

# **WP 10 Deliverable No. 10.5 – D65**

## **Report on the characterisation of MPOs**

Project acronym:  
**AHEAD2020**

Project Title:  
**Integrated Activities for the High Energy Astrophysics Domain**

Grant Agreement No: **871158**

**This deliverable is part of a project that has received funding from the European Union's  
Horizon 2020 research and innovation programme**

Start date of the project:  
**2020-03-02**

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<b>Version</b>	<b>Revision Date</b>	<b>Prepared by</b>	<b>Review and approval</b>
1.0	31.10.2022	Charly Feldman	

<b>Distribution List</b>	<b>Date</b>	<b>Version</b>
Vadim Burwitz	01.11.2022	1.0

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## Commissioning of the test stand

Since the previous report, there has been much progress in the build and commissioning of the Vertical Test Facility (VTF) at the University of Leicester, but also some unfortunate technical setbacks. The VTF has been severely delayed due to Covid, resource availability and office/building moves. It was hoped that the VTF would be commissioned before the summer of 2022 and some initial data has been taken, but further upgrades and electronics issues have delayed full testing.

The purpose of the VTF (Figure 1) is to enable fast screening of individual MPOs and provide fast screening of large batches of optics. In order to determine how long it would actually take to change over from one MPO under test to another, several dry runs of the procedure were performed. The current estimate, based on these dry runs, is 2 hrs, far quicker than originally thought. This would enable up to 3 MPOs and possibly 4 to be tested in a day.



*Figure 1: The VTF facility.*

The software, which controls the Micro Channel Plate (MCP) detector, the actuators for the Micro Pore Optic (MPO) mounting stage and the Z-drive bellows, which adjusts the source to optic distance, is working and has been tested although the movement has not been calibrated.

Regrettably, during one of the dry-runs in March, a step was missed and the turbo pumps controlling the pressure in the source and detector sections shut down allowing the pressure within these sections of the facility to increase to 1 mbar. As the source and detector were powered up at the time, this rapid increase in pressure blew the filament on the X-ray source and caused damage to the detector and

preamps. The detector gain was also affected by the uncontrolled power down, but after extensive investigations, the detector is now up and running again.

The first MPO was placed in to the VTF test facility and an image obtained (see Figure 2). This image was not as expected and highlighted the need to improve the modelling. Work has been undertaken to improve the model and is still ongoing.

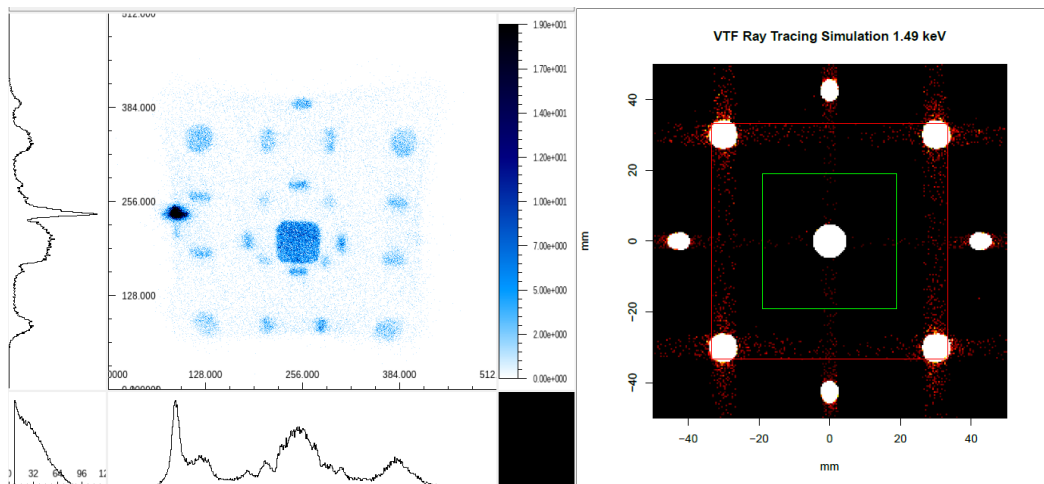


Figure 2: First image of an MPO using the VTF on the left and a model of the set-up on the right.

