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## Multi-band frequency-selective surfaces with independent band tuning

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## With Independent Band Tuning

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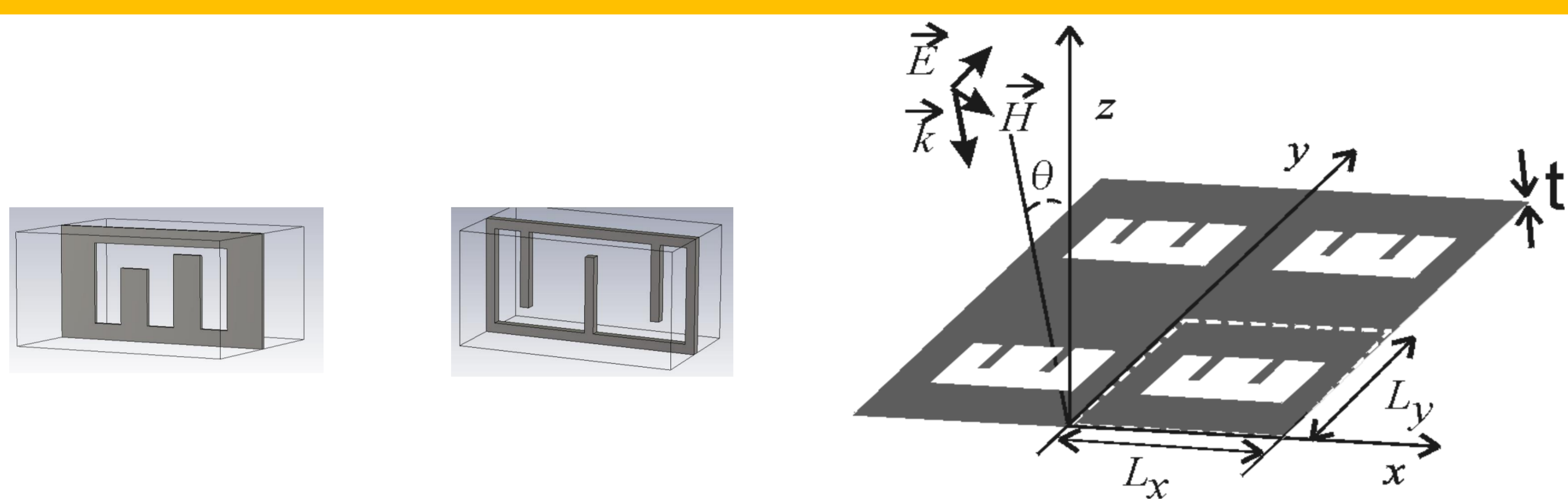
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### I. Objectives

