

Cosmic Frontier 1
WIMP Dark Matter Direct Detection
Working Group A Update

Dan Bauer, Fermilab

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SLAC Cosmic Frontier Workshop

CF1 Working Group A

Group Leader

Dan Bauer

Contributors

Lauren Hsu

Dan Bauer

Matthew Szydagis

Richard Schnee

Blas Cabrera

Luca Grandi

Aldo Ianni

Frank Calaprice

Emilija Pantic

David Cline

Andrew Hime

Bob Webb

Mike Witherell

Rick Gaitskell

Tom Shutt

Andrew Sonnenshein

Reina Maruyama

Enectali Figueroa

Tarek Saab

John Orrell

Working group A formed on January 17, 2013

Email listserv created January 24, 2013

Discussions mainly by email

First telecon last Friday

Met twice face-to-face at this workshop

Very useful discussions

People are busy, but willing to devote effort

Will continue telecon and email discussions over the next few months

May try for a face-to-face meeting in May/June timescale at Fermilab

CF1 Working Group A Charge

Charge 1: Summarize the state of direct searches for dark matter.

Describe the technology classes being used today for direct detection of dark matter.

Create an up-to-date summary of current limits and detection claims.

Update from this workshop on Charge 1

We supplied a detailed set of 10 questions to the experiments in order to gather the information needed for Charge 1

We know this was a difficult homework exercise

Thanks to the experiments for making a serious attempt to answer these questions in your presentations!

If you haven't already done so, please post a text answer to the questions on the wiki, and add a link to your slides

We will follow up with you on missing information and request that those experiments who weren't able to present at this workshop supply written answers

There will be an opportunity to provide updates until June

Where to we go from here on Charge 1?

- Working Group A will try to summarize the information and make a snapshot of the field
 - Clearly we need to separate experiments into stages, indicating how much is known
 - Concept, R&D, Construction, Operating
 - Also separate by technology, as per the charge
- White paper section needs to have clear, concise summary text and graphics
 - Capture detailed information in tables as reference
 - Need a graphical way to summarize experimental reach beyond the single sensitivity plot
- Aim for white paper text within a month
 - Split up the work by asking people to summarize technologies they are not working on, to minimize bias
 - Iterate and converge by June

CF1A Draft Revised Charge 2

Charge 2: Review the motivation for future generations of direct searches for WIMP dark matter.

Given theoretical input and experimental constraints from CF1B and CF4, what are the favored regions in WIMP-nucleon cross section and mass?

Will the planned direct detection searches cover these regions in the next 10-20 years?

What other physics might be explored with such searches?

What would be the impact on planned direct detection searches if strong evidence for WIMPS emerges from the LHC or indirect detection?

What are the models where direct detection provides the most compelling limits?

Update from this workshop on Charge 2

- Focused on clarifying the questions
 - Did we miss anything important from the original charge?
 - Some items got folded into Charge 3
- Discussed how to gather the info needed to answer ?s
 - Experimental information gathered from Charge 1 and from CF2, CF4 (indirect, collider searches)
 - Benchmarks from CF1B, CF4
 - Complementarity models from CF4
- Need this info as soon as possible in order to start drafting this section of the white paper
 - If we get info in next few weeks, provide draft answers in April and white paper section in June

CF1A Draft Revised Charge 3

Charge 3: Develop criteria and figures of merit by which future generations of direct dark matter search experiments can be evaluated in terms of sensitivity and discovery potential.

What are the most important criteria for evaluating sensitivity and discovery potential?

In three WIMP mass ranges (<10 GeV, 10-1000 GeV, >1000 GeV), describe how fiducial target mass, background performance, energy threshold/resolution and systematics play into sensitivity and discovery potential

Attempt to construct a “decision tree” for dark matter direct detection

What should be the boundaries for WIMP direct detection experiments?

Is it important to reach the “neutrino floor” for all WIMP masses?

What should be our spin-dependent floor, if nothing is found in spin-independent?

How low should we go in WIMP mass; is there a case to push below 1 GeV?

How high should we go in WIMP mass; is there a case for > 10 TeV?

CF1A Draft Revised Charge 3

Charge 3: Develop criteria and figures of merit by which future generations of direct dark matter search experiments can be evaluated in terms of sensitivity and discovery potential.

What would it take to convince the community that WIMP dark matter has been discovered?

What are our criteria for “evidence for” and “discovery of” WIMPS?

How many confirmations, and of what type, are required?

If WIMPs are discovered in direct detection, what can we learn about their properties?

How well could the WIMP mass be determined?

How would we design follow-on experiments to provide more information?

Complementary searches with different targets, better energy resolution,?

What additional information would be gained from annual modulation experiments?

What would we learn from directional experiments?

Update from this workshop on Charge 3

- These are some of the most interesting questions for working group A
 - All of these need thought, and many need actual work to answer
 - Split the task within the group by questions
 - Criteria
 - Decision Tree
 - Boundaries
 - Convincing the community
 - WIMP properties
 - Try to get draft answers in April, drafts of white paper section by June