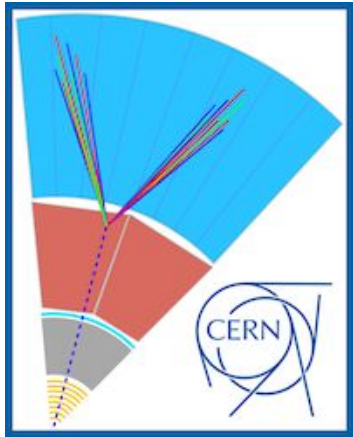# LHC LLP WG
Current status and plans

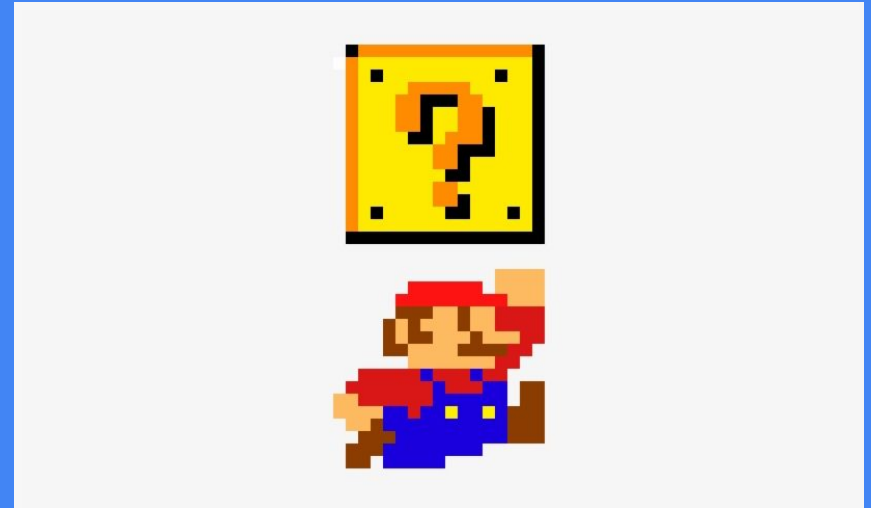**Carlos Vázquez Sierra (CERN)**
on behalf of the WG convenors

LHC LLP WG 2nd meeting

What's this?

WG concept & convenors

The LHC LLP WG concept

Formed to complement the LLP Community (open to any and all LLP experiment or idea around the world), serves as a **formal bridge** with and between the approved LHC experiments, to focus on their main needs. The mandate of the WG consists aims for:

- Facilitate communication between the experimental and theoretical LLP communities,
- Provide recommendations for benchmark models to be used in LLP interpretations,
- Develop and/or validate MC tools for event generation,
- Recommend the experiments on how to present results such it facilitate reinterpretation,
- Discuss possible new search directions based on input from theory and/or experiment.

Continue to have **regular WG meetings** typically embedded in LLP workshops ([first meeting](#) on May, 2020 @ LLP7 workshop), to discuss the **current status and future plans** (subscribe to [lhc-llpwg@cern.ch](#) @ [e-groups](#), we also have a [website](#)). We also plan to have **topical public meetings** in between.

The LHC LLP WG convenors

- **ATLAS:** James Beacham and Sascha Mehlhase
- **CMS:** Juliette Alimena and Albert de Roeck
- **FASER:** Dave Casper
- **LHCb:** Federico Leo Redi and Carlos Vázquez Sierra
- **MoEDAL:** James Pinfold
- **Theory:** Nishita Desai and José Zurita

Mandate of **2 years** (experimental convenors nominated by experiments' PCs, theory convenors nominated by LPCC in consultation with experimental convenors). Reach us via lhc-llpwg-admin@cern.ch.

A bit of perspective...

