CNID Strategic Planning
WG10 - Characterization Techniques

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1 Executive Summary (Recommended: one page maximum)

WG10 should be framed as a transversal instrumentation activity rather than as a narrow list of isolated techniques. Across the updated survey, the responding community covers the characterization chain required to validate detector technologies: detector- and module-level testing, readout and DAQ performance evaluation, radiation and environmental qualification, cryogenic and low-background validation, EMC/RF studies, and application-oriented benchmarking.

From the current survey, 19 groups have identified activities related to WG10. Together, they form a technically dense community, but one that also shows a structural dependence on non-permanent personnel and a limited pool of dedicated technical staff.

The scientific and technological scope is broad but coherent. It spans characterization techniques for silicon detectors used in tracking and timing, DMAPS and related pixel technologies, neutron instrumentation and dosimetry, X- and gamma-ray instrumentation, cryogenic and superconducting sensors including TES and single-photon detection, low-background detector systems, neutrino instrumentation, and detector concepts for medical, industrial, astroparticle, and space-related applications.

The community already possesses a strong national base of enabling characterization infrastructures: electrical and optical characterization laboratories, SPA/TPA-TCT developments, ion-beam and neutron facilities, irradiation and test-beam access, RF/EMC laboratories, cryogenic platforms, low-background environments, and detector/ readout validation setups. What is still missing is not only hardware, but a visible and coordinated access model, together with a shared portfolio of protocols, metadata standards, and reference workflows.

WG10 is also clearly aligned with the European detector R&D ecosystem. DRD participation is strongest in DRD3, with additional presence in DRD7, DRD5, and DRD1. This positions the Spanish community well for future detector developments, but it also highlights critical bottlenecks: fragmented characterization protocols, uneven access to automated test systems, insufficient continuity in firmware and technical profiles, and limited consolidated expertise in cryogenic and low-background characterization workflows.

The most credible 5-year strategy for WG10 is therefore to move from a descriptive map of capabilities to a coordinated operating model. The recommended priorities are: (i) a national, searchable portfolio of characterization facilities, techniques, and contacts; (ii) common characterization protocols and data-format conventions; (iii) targeted support for automated characterization, DAQ/readout validation, irradiation workflows, and cryogenic/low-background testing; (iv) training and mobility schemes for engineers, technicians, and PhD students; and (v) a small number of cross-WG demonstrators that convert the network from a catalogue into a working infrastructure.

2 Findings (Recommended: 4 pages maximum)

2.1 Scientific and Technical Focus Areas

The survey responses show that WG10 covers a broad but reasonably coherent set of activities along the detector characterization and validation chain. The balance is not the same across all groups, but several recurring lines of work appear clearly in the survey.

WG10 should not be understood simply as a collection of isolated characterization techniques. Rather, it represents a transversal capability that supports detector development by providing the methods, infrastructures and protocols required to validate detector and readout performance under controlled and reproducible conditions.

The main technological domains and expertise represented in WG10 are:

- **Basic detector performance characterization:** electrical characterization, gain and noise measurements, calibration, metrology, environmental testing, stability studies, and detector response under controlled laboratory operating conditions.

- **Detector response under optical, particle-beam and radiation environments:** charge-collection studies, characterization with radioactive sources, optical and laser-based testing including SPA-TCT and TPA-TCT, beam-test characterization, ion-beam methods such as IBIC and TRIBIC, irradiation campaigns, post-irradiation studies, radiation-damage assessment, and detector response under application-relevant radiation environments.

- **Readout electronics, DAQ, timing, and control validation:** characterization of readout chains, readout-ASIC response and calibration, low-noise front-end performance, digital pulse-shape analysis, synchronization and clocking, power-distribution effects, FPGA/SoC-based DAQ validation, and data-quality checks.

- **System-level validation and application-oriented benchmarking:** end-to-end validation of detector modules and readout systems, cryogenic validation, low-background operation, EMC/RF qualification, reliability studies, quality-control procedures, and performance benchmarking for HEP, neutrino, medical, industrial, astroparticle, and space-related applications.

