

Searching for long-lived particles at the LHC: Fifth workshop of the LHC LLP Community

27-29 May 2019
CERN

Re-interpretations WG

Summary

Convenors: Nishita Desai, Sabine Kraml, Andre Lessa

Goal

Determine what the search results mean for a model *different* from the benchmark used by the experimental analysis

Activity

- 1 A tutorial on what it means to “re-interpret” a result; illustrated using Displaced Vertex analysis
- 2 Discussion on how to collect personal re-interpretation codes and make them visible
- 3 Overview of new analysis and an evaluation of what information is available to theorists

GitHub.com/llprecasting

GitHub, Inc. [US] | https://github.com/llprecasting/recastingCodes

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A collection of public codes for recasting long-lived particle searches Edit

Manage topics

3 commits 1 branch 0 releases 1 contributor

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andlessa Updated README	Latest commit f9bca4f 30 minutes ago
DisplacedVertices Added first recasting code	an hour ago
HSCPs/CMS-EXO-12-026 Added first recasting code	an hour ago
README.md Updated README	30 minutes ago

README.md

LLP Recasting Repository

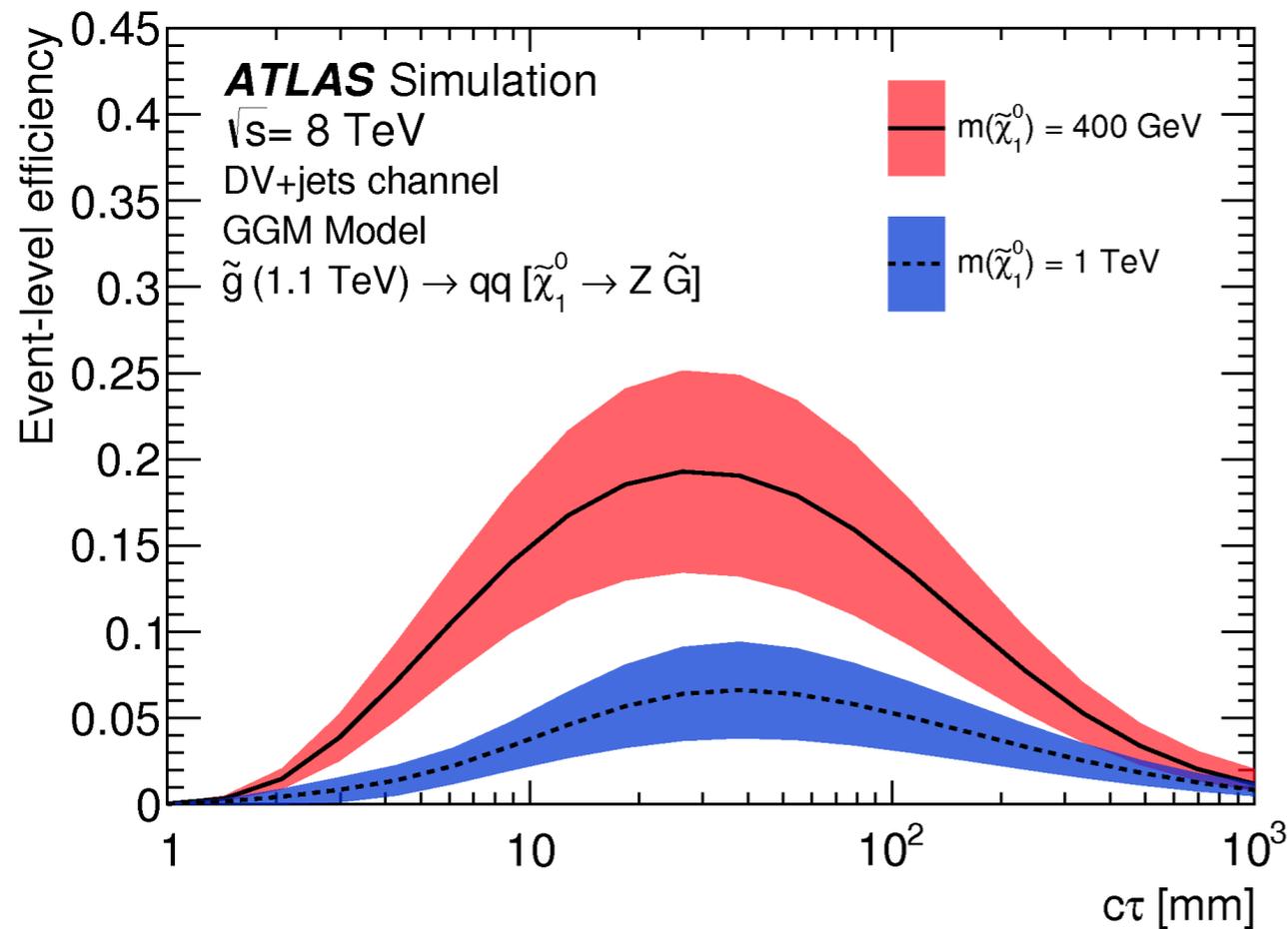
This repository holds example codes for recasting long-lived particle (LLP) searches. The code authors and repository maintainers are not responsible for how the code is used and the user should use discretion when applying it to new models.

