Theory @ Institut Néel :

Master internships 2018/2019

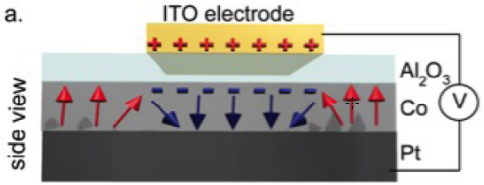
Presentation by Serge Florens

Néel Institute : a big lab !

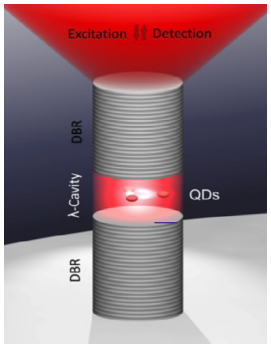
- 160 permanent researchers (CNRS, UGA, Phelma)
- 120 permanent technical staff
- 50 regular visitors
- 40 Postdocs
- 110 PhD students
- 70 Master Interns

Great variety of scientific topics in condensed matter

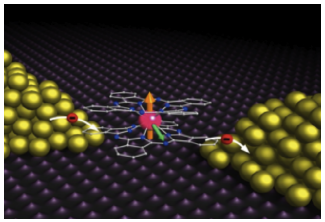
- Magnetism

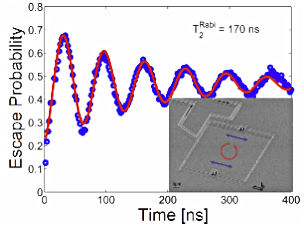


- Optics

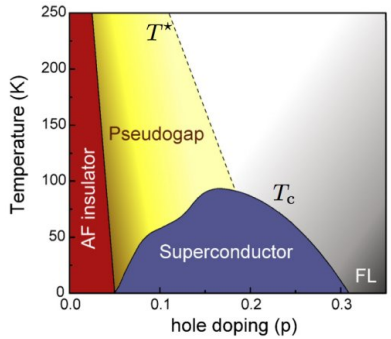


- Quantum electronics



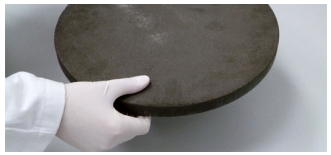


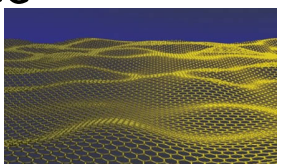
- Superconductivity



- Quantum fluids

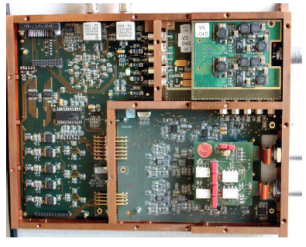
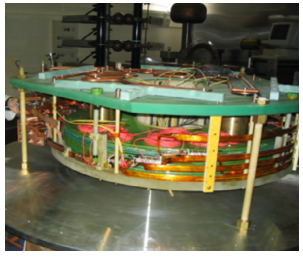
- Material science



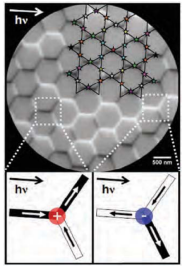


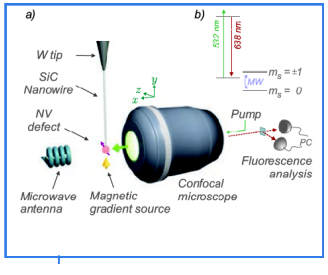
Néel Institute : research organization

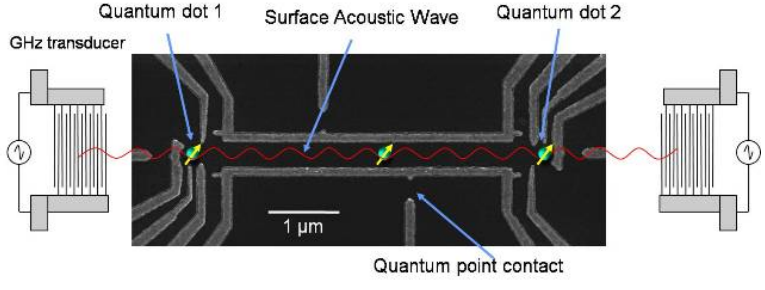
- Research from fundamental to applied science
- Tradition in cutting-edge home-made instrumentation


