



**PROCEDURE N°
AOO.20-2025**

06/03/2026

“KID 200MM”

LOT 1 : PULVÉRISATION CATHODIQUE CONFOCALE

**LOT 2 : CARACTÉRISATION NON-DESTRUCTIVE DE
COUCHES MINCES**

“KID 200MM”

LOT 1: CONFOCAL SPUTTERING

**LOT 2: NON-DESTRUCTIVE THIN FILMS PROBE
STATION**

**Cahier des Clauses Techniques Particulières
Procurement Specification**



CNRS – Délégation Alpes

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1. ACRONYMS AND ABBREVIATIONS

PVD	Physical Vapour Deposition
KID	Kinetic Inductance Detectors
IRAM	Institut de RadioAstronomie Millimétrique
CNRS	Centre Nationale de la Recherche Scientifique
TBD	To Be Determined
LL	Load-Lock
SCCM	Standard Cubic Centimeters per Minute
T0 order form	Date at which the provider(s) are notified with a signed
PLC	Programmable Logic Controller
OAS	Optional Additional Service

2. INTRODUCTION AND LOT-BY-LOT STRUCTURE

To meet the requirements of future high-throughput astronomy/physics instruments using our KID (Kinetic Inductance Detectors), we need to establish in-house technological capabilities of realising and pre-characterise high-quality metallic thin films over a surface up to 200 mm in diameter, as opposed to the current 100 mm. In order to achieve this goal, we issue a call composed by two lots as follows:

Lot 1: high-quality metallic thin films deposition. Acquire the capability of **depositing in-house high-quality metallic, and mostly superconducting, thin films (Al, Ti, Au, Nb, TBD)** on top of dielectric substrates (typically Silicon, Quartz, Sapphire ..) of thickness comprised between 0.1 mm (100 μ m) and 10 mm and diameters up to 200 mm. The typical thickness of the deposited films will not exceed 500 nm. Besides the high-quality (high purity), the uniformity of the film thickness is a strong driver. We target a film thickness uniformity better than 3% over a diameter of 180 mm, 2% over a diameter of 130 mm, and better than 1% over the inner 90 mm. In order to realize multi-layers, we need to deposit up to five materials without breaking the vacuum. The surface of the dielectric substrate must be cleaned in-situ by RF plasma etching before realizing the deposition.

Lot 2: Metallic thin-films non-destructive characterisation. In order to test the uniformity of the metallic films, we require a suitable **non-destructive** semi-automatic probe station able to map, on a single wafer, the metallic film resistivity in the range 0.01-10 Ohm/square. The produced map must have a scanning pitch not bigger than 1 mm.

Considering a number of technical advantages, we have identified the “**confocal sputtering**” **technique** as the most promising to achieve the Lot 1 goals and we issue this call to acquire a suitable deposition system.

Regarding the non-destructive characterisation of thin films, LOT 2, we have identified the **Eddy/Focault current technique** as the most promising to achieve our goals.

We stress the fact that there are no common technical specifications between the two lots of the present call. For this reason, in the following paragraphs, we will describe them separately.

3. DETAILED TECHNICAL REQUIREMENTS

In this paragraph, we report the detailed performance required for the confocal sputtering machine (Lot 1) and the non-destructive probe station (Lot 2).

3.1 LOT 1: ConFocal Sputtering Machine - Technical requirements

The sputtering system for which we call for quotations must satisfy the following **mandatory requirements**:

- **Type of sputtering:** DC.
- **Configuration of the targets (cathodes):** confocal for best film thickness uniformity. The biggest target size should not exceed 4 inches in diameter. It is possible to mix cathodes with different sizes, provided that the film thickness uniformity performances (see below) are satisfied.
- **Sputtering geometry:** sputter-down, i.e. the cathodes lie above the substrate.
- **Number of targets (cathodes):** five (5). It must be possible, of course, in order to realize high-quality metallic multi-layers, to switch between them without breaking the vacuum. The **metallic layers** will be deposited sequentially, selecting one target at a time, i.e. **no need for co-sputtering**.
- **Individual shutters.** Every target will be protected by a shutter to suppress cross-contaminations.
- **General shutter.** We require the sample to be protected as well by a common and independent shutter.
- **Metallic film thickness uniformity for Aluminium and Titanium films (better uniformity).** For the mandatory Al and Ti targets (best uniformity, probably larger targets) our goals (minimal specs) are: < 3(5)% on diameter of 180 mm, < 2(3)% on 130mm and < 1(2)% on 90 mm. The performance validation tests will be made with standard silicon wafers with thickness between 100 and 750 microns, and Aluminium and Titanium film thicknesses between 20 and 40 nm. The uniformity is defined as the peak-to-peak-thickness difference divided by the average film thickness.
- **Metallic film thickness uniformity for Niobium, Gold and TBD films (relaxed uniformity).** For the remaining three targets (Au, Nb, TBD) our goals (minimal specs) on the uniformity are: < 9(15)% on diameter of 180 mm, < 6(10)% on 130 mm and < 3(5)% on 90 mm. The performance validation tests will be made with standard silicon

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wafers with thickness between 100 and 750 microns, on which we will deposit Nb films with a thickness between 100 and 200 nm. The uniformity is defined as the peak-to-peak-thickness difference divided by the average film thickness.

