MiFoBio
Functional Microscopy for Biology
Presqu'île de Giens, France 5-12 Nov 2021

MFM
Microscopie de
Fluorescence
Multidimensionnelle

TR-T-06 – Suivi de qualité d'un microscope photonique dans le temps
Dialogue avec les constructeurs

Preamble :

- The manufacturers invited to this round table were invited because they are manufacturers of wide-field microscopes, confocal microscopes and lenses dedicated to light microscopy. Dialogue is of course **open to all manufacturers of microscopes and peripherals.**

- Terminology: Metrology vs Quality Control

- Restitution of work carried out for several years: a dialogue was initiated by the GT-3M to try to harmonize the protocols for monitoring the quality of the systems over time.

Leica MICROSYSTEMS

Nikon

OLYMPUS

ZEISS

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Program:

- Presentation of the issues;

- Report of discussions between GT3M and manufacturers over the past years;

- Discussion around a proposal for the harmonization of the first measures to - be carried out after installation on site, in addition to "official" training;

- Advances in commercial systems metrology;

- International quality monitoring of a light microscope over time: QUAREP-LiMi and MicroMeta App initiatives;

- Additional matters: joint letter signed by Germany, Switzerland and France attached;
- Balance sheet

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1. Presentation of the issues

Observation: the quality control of light microscopy systems is too often neglected by users.
Lack of (human) means, lack of tools, lack of protocols.

Upon purchase, the sensitive points of a microscope are not quantified.

In Life Sciences, to quantify an image, measurements of sensitive points over time are the key to the reliability and reproducibility of the results.

Develop quick and simple protocols, using inexpensive tools [shared with manufacturers] - GT 3M.

Be aware of what is feasible at national level.

1. Presentation of the issues

RTmfm's GT3M workflow presentation

- **Tools**

Bead slides (1µm, 170nm), plastic slides, power meter.

- **Protocols**

Developed and tested by GT3M for several years, metrics and limit values
10 core-facilities involved
– publication in progress : https://www.biorxiv.org/content/10.1101/2021.06.16.448633v1

- **Analyse : MetroloJ_QC**

Plugin ImageJ/FiJi : https://github.com/MontpellierRessourcesImagerie/MetroloJ_QC

- **Monitoring over time**

1. Presentation of the issues: why it is good

For users

Better understanding of the system

Monitoring over time = reproducibility

Reduced system downtime

For companies

Everything is ready ! Protocols, samples, analysis

Time saving for everyone: common vocabulary = less travel

Branding, dialogue, loyalty

2. Report of discussions between GT3M and manufacturers over the past years

Leica : 5 meetings
Nikon : 3 meetings
Olympus : 3 meetings
Zeiss : 4 meetings

summary tables
(confidential)

Thank you for your investment and your goodwill !!!!

Results :

- blocking points :
  - .dialogue with the factory / developers sometimes hard for you and us
  - .the factories rarely share the ITP (Inspection & Test Plan) values

But the will is there!

3. Discussion around a proposal for the harmonization of the first measures to be carried out after installation on site, in addition to training

Proposal to everyone to apply the GT3M RTmfm protocols to the installation of a system.

Less than 1/2d of training - learning the software.

Source power / Homogeneity / Co-registration / PSF / Drift / Repositioning / Camera noise

User awareness of QC over time Improved dialogue with after-sales service to troubleshoot machines more quickly with establishment of a common vocabulary = less travel

