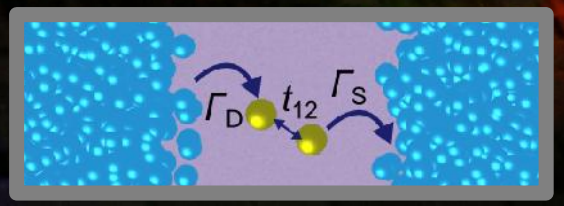
Grenoble, France

Postdoctoral position
on the physics of single dopants



in the nano-Si physics group:

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S. Ray (PD)

We offer a 2-year post-doctoral position at CEA-Grenoble, on single dopant physics using Silicon CMOS technology. This new field offers excellent prospects after the postdoc, with opportunities both in academic or industrial research.

In the last year our group has developped a robust and reliable method to obtain Single Atom Transistors (SATs) and Coupled-Atom Transistors (CATs) with state-of-the-art technology.
The devices, fabricated on 300mm wafers by our partner CEA-Leti, take advantage of the aggressive downscaling of fully-depleted silicon-on-insulator (FD-SOI) technology to reach channel dimensions (width, length, thickness) of the order of 10nm with very close control gates. We implement a multi-gate design in order to add new (quantum) functionalities in state-of-the-art technology.

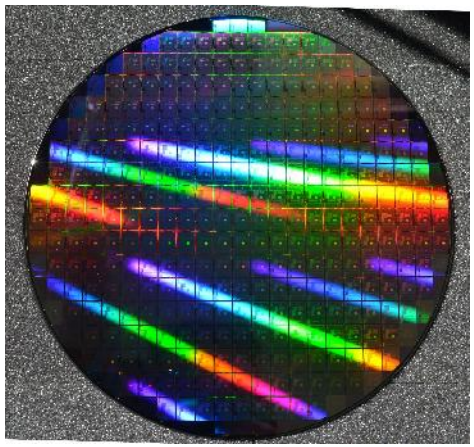


Fig1: 300mm wafer using trigate SOI technology, with SATs and CATs. collaboration CEA-INAC & CEA-Leti

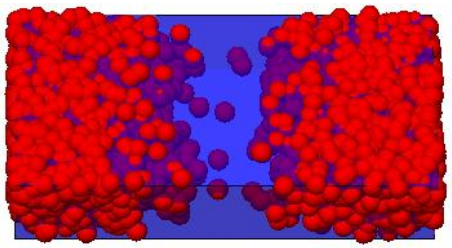


Fig. 2: Single-Atom transistor using dopant diffusion in a very small CMOS transistor channel volume.
Nature Nanotech. 5, 133 (2010)

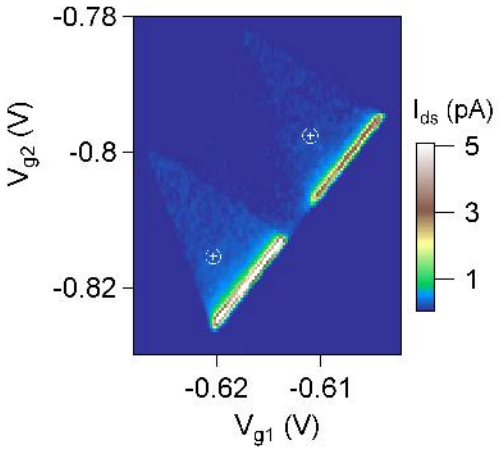
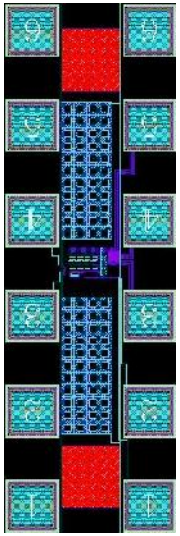
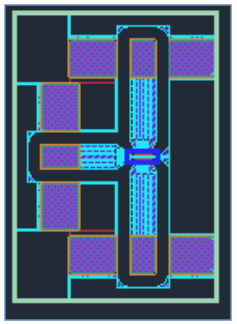


Fig. 3: Experimental signature at 100mK of a Coupled-Atom transistor in which transport occurs via two dopant's orbitals in series. This allows to perform spectroscopy, electron pumping and probe coherence.
Phys. Rev. Lett. 108, 206812 (2012)
Nature Comm. 4, 1581 (2013)
Phys. Rev. Lett. 110, 136802 (2012)

The postdoctoral fellow will investigate **new coupled-atom transistors** with different couplings to the leads and between the donor states. The problem of ionisation energies and double-occupation is of great interest, and can be addressed in our system where interfaces with insulators as well as conductors are very well controled.
The introduction of the first hybrid DUV/e-beam full CMOS process will allow the candidate to measure samples with **on-chip single-charge detectors and on-chip electronics** (images on the right).
Another direction to explore is electron pumps: these devices will allow to study extensively single charge pumping, both as a tool for probing transport mechanisms (like non-adiabatic charge pumping) or for metrology applications. This can be done in collaboration with PTB in Germany and the university of Riga, which are partners of the project.





