Doctoral thesis disposition
Soft matter metamaterials

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– opis LC *splošen opis [1] – dvolomnost *splošno [2] – elastičnost za self-assembly: zakaj urejenost *spomin v poroznih mat. [3] *urejanje koloidov eksperimentalno [4, 5] *urejanje koloidov teoretično [6] – razvoj waveguidinga *LC kot dodatek obstojecim opticnim vlaknom [7, 8], *vlakna izkljucno iz LC [9]?

– opis MTM – kaj so to *review [10] – kako maš tudi akustične MTM, pa tudi jih maš za različne valovne dolžine svetlobe (ni neg. n za vse lambda) – optične lastnosti: – neg. lom [11, 12] – t.i. plašči nevidnosti [13] – leče z resolucijo pod valovno limito *metalenses at visible wavelengths: [14] – v zadnjem času bolj oblikovanje valovnih front (polarizacije, faze) [15] – nadzor transmitivnosti *absorberji [16] – metasurface *review Nature [17] – all-dielectric MTM *review Nature [18] – hyperbolic *review Nature [19] – za urejanje direktorskega polja *s svetlobo čez metasurface in zakleneš direktorsko polje LC [20]

– MTM with LC – neg. refraction classically *neg. lom v klasičnih LC [21, 22] – self-assembly from direct laser writing *npr. [23] – bottoms up approach – metallic spheres in LC: disordered hyperbolic medium *dielektrične krogle [24, 25] – MTM building blocks shaped as LC to achieve order *ordered nanorods [26, 27, 28] *oblong plastic building blocks with embedded resonators [29] *nanoparticle with LC molecules bound to it [30] – tuning: controlling of the resonant frequency *switch [31] *tuning [32]

A way to engineer soft (meta-)materials is to combine liquid crystal with metallic colloids. The elasticity of liquid crystals affects the distribution and arrangement of colloids. As some orientations of the colloid are more favourable in terms of free energy, the horseshoe colloids might, as the theoretical studies of J. Aplinc [?] show, self-assemble in 2D and 3D crystals. The analysis of the interplay between the influences of the geometry of such a photonic crystal and the optical parameters of the materials used provides a rich case of study. Since the optical parameters are highly dependent on the frequency of light, diverse response is achieved across different wavelengths. Experimental realisation of these ideas would be explored in the team of prof. Muševič, group F5 on JSI.

A crucial reason why to control and manipulate light is to guide it. Many different applications, from photonic circuits to waveguides, all designed to convey information, rely on efficient control of light. An compelling option for waveguiding is to enhance their properties with liquid crystals. In cooperation with prof. Etienne Brasselet from University of Bordeaux, different proposals for waveguides, filled with liquid crystals, will be simulated and analysed theoretically. Through different boundary conditions and other manipulation, different director profiles can be introduced into the liquid crystal, which can in turn affect the propagation of light. With some director profiles we can achieve focusing; special emphasis will be put on the director profiles which exhibit focusing for positive anisotropy ($n_o < n_e$).

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