There is a clear thematic overlap with the Electronics WG in the areas of readout-chain validation, ASIC characterization, low-noise front-end performance, DAQ/firmware testing, synchronization, clock distribution, power distribution and EMC/EMI studies. In WG10, these topics are addressed from the perspective of detector characterization and system validation: the focus is on measuring, calibrating, benchmarking and qualifying the performance of detectors and readout systems, rather than on electronics design itself.

The experimental domains connected to WG10 activities include high-energy and high-rate detectors, low-signal and large-scale detector systems, nuclear-physics and radiation-based instrumentation, and applied instrumentation for medical, industrial and technology-transfer contexts. The corresponding R&D lines connect naturally to silicon tracking and timing detectors, DMAPS and related pixel technologies, neutron instrumentation and dosimetry, X- and gamma-ray instrumentation, cryogenic and superconducting sensors, low-background detector systems, neutrino instrumentation and detector systems for medical, industrial, astroparticle and space-related applications.

2.2 SWOT Analysis

2.2.1 General CNID-level SWOT

Strengths	Weaknesses
• Broad national expertise in instrumentation across universities, CSIC institutes, research centers, and technological institutes. • Strong participation in international detector R&D collaborations and experimental programs. • Complementary capabilities distributed across different institutes and application domains. • Existing experience in cross-institutional detector R&D projects.	• Limited availability of long-term technical staff in several centers, especially for highly specialized instrumentation tasks. • Dependence on short-term contracts to maintain know-how in critical technical areas. • Fragmented visibility of available infrastructures, expertise, and contact points. • Uneven access to technical support in electronics, mechanics, computing, DAQ, and system operation.
Opportunities	**Threats**
• Build a coordinated national portfolio of instrumentation infrastructures and expertise. • Use CNID as a framework to coordinate shared infrastructures, training actions, and cross-WG demonstrators. • Increase national visibility in European detector R&D roadmaps and future EU calls. • Promote shared training actions for students, engineers, and technicians.	• Loss of technical know-how due to staff turnover and lack of stable technical career paths. • Underfunding of instrumentation-specific activities compared with physics-analysis or experiment-operation activities. • Duplication of small local efforts without sufficient coordination or interoperability. • Aging or space-constrained infrastructures in some centers.

2.2.2 WG10-specific SWOT

Strengths	Weaknesses
• Strong expertise in detector characterization, including electrical, optical, laser-based, ion-beam, irradiation, beam-test, EMC/RF, cryogenic, and low-background techniques. • Access to complementary national and international characterization infrastructures. • Experience in detector and readout validation for HEP, nuclear physics, neutrino, astroparticle, medical, and industrial applications. • Clear alignment with European detector R&D activities, especially DRD3, with additional links to DRD7, DRD5, and DRD1. • Existing activity in application-oriented validation, including medical imaging, dosimetry, tomography, and radiation-monitoring systems.	• Lack of harmonized characterization protocols and data-format conventions across laboratories. • Uneven level of automation, documentation, and reproducibility in characterization workflows. • Limited availability of firmware and DAQ expertise in some groups for maintaining advanced characterization setups. • Limited consolidated expertise in cryogenic and low-background characterization workflows, including low-noise and multiplexed readout validation where relevant. • Access conditions to some specialized infrastructures are not yet sufficiently visible or standardized.
Opportunities	**Threats**
• Define WG10-wide characterization protocols, metadata standards, and reference workflows. • Create a searchable national portfolio of characterization facilities, techniques, contacts, access conditions, and typical use cases. • Develop coordinated irradiation and post-irradiation characterization campaigns. • Launch cross-WG demonstrators where characterization is a central deliverable. • Use WG10 as a platform for training and mobility in advanced detector characterization methods.	• Characterization capabilities may remain fragmented if no common operating model is established. • Dependence on external test-beam and irradiation schedules may limit strategic autonomy. • Loss of expertise in specialized techniques such as TCT, IBIC/TRIBIC, cryogenic testing, EMC/RF validation, or low-background operation. • Characterization may be perceived as a support activity rather than as a strategic R&D capability. • Lack of sustained funding for operation, maintenance, and upgrade of shared characterization infrastructures.