A strong background in nano-electronic devices and physics as well as measurements at low temperature will be very helpful.

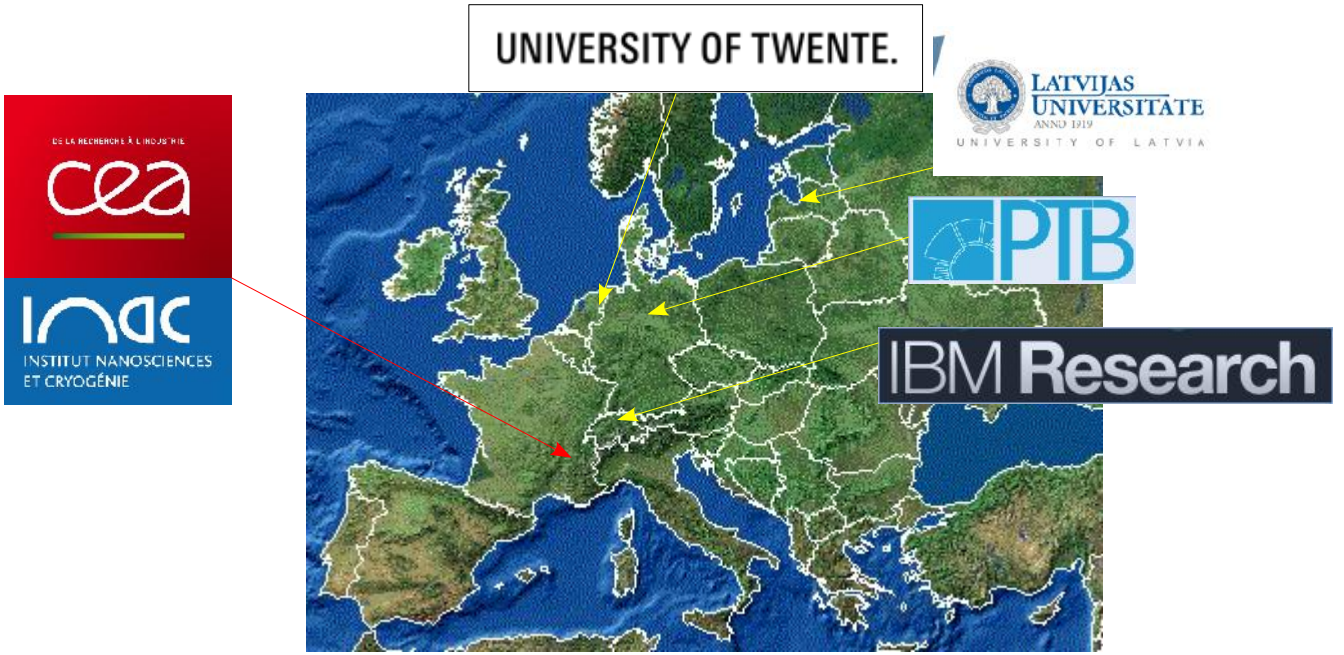
Full support in cryogenics and low-noise electronics

- conventional dilution refridgerator with RF lines & RF-SET reflectrometry setup
- conventional fast dilution refridgerator for conductance measurements
- new in 2014: home-made cryo-free He3 system custom designed for our use.
- new end of 2013: automated 300mm probe station allowing to select among the thousands of devices available.

We coordinate the SiAM project, standing for “Silicon at the Atomic and Molecular scale”, which aims at introducing a single atom, the most basic quantum system, in future ICT devices and circuits:

- At the device level, with the demonstration of atomic devices (single dopant) and molecular devices (coupled dopants) made with all fabrication methods currently available. A crucial effort towards integration of deterministic implantation in CMOS technology will be made.
- In the theoretical understanding, for exploiting the specific features of dopant-based devices, especially time-dependent processes.
- At the system level, with circuits exploiting the atomic characteristics of dopant based devices.

The main idea behind this work is to use the very sharp, deep and reproducible potential created by a dopant in a semiconductor host crystal, resulting in an isolated system robustly shielded from distortion in the environment. (http://www.the-siam-project.eu/)



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Grenoble campus

Surrounded by mountains, the Grenoble area offers both an excellent quality of life and an exciting scientific campus, with more than 10000 researchers in basic research, applied science and industry

Starting from right to left, the ESRF synchrotron facility, the ILL neutron reactor, ST microelectronics, CNRS and CEA labs and the city of Grenoble behind.