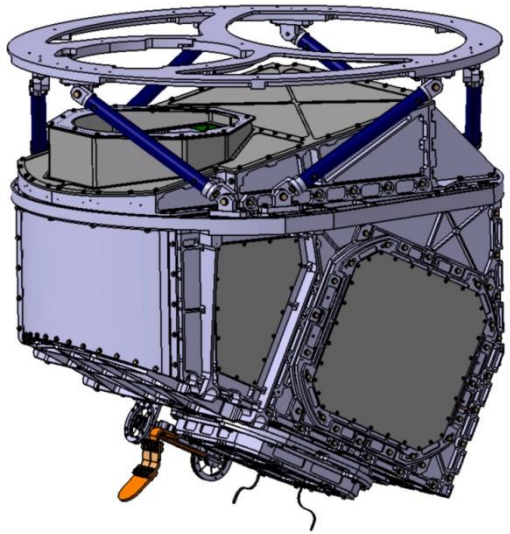
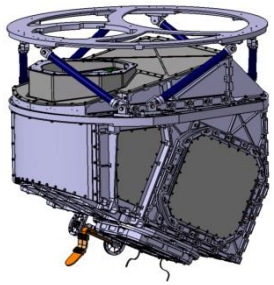
1K box sub-system for QUBIC



For Technological Demonstrator (T.D.)

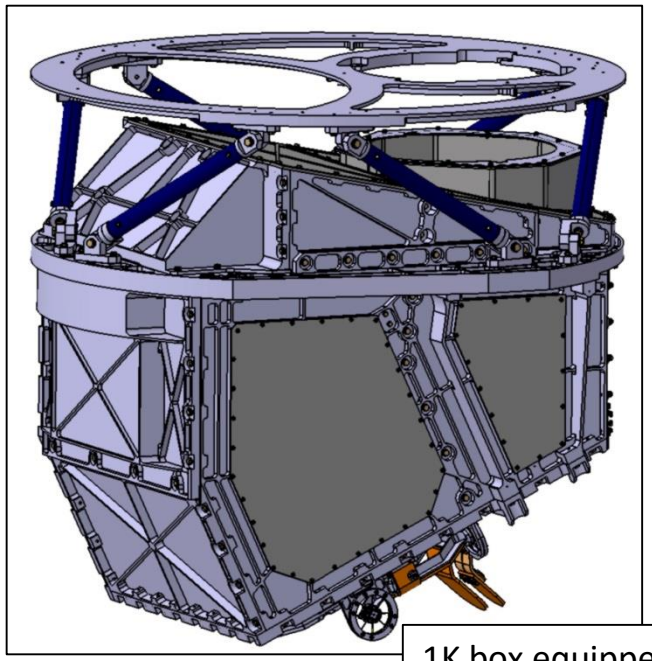
And

For Final Instrument (F.I.)

