
**Inputs and Questions from
WG4: New Candidates, Targets, and Complementarity**

U.S. Cosmic Visions: New Ideas in Dark Matter

University of Maryland

Jonathan Feng and Paddy Fox, conveners

24 March 2017

INPUTS AND QUESTIONS FROM WG4

1:10pm - 3:40pm WG3-WG4 Joint Parallel

Philip Schuster (SLAC): Accelerator Complementarity

Iftah Galon (UC Irvine): Non-accelerator Probes of Light Bosons: The ^8Be Anomaly and a Protophobic 5^{th} Force

Omar Moreno (SLAC): HPS First Results

Nikita Blinov (SLAC): Non-Abelian Sectors at Fixed Target

Claudia Frugiuele (Weizmann): Sensitivity of Neutrino Facilities to Leptophobic Z' and DM

4:00pm - 6:30pm WG4 Parallel

Mark Boulay (Carleton): Argon DM Searches: DarkSide-20K and Beyond

Richard Hill (Perimeter): Proton Radius

Jonathan Kozaczuk (U Mass Amherst): ^8Be and Axial Vector Bosons

Xilin Zhang (U Washington): ^8Be Nuclear Theory Predictions

Rafael Lang (Purdue): Future ^8Be Experiments

Kyle Leach (Colorado School of Mines): Future ^8Be Experiments

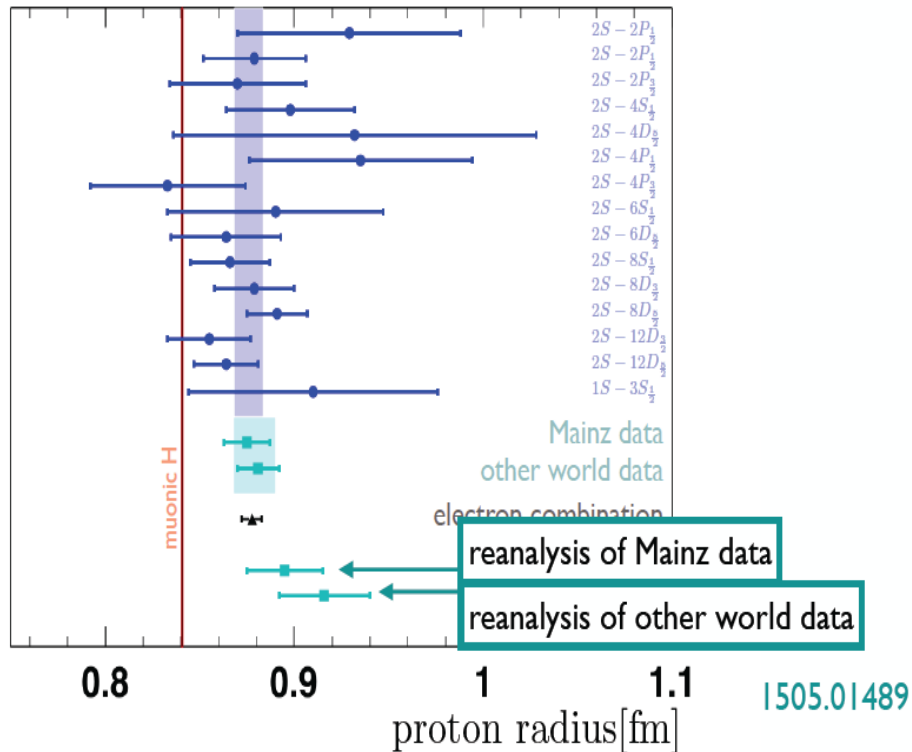
Claudia Frugiuele (Weizmann): Isotope Shift Spectroscopy

