Minicolloque n°18 **X Oral** **☐ Poster**

Metallicity and ferroelectricity in $SrTiO_3$ and related compounds

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Strontium titanate avoids ferroelectric ordering thanks to quantum fluctuations. Since the low-temperature dielectric constant becomes extremely large, the effective Bohr radius is as long as a micron. Consequently, the insulator can be easily turned to a dilute metal subject to an intriguing superconducting instability. Substituting a tiny fraction of strontium atoms with calcium stabilizes ferroelectric order. Remarkably, dilute superconductivity and dilute ferroelectricity coexist in a narrow window of doping in $Sr_{1-x}Ca_xTiO_{3-\delta}$ [1]. The electrical transport in this dilute metal and the thermal transport in the parent insulator both present intriguing features [2-4].

[1] C. W. Rischau et al., Nature Physics 13, 643 (2017)
[2] C. Collignon et al., Annual Review of Condensed Matter Physics, 10, 25 (2019)
[3] C. Collignon et al., Physical Review X 10, 031025 (2020)
[4] X. Lu et al., Physical Review Lett. 124, 105901 (2020)