

APPLICATION GUIDE FOR QUANTUM COMPUTING RESOURCES

This Access Guide provides a guideline on how to apply to the **currently experimental quantum computing machines** within the RES. Users accessing Quantum Computing (QUANTUM) should expect **evolving capabilities, some unexpected issues and an opportunity to test and contribute** to RES' quantum computing capabilities.

Please note that the available quantum chips at the BSC cluster **may change over time during the RES access period**. Currently, this cluster hosts two chips: one with 5 qubits and another with 10 qubits. A new 20-qubit chip is expected to be installed around June/July. You can find **updated information about the cluster** and available resources at the following link: <https://www.bsc.es/supportkc/docs/Quantum/intro>

Step 0: Before applying...

The first thing you will see when starting an application is the following text clarifying **the intended use of RES resources**. Please read it carefully, as well as the [RES Access Protocol](#), before continuing your application, and click "Create new application" to continue with the application process.

At the BSC, the quantum machine is **mainly intended for chip usage and low CPU demand**. Each quantum job is associated with a 40-CPU node, which can be used to run supporting code, but **the main computation must involve the quantum chip. Jobs that do not make use of the chip will not be accepted**. If your application involves hybrid workflows, make sure to request both Quantum and the appropriate classical systems (e.g., MN5-ACC, MN5-GPP). Requesting QUANTUM resources **does NOT exclude you from requesting other machines**.

Additionally, RES also provides access to QUANTUM resources at CESGA:

- To **QMIO**, a 32-qubit hybrid quantum computer installed at CESGA. Technical and detailed information can be found at: https://cesga-docs.gitlab.io/qmio-user-guide/installation_overview.html
- **Quantum simulation resources**, including:
 - **Qulacs**, a simulator that enables realistic implementation of hybrid quantum algorithms within the Qmio architecture. More details can be found at <https://cesga-docs.gitlab.io/qmio-user-guide/simulators.html>
 - **CUNQA**, a distributed quantum computer emulator developed by CESGA. More info at: <https://cesga-docs.gitlab.io/qmio-user-guide/simulators.html>

Before applying ...

The deadline for next period applications is 08/05/2025 11:00:00, CET.

Dear user,

Each application to the RES is expected to be destined to perform an activity (a term that can be understood as one experiment or several) and not for long term projects. The RES understands that one project can include more than one activity. Considering that, an applicant can submit more than one application for different activities framed in a same global project.

For activities whose computing needs require access to resources during more than a period to be properly developed, applicants can request access for up to two periods (a first period as new application and a second period as continuation activity). The request for a continuation will be evaluated and the applicants will have to report to the Access Committee the results obtained during the first period. For more information [click here](#).

If you need help or any clarification, please contact us in applications@bsc.es.

Thanks for your cooperation,
Spanish Supercomputing Network.

Step 1: General information

Firstly, you will have to name your activity with a **descriptive, scientifically meaningful name** that encapsulates the core of the research within your project.

Then, you must select **the scientific area that best fits your activity**. If any category fits your project, that means we do not receive enough applications in that category to create a specific panel. In this case, or if you're unsure where to categorize your project, contact us via applications@bsc.es and we will advise you about how to proceed.

1. General Information

a) Activity Title

b) Area

Your application will be evaluated by different expert teams depending on your area selection.

c) Type of application

☐ Standard Activity for the next 4 months

☐ Standard Activity for the next 4 months (For a novel user, without previous expertise in HPC), it will remove from the review the evaluation of the previous expertise of the team in the HPC. This option can be selected only for users with less than 1 year of expertise in the usage of HPC.

☐ Pre-reservation of hours for European projects (this option allow the users submitting a EU proposal to have a reservation of hours for a maximum of 2 years. The hours will be granted only if the EU proposal is approved and granted by the EC).

☐ Small development AI projects : Small access to non-prioritised resources, for AI activities related to publicly funded projects.

