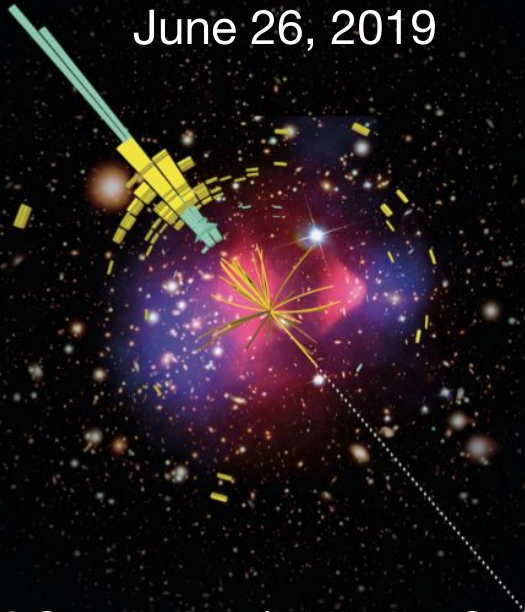


Introduction

LHC Dark Matter WG meeting on t-channel white paper effort
June 26, 2019



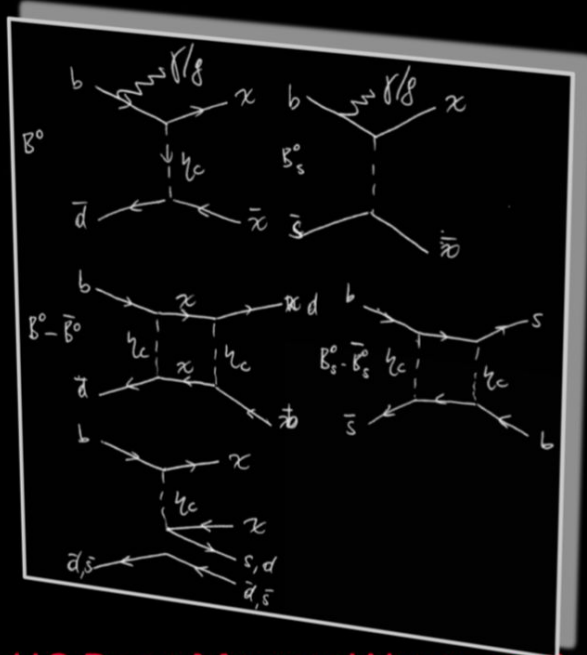
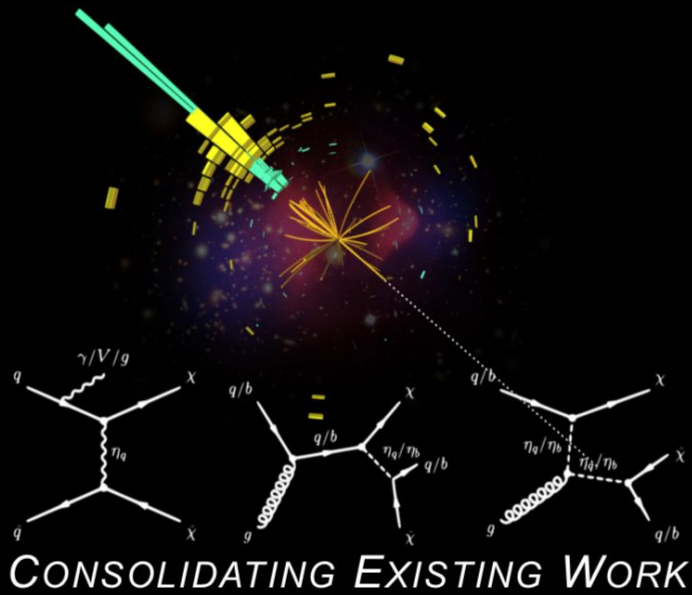
Oleg Brandt (U of Cambridge), Xabier Cid Vidal (), Uli Haisch (Oxford), Phil Harris (MIT), Christian Ohm (KTH), Tim Tait (UCI)

