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April 26, 2017

To: DUNE Collaboration Institutional Board

From:
Frank Krennrich
Professor and Chair
Department of Physics and Astronomy
Iowa State University

Dear Collaboration Board,

Herewith, I would like to submit my application to become a member of the DUNE Collaboration.

My background is in particle astrophysics with very high-energy (VHE-) gamma rays (100 GeV - 100 TeV). VHE photons are used to address a range of important questions at the interface of astrophysics and particle physics (astrophysical particle acceleration, particle propagation in cosmological radiation fields, dark matter and antimatter searches). As an experimental physicist I have worked on the HEGRA experiment in La Palma (1990 - 1994) during my graduate studies. During my postdoc and faculty career, I have worked on the Whipple 10m gamma ray telescope (1994 - 2000) and the VERITAS experiment (1999 - present), both located in southern Arizona. Recently, I have completed my contributions to the design and construction of a prototype telescope for the Cherenkov Telescope Array project (2008 - 2016). A broadening and redirection of my research effort has led to my involvement in the ANNIE experiment (2014 - present) at Fermilab.

Scientifically, my work in VHE gamma rays has evolved around the study of the second most dominant cosmological radiation field, the extragalactic background light (EBL; ultraviolet – infrared). It is second in intensity only to the cosmic microwave background, yet it is difficult to measure directly due to local foregrounds. It contains components from all radiative energy releases since the time of decoupling, making it an important cosmological probe of, e.g., the star/galaxy formation history of our universe. VHE-gamma rays from distant sources provide a stringent indirect measurement through their absorption via pair production with these soft photon fields. While the flux of diffuse neutrinos from past supernovae should strongly correlate with the EBL intensity, any potential discrepancies are interesting, suggesting the presence of other contributors. Science questions related to supernova neutrinos, including the detection of individual bursts and the measurement of the diffuse flux are a key driver for my interest in neutrino physics.

What can I do for DUNE? Throughout my career, I have had major roles in designing and building

instrumentation, including a drive and control system for the first of the HEGRA air Cherenkov telescopes. My leadership in developing and delivering the VERITAS cameras (four instruments each including 500 photomultipliers, Winston cones and front-end electronics) has led to the successful operation and science output of VERITAS. More recently, I have in collaboration with the electronics-engineering group at Argonne National Lab (Gary Drake and John Anderson) developed a new VERITAS camera trigger system (400 MHz FPGAs, operating since 2011) and a timing and clock distribution system for a CTA telescope. Contributions to the ANNIE experiment include work with my current postdoc on the readout (500 MHz FADC system), trigger and timing distribution. All instruments designed under my leadership were delivered on-schedule and within the allocated budget.

Over the next few years, I anticipate my research group (currently 1 graduate student, 2 postdoc positions including a vacancy) to shift further towards neutrino physics, with the possibility of 1 postdoc FTE starting to work on the DUNE project. The Department of Physics and Astronomy at Iowa State University through the Ames Laboratory operates a strong infrastructure and support for cryogenic experimental setups, and would allow me to contribute to the cold electronics group of DUNE. My involvement could initially be on developing testing and quality assurance processes, and over time evolve to contributions to the actual processing and validation of components and boards for the cold electronics system of DUNE. Given my long-standing interest in instrumentation and experience with electronics and detector procurement, construction and deployment, I feel that this could become an appropriate role for my research group.

Furthermore, my joining the current DUNE effort at Iowa State University (Profs. Sanchez and Weinstein) would help to potentially increase the impact of the group, e.g. my scientific interests provide synergies with Prof. Weinstein's work on DUNE.

For full disclosure I should also say that I have served as Department chair since 2013, and I have indicated interest in continuing this role for a few more years beyond 2018.

Sincerely,

Frank Krennrich

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