



Letter of support
from the Centre National de la Recherche Scientifique (CNRS)
regarding the International Research Network
« ELGAR : European Laboratory for Gravitation and Atom-interferometric Research »

In Paris, July 5th, 2023

To CNRS partners of the IRN ELGAR:

- *In France:* Institut d'Optique Graduate School, Université de Bordeaux, Collège de France, Ecole Normale Supérieure – PSL, Sorbonne Université, Conservatoire national des arts et métiers, Avignon Université, Observatoire de Paris – PSL, Université de Strasbourg, Observatoire de la Côte d'Azur, Université Côte d'Azur
- *In Germany:* Leibniz Universität Hannover, Humboldt Universität Berlin, German Aerospace Center (DLR)
- *In Italy:* European Laboratory for Non-Linear Spectroscopy (LENs), National Institute for Nuclear Physics (INFN)
- *In Greece:* Institute of Electronic Structure and Laser - FORTH
- *In United Kingdom:* University of Birmingham
- *In Spain:* Institut d'Estudis Espacials de Catalunya

Dear Partners,

Conducting research in all fields of knowledge, the CNRS promotes international research collaboration. This includes the support to International Research Networks (IRN). These refer to initiatives gathering scientists from organizations of various countries jointly involved in a theme-based scientific dialogue by means of international scientific seminars and workshops.

I would like to inform you hereby that, under this scheme, the CNRS has selected the **International Research Network « ELGAR : European Laboratory for Gravitation and Atom-interferometric Research »** involving scientists from France, Germany, Italy, Greece, United Kingdom and Spain. The scientific programme of the said Network is scheduled to run from **January 1st, 2023 to the December 31st, 2027** (5 years) and is attached to this letter. Subject to performance and availability of funds, the CNRS plans to specifically devote **€ 60 000** to it for its duration.

Typically, CNRS grants its support to these networks after evaluating proposals submitted by members of CNRS-affiliated research units in conjunction with other participating scientists. This evaluation takes into account the scientific interest and potential outcomes of the projected joint activities as well as existing ties and complementarity amongst the participating scientists. The CNRS support takes the form of dedicated financing aiming at covering part of the international extra cost arising from the conduct of the networks (i.e. international travel and living expenses, meeting organizational costs), which complements funds directly contributed by the participating laboratories and research teams.

Besides, these Networks are to meet the following conditions:

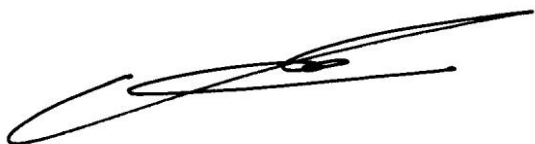
- Publications related to the work carried-out in common within a Network shall mention the Network explicitly as well as the organizations involved in it.
- Any information exchanged within a Network and identified as confidential shall be kept strictly confidential for the duration of the said Network and for five (5) years after its completion.

We hope that your organization will share our interest in this Network and will be able to provide it with financial support. In this case, I would be grateful if you could kindly inform the CNRS by emailing a letter of support specifically relating to the aforementioned Network to Juliette Néel (juliette.neel@cnrs.fr). For your convenience, a template is proposed herewith.

I would be most grateful if you could take the necessary steps to provide us with a prompt reply.

Looking forward to your cooperation.

