

DE LA RECHERCHE À L'INDUSTRIE

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Flagship 2020-2024

NanoSaclay
Laboratoire d'Excellence
en Nanosciences et Nanotechnologies

BOGART:

**Bottom-up Synthesis and
Properties of Graphene
Related Materials**

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Duration: January 2020 to December 2024 (60 months)

Budget: 479 526 €

The project BOGART aims to achieve a breakthrough in terms of synthesis and exploitation of the optical and electronic properties of graphene related materials: Graphene quantum dots (GQDs), Graphene nanoribbons (GNRs) and Graphene Nanomeshes (GNMs).

3 Technological barriers:

- GNM: size of the structures
 - Large enough to be compared with theory
 - Large enough to be contacted for transport measurements
- GNRs: reveal their intrinsic properties
 - Solubilization (fight against aggregation)
 - Defect densities
- GQDs: Make a reliable structure-properties relationship (toward reverse engineering)

Partners:

CEA-NIMBE: Stéphane Campidelli

- Chemist, coordinator and synthesis of GQD and GNM precursors. Participants: Vincent Derycke, Daniel Medina-Lopez (PhD)

Laboratoire LuMIn (Lumière, Matière et Interfaces): Jean-Sébastien Lauret

- Physicist, study of the optical properties. Participants: Loic Rondin, Thomas Liu (PhD)

ICMMO: Vincent Huc

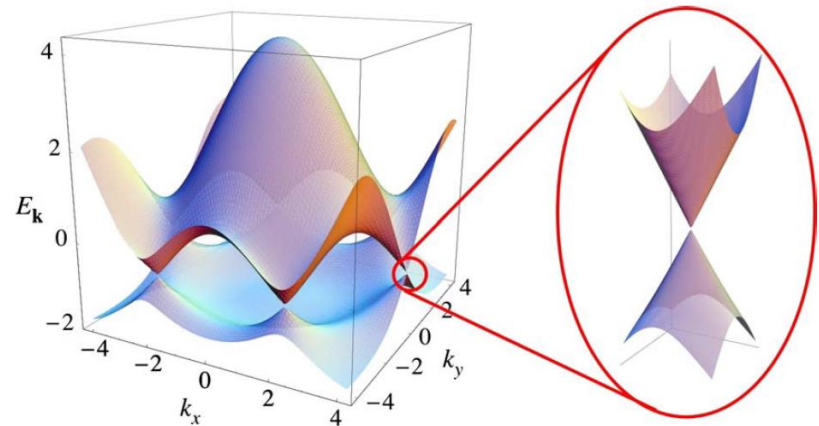
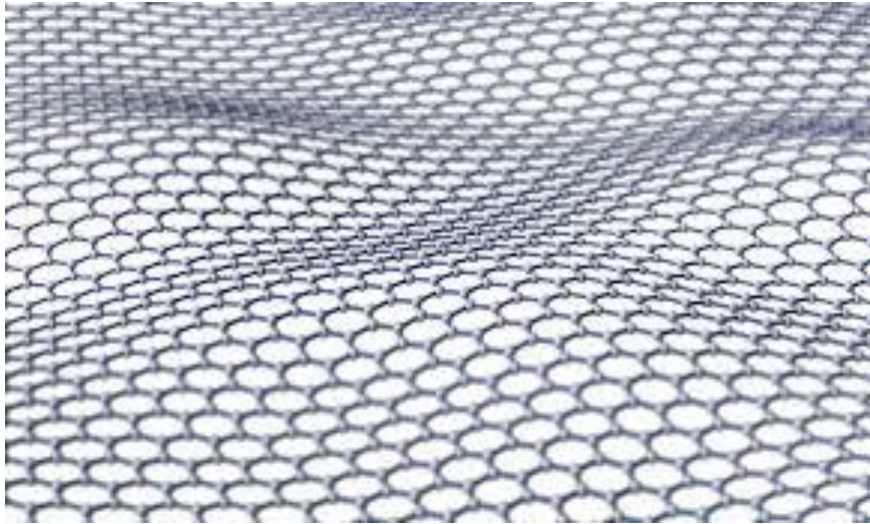
- Chemist, synthesis of GNR and GNM precursors. Participant: Talal Mallah

