



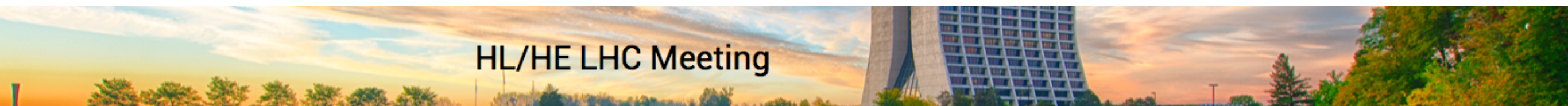
WG3: BSM @ HL-LHC & HE-LHC

Status report

WG3 conveners

EX: Monica D'Onofrio (ATLAS), Keith Ulmer (CMS), Xabier Cid Vidal (LHCb)

TH: Patrick Fox, Riccardo Torre



HL/HE LHC Meeting

???

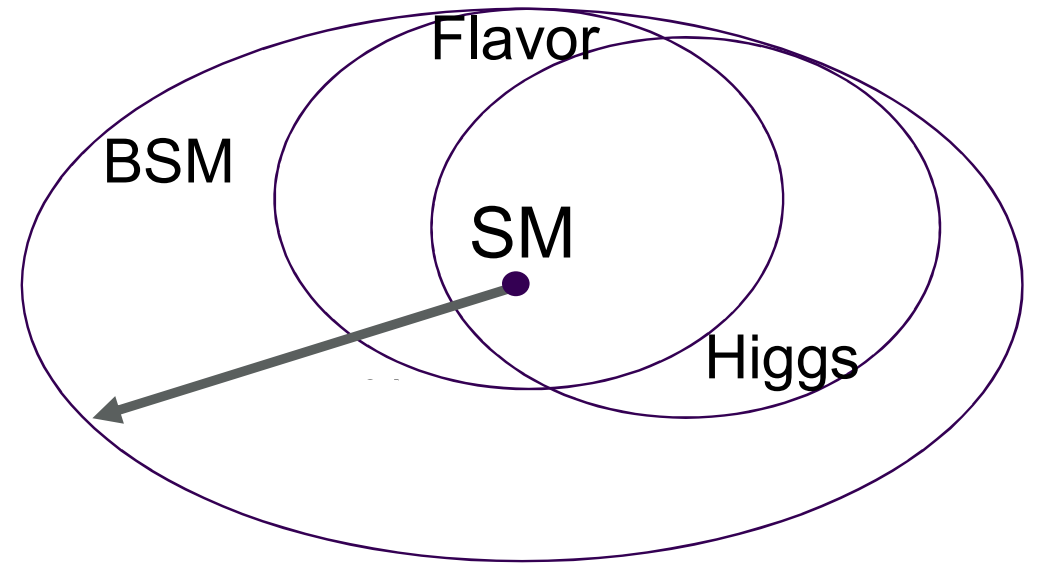
- Hierarchy problem
- Origin of Dark Matter
- Strong CP problem
- Neutrino masses
- Matter/anti-matter asymmetry
- Explanation of Yukawas, fermion masses
- Quantum gravity
- Inflation
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Many potential explanations of these involve physics that can be probed at LHC or HE-LHC

all involve BSM physics

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Good synergy between WG's 2, 3, and 4

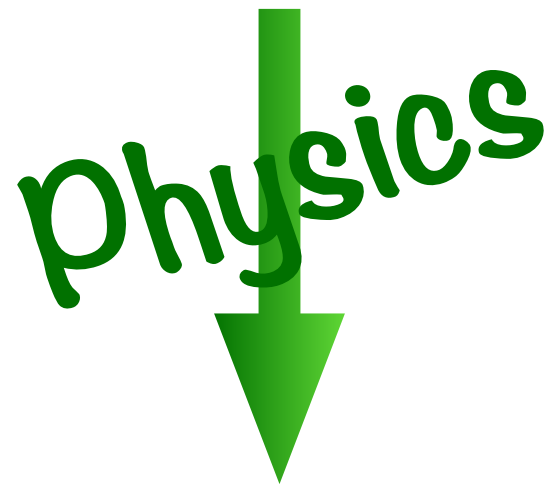
HL/HE-LHC

Reference Parameters:

- **HL-LHC:** $\sqrt{s} = 14$ TeV; $L = 3 \text{ ab}^{-1}$; for LHCb: $50 \rightarrow 300 \text{ fb}^{-1}$;
- **HE-LHC:** $\sqrt{s} = 27$ TeV; $L = 15 \text{ ab}^{-1}$;

Both present great opportunity to learn about SM/discover BSM

Opportunities, challenges, complementarity, uniqueness of each?



Yellow report as input to European Strategy for Particle Physics

What is the reach of HL/HE-LHC?

We can update existing analyses for 3/ab, compare techniques

But we should also think of new types of analyses that take advantage of the increase in luminosity or energy

e.g.

- Go out on tails

- Require boosting

- Associated production for trigger or just to suppress background

- Other interesting corners of phase space that may become available?