4. Advances in commercial systems metrology

Leica MICROSYSTEMS

Nikon

OLYMPUS

ZEISS

5 min presentation per constructeur

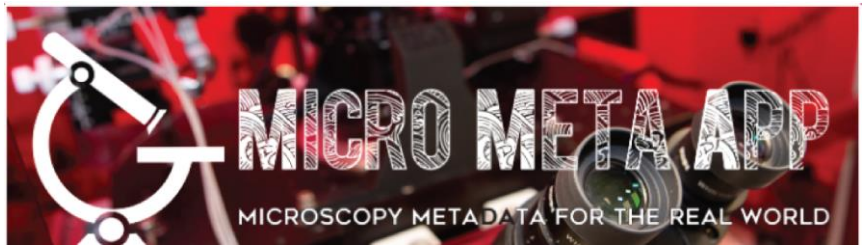
5. The quality monitoring of a light microscope over time internationally : QUAREP-LiMi and MicroMeta App

Quality Assessment and Reproducibility for Instruments & Images in Light Microscopy

- Enthusiastic consortium created in April 2020 at the initiative of GerBI and RTmfm335 participants, 29 countries represented
- Academics, companies, ISO, publishers ...National networks (RMS, BINA, GerBI, RTmfm, Netherland, Japan ...)
- 11 WG (source, detectors, homogeneity, co-registration, PSF, [...], metadata, image quality, good practices in publication of microscopy data)
- international harmonization of measurement methods

What feedback from your side?

5. The quality monitoring of a light microscope over time internationally : QUAREP-LiMi and MicroMeta App



Intuitive and visual software for managing microscope metadata

https://github.com/WU-BIMAC/MicroMetaApp.github.io

Caterina Strambio-De-Castilla *et al.*, (Univ. Mass.)
Micro-Meta App: an interactive software tool to facilitate the collection of microscopy metadata based on community-driven specifications
In press, Nat. Meth., 2021