ISMO: Hamid Oughaddou

- Physicist, GNM growth and STM characterization. Participant: Andrew Mayne

CEA-SPEC: Sylvain Latil

- Physicist, theory on electronic and optical properties of graphene related materials. Participants: Yannick Dappe and Van Binh Vu (M2 – future PhD)



Semimetal, bandgap = 0 eV

A. H. Castro Neto, et al. *Rev. Mod. Phys.*, 2009, **81**, 109



2010

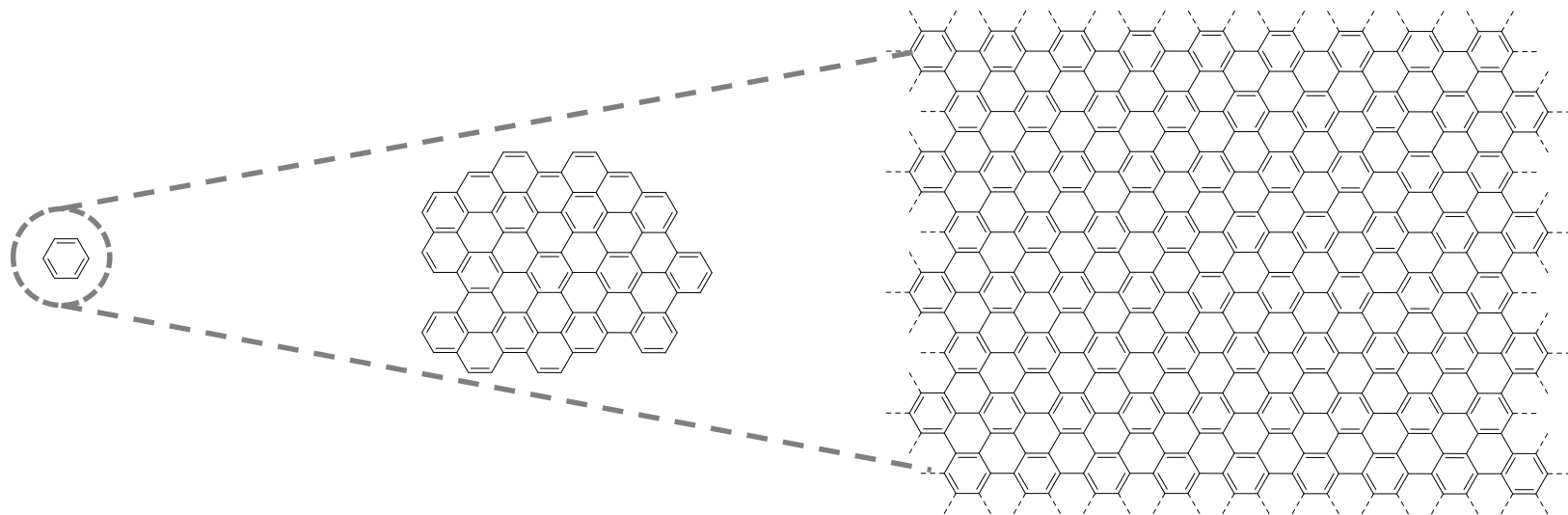


A. Geim & K. Novoselov

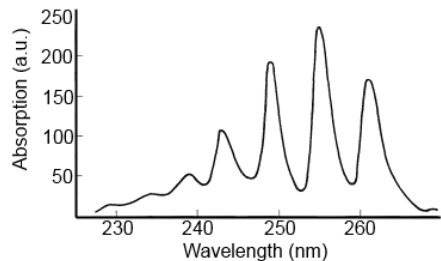
“It is unlikely that graphene will make it into high-performance integrated logic circuits as a planar channel material within the next decade because of the absence of a bandgap.”

