INPhINIT  “La Caixa”  (<https://hosts.lacaixafellowships.org/finder>).

Date limit: **04/02/2020**

Job Offer

**Modeling virus dissemination in the subsurface and potential risk implications (Prof.Xavier Sanchez-Vila)**

**Research Project / Research Group Description:**

 Waterborne diseases kill. They are the cause of a large number of health issues -cholera, hepatitis, dysentery, SARS- worldwide, and cause over 2 million deaths every year, mostly children under 5. Waterborne diseases are reported worldwide, but there is a relationship between the incidence of waterborne diseases and poverty. In a vicious circle, people with little access to a reliable source of safe water, in quantity and quality, mostly in rural areas, must devote a portion of their time to fetch water for their families, sometimes seeking unsafe alternatives. As a side effect, perpetuation of gender roles, biasing access to education to young girls. This proposal focuses on groundwater, a large source of water supply, with about half the population worldwide supplied from wells, over 70% if only rural areas are considered. Groundwater bears a number of threats (viruses, bacteria and chemicals of emerging concern). The PhD candidate will incorporate to the Hydrogeology Research Group of UPC-CIMNE. The Hydrogeology Group is working on the characterization of permeable media by hydraulic and hydrochemical data. Applications include groundwater resources, aquifer management, study of wetlands, saltwater intrusion in the soil, and managed water resources. The methods span all scales from the micropore to the regional, including experimental work, process description, and numerical modeling of flow and mass transport including the reactive component between dissolved substances and water-solid interactions.

**-Job position description:**

We focus here on virus transport that, in the literature are treated either as solutes or as colloids, with sophisticated approaches including a three-phase system (immobile solid, aqueous, and colloidal phases). Viruses can absorb to larger natural colloids and compete for the sites with dissolved substances, but nobody has yet explored the impact of considerin their duality colloid/particle, that may explain the large distances traveled by some viruses under specific geochemical setups. We will include here concepts such as aggregation of colloids, formation of self-colloids, and transport in a multicontinuum porous media, thus introducing new terms in the traditional virus transport equations. The solution of the newequations will help explaining why (and when and how) wells or springs that are pathogen-free show a sudden outbreak. Solutions will be sought using fully meshless Lagrangian methods, as this framework allows dealing with the intrinsic natural heterogeneity of porous media and a variety of complex transport processes. These methods simulate solute transport by tracking in time a large number of particles injected into the system that interact between themselves and with the media. The state, position, and mass of the particles are changed according to predefined relationships representing the actual processes occurring at different scales. This methodology avoids numerical difficulties such as numerical dispersion and oscillations. Multivariate statistics will be used to synthetically create geological images of aquifers including preferential pathways that concentrate flow and drive virus (and in general pollutant) migration, and recognized as crucial to characterize risk events.