S1. CLAS_MED ABSTRACT

Title of the Project:	CLAS-MED
Area of Intervention:	PHYSICAL SCIENCE AND ENGINEERING (PE) - Excellent Science di HORIZON2020
Institution of Reference: Coordinator of the Project:	INFN Contalbrigo Marco
Other EPR Research Institutions:	
Other Institutions:	Involved Institutions: University of Ferrara, University of Bari, University of Roma I, Istituto Superiore di Sanita' (Italia), Thomas Jefferson National Accelerator Facility (USA), Budker Institute of Nuclear Physics (Russia), Institute of Catalysis (Russia), Universidad Tecnica Federico Santa Maria de Valparaiso (Chile), University of Glasgow (UK), Argonne National Laboratory (USA), Institut für Kernphysik of Mainz (Germania). Subjects potentially interested: Bruno Kessler Fundation for SiPM development, electronic companies like CAEN and medical diagnostic companies like Metaltronica.
Short Description of the Project:	The project is part of the ongoing international research activity aiming to study the three-dimensional (3D) structure of the nucleon and, more in general, of strong interactions and confinement of quarks in stable hadronic states. The project foresees the upgrade of the large acceptance spectrometer CLAS12 in Hall-B at the Thomas Jefferson National Accelerator Facility (JLab), Newport News VA, USA, with the realization of a Ring Imaging Cherenkov (RICH) detector to improve the hadron identification capabilities and to allow for measurements sensitive to the quark flavors (see Attachment 3). The project foresees the realization of the CLAS12 RICH detector in its basic configuration (two azimuthal sectors out of six, each covering an area of about 4 squared meters) in time for the beginning of the dedicated experiments with the 12 GeV beam. The first sector allows to start the physics program with unpolarized and polarized targets. The second sector extends the kinematical coverage into the most interesting regions and allows for the symmetric arrangement needed to control systematic effects in precision measurements with polarized targets. These measurements are crucial for the study of partonic dynamics related to angular momentum and spin-orbit effects with flavor sensitivity. The research and development activity needed for the realization of a large area detector at affordable costs has potential spillovers both on fundamental research (Nuclear and Particle Physics) and on applied research such as Medical Imaging with radionuclide (single photon and positron emission and their tomographic versions). In fact spatial and time resolution, compactness, insensitivity to magnetic fields and large area at effective costs are key elements for innovative devices in medical application such as early diagnosis of tumors as well as in-vivo studies of human diseases.

Goals of the Project:	*) Preserve the Italian groups in a leading position in a frontier field of research (the 3D study of the nucleon), which they contributed to launch in recent years. *) Contribute significantly to the construction of the most complete facility for the 3D study of the nucleon in the medium term, with the construction of a RICH detector for the identification of hadrons that allows measurements sensitive to the quark flavors. *) Study innovative techniques for detection of photons over large areas, based on the development of integrated electronics dedicated to cutting-edge detectors with potential impact for High-Energy Physics and Nuclear Medicine.
Course of Intervention:	Course of intervention 1
Verification Criteria: A) Skills development. B) Involvement of public and private institutions. C) Investment attraction, Socio-Economic Impact and Financial Sustainability D) Team and Governance.	A) Knowledge of the structure of the nucleon in 3D, the strong force and QCD. Reconstruction techniques (pattern-recognition) and data analysis. Innovative techniques of position sensitive photo-detection at low cost. Integrated electronics for new types of photodetectors. New instruments for medical diagnostics and therapy and biomedical research. B) INFN, along with associated personnel from different Italian Universities, has the lead role in the project, which includes several public Institutions at international level. The project foresees the collaboration with Italian public Institutions and private companies well-advanced in photodetection, electronics and medical diagnostics. C) The project, under Italian leadership, has already attracted funding from foreign Institutions which cover a significant part of the initial investment and the costs of the second and third year of activity. The project aims to maintain the Italian groups in a prominent position in fundamental science (3D study of the nucleon structure) and technology (state-of-the-art Cherenkov detectors) and to assess the potential impact of new photodetection systems for medical diagnostics in collaboration with national companies. Examples of the fruitful connections are the MBI project between ISS, INFN and the Metaltronica company for scintimammograpy and the patent RM2008A000451 registered by members of the project. D) The project coordinates an international effort under the Italian leadership. The Italian team (24 people, of which 5 women researchers and 7 young researchers under 35 years old, corresponding to 15 FTE, whose 7 FTE are from staff members) brings together several experts in the field and presents a balanced mix of employees of the Universities and Italian Research Institutions together with young researchers with fixed-term contracts. The governance is made up of people who are actively involved in the areas of the project, who have extensive and complementary experience in related research fields and held positions of scientific (experiment spokesperson and analysis coordinator, head of scientific units) and technologic (experiment technical coordinator, head of technologic units) responsibility : see S3 Diagram and Attachment 1.
	The estimated cost of the project is 5.79 million Euros, including the cost of structured staff (salaries) for the part of correlated activities that accounts for

