Letter of Intent

Virtual Access Activity:

Acronym and title: SHARE, Strangeness in Hadronic and Astrophysical Systems - Toward Open Access REsources

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1. Research objectives.

1.1 Scientific context.

Understanding low-energy interactions involving strange hadrons, such as hyperons and kaons, is a central challenge in nuclear and particle physics. Microscopic descriptions of these interactions are primarily based on effective field theories and phenomenological models, which must be anchored and validated by using high-precision experimental inputs. In recent years, several European and worldwide research facilities and infrastructures (e.g. DAΦNE, FAIR, MAMI, CERN, J-PARC, JLab and RHIC) have begun producing increasingly precise data on hypernuclei (*binding energies, lifetimes, production yields*), interactions of hyperons and kaons with nucleons (*cross sections, branching ratios, correlation functions, energy and width*), using innovative complementary methodologies and cutting-edge detection techniques. At the same time, theoretical efforts have led to the development of advanced computational tools that allow for more accurate and systematic predictions, incorporating higher-order corrections, coupled-channel dynamics, and input from lattice QCD.

Many of these tools are implemented in modern, high-performance programming languages and frameworks, allowing for efficient and reproducible calculations. However, a major obstacle remains: despite these advances, both the theoretical tools and the growing volume of experimental data remain scattered across institutions and collaborations, and they are often difficult to access to the wider scientific community, especially for non-specialists or early-career researchers.

1.2 Objectives.

The SHARE project aims to address these challenges **by developing an integrated, openly accessible online platform that consolidates experimental datasets, analysis tools, and state-of-the-art theoretical codes related to strangeness in hadronic physics**. The platform will be organised in three main categories:

- Experimental data base. This category will serve as a repository for all the experimental measurements that are necessary to fit and constrain the parameters and low-energy constants of effective field theories and phenomenological interaction models;
- Tools for data analysis. This category will include hyperlinks to the tools and codes that are used for the interpretation of the experimental data as well as routines to calculate experimental observables (e.g. cross sections, correlation functions).
- Theoretical models. This category will include a description of the state-of-the-art interaction models for strange hadrons, a database repository of different theoretical predictions/results with contacts of the responsible groups.

The platform will be designed for ease of use and long-term sustainability, exploiting transversal links between the theoretical and experimental community, providing a centralized resource for data access, code storage, and collaborative development.

In addition, the project will organize workshops (at e.g. ECT*, CERN, INFN-LNF) with two primary objectives:

- discuss the data sets to be included in the repository and the format of the data, as well as to decide the state-of-the-art interactions and models to be used for different purposes;

- targeted training sessions and to help both early-career and experienced researchers to stay current with the rapidly evolving landscape of computational tools (such as analysis scripts, interaction models, and simulation codes) and programming environments.

These activities will support cross-disciplinary fertilisations and a wider sharing of information, knowledge and technologies across the community and ensure broader adoption of best practices in data analysis and theoretical modeling. By combining open access to resources with structured knowledge transfer, this initiative will significantly enhance research efficiency and collaboration and its applications to solve open questions in the field of strange hadron physics.

2. Connection to Transnational Access infrastructures (TAs) and / or Virtual Access projects (VAs).

This project is closely aligned with several existing European and international research infrastructures that operate under Transnational Access scheme. In particular, experimental data relevant to the strangeness sector, such as hyperon-nucleon scattering, hypernuclear spectroscopy, kaonic atoms and kaon induced reactions, are being produced at major facilities including DAΦNE (Italy), FAIR (Germany), MAMI (Germany), CERN (Switzerland), J-PARC (Japan), JLab and RHIC (USA). These infrastructures serve(d) as key Transnational Access points, offering advanced experimental setups and beamlines that are necessary for generating the high-precision data required for effective field theory modeling and microscopic interaction studies. ECT* could host focused theory-experiment workshops and support global efforts within the SHARE VA.

3. Estimated budget request.

We foresee to complete the project within 4 years, with the following estimated budget:

- Two 4 years 50% positions for postdoctoral researchers are needed for the preparation of the SHARE platform. The workload will be 0.5 FTE, corresponding to 50k Euro/year and a total of 200k Euro;
- An additional amount of 160k Euro will allow the organization of two annual workshops (or schools) for user training and general discussions between users and developers to determine the priorities of future developments.

The total request budget (including Indirect Cost) for the project amounts to 432k Euro.

4. Participating and partner institutions.

CERN, Czech Technical Univ. in Prague, TU Darmstadt, INFN (Catania, LNF, Pisa), Instituto de Estructura de la Materia Madrid, TU Munich, RIKEN, Tokyo Metropolitan Univ.