2.2.3 Critical gaps

The critical gaps identified for WG10 are not primarily a lack of isolated instruments, but a lack of coordination, standardization, and continuity. The main gaps are:

- A national, searchable catalogue of characterization infrastructures, techniques, access conditions, and contact points.
- Common protocols for representative characterization workflows, including electrical tests, optical and laser-based measurements, irradiation campaigns, beam tests, cryogenic validation, EMC/RF studies, and DAQ/readout validation.
- Common metadata and data-format conventions allowing results from different laboratories to be compared, archived, and reused.
- Technical continuity in firmware, DAQ, automation, calibration, and operation of advanced characterization setups.
- Structured training in specialized characterization techniques such as SPA/TPA-TCT, IBIC/TRIBIC, irradiation planning, cryogenic testing, EMC/RF validation, and low-background operation.
- Clearer coordination of access to test-beam, irradiation, ion-beam, underground, cryogenic, and EMC/RF facilities.
- Consolidated know-how in cryogenic and low-background characterization workflows, including low-noise and multiplexed readout validation where relevant.

2.3 Infrastructure and Capability Mapping

The survey confirms that WG10 already brings together a significant set of infrastructures and enabling capabilities distributed across several centers. These infrastructures are not uniform, and they are not always available under the same conditions, but they are complementary and potentially shareable if made visible through a common access model.

A key message is that the limiting factor is no longer only equipment availability. The main bottleneck is the lack of a searchable portfolio, transparent access conditions, and shared best practices that would allow the network to operate as a coordinated characterization infrastructure rather than as a set of isolated local assets.

2.3.1 Characterization infrastructures

Infrastructure	**External access**	**Description**
Electrical and environmental characterization laboratories	Partial / to be defined	Laboratories for detector and module characterization through I–V/C–V measurements, leakage-current studies, gain and noise measurements, calibration, stability tests, and response measurements under controlled temperature, humidity, vacuum, or other laboratory operating conditions.
Optical and laser-based characterization laboratories	Partial / to be defined	Facilities for optical detector characterization, including laser-based transient-response measurements, charge-collection mapping, timing-response studies, detector-uniformity measurements, and SPA-TCT/TPA-TCT developments.
Beam-based, ion-beam, and irradiation characterization facilities	Yes / coordinated access	Facilities and workflows for detector characterization with particle beams, ion beams, microbeams, neutron fields, and irradiation lines. They support charge-collection studies, radiation-damage assessment, radiation-hardness qualification, and pre-/post-irradiation characterization.
DAQ, readout, timing, and control validation setups	Partial / to be defined	Test benches for validating readout-chain performance, ASIC/readout response and calibration, synchronization, clock distribution, data throughput, trigger behavior, digital pulse processing, data quality, and acquisition stability.
EMC/RF validation laboratories	Partial / yes	Facilities for EMC/EMI studies of detector modules, readout chains, power-distribution systems, and integrated detector setups, including validation of detector performance under realistic electromagnetic and system-level operating conditions.
Cryogenic characterization platforms	Partial / to be defined	Low-temperature platforms for detector characterization, cryogenic sensor response, ultra-low-noise measurements, readout validation, and long-term stability studies under cryogenic operating conditions.
Low-background characterization environments	Coordinated access	Underground or shielded environments for rare-event detector validation, low-background operation, radiopurity-related studies, long-duration stability measurements, and detector performance studies under low-background conditions.
Metrology and QA/QC platforms	Partial / to be defined	Facilities for detector inspection, dimensional metrology, quality-control procedures, calibration checks, reproducibility studies, and performance benchmarking of detectors, modules, and readout systems.

