

## ***PHD PROPOSAL***

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### **Guided mater waves: a new kind of probe**

We propose to investigate the interaction of a propagating matter wave through complex structures. We have initiated this research line recently. The matter wave is produced from a Bose-Einstein condensate (BEC). By outcoupling atoms from the BEC we can produce quasi-monomode (transverse) guided atom laser. Atoms propagate in a guide provided by an out-of-resonance powerful laser beam. In recent experiments, we have identified a transition to chaos, we have also investigated the X geometry for matter wave beam splitting, and have demonstrated the multiple Bragg reflection of matter wave when it interacts with a periodic structure. This latter work has revealed the possibility of realizing Bragg cavity whose walls are provided by the envelop of the period structure.

Our next projects include : (i) the efficient feeding of the Bragg cavity and its dynamical control, (ii) the atom optics in the cavity in the presence of strong atom-atom interactions, (iii) the interaction of the matter wave with time dependent potentials to engineer the momentum of the BEC, (iv) the interactions of the matter wave with a disordered potential to study the equivalent of conduction in solid state physics, (v) the demonstration of confined induced resonances in wave guides with large confining strength and (vi) the probing of quantum phases using a matter wave probe.

Part of the research program requires the building of a new setup with the possibility of having very high optical resolution either for shaping optical potential or to image atoms. This system shall allow the investigation of long range forces between an atom trapped in an optical tweezer and a Bose-Einstein condensate.