AST-RX: Accès Scientifique à la Tomographie par Rayons X

UAR 2700 2AD (CNRS-MNHN)

The team

Technical manager / Principal engineer: Marta BELLATO (IE MNHN – UMS 2700).

Image analysis and training engineer: Patricia WILS (IR MNHN – UMS 2700).

Scientific coordinators: Sandrine LADEVEZE and Helder GOMES RODRIGUES (UMR 7207 CR2P).

The facilities

The platform includes two computed tomographs (CT-scan equipment).

- The « *v | tome | x L 240-180* » model from Baker Hughes Waygate Technologies, kwon as <u>OB-LIX</u>, having a large cabin and the following technical characteristics: two interchangeable tubes, 240 kV / 320 W microfocus tube and 180 kV / 15 W nanofocus tube; 400×400 mm detector with a 2024×2024 pixel matrix (pitch 200 μm).

- The « *EasyTom S 150* » model from RX Solutions, known as <u>ID-FIX</u>, having smaller cabin-dimensions and the following technical characteristics: a 150 kV / 75 W microfocus tube; 250×320 mm detector with a 2024×2536 pixel matrix (pitch 124 μm).

The Tomography Imaging Platform is located in building 140, 1 allée de l'orangerie Campus Buffon, 43 rue Buffon 75005 Paris, France.

Operating procedure

The different steps of a tomographic acquisition project, as well as the associated methods, are developed in this document in the following order:

1. Application form / Request of access

The **request** for CT acquisitions is available on-line **by submitting an application form**: https://3dtheque.mnhn.fr/platform/astrx, and after agreeing of the collection curator of specimens concerned (paragraph 2).

The following information is mandatory:

Works request: acquisitions

- Project title.

- **Need for training** (Avizo software) **or technical support** (image post-processing).

List of participants

- **Project leader** (name, affiliation, address, phone, e-mail).

- **Project collaborators** (name(s), affiliation(s)).

Scientific project

- **Summary** (200 words maximum).

- **Methodology.** Why do you need to use tomography for your project? Which structures do you wish to highlight (area of interest)? What types of post-processing analysis will be used? *etc.* (200 words maximum).

- **Project framework.** Explanations on the broader framework of your project (Master, Thesis, funded research program (ANR, ERC, PICS, etc.), preventive conservation, exhibition, restoration, etc.). (200 words maximum).

Study material

- **Material and methods.** Details of the material to be analyzed (number and size of specimens, photographs[i]); (500 words maximum).

- **Total number of specimens.**

- **Catalog number.** The inventory number is strongly recommended for MNHN specimens.

Administrative information

- **Curatorial manager** (or specimen manager) ; (name, affiliation, phone, e-mail).

- **Invoicing contact.** (name, affiliation, billing address, phone, e-mail). It is no possible to invoice an individual, only institutions/laboratories/units.

Restitution

- Desired period for the tomographic acquisitions ; please indicate periods where you will be available /unavailable. The acquisition period will also be defined in accordance with the timetable and the priorities of the AST-RX platform.

[i] A file may be attached (preferably in pdf format; 32 MB maximum).

The call for new applications **will close for periods yearly** (for example summer and end-of-year holidays).

2. Technical evaluation and feasibility / Selection and prioritization criteria

The application is evaluated by the technical and scientific staff to ensure the applicant's suitability and feasibility (technical adequacy of demand with acquisition equipment).

File completion and submission procedure follow-up are criteria for application admissibility.

For a project involving <u>MNHN specimens</u>: the **collection curator** concerned, and hence the directors of the MNHN collections, **MUST be consulted** (via the Colhelper interface: http://colhelper.mnhn.fr/) **and agree before filing the application** form. **Inventory numbers for specimens from the MNHN are mandatory** in order to ensure the data backup.

For a project involving <u>external MNHN specimens</u>: the collection curator concerned MUST agree before filing the application.

A **maximum number of 5 days of acquisitions** is given for each project to ensure access to all applicants. A priority is given to projects **(I)** of **students** (master, PhD) **(II) MNHN** researchers, and then **(III) externs**.

3. Tariff / Price quote and purchase order

Once the application form is validated, **a price quote is sent** electronically **to the project leader**.

The pricing relies on an estimation of the equipment used for the scanning and of acquisition duration. As well it depend to the institution (or laboratory) responsible for credit [ii].