Table 1: Main categories of WG10 characterization infrastructures and capabilities.

2.3.2 Open and shared facilities relevant to WG10

Infrastructure / facility	ICTS?	Type of service relevant to WG10
CNA – Centro Nacional de Aceleradores	Yes	Ion and proton irradiation, ion-beam characterization, detector testing, radiation-damage studies, and dosimetry-related measurements.
CMAM-UAM	Yes	Ion-beam irradiation and characterization capabilities relevant for detector response studies, radiation-tolerance qualification, and post-irradiation characterization.
CERN and DESY test-beam facilities	No	Particle-beam characterization of detector prototypes, timing systems, tracking devices, readout chains, and system-level detector demonstrators.
Underground laboratories, including LSC and LSM	Yes / no, depending on facility	Low-background and underground detector characterization, rare-event detector validation, radiopurity-related studies, and long-term operation in shielded environments.
RF/EMC laboratory at ITA	To be defined	EMC/EMI validation of detector modules, power-distribution systems, readout chains, front-end electronics, and integrated instrumentation setups.
Laser characterization laboratories (IFCA, IFIC, LSB-EUH, ...)	No	Optical and laser-based detector characterization, including TCT-type measurements, charge-collection mapping, timing-response studies, and detector-response uniformity measurements.

Table 2: Open or shared facilities of direct relevance to WG10 activities.

2.3.3 Software, DAQ, and data capabilities

WG10 also depends on software, DAQ, and analysis capabilities that are essential to make characterization workflows reproducible. These include laboratory-control software, DAQ and slow-control frameworks, digital pulse-processing tools, data-quality monitoring, GEANT4-based detector studies, radiation-transport and dosimetry simulations where relevant, Python/ROOT-based analysis pipelines, calibration tools, and metadata handling frameworks.

A specific WG10 need is to improve interoperability between laboratories through documented calibration procedures, shared analysis examples, common metadata schemes, and standardized output formats for characterization data. This would allow characterization results from different groups to be compared, archived, and reused more effectively.

2.4 Current and Potential National Collaborations

Several national collaborations are already visible in the survey. WG10 should build on these existing links, but keep the focus on characterization, validation, qualification, and benchmarking activities.

- **Semiconductor detector characterization:** IMB-CNM, IFAE, IFCA, IFIC, IGFAE, CNA, and ITA already define a strong collaboration axis around electrical characterization, charge-collection studies, irradiation and post-irradiation validation, timing performance, detector QA, and silicon technologies such as LGADs, DMAPS, CCDs, and related devices.
- **Laser-, beam-, and ion-beam-based characterization:** IFCA and IFIC provide a clear line around TPA-TCT and related laser-based methods, with natural connections to CNA for ion-beam and irradiation characterization and to external test-beam facilities such as CERN and DESY.
- **Readout, DAQ, timing, and EMC/RF validation:** IFCA, IGFAE, IFAE, IFIC, and UPC share interests in detector/readout validation, timing and DAQ performance, while ITA pro-

vides complementary expertise in electrical-system and EMC/EMI validation. This is the main interface with the Electronics WG.

- **Cryogenic, low-background, neutrino, and astroparticle instrumentation:** INMA, IFAE-Neutrinos, DIPC, IGFAE-Neutrinos, CIEMAT, and IFCA define a potential collaboration axis around cryogenic devices, low-background validation, neutrino instrumentation, and astroparticle-oriented characterization.
- **Nuclear, medical, and industrial applications:** USAL, UHU, CNA, UPC, IFIC-IRIS, IFAE-MEDIIP, IFAE-Gamma, ITA, and related detector groups provide collaboration opportunities in neutron detection, dosimetry, medical imaging, proton therapy, tomography, radiation monitoring, and compact detector systems.