- Leading expertise in nanoscale and quantum engineering



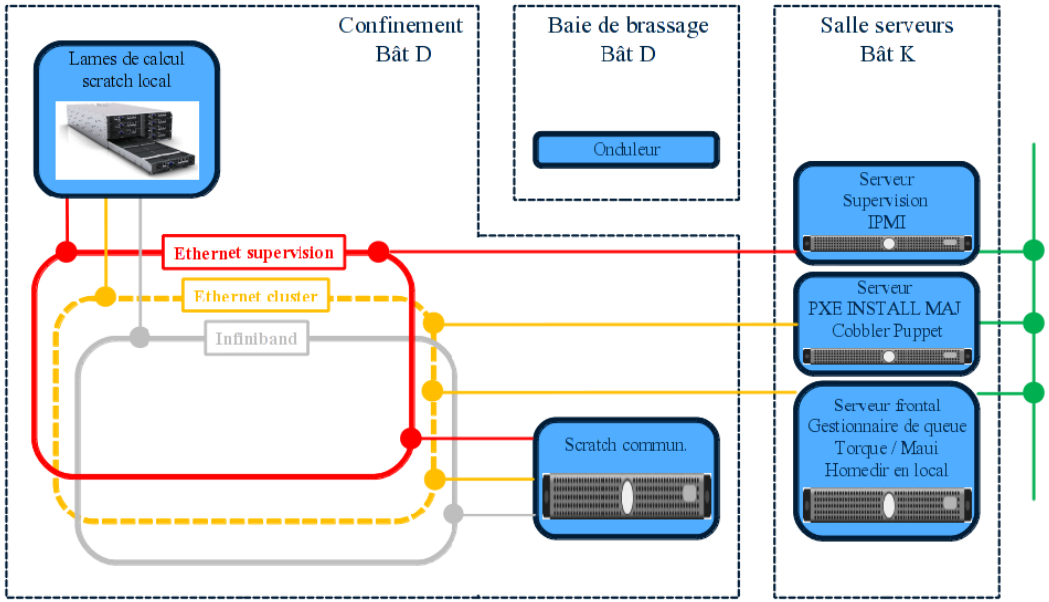




- Working in extreme conditions :
  $L = 10$ nm, $E = 0.1$meV, $T = 1$ K, $B = 1$T, $\omega = 20$ GHz
- Great environment : CEA, ILL, ESRF, LCMI, LPMMC, UGA...
- Strong interplay between theory and experiments

Theory @ Néel : overview

- About 20 researchers + about 12 PhD students/postdocs
- Organization : 2 theory teams + a few theoreticians in experimental teams
- Scientific life : weekly experimental and theory seminars (internal or joint with other labs of the polygone)
- Computing facility : cluster with 256 cores for 5 TeraFlops



Practical information for future Interns

Duration and salary :

- Minimum of 2 months
- Salary of 546 euros per month
- M2 internship may be extended over the summer
- For Germans : Diplomarbeit (one year project) is in principle possible if funding is available

Life @ Néel :

- Internal student seminar + buffet (twice per month)
- Good coffee...
- Check our new twitter account : #NeelTheory