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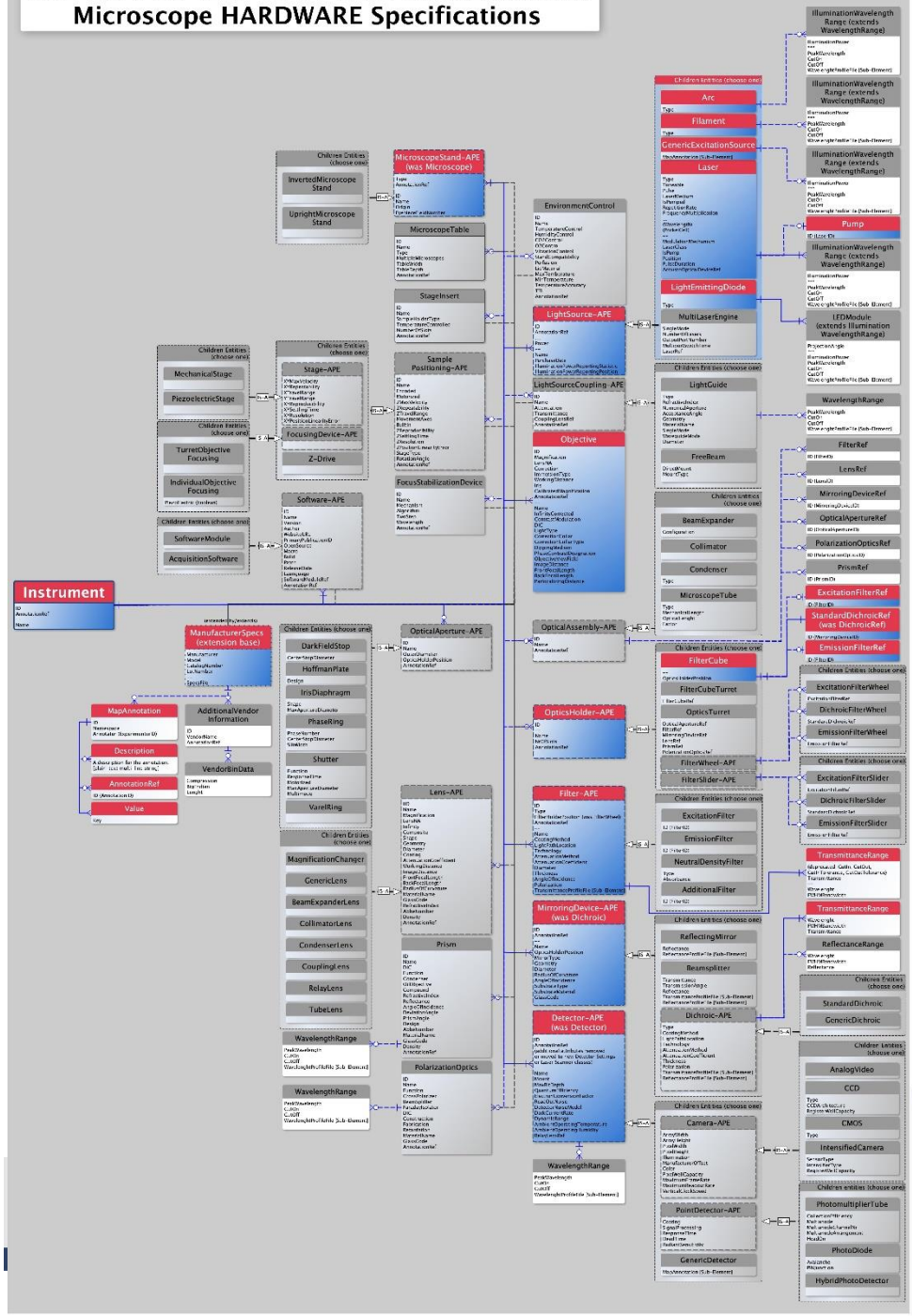
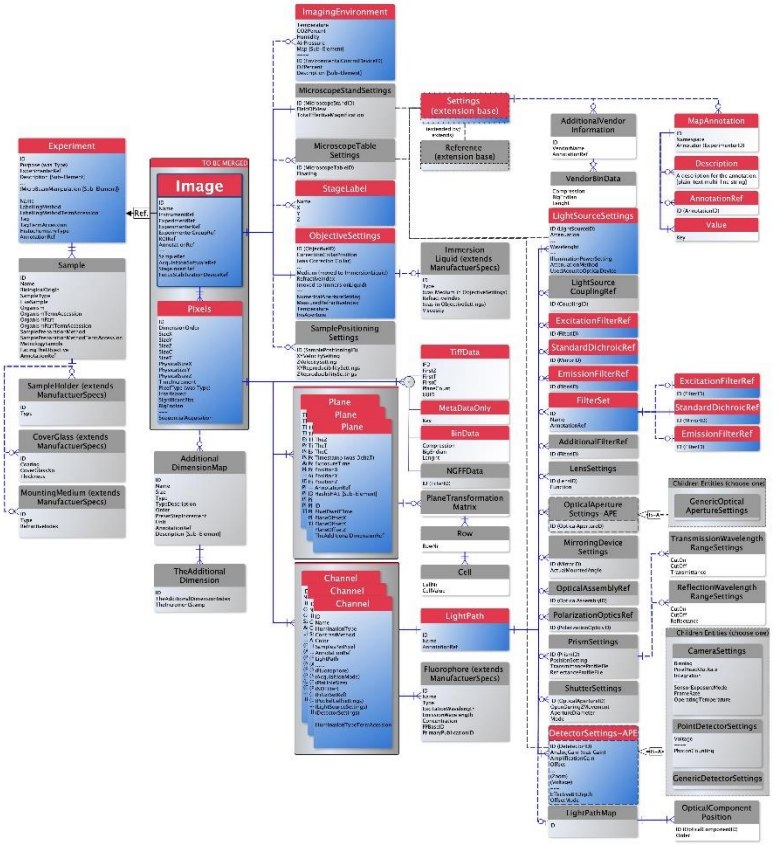
OME Core vs. 4DN-BINA-OME Basic Extension Microscope HARDWARE Specifications



OME Core vs. 4DN-BINA-OME Basic Extension Image ACQUISITION Settings



Legend

This is a Entity-Relationship diagrammatic representation of a proposed REVISION of the OME Core data model (blue/red boxes) along side a proposed OME-BASIC EXTENSION (grey boxes) developed by members of the Imaging Working Group of the 4D Nucleome network (https://www.4dnucleome.org) and by members of the BINA Quality Control and Data Management Working Group (https://www.bioimagingna.org/qc-dm-wg).

