# Sonic Crystal Noise Barriers (SCNB)

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## Project in collaborations with...

- Transport Research Laboratory (Full-scale trials)
- University of Salford (analytical and numerical analysis)

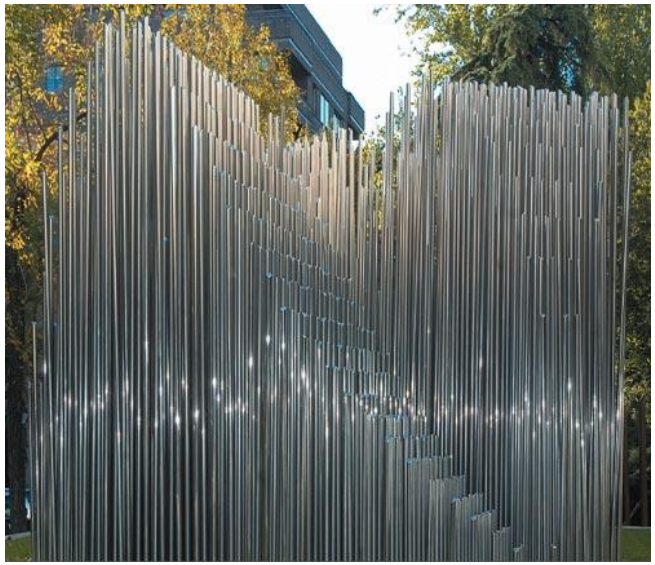
# Sonic crystal overview

Discovery made by two scientist named Francisco Meseguer and Jaime Llinares in Madrid, Spain (1995)

Periodic arrangement of elements that changes the way sound propagates.

Fundamentally uses properties of waves, such as scattering and interference to create band gaps (Stop band) at certain frequencies in acoustic transmission.

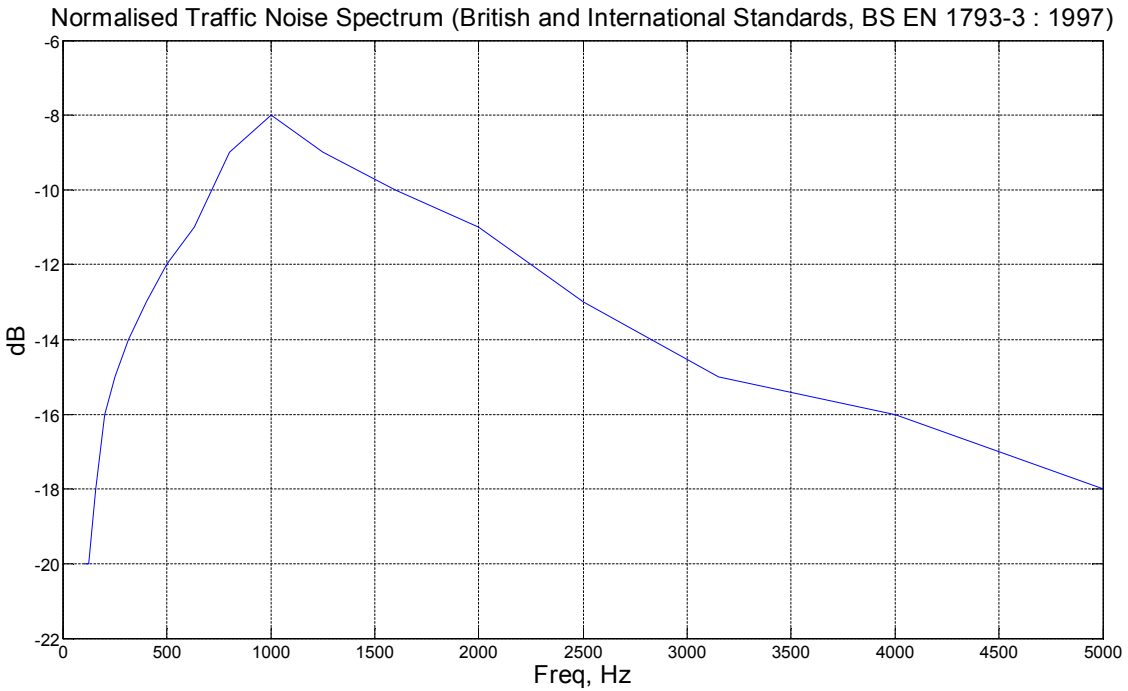
Measuring the insertion loss of the SCNB will be essential – Difference between Sound Pressure Level at a point in space with and without the array.



