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July 14, 2017

To the DUNE:

**Institutional Board Chair**

Robert Wilson, Professor of Physics at Colorado State University.

**Collaboration Co-spokepersons**

Mark Thomson, Professor of Physics at University of Cambridge.

Edward Blucher, Professor of Physics at University of Chicago.

Dear Sir,

This is a petition letter to present an application of Federal University of São Carlos (*Universidade Federal de São Carlos - UFSCAR*) to participate in the DUNE experiment. In this letter we state our intent to join the ongoing Brazilian effort acting within the DUNE collaboration framework in a common and coordinated manner. We hope to provide relevant contribution to DUNE project, which we perceive as an outstanding experiment and an important step towards a world-wide neutrino research program, and aim to bring in our skill set in instrumentation, data analysis and simulations from past experiences with particle physics experiments. In particular, our initial involvement should be well articulated with the ongoing research and development activities of the ARAPUCA devices in collaboration with our colleagues at UNICAMP (E. Segreto), UFABC (L. Paulucci, A. Machado). In the following text we provide some details on our expectations concerning our possible participation in the DUNE collaboration and a short description of our previous activities in the particle physics field as we hope for fruitful and productive scientific relations in the near future.

Yours sincerely,

A handwritten signature in blue ink that reads 'Franciole da Cunha Marinho'.

Dr Franciole Marinho

## Previous research background

We have developed activities in the particle physics field for about 13 years. In this period, we were involved in three major types of projects: detectors instrumentation, physics analysis and sensor's Monte Carlo simulations. We dedicated efforts on feasibility studies for  $B$  mesons rare decays searches on LHCb experiment early on its commissioning period and also on searches for signs of universal extra dimensions on CMS experiment. For instance, we developed the *burnin* setup for long term evaluation and quality assurance of the VELO modules of the LHCb experiment. After the end of the LHC Run I we characterized the depletion voltages of those semiconductor sensors during the shutdown period observing type inversion due to radiation dose and annealing effects using noise data. At the moment, the upgrade project for the VELO system is undergoing where we participated in some of the x-ray studies performed with early pixel prototypes (Timepix) with a monochromatic synchrotron line or radioactive sources for energy deposit calibrations in Brazil. The advanced phase of this project is now driven by beam tests for which we provided interpretation for observed effects using Monte Carlo simulations for device modeling. Lately, we are developing a complete simulation of the ARAPUCA devices describing their optical properties, overall efficiencies and timing for R&D purposes on the SBND experiment and for protoDUNE.

## Members

- 1 faculty: Franciole Marinho
- 1 postdoc (prospective), 2 undergrad students

## Scientific and technical interests

We propose to contribute to DUNE joining Brazilian efforts in activities involving the photon detection system such as detector and subsystems prototyping, tests, integration, commissioning and operation. In particular, our main activities are on the development and simulation of devices for collection of Ar scintillation light. This is already undergoing with the development of full simulations of the ARAPUCA devices exploring new geometries (shape of components and positioning of photosensors), adequate interaction models, wavelength shifters and dichroic materials in order to maximize light collection. We are also involved with the data analysis and operation of the prototype testing activities performed in Campinas. Simulation and test results seem to be in agreement. In the future we are willing to participate on the integration of the arapuca in the full simulation of the DUNE light collection system. As aforementioned, these activities are performed in collaboration with our UNICAMP and UFABC colleagues with preliminar studies for protoDUNE already performed. We are also planning to contribute in the development of physics analysis, in particular on the possible impact ARAPUCA measurements may have in physics results.

## Resources

Initially we expect to contribute with a quote of 0.2 FTE per faculty. This contribution should naturally increase as students are getting involved with our simulation studies and should soon participate in other R&D activities. Perspective for postdoc fellowships dedicated to DUNE are also a possibility. We are willing to apply for funds for DUNE experiment and send students and researchers to Fermilab to do on site operation and data taking shifts conditionally to availability of funds.

## Potential funding sources

There are three main agencies available for funding the diverse activities necessary for research: São Paulo Research Foundation (FAPESP), National Council for Research and Development (CNPq) and the Coordination for Improvement of Higher-level Education (CAPES). These could be potential sources for local R&D, traveling expenses, student grants and fellowships. In particular, FAPESP has recently demonstrated great interest on supporting neutrino experimental activities in São Paulo state. We recently applied for a joint grant proposal for improvements of our regional computational power and should participate contributing to the forthcoming hardware projects together with the UNICAMP and UFABC groups.