SEMINARIO
Departamentos de Física Teórica I y II
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TITULO: Fluctuations in quantum many-body systems: a trip through momentum space and real space

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ABSTRACT:

Noise and its correlations represent an essential probe of the nature of complex quantum systems. Fluctuations in quantum systems are both of thermal and quantum origin, and telling apart the thermal and quantum components of fluctuations is a formidable challenge. Nonetheless, accomplishing this task would give access to two fundamental aspects: the actual temperature of the quantum degrees of freedom, and their entanglement properties.

Experimental access to noise in condensed-matter setups is often hindered by the large amount of statistics required, and/or by the necessity of developing multi-port measurements. In this respect cold atoms trapped in light-induced potentials offer a unique opportunity to study noise in quantum many-body systems, including the full noise statistics, either in momentum space (via time-of-flight images) or in real space (via in-situ images). In this talk I will first discuss how noise in momentum space can serve as an invaluable tool for thermometry via fluctuation-dissipation relations, generally valid for classical systems; the violation of such relations for quantum systems provides new insight into

the structure of quantum fluctuations in momentum space. On the other hand, noise in real space -- in the form of local density fluctuations -- is a direct manifestation of entanglement between a part of an extended quantum system and its complement. Focusing on simple systems of relevance to cold-atom setups, I shall discuss the fundamental links — as well as the discrepancies — between entanglement entropies and density fluctuations, based on a microscopic insight into the spatial structure of both properties.