

Data Management Plan PICO Dark Matter Searches

July 3, 2015

Experiment description:

The PICO Collaboration operates bubble chamber experiments to search for dark matter particles. The detectors are pressure-controlled vessels filled with halocarbons. The halocarbon targets are mildly superheated such that particle interactions will cause boiling. The boiling is detected by the pressure increase, the acoustic signature of bubble formation and with video cameras

The PICO Collaboration has been operating bubble chambers deep underground at SNOLAB in Lively, Ontario, Canada, beginning in November 2010 with the small PICO-2L detector. In 2012, a larger detector, PICO-60 began to operate.

DOE's roles in the experiment:

The Department of Energy, Office of Science, Office of High Energy Physics funded early stage R&D and design work and construction of the detectors at Fermilab. DOE provided the majority of funding for the deployment at SNOLAB and continues to provide significant support for operations, which are a shared responsibility with Canadian institutions.

Partnerships:

The collaboration is supported by funding from the DOE, the National Science Foundation (NSF), the National Sciences and Engineering Research Council of Canada (NSERC), the Canada Foundation for Innovation (CFI), the Kavli Institute for Cosmological Physics at the University of Chicago, the Spanish Ministerio de Economía y Competitividad, the Department of Atomic Energy (DAE) in India, and the Czech Ministry of Education, Youth and Sports.

Organization – Agency/Lab level

Fermilab is the lead laboratory for the experiment construction and operations. The PICO scientific collaboration is an independent group of Universities and Laboratories devoted to scientific analysis and R&D for future experiments.

Organization – Experiment level

The PICO collaboration is lead by two Co-spokesmen, currently Juan Collar (University of Chicago) and Tony Noble (Queens University).

The PICO Scientific Board is is responsible for decisions related to scientific strategy, including the data management policy. The board membership currently includes all faculty and scientists

with permanent or tenure-track appointments. The board is lead by a rotating Chair, currently Andrew Sonnenschein (Fermilab) and a Chair- elect, Russell Neilson (Drexel University). Board decision making is by consensus.

Experiment operations of PICO-60 are lead by Andrew Sonnenschein (Fermilab) and of PICO-2L by Michael Crisler (Fermilab).

Collaboration:

The PICO collaboration consists of 17 institutions from the USA, Canada, the Czech Republic, India, Mexico and Spain. Collaboration members are listed below.

Czech Technical University in Prague (R. Filgas, S. Pospisil, I. Stekl)

Drexel University (R. Neilson)

Fermilab (S.J. Brice, P.S. Cooper, M. Crisler, W.H. Lippincott, E. Ramberg, A. Sonnenschein, M. K Ruschman)

Indiana University, South Bend (IUSB) (E. Behnke, H. Borsodi, O. Harris, I. Levine, E. Mann, J. Wells)

Laurentian University (J. Farine, A. Leblanc, R. Podviyanuk, O. Scallon, U. Wichoski + undergraduate students)

Northwestern University (D. Baxter, C.E. Dahl, M. Jin, J. Zhang)

Pacific Northwest National Laboratory (D.M. Asner, J. Hall)

Queens University (C. Amole, M. Besnier, G. Caria, G. Giroux, A. Kamaha, A. Noble, S. Olson)

Saha Institute of Nuclear Physics (P. Bhattacharjee, M. Das, S. Seth)

SNOLAB (E. Vazquez- Jauregui, Ian Lawson)

The University of Chicago (J.I. Collar, A.E. Robinson)

Universitat Politecnica De Valencia (M. Ardid, M. Bou-Cabo, I. Felis)

Universidad Nacional Autonoma de México (Eric Vazquez- Jauregui)

University of Alberta (C. B. Krauss, S. Fallows, P. Mitra)

University of Montreal (F. Debris, M. Fines-Neuschild, C.M. Jackson, M. Lafrenière, M. Laurin, L. Lessard, J.-P. Martin, M.-C. Piro, A. Plante, O. Scallon, N. Starinski, V. Zacek)

University of Toronto (K. Clark)

Virginia Tech (D. Maurya, S. Priya)

Data policy management:

The PICO Collaboration is responsible for setting the data policy, making data public, and archiving data. The data policy is created and modified by the Scientific Board.

For each PICO publication, there is an analysis team that produces and vets the results. It is the responsibility of the data analysis team to make the data associated with results public within a reasonable time after publication. The analysis team is responsible for defining the scope of these public data releases.

Data Description & Processing:

The raw data from the PICO experiment includes a number of data for each bubble:

- A set of photographs preceding and including the bubble formation.
- The thermodynamic data, temperature and pressure, of the chamber throughout the expansion.
- The data acquisition settings and readings at the time of the bubble.
- The location and type of any calibration sources present.
- The duration and time of the expansion and bubble.
- A set of acoustic recordings of the bubble formation.

The processed data include:

- The 3 dimensional position of the bubble reconstructed from the photographic images.
- Parameters derived from the acoustic recordings, which have been shown to identify the type of radiation responsible for the bubble.
- Fits to the fast pressure rise associated with bubble formation, which has been shown to add additional information about the environment of the bubble formation.
- The energy threshold for bubble formation, using the calculation described by Seitz in Phys. Fluids 1, 2 (1958).

Data are routinely transferred to Fermilab and automatically processed on the FermiGrid. All data are reprocessed when a new version of the data processing software is released.

Data Products and Releases:

The scope of these public data releases is decided by the analysis team, but includes the data displayed in charts, figures and images. In addition, more extensive information about the

particle interaction events, such as time, acoustic power, pressure, temperature, will be made public as necessary to reproduce the results.

Plan for Serving Data to the Collaboration and Community:

Fermilab hosts servers containing the raw and processed data files for the PICO Collaboration. The University of Chicago hosts a Subversion repository server for the analysis software. All documentation relating to PICO construction, analysis, operations, and presentation are hosted on a document database server at Fermilab.

The raw data, full processed files, and analysis software will be made available to the community upon request. The Collaboration considers the data proprietary until results from those data have been published.

Plan for Archiving Data:

All data, raw and processed, will be archived at Fermilab for at least 5 years, and as long as costs permit. In addition, the PICO Collaboration is pursuing a secondary archive in Canada.

Plan for Making Data Used in Publications Available:

If possible, all PICO publications are posted on the arXiv.org website when they are submitted to the journal. All data points shown in the published graph will be available in a machine-readable form in ancillary files in the arXiv.org entry for that publication. If it is not possible to upload the manuscript to arXiv.org, then arrangements will be made with the publisher to post these data as supplemental data on the journal website.

Responsiveness to SC Statement on Digital Data Management

This data management plan fully follows the Office of Science Statement on Digital Data Management.