Great talks, but not reviewed here: see closeout talk tomorrow

ANOMALIES PROVIDE TARGETS

Proton Radius Anomaly

Reanalysis of scattering data reveals strong influence of shape assumptions



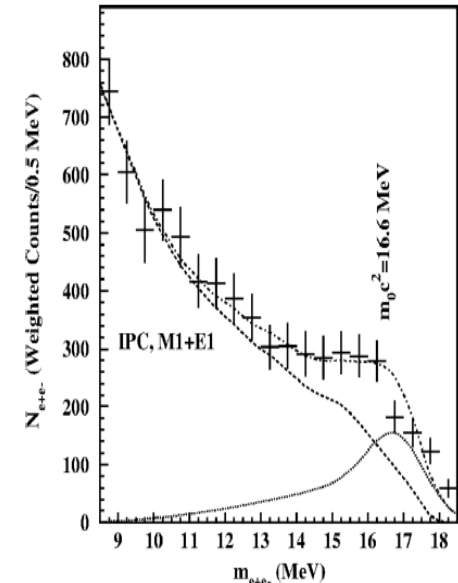
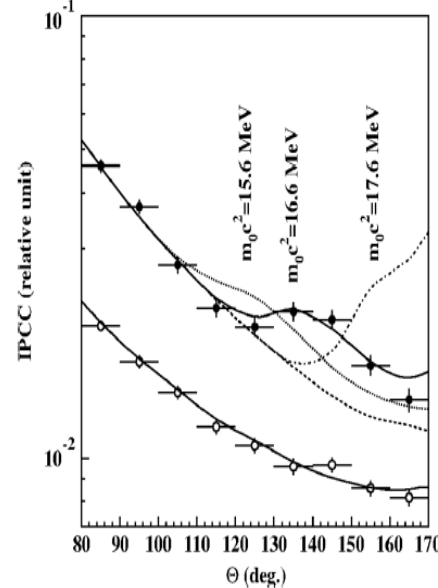
Errors larger, but discrepancy remains

Richard Hill

^8Be Anomaly

The Atomki Result

• Bump-like excess in two distributions from Krasznahorkay et al.



$$\theta_{ee}^{\text{Excess}} \gtrsim 140^\circ$$

$$m_{ee} \approx 17 \text{ MeV}$$

Excess statistical significance $6.8\sigma - 1.07\chi^2/\text{d.o.f}$



Iftah Galon, Jonathan Kozaczuk, Xilin Zhang

PROPOSED ^8Be EXPERIMENTS

Purdue (Lang)

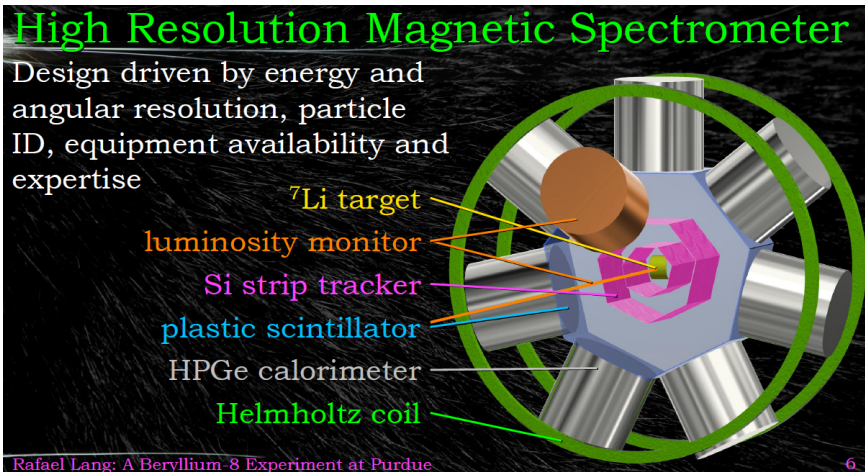


^8BeP : A ^8Be Experiment at Purdue

Rafael F. Lang, Marc Caffee, David Koltick,
Matthew Jones, Brijesh Srivastava, Thomas Ward
Department of Physics and Astronomy, Purdue University
New Ideas in Dark Matter, College Park, March 2017

High Resolution Magnetic Spectrometer

Design driven by energy and angular resolution, particle ID, equipment availability and expertise



- ^7Li target
- luminosity monitor
- Si strip tracker
- plastic scintillator
- HPGe calorimeter
- Helmholtz coil

Rafael Lang: A Beryllium-8 Experiment at Purdue

Timescale: <2 years, <\$750K

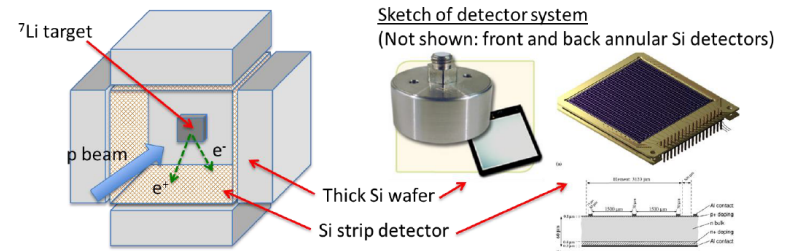
24 Mar 2017

Notre Dame (Leach)

