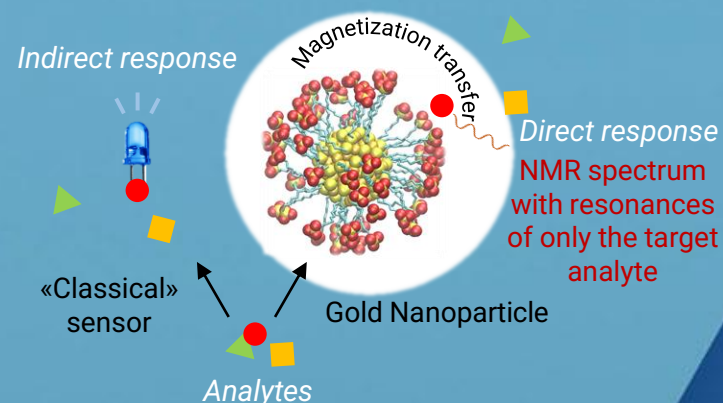


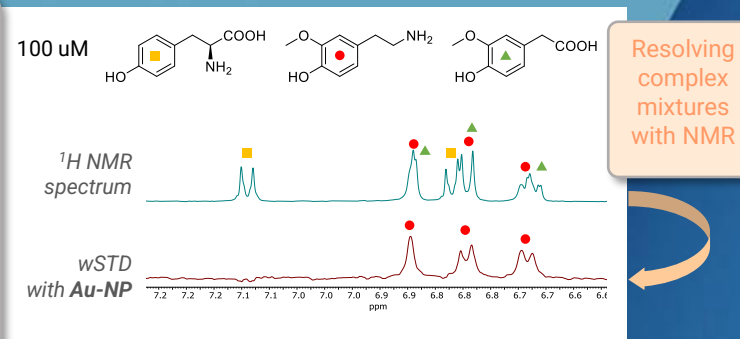
Introduction

The majority of sensing methodologies for the detection of target compounds in complex mixtures exploit the feedback of a sensor to indirectly detect the analytes of interest. The response is then processed using standards, if available, and ensured by the robust selectivity of the sensor itself. On the other hand, **NMR chemosensing aims to obtain signals directly from the analytes**, in the form of an NMR spectrum, to unequivocally identified the target molecules.



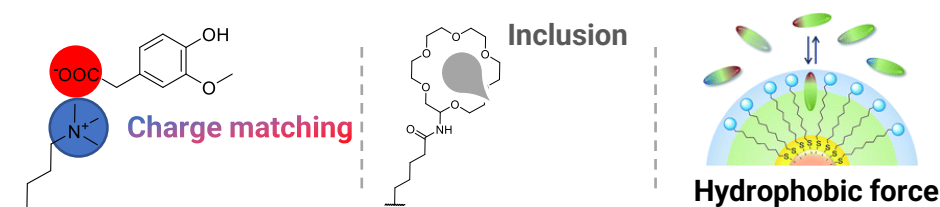
NMR methodologies

Different NMR approaches can be applied by exploiting the selective binding of gold nanoparticles. The core of these techniques relies on the intermolecular NOE effect, which produce a **magnetization transfer from the nanoparticles' organic ligands to bound analytes**. These techniques can be differentiated in **non-mediated (NOE Pumping, Saturation Transfer Difference (STD))** and **mediated (Water-Ligand Observed via Gradient Spectroscopy (wLOGSY), water-mediated STD (wSTD))** experiments.¹

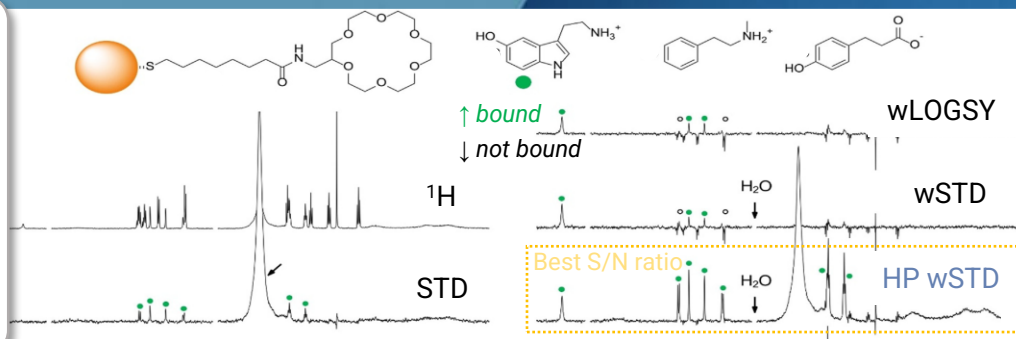


Results & Discussion

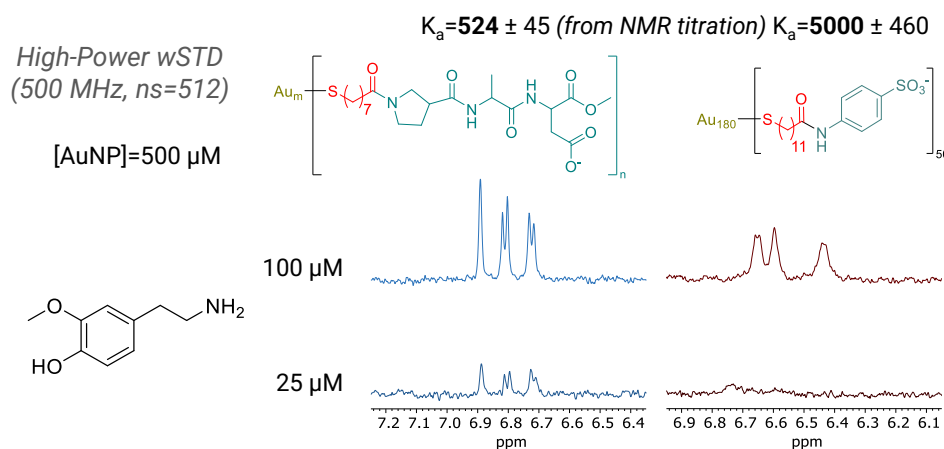
1 Gold nanoparticles with ≈ 2 nm diameter can be prepared by a two-phase adapted Brust-Schiffrin protocol.² **Selectivity and affinity** of Au-NP are modulated on the basis of the chosen thiol (charges matching, hydrophilicity, pockets formations, etc.).



2 When analyzing mixtures containing analytes at μM concentration, the **sensitivity** of the NMR technique is crucial. High-power w-STD has shown the best performances. In this case the peak of water is selectively inverted using a high power ($\sqrt{2}B_1=750$ Hz) Gaussian pulse, in order to wipe-out all spurious effects arising from non-bonded analytes.



3 Inspired by the binding capacity of proteins, tripetidic thiols have been prepared using a solid-state synthesis. The corresponding nanoparticles, were tested on **catecholamine metabolites, a key urine bio-markers for neuroblastoma diagnosis**.³ These molecules are present in child urine at a μM concentration down to nM, increasing in pathological condition. The choice of Au-NP with suitable association constant is crucial to assure acceptable S/N and preservation of fine structure of signals.



Conclusions

Au-NP are tailorable chemosensors which can be synthesised with relative easiness. Depending on the analytical requests, a vast choice of ligands can be selected to proper match the physico-chemical properties of the target analytes. The use of 1D NMR techniques have been pushed to detect μM concentration of diagnostic bio-markers.