The AST-RX team is in charge of estimation of the cost.

Tariffs OB-LIX (*v|tome|x L 240-180*)

User's affiliation	Muséum price	Académique price	Private price
Cost per half-day OB-LIX *	125 €	300 €	625 €
Cost per day OB-LIX	250 €	600 €	1250 €

* A half-day is equal to 3 ½ hours of work (e.g. 9:30 am – 1:00 pm and 2:00 pm – 5:30 pm))

> [ii] All payments are subject to a 20% tax (VAT), expect for intern credits.
> No more notion of origin of specimens (MNHN or external) from February 2023. To inform about of the inventory numbers for specimens from the MNHN is still mandatory.

Tariffs ID-FIX (*EasyTom S 150*)

User's affiliation	Muséum price	Académique price	Private price
Cost per half-day ID-FIX *	65 €	130 €	440 €
Cost per day ID-FIX	130 €	260 €	880 €

* A half-day is equal to 3 ½ hours of work (e.g. 9:30 am – 1:00 pm and 2:00 pm – 5:30 pm)

The **number of acquisitions** that can be done **in a day depends on the specimens** (density, size, desired resolution). An acquisition may include several specimens on a sample holder. It is thus indispensable to provide a complete **description of the specimens** and **the scientific question** (whole object, region of interest) in order to facilitate the duration estimation.

The schedule, as agreed with the project leader and the operator of the equipment, will be communicated by e-mail. Where there are multiple acquisition requests, **priority** will fixed based on criteria given at the paragraph 1. **Wait time** can be from three to six months.

NB: the **PO** has to have **(a)** an **official purchase number** from your institution/laboratory, **(b)** it has to be in **Euros €**, **(c)** it has to be **signed by your institution**/laboratory and **(d)** it has **to include VAT**. If, for a reason VAT is not applicable for your institution, please to indicate that onto the PO. Only a bank transfer by your institution is accepted (no credit cards or personal transfer bank). The project leader undertakes to ensure in advance that it fits the financial conditions by contacting the manager of his laboratory or the financial department of his institution.

4. Performing acquisitions / Equipment differences

Sample holder

Prior to CT-scanning, **the specimen should be positioned** with its longer dimension **in vertical orientation** in a **sample holder** made **in a radiolucent material**. Specimens will have to be prepared beforehand by the project manager (in tandem with the collection curator and the platform operator).

- With the **OB-LIX** μCT, only **one specimen** can be scanned **at a time**, or multiple specimens if the samples are packed together.

- The **ID-FIX** μCT is equipped with **an automatic specimen loader** that **can handle up to 5 specimens** of different sizes. Depending on the size of the specimens, the loader can be set-up in two ways: 5 specimens with maximum size Ø 4,75 × 16 cm (H); or 3 specimens with maximum size Ø 7,5 × 16 cm (H).

Specimen dimensions and field of view

- The **OB-LIX** μCT – with a large cabin – can accommodate a specimen of maximum height 120 cm (H). However, **the field of view** is about Ø 34 x 34 cm (H) and it **can reach about Ø 60 × 65 cm (H)** when moving the detector horizontally and vertically. This acquisition mode (multi-scan) is time-consuming and the resulting data is 4 to 12 times bigger. The specimen's maximum weight is **50 Kg**.

- The **ID-FIX** μCT – with a smaller cabin – can accommodate a specimen with a maximum diameter of 25 cm (Ø) and a maximum height of 41 cm (H). However, **the field of view** is Ø 25 x 31 cm (H) and it **can be increased up to Ø 23 x 38 cm (H)** when moving the axes of the turntable. The specimen's maximum weight is **5 Kg**. The dimensions are indicative; in particular, it will be necessary to ensure the safety of the sample according to its weight.

Local tomography

The acquisition may concern a specific region of interest. However, a local acquisition is not faster than a standard one.

Dataset size

The data obtained is a stack of images, representative of the specimen's density. **These stacks are 16-bit TIFF images**. The size of the final dataset does not depend on the specimen size. The size of a standard dataset (OB-LIX μCT - normal mode) is between 5 to 20 Gb.

Resolution

The **smallest voxel size** of the resulting images stack **depends** (among other parameters) **on the dimensions of the specimens**.

