MOLOC :MOlecular LOgic Circuits

FET-Proactive Nanoscale ICT - **New Functionalities**

Objective

Provide the foundations and proofs of concept
of a Post-Boolean approach
based on the internal degrees of freedom of molecular structures
(also nanostructures, dopants in bulk material)
addressed electrically or optically at the atomic/molecular scale
to implement new functionalities in logic circuits .

New functionalities

•Logic is implemented at the hardware level :The molecule itself acts as a logic circuit (**more than a switch**).

•The logic is implemented by the **dynamics** of the non stationary molecular states created by the optical, electrochemical or electrical inputs. This dynamics is fast to ultrafast.

•**Concatenation** of the logic operation of two molecules.

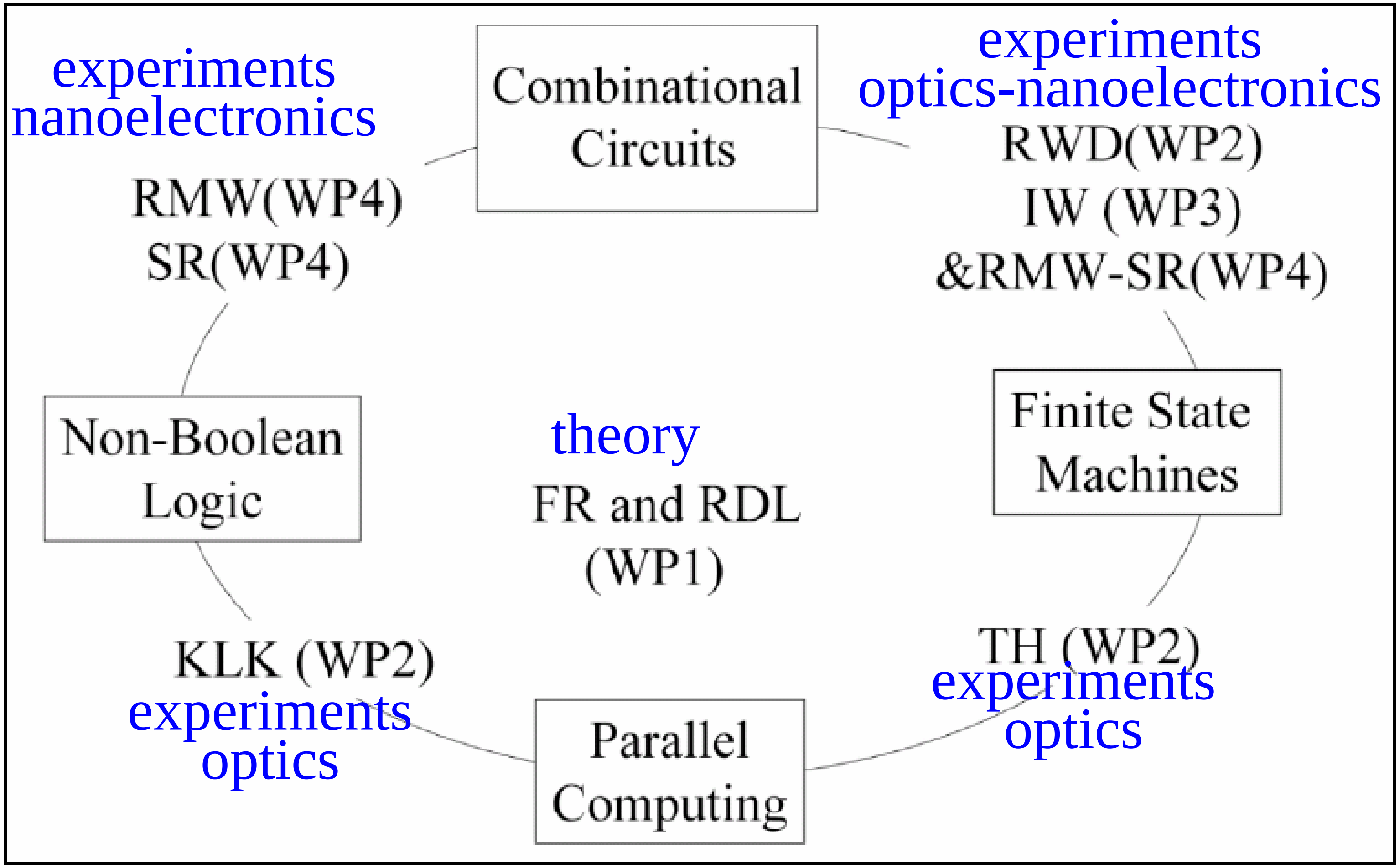
•Use the addressed molecular discrete states and their dynamics to implement:

- **multivalued logic**, e.g. ternary gates,
- **parallelism** : several molecular states can be addressed simultaneously by optical pulses (finite state machines with internal memory).

Presentation of the consortium

- F. Remacle (Theorist, WP1) : coordinator ,ULg, Liège.
- R. D. Levine (Theorist, WP1 leader) : HUJI, Jerusalem
- T. Halfmann (Quantum optics, WP2 leader): TU-Darmstadt
- R. Weinkauf (Optical excitation, WP2) : Düsseldorf University
- K. L. Kompa (Quantum optics, WP2) : MPQ, Garching
- I. Willner (Photo and electrochemistry of nanosystems, WP3) : HUJI, Jerusalem.
- S. Rogge (Atomic scale electronics, WP4 leader) : TU-Delft
- R. Waser (Nanoelectronics, WP4) : FZ-Jülich

Collaborative effort towards the MOLOC objectives



The MOLOC approach is based on multidisciplinary research

Closely combine theory and experiments for the design of the molecular logic circuits.

Experiments :Confined (atomic and molecular) systems addressed by different experimental techniques will be investigated in parallel

- addressing by optical short (ps to fs) laser pulses of atomic and molecular quantum systems in solids, immobilized on surface and in solution (WP2).
- electrochemical addressing of nanoparticles and nanoparticles arrays (WP3).
- electrical addressing of quantum systems (dopant molecules in semi-conductor, molecules in nanogaps) in solid state (WP4).

Theory (WP1)

- Develop ways to implement at the molecular level
  - non-Boolean logic
  - parallel computing
- Characterize the structure, energetics and dynamics of the systems investigated by the experimental partners.
- Control of the dynamics of the optical/electrochemically/electrically produce quantum states towards the required output
- Use the huge number of available quantum states to achieve high redundancy and error tolerance