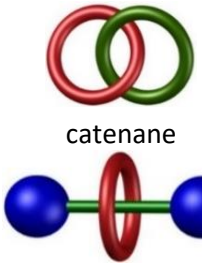
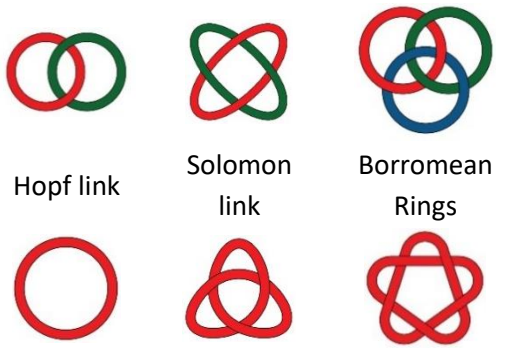
Towards supramolecular nanotopology: in search of new motives for the construction of molecular links and knots.

Mechanically Interlocked Molecules (MIMs) are systems that, unlike other, are not solely covalently connected, but are defined by a presence of the mechanical bond. The latter is defined as *"an entanglement in space between two or more molecular entities (components) such that they cannot be separated without breaking or distorting chemical bonds between atoms"*.[1] The most classic examples of MIMs are catenanes and rotaxanes. MIMs have attracted considerable interest not only due to their clear aesthetic appeal but also because of unique properties arising from presence of mechanically connected components. Over last fifty years the research focused on Mechanically Interlocked Molecules (MIMs) has transformed from the academic curiosity to the well-grounded branch of Synthetic Chemistry.



Mechanically Interlocked Molecules.

One group of a particularly fascinating MIM systems are molecular links and knots – topologically complex nanoscale manifestations of the abstract mathematical objects. The Knot Theory – a sub-field of Topology – has predicted existence of at least six billion of only prime knots setting the targets for generations of synthetic chemists. Even though the molecular links and knots were first synthetically addressed in 80's of the past century the field has not fully flourished yet. In the challenge of designing and constructing new systems and reaching for higher structural complexity, new synthetic strategies as well as novel building blocks must be developed.



Knots and links.

The primary objective of the research project is a development of synthetic strategies yielding new ligands, and their exploitation as sub-components for self-assembly of original molecular links and knots. In a consequence a group of sub-components will be developed, considerably expanding the scope of accessible motifs allowing to target molecular knots and links, and to address otherwise inaccessible topologies.

Development of a new set of sub-components will lay ground for the synthesis of an original links and knots. A significant degree of freedom in the functionalization of the building blocks will help to construct MIMs demonstrating tuneable properties. Most importantly, the designed sub-components will significantly increase the number of accessible constructional elements of complex topologies, allowing for preparation of these which were otherwise inaccessible.

Finally, one can anticipate that the successful development of new synthetic tools will help to address the problem of MIMs functions and real-life applications, bringing to fruition the opinion expressed by the Nobel Laureate Sir Fraser J. Stoddart that *„with molecular nanotopology in tow, molecular nanotechnology is about to leave the nanoworld and enter the nanogalaxy*".[2]

[1] Bruns, C. J., & Stoddart, J. F. *The Nature of the Mechanical Bond: From Molecules to Machines*, **2016**, Wiley.
[2] J. Fraser Stoddart *Nano Letters*, **2020**, DOI: 10.1021/acs.nanolett.0c02366