London Centre for TeraUniverse Studies - IPPP Workshop

"Next generation of
simplified Dark Matter models"

May 6, 2016, Imperial College London

Motivation and Scope:

This informal brainstorming meeting follows thematically the one we hosted in May 2014, which focused on the interplay and characterization of Dark Matter (DM) searches at Colliders and Direct Detection experiments summarized in a white paper [1].

Since then several important developments in the characterisation of DM searches at colliders took place, most notably the activities of the LHC DM forum [2] and the newly founded LHC DM working group [3].

Central to this effort are simplified DM models (SDMM) that have become the main vehicle to characterise DM searches at colliders and that are used for comparisons with other experiments such as Direct Detection and Indirect Detection searches.

Today, the majority of this SDMM are derived from simple Lagrangians, which are governed by four basic parameters: mediator mass (m_{med}), Dark Matter candidate mass (m_{DM}), coupling of the mediator to the Standard Model particles (usually quarks or gluons, g_{SM}), and coupling of the mediator to Dark Matter candidates (g_{DM}).

While these very simplistic SDMM have been very useful to map out the general characteristics of DM searches at colliders, they are often too simple to fully capture the detailed physics of all relevant searches.

Therefore, a well-defined extension of these simple SDMM is required in order to allow a more refined characterisation and comparison of all relevant DM searches. This should also include searches like the dijet, dilepton, and diphoton resonance searches, which are not directly probing the Dark Matter candidate but can be very powerful to constrain the mediator mass and couplings.

Furthermore, this next generation of SDMMs should ideally also address some of the theoretical shortcomings that come along with the very simplistic first-generation models.

The scope of this brainstorming workshop is to discuss options of defining the next generation of SDMM and, if deemed relevant/possible, to contribute to the development of consistent and state-of-the-art extensions of the SDMM.

[1] Phys.Dark Univ. 9-10 (2015) 51-58, arXiv:1409.4075 based on JHEP 1501 (2015) 037, arXiv:1407.8257
[2] arXiv:1507.00966
[3] http://lpcc.web.cern.ch/LPCC/index.php?page=dm_wg

Tentative **Programme:**

10:00 Coffee

10:30 Session 1: **Where are we today** [session convener J. Ellis]
- **10:30**: *Summary of DM forum and LHC DM WG recommendations* 15+5' (O. Buchmueller, K. Hahn, S. Malik)
- **10:50:** *More about Vector and Axial-Vector simplified models* 15+5' (F. Kahlhoefer)
- **11:10:** *More about Scalar and Pseudoscalar simplified models* 15+5' (P. Harris)
- **11:30:** *More about t-channel simplified models* 15+5' (XXX???)
- **11:50:** *Interplay of collider and Direct Detection Experiments* 15+5' (C. McCabe, David Cerdeno)
- **12:10:** *Interplay of collider and Indirect Detection Experiments* 15+5' (C. Boehm, Aaron Vincent)

12:30 Lunch

13:30 Continue Session 1: **Where are we today** [session convener V. Khoze]
- **13:30**: *Simplified models for Hinv* 15+5' (N. Wardle, J. Brook)
- **13:50:** *Simplified models for Higgs Portal* 15+5' (P. Penning)
- **14:10:** Simplified models for DM + heavy flavour 15+5' (K. Hahn, A. De Cosa)

15:00 Session 2: **The next generation of simplified models** [session convener: O. Buchmueller]

- **15:00:** *What are the requirements and constraints?* 15+5' (F. Kahlhoefer, U. Haisch, C. McCabe)
- **15:20:** *750 and how it could fit into DM* 15+5' (V. Khoze)
- **15:40**: *What are the connections to a full theory like SUSY* 15+5' (J. Ellis)
- **15:40:** *What are requirements for a global fit in DM* 15+5' (O. Buchmueller, S. Malik, P. Scot)

16:00 Coffee (prepare for session 3)

17:00 Session 3: **The next generation of simplified**
17:00: Round Table Discussion: Moderators: G. Landsberg and A. De Roeck 60' (All)

18:00 Session 4: Closing
- 18:00: What next? 15' (All)

19:30 Dinner