Finally, you will be asked about **the type of activity you want to perform**. In the case of QUANTUM applications, choose between any of them except for the prereservation, which doesn't apply to quantum computing projects. The available options are:

1. **Standard activity:** For accessing your selected systems in a 5-month period. Subject to the limitations established in the access protocol.
2. **Standard activity for the next 5 months (continuation):** To request after completing a standard activity that requires further experiments/simulations. These activities are prioritized for the previously assigned machine, and the application form is simplified.
3. **Small projects/test:** Conceptualized for users that want to test algorithms procedures in a specific machine

Step 2: Research Project description

In this step, you will have to provide some information about the research project and the specific computational activity you want to perform. This is a crucial part of the application, as **it will serve to assess both the scientific excellence of the proposal and part of its technical viability**.

2. Research Project Description

a) Brief description of the Project

If this Activity takes place in the context of a Scientific Research Project, give a brief description of the Project, including the reference of National or International grants which support it. Summarize the research in the context of the current state-of-the-art, including references if appropriate. (Maximum 5000 characters).

In section 2a you will have to describe **a general outline of your project**: what you aim to obtain and why this project should be granted. You can include references if appropriate.

b) Grants and funded projects related to this activity

[+ Add New Grant](#)

Then, in section 2b, you will be asked to provide grant references that already back your project, **if applicable**. That will impact positively on your application, but it's **not mandatory** to already have a grant for your project.

After that, in section 2d you must explain **the calculations and simulations you will perform and why they require the use of RES resources**. For QUANTUM activities, you may specify the experiments, the models and/or the simulations you want to perform in detail, so it can be properly assessed by the Scientific and Technical Committees.

d) Specific Activity proposed

Describe the specific Activity proposed. Discuss the need for Supercomputing facilities. Describe in detail the specific calculations you plan to do, and their relevance to the Research Project. If the Activity is a 'Long Term Activity' (which will extend over several applications periods), you must clearly specify which calculations will be done in this period, and which ones will be done in following periods. (Maximum 10000 characters).

e) Computational algorithms and codes outline

Outline the computational algorithms and codes, and their suitability for supercomputing facilities. Describe any benchmarks performed on HPC systems. (Maximum 3000 characters).

Lastly, in section 2e, you must provide **the specific algorithms and methodologies you will use** if granted access to RES resources. This includes **any hybrid quantum-classical approach**, error mitigation techniques or specialized software tools. Specifically, for projects targeting the BSC quantum chips, you must also include technical details such as:

- Number of qubits required
- Maximum circuit depth
- Number of shots
- Gate set used *
- Estimated duration of the longest job *

As a reference, **a typical job with a circuit depth of 1000 and 10,000 shots takes around 20 seconds to execute**. Providing these details is essential for assessing the feasibility and resource impact of your proposal.

More technical information about the available chips and the quantum cluster — including **benchmark results** and reference execution times for circuits with different depths and configurations — can be found at: <https://www.bsc.es/supportkc/docs/Quantum/intro>

Step 3: Software and libraries

In this step, you will have to **detail every single piece of software** that you will need to use if given access to RES resources. For QUANTUM projects, you just need to detail software in section 3d), and **IGNORE** sections 3a), 3b) and 3c).

For instance, at the BSC, quantum computing workflows are based on Python, **using the Qibo and Qililab libraries**. If you already know that you will need additional or specific software for your quantum workflows, **please include it in this section 3d)**. However, you may also request specific libraries later, depending on your project's evolving needs.

If you intend to use other libraries or frameworks, please note that you will need to convert your **quantum circuits to be compatible with Qibo, as it is the execution backend used for quantum jobs at BSC**. Additionally, Qililab supports pulse-level control, allowing users to define custom pulse sequences for advanced experiments.

More information about Qibo and Qililab can be found at:

<https://qibo.science/qibo/stable/>

<https://qaas.readthedocs.io/projects/qililab/en/latest/>

d) Other requested software

(Additional information might be requested by the Access Committee)

e) Proprietary software

In case of proprietary software, you should include software name, short description, link to web page with full software description.

