

key4HEP - Guinea Pig Report

Carsten Hensel, ILD Workshop 15/1/2024

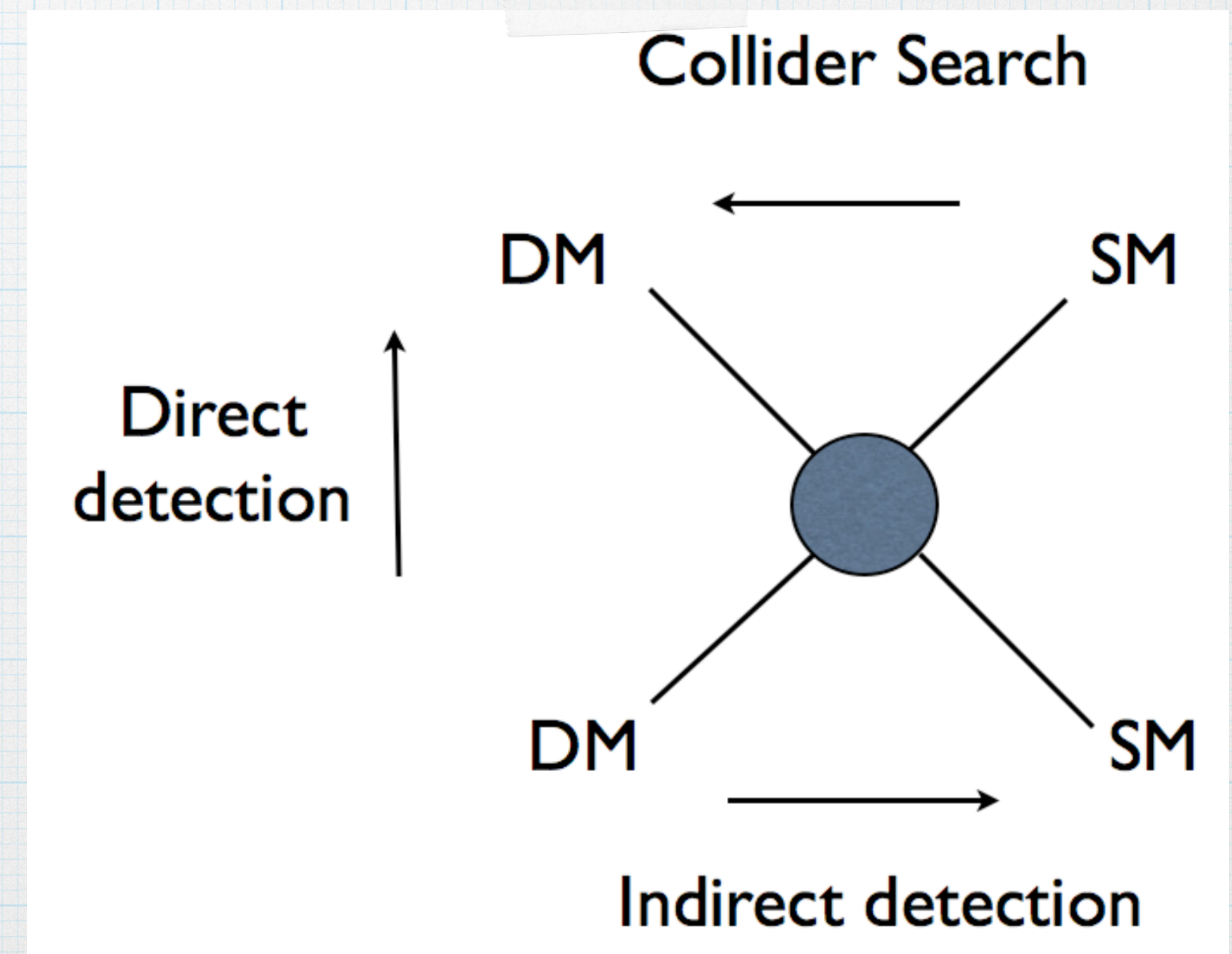


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Plans

- * Only invisible Higgs decay in SM: $H \rightarrow ZZ^* \rightarrow 4\nu$
- * BR is small: $\sim 0.1\%$
- * If size-able invisible Higgs decays found: sign for physics beyond SM
 - * e.g. Higgs Portal Model connects SM and DM
 - * $SM \rightarrow H \rightarrow \chi\chi$ (and χ invisible)
 - * (DM candidate χ : scalar, fermionic or vectorial)
- * Set up an analysis in key4HEP for Higgs to invisible.
 - * Put key4HEP (Gaudi) through the wringer



Disclaimer

- * I'm a key4HEP novice.
- * This is not a full-time project of mine.