Kinematic sculpture by Eusebio Sempere

# Traffic noise

- Audible frequency for humans: around 20Hz – 20KHz.
- Contribution of traffic noise: vehicle's movement (noise dominate at high speed) and engine and transmission system (noise dominate at slow speed).
- Traffic noise in the frequency band of 100Hz – 5KHz (Centred at 1KHz).



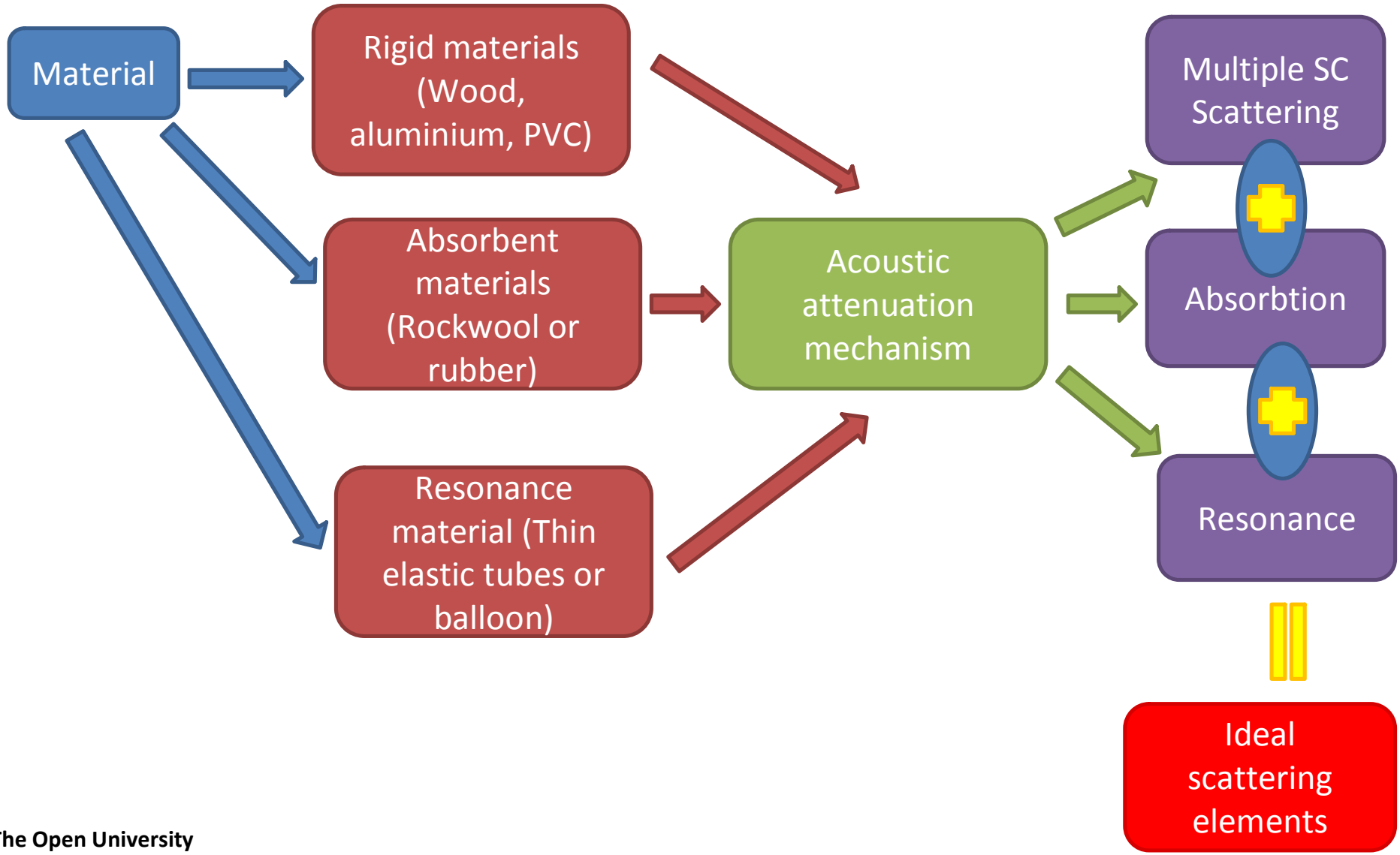
# Motivations

1) Richer physics – new acoustical phenomena or property.
2) Improved aesthetics - Opaque barriers.
3) Green – possibilities of using trees as the sonic crystal elements.
4) Reduced wind loading effects – turbulence and wind gradient.
5) Cost - Cheaper to produce due to reduce material.