These potential collaboration lines suggest several concrete cross-WG or inter-WG actions:

- a shared timing and spatial-resolution telescope for silicon detector and readout validation, involving groups working on LGADs, DMAPS, tracking detectors, DAQ, and timing systems;
- coordinated irradiation and post-irradiation characterization campaigns, connecting detector groups with CNA and other irradiation or ion-beam facilities;
- a common framework for TCT, IBIC/TRIBIC, beam-test, and charge-collection measurements, including calibration, metadata, and reporting conventions;
- a detector/readout validation task force with the Electronics WG, focused on DAQ, timing, synchronization, power-distribution effects, and EMC/RF qualification;
- a cryogenic and low-background characterization task force connecting neutrino, astroparticle, TES/superconducting-sensor, and underground-detector activities;
- application-oriented demonstrators in medical imaging, dosimetry, tomography, or radiation monitoring, where characterization and validation are prerequisites for KTT.

2.5 Internationalization

WG10 is well aligned with the European detector R&D ecosystem. The strongest connection is with DRD3, through semiconductor detector characterization, radiation-tolerance studies, timing detector validation, and detector performance benchmarking. Additional links exist with DRD7 in readout, DAQ, timing, synchronization, and system-level validation; with DRD5 in cryogenic, quantum, and low-temperature detector technologies; and with DRD1 where gaseous or TPC-related detector characterization is relevant.

This international positioning should not be presented only as a passive affiliation list. WG10 can act as a coordination layer for Spanish participation in future detector R&D initiatives by making national characterization capabilities more visible, identifying shared contributions to international work packages, and aligning Spanish characterization protocols with international benchmarking practices.

The WG10 scope is also connected to broader international roadmaps, including the ECFA Detector R&D strategy, CPAD detector-development priorities, ApPEC priorities in astroparticle and rare-event instrumentation, and NuPECC-related needs in nuclear-physics detector systems. Future Horizon Europe calls, as well as AIDAInnova- and EURO-LABS-type frameworks, provide natural opportunities for WG10 activities related to shared infrastructures, test-beam and irradiation access, characterization standards, training, and detector-performance validation.

3 Recommendations (Recommended: 3 pages maximum)

3.1 Strategic Priorities for the WG (5-Year Horizon)

he main strategic priority for WG10 is to move from a descriptive map of capabilities to a coordinated operating model for detector characterization across the CNID network. This model should be built around shared infrastructures, common protocols, visible contact points, and well-defined cross-WG actions.

- **Create a national portfolio of characterization capabilities.** WG10 should publish and maintain a searchable portfolio of characterization techniques, infrastructures, contact points, access conditions, and typical use cases. This should include electrical, optical, laser-based, beam-based, ion-beam, irradiation, cryogenic, low-background, EMC/RF, DAQ/readout, timing, and detector-performance validation capabilities.
- **Establish common characterization protocols and data conventions.** WG10 should define a minimal set of shared procedures, metadata, and data-format conventions for representative characterization workflows, including electrical tests, SPA/TPA-TCT, IBIC/TRIBIC, irradiation and post-irradiation campaigns, beam tests, DAQ/readout validation, cryogenic tests, low-background operation, and EMC/RF qualification.
- **Consolidate critical characterization workflows.** Priority should be given to capabilities that are difficult to reproduce locally and are essential for competitiveness: coordinated irradiation campaigns, laser- and ion-beam-based charge-collection studies, timing and tracking validation, cryogenic and low-background characterization, EMC/RF validation, and automated DAQ/readout test systems.
- **Launch mission-oriented task forces around critical gaps.** WG10 should create small, time-limited task forces with named participants and concrete deliverables. Initial candidates include: 4D/timing detector characterization, TCT and ion-beam characterization standards, irradiation and post-irradiation workflows, cryogenic and low-background characterization, and detector/readout validation in coordination with the Electronics WG.
- **Select a small number of cross-WG demonstrators.** Rather than open-ended collaboration lists, WG10 should promote two or three demonstrators with named leads, milestones, and measurable outputs. Possible examples are a shared timing/spatial-resolution telescope, a coordinated irradiation and post-irradiation validation campaign, a common detector/readout validation benchmark, and an application-oriented demonstrator for medical or industrial KTT.