Please contribute your code. Send an email to llp-recasting@googlegroups.com

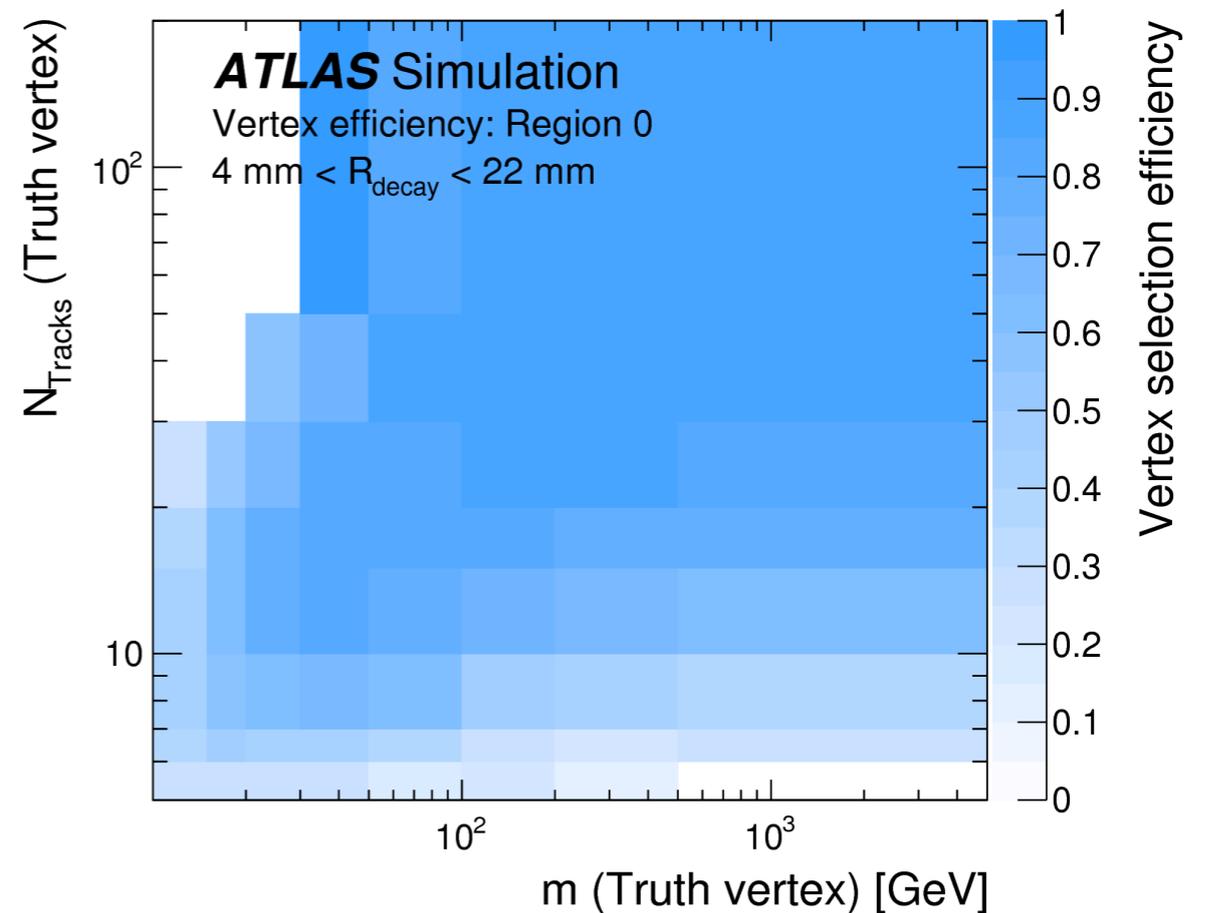
Include a README with citation to your paper to be used by anyone who uses your code.