The first THESEUS MPO was placed in to the facility and an image taken as shown in. This image showed that for a flat MPO, as is the case for the THESEUS MPOs currently, the source to optic distance and optic to detector distance have to be exactly equal in order to measure the MPO. The facility was adapted (Figure 4) to get the distances as close as possible and a series of images were taken during alignment of the MPO (Figure 5).

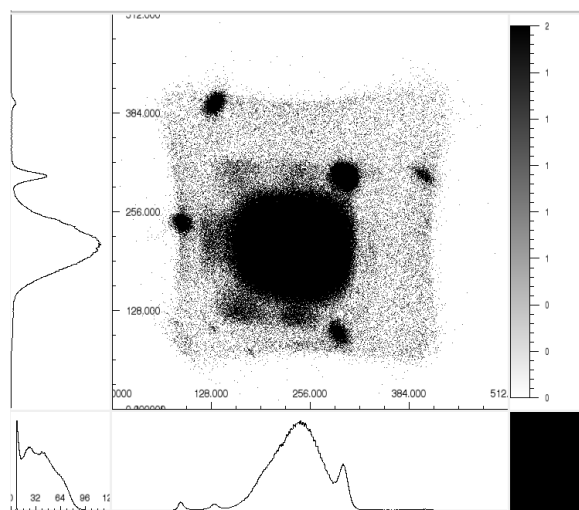
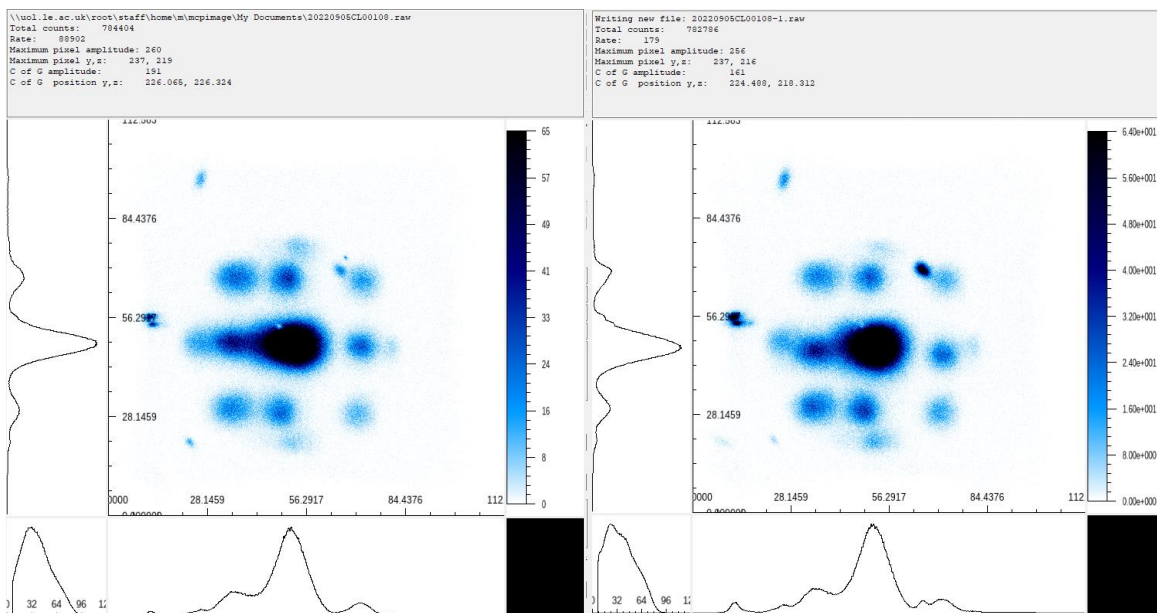


Figure 3: First (saturated) image of a THESEUS MPO within the VTF.