Meeting on April 26

DARK MATTER MODELS | @LHC WITH *t*-CHANNEL MEDIATORS & B-FACTORIES

26 April 2019 • 13:00-18:00 • CERN 40-S2-C01 (Salle Curie) • Vidyo

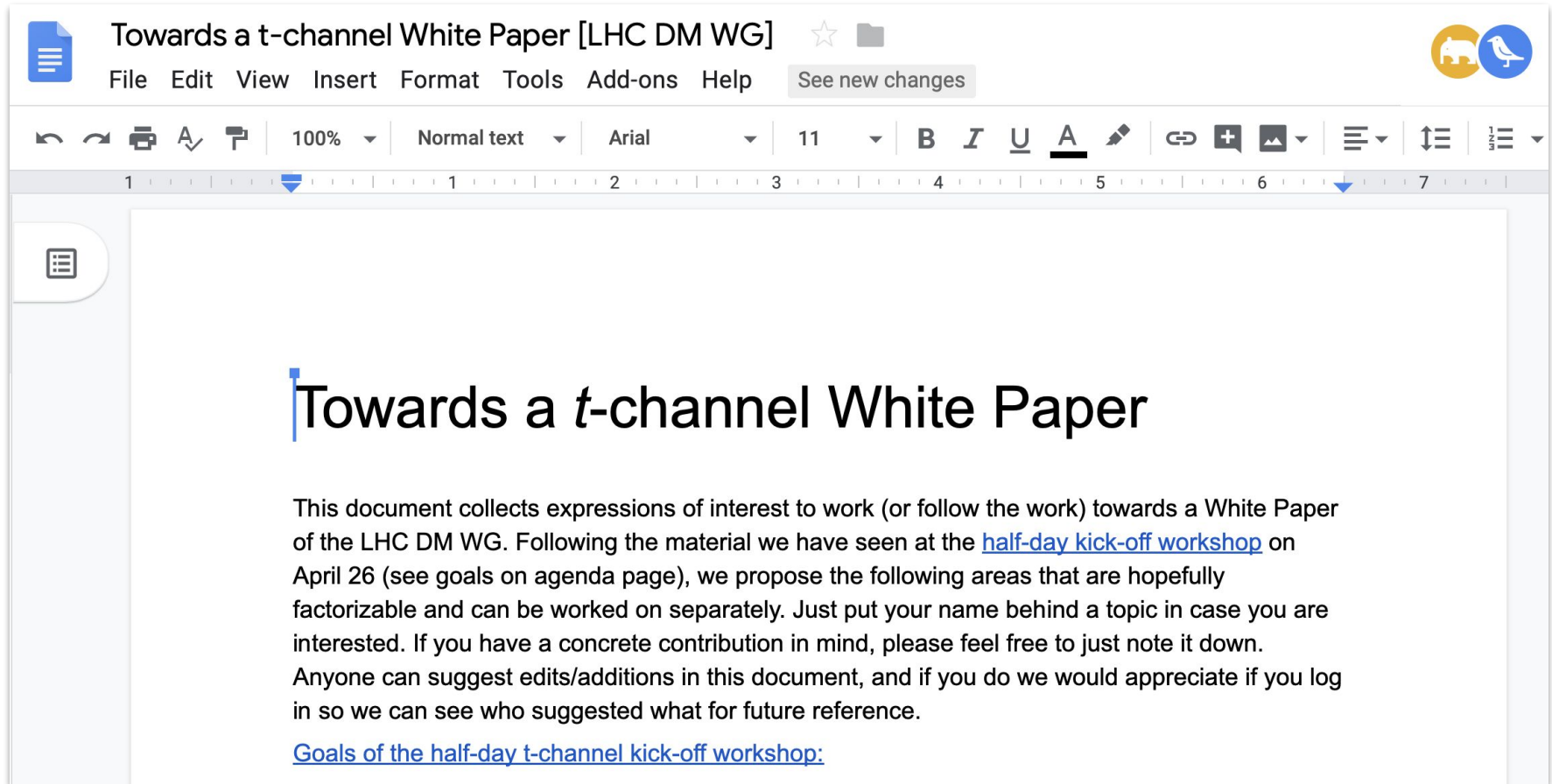
& GOING BEYOND?