Sincerely,



On behalf of Prof. Antoine Petit, Chairman and Chief Executive Officer
Dr..Christelle ROY, Director of European and International Affairs Department

Attached documents:

- Annex 1 – Scientific summary and list of participants
- Annex 2 – Template of letter of support



Lettre de soutien
du Centre national de la recherche scientifique (CNRS)
au réseau de recherche international (*International Research Network*)
« ELGAR : European Laboratory for Gravitation and Atom-interferometric Research »

Le 5 juillet 2023, Paris

À l'attention des partenaires du CNRS :

- *En France:* Institut d'Optique Graduate School, Université de Bordeaux, Collège de France, Ecole Normale Supérieure – PSL, Sorbonne Université, Conservatoire national des arts et métiers, Avignon Université, Observatoire de Paris – PSL, Université de Strasbourg, Observatoire de la Côte d'Azur, Université Côte d'Azur
- *En Allemagne:* Leibniz Universität Hannover, Humboldt Universität Berlin, German Aerospace Center (DLR)
- *En Italie:* European Laboratory for Non-Linear Spectroscopy (LENS), National Institute for Nuclear Physics (INFN)
- *En Grèce:* Institute of Electronic Structure and Laser - FORTH
- *Au Royaume-Uni:* University of Birmingham
- *En Espagne:* Institut d'Estudis Espacials de Catalunya

Chères et chers collègues,

Le CNRS conduit des recherches dans tous les domaines de la connaissance et participe à la promotion de la collaboration scientifique internationale. Il encourage notamment les **réseaux de recherche internationaux (*International Research Networks*)**. Il s'agit d'actions qui associent des scientifiques appartenant à des institutions de plusieurs pays dont la finalité est le développement de réseaux de coordination scientifique à travers l'organisation de séminaires et d'ateliers.

Dans ce cadre, j'aimerais vous signaler que le CNRS a sélectionné le **Réseau de recherche international « ELGAR : European Laboratory for Gravitation and Atom-interferometric Research »** qui implique des scientifiques en France, en Allemagne, en Italie, en Grèce, au Royaume-Uni et en Espagne. Le programme scientifique associé à ce réseau, joint à cette lettre, prévoit son développement sur cinq (5) ans, **du 1^{er} janvier 2023 au 31 décembre 2027**. Sous réserve du bon déroulement de l'activité et de la disponibilité des fonds, le CNRS envisage ainsi d'octroyer sur cinq ans **60 000 €** à ce réseau.

De manière générale, le CNRS apporte son soutien à ces réseaux après évaluation des propositions effectuées conjointement par les membres des laboratoires de recherche affiliés au CNRS et les autres scientifiques participant à ces actions. Cette évaluation prend en compte l'intérêt scientifique et les retombées potentielles des activités conjointes projetées ainsi que les liens existants et la complémentarité entre les scientifiques participant aux réseaux. Le soutien du CNRS prend la forme d'un financement spécifique destiné à couvrir une partie des surcoûts générés par le développement de ces projets de recherche (il peut s'agir, par exemple, des coûts de transports internationaux, de



séjours ou d'organisation de réunions). Ce financement est complémentaire des coûts qui sont directement couverts par les laboratoires et équipes de recherche impliqués.

Ces réseaux remplissent en outre les conditions suivantes :

- Les publications relatives au travail mené en commun font référence au réseau ainsi qu'aux établissements impliqués ;
- Toute information communiquée dans le cadre du réseau et qui est identifiée comme confidentielle conserve un caractère strictement confidentiel pendant toute la durée du réseau et cinq (5) ans après son terme.

Nous espérons que votre établissement partagera l'intérêt que nous portons à ce réseau et qu'il pourra contribuer à son soutien financier et à son bon déroulement selon les conditions ci-dessus énumérées. Dans cette hypothèse, et en accord avec vos procédures internes d'évaluation et de financement, je vous serais reconnaissant de bien vouloir en informer le CNRS en envoyant par courrier électronique adressé à Madame Juliette Néel (juliette.neel@cnrs.fr) une lettre de soutien qui se référera de façon spécifique au dit réseau. À cette fin, je me permets de vous adresser ci-joint un modèle de lettre facultatif.

Dans l'attente de votre réponse, je vous prie de croire, chers et chères collègues, en l'assurance de ma considération distinguée.