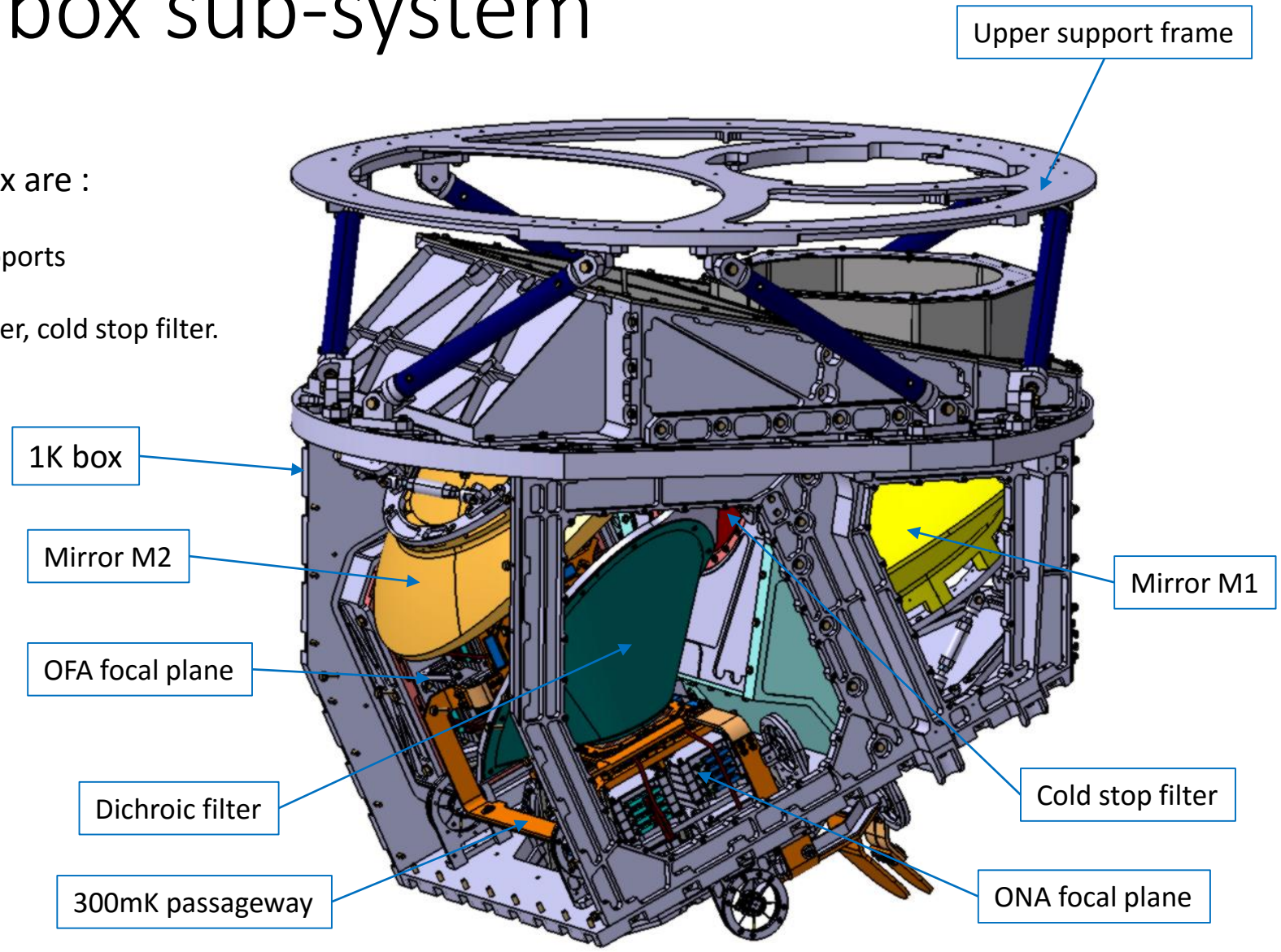


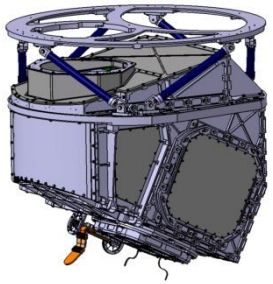
1K box sub-system

- The mains components of the 1K box are :
  - The 2 focal planes and their supports
  - The mirrors M1 and M2 and their supports
  - The 300mK passageway and links
  - The filters : 300mK filters, dichroic filter, cold stop filter.
  - And the 1K box itself



1K box equipped





Status of the 1K box sub-system : blocking points and schedule (1/2)

- ***Focal planes (mechanical component)*** *:*

The design of the 2 focal planes is almost finished, the following points have to be finalized

→ The definition of the 300mK filters is to freeze (input from Cardiff ?)

→ The choice of the material of the 8 pillars (which isolate the 300mK from 1K), to replace stainless steel with carbon fibers

For TD : much of the mechanical parts made (essentially at LAL and APC). Only few mechanical parts are have to be finalized (2D drawings) and manufactured (see the 2 previous points)

For FI : the focal planes shall be manufactured

- ***Mirrors M1 and M2*** *:*

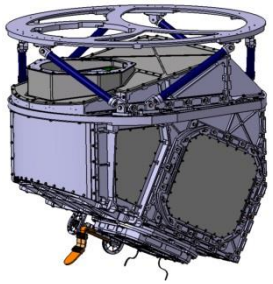
The design of the 2 mirrors finished (TD and FI) and the TD mirrors M1 and M2 are machining (Milano Bicocca). For FI, the 2 mirrors shall be manufactured.

