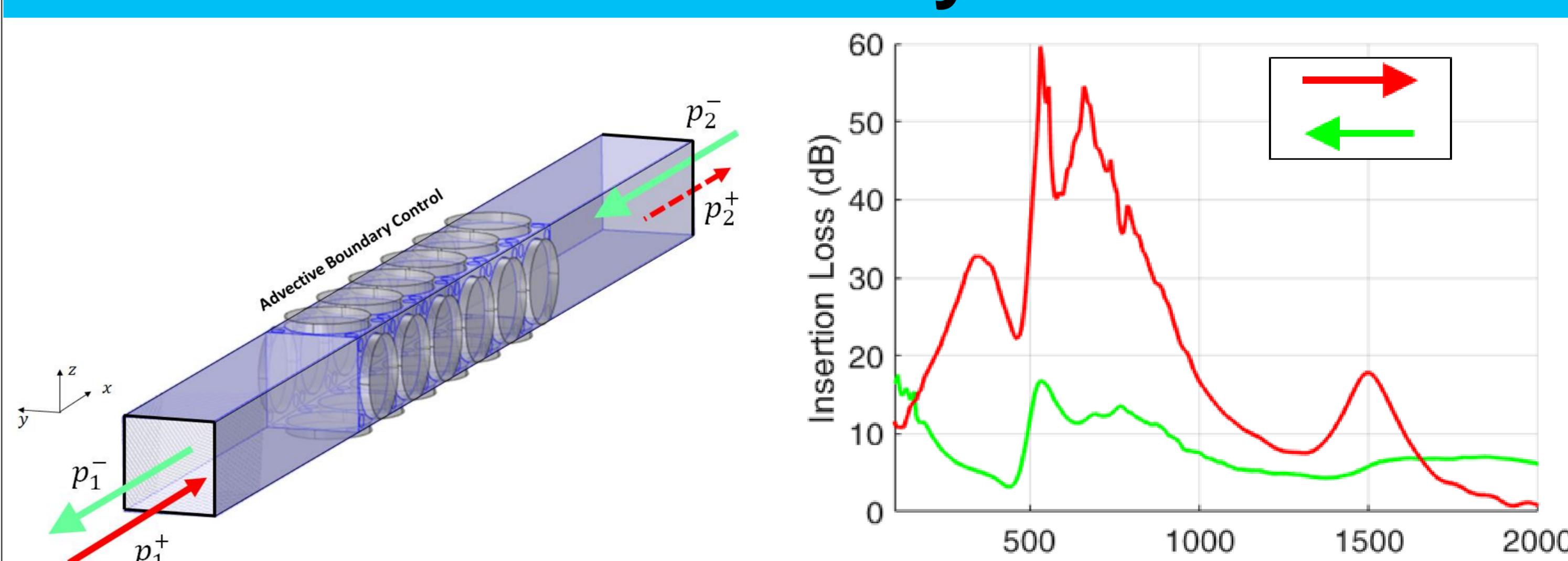


$c_a \leq c_0$ for passivity

Measured Scattering



Non-reciprocal effect by the Advective Boundary



Publication

S. Karkar, E. De Bono, M. Collet, G. Matten, M. Ouisse, and E. Rivet. "Broadband nonreciprocal acoustic propagation using programmable boundary conditions: From analytical modeling to experimental implementation". Phys. Rev. Applied, 12:054033, Nov 2019.



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