- **Substrate rotation** during deposition is needed in order to achieve the required uniformity. We ask the providers to give details in the quotation.
- **Dielectric substrates size:** 50.8, 76.2, 100, 150 and 200 mm. The substrate holder must allow easy centering of the wafers of these sizes. We require the provider to include an additional (spare) substrate holder.
- **Dielectric substrate thickness:** from 0.05 mm (50 μ m) to 10 mm. As already pointed out, the film uniformity will be established for standard wafer thickness of 0.3-1 mm. A degradation of the metallic film thickness uniformity for substrates thicker than 1 mm will be tolerated.
- **Outgassing:** bake-out the sputtering chamber walls at a temperature of up to **100 C**.
- **Protection screens.** The inner deposition chamber walls will be protected by easily-replaceable protection screens. We require the provider to deliver one additional (spare) set of screens, including spares for the shutters (both general and specific to cathodes).
- **Substrate thermalisation.** It will be possible to thermalize (for example using cooled water) the substrate during deposition, at a temperature of 20C or lower. We do not require cryogenic (e.g. LN2) cooling of the substrate; our goal here is just to avoid burning the photo-lithography photoresist in case of lift-off processes. In our clean room we have cooling water available at a temperature around 16C.
- **Main chamber vacuum.** It will be achieved by a combination of a cryogenic pump and a suitable primary dry pump. The deposition chamber limit vacuum will be lower than $5 \cdot 10^{-8}$ mbar, to be achieved in less than 48 hours (goal), or 72 (minimal requirement). To monitor the vacuum level we require at least three sensors: pirani for primary vacuum, penning for high vacuum and baratron gauge for process. Both manual and automatic pumping procedures should be available.
- The **main chamber DC generator** is typically around 2000 W. We ask the providers to specify the main characteristics of the generator.
- **Main chamber hublot.** We require optical access to the main deposition chamber.
- **Additional (blank) flanges.** At least two additional CF flanges, giving optical access to the substrate, will be added to the main chamber. For example to add later a mass spectrometer or similar options.
- **Load-lock (LL) vacuum.** A separated load-lock chamber must be present to allow keeping the main chamber in vacuum permanently. The LL will be equipped with a turbo pump backed by a dry primary pump. They will allow reaching a vacuum better than $5 \cdot 10^{-5}$ mbar in 10 minutes or less in the LL. A valve will be installed between the LL and the main chamber, plus a by-pass in order to vent the loadlock without stopping

the turbo pump. This will allow extending the life of the turbo pump. The pumping process will be handled by the PLC controller. We require a pirani and a penning gauge for vacuum measurement.

- **Load lock specifications:** single wafer loading, motorized articulated arm. The substrate will not be flipped during the transfer of the substrate. Optical access to the substrate while loaded in the LL will be provided to verify the loading procedure.
- **Gas lines.** The deposition chamber will be equipped with three gas lines. In particular: Ar (range 10-100 SCCM for Ar), N₂, O₂ (range 5-50 SCCM for the N₂ and O₂ injections). The lines must be equipped with mass-flow controllers. A butterfly valve, or other kind of suitable automatic valve which can be operated by an automatic feedback loop, and the needed pressure gauges, will regulate the total pressure in the deposition chamber between 10^{-3} and 0.5 mbars with a precision of around 1%. We ask the possible providers to give information about the way they plan to control the N₂, O₂, Ar gases flux, and the total pressure in the chamber during the deposition (N₂, O₂) or the Ar etching. For example, explain the flow-meters ranges and stability and motorization/regulation of the pumping valve. We note however that the chamber pressure and the gas flows need to be regulated independently.
- **Substrate in-situ Argon milling.** The substrate must be cleaned in-situ, prior to metallic deposition, by RF Argon ion etching (e.g. pre-deposition substrate cleaning), for example to remove the native silicon dioxide from silicon wafers. This means that the substrate holder must be polarisable. The maximum RF power will be, ideally, around 300 W. The target etching rate on a native SiO₂ layer should be of the order of 1 nm per minute. The etching rate uniformity across the maximum substrate area (200 mm diameter) will be better than 25%.
- **Control interface software and PC.** Operating on Windows OS 11, and upgradable to later Windows versions. In order to allow a suitable selection, the provider should give all possible information (for example links to on-line documentation or similar) about the interface in the quotation. The PC should be equipped with an ethernet port.
- **Programmable Logic Controller (PLC),** for automatic control of each component. PLC is connected to system instrumentation, with I/O modules, digital analog converter and analog digital converter. PLC should be able to control the machine without the PC. The controller will be able to execute automatic pumping processes in order to start the system with pumps and valves taking into account their security interlocks. The controller must read all the vacuum pressure gauges and the power of the generators. The controller is able to execute the needed metal deposition steps and display the status of the machine in real time, for example: generator power, time, pressure, gas flow, selected target, rotation status of the substrate, temperature and all the other relevant values. The controller is also able to manage alarms and potential problems.

