

# Supplemental Material

## Multi-band asymmetric transmission of airborne sound by coded metasurfaces

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### 3-bit-period and 4-bit-period Coding Sequences

To further analyze the asymmetric transmission for the other coding sequences, we discussed the case of non-alternating arrangement of bit “0” and “1”, such as, the 3-bit-period and 4-bit-period sequences. The transmission spectrum and the corresponding contrast ratio of 3-bit-period coding sequences are shown in Fig. S1. The 3-bit-period coding sequences include “001001...” and “011011...”. For PI, only one transmission band at around 4500 Hz is obtained, which is similar with the all-“0” and all-“1” cases. For NI, the first band appears at around 4500 Hz with lower transmission rate. When two “0” or “1” bits are linked, the acoustic field at one of the output slit could not be canceled out according to the theoretical analyses of interference. Thus, the contrast ratio will be lower for the first band. Two higher order transmission bands for “001001...” and three higher order transmission bands for “011011...” will appear at higher frequencies, where the contrast ratio will change its sign.

The transmission spectrum and corresponding contrast ratio of 4-bit-period coding sequences become more complicated, as shown in Fig. S2. The 4-bit-period coding sequences include “00010001...”, “01110111...” and “00110011...”. For PI, one minor peak at around 4300 Hz arises in the first transmission band. For NI, the first band also appears, and the higher band is more complicated as more propagation modes could be stimulated. The contrast ratios of “00010001...” and “01110111...” are further decreased in the first band compared with those of “001001...” and “011011...” as the acoustic field at more output slits could not be canceled out for NI.

Over all, in the case of non-alternating arrangement of “0” and “1”, the transmission band for PI at around 4500 Hz will generally maintain. The first band for NI also appears at around 4500 Hz with lower transmission rate as the acoustic field at the output slits may not be canceled out. As a result, the contrast ratio will be lower for the first band. This phenomenon can be treated as a transition state between all-“0(1)” and “0101...” coding sequences.

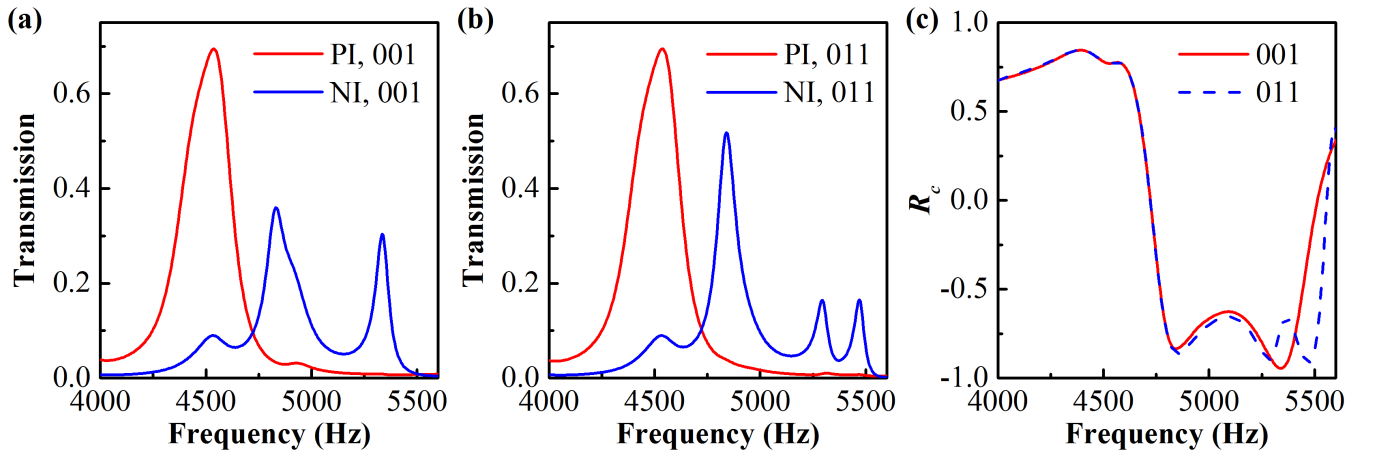


FIG. S1. (a, b) Transmission of “001001...” and “011011...” for PI and NI. (c) Contrast ratio of “001001...” and “011011...”.