EXPERIMENTAL + THEORY WORKSHOP
<https://indico.cern.ch/e/tChannelDM>

LHC DARK MATTER WORKING GROUP
ORGANISERS: OLEG BRANDT • ULRICH HAISCH • PHILIPP HARRIS • CHRISTIAN OHM
• TIM TAIT • XABIER CID VIDAL

Expressions of (lots of) interest via google doc



The image shows a screenshot of a Google Docs document. The title bar at the top reads "Towards a t-channel White Paper [LHC DM WG]". Below the title bar is a menu bar with options: File, Edit, View, Insert, Format, Tools, Add-ons, Help. To the right of the menu bar is a "See new changes" button. Below the menu bar is a toolbar with various editing tools like undo, redo, print, text color, background color, font size (100%), text style (Normal text), font family (Arial), font size (11), bold (B), italic (I), underline (U), text color (A), link, insert, and zoom. Below the toolbar is a ruler showing line numbers 1 through 7. The main content area of the document contains a large heading "Towards a *t*-channel White Paper" and a paragraph of text. The text reads: "This document collects expressions of interest to work (or follow the work) towards a White Paper of the LHC DM WG. Following the material we have seen at the [half-day kick-off workshop](#) on April 26 (see goals on agenda page), we propose the following areas that are hopefully factorizable and can be worked on separately. Just put your name behind a topic in case you are interested. If you have a concrete contribution in mind, please feel free to just note it down. Anyone can suggest edits/additions in this document, and if you do we would appreciate if you log in so we can see who suggested what for future reference." Below the paragraph is a blue hyperlink: "[Goals of the half-day t-channel kick-off workshop:](#)".

Towards a *t*-channel White Paper

This document collects expressions of interest to work (or follow the work) towards a White Paper of the LHC DM WG. Following the material we have seen at the [half-day kick-off workshop](#) on April 26 (see goals on agenda page), we propose the following areas that are hopefully factorizable and can be worked on separately. Just put your name behind a topic in case you are interested. If you have a concrete contribution in mind, please feel free to just note it down. Anyone can suggest edits/additions in this document, and if you do we would appreciate if you log in so we can see who suggested what for future reference.

[Goals of the half-day t-channel kick-off workshop:](#)

Expressions of (lots of) interest via google doc

Topics and efforts for t-channel white paper

Introduction/context

1 Consolidating existing work

1.1 Common Über-UFO

1.2 Proposals for initial recommendations for interpretations in early full Run-2 results [short time scale]

1.3 Summarise interplay between Dirac/Majorana/Scalar DM

1.4 Study interplay between jet+MET and dijet+MET

2 Going beyond

2.1 Long-lived particles in t-channel dark matter models

2.2 Constraints from oscillation measurements in K, D, and B systems

2.3 Constraints from X+MET searches in K, D, and B systems

2.4 Ideas on opposite-side tagging at LHCb

2.5 Flavoured DM beyond MFV

Expressions of (lots of) interest via google doc

1.1 Common Über-UFO

Currently, CMS and ATLAS use different models with RH up-type (CMS) and LH (ATLAS) couplings, different coupling values, both Dirac DM. Can we construct an Über-UFO that (through switches) can do both and go beyond? Something like this:

- Dirac DM case
 - Majorana DM case
 - [nice to have] Scalar DM case
 - [nice to have] LH vs. RH up-type vs. RH down-type couplings
 - [nice to have] enhanced couplings of 3rd gen
- Tim Tait
 - Kirtimaan Mohan, Dipan Sengupta
 - Benjamin Fuks, Kentarou Mawatari, Chiara Arina, Luca Mantani (DMSimp-t)
 - Nishita Desai
 - Michele Papucci
 - Yang Bai
 - Alejandro Ibarra
 - Pyungwon Ko

Expressions of (lots of) interest via google doc

1.2 Proposals for initial recommendations for interpretations in early full Run-2 results [short time scale]

A step before the common Über-UFO, can we come up with a common prescription for t-channel interpretations using either CMS or ATLAS model, or yet another one that can do the same? This is on a short time scale to do a first round of interpretations using full Run 2 results that are coming out now.