Conventional road barrier

SCNB

# Possibilities of enhancing the attenuation band: Material



# Possibilities of enhancing the attenuation band: Optimisation process

1) Creating defects such as vacancies (Quasi Ordered Structure, QOS).
2) Mixed array of scattering elements.

3) Genetic Algorithms (GA) – i) Selection
ii) Cross over
iii) Mutation

4) Filling fractions (Different diameter)

5) Geometrical design of SC (Square, triangle or hexagonal lattice)

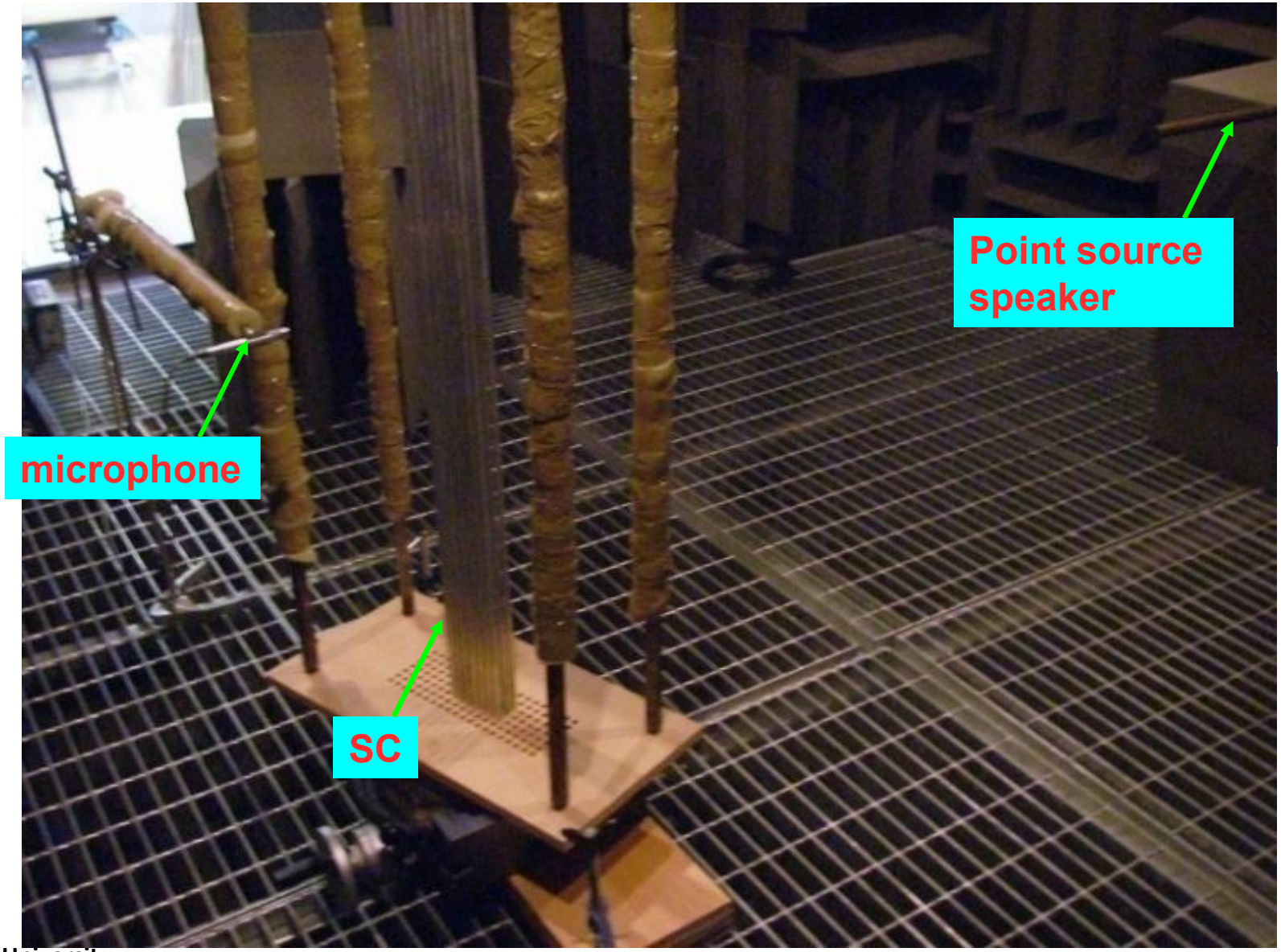
# Current Experiments

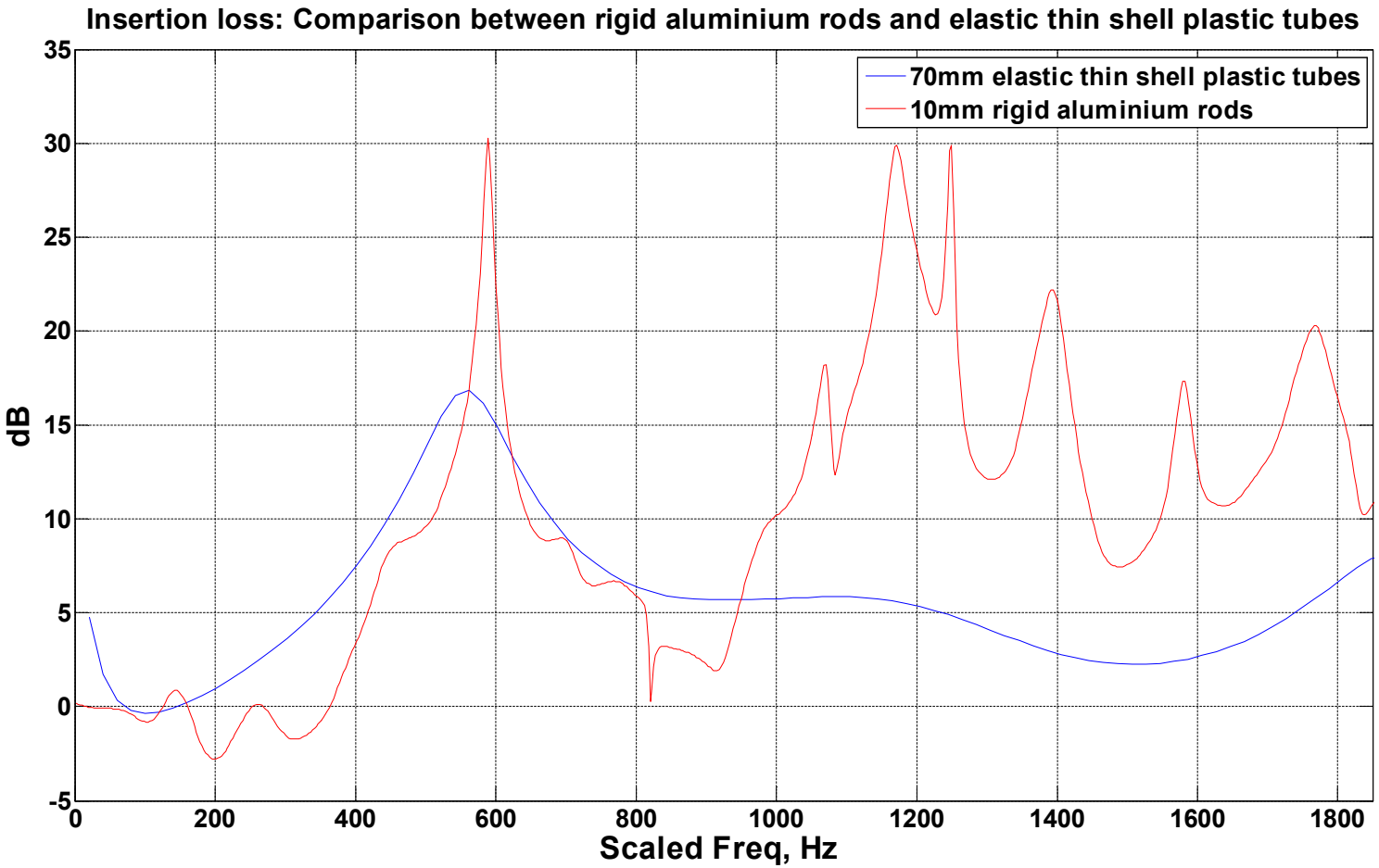
1) MLSSA (Maximum Length Sequence System Analyzer) – Broadband spectrum.
2) Anechoic chamber (3m x 3m x 3m)
3) Two types of crystal elements
4) Both having same filling fraction of 32%.
5) Both arranged geometrically in square lattice.

6x2 soft thin shell plastic tubes (70mm x 2m, thickness 0.15mm)

7x3 Rigid aluminium rods (10mm x 2m)

# Experiment setup






Scale factor differences of about 2.85 times (plastic tubes) and 20 times (aluminium rods)