Simplified model vs object-level efficiencies

Example: two versions of ATLAS DV + jets analysis



Phys. Rev. D 92, 072004 (2015)



Phys. Rev. D 97 (2018) 052012

Status of the new analyses

Likelihoods

Search	arXiv
Delayed Jets	EXO-19-001
Disappearing Tracks	SUS-19-005
Displaced Jets	1811.07991

Material	Simplified	Object	HepData
✓	✓	(✓)	✓

Search	arXiv
Highly ionizing particles/monopoles	1905.10130
Disp (& prompt) heavy neutral leptons	1905.09787
Displaced hadronic (CalRatio) jets	1902.03094
Heavy charged LLPs	1902.01636
Displaced vertex + displaced muon	CONF-2019-006
Multi-charged LLPs	1812.03673
Muon vertex	1811.07370
Z + Displaced hadronic (CalRatio) jet	1811.02542

Material	Simplified	Object	HepData
✓	✓	(✓)	
✓	✓		
✓	✓		
✓	✓	✓	✓
✓	✓		✓
✓	✓		✓
✓	✓		✓

dE/dx cut

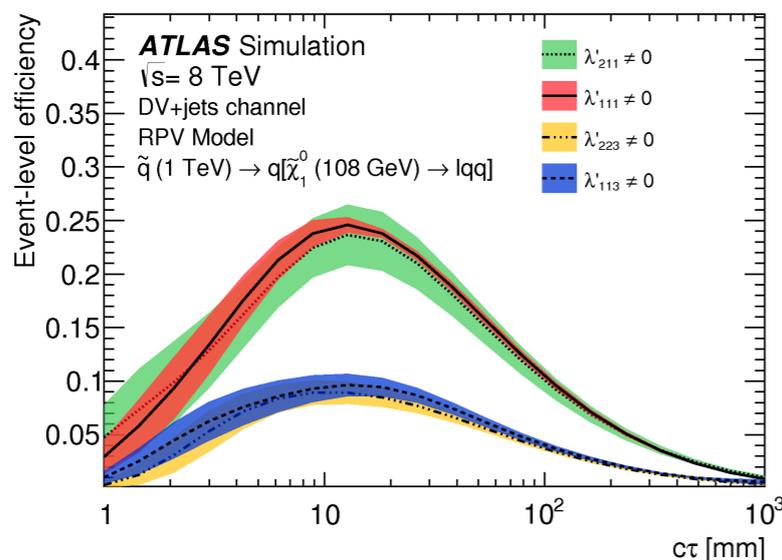
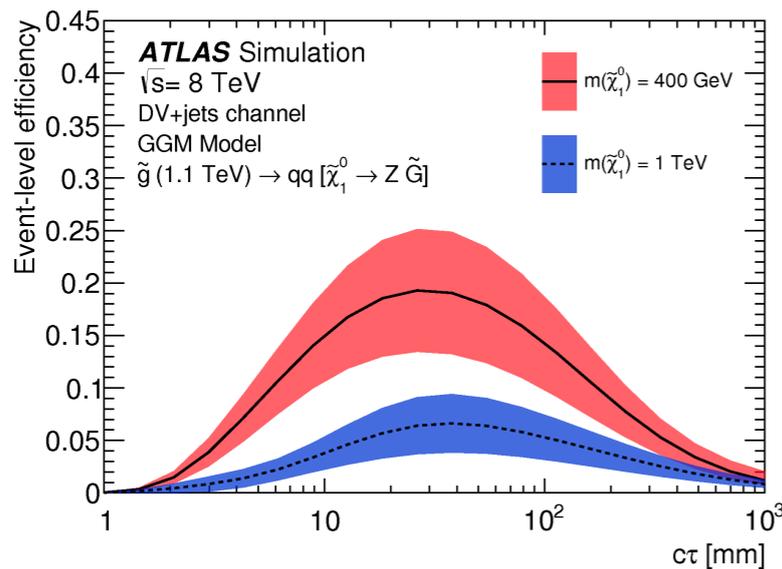
Provide efficiency tables