The Entity-Relationship formalism can be utilized to model information about a real-world situation or an actual object (in this case a Microscope INSTRUMENT and an IMAGE acquired using that Instrument) by using three types of model elements:
1) ENTITIES, represented by Boxes;
2) RELATIONSHIPS, represented by blue lines connecting boxes; and
3) ATTRIBUTES, represented by fields within boxes

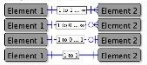
When describing a real-life situation or object:
1) ENTITIES correspond to NOUNS – the items we want to collect information about.
2) RELATIONSHIPS correspond to VERBS – actions/states/occurrences that connect Entities with each other.
3) ATTRIBUTES correspond to ADJECTIVES – they describe the actual information (in our case metadata) that we want to record about each Entity.

In order to interpret the schema please start either from the «INSTRUMENT» element for the Microscope Hardware Specifications section of the diagram or from the «IMAGE» element of the Image Acquisition Settings sections. Then follow the blue lines to the connected boxes and think something like:
1) An Instrument has a Microscope Body, might rest on a Microscope Table, utilizes a Light Source and magnifies the sample using an Objective.
2) Alternatively, an Image was produced as part of a specific Experiment, was collected in a specific Imaging Environment and using specific Microscope Settings and has four Channels.

For questions or comments please contact: caterina.strambio@umassmed.edu

Notes

Blue edges, blue edges represent RELATIONSHIPS between entities. SOLID EDGES are used to connect an Element with a REQUIRED Sub-Element. DASHED EDGES are used to connect an Element with an OPTIONAL Sub-Element.
In addition, different CARDINALITIES can be represented as follow