- The smallest achievable voxel size for the <u>OB-LIX</u> µCt is 1 µm for the samples of a few millimeters and under specific acquisition conditions.

- The smallest achievable voxel size for the <u>ID-FIX</u> µCt is 5 µm.

5.   Billing / Project closing

Once the acquisitions are complete, an **attestation of service provide** is completed and **sent to the project leader**. The project leader **has to send back** – via e-mail astrx@mnhn.fr – this document **filled in properly, dated and signed** in order to proceed to the invoicing and the payment.

> N.B.: The processing of **payment requires (3)** the **completion of acquisitions** then **(4) a signed attestation of service done**. In order to use credits before a specific date, the project leader is expected to submit an application form a few months in advance.

Invoice for services performed by the AST-RX platform are deposited on the Chorus Pro public management portal. For any financial question, the applicant has to contact the manager of his unit/laboratory or the financial department of his institution.

6.   Data management

The data obtained is a stack of 2D images. These stacks are 16-bit TIFF images. A file who contains all information about acquisition parameters is included.

For <u>specimens from MNHN collections</u>: **the data is transferred** from the platform **to the managing data service portal of the Collections Direction** http://3dthèque.mnhn.fr/. This service will then transfer the data to the project manager. **Only** the **reconstructed data** (2D image stacks) **are stored** and not the radiographies. Only the data of the specimens having an inventory number from MNHN collections are stored.

For <u>external specimens</u>: the data is transferred from the platform to the **project leader** who **must provide an external drive** for this purpose. The project leader will then transfer a copy of the data to the curator of specimen(s). **The image stacks of external specimens are not stored.**

The MNHN collection specimen images are property of the Museum. Any request for access to the digitalization already performed is done via the Colhelper interface http://colhelper.mnhn.fr (section "Choice of types of request", "Images"). The right to use these images is given for a single use only, and for the purpose/s defined in the initial request for authorization to use them. The use of these data for profit (sale of images, of 3D models, of 3D replicas, *etc.*) is strictly forbidden.

7.   Data post-processing / Training

The **post-processing work** (image analysis, segmentation, 3D modelisation 3D, measurements, *etc.*) **cannot be done** within the AST-RX platform nor **by the operator**. Only a quick overview of the data and a pre-rendered 3D visualisation can be proposed by the operator.

> Post-processing software **training** and **access to dedicated workstations** (Image J; Avizo; 3D Sliser) are proposed within the UAR 2700 2AD. A specific form is available:
> https://uar2700.mnhn.fr/fr/service-danalyse-de-donnees-9023 | https://uar2700.mnhn.fr/

8. Diffusion and publication / Citation and acknowledgements

The AST-RX team shall respect the **confidentiality** of the work presented in all applications submitted. They cannot be co-authors of any work based solely on their role within the platform; co-authorship is only authorized when a real scientific and consistent contribution is provided.

Publications resulting from work done within the platform must mention the UAR 2700 in the **acknowledgments** under the terms:
« AST-RX, plateau d'Accès Scientifique à la Tomographie à Rayons X du MNHN, UAR 2700 2AD CNRS-MNHN, Paris ».
An exhaustive **list of the publications relying on data acquired on the platform** must be send by the project manager to the AST-RX team (astrx@mnhn.fr).

9. General Data Protection Regulation

The information collected in the application form is necessary to request acquisitions from the AST-RX technical platform, as well as for the realization of statistics, and is intended for use by UAR 2700 2AD, CP 26 3rd floor 57, rue Cuvier 75005 Paris, France. The legal basis of this data processing is the execution of the contract between you and the UAR 2700. Obligatory information is indicated by an asterisk, and is required at the time of data collection via the form (https://3dtheque.mnhn.fr/request/astrx). Any lack of response or any response deemed abnormal by the UAR 2700 is likely to result in a refusal to consider your request. Your data are kept for a period of 3 years. No transfer of data outside the European Union is carried out.

In accordance with the applicable regulations on the protection of personal data, you have the right to access, rectify, limit processing, portability to request the transfer of your data where possible. You can give instructions on the use of your data after your death. These rights can be exercised by sending an e-mail to the UAR 2700 (ast-rx@mnhn.fr) or to the data protection officer (dpo@mnhn.fr). All requests must be accompanied by proof of identity. In case of difficulty in the management of your personal data, you can file a complaint with the French supervisory authority.