Potential contributions

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bringing also expertise by
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• Detector design is driven by physics requirements and