Au nom du Prof. Antoine Petit, Président-directeur général du CNRS
Dr. Christelle Roy, Directrice de la Direction Europe et International du CNRS

Documents joints:

- Annexe 1 – Résumé Scientifique et liste des participants
- Annexe 2 – Modèle de lettre de soutien



Annex 1 - SUMMARY SHEET
OF THE INTERNATIONAL RESEARCH NETWORK (IRN)
ELGAR
2023-2027

1) Project summary, main goals and expected results

Since 2014, The ELGAR collaboration supports the realization of an underground infrastructure based on the latest progress in atomic physics, to study space-time and gravitation with the primary goal of detecting GWs in the infrasound band (0.1 Hz to 10 Hz). ELGAR would cover the band between future space-based instruments and third generation ground-based detectors: this would open multi-frequency GW astronomy, whose scientific potential is enormous. ELGAR would be the first large scale instrument that relies solely on quantum technologies and the only project of research infrastructure in Europe based on matter wave interferometry. Thanks to an intense networking program the IRN will have an important leverage effect to organize coherently new research actions serving the objectives of ELGAR by strengthening its main technological bricks. This work will be the base of a solid development roadmap that is crucial to clear the last obstacles before funding.

The scientific potential of GWs is enormous, in terms of providing a deep view into the past of our universe and complement other observation windows such as radio telescopes or infrared observatory. The success of this new astronomy relies on our faculty to expand our observation frequency window to other frequencies, and mostly depends on the decisions being made to develop low frequency GW observations infrastructures: **ELGAR is a proposal for such a long baseline, mid-frequency, GW observation infrastructure.** Its core technology relies on quantum physics to study space-time and gravitation. ELGAR directly inherits from the Matter-wave laser Interferometer Gravitation Antenna large equipment under construction in France, and drives pan-European synergies from top research centers in Quantum sensors in Germany and Italy as well as the UK Quantum Technology Hub for Sensors and Metrology. Besides these new perspectives in GW detection, **the efforts in pushing to the limits the sensitivity of quantum sensors based on matter-wave interferometry will contribute to extending the leadership of European research centers in the field of applied and fundamental physics.** The technical developments pushed in ELGAR can impact existing or future high precision experiments by allowing a new class of matter-wave interferometers with brand new properties: ELGAR could lead to breakthroughs in the development of future inertial sensors for applications in gravity survey or inertial navigation but could also enable **new tests of fundamental theories of physics with unprecedented precision.**

The ELGAR consortium is assembled to target excellence, experience and complementarity. It brings the cumulative expertise of experimental and theoretical European science teams from the fields of geoscience, GW, ultracold atoms and atom interferometry together in a joint effort. **The consortium is also built in synergy with major national initiatives** related to atom interferometry and GW detection such as the MIGA project under construction in France, the VLBAI experiment in Germany and the MAGIA Advanced experiment in Italy.



Thanks to an intense networking program, the IRN will have **an important leverage effect to organize coherently new research actions serving the objectives of ELGAR**. The IRN will push further the key technological developments to carry out for the future development of the antenna and develop the community of large-scale atom interferometry for GW detection: ELGAR could become a EU 'Starting Community' organized around the pre-existing large-scale facilities related to the project. By supporting participation to specific conferences, the IRN will enlarge the scientific support for the realization of the future infrastructure.

The IRN will also prepare and structure the future submission of ELGAR as design study in answer to a future Horizon Europe call: a conceptual design document and a development roadmap will be prepared. These elements will be crucial to clear the last obstacles before funding.