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- **Automation modes.** We will need three modes: a) full automatic for reproducible deposition with steps that can be repeated; b) semi automatic mode for beginners users with high security level and c) manual mode only for advanced users (only for repair and maintenance).
- **Documentation.** Detailed mechanical and electrical plans of the machine need to be provided besides proper user manuals.
- **Warranty.** A standard warranty of 24 months is required for the sputtering machine. On top on that, optionally, the supplier may, if it wishes, separately price an extension of warranty in the form of an annual maintenance contract (PSE n°01) as well as an extension of warranty in the form of a maintenance contract for a period of 2 years (PSE n°02).
- **CE Marking:** REGULATION (EU) 2023/1230 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

3.2 LOT 2: Non-destructive probe station - Technical requirements

- **Metallic film characterisation specifications.** We require a contact-free (e.g. Eddy current), semi-automatic, single-wafer tool allowing non-destructive mapping of the resistivity of the produced metal films, in the range, at least, of 0.01-10 Ohms/square and across a wafer diameter of at least 200 mm. The mapping grid (scanning pitch) will be equal or better than 1×1 mm. The metal film thickness to be measured will be between 5 and 500 nm.
- **Sheet resistivity measurement accuracy.** We require an accuracy of better than 10% over the whole measurement range, but enhanced/optimised to reach better than 2% over the range 0.5 - 3 Ohms/square.
- **Substrates.** The probe station must be compatible with wafers of diameter up to 200 mm or bigger and thickness from 0.05mm up to 5mm.
- **Software.** We require the probe station to be controllable by a PC, and provided with acquisition and plotting/analysis software.
- **Documentation.** Detailed mechanical plans of the machine need to be provided besides proper user manuals.
- **Warranty.** A standard warranty of 24 months is required for the probe station. On top on that, optionally, the supplier may, if it wishes, separately price an extension of warranty in the form of an annual maintenance contract (PSE n°01) as well as an extension of warranty in the form of a maintenance contract for a period of 2 years (PSE n°02).
- **CE Marking:** REGULATION (EU) 2023/1230 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

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4. ASSETS

In this paragraph we provide a list of **assets, i.e. non-mandatory specifications, and information** that, if included in the quotation, will **be evaluated positively during the selection process**.

4.1 LOT 1: ConFocal Sputtering Machine - Assets

- Inclusion in the offer of the **sputtering targets**, Al, Ti, Nb and in case Au.
- **Index of reparability in the long term.** In particular for the important components like the generators, the pumps, valves, vacuum and flux sensors, the PLC and the control PC. Please provide information to allow better evaluation.
- Presence of an “**energy saver**” **mode** allowing, for example, to program weekly shutdowns of the most energy consuming items.
- **Energy consumption of the equipment.** Please provide information to allow to estimate the yearly energy consumption of the equipment.
- **Gas injections.** The uniformity performance of the N₂ and O₂ gas injection will be considered. The goal is to ensure optimal uniformity of the chemical composition of the deposited film. For example, the injection might be done using a ring with holes or similar. Please provide information regarding this point.
- **System compactness.** For the same performance, we shall privilege more compact systems, in particular we will evaluate the diameter of the main chamber.
- **Ergonomy.** We will evaluate the ease of cathode maintenance and standard load/unload operations in the context of our clean/gray rooms. If possible, please provide details about the cathode maintenance procedure in the quotation.