- Tim Tait
- Phil Harris
- Greg Landsberg
- Liantao Wang
- Hao Zhang
- Haipeng An
- Myeonghun Park
- Benjamin Fuks
- Shih-Chieh Hsu
- Kirtimaan Mohan
- David Yu
- Dipan Sengupta
- Pyungwon Ko

Expressions of (lots of) interest via google doc

1.3 Summarise interplay between Dirac/Majorana/Scalar DM

Come up with a short overview of how signatures interplay, compile references to pheno work where this has been studied. This should also contain discussions and constraints for the different scenarios from DD and ID results.

- Tim Tait
- Laura Lopez Honorez
- Liantao Wang
- Christian Ohm
- Hao Zhang
- Poulou Poulou
- Haipeng An
- Benjamin Fuks
- Michel Tytgat
- Jerome Vandecasteele
- Gilly Elor
- Linda Carpenter
- Adil Jueid
- Dipan Sengupta
- Alejandro Ibarra
- Mathias Garny
- Federica Giacchino
- Stefan Vogl
- Matteo Bauce

Expressions of (lots of) interest via google doc

1.4 Study interplay between jet+MET and dijet+MET

Study the contribution of the squark-type searches. Can be done either through recasting 36/fb analyses (theory-driven), or in upcoming full Run 2 papers (experiment-driven). Ideally we'd have both!

- Oleg Brandt
- Liantao Wang
- Hao Zhang
- Myeonghun Park
- Frederik Ruehr
- Nishita Desai
- Alex Schuy
- Kirtimaan Mohan
- David Yu
- José Ruiz
- Dipan Sengupta
- Haoran Zhao
- Priscilla Pani
- Giacomo Polesello
- James Frost
- David Berge
- Matteo Bauce
- Steve Worm

Expressions of (lots of) interest via google doc

2 Going beyond

2.1 Long-lived particles in t-channel dark matter models

What final states play a role in t-channel dark matter models that give long lived particles? How do freeze-out/freeze-in mechanisms play a role (if relevant)? This work could go in parallel to the stuff in Section 1.

- Phil Harris
- Jan Heisig
- Laura Lopez Honorez
- Christian Ohm
- Poulou Poulou
- Kate Pachal
- Nishita Desai
- Wan Jin Yeo
- Michele Papucci
- Marie-Helene Genest
- Alejandro Ibarra
- Mathias Garny
- Raman Khurana
- Priscilla Pani
- Stefan Vogl

Expressions of (lots of) interest via google doc

2.2 Constraints from oscillation measurements in K, D, and B systems

What can we learn from the oscillation frequency measurements in neutral meson systems like K, D, B?

- Greg Landsberg
- Mitesh Patel
- Gilly Elor

2.3 Constraints from X+MET searches in K, D, and B systems

Summarise what can/cannot be done at B-factories / LHCb. This is something that could be naturally driven by B-factory / LHCb communities

- Xabier Cid Vidal
- Christopher Smith

Expressions of (lots of) interest via google doc

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- Xabier Cid Vidal
- Christopher Smith

Expressions of (lots of) interest via google doc

2.4 Ideas on opposite-side tagging at LHCb

How can the sensitivity of LHCb to direct search strategies involving MET be enhanced? What can be done with opposite side tagging, for instance identifying $\phi \rightarrow K^+K^-$ decays (50% BR)?

- Xabier Cid Vidal
- Mitesh Patel

2.5 Flavoured DM beyond MFV

Maybe mostly a short discussion of this possibility, with reference to existing work - and prospects for looking into this in more detail in the future.

- Monika Blanke
- Priscilla Pani
- Giacomo Polesello

Purpose of today's meeting

1. Understand what is already available on the model side:
 - a. What can the existing UFOs do?
 - b. What from wishlist is missing?
 - c. Can we merge all we need into the same UFO?
2. Discussion: how do we organize the work ahead? Proposal:
 - a. Determine through discussion what parts depend on each other and what can be done in parallel
 - b. Organize smaller calls and/or working meetings with those interested in specific parts outlined above
 - c. Decide today rough outline/timeline for work ahead
 - d. Regularly report progress via email, discussion meetings as needed

Practicalities: Paper repo exists, [DMWG-tChannel-whitepaper](#)

LHC-DMWG / [DMWG-tChannel-whitepaper](#) Unwatch 4 Star 0 Fork 0


[Code](#) [Issues 0](#) [Pull requests 0](#) [Projects 0](#) [Wiki](#) [Security](#) [Insights](#) [Settings](#)