How can theorists use your efficiency parametrisation for signal model different from your benchmark?

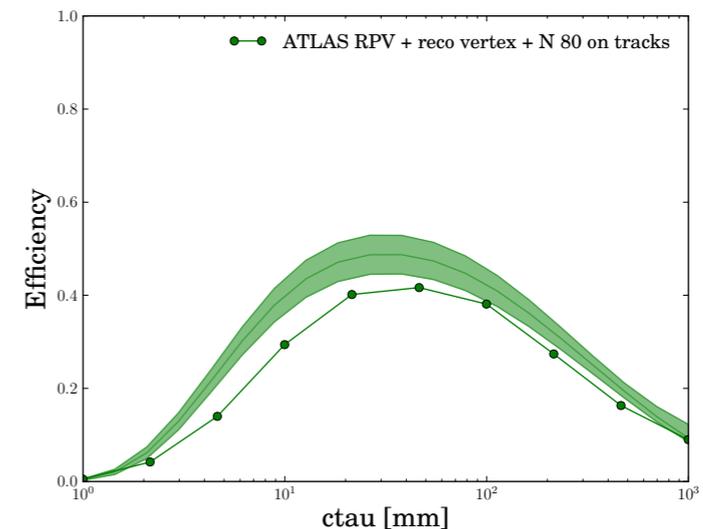
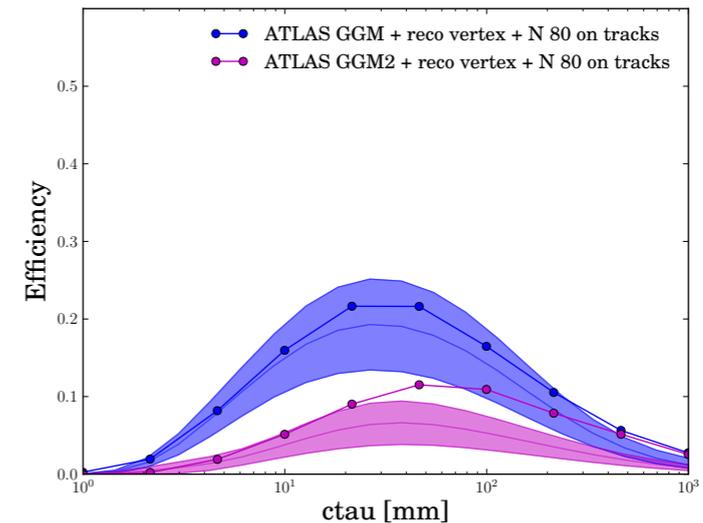
- Provide efficiency tables for more than one benchmark scenario + different masses / splittings
- Mention “hidden” requirements (e.g. isolation, what happens if there are extra prompt jets or leptons in the event?)
- If possible, provide efficiency in terms of particle kinematic properties (e.g. p_T , η , production or decay r/z , d_0) rather than theory parameters like masses & proper lifetime. *This can be more conservative than what you actually did (e.g. use fiducial volume rather than all of detector and provide a multiplicative efficiency factor.)*