4.2 LOT 2: Non-destructive probe station - Assets

- **System compactness.** For the same overall performance, we shall privilege more compact systems.
- **Index of reparability in the long term.**

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5. INSTALLATION CONSTRAINTS

The installation of the system will be performed in the IRAM (Institut de RadioAstronomie Millimetrique) microfabrication facility, located at the following address:

Institut de Radioastronomie Millimétrique (IRAM)

300 rue de la Piscine, Domaine Universitaire

38400 Saint Martin d'Hères

FRANCE

For more precisions, please read Articles 6.2.4 and 6.4.2. of the CCAP.

We provide here detailed information regarding the installation constraints that must be satisfied by the proposed system.

5.1 LOT 1: ConFocal Sputtering Machine - Installation constraints

The footprint of the deposition machine (lot 1) must be within the constraints presented in the figure below.

In RED : available footprint in grey room. The space needed to open the machine and work on the targets must be within this footprint.
In BLUE : available footprint in clean room, e.g. for SAS, PC.
In GREEN : the maintenance access side.

The separating plastic wall will be adapted to the chosen machine.

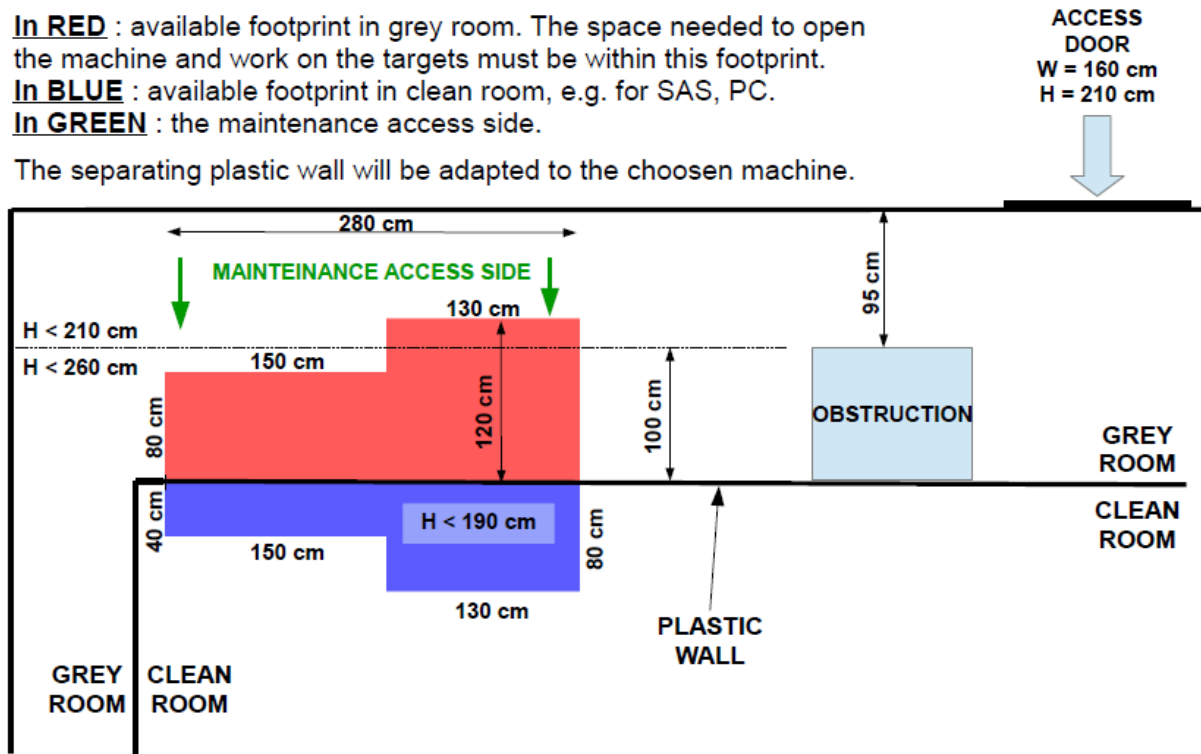


Figure 1. Maximal volumes occupied by the sputtering machine (lot 1). In red the space in the grey room (including maintenance, for example cathode replacement); in blue the space in the clean room, exclusively for load lock, control computer screen and keyboard. **The total width of the machine will not surpass 280 cm (including the space needed to open the chamber).** Maintenance should be possible from the back side of the machine **only**. The non-destructive probe station (lot 2) will be installed in the clean room on a separate table and **is not to be considered here**.

Even in a state where the main chamber is opened for maintenance, e.g. changing of sputtering targets, the system stays confined in the red area shown in the figure 1. It is understood that the sketch gives the available space possibilities, but the system should be as compact as possible, and should not occupy the total available space. **The available space in the cleanroom should be exclusively used by elements that necessitate user interaction (load lock, control elements such as a keyboard).** A through-the-wall solution is requested, but electrical racks should have their front panel aligned with the existing cleanroom wall. Easy maintenance and accessibility of all elements will be evaluated. It will be possible to open the main chamber, for maintenance, from within the grey room. The sputtering machine and its sub-systems will have to be entered in the grey room through the door shown in figure and going through the corridor.