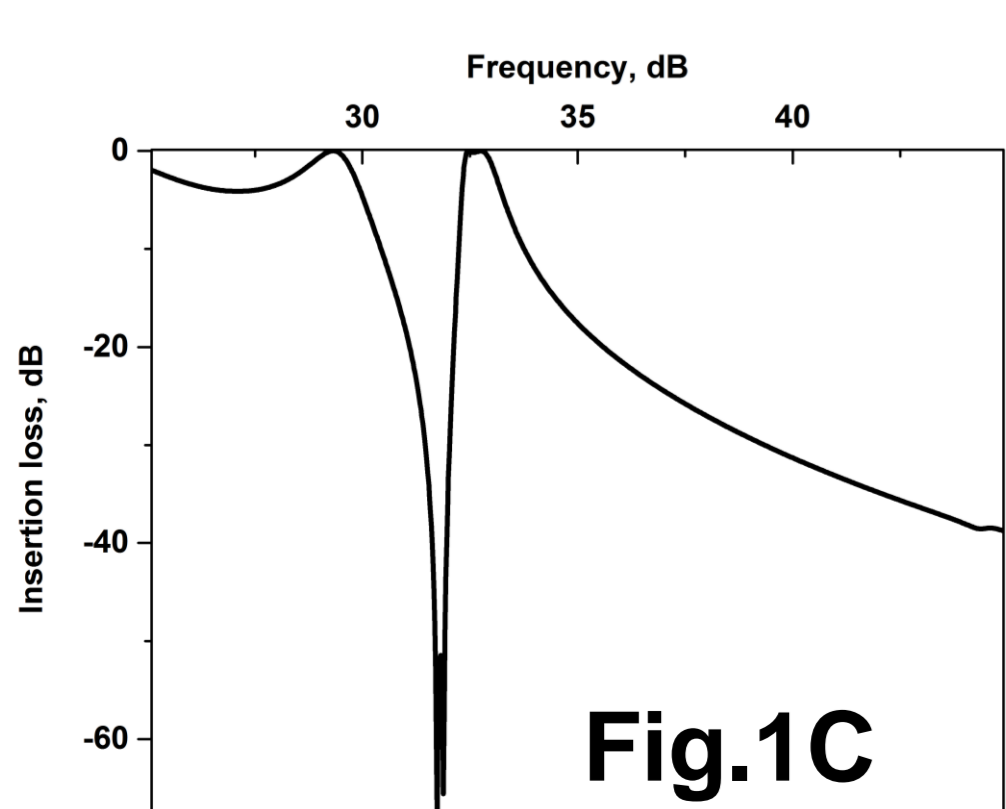
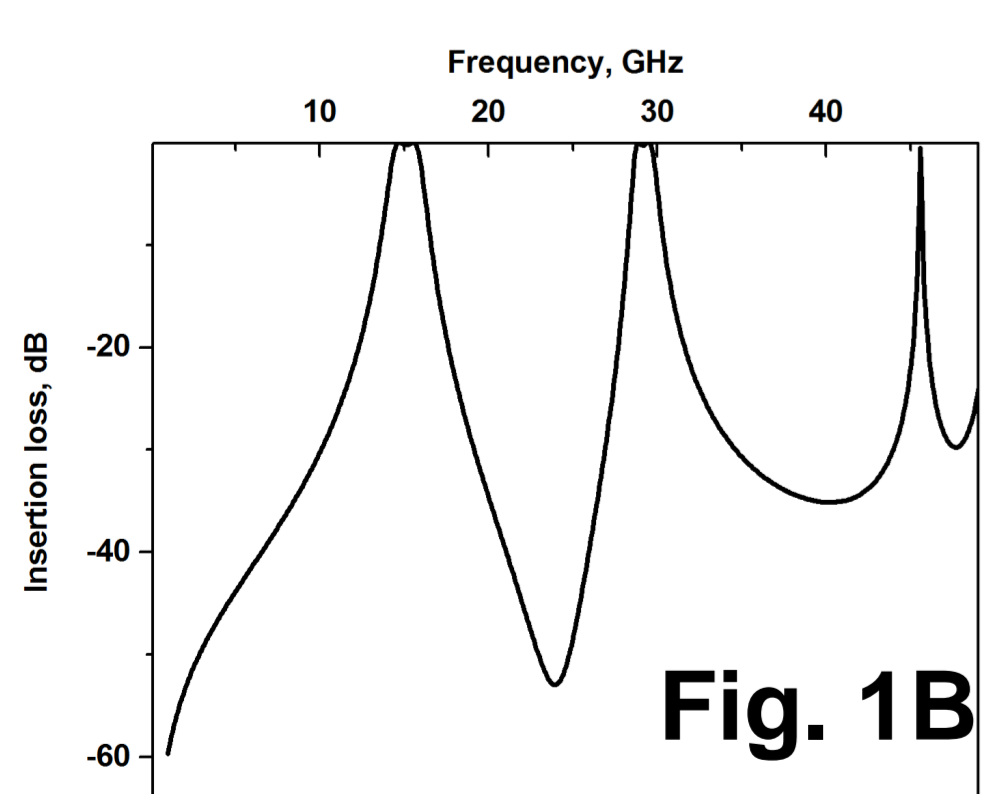
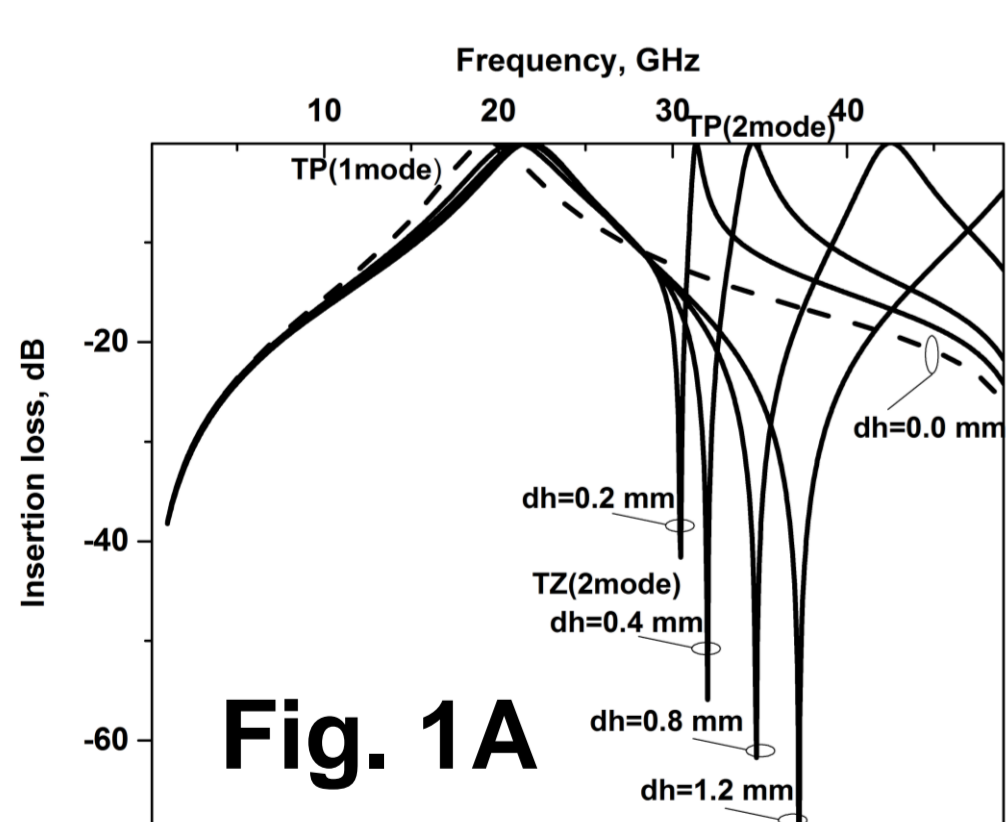
- To design a frequency selective surface (FSS) enabling narrow-band pseudo-elliptic transmission of incident TE-polarized wave in a single-band or multi-band operating regime.
- To design a FSS enabling mixed-type frequency response, namely closely-spaced transmission of incident TE-polarized and its reflection simultaneously.
- To design a FSS providing independent control of passbands and stopbands.
- Such FSSs have found applications in a variety of applications such as wireless communications, radar systems, and satellite communications.

