NeXT-Grenoble: THE NEW NEUTRON AND X-RAY TOMOGRAPHY INSTRUMENT IN GRENOBLE

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Summary: NeXT-Grenoble is a new tomography instrument which combines the uniquely powerful neutron flux offered by the Institut Laue-Langevin with x-ray imaging, making simultaneous acquisition possible which allows their complementarity to be exploited, for example during *in-situ* tests.

NeXT-Grenoble is a new Neutron and X-ray Tomography facility in Grenoble, born in 2016 from a collaboration between the Institut Laue-Langevin and the Université Grenoble Alpes (specifically Laboratoire 3SR), and takes advantage of its world-leading cold neutron flux.

A key feature of the instrument is the possibility to perform *simultaneous* x-ray and neutron tomography as sketched in Fig. 1, in order to take advantage of the high complementarity of the attenuation coefficients of these two techniques. Indeed, neutrons and x-rays interact differently with the atomic structure of materials, which means that they can provide different information about the same material. For instance, neutrons interact with hydrogen-rich substances more readily than x-rays, simplifying therefore the identification of water and hydrocarbons as highlighted in Fig. 1. Moreover, the registration of the two volumes is made possible by recent developments [1] as implemented in [2] which also provide phase identification with much more ease than with either image individually. The high complementarity of neutron and x-rays can be taken advantage of to explore a plethora of processes of great relevance in several fields (geomaterials, energy storage, bio-mechanics, plants, *etc*).

Beside the complementary x-ray and neutron setup, this instrument takes advantage of the worlds highest neutron flux offered by the Institut Laue-Langevin, allowing for unprecedented resolutions (≤ 4 μm true resolution) and speeds (1 second tomographies), a new record in the domain of neutron imaging.

Also, the instrument was designed having in mind a broad variety of thermo-chemo-hydro-mechanical *in-situ/in-operando* testing applications. It is capable of withstanding the weight of cells up to several hundred kilograms while remaining stable at high resolutions thanks to the granite exoskeleton and its large and accurate hollow rotary stage. Correspondingly, the instrument allows for voluminous cells thanks to the movable detector and the abundant free space above ($\sim$ 1 m) and below the instrument ($\sim$ 1.5 m). This, together with the aforementioned performances has already allowed, for example, a range of high pressure ([3, 4]), high temperature [5] and hydro-mechanical *in-situ* tests ([3, 4, 6]) to be successfully performed at high speeds ([6, 5]).

A major upgrade of the instrument is foreseen in the forthcoming two years to further improve its performances as well as to add new options (*e.g.*, monochromation, polarised neutrons, grating interferometry).

This instrument is open for proposals through its dedicated website https://next-grenoble.fr/.

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The current state and future plans of this instrument as well as some key applications will be shown in this contribution.

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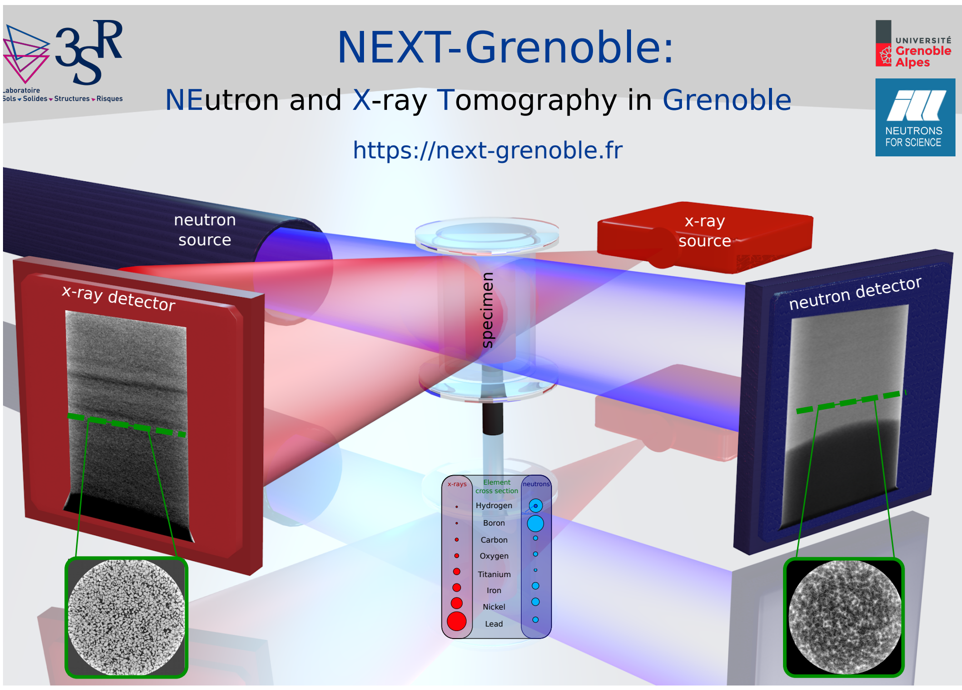

Figure 1: Sketch of the concept underlying NeXT: the high complementarity of x-rays and neutrons can be exploited, *for example* to study the hydro-mechanical properties of geomaterials: the flow properties can be explored using the hydrogen attenuation of neutrons while their evolving microstructure can be investigated optimally with x-rays.