Figure 4: Extension added to the source section to try to make the source to optic distance equal to the optic to detector distance.



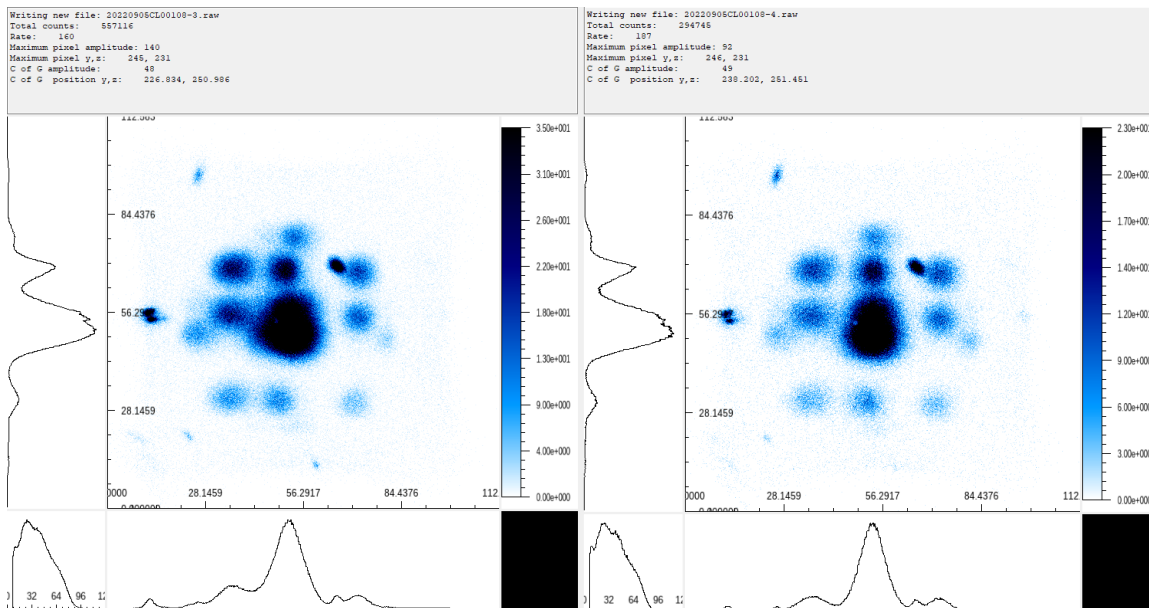


Figure 5: Series of images taken of the first THESEUS MPO during alignment.

Unfortunately, during this series of images, the electronics that control the X-ray source suffered a high voltage break down due to age (20 years old) and had to be returned to the manufacturers for repair. During this period, additional pieces of hardware have been purchased to allow greater control and flexibility of the source to optic and optic to detector distances. In addition, the mounting and optic manipulation stage are being upgraded to improve the movement of the optic and to stop the manipulation stage from jamming during optic alignment.

It is hoped that the VTF will be fully commissioned and the MPOs for the THESEUS Phase A campaign and the SMILE flight MPOs will be tested within the next month in the facility.

As no measurements have been made of an MPO with the correct source and detector distances or in correct alignment, no comparison has been made between the previous measurements and the VTF measurements.

## Summary

The build and commissioning of the Vertical Test Facility (VTF) at the University of Leicester has had some progress, but also some unfortunate technical setbacks.

The detector has been repaired since the damage caused in March (previous report) and images for the first MPO were taken on 6<sup>th</sup> June 2022. Images of the first THESEUS Phase A MPO were taken in August but they were very hard to interpret as the source to optic distance was not equal to the optic to detector distance. The facility was adapted to improve the distances but unfortunately, after a short series of images were taken, the electronics that control the X-ray source suffered a high voltage break down due to age (20 years old) and had to be returned to the manufacturers for repair. The facility is being upgraded whilst the source is being repaired to make alignment of the MPOs easier and to make the distances between the source to optic and optic to detector closer to each other. It is hoped that the SMILE flight optics will be tested within the next month.