Appunti di Fisica '16
&
Dottorato di Ricerca in Fisica

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Dip. di Scienze Matematiche e Informatiche,
Scienze Fisiche e Scienze della Terra

Organic molecules and hybrid perovskites: soft matter for novel photonic devices

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Organic semiconductor molecules, well known for OLED (Organic Light Emitting Diode) technology currently used in high performance lamps and displays, are excellent materials to study and exploit different light-matter coupling regimes: weak (WC), strong (SC) and ultrastrong coupling (USC). While the WC regime is useful to increase efficiency and color quality of OLEDs through the placement of the active material into an optical feedback (i.e. a dielectric microcavity), in SC and USC regimes emitting molecules exchange energy with the cavity at a rate larger than the losses from the cavity and the dephasing of the excitons, generating two hybrid states called polaritons where light and matter are mixed. The study of electroluminescent processes from organic polaritons is fundamental to fabricate devices that generate Bose-Einstein condensates under electrical injection at room temperature. Besides organic compounds, recently another class of semiconductors is attracting the attention of scientific community for the development of novel coherent light sources: hybrid organic-inorganic perovskites. These materials feature a unique combination of properties: they can be easily fabricated, both from solution or thermal evaporation, and have bright, color tunable optical emission, like organics. Furthermore their conduction properties resemble those of inorganic semiconductors, with large carrier mobility and diffusion lengths and they support

high emission efficiencies at high pump densities, which is fundamental to reach population inversion and lasing.