Whitepaper with recommendations for models with t-channel production of Dark Matter. [Edit](#)

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[3 commits](#) [1 branch](#) [0 releases](#) [1 contributor](#) [GPL-3.0](#)

Branch: [master](#) [New pull request](#) [Create new file](#) [Upload files](#) [Find File](#) [Clone or download](#)

 **cohm** Adding gitignore, setting tentative title Latest commit cfbaaa4 29 days ago

.gitignore	Adding gitignore, setting tentative title	29 days ago
JHEP.bst	Initial commit, empty template	29 days ago
LICENSE	Initial commit, empty template	29 days ago
README.md	Initial commit	29 days ago
compile.sh	Initial commit, empty template	29 days ago
jcappub.sty	Initial commit, empty template	29 days ago
tChannel-whitepaper.bib	Initial commit, empty template	29 days ago
tChannel-whitepaper.tex	Adding gitignore, setting tentative title	29 days ago

Practicalities: What about UFOs? Github: [LHC-DMWG](#)

Once we've converged on UFO(s) for recommendations, we would want to host and/or point to models from here!

LHC Dark Matter Working Group
LHC Dark Matter Working Group repository
CERN | <http://lpc.web.cern.ch/...> | lhc-dmwg-admin@cern...

Repositories 10 | Packages | People 19 | Teams | Projects | Settings

Find a repository... | Type: All | Language: All | Customize pins | New

RelicDensityCurves
DM relic density curves for various models
CC-BY-SA-4.0 | 0 forks | 1 star | 0 issues | 0 pull requests | Updated 6 days ago

model-repository ← (indicated by a red arrow)
Python | 2 forks | 1 star | 0 issues | 1 pull request | Updated 13 days ago


DMWG-ComparisonLHCvsDDvsID-whitepaper
Recommendations on presenting LHC searches for missing transverse energy signals using simplified s-channel models of dark matter - <https://arxiv.org/abs/1603.04156>
TeX | 0 forks | 0 stars | 0 issues | 0 pull requests | Updated 13 days ago


Top languages: TeX, Python, HTML


People: 19




Today's agenda



Towards an LHC DM WG white paper on models with t -channel production of DM @ LHC (LHC DM WG public meeting)

 Wednesday 26 Jun 2019, 16:00 → 18:00 Europe/Zurich

 37/R-022 - ACCESS WITH CERN CARD (CERN)



 Christian Ohm (KTH Royal Institute of Technology (SE)), Oleg Brandt (Ruprecht Karls Universitaet Heidelberg (DE)), Philip Coleman Harris (Massachusetts Inst. of Technology (US)), Tim M.P. Tait (University of California, Irvine), Ulrich Andreas Haisch (University of Oxford (GB)), Xabier Cid Vidal (Instituto Galego de Física de Altas Enerxías)



Videoconference Rooms  Dark_Matter_WG_t-channel_models [Join](#)  37/R-022 

16:00 → 16:15 **Introduction**  15m 



Goals of the meeting and outline of plan towards white paper.

Speakers: Christian Ohm (KTH Royal Institute of Technology (SE)), Oleg Brandt (Ruprecht Karls Universitaet Heidelberg (DE)), Philip Coleman Harris (Massachusetts Inst. of Technology (US)), Tim M.P. Tait (University of California, Irvine), Uli Haisch, Ulrich Andreas Haisch (University of Oxford (GB)), Xabier Cid Vidal (Instituto Galego de Física de Altas Enerxías)



16:15 → 16:45 **Progress on Über-UFO**  30m 



Report on the DMSimp implementation  10m 



Speaker: Luca Mantani (UCLouvain)



Report on the implementation by Haipeng et al.  10m 

Speakers: Dr Haipeng An (Caltech), Haipeng An (Perimeter Institute), Haipeng An (Tsinghua University), Haipeng An (University of Maryland)

16:45 → 17:05 **Progress on comparing sensitivity for different LHC signatures**  20m 

Report 1  10m 

Report 2  10m 

17:05 → 17:35 **Discussion: how we organize the work moving forward**  30m 

Discussion where we decide on how to organize the work going into the paper. What can be factorized? What can go in parallel? Probably good to organize smaller meetings for those working on the same parts.