**Contact person:**

**Joaquin Gómez Camacho (**[**gomez@us.es**](mailto:gomez@us.es)**).**

**Deputy:**

**Carlos Guerrero (**[**cguerrero4@us.es**](mailto:cguerrero4@us.es)**).**

**Description of the infrastructure**

Name of the infrastructure (and its installations, if applicable):

Centro Nacional de Aceleradores (CNA)

Location (town, country) of the infrastructure: *If the infrastructure comprises more than one installation (i.e. parts of the infrastructure that can be used independently and for which the operating costs can be singled out) at different locations, indicate briefly the location of each installation and give a justification for considering them as a single infrastructure.*

*Sevilla, Spain*

Web site address:

www.cna.us.es

Annual operating costs (excl. investment costs) of the infrastructure (€):

1350000

Description of the infrastructure: *Give a brief general description of the infrastructure to which access is offered. Illustrate, in particular, its state-of-the-art equipment and services offered to users that make it rare or unique in Europe. Outline the areas of research normally supported by the infrastructure, as well as new areas opening to users, if any. If the infrastructure is composed of several installations, describe these including their specific features. If parts of the infrastructure are still under construction, specify the starting date of construction and indicate the date when access can realistically be made available.*

The Centro Nacional de Aceleradores (CNA) is a joint centre of the University of Sevilla, the regional government of Andalusia and the Spanish higher research council CSIC. It is recognized by the Spanish government as a Scientific and Technological Singular Facility (ICTS), which are major user oriented facilities covering all the fields of science. CNA has a 3 MV tandem accelerator, an 18 MeV cyclotron, a 1 MV tandetron, a compact MICADAS radiocarbon system, a 60-Co irradiator and a PET-CT scanner. Recent instrumentation developments at CNA include a neutron beam line (known as HISPANOS) with time of flight capabilities, a microprobe application allowing to study radiation damage on detectors using the IBIC (ion beam induced current) technique, and an Accelerator Mass Spectrometry (AMS) accelerator optimized for measurements of actinides.

Services currently offered by the infrastructure: *Describe the services offered by the infrastructure and its research environment, and demonstrate how they will enable scientists to carry out high-quality research, giving examples of relevant scientific achievements it enabled. Demonstrate that there is a widespread interest from users in other countries to conduct research at the infrastructure (or make otherwise use of its services), e.g. by indicating the number of international users currently using the facility per year.*

Under the EUROLABS project, CNA provides access to its major facilities: The 3MV Tandem, the 18 MV cyclotron and the 1 MV Tandetron. They provide a variety of beams of stable ions, as well as neutrons, which can be used for basic nuclear physics, applied nuclear physics and instrumentation developments. CNA carries out about 120 beam time applications per year, which are selected by an external scientific committee. 10% of these experiments are proposed by scientists of non-spanish institutions.

Some examples follow:

Recent applications of the CNA beams include the development of “solid helium” targets. These are materials, in which a matrix of silicon contains a very large fraction of helium atoms, in such a way that they can be used as targets in nuclear reaction experiments with exotic beams, for which alpha particles could not be used as projectiles. The materials science users of CNA developed these materials, for different purposes. Through the interaction with CNA scientists, nuclear physics applications were applications were found, a patent was developed, the targets were characterized in p-4He scattering, the feasibility of 4He was demonstrated through 6Li-4He scattering, experiments with heavy stable projectiles were carried out with the solid He targets at LNS in Catania, and proposals with exotic beams on ISOLDE have been submitted.

On the instrumentation side, the CNA microprobe has been used to characterize the radiation damage of silicon detectors, within the RD50 collaboration, which is focused on the radiation damage of silicon detectors, used in LHC. CNA provides the IBIC (Ion beam indiced current), which allow to investigate in detail, and with a large special resolution, the effect of irradiation on a variety of sensors.

CNA has recently installed a system that allows to pulse beams produced in the Tandem accelerator. That allows to determine the energy of the neutrons produced by reactions with selected targets, through time of flight measurements. This has allowed to measure the energy dependence of different neutron induced reactions, providing complementary measurements to dedicated time of flight facilities such as nTOF.

CNA has recently installed a He stripping gas in its AMS system. This has allowed to increase the sensitivity for the measurements of actinides. Minor actinide isotopes such as 236-U, 237-Np, 239-Pu and 240-Pu have been accurately measured, for environmental studies. However, the accuracy achieved at CNA opens the possibility of measuring very low cross sections involving actinides, through the measurement of the traces produced in the targets.

Recent references appear at Eur. Phys. J. Plus (2021) **136**: 273

<https://doi.org/10.1140/epjp/s13360-021-01253-x>

Modality of access under this proposal: *Outline how a user, or user group, will be given access to the infrastructure or to its services (e.g.* ***trans-national/virtual****, type of equipment/service used, expected output/deliverables, etc.).*

*For* ***trans-national access*** *indicate the typical execution and duration of work (if access is provided ‘in person’, thus not remotely, indicated the estimated number of days spent at the infrastructure), and, where relevant, how the users will be integrated into the scheduling of the infrastructure and the degree of independence they will experience with respect to the normal research activity of the infrastructure.* *Define clearly, for each installation, the* ***unit of access*** *used to measure the access offered and indicate what is covered and included (e.g. preparatory work, specific training courses) in one unit. This is essential for monitoring the access provided under this project, but also to justify the corresponding costs. Indicate for each installation which modality will be used to declare access costs (on the basis of* ***unit cost****, as* ***actual cost****, or as a* ***combination*** *of the two) and justify your choice.*

*For* ***virtual access****, define clearly, for each installation, the* ***unit of access*** *used to measure the access offered and indicate what is covered and included in one unit. This is essential for monitoring the access provided under the project, but also to justify the corresponding costs. Indicate for each installation which modality will be used to declare access costs (on the basis of* ***unit cost****, as* ***actual cost****, or as a* ***combination*** *of the two) and justify your choice.*

Transnational access.

