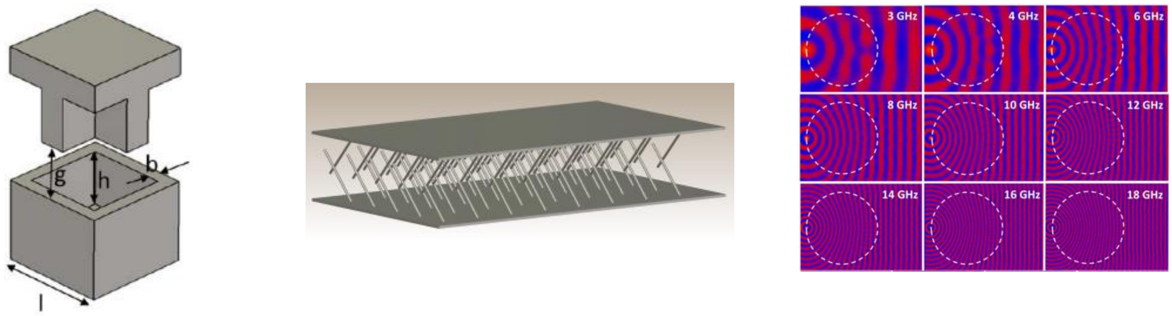
Post-doc Position:
Metasurfaces with Higher Symmetries for Efficient Communicating Devices

Context. In the recently discovered higher-symmetry metasurfaces (HSM) [1][2], unit-cell elements exhibit ***additional internal symmetries*** beyond the periodic symmetry of the device. Fig. 1a shows an example of a unit cell of a glide-symmetric structure, a particular case of higher symmetry. This structure is not only periodic, but each cell is also invariant after a translation of half a period and a mirror reflection. Fig. 1b shows another glide-symmetric structure, providing anisotropy due to the presence of skewed cylinders. These additional symmetries provide marvelous properties of the waves propagating across HSM. A stable equivalent refractive index over an ultra wide band (UWB) was achieved in a parallel–plate waveguide whose plates were glide-symmetric holey metasurfaces, and where radiation occurs at the end of the waveguide (Fig. 1c). As an additional advantage, no dielectric materials were needed. These structures open a unique opportunity for **UWB dielectric-less** metasurfaces which can be used to produce flat lens antennas (e.g., Luneburg lenses) with **1D scanning capabilities**. Since dielectrics are usually responsible for the most of the losses in metasurfaces, HSM promise to be low loss, leading to **high-power** (e.g., base stations) **and spatial applications**.



(a) (b) (c)

Fig. 1 – (a) Unit cell of a glide-symmetric structure. (b) Example of anisotropic glide-symmetric metasurface. (c) UWB glide-symmetric Luneburg lens transforming a cylindrical wave into a plane wave for directive radiation at its end (the phase of the fields is shown in the picture).

Research Activites. Due to the difficulty to study HSM metasurfaces for the presence of different geometric scales (large device, small details in each cell), reliable models need to be developed. Furthermore, HSM may also present strong interaction between surfaces (Fig. 1a) preventing from using approximate boundary conditions separately on each of them.

The postdoc will work on the modeling and the design of HSM. She/he will derive modeling methods (e.g., mode matching, method of moments, circuit models) for the unit cell of different kinds of HSM (e.g., those shown in Fig. 1b and others). She/he will work on HSM metasurfaces not yet studied, capable to obtain specific wave propagation properties (i.e., anisotropy). On the basis of the obtained results, she/he will be in charge of the fabrication of one or more prototypes and their measurements.

She/he will collaborate with other two PhD students recruited on similar subjects on different projects (an ANR JCJ grant recently obtained by the post-doc responsible), and researchers at KTH Royal Institute of Technology, Stockholm, Sweden, in the framework of an existing collaboration with UPMC. She/he will have access to the computational facilities of the UPMC (laboratory simulation server, simulating software) as well as UPMC fabrication and measurement facilities (milling machine, 3D printer, anechoic chamber and measurement equipment).

Skills required:

- The candidate must have defended a PhD thesis in the field of electrical engineering, physics or applied mathematics.
- The candidate should have performed original research in computational electromagnetics (e.g., mode matching, method of moments, finite-element methods).
- Good knowledge of analytic methods in electromagnetics is necessary: modal expansions, equivalent-circuit theory, periodic media. Previous experience on homogenization techniques will be a plus.
- The candidate needs to be autonomous, hard-working, and motivated.

Place and dates of the postdoc:

Laboratoire d'Electronique et Electromagnétisme (L2E), Campus Jussieu

Duration:1 year.

Starting date: as soon as possible, no later than July 2017.

Contact:

Guido VALERIO: guido.valerio@upmc.fr, +33 (0) 1 44 27 42 36

References:

[1] G. Valerio, Z. Sipus, A. Grbic, and O. Quevedo-Teruel, "Accurate equivalent-circuit descriptions of thin glide-symmetric corrugated metasurfaces," submitted to *IEEE Trans Antennas and Propag*.

[2] O. Quevedo-Teruel, M. Ebrahimpouri, and M. Ng Mou Kehn, "Ultra wide band metasurface lenses based on off-shifted opposite layers," *IEEE Antennas Wireless Prop. Lett*, vol. 15, 2016, pp. 484–487.