Example of why only simplified model efficiencies are not enough

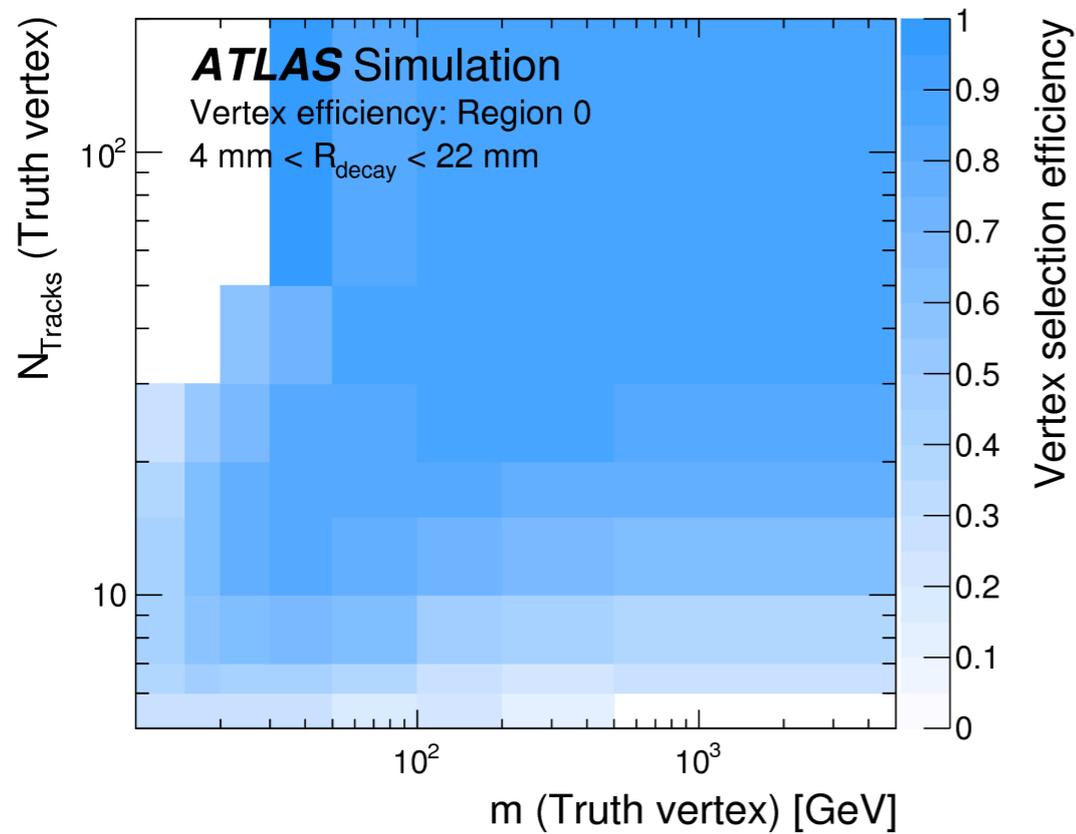
Using different simplified model efficiencies from the same study gives different exclusions (for a model that different from the benchmark).