### II. Proposed FSS design



- Proposed FSS is a thin metal perforated screen whose elementary cell contains a rectangular aperture with a set of pins implemented in its broad walls.
- Depending on the aperture geometry, namely dimensions of the pins, their location in the aperture cross-section and number of pins, different types of frequency responses are provided by a free-standing perforated screen for incident TE-polarized wave.
- Different operating regimes are generated by involving the higher modes of aperture into electromagnetic interaction. Operating regime type depends strongly on the number of modes involved into electromagnetic interactions.

### III. Two-pin based designs



- Single standing two-pin FSS provides transmission response if pins are equal (dashed line in Fig. 1A).
- It provides generation of additional pair of a transmission pole (TP) and a transmission zero (TZ) if pins are unequal. Frequency separation between TP and TZ is controlled by changing a difference in pins' heights mainly.
- Involving the second (1<sup>st</sup> higher) mode into electromagnetic interaction is a physical reason of such a response.
- Two-band transmission response (Fig. 1B) or a singlet-type response (Fig. 1C) are achieved by cascading a pair of proposed FSS.

### IV. Tri-pin based designs

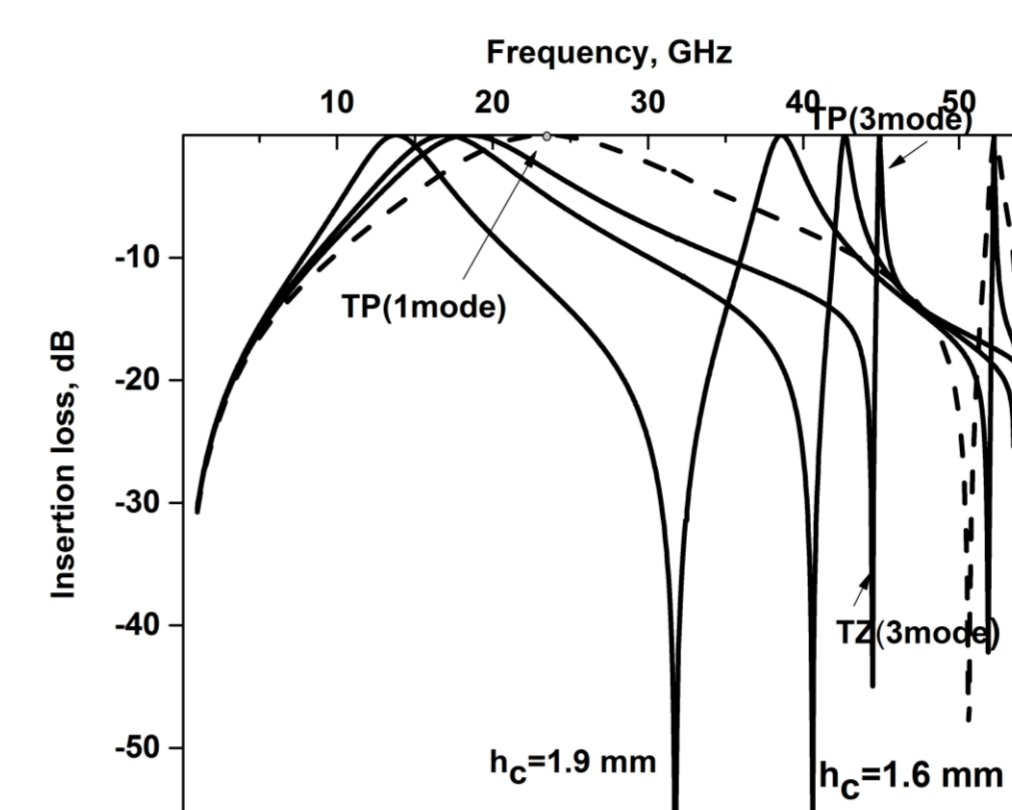


Fig. 2A

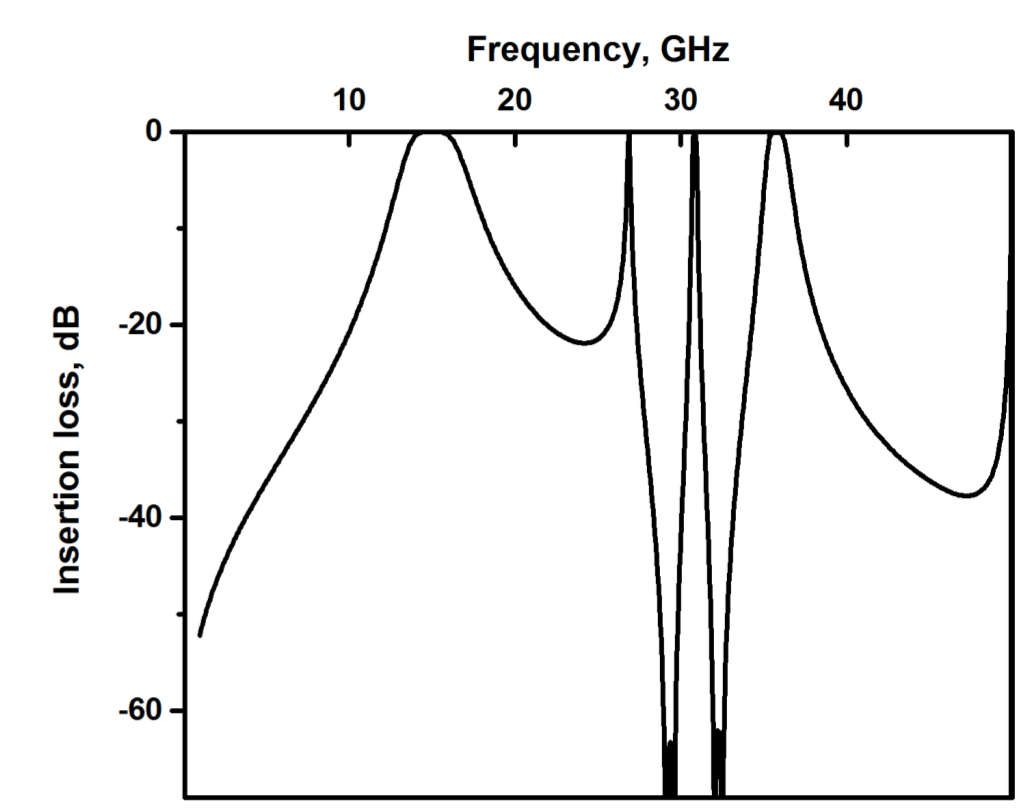


Fig. 2B

- Single standing tri-pin FSS enables two-band transmission response as well (Fig. 2A).
- Even symmetric FSS with equal pins enables generation of quasi-elliptic response Fig. C).
- Generation of additional pair of a transmission pole (TP) and a transmission zero (TZ) is caused by involving the 3<sup>rd</sup> (2<sup>nd</sup> higher) mode into electromagnetic interaction.
- FSS with broken symmetry enables tri-band transmission response achieved by additional involving the 2<sup>nd</sup> mode. Fig.B shows a response of doubled tri-band tri-pin based FSS. Depending on the input task, the response can be interpreted in different manner, namely as two-stopband one.
- Fig D shows plots of frequencies of the resonances and their Q-factor vs the angle  $\Theta$  of incident wave.