M1 or M2 Internship with Jean-Christian Angles D'Auriac

Contact : dauriac@neel.cnrs.fr

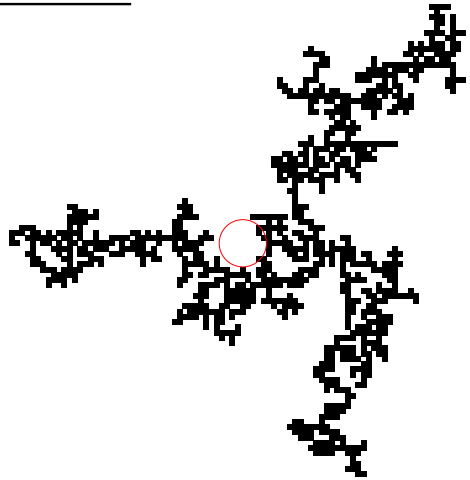
Possibility of PhD : No

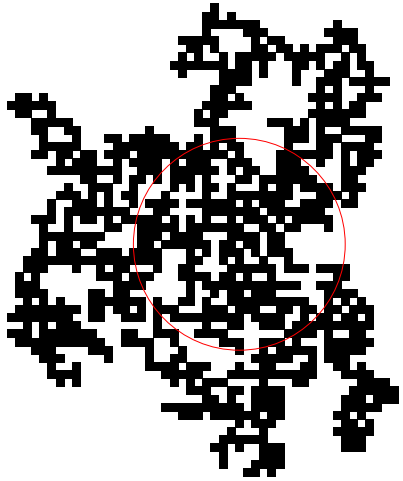
Topic : Deep learning and statistical physics

Title : "Can a neural network recognize a critical state ?"

Goal : Train a neural network to decide whether a given Bernoulli cluster is critical or not

Methods : Numerical simulations





M1 or M2 Internship with Serge Florens

Contact : serge.florens@neel.cnrs.fr

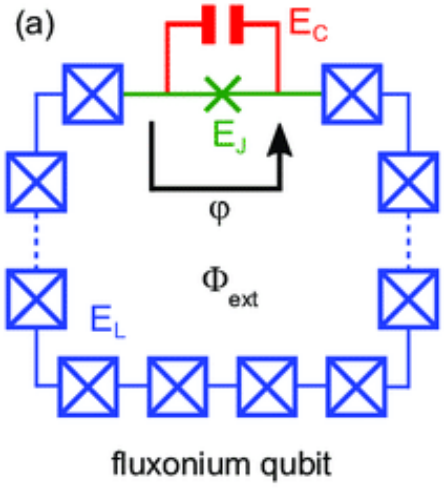
Possibility of PhD : No

Topic : Superconducting quantum circuits

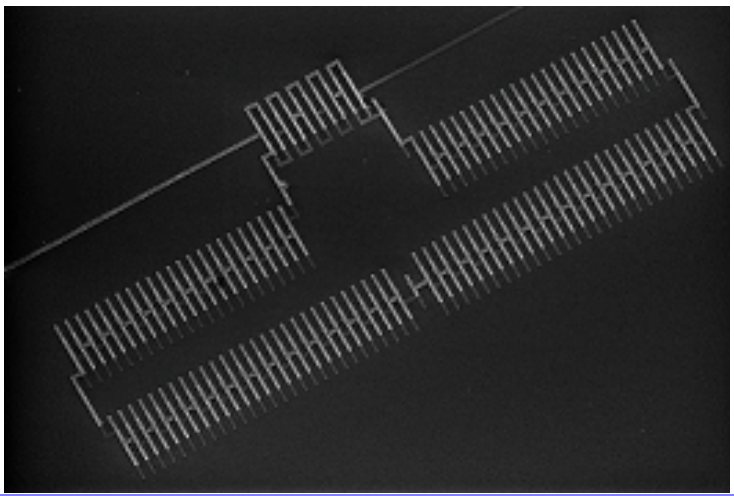
Title : “Many-body qubits”