The typical experiments at CNA, envisaged on this proposal, require one week (5 days), although shorter or longer proposals are viable as well. The spokesperson of the experiment will establish previous contact with the facility coordinator, who will schedule the experiment and ensure that the measurements are feasible, given the status of the facility. During the experiment, external users will closely collaborate with the local team, composed of accelerator technicians and beam line physicists, receiving priority over the normal research activities. The unit of access is the hour of beam time, which corresponds to the situation in which the accelerator is delivering the corresponding particle beam. Additional time, associated to preparatory work such as detector installation or dismounting, as well as the analysis, is not counted in access units. For hands-on training courses, which require the use of accelerators, access units will correspond to the hours in which the accelerator is working. Under normal operation, one full day consists of 8 beam time hours, although there is the possibility of running continuously, upon request.

Support offered under this proposal: *Describe the scientific, technical and, for trans-national access, logistic support that would be offered to the users. Where relevant, emphasise the quality of the scientific environment in which the users will be working and explain how this might stimulate their research. Explain to what extent such support is already routinely provided to external users.*

The support of the users starts in the preparation phase of the proposal. They can contact the CNA coordinator, that will advise on the general procedures to prepare the experimental application, given the CNA capabilities. Once the experiment is approved, the spokesperson of the experiment will contact the coordinator of the specific accelerator facility, who would set the adequate schedule for the experiment, and perform initial tests, if required, of the accelerators. Also, they will arrange the shipping of the necessary equipment. During the time of the experiment, the external users, along with the local beam line scientists, will set up the detection and data acquisition systems. The optimal beam conditions can be adjusted through the interaction of the external users, the local line scientists, and the accelerator operators. CNA is a cross-disciplinary facility, so its staff participates in experiments that range from basic nuclear science to diverse applications, such as material science, health, etc. Also, diverse beams and detection equipment are available for users. This can benefit the users, in a way that more dedicated and less accessible international facilities cannot. CNA, thanks to its user-oriented character, is strongly focused and used to work with external users. The ICTS (national singular facility) character of CNA, obtained in 2008, and the national funds associated to it, require a constant monitoring of the use by the external researchers, which is shown in strategic plans of the center performed and evaluated every 4 years. Also, the scientific committee of CNA, composed by external scientists, is informed every 6 months of the progress of the center, with an emphasis on the proposals and experiments form external users.

Outreach to new users: *State what measures are taken to attract new potential users (e.g. web page, call for proposals, etc.), including specific user groups such as users coming from SMEs or representing new areas of research, if appropriate. Indicate why and to which extent the EU funding of this trans-national and/or virtual access activity will provide European research teams with new opportunities of access to the infrastructure. Indicate whether the number of trans-national and/or virtual users is expected to increase as a result of this proposal, and how you will monitor such an increase. If trans-national access to the infrastructure is being opened to users other than those from the host country of the infrastructure for the first time, what evidence is there that there will be sufficient demand for the access offered under this proposal?*

CNA, as a user-oriented facility, is strongly motivated to attract new users. Indeed, the CNA website [www.cna.us.es](http://www.cna.us.es/) contains a dedicated section with the details for Calls, which are opened every three months:

http://institucionales.us.es/solicitudescna/index.php/en/

The website contains a guide for first time users, which they find especially useful. In any case, we are aware that the best way to attract new potential users is for local as well as external users to promote the CNA capacities in scientific meetings. However, potential interested users contacted for instance in a conference, are required to present a new proposal for a new facility and find funds for traveling and accommodation for a facility which is in the periphery of Europe. It is not surprising that they often desist once they go back home. A trans-national access program, coordinated with major nuclear physics facilities in Europe, will indeed be very effective to overcome the inertia that potential interested users may feel. We do certainly expect to have an increase in the quantity and quality of international users of CNA as a result of the participation in EUROLABS.

Review procedure under this proposal: *For trans-national access activities, describe the peer review procedure that will be used to select users under this proposal. Outline the composition of the User Selection Panel. Demonstrate that the selection of users will follow the principles of transparency, fairness and impartiality. As the selection will be based on the evaluation of scientific merit of the applications, but with priority to new users and users coming from countries where such infrastructure is not available, indicate any additional selection rule that you would like to add.*

*For virtual access activities, describe how and when the periodical assessment of the services offered to the scientific community will be carried out (e.g. by an international review panel). The corresponding assessment reports must be defined as deliverables to the EC.*

CNA (Sevilla, Spain), along with ATOMKI (Debrecen, Hungary), and C2TN (Lisboa, Portugal) will form a Cluster of Low Energy Accelerators for Research (CLEAR). The three facilities will set up a common web page, and a common access procedure, for users which qualify for transnational funds.

Proposals will be reviewed by a common access committee, with representation of scientists of the three facilities, along with a representative of the EUROLABS management, that will award the access costs and travel and living allowances to the best projects. Present funding allows to fund four experimental projects per year for each facility.

Selected projects will be made public in the CLEAR webpage. The minutes of the selection committee will be made available for the EUROLABS management and as project deliverables.

The access committee will select the proposals attending to the following criteria:

1. Scientific merit of the project.
2. Relevance of the project for other physical or virtual access facilities in EUROLABS.
3. Users which are new in the facilities.
4. Users from countries who do not have adequate facilities to carry out this research.
5. Users taking into account a promotion of diversity (gender, scientific status, research field).