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Probability that a band-gap extremum is located on the irreducible Brillouin-zone contour for the 17 different plane crystallographic lattices

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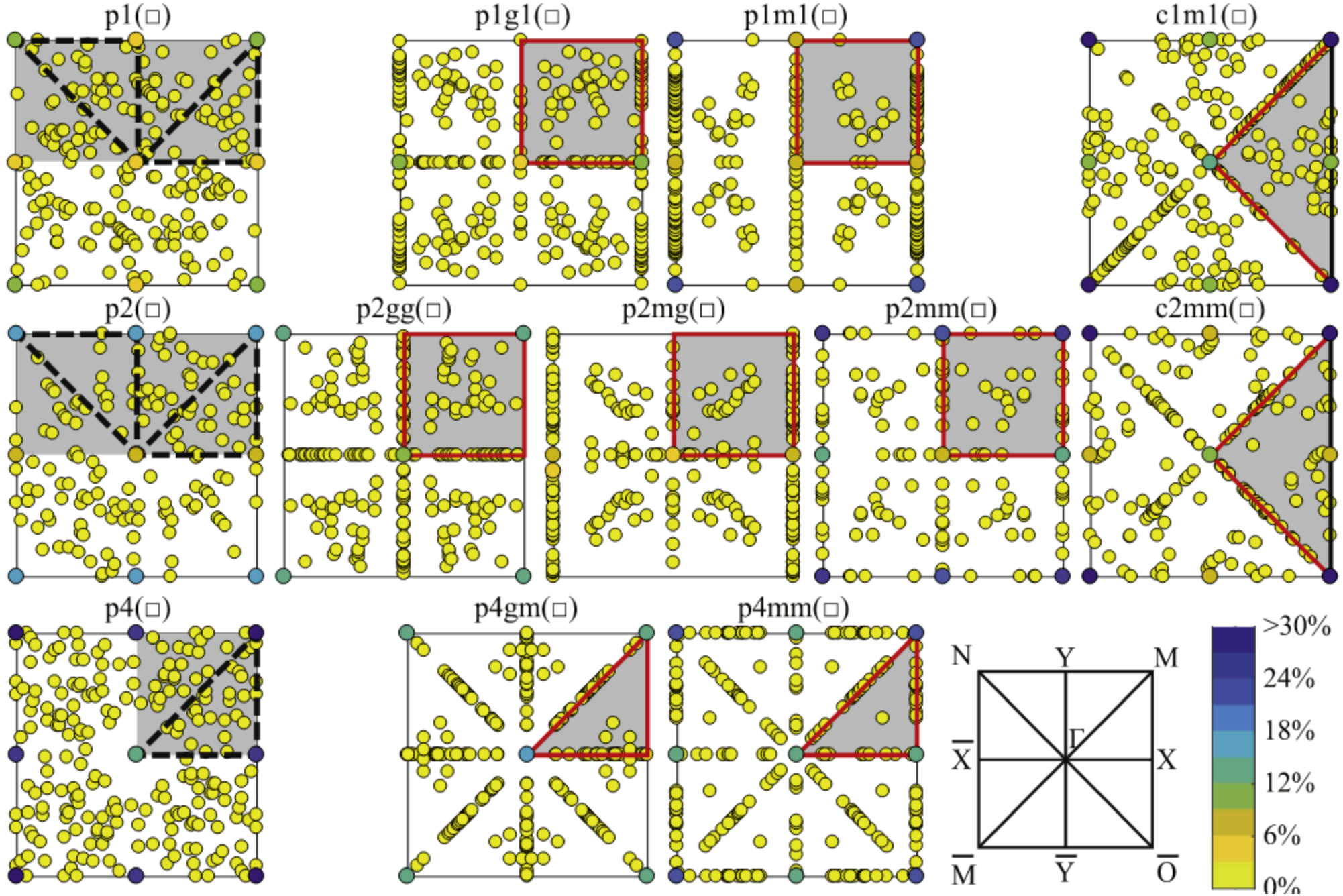
p1(□)
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18%
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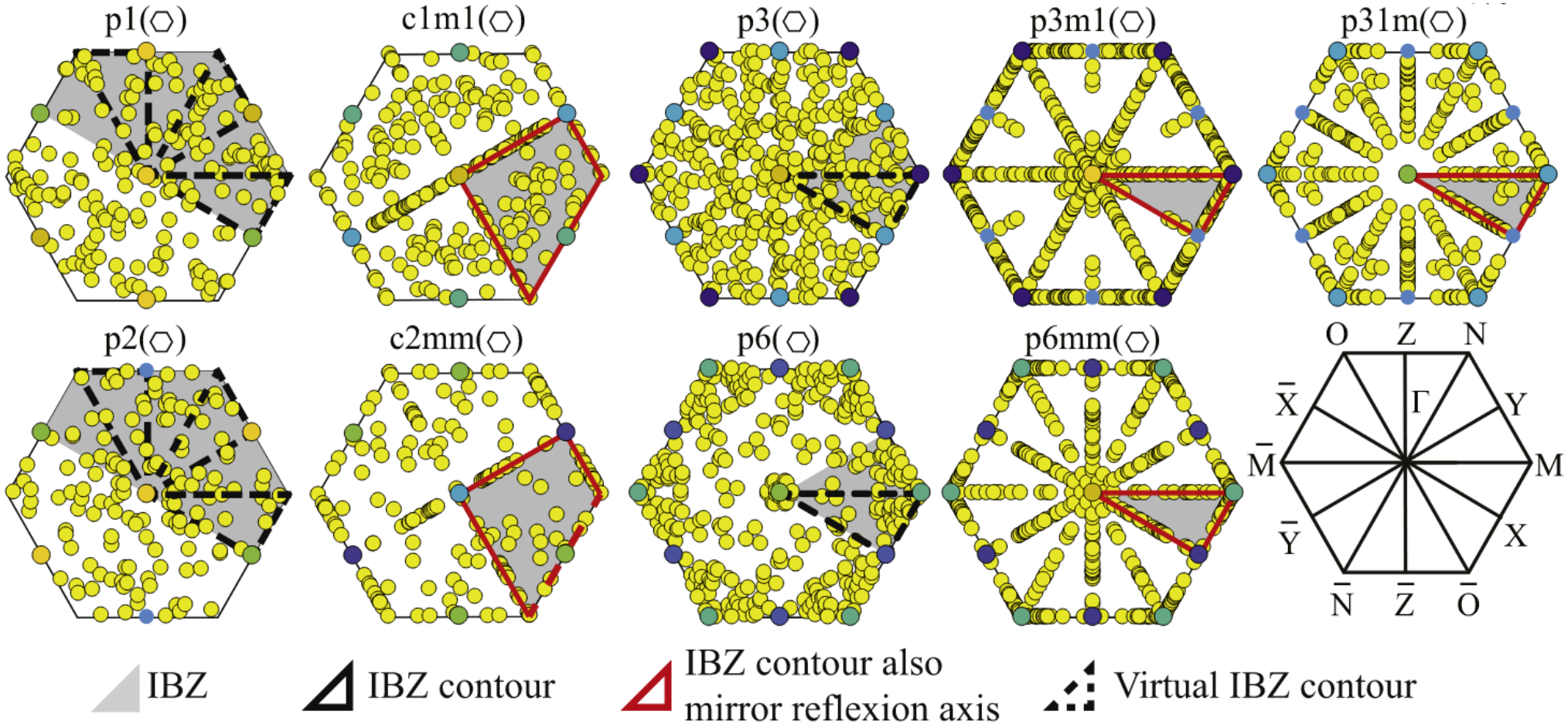