Theory & experimental perspectives
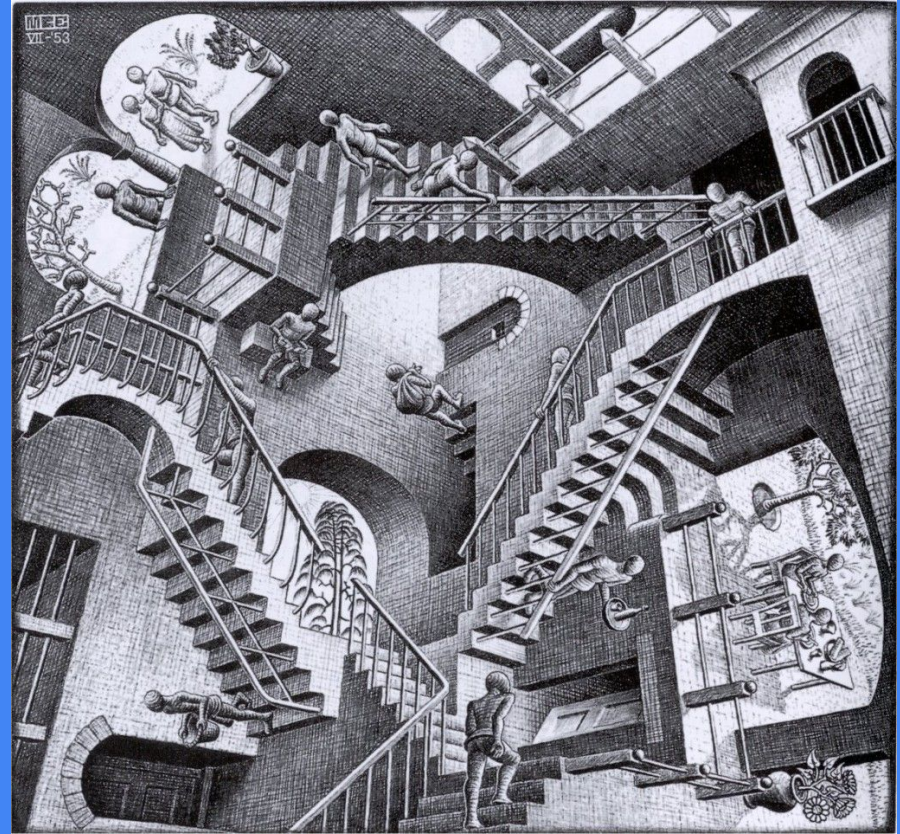
Theory perspective

General objectives and ideas which have been identified so far:

- Provide **standard tools for simulation** (UFO models, MC for **dark showers**),
- Provide **simplified models** targeting specific signatures and topologies,
- Provide suggestions on **how to present results** (standardise object definitions),
- **Feedback** from **experimentalists** in order **to provide reinterpretations**,
- Keep an **updated survey of coverage gaps** (very helpful for experiments).

Any other ideas? Let us know! Your input is <u>highly valuable!</u>

Experimental perspective

General objectives and ideas which have been identified so far:

- **Provide requested feedback to theorists, follow their recommendations!**
- Liaise with internal EXP WG convenors (propagate TH suggestions),
- Identify and discuss **potential triggers for LHC Run-3** conditions,
- Write new/implement **existing tools and algorithms** for **LLP searches**,
- Coordinate among the experiments in order to **exploit complementarity**,
- Provide recommendations for **HL-LHC phase/Run 4 and beyond.**

Any other ideas? Let us know! Your input is <u>highly valuable</u>!

Alright, let's do this!

Proposed structure & deliverables

1. Simulation and tools

Provide **standard tools for simulation** and **benchmark models**:

- Standardise object definitions and models,
- Provide these elements to the community in a **centralised way**,
- Propose the experiments to **integrate these models** in their frameworks.

Provide **other tools** and **identify what is needed from experiments:**

- Help to standardise tools and provide elements to the community (*i.e.* ML),
- Help to identify what is needed from the experiments (*i.e.* open data).

Do we have enough interested people to make this happen?

2. Reinterpretations (1/2)

Provide **potential signatures to experiments** to **cover the gaps**:

- Update **survey of coverage gaps** in a regular way,
- Suggest the experiments on **potential signatures** to cover these gaps.

Provide combined results and recommend the experiments on 'how to publish':

- Translate results from various experiments into **combined plots**,
- **Feedback** from **experimentalists** in order **to provide reinterpretations**,
- **Recommend** the experiments the best way to **provide their results,**
- Agree and **suggest** the experiments on **limit-setting benchmarks.**

2. Reinterpretations (2/2)

Many projects on-going (see [Nishita's summary](#)):

- Improve simulation tools (*i.e.* vertexing in Delphes, used for reinterpreting),
- Solve problems with reinterpretation (*i.e.* ATLAS disappearing tracks),
- Validate new analyses (*i.e.* CMS, ATLAS).

Work force already established ([mailing list](#), [Mattermost](#), [Google Docs](#), [github](#)).

3. Dark Showers

Many topics identified during the dedicated workshop session (see [Simon's](#) talk):

- Converge on a simulation benchmark for dark showers,
- How can we accommodate cosmology/astrophysics constraints?
- Development of tools dedicated for dark shower searches (*i.e.* event isotropy),
- Joint forum between theorists and experiments (*i.e.* Snowmass white paper).

Broad topic with many possibilities and potential projects!

4. Heavy Neutral Leptons (HNLs)

Prepare a proper HNLs simulation framework common to all the experiments:

- Address the HNL polarisation issue in simulation (long standing issue),
- Discuss if using any other generator than MadGraph (MG) or Pythia,
- Include NLO & other simulation than one single Majorana/Dirac flavor in MG.
- **Dedicated meeting on 9th of December (tba).**

Further open topics to be discussed ([mailing list](mailing%20list)):

- Ensure there is a set of common tools across the experiments,
- Explore other possibilities (i.e. special decay modes, decays at low masses),
- LHCb to provide tools and knowledge on HNLs from B-decays (ATLAS, CMS).