For TD and FI, the design of the supports of the 2 mirrors have to be finalized : the detailed design (2D drawings for manufacturing).

A “final CAD model” (for TD and FI) of the supports of the mirrors have to be done, to know exactly how to set the 6 actuators of the supports to move the mirrors for alignment.

- ***300mk passageway and links*** *:*

For TD and FI, the design of the supports of the 300mk passageway and links have to be finalized : the detailed design (2D drawings for manufacturing).



Status of the 1K box sub-system : blocking points and schedule (2/2)

- ***1K box itself (for TD and FI)*** *:*

The design of the 1K box (itself) is almost finished, the following points have to be finalized :

→ Design of the interfaces with the heat switches (Location of the connection of the 4K/1K heat switches with the 1K box)

→ Design of the connection of the 1K fridge with the 1K box

→ Design of the connection of the 300mK fridge with the 1K box and the 300mK passageway

→ The definition of the cold stop filter is to freeze (input from Cardiff ?), to finalize the design of its support

→ Finalize the design and the test of the 6 pillars (between 4K and 1K) in carbon fibers

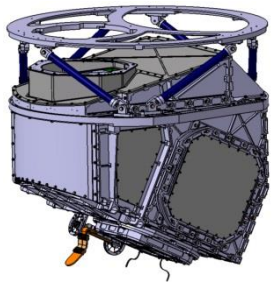
→ The detail design (2D drawings for manufacturing)

Remake the finite element analysis (thermo-mechanical analysis) with an update model.

- ***Dichroic filter (FI)*** *:*

No dichroic filter for TD ?

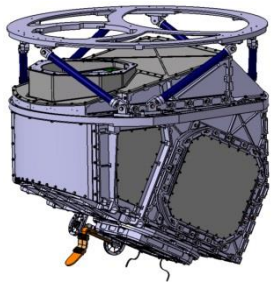
The definition of the dichroic filter is to freeze (input from Cardiff ?), to finalize the design of its support and baffle for FI.



Interfaces with other sub-systems (1/2)

Mechanical Interfaces :

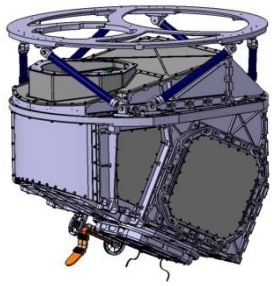
- With cryostat – *"partly Frozen"*
  - → See document "QCI0012-I-1K_box_equipped-Rev1,1.pdf" (in Atrium – 77562)
  - → 1K box inertia moment has to be estimated.
  - → Connection 4K/1K heat switches with 1K box to be defined
  - → Interfaces with 1K and Sub-K fridge to be defined
- With horns and switches – *Frozen*
  - → See document "QCE0104-I-Upper_frame_support-rev1.0.pdf" (in Atrium – 112565)
- With mirrors – *Frozen*
  - → See document "QCB0054-Demonstrator_mirror_M1-rev1.0.pdf" (in Atrium – 96535)
  - → See document "QCB0055-Demonstrator_mirror_M2-rev1.0.pdf" (in Atrium – 96539)
  - → See document "QCB0031-Mirror_M1-Draft02.pdf" (in Atrium – 77566)
  - → See document "QCB0032-Mirror_M2-Draft02.pdf" (in Atrium – 77565)



Interfaces with other sub-systems (2/2)

Mechanical Interfaces :