Define your own efficiency function

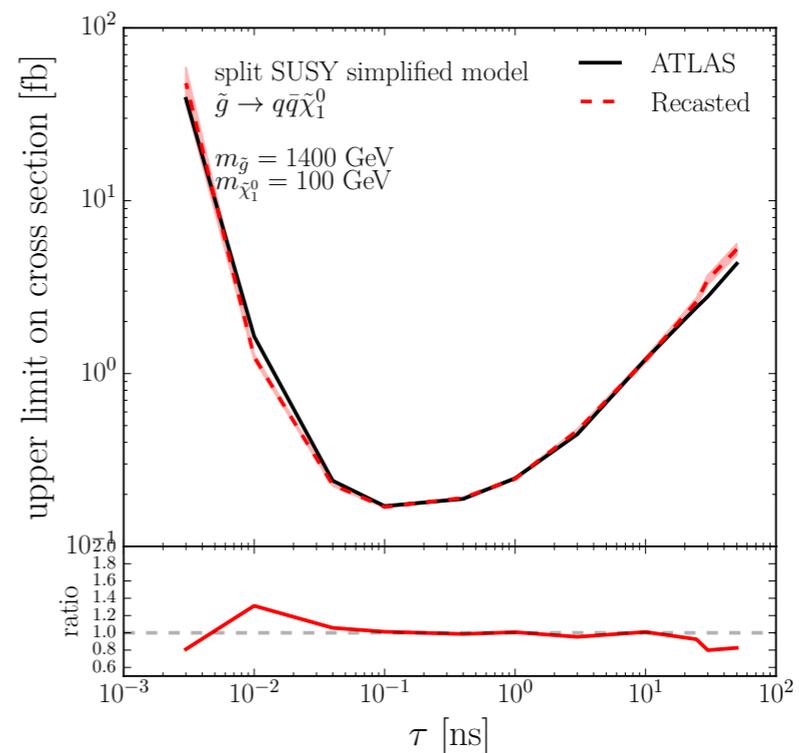
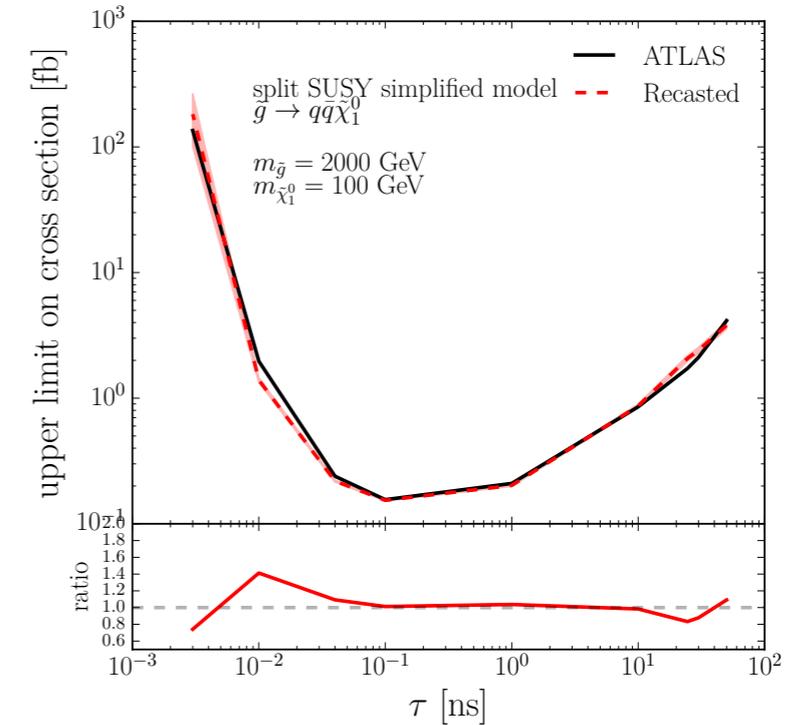


Example of providing object-level efficiencies in fiducial region



Phys. Rev. D 97 (2018) 052012

Would have been good to have a different benchmark model to also validate against.