3.2 Infrastructure and Resource Optimization

WG10 should promote a shared-use model for characterization infrastructures, avoiding both duplication of local capabilities and excessive dependence on informal bilateral access. The first step should be a central portfolio of facilities and services, linked to named contact points, access conditions, typical measurements, and examples of use.

- **Create a central access portfolio.** The portfolio should include characterization facilities, available techniques, contact persons, access conditions, expected user preparation, and constraints related to scheduling, safety, irradiation status, cryogenic operation, or underground access.
- **Define a lightweight access and booking model.** For facilities that can realistically be shared across institutions, WG10 should define simple procedures for requesting access, prioritizing campaigns, documenting measurements, and reporting results. This is especially relevant for irradiation lines, laser/TCT setups, ion-beam facilities, cryogenic platforms, RF/EMC validation laboratories, and underground or low-background environments.
- **Prioritize upgrades that enable shared and reproducible use.** Investments should focus on capabilities that improve reliability, automation, throughput, and comparability across laboratories: automated detector testing, improved laser/TCT operation, standardized DAQ/readout validation setups, calibrated irradiation workflows, cryogenic and low-background test infrastructure, RF/EMC validation assets, and common software tools for metadata, calibration, and data analysis.

- **Link infrastructure operation to protocols and training.** Shared infrastructures should not be treated only as hardware. Each major facility should be associated with documented procedures, reference datasets where possible, basic user training, and a minimal reporting format to ensure that results can be compared and reused across the network.

3.3 Training and Talent Development

WG10 should develop a targeted training and mobility programme focused on detector characterization techniques and on the technical skills required to operate, document, and maintain specialized characterization infrastructures. The objective is to reduce the dependence on isolated local expertise and to make advanced characterization workflows reproducible across the CNID network.

- **Organize hands-on training on core characterization techniques.** Priority topics include electrical detector characterization, gain and noise measurements, calibration procedures, SPA/TPA-TCT, IBIC/TRIBIC, beam-test preparation, irradiation planning, post-irradiation characterization, cryogenic testing, low-background operation, and EMC/RF validation.
- **Strengthen training in DAQ, readout, timing, and control validation.** WG10 should promote practical training on DAQ operation, synchronization, clock distribution, trigger validation, digital pulse processing, data-quality monitoring, ASIC/readout calibration, and stability checks of characterization setups. This activity should be coordinated with the Electronics WG where appropriate.
- **Promote reproducible analysis and common data practices.** Training should include metadata definition, uncertainty reporting, calibration workflows, common data formats, version-controlled analysis scripts, and documentation of characterization campaigns. These elements are essential for comparing results obtained at different laboratories.
- **Support short mobility stays at specialized facilities.** Mobility of PhD students, engineers, technicians, and early-career researchers should be supported through short stays at laboratories hosting critical characterization capabilities, such as TCT setups, ion-beam facilities, irradiation lines, RF/EMC laboratories, cryogenic platforms, underground laboratories, and DAQ/readout validation benches.
- **Create a WG10 instrumentation school or recurring mini-workshop.** A compact annual or biennial school should combine lectures, hands-on sessions, and facility visits. It should be used to circulate practical know-how, document common procedures, and train new users of shared characterization infrastructures.

