Proteomics is the next frontier for healthcare, but the progress is lagged by the restrictions to access protein sequencing. While protein sequencing methods started to develop before DNA, the widespread access and superior sensitivity of semiconductor or nanopore DNA sequencing technologies have given today the lead in the clinical context to Genomics.

DNA sequencing was based on molecular amplification using polymerase and the fingerprints of the nucleotides transduced by electrical signals resolved by nanopores (Oxford Nanopore) or by the polymerase assisted additions of nucleotides that occur only when a complementary nucleotide is added transduced by electrical signals (Ion-torrent Thermo Fisher). However, polymerase-like amplification methods do not exist for protein sequencing and the read out of amino acids (AAs) is still based on cumbersome and slow approaches like Blots, or expensive solutions like mass spectrometry (MS). These hamper the implementation of in-situ identification and characterisation of proteins.

Several attempts of single protein sequencing methodologies have been disclosed in the last five years, but they are conceptually similar approaches than the ones employed for DNA, based on affinity methods (labels or enzymes) or Nanopores. The new generation of protein and peptide sequencing will require an innovative technology made by new materials and components because the adaptation of the approaches employed with DNA are not able to cope with the difficulties to resolve 20 AAs (compared to only 4 nucleotides) with the high sensitivity (approaching single molecule) that the new healthcare applications require.

Here we will discuss the unique fingerprints that can be found with graphene. These fingerprints, in principle, could go beyond MS fingerprints as we have observed ways to distinguish the 20 standard amino acids for ex-novo sequencing without genetic information. We will discuss a way to deploy these fingerprints for sequencing and why the quantum properties of graphene make it the best adapted technology to transduce the amino acid signatures rather than traditional semiconductor field effect transistors.