K. S. Novoselov et al *Nature* 2012, **490**, 192

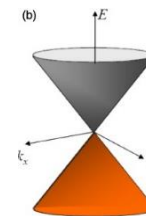
A GAP IN GRAPHENE



■ Absorption at **260 nm** (4.77 eV)

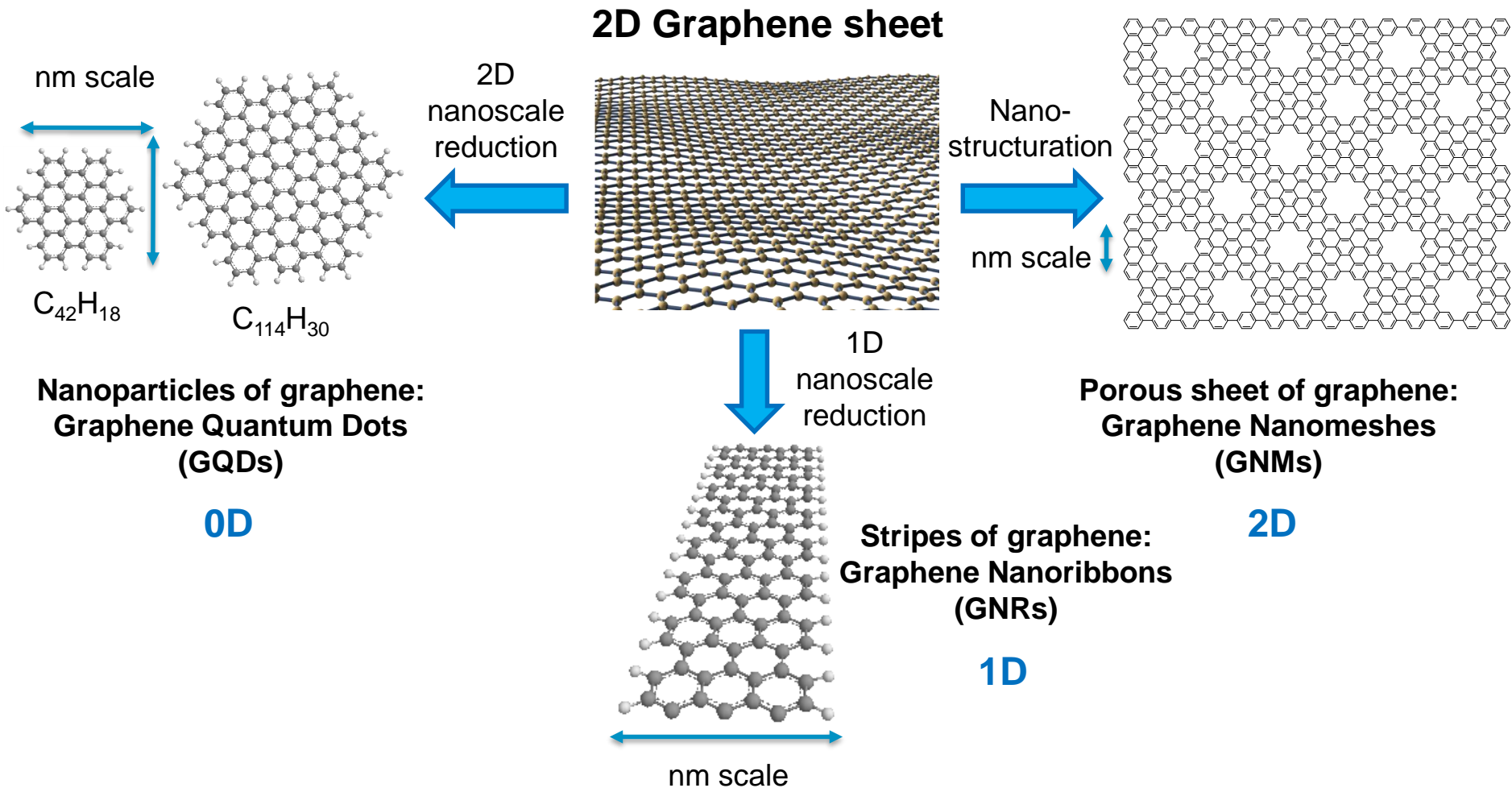