5. Triggers for LHC Run 3

Provide recommendations for experiments for LHC Run 3:

- First LHC stable beams to happen in 2022 (experiments are preparing for this),
- This is the **adequate moment** to provide suggestions to the experiments.

White paper in preparation - <u>first WG deliverable</u>:

- Provide theorists an idea of **how capable the experiments would be in Run 3,**
- Provide recommendations to experimentalists to i**mplement new triggers,**
- Aim to make this document public **before the end of the year,**
- **See talk by David and Yuri in this session for more details.**

6. LHC Run 4 and beyond

Keep our role of providing recommendations to the experiments:

- Experiments have started to prepare for LHC Upgrade 2 (Run 4 and beyond),
- We should keep thinking on how to find LLPs in the next generation LHC,
- Some ideas already circulating: **prepare a white paper as in 2021?**

Summary

- All contents shown in the previous slides are **Community efforts**.
- However, there is **an option to become official sub-WGs.**
- This can help to **formalize things,** and to **coordinate with other LPCC WGs.**

Summary

- **To be discussed with the contributors first, however, this is a proposal:**

Topic	Potential sub-WG?	Deliverables
1. Simulation and tools	Might be (needs enough people)	• MC benchmark models? • ML-based tools?
2. Reinterpretations	Yes (many works on-going)	• ATLAS dis. tracks recast • DELPHES vertexing tool
3. Dark Showers	May be (various ideas and work)	• Joint EXP+TH paper? • Simulation framework?
4. HNLs	Yes (subgroup meetings starting)	• Simulation framework!
5. LHC Run 3 triggers	Not needed	• **Run 3 trigger WP on LLP!**
6. LHC Run 4 and beyond	Not needed	• HL-LHC LLP white paper?

So... are we done yet?
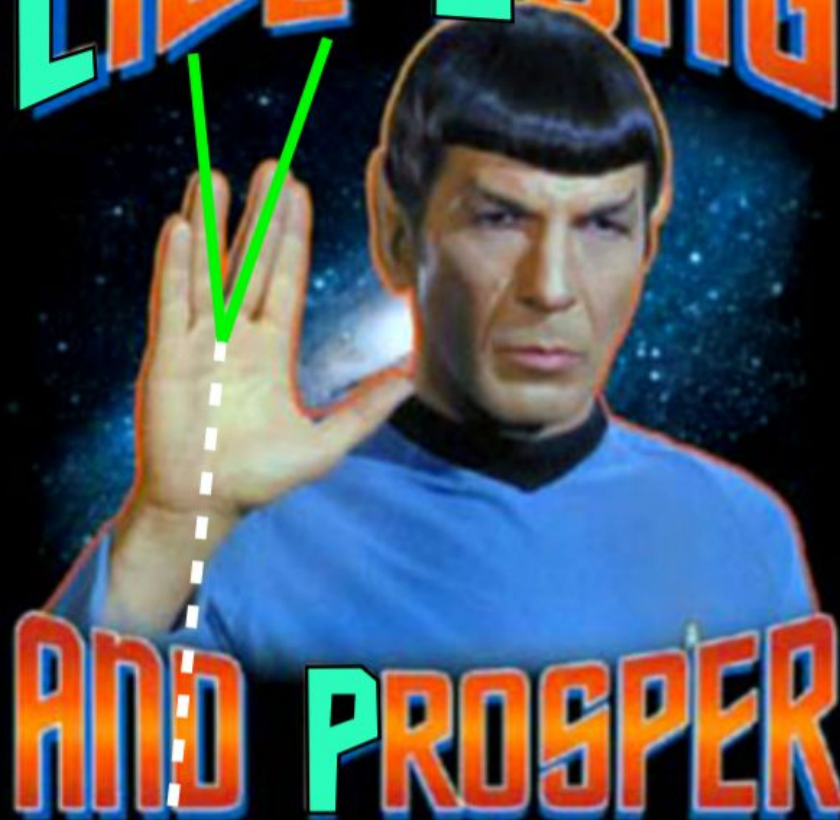
Conclusions

Conclusions

- First LHC LLP WG deliverable (R3 trigger WP) in its way.
- However, **many more ideas can be covered** and **become sub-WGs.**
- Lots of inspiration from the community workshops, many works on-going.
- However, the **proposed structure** needs (or at least, would be desirable to):
  a) **Feedback** from the community,
  b) Review if we have **enough people** for this works,
  c) **Dedicated** sub-WG meetings (can happen in between workshops)
  d) Define a **plan** for next deliverables, after the WP is published.
- **Keep contact with other LPCC WGs:**
  - Informal contact with DM WG to identify common areas of interest,
  - Could contact the Higgs WG (in particular, Exotic Higgs decay sub-WG).

Conclusions

We want to hear your opinion, and would like to invite you to join us!

Credit: David Curtin