Step 4: Research team description

In this step, you will have to provide information about the research team that will be using the resources you are applying to. Note that in this step **you are not creating accounts to access the supercomputer**, but just listing all the people involved in the project. Access accounts will be created later, once you have been granted RES resources.

The Team leader is the person requesting the resources, even if they have a supervisor (i.e. in a TFG/TFM). It could be the case that your institution is still not registered in our database. **You can add that institution manually.** Just click in the 'Not found' message to open a new field when you can manually enter your institution's name, as shown in the images below.

4. Research Team Description

a) Personal Data

Name of Team Leader	
Gender	Select an option
e-mail	
Institution	Example institution
Phone	Not found. Click here to set a new institution name. (0)
Nationality	Spain

4. Research Team Description

a) Personal Data

Name of Team Leader	
Gender	Select an option
e-mail	
Institution	[0] New institution. Write below the name.
New institution name	Example institution
Phone	
Nationality	Spain

Following with the team leader information, you will have to provide a brief CV of the team leader or any other member of the team that is relevant to the application.

b) Curriculum Vitae of the Team Leader

Please, provide a brief Curriculum Vitae of the Team Leader, including any relevant information that may help in demonstrating his/her qualifications to lead the proposed activity. (Maximum 2500 characters)

Apart from the team leader, you will have to list every other member involved in this activity. You can include any member taking part on the project, including supervisors or any other member. Please, write their names, institution and e-mail in the following format:

- John Smith, Example Institution, john.smith@exampleinstitution.com
- Juan Pérez, Institución de Ejemplo, juan.perez@institucionejemplo.com

c) Names of other researchers involved in this activity

Include only name, institution and e-mail.

Finally, you will be asked to provide up to 5 relevant publications from **any member of the research team**, not necessarily the team leader. That's not mandatory but will impact positively on your request in the case they can be provided.

d) Relevant publications

List the five most relevant publications, in the last five years, from the members of the research team that guarantee the scientific quality of the proposed Activity and demonstrate the qualifications of the team to complete it.

Step 5: Resources

Following next, you will find **the core section for the technical review** of your activity. Firstly, you will be shown the list of **all RES eligible machines**, with **their key technical features** and a link to more detailed information about it. You can show/hide this list at your convenience.

5. Resources

Show / Hide Available Machines

MareNostrum5 GPP MNS GENERAL PURPOSE partition (only CPU codes) INTEL CPU cluster with Intel Shappire rapids processor and 112 cores per node, up to 6408 nodes	MareNostrum5 ACC MNS ACCELERATED - GPU partition (only codes using GPU): NVIDIA + INTEL cluster with Intel Shappire rapids processor and 4 H100 with 64 GB HBM2 memory, up to 1100 nodes with 4 GPUS each one (80 cores per node, 20 per gpu)
Altamira Xeon E5-2670 a 2.6 GHz with Infiniband/ 5120 cores Click here for more information	Picasso Intel SandyBridge-EP E5-2670/1600 20M a 2.6 GHz with Infiniband/ 4016 cores Click here for more information
Tirant 672 SandyBridge 2.6 GHz with Infiniband/ 5376 cores Click here for more information	Agustina AMD Epyc 7513 2.6GHz / 6144 cores / 25.4 TB DDR4 3200MHz / Infiniband HDR100
La Palma Intel Xeon SandyBridge a 2.6GHz with Infiniband/ 4032 cores Click here for more information	Caléndula Intel Xeon E5450, 3GHz with Infiniband / 1440 cores Click here for more information
Lusitania II Intel SandyBridge-EP E5-2670/1600 with Infiniband / 3000 cores Click here for more information	Cibeles Intel(R) Xeon(R) Gold 6330 at 2.0GHz, with Infiniband HDR at 200Gbps non blocking and with 1PB of storage using Lustre Click here for more information
Urederra Urederra is a cluster with 760 Cores Intel(R) Xeon(R) CPU E5-2640 v4 @ 2.40GHz, 5Tb of main memory Click here for more information	CIEMAT-XULA Xula is a cluster of 44 nodes, each one with 2 Intel Gold 6148, 192GB RDIMM, 2TB SAS and 240GB SSD SATA Click here for more information
CIEMAT-TURGALUM Turgalum is a cluster of 40 nodes, each one with 2 Intel 6254, 192 GB main memory and Infiniband EDR100 Click here for more information	Finis Terrae III ATOS CPU cluster with 22.656 cores Intel Xeon Ice Lake 8352Y, Infiniband HDR, 118TB memory, 5 PB disk Click here for more information
Finis Terrae III - GPU ATOS GPU cluster with 64 GPU-nodes with 2 NVIDIA A100 GPUS each one, Infiniband HDR and 5PB disk Click here for more information	Pirineus III INTEL CPU Cluster with Intel Platinum 8268 2.9 GHz (19 nodes) & Intel Gold 6342 2.8 GHz (40 nodes) Click here for more information

