Dark showers snowmass LOI
Aims and goals

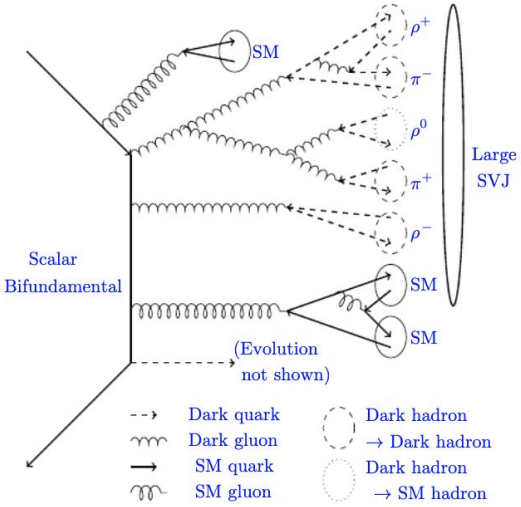
Suchita Kulkarni
Junior group leader
Together with: Caterina Doglioni, Marie-Helene Genest

NAWI Graz
Natural Sciences

FWF
Der Wissenschaftsfonds.

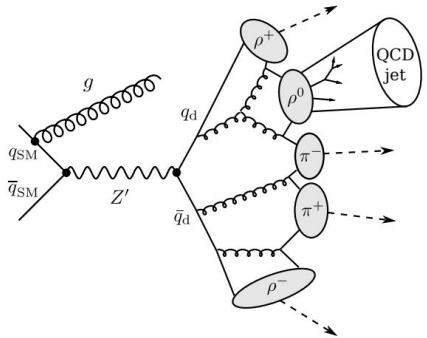
UNI
GRAZ

Dark showers at the LHC



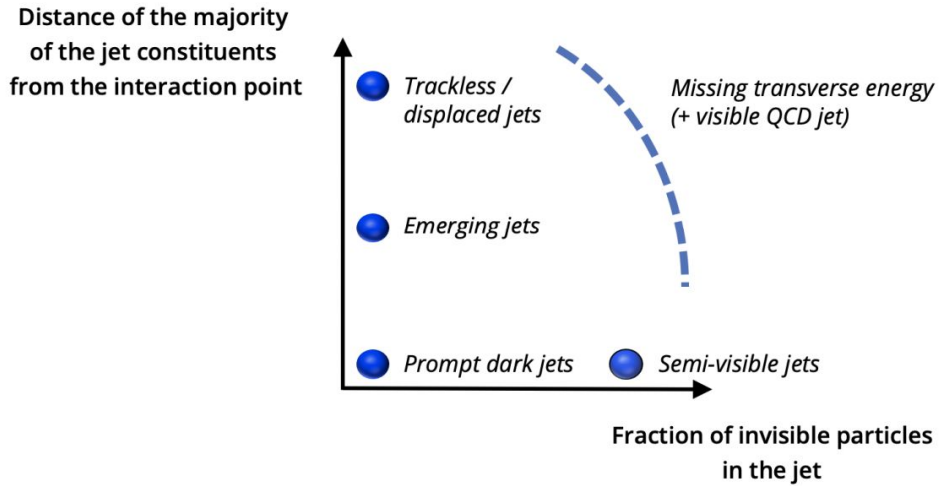
arXiv:2007.11597

arXiv:1907.04346



- What if dark matter is a result of confinement in some hidden non-abelian sector?
- We want to analyse and understand the LHC phenomenology of such sectors
- Will primarily concentrate on SU(N) theories with hadronic final states

Signature parameter space



- How is the signature space populated by different theory scenarios?
- What kind of tools do we need? E.g is pythia sufficient to simulate every SU(N) model we can think of? If not, how to develop it further?

An initial wishlist

- Comparison of benchmarks currently used at the LHC
  - SUSY/MET searches (monojet-like, MET+cascades...)
  - Prompt dark jets model
  - Semi-visible jets
  - Emerging jets
  - Trackless/displaced jets (primarily applicable for neutral LLPs)
- What theory models lead to maximum overlap between different signatures?
  - Maybe not all signatures are in the same model, so one can try and understand excesses at the LHC that appear in only one or two of the signatures and guide further studies more along those models
- This is an initial possibility - we have scope for expansion within and beyond snowmass

Action items

- Collect public model repositories - collaborative aspect of making models public
- Find common information that exists already in the various collaborations (generator level, can be shared by ATLAS/CMS)
- Pick up one model per group of people
  - Start with a model, create model files
  - Validate the model (recreate elementary plots, check behaviour of BR/cross-sections)

Action items

- Pick up one model per group of people
  - Understand the signature (even without a detector)
    - Define a set of plots that would show a certain signature
      - Eg lifetime of heavier bound states (constituents of the jet)
      - Invisible fraction of the jet constituents (R_inv)
      - Invariant mass of the 2 jets in s-channel
      - Kinematic plots (also t-channel: MT…)
  - Understand the DM phenomenology (includes relic density generation mechanisms, direct/indirect limit calculations, astrophysical probes if applicable)
  - Find common parameter values across the different models
  - Share information with each other publically

Timeline/possible outcomes

- We have setup github repository and will create shared documents to centralise resources
- We begin with collecting existing public information
  - A common github community is created here, feel free to link/commit your model files in the repository - see next slide
  - We will circulate a common google document to be populated with github repositories/model files/relevant pheno studies → it will be also mirrored in a git page
- Link to our LOI is here
- Link to previous joint EF09/10 meeting is here
- Mailing list <<dark-showers-snowmass21>> can be subscribed to via e-groups.
- Timeline:
  - We should aim at first draft of white paper around May 2021
  - Submission deadline is end of July 2021

Github info & structure

We are a “community” → send Caterina/Suchita your GitHub username and you’ll be able to commit

Anyone can commit individual Git “projects”, along the following lines:

- New model cards: add them to a directory in the `models-repository` project
- New RIVET/ROOT/Delphes/... analyses: make a new project and call it `analysis-[tool]-[description]`
- Whitepaper(s): make a new project and call it `whitepaper-[description]`
- Documentation / HOWTOs: make a new project and call it `documentation-[description]`
  - Ask Caterina if you’d like to do this - there are nice solutions!

Documentation is important: a great achievement of this effort would be to have others be able to run our models/code, so we can start with that mindset. Also, pure documentations projects are welcome!

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