Goal : Design & optimize qubits based on many degrees of freedom

Methods : Variational simulations



fluxonium qubit



M1 or M2 Internship with Adolfo Grushin

Contact : adolfo.grushin@neel.cnrs.fr

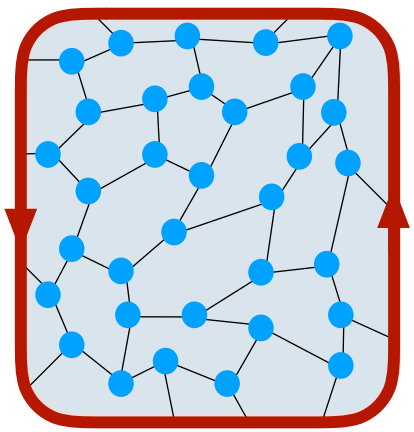
Possibility of PhD : Yes

Topic : Topological condensed matter

Title : Finding amorphous topological matter

Goal : Explore models without translational symmetry that can be topological

Methods : Tight binging modeling



M1 or M2 Internship with Adolfo Grushin

Contact : adolfo.grushin@neel.cnrs.fr

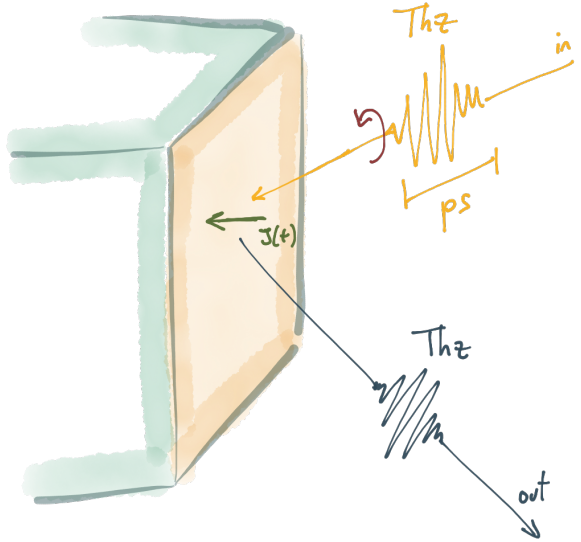
Possibility of PhD : Yes

Topic : Topological condensed matter

Title : Topological non-linear optical respones

Goal : Explore topological non-linear responses in metals

Methods : Tight-binding modeling, non-linear response theory



M1 or M2 Internship with Adolfo Grushin

Contact : adolfo.grushin@neel.cnrs.fr

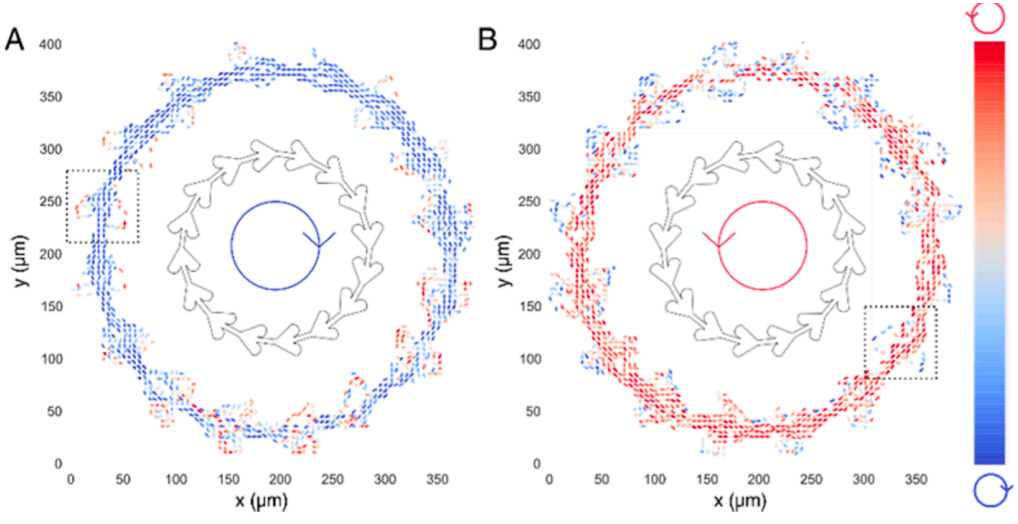
Possibility of PhD : Yes

Topic : Topological condensed matter

Title : Topological states in active matter

Goal : Can active matter can be topological ?

