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Synchrotron microtomography in palaeontology, a bright future for the South African exceptionnal fossil heritage at the ESRF

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The first application of X-ray synchrotron microtomography in palaeontology was performed in 2000 at the ESRF on the beamline ID19. This topic has been so successful that it has become one of the very visible research topics at the ESRF, making synchrotron microtomography the golden standard for non-destructive imaging of internal structure in fossils, when conventional microtomography reaches its limit. Considering the exceptional fossil record preserved in South Africa, palaeontology became a major collaborative topics between the ESRF and South-Africa during the last decade. More recently, archaeological applications have joined this portfolio. In most of synchrotrons using microtomography, sample size is typically limited to few millimeters in most of the beamlines, with only a handful of them allowing specimens in the decimeter range. Larger specimens are typically imaged with high energy conventional X-ray tomographs, but with severe restrictions in term of resolution and sensitivity. There is a clear lack of solution for high-sensitivity imaging in large fossils.

The BM18 beamline project at the ESRF, made possible by the development of the EBS new source, aims to tackle these limitations all at once by making possible synchrotron multi-resolution imaging on much larger samples than today, with special emphasis on fossils and natural and cultural heritage specimens. In addition to the other beamlines that were already involved in the thematics (ID19, ID17, BM05) BM18 will be able to image specimens up to 1 m in diameter and 2.5 m vertically. It will cover a pixel size range from 200 µm down to 1 µm, thanks to a 30 cm wide polychromatic beam able to reach 300 keV, tunable in flux, spectrum and geometry through various in-line X-ray optics. The whole beamline is designed for multi-resolution investigations using semi-automatic multi-detector system. The exceptional coherence properties of the ESRF-EBS, coupled with the 38 m of propagation on BM18 will allow phase contrasts imaging capabilities without equivalent worldwide.
BM18 should open tremendous new research capabilities for paleontology, but also for many other research fields, including archaeology, cultural heritage or evolutionary biology. The expected start of first user operations is planned for September 2021.

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