Don't loose sight of light, weakly coupled new physics

- Take advantage of high pT to dig under SM and search for light stuff

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Join WG mailing list: <https://indico.cern.ch/event/647676/overview>

Contribute to Yellow Report

WG3 (BSM) Activities

hllhc-wg3-admin@cern.ch

Conveners: Patrick J. Fox and Riccardo Torre (TH), Monica D'Onofrio (ATLAS), Keith Ulmer (CMS), Xabier Cid Vidal (LHCb)

- **CERN kickoff meeting (Oct 30-Nov 1, 2017)**
 - >30 BSM talks
- **Fermilab meeting (now!)**
 - >30 BSM talks
- **On-line (vidyo) meeting (Apr 23, 2018)**
- **On-line (vidyo) meeting (~May 21, 2018)**
- **First draft of contributions (May 30, 2018)**
- **CERN plenary meeting (June 18-20, 2018)**
- **More on-line meetings**
- **Yellow Report (Dec 18, 2018)**

*More info on
twiki*

Many proposed analyses for HL and HE, from theorists and ATLAS, CMS and LHCb members

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Many proposed analyses for HL and HE, from theorists and ATLAS, CMS and LHCb members e.g.

- SUSY, with and without R-parity
- Resonances
- Long lived particles
- Future new detectors: MATHUSLA, CODEX-b, FASER, milliQan
- New collider: e-p LHeC
- Dark Matter
- Extended scalar sectors
- Axions
- Neutral naturalness
-

To see ongoing work, to propose a new analysis etc see [spreadsheet](#)

WG3 (BSM) Activities

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Conveners: Pa

Draft Table of Contents of report:

ier Cid Vidal (LHCb)

The table of content is based on the input collected so far in this online [spreadsheet](#). That does not yet included all experimental studies already done

1. Introduction and overview

1. New Physics models
2. Analysis methods and approaches
3. Treatment of systematic uncertainties

2. Supersymmetry

1. generic searches for [SUSY](#)
 - a. Prospects for realistic [SUSY](#) models at the HL-/HE-LHC (*S. Heinemeyer et al.*)
 - b. Probing [SUSY](#) at HL- and HE-LHC (*T. Han et al.*)
2. [SUSY](#) strong production
 - a. Prospects for third generation squark production at the HL-LHC and HE-LHC (*I. Vivarelli et al. ATLAS*)
 - b. same-sign dilepton [SUSY](#) (*CMS*)
3. [SUSY](#) EWK production
 - a. Prospects for [C1N2](#) via WZ and Wh in multilepton at the HL-LHC and HE-LHC (*A. de Santo et al. ATLAS*)
 - b. Prospects for chargino pair production at HL- and HE-LHC (*S. Carra' et al. ATLAS*)
 - c. Search for chargino-neutral in Wh channel using 1Lbb final states (*M. D'Onofrio et al. ATLAS*)
 - d. Prospects for direct stau production at the HL-LHC (*C. Zhong et al. ATLAS*)
 - e. Compressed electroweakinos at HL- and HE-LHC (*S. Amoroso et al. ATLAS*)
 - f. Prospects for radiative natural SUSy at HL- and HE-LHC (*H. Baer et al.*)
 - g. Constraining slepton and chargino through compressed top squark search (*P. Konar et al.*)
 - h. light Higgsino - ISR + 2leptons and VBS + 2leptons (*CMS*)

3. Dark Matter searches

1. DM + jets
 - a. Prospects for DM interpretations in jet+MET analysis at HL/HE-HLC (*C. Gustavino et al. ATLAS*)
 - b. Monojet searches for DM (*CMS*)
2. DM + ttbar / bbbar
 - a. Prospects for associated production of dark matter and top quark pairs at the HL-LHC (*F. Meloni et al. ATLAS*)
 - b. Prospects for associated production of dark matter and bottom quark pairs at the HL-LHC (*M. McDonald et al. ATLAS*)
 - c. HL/HE-HLC prospect for determining the CP nature of spin-0 mediators in associated production of dark matter and top pairs (*U. Hais*)
3. DM + single top
 - a. HL/HE-HLC prospect for DM and a single top-quark production in a 2HDM model with a pseudoscalar mediator (*P. Pani et al.*)
 - b. Studies of DM production in single-top events (*CMS*)
 - c. Studies of DM production in single-top events (*ATLAS*)
4. More models expected to be targeted
 - a. Prospects for pure WIMP (pure triplet) Dark Matter at HL-LHC (*L. Carminati et al. ATLAS*)

4. Long Lived particles

1. Prospects for long lived particles
 - a. Prospects for long lived particles (LLP) Dark Matter at HL-LHC (*L. Carminati et al. ATLAS*)
2. More models expected to be targeted
 - a. Studies of DM production in single-top events (*ATLAS*)
 - b. Studies of DM production in single-top events (*CMS*)
 - c. HL/HE-HLC prospect for DM and a single top-quark production in a 2HDM model with a pseudoscalar mediator (*P. Pani et al.*)

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How and what to simulate?

Studies need to be as “realistic as necessary”

Scale existing results

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gen. level + smearing

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Delphes detector simulator?

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Full sim.

Also should make uniform assumptions

SM backgrounds may be different for HL/HE

Collect list of generated background samples in a central place? On the twiki?

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**Increased lumi/energy may allow new techniques
and channels to be used that haven't been used
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Some general workshop details

WIFI: “guest” or “eduroam” should work

Coffee: in the lobby (but you already know that)

Lunches: Lobby, then 2nd floor or other seminar room (across lobby)

Thursday social: right after the last session on Thursday (~5:30pm) we will adjourn to the “Frontier Pub” in Aspen East.

Dinners in general: see “resources” link on workshop webpage, or ask a local

Please upload talks to Indico before your session starts