The information on the “More information” link is the most up-to-date available, but you can find fundamental information about our systems below:

MareNostrum5 Ona: Two superconducting, digital quantum chips: one with **20 qubits*** and another with **10 qubits**. Each chip is connected to a compute node with **40 CPU cores (Intel Xeon Platinum 8352Y)** for classical pre- and post-processing.

***Chip availability may vary.**

Finisterrae-Qmio: One superconducting QPU that consist of **32-coaxmon qubits** handled by microwave pulses connected to a compute node with **64 CPU cores (Intel Xeon Gold 6338)** for classical pre- and post-processing.

After checking the available machines, you will have to establish **which machine/s you want to request resources to**. Please remember that you can add more than one machine, if your activity requires them, with their own resources request each, **even if they use different resources** (QUANTUM, classical CPU, classical CPU+GPU).

a) To which machine(s) are you requesting access?

MareNostrum5 ACC + Add Machine

MareNostrum5 ACC

MNS ACCELERATED - GPU partition (only codes using GPU): NVIDIA + INTEL cluster with Intel Shappire rapids processor and 4 H100 with 64 GB HBM2 memory, up to 1100 nodes with 4 GPUS each one (80 cores per node, 20 per gpu)

INFORMATION: The estimated cost of the requested hours, considering only the electricity cost, is --- euros.

Once you have selected your desired machine, click on the button “Add machine” to **open the “Resource Request menu”**. The menu was originally designed for HPC activities, so the terminology refers to HPC concepts.

Please, try to estimate in terms of resource consumption, the typical run as well as the largest case (the most resource demanding experiment) for your simulation.

Requested machine MareNostrum5 GPP (MNS GENERAL PURPOSE partition (only CPU codes) INTEL CPU cluster with Intel Shappire rapids processor and 112 cores per node, up to 6408 nodes)

Interprocess communication Null

Typical Job Run			
Number of processors needed for each job	1000		
Estimated number of jobs to submit	200		
Average job durations (hours) per job	1		
Total memory used by the job (GBytes)	1		
Largest Job Run			
Number of processors needed for each job	1000		
Estimated number of jobs to submit	200		
Average job durations (hours) per job	1		
Total memory used by the job (GBytes)	1		
Total disk space (Gigabytes)	Minimum	256	Desirable 256
Total scratch space (Gigabytes)	Minimum	256	Desirable 256
Total Requested time (Thousands of hours)	200		

If this activity is asking for more than 10Million CPU hours, you need to justify the amount of resources requested for the activity. (max 1000 characters)

For QUANTUM projects, almost every field of this menu **must** be set to 1, as shown in the upper image. The are only 3 required fields:

