

# A 2D $^{39}\text{K}$ Bose gas brazilian experiment.

Gabriel T. Belumat,<sup>1,\*</sup> L. B. Pietro,<sup>1</sup> P.

H. C. Cunha,<sup>1</sup> and P. C. M. Castilho<sup>1</sup>

<sup>1</sup>*2DK Lab*

*Institute of Physics of São Carlos,*

*University of São Paulo, São Carlos-SP, Brazil*

Experiments with ultra-cold atoms are an important feature for studying the quantum behavior of matter. The ability to adjust parameters such as interactions, temperature and potential enables us to simulate different phenomena in a macroscopic cloud that is easy to visualize. At the Institute of Physics of São Carlos, our group is developing a new ultra-cold atoms experiment to produce two-dimensional Bose gases of potassium-39. We will use Feshbach resonances [1] to adjust the interactions, an optical accordion [2] to dynamically control the dimensionality and a digital micromirror device (DMD) to generate arbitrary in-plane potentials. The system will be used to study 3D-2D crossover effects, as well as superfluidity in the 2D regime, that occurs via a Berezinskii-Kosterlitz-Thouless (BKT) transition [3]. In this work we describe the path to produce the first Bose-Einstein condensate with tunable interactions of Latin America and the current status of our setup.

---

[1] C. Chin *et al.*, *Rev. Mod. Phys., American Physical Society* **v. 82**, (2010).

[2] J. L. Ville *et al.*, *Physical review. A* **95(1)** (2017).

[3] J. M. Kosterlitz and D. J. Thouless, *J. Phys. C: Solid State Phys* **6** 1181 (1973).

---

\* gabriel.belumat@usp.br