Economic value, Future Costs of Operation and Maintenance for the Life of the Program/Project, Financial Estimate and Co-founding:	about 1 MEuro. Four annual research grants in each year of activity are foreseen, at a total cost of 276 kEuro (see S2 Table). The bulk of expenses (3.65 million Euro) covers the materials for the construction of the RICH in the basic configuration and for the R&D on innovative photodetection systems. The funds FOE7% (2.19 million Euro) contribute to the funding in the first year of activity which includes the investment in the major RICH components (aerogel and photomultipliers for the RICH and chips for the readout electronics) that must be ordered at the beginning of the project, in order to ensure the production time and the subsequent quality control and assembly, and the starting phase of the R&D activities. The co-funding part comprises funds already received or budgeted for, for a total of 144 kEuro for personnel and 1858 kEuro for material, which cover a significant part of the initial investment and the exposed costs of the second and third year of the project. The project foresees the use of already acquired components and existing infrastructures, partially realized in the just completed preparatory phase and funded in Italy by INFN for a total amount of about 300 kEuro. The costs of management and maintenance (both for personnel and material) are foreseen to be under the availability of ordinary funds of the involved Institutions.
Additional Possible Fund Coverage:	The capability to draw foreign investment and cover the uninsured costs of the second and third year (10 % of the total) is demonstrated by the funding received so far.
Status of the Project:	The project is part of an ongoing activity which has concluded the preparatory phase (see Attachment 2). The phase of prototyping, just ended, has identified a solution capable of ensuring the required performance in time for the experiments dedicated to the study of the 3D structure of the nucleon in the Hall-B of JLab. The proposed solution involves a hybrid proximity and mirror-focusing RICH detector that uses aerogel as radiator and multi-anode photomultipliers. The project foresees a R&D activity dedicated to the development of integrated electronics, which allows on one hand to maximize the performance of the basic configuration, on the other hand the use of innovative photon detectors (SiPM, last generation micro-channel plate or GEM chambers with appropriate photo-converter) at affordable costs, allowing the extension of the RICH coverage in kinematic regions otherwise inaccessible and potential spillovers in medical applications.
Realization Time:	36 months (three years)
Key words:	3D Structure of the Nucleon, QCD, Cherenkov Detectors, Large-area Photodetectors, Nuclear Medicine.

S2: CLAS_MED COST EESTIMATE (kEuro)

Major items	Cost	FOE 7%	Co-funding (cost coverage to this day)	Percentage
Personnel in Italy (staff)	1000		1000 (1000)	17 %
Personnel in Italy (to be hired)	276	92	184 (144)	5 %
Material	3645	1590	2055 (1858)	63 %
Equipement				
Infrastructure				
General Costs	869	505	364	15 %
Other Costs				

Total	5790	2187	3603 (3002)	100%

S3: CLAS-MED TEAM AND GOVERNANCE