The total weight of the machine should not be greater than 600 kg/m².

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5.2 LOT 2: Non-destructive probe station - Installation constrains

The characterisation non-destructive probe station will be a table-top system with a footprint smaller than 1000×1000 mm. It will be installed in the clean room on a separate table and **should not be considered** as part of the footprints shown in figure 1, that refer exclusively to the confocal deposition machine (Lot 1). The probe station should work with 220V standard AC power plug.

6. ACCEPTANCE PROCEDURE AND DOCUMENTATION

We ask the providers to specify in the quotation the standard acceptance, shipping, installation and basic training procedure that is proposed. We define in this context T0 as the date at which the selected providers are notified the duly signed order form. Candidates are invited to review the **details of all execution phases of each lot**, as defined in Article 6 of the CCAP (Cahier des clauses administratives particulières).

6.1 LOT 1: ConFocal Sputtering Machine - Acceptance

The acceptance process for the Lot 1 will include at least:

- **Preliminary visit (T1).** A visit at the provider site to check the system when it is ready to produce metallic thin films with the wanted specifications. **Earlier than T0 + 12 months.**
- **Performance initial tests (T2).** The production, at the provider site, of a sufficient number of wafers covered with metallic layers that CNRS will evaluate, also by producing some test devices out of those metallic films. Producing and testing these validation devices will take roughly two weeks. This step will come with the shipping clearance. **Earlier than T0 + 13 months.**
- **Pre-shipping visit – Shipping of the system**
 - **Pre-shipping visit.** A visit at the provider site to check the system before shipping.
 - **Shipping, Earlier than T0 + 14 months**
- **Installation and Setup, Training session (T4)**
 - **Installation and setup** of the system in our clean room, after having communicated the details of the interfaces to be prepared on our side (e.g. electrical, industrial water and others)
 - **Training session** to our personnel (up to 6 persons) and **handover of the documentation. Earlier than T0 + 15 months**
- **Equipment verification and acceptance procedures (T5)**

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- **Performance final test.** Aluminium and Titanium films will be produced and tested by CNRS in order to reproduce the results already obtained at the provider site.
- **Final acceptance meeting. Earlier than T0+16 months.**

The documentation will comprise at least: a) a User Manual with detailed operation instructions, troubleshooting, software description; b) a maintenance plan; c) the factory test report; d) documentation of the sub-systems, as for example the pumps, generators, compressors, valves, sensors.

For more details, please refer to the provisions of article 6.2 of the CCAP.

6.2 LOT 2: Non-destructive probe station - Acceptance

The acceptance process for the Lot 2 will include:

- **Shipping, installation and setup** of the system in our clean room.
- **Performance final test** to be performed using metallic films provided by CNRS, on 100 mm and 150 mm coated wafers.
- **Final acceptance. Earlier than T0+12 months.**

The documentation will comprise at least: a) a User Manual with detailed operation instructions, troubleshooting, software description; b) the factory test report.

For more details, please refer to the provisions of article 6.4 of the CCAP.

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7. WARRANTY AND AFTER-SALES SERVICE

The supplier(s) of both Lot 1 (sputtering machine) and Lot 2 (probe station) shall provide, within the given budget of this call, a warranty of 24 months.

The warranty will also include technical support for the operation of the equipment (software/hardware settings), with the possibility in particular of contacting a technician by telephone or email (in such cases, an initial response will be provided by the contractor within the following 24 hours). If on-site intervention is required, this intervention by the contractor's teams will take place no later than 7 calendar days from the request (the 7-calendar-day period shall start running from the day following the intervention request), during normal business hours.

On top on that, optionally, the supplier(s) of both Lot 1 and Lot 2 may, if it wishes, separately price an extension of warranty in the form of an annual maintenance contract (PSE n°01) as well as an extension of warranty in the form of a maintenance contract for a period of 2 years (PSE n°02).

Further details are available in Article 6.3 of the "Règlement de la consultation (RC)".

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8. PROPOSAL EVALUATION CRITERIA

Candidates are invited to review the bid evaluation criteria defined in Article XII of the “Règlement de la consultation”.

If the proposals exceed the allocated budget of maximum 400 000 euros HT (for Lot 1) or 100 000 euros HT (for Lot 2) they will unfortunately have to be rejected a priori.

END OF THE DOCUMENT