- With filters (300mK, dichroic and cold stop) – *Not Frozen*
  - → See document “QCF0410-Focal_plane_filter-rev0.0.pdf” (in Atrium – 113107) - (for FI)
  - → See document “QCF0434-Bague_filtre-rev0.0.pdf” (in Atrium – 113107) - (for FI)
  - → See document “QCF0438-Quarter_Focal_plane_filter-rev0.0.pdf” (in Atrium – 113107) - (for TD)
  - → See document “QCF0437-Quart_bague_filtre-rev0.0.pdf” (in Atrium – 113107) - (for TD)
  - → See document “QCB0067-Dichroic_filter-rev0.1.pdf” (in Atrium – 77570)
  - → See document “QCB0069-Dichroic_ring-rev0.1.pdf” (in Atrium – 77570)
  - → See document “QCE0109-CS_filter-rev0.1.pdf” (in Atrium – 112593)
  - → See document “QCE0108-CS_filter_ring-rev0.1.pdf” (in Atrium – 112593)



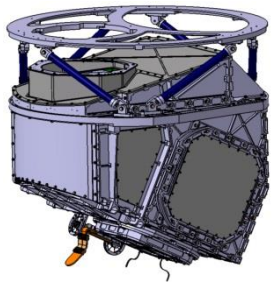
Test, Delivery, Assembly, Calibration Operations (1/2)

- Tools required for assembly operations (design and manufacture to be done)
  - 1 Tool for the focal planes
    → To assemble and to position correctly the detector on the focal plan.
  - 1 Tool for each support of the mirrors
    → To make a known reference of each mirror before alignment.
  - 4 Tools for the 1K box
    → To assemble and to glue the 6 pillars
    → To support the 1K box during its integration before to assemble the upper frame support on the 1K box
    → To assemble and to position correctly the upper frame support on the 1K box
    → To support the 1 K box during alignment and to do some tests
  - 1 or several tools (to be defined) for the integration of the 1K box in the cryostat.

- Tools for alignment operations (design and manufacture to be done)

The aim of these tools is to make a know reference before to set the different parts, if it is necessary for alignment

- 1 tool to align the focal plan ONA with the mirror M1
- 1 tool to align the focal plan OFA with the focal plane ONA
- 1 tool to align the dichroic filter with the focal plan OFA
- 1 tool to align the mirror M2 with the mirror M1



Test, Delivery, Assembly, Calibration Operations (2/2)

- Tests of the 1K box in your premises (APC) :
  - Make a dimensional inspection (metrology with MMT) of some parts (To be defined)
  - Measure the position of the 2 mirrors and the 2 focal plans (if it is possible with a laser tracker for example), to know after alignment their locations
  - Measure the deformation (if it is possible with laser tracker for example) of the 1K box and in particular of the inner parts (focal planes and mirrors) in the 6 worst cases of the 1K box position, to know the effect of the gravity on the alignment.

