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Spike Proteins in MERS-CoV, SARS-CoV and SARS-CoV-2 Coronaviruses: Differences in Proteic Conformation

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In recent years, three different coronaviruses (MERS-CoV, SARS-CoV and SARS-CoV-2), posed a grave threat to the global public health, security and economy. All these RNA viruses present a similar surface structure characterized by Spike Glycoproteins (S) having a key role in viral pathogenesis. The S proteins protrude from the surface of mature virion (see Fig. 1), and are responsible for anchoring the host cellular membrane though its receptors. Through biological investigations, has been proposed that the transmissibility of different CoVs viruses is strongly related to different spike protein secondary conformation.
Here, we investigate through infrared and terahertz spectroscopy, the secondary conformation of Spike glycoproteins for MERS-CoV, SARS-CoV and SARS-CoV-2. We experimentally prove that the three viruses present Spike glycoproteins with different secondary conformations. In particular, SARS-CoV-2 has a secondary conformation characterized by the formation of intermolecular β-sheet structures, more able to anchoring the virus to human receptors.
Moreover, we also proved that the conformation of SARS-CoV-2 strongly change by passing from an alkaline environment (characterizing the bats ambient) to physiological one (characteristic of human physiology). All these information, strongly indicate the huge capability of the SARS-CoV-2 virus to adapt to different external conditions and paves the way to use vibrational spectroscopy as an alternative monitoring approach (in particular in open spaces), overcoming the limitations of conventional bio-chemical ones.

Primary authors: Dr D'ARCO, Annalisa (Istituto Nazionale di Fisica Nucleare and SBAI Department, Sapienza University of Rome); Dr DI FABRIZIO, Marta (Department of Physics, Sapienza University of Rome); Prof. DELLA VENTURA, Giancarlo (Department of Science, University of Roma Tre); Dr MARCELLI, Augusto (LNF); Prof. LUPI, Stefano (INFN-LNF and Department of Physics, Sapienza University of Rome)

Presenter: Dr D'ARCO, Annalisa (Istituto Nazionale di Fisica Nucleare and SBAI Department, Sapienza University of Rome)

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