Reinterpretation by G. Cottin. & A. Lessa

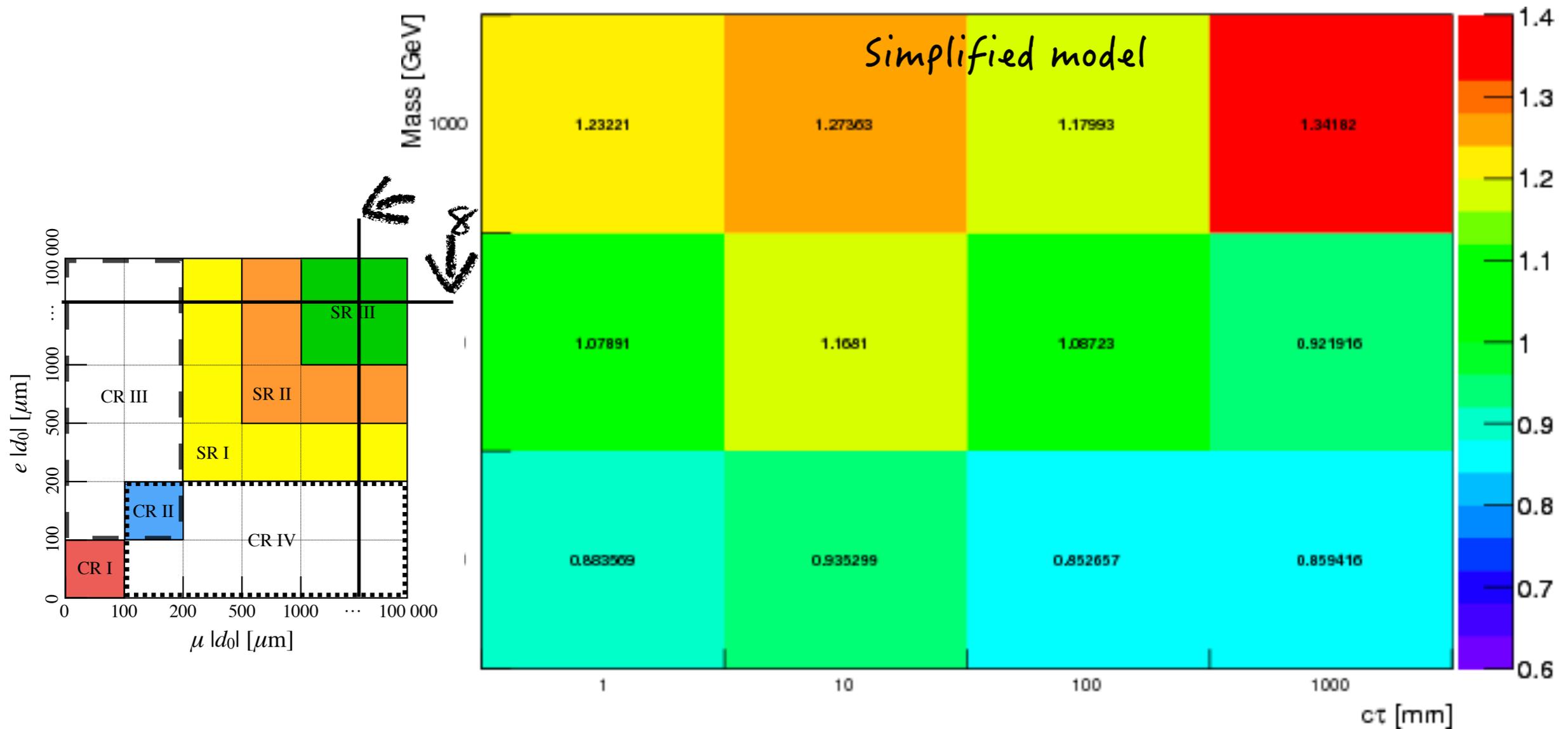
Providing Information for Reinterpretation

**How to ensure what you provide is usable:
Perform a “closure test”**

- Determine what level is appropriate for providing efficiencies (e.g. generator-level, generator + basic reconstruction + smearing a.k.a Delphes, Fastsim etc.)
- Publish your benchmark model, parameters, name the codes and version used (e.g. publish UFO, param cards to be used with Madgraph version xxx)
- Publish how well this setup reproduces limits in the different benchmark points (ideally $\sim 10\%$).

Example of a closure test

CMS displaced leptons; Phys. Rev. Lett. 114, 061801 (2015)



What can we (re-interpreters) do?

1. Take a look at your benchmark model and **suggest a complementary model** to validate efficiencies
2. Tell you how well your simplified model translates to other models
3. Tell you if the efficiency parameterisation you've chosen **can be used** by theorists or there is too much missing information
4. Tell you **what additional information would be necessary** to use your search for reinterpretation.
5. For a simplified model based study, suggest model parameter choices that allow maximal interpolation of efficiencies to encapsulate kinematic effects

If you would like to ask what information is needed or if the information you're planning to provide is useable, you can send an email to llp-recasting@googlegroups.com

We don't need to see your data or the details of your analysis

To theorists or experimentalists who have done a reinterpretation study and want to help, you are welcome to join the group, send us an email.