Fig. 7. Localization in the BZ of 300 randomly selected full band-gap extrema, for the different plane crystallographic groups possessing square (□) or hexagonal (⬡) BZ. The scale indicates the percentage of times a position of the IBZ is targeted.

Note that for a fully unsymmetric UC, cf. Fig. 1a, the OABCO contour does not represent the full IBC. In this work, however, only the OABCO and OABCOB contours are considered during the optimization while **no symmetry is imposed in the UC** to minimize the computational effort. The entire first Brillouin zone is checked in post-processing to ensure a full omni-directional bandgap is achieved.

Imposing symmetry reduces the amount of design variables, respectively to one forth and one eight for both considered symmetries. Therefore it is generally more difficult to find resulting omni-directional bandgaps.

The symmetry is only imposed during the analysis of the zipper methodology, further on in this manuscript, no symmetry is imposed to allow the largest possible design freedom to the optimizer.

During topology optimization, the geometry of the unit cell of phononic crystals will be changed step by step but will keep the required symmetry.

Considering the possible influence of initial designs on final results, we start from random designs which satisfy the inherent symmetry and repeat the whole procedure several times with accidental similar results.

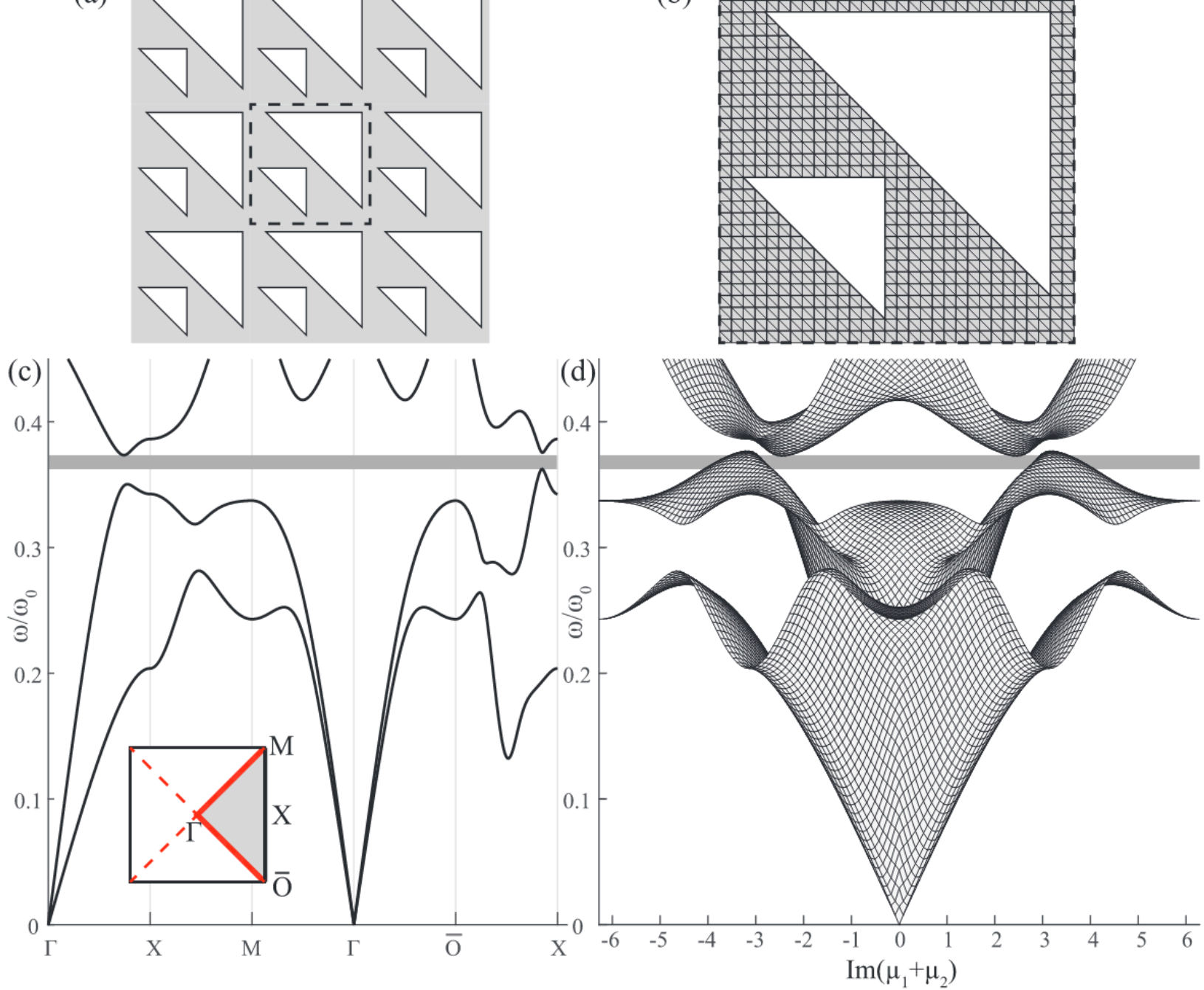

Fig. 4. Periodic Sierpinski right-angled isosceles triangles with a porosity of 40% (a), and a detailed discretized unit cell (b). Dispersion curves at the contour of the IBZ (c) and dispersion surfaces for the full BZ (d). The band-gap, in gray, is not omnidirectional.