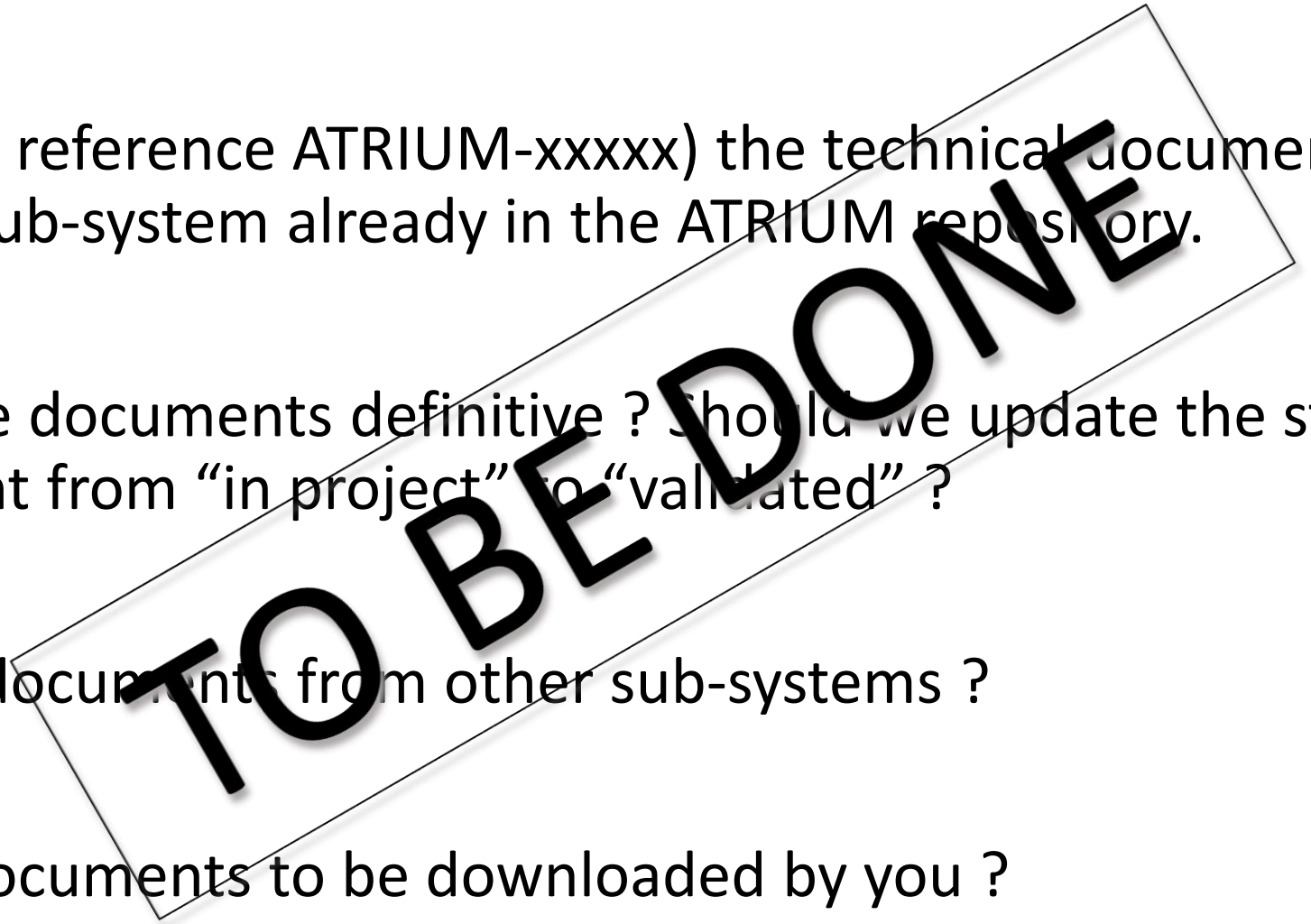
- Delivery to APC :
  - No special care needed for the transportation and handling –> Assembly and integration at APC.

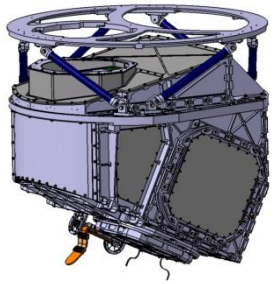
- Assembly Operations in APC :

For assembly operation, we need : tools as first point above, hall assembly, mechanical workshop, crane or handling systems and metrology systems (MMT, laser tracker)

ATRIUM and Documentation

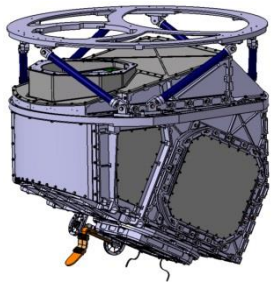
- List (with reference ATRIUM-xxxxx) the technical documents related to your sub-system already in the ATRIUM repository.
- Are these documents definitive ? Should we update the status of the document from “in project” to “validated” ?
- Missing documents from other sub-systems ?
- Future documents to be downloaded by you ?





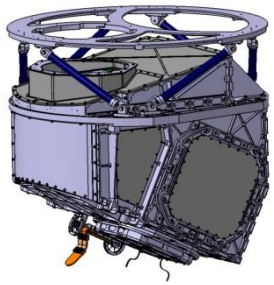
Budget (excluding salaries)for T.D. + F.I.

	Spendings (type and amount)	Funding (source and amount)	Status of funding (granted / under examination)
2016			
2017			
2018			



Manpower

Name and responsibility	% FTE 2016	% FTE 2017	% FTE 2018
C. Chapron	100	100	50
TOTAL FTE			



Risks analysis

- Risk : the manpower
  → Impact : schedule