key4HEP

- * Software stack that connects and extends individual packages towards a complete data processing framework for detector studies

- * Fast/full simulation

- * Reconstruction

- * Analysis

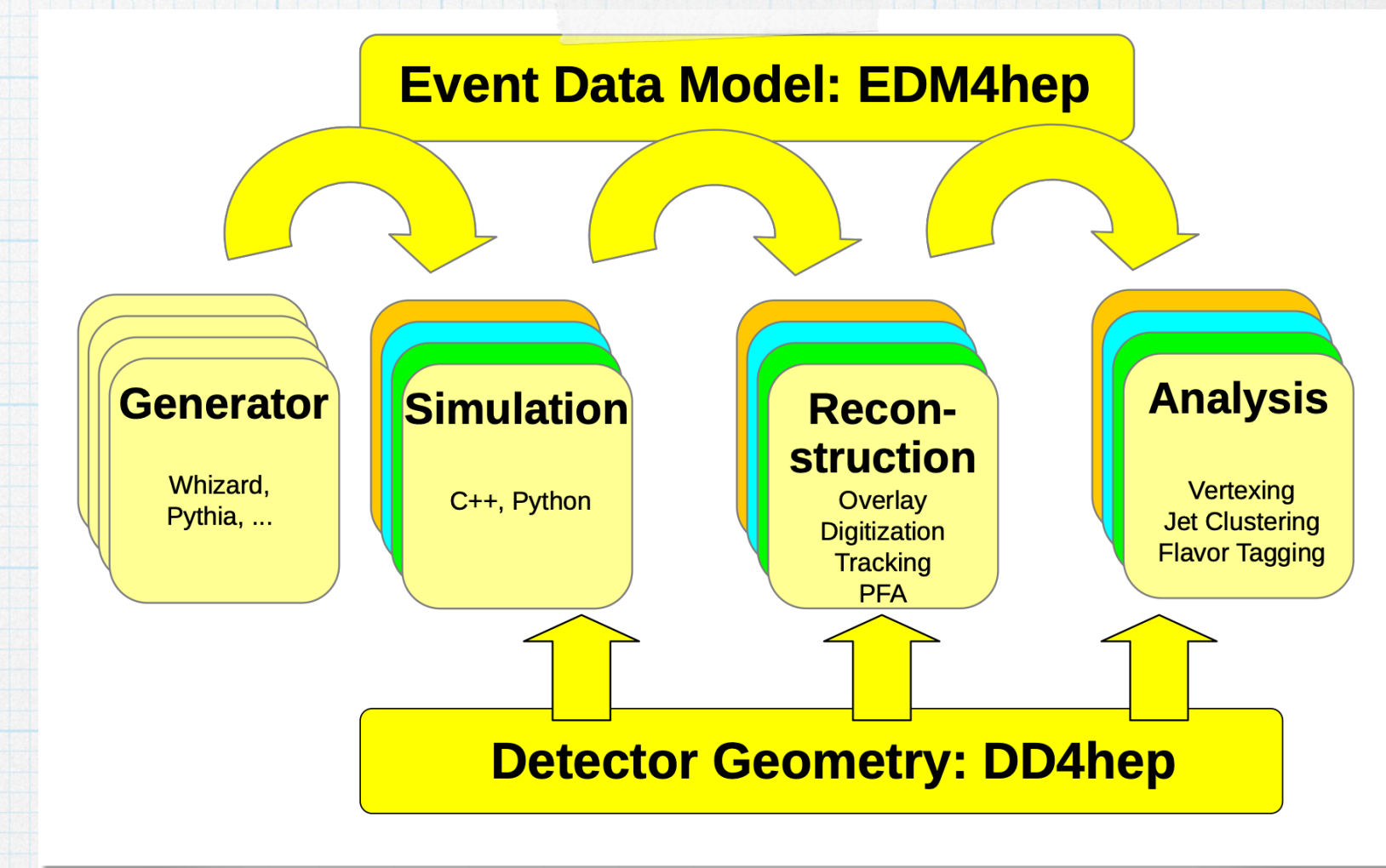
- * Ingredients

- * Event data model: **EDM4hep**

- * Geometry information: **DD4hep**

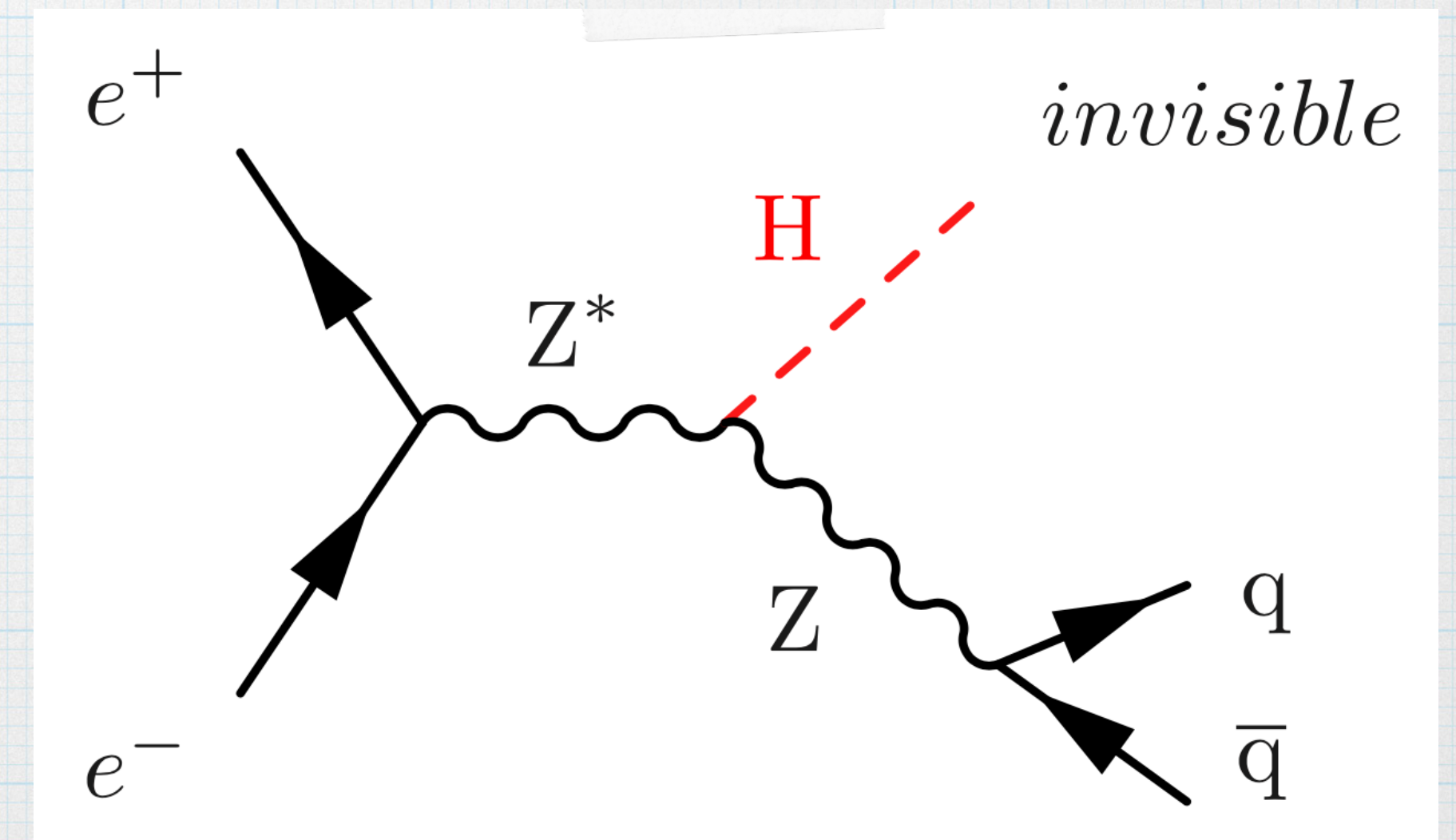
- * Framework: **Gaudi**

- * Packaging and deployment: **Spack**



Analysis Shopping List

- * Forced two-jet reconstruction/two leptons required
- * Isolated lepton/jet veto
- * Z mass reconstruction from di-jet/di-lepton
- * ISR corrected recoil mass selection
- * Toy MC to set upper limit



More Analysis Details

- * MC files lcio files converted to EDM4hep **lcio2edm4hep**
- * **fastjet** (Marlin wrapper)
- * **IsolatedLeptonTagging** (Marlin wrapper)
 - * Identify all isolated leptons
- * **LeptonPairing** (Marlin wrapper/Gaudi Algorithm)
 - * Select Z pair candidate
 - * Brems/FSR recovery

k4MarlinWrapper runs
Marlin processors
As Gaudi algorithms.



Proven To Work

- * Usage of **lcio** files in Gaudi ✓
- * 'Gaudification' of Marlin processors (**Marlin wrappers**) ✓
- * Chaining **mixture** of Gaudi algorithms and Marlin wrappers ✓

Final Remarks

- * Assuming some experience with a framework expect a rather flat learning curve.
- * Using Gaudi is like putting together a Lego set.
- * Not everything has to be an algorithm!
- * If something doesn't work...
 - * First rule: look for a problem on your side.
 - * key4HEP developers are very helpful
- * Documentation needs a revision