Methods : Diffusion equation



M2 Internship with Régis Mélin

Contact : regis.melin@neel.cnrs.fr

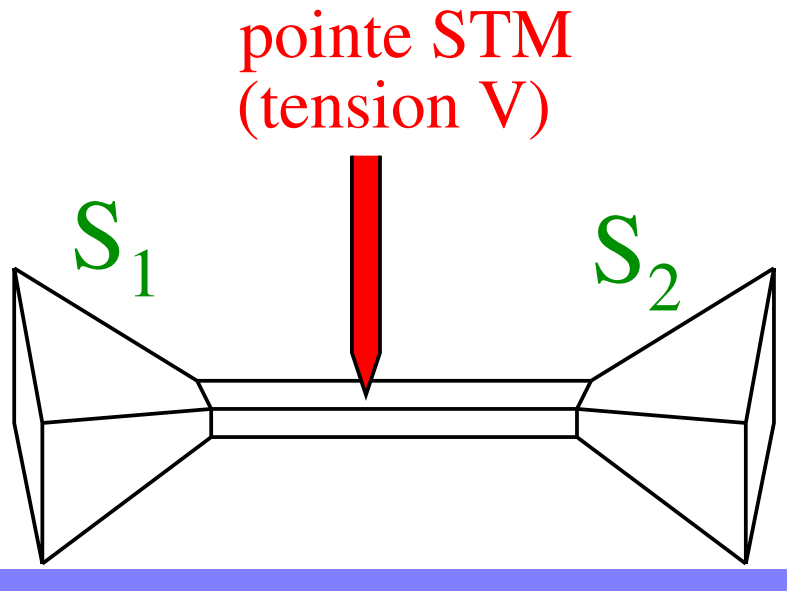
Possibility of PhD : Yes

Topic : Mesoscopic superconductivity

Title : Injection of a normal current in a junction

Goal : Model a scanning tunneling microscopy experiment

Methods : Non-equilibrium recursive Green's functions



M2 Internship with Régis Mélin

Contact : regis.melin@neel.cnrs.fr

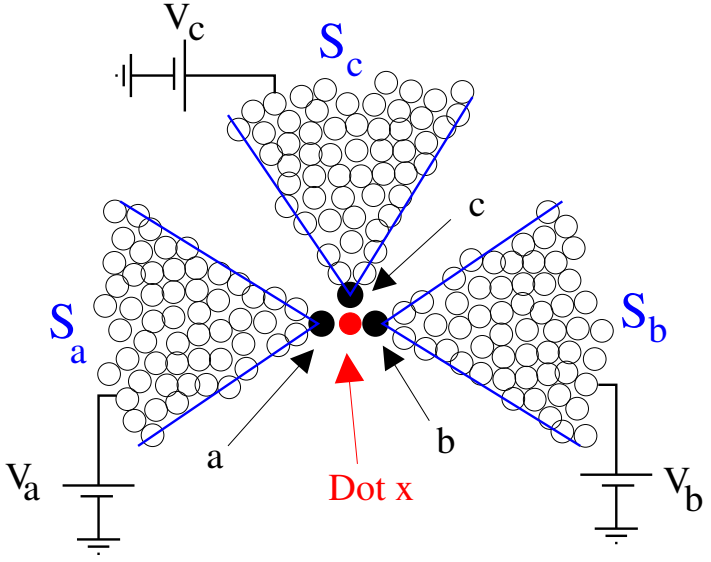
Possibility of PhD : Yes

Topic : Mesoscopic superconductivity

Title : Josephson transport with two frequencies

Goal : simulate a 3-terminal junction with 2 independent voltages

Methods : Semi-classical theory



M1 or M2 Internship with Valerio Olevano

Contact : valerio.olevano@neel.cnrs.fr

Possibility of PhD : No

Topic : Electronic structure

Title : "Exact resolution of the Schrödinger equation for Helium"

Goal : Use solution to benchmark approximate many-body theories or reverse engineer new approximations

Methods : Hylleraas wavefunction