- **Total requested time: Estimate the time the system will be blocked from operating it yourself**, not only the “quantum time” required for running your project. This estimation will help to allocate QUANTUM projects more efficiently and perform recalibrations better and **MUST be written in hours**, not kilohours. If you estimate a use of 2 hours, just write “2” in the “Total Requested Time” field. **REFERENCE:** A typical job with a **circuit depth of 1000** and **10,000 shots** takes around **20 seconds** to execute. Running 1000 independent jobs of this type would take approximately **5 hours and 30 minutes in total**. However, most of this time is spent on connection overhead. If multiple circuits are executed without closing the connection between jobs, the total runtime can be significantly reduced. More details on optimized execution strategies will be available on the official website.
- **Processors needed for each job & Estimated number of jobs to submit:** To avoid error messages and other possible issues, set the processors number to 1000 and the number of jobs to submit equal to the amount of hours you are requesting.
- **Total disk and scratch space:** You have to set **a minimum amount of 256GB** in both the “Minimum” and “Desirable” fields. If you expect to need more than this storage, please **estimate how much you’ll need and fill the fields accordingly**.

When you have added the machines you need for completing the proposed activity, you must select one of the following options. This step is really important, as it can greatly affect to your assigned resources:

- If you select “Only selected machine” (first option), your request will only be able to be assigned to your selected machine. **This option is only suitable if your activity needs an specific architecture or computational requirements.** Have in mind that this can imply that **your application might be fully rejected if no computing time is left in that machine.**
- If you select “Any machine” (second option), your request can be assigned to your selected machine, or to any similar other if that machine’s resources have been exhausted. **This option is suitable if your activity can be run in different machines,** but you have a preference for a particular one. Your activity **might be assigned to another machine** if no computing time is left in your preferred one.

Please select:

☒ The required resources have to be executed in the selected machines, the other architectures do not fit the requirements to execute the proposal.

** this option implies that if no hours in this machine/these machines are available, the access committee will reject the full application.

☐ The architectures selected for the requested resources are only a suggestion. If no hours in this machine/these machines are available, please grant resources in any other similar architecture where the codes used for the application may run efficiently.

** this option implies that if no hours in this machine/these machines are available, the access committee will allocate the activity in any other similar machine.

Also note that the option you select will apply to all the machines you have selected; either CPU systems, CPU+GPU systems or QUANTUM machines.

Steps 6, 7 and 8: Abstract, CURES and Usage Terms & Conditions

Once you arrive to this point, your application is nearly finished. You only need to provide a brief abstract of your project to publish in our website, answer two questions regarding the RES Users’ Committee (CURES) and read and accept our terms and conditions. Once you have done so click “Save Application”.

6. Abstract for publication

Max. 850 characters, ready for publication in the web page in case the proposal is accepted.

7. Contact with CURES during last year

Information about the RES Users Committee (CURES).

a) User has contacted the CURES during last year
☒ Yes ☐ No

b) If so, was the answer satisfactory and useful?
☐ Yes ☐ No

8. Usage Terms & Conditions

☒ I have read and accept the Usage Terms & Conditions.

The data will be saved. You may continue editing it until the deadline. It will not be accesible to the Access Comittee if you do not submit it.

Last steps: After saving your application

After clicking “Save Application”, your application will be saved but not sent. Your application will be accessible in your RES intranet profile with a temporary identifier.

You can edit your application, and we encourage you to do so, as many times as you need before the deadline.

When you are ready to send your application, just click “Submit Application”. This can’t be undone, and you will no longer be able to edit your application. Be sure you don’t need to make any changes before submitting it!

TEMP-2025-2-0003 Test application to create the QUANTUM application guide.

 Your application has been saved but **it has not been submitted yet**. You must submit your application before the deadline.

[View Application](#) [Edit Permissions](#)

[Edit Application](#)

[Remove Application](#)

[Mark this activity as resigned](#)

[Submit Application](#)

[Print PDF](#)

You must submit your application. 

1. General Information

Activity Id

TEMP-2025-2-0003

a) Activity Title

Test application to create the QUANTUM application guide.

b) Area

Astronomy, Space and Earth Sciences

c) Type of application

Standard Activity for the next 4 months

--- 2. Research Project Description

a) In this Test Activity?