■ **Semimetal**, bandgap = **0 eV**



Control of the bandgap for optical or electronic applications

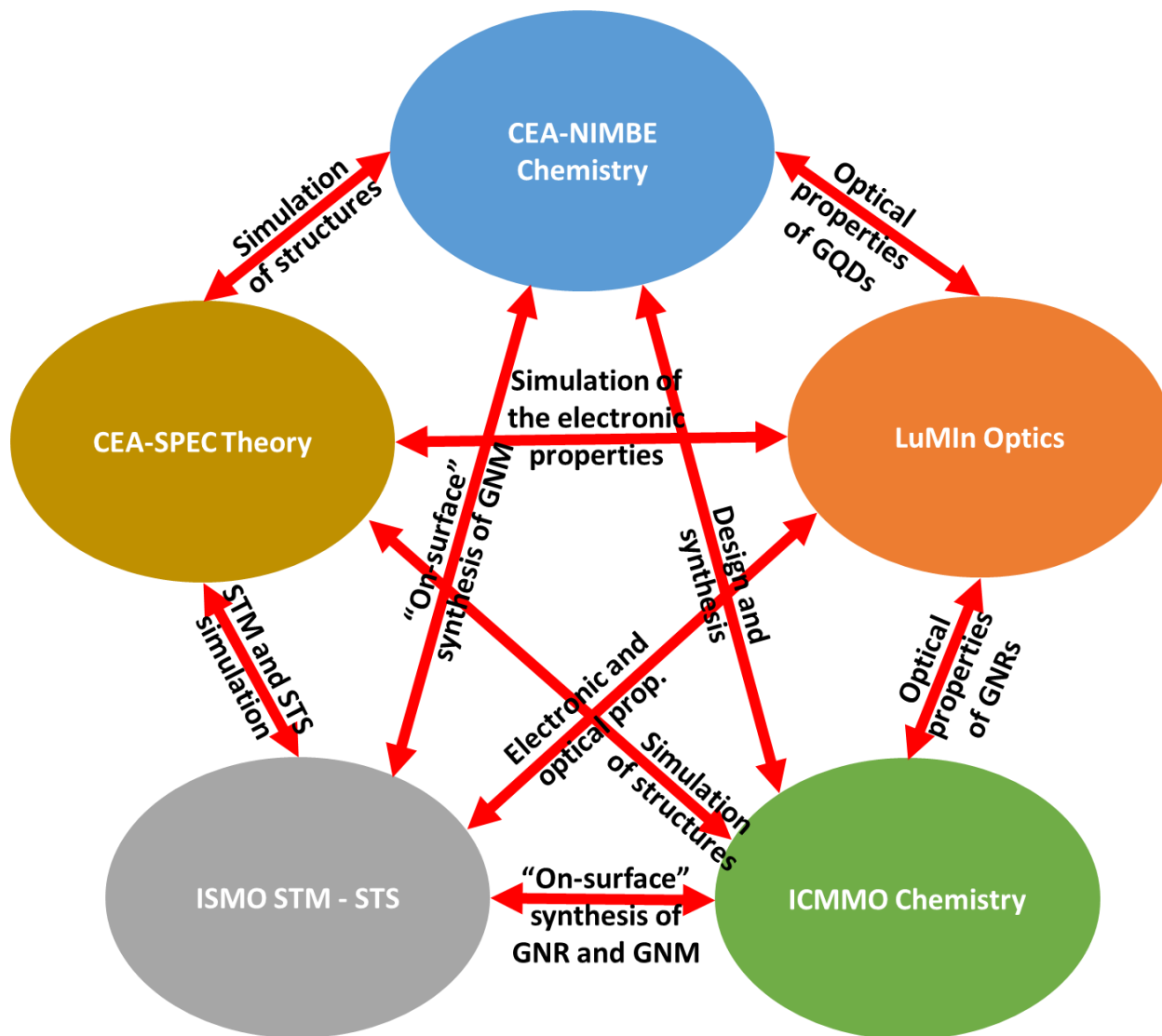
A GAP IN GRAPHENE

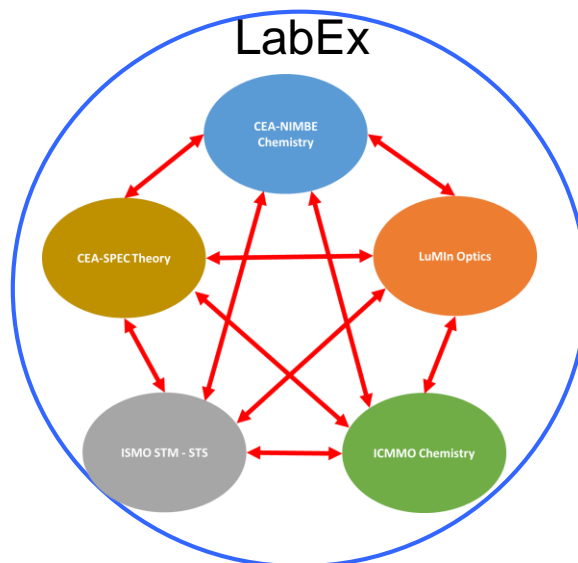