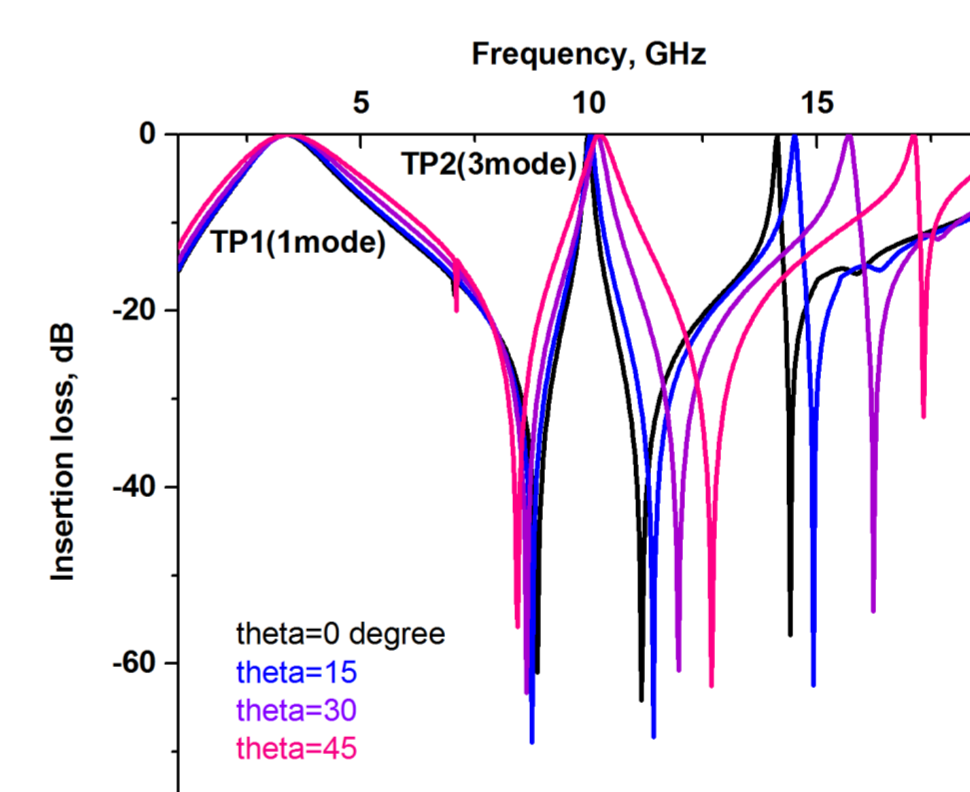


Fig. C

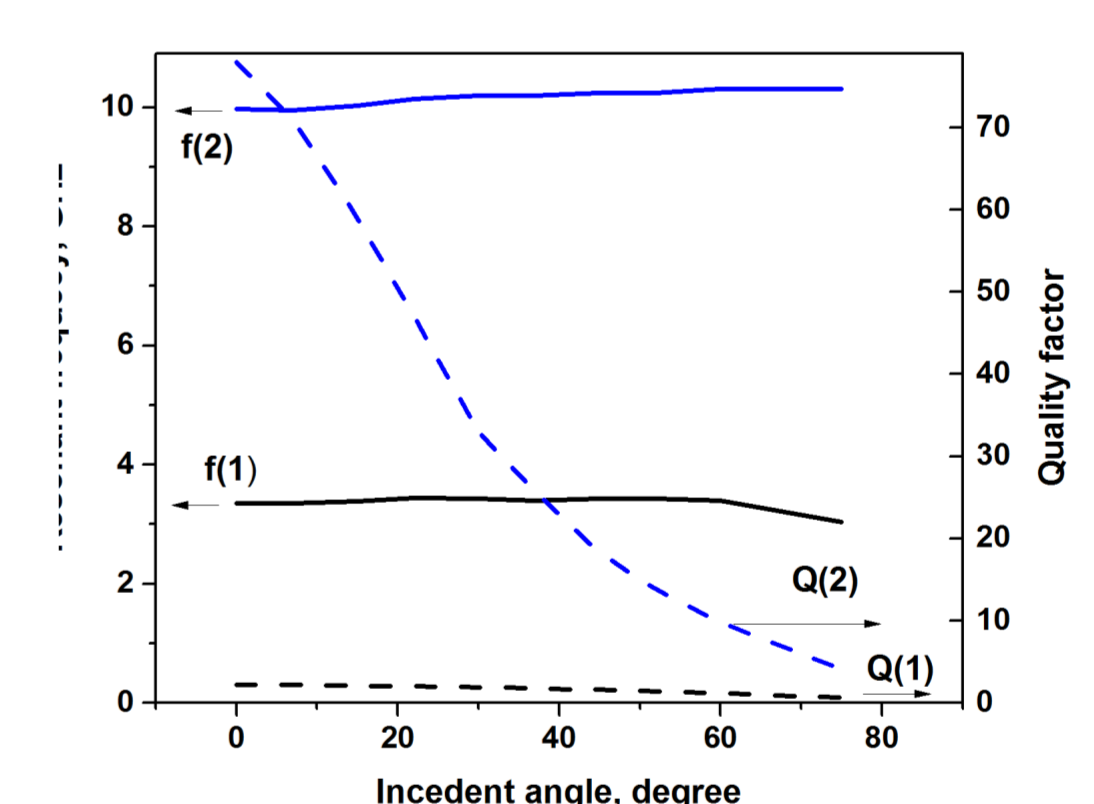


Fig. D

### V. Multi-pin based designs

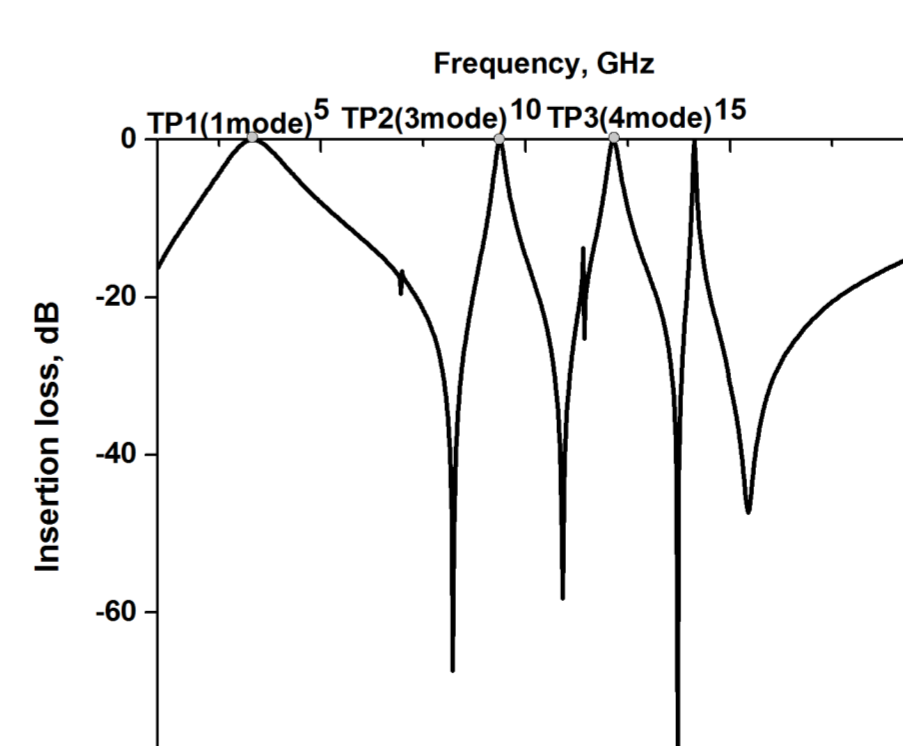


Fig. A

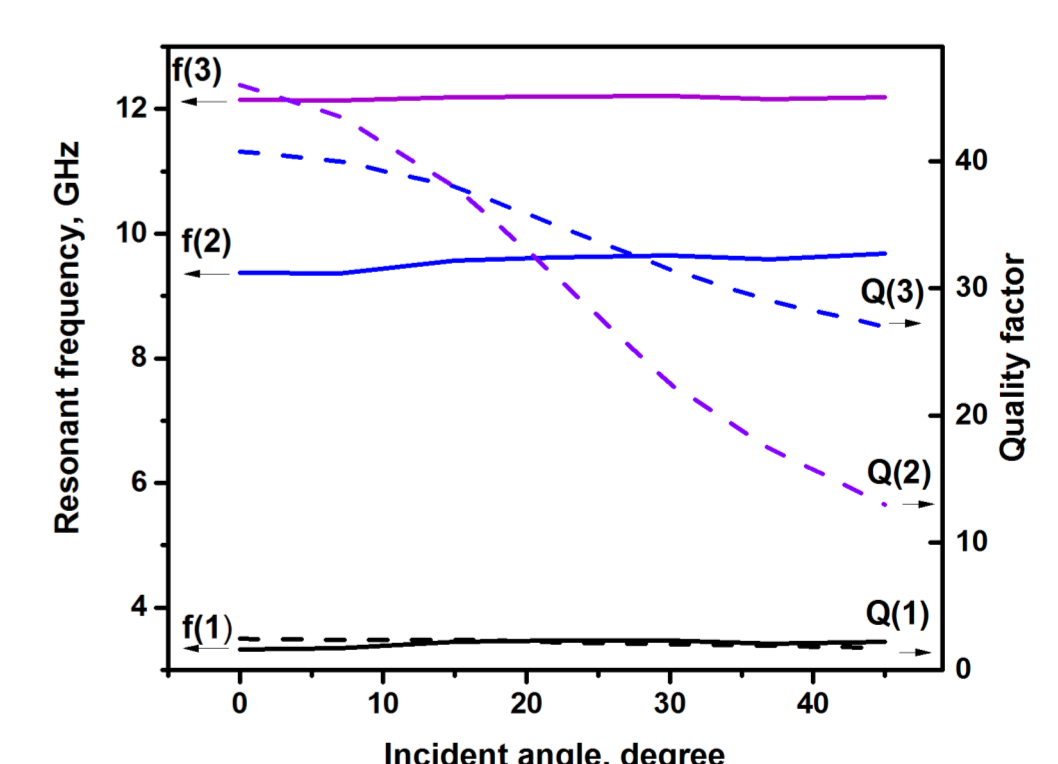


Fig. B

Typical multi-band response provided by a multi-pin section (Fig. A) . Fig. B shows plots of frequencies of the resonances and their Q-factor vs the angle  $\Theta$  of incident wave

### Acknowledgement

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