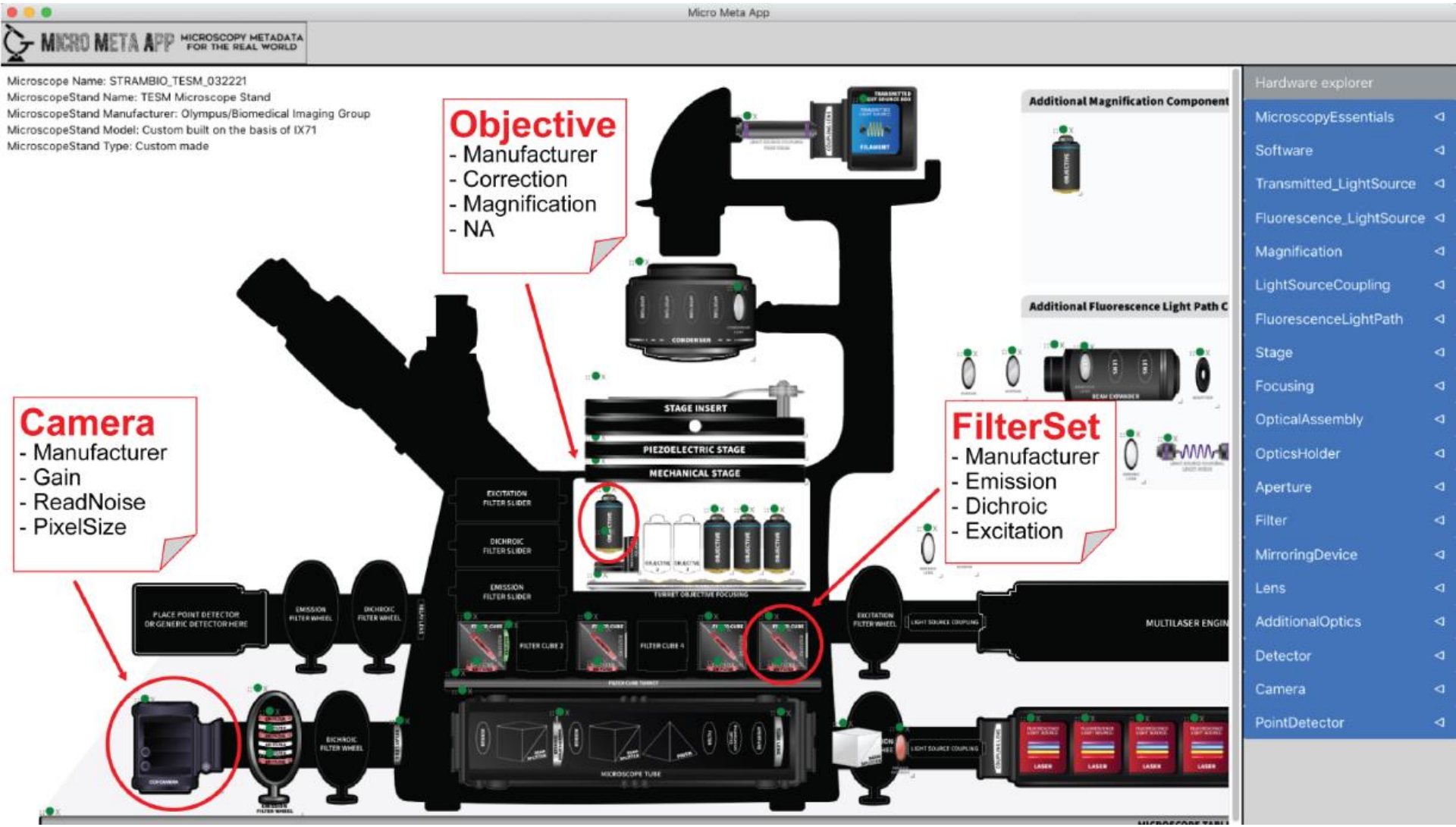


Black dashed arrows, these arrows simbolize an inheritance relationship similar to what would connect a hypothetical "feline" parent element with a "Cat" child element. In this example, while the "Cat" element represents a "concrete" entity that exist in the real-world, the "feline" element represents an "abstract" category that is only useful for categorization proposes. In a similar manner, these arrows connect concrete elements that represents actual microscope hardware components with their Abstract Parent Elements (APE), which are utilized for making the model less repetitive and more efficient to read by software tools.
These arrows should be read as follows, a "Laser" IS A "LightSource".

Dashed grey edges, these edges signify "Extends" and they should be read as follows: "Objective" extends "ManufacturerSpecs". In this example, the concept of extension indicates that Objective is of type "ManufacturerSpecs" but it has additional attributes that are unique to it and distinguishes from other elements.

- AnnotationRef, this element always refers to a Comment/Annotation element as described for Channel. However for simplicity sake most Comment/Annotation elements have been omitted and the AnnotationRef has been inserted in the referring element as an attribute.
- Sub-Element, For simplicity and when indicated Sub-Elements are listed within the referring element as an attribute.
- References, For simplicity and when indicated, References (e.g., ImageRef) are listed within the referring element as attributes.
- Units were omitted from this diagram for simplicity. However, they are essential for reproducibility and they are included in the model and in all its formal representations.
- Attributes listed after the ----- separator have been added to the OME Core as part of the proposed revision.
- Attributes listed in parenthesis and after the ---- separator have been removed as part of the proposed extension.
- APE, Abstract Parent Entity (see explanation above).