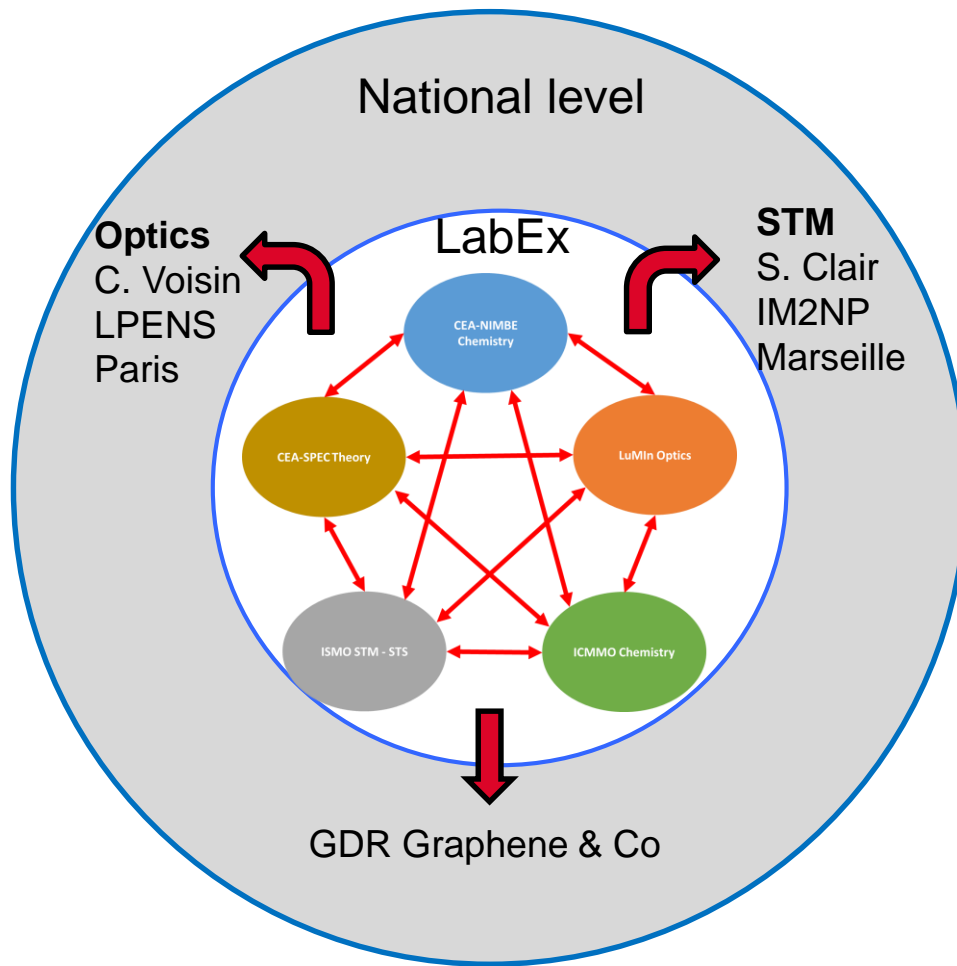
Possibility to control the electronic, spin or optical properties through the design of the structure **BUT** Needs a precise control of the shape; size and edges

