



With the advent of the LHC and the need for ever increasing accuracy, techniques in loops calculations have witnessed tremendous progress borrowing from highly complex mathematical structures and improving and adapting these structures. A very recent development concerns the use of *symbols*. **Giorgios Papathanasiou** will introduce some of these concepts starting from an elementary exposition of how these objects appear from the integrals one encounters in the evaluation of scattering amplitudes beyond tree-level. There will be 4 lectures:

1: Analytic structure of scattering amplitudes and Feynman integrals. Algebraic and transcendental functions. Classical polylogarithms.

2: Multiple polylogarithms (MPL): Integral and Series representations. Shuffle and quasi-shuffle algebras.

3: The symbol map. Properties. Integrability condition. Application: Resolving identities among MPLs and simplifying expressions.

4: (Optional) Advanced topics: The Hopf algebra of MPLs and the coproduct. Bootstrapping amplitudes. Expanding the symbol.