The IRN work program will be divided in three Work Packages (WPs):

- **WP1: Consolidating the science case and the technological aspects of the antenna.** Three main topics will be addressed in a series of topical workshops organized yearly in the participating countries:
 1. Advanced atom source and matter-wave manipulation for ultra-sensitive matter-wave interferometry
 2. Strategies for Newtonian Noise (NN) reduction, a central issue for low frequency GW detectors which must be tackled to reach a high GW sensitivity under 1 Hz.
 3. Simulation of the antenna response for different sources and metrology.
- **WP2: Fostering collaboration between IRN members and enlarge the scientific support for ELGAR:** During the consortium meeting, the IRN partners will study new opportunities of collaboration and review their funding options through available national or EU calls. This activity will also be supported by a series of visits between the large national facilities connected to ELGAR. The IRN will also support and organize participation of its members to key international conferences in order to enlarge the support to the project.
- **WP3: Organizing the support for the infrastructure realization at the EU level,** that is focused on specific actions to push forward the realization of the ELGAR infrastructure at EU level:
 1. Setup a roadmap for the ELGAR construction. This activity will identify all the actions at national and EU level to include ELGAR in the landscape of future GW detectors and harmonize its connection with other GW projects at EU level.
 2. Review and organize a response to a future EU Design Study call. A Design study would address all key conceptual, technical, legal and financial questions for ELGAR realization. An important preliminary step will be to organize a review of the ELGAR conceptual design by an external international panel of experts.



2) List of Participants

a) in France

Name	Laboratory	Institutional affiliation (employer)
Coordinator : CANUEL Benjamin	UMR5298 – Laboratoire Photonique Numérique & Nanosciences (LP2N)	CNRS
BATTELIER Baptiste		CNRS
BERNON Simon		Université de Bordeaux
BERTOLDI Andrea		Institut d'Optique Graduate School
GUELLATI-KHELIFA Saïda	UMR8552 – Laboratoire Kastler Brossel (LKB)	Conservatoire national des arts et métiers
CLADE Pierre		CNRS
GAFFET Stephane	UAR3538 – Laboratoire souterrain à bas bruit (LSBB)	CNRS
LAZARO Ignacio		
LANDRAGIN Arnaud	UMR8630 – Systèmes de référence temps-espace (SYRTE)	CNRS
BEAUFILS Quentin		
SIDORENKOV Leonid		
ROSAT Severine	UMR7063 – Institut Terre Environnement Strasbourg (ITES)	CNRS
CHRISTENSEN Nelson	UMR7250 – Astrophysique Relativiste, Théories, Expériences, Metrologie, Instrumentation, Signaux (ARTEMIS)	CNRS
CHAIBI Oualid		

b) in Germany

Name	Laboratory	Institutional affiliation (employer)
Coordinator : SCHLIPPERT Dennis	Institut für Quantenoptik	Leibniz Universität Hannover
ABEND Sven		
HAMMERER Klemens		
GAALOUL Naceur		
RASEL Ernst		
SCHUBERT Christian		
PETERS Achim	AG Optische Metrologie	Humboldt Universität Berlin
KRUTZIK Markus		
SCHKOLNIK Vladimir		
ROURA Albert	Institute of Quantum Technologies	German Aerospace Center (DLR)
BRAXMAIER Claus		

c) in Italy

Name	Laboratory	Institutional affiliation (employer)
Coordinator : TINO Guglielmos		European Laboratory for Non-Linear Spectroscopy (LENS)
FATTORI Marco		
SALVI Leonardo		

SORRENTINO Fiodor		INFN
PREVEDELLI Marco		
ROSI Gabriele		
VICERE Andrea		

d) in Greece

Name	Laboratory	Institutional affiliation (employer)
Coordinator : VON		Institute of Electronic Structure and Laser - FORTH
KLITZING Wolf		
PLEXOUSAKIS Dimitris		

e) in United Kingdom

Name	Laboratory	Institutional affiliation (employer)
Coordinator : BONGS Kai	School of Physics and Astronomy	University of Birmingham
HOLYNSKI Michael		
LIEN Yu-Hung		

f) in Spain

Name	Laboratory	Institutional affiliation (employer)
Coordinator : SOPUERTA	Institute of Space Sciences	Institut d'Estudis Espacials de Catalunya
Carlos		
BLAS Diego		
NOFRARIAS Miquel		