5. The quality monitoring of a light microscope over time internationally : QUAREP-LiMi and MicroMeta App



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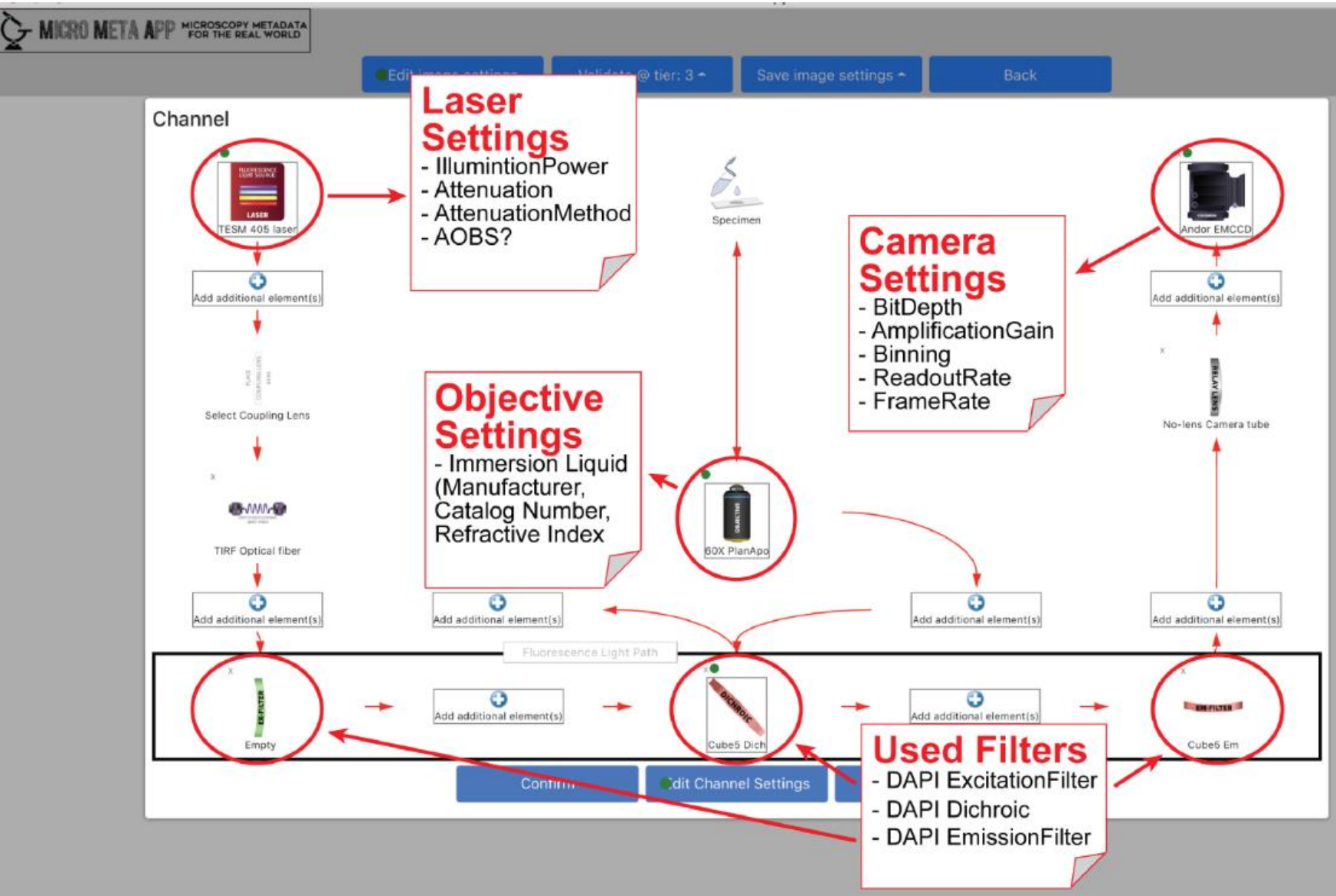

6. Questions supplémentaires : lettre commune signée par l'Allemagne, la Suisse et la France

PDF…

7. Bilan