3.4 Strategic Risks and Mitigation Measures

Risk	Mitigation measure
Fragmentation of characterization capabilities across centers, with limited visibility of available infrastructures and expertise.	Create a WG10 portfolio of characterization facilities, techniques, contact points, access conditions, and typical use cases.
Lack of common protocols, metadata, and data-format conventions, limiting the comparison and reuse of characterization results.	Define a minimal set of WG10 reference protocols for representative workflows such as electrical tests, TCT, irradiation campaigns, beam tests, cryogenic validation, EMC/RF qualification, and DAQ/readout validation.
Loss of technical know-how due to short-term contracts, staff turnover, and dependence on isolated local expertise.	Support documentation, short mobility stays, hands-on training, and recurring WG10 mini-workshops focused on specialized characterization techniques.
Insufficient continuity in DAQ, firmware, automation, and readout-validation expertise for advanced characterization setups.	Coordinate with the Electronics WG and promote shared validation benches, documented DAQ/readout workflows, and targeted training for characterization-oriented firmware and control systems.
Dependence on external test-beam, irradiation, ion-beam, cryogenic, or underground facility schedules.	Plan coordinated characterization campaigns, prepare common pre-/post-measurement procedures, and identify complementary national facilities whenever possible.
Specialized techniques such as SPA/TPA-TCT, IBIC/TRIBIC, cryogenic testing, low-background operation, or EMC/RF validation remain concentrated in a few groups.	Create mission-oriented task forces around these techniques, with named contacts, documented procedures, and training actions for new users.
Characterization is perceived as a support activity rather than as a strategic R&D capability.	Include characterization deliverables explicitly in CNID actions, European proposals, cross-WG demonstrators, and KTT-oriented projects.

Table 3: Main strategic risks identified for WG10 and proposed mitigation measures.

3.5 Knowledge and Technology Transfer (KTT)

WG10 has a direct KTT dimension because characterization and validation are prerequisites for transferring detector technologies beyond fundamental research. The most relevant opportunities are medical imaging, proton-therapy dosimetry, neutron dosimetry, tomography, radiation monitoring, compact detector systems, EMC/RF qualification, and reliability validation of specialized instrumentation.

The recommended action is to select a small number of application-oriented demonstrators where WG10 contributes with measurable characterization deliverables: validation protocols, performance benchmarks, calibration procedures, uncertainty reporting, and reproducible test workflows.

3.6 Internationalization

WG10 should play a more explicit role in coordinating Spanish visibility in international detector R&D activities where characterization is a central component. The priority should be to move from individual participation in international projects to coordinated national contributions around shared characterization capabilities.

- Promote coordinated Spanish contributions to DRD3 activities related to semiconductor detector characterization, timing performance, radiation tolerance, and detector benchmarking.
- Strengthen the interface with DRD7 in topics where detector characterization depends on readout, DAQ, timing, synchronization, and system-level validation.
- Identify concrete WG10 contributions to future AIDAInnova-, EURO-LABS-, and Horizon-Europe-type calls, especially in shared infrastructures, test-beam and irradiation access, characterization standards, and training.

- Encourage WG10 participation in international working groups or coordination bodies where characterization protocols, benchmarking procedures, or access to shared facilities are discussed.
- Use the WG10 infrastructure portfolio to make Spanish characterization capabilities more visible to international collaborations and European R&D networks.

3.7 Funding

WG10 should advocate for instrumentation-specific funding lines that explicitly recognize detector characterization as a strategic R&D activity. These calls should support not only equipment acquisition, but also operation, maintenance, technical support, training, mobility, and shared access to characterization infrastructures.

Priority funding targets are:

- shared characterization infrastructures and their operation;
- upgrades that improve automation, reproducibility, throughput, and inter-laboratory comparability;
- coordinated irradiation, beam-test, laser/TCT, ion-beam, cryogenic, low-background, and EMC/RF characterization campaigns;
- common DAQ/readout validation tools, metadata schemes, and analysis frameworks;
- short mobility stays for engineers, technicians, PhD students, and early-career researchers;
- cross-WG demonstrators with measurable characterization deliverables.

WG10 should also promote clustered proposals around shared characterization needs, rather than isolated requests for local equipment. Detailed project-by-project funding inventories should be kept outside the strategic report and compiled separately through the institutional channels.

A Contributing Groups and Contact Points

Group / Organization	Contact name	Email
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