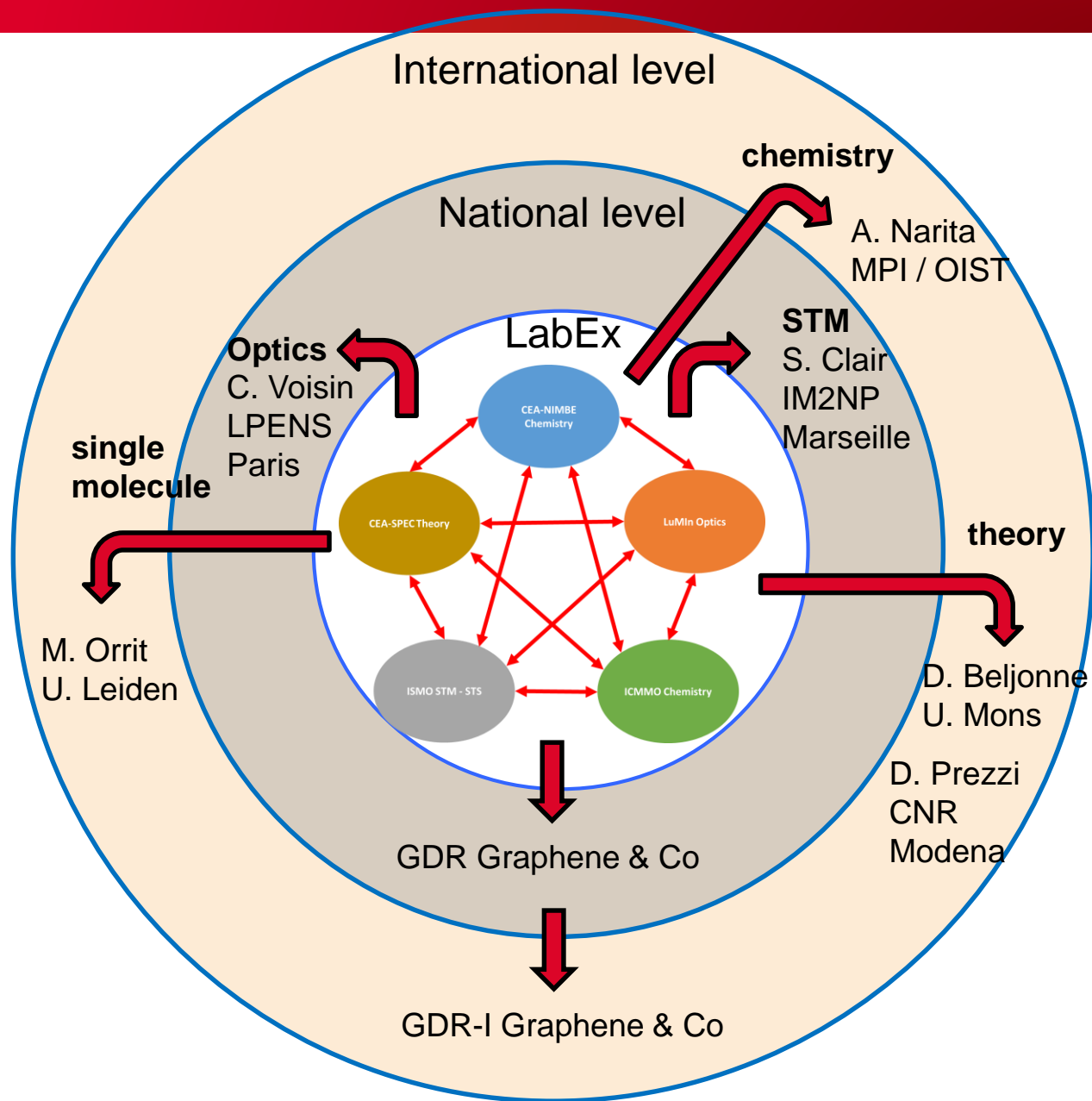
“Bottom-up” chemical synthesis is mandatory

STRUCTURATION









Thank you!



Commissariat à l'énergie atomique et aux énergies alternatives
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