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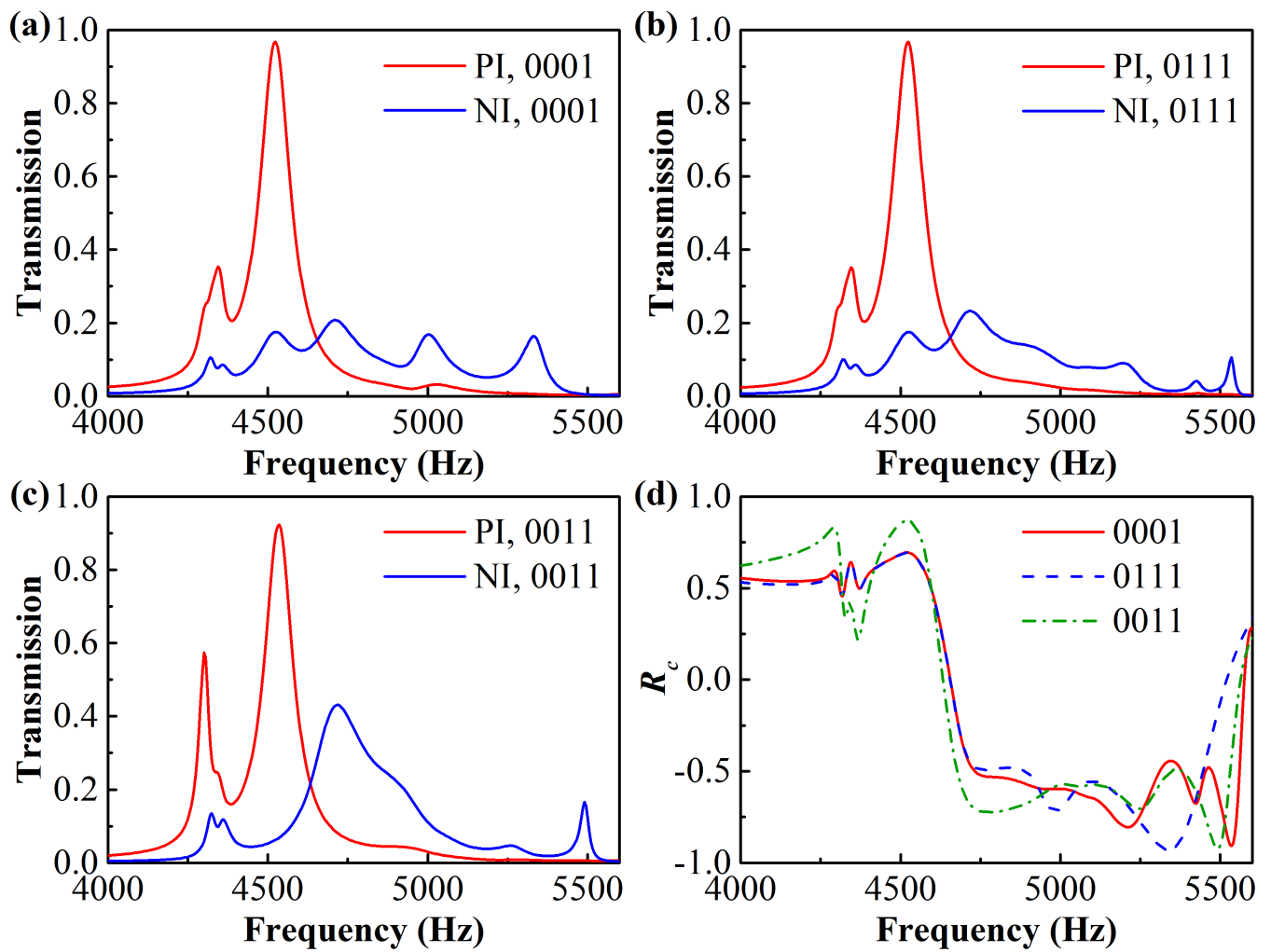


FIG. S2. (a, b) Transmission of "00010001...", "01110111..." and "00110011..." for PI and NI. (c) Contrast ratio of "00010001...", "01110111..." and "00110011...".