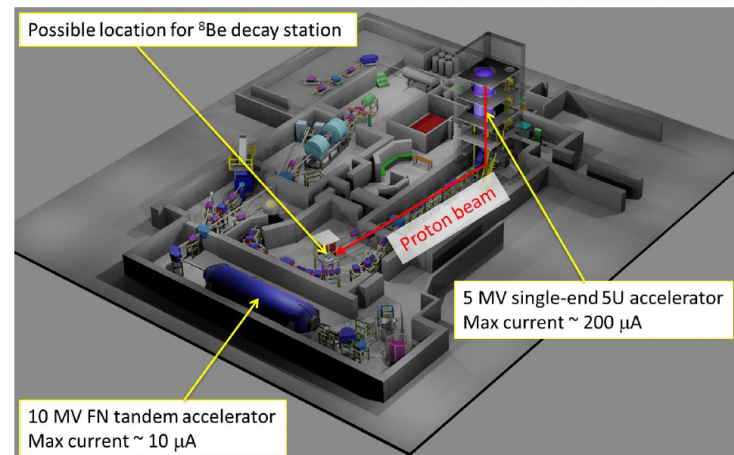


A ^8Be IPC Decay Measurement at the Notre Dame-NSL

M. Brodeur (U. Notre Dame) and K.G. Leach (Colorado School of Mines)



The Nuclear Science Laboratory of the University of Notre Dame



Timescale: 1-2 years, \$750K, including manpower

ATOMIC PHYSICS PROBES

Claudia Frugieuele



Probing new long range interactions via isotope spectroscopy

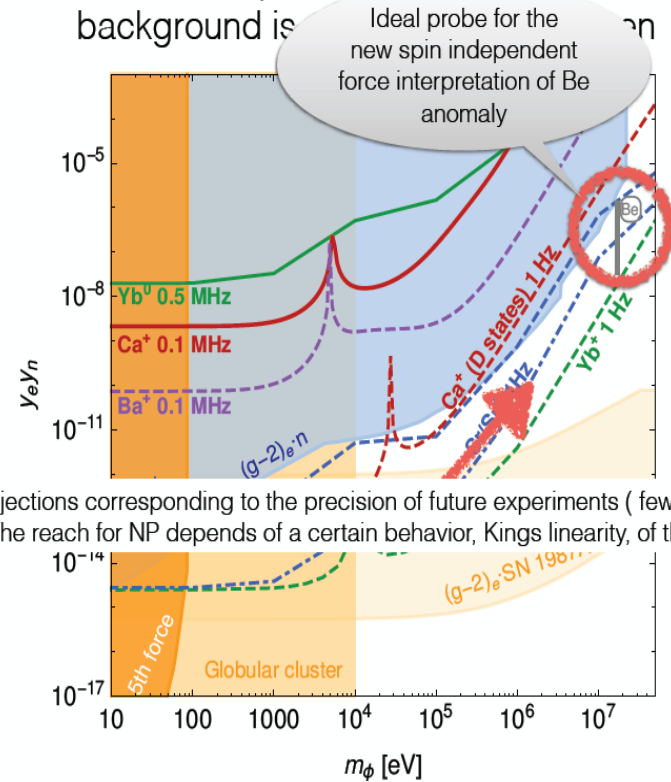
U.S. Cosmic Visions: New Ideas in Dark Matter:

Julian C. Berengut, Dmitry Budker, Cedric Delaunay, Victor V. Flambaum, Claudia Frugieuele, Elina Fuchs, Christophe Groje

Roni Harnik, Roei Ozeri, Gilad Perez, and Yotam Soreq

to appear soon

We can even come up with an observable where the SM background is



Projections corresponding to the precision of future experiments (few years time scale). The reach for NP depends of a certain behavior, Kings linearity, of the measurement

Timescale: short, Cost: cheap

INPUTS AND QUESTIONS

- Many new ideas in dark matter involve low mass scales, leading naturally to overlap with nuclear physics, condensed matter physics, atomic physics
- Proposed experiments certainly fall within the DOE HEP Program Mission to “Discover the elementary constituents of matter and energy [and] probe the interactions between them,” but are in areas traditionally funded by other areas of the DOE Office of Science and the NSF. We are assuming at this point we should be driven by the science. (Cf. supernovae, CMB, etc.)
- Many of the proposed experiments are inexpensive, have short timescales, and time is of the essence. Are there ways to get small amounts of funding (~\$30K) soon (this summer)?