**MOLAB User Report**

**Project Title:** THertzHyperPHerc: THertz and NIR Hyperspectral imaging of opistographic and multilayered papyri

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**Venue:** Officina dei Papiri Ercolanesi, ‘Vittorio Emanuele III’ National Library of Naples (IT)

**Report text:**

***Scientific background***

*PHerc.* 1691/1021, belonging to the papyrus collection from Herculaneum,is an opistographic roll. Twelve text columns (cols. Z-M), which belong to the same text as that written on the *recto* and that are indirectly known to us through 18th-century apographs, were added on the back of the roll by either the scribe or a corrector. Currently, the unrolled fragments are sticked to kraft paper and this does not allow to read the text written on the back any more. The challenge is to read the latterthrough non-invasive techniques without removing the extremely fragile papyrus fragments from their kraft paper, whatwould result in their irreparable destruction. The application of advanced non-invasive techniques is the only way at our disposition today for recovering the precious textual portions written on the *verso*.

***Techniques***

TeraHertz imaging is a recently demonstrated tool for content extraction and contrast enhancement through layered structures such us medieval manuscripts or multilayered papyrus fragments, with anhigh penetration capacity. A French TeraHertz MOLABlead by D. Giovannacci was made available by IPERION CH and installed on May 2018 in the premises of the Officina dei Papiri Ercolanesi of the ‘Vittorio Emanuele III’ National Library of Naples.Conventional multispectral imaging has historicallyproduced excellent results on several kinds of papyri and, especially, onHerculaneum papyri, butis not able to penetrate into papyrus layer(s). On the contrary, NIR Hyperspectral imaging ispartially able to do so. Another FrenchMOLAB specialised in this technique and lead by Ch. Andraud was made available by IPERION CHand installed on February 2018 in the Officina dei Papiri Ercolanesi. To our knowledge, this was the very first time that these techniques were tested on Herculaneum papyri.

***Results***

NIR Hyperspectral imaging.All fragments from*PHerc*. 1691/1021(nine large papyrus fragments) were imaged and analysed through different filters with excellent results in terms of contrast and text legibility. This crucially impacted on the text reconstruction, by producing a textual improvement of about 10%more than was previouslypossiblethrough conventional multispectral imaging. Moreover and most importantly, some portions of the Greek text lying on the *verso* and previously known to us only through the witness of the Oxonian apographs were revealed again more than 200 years after their first discovery. The textual comparison with the Oxonian apographs allowed to establish their exact position with respect to the *recto*.The recovery of the text lying on the *verso* is finalised to the new critical edition of this book currently being prepared by K. Fleischer in the framework of the European ProjectREA Marie Skłodowska-Curie IF 703798-AcadHist supervised by G. Ranocchia. A specialised article discussing these groundbreaking results is now being prepared for publication in a physical review. TeraHertz imaging: five substantial papyrus fragments belonging to*PHerc*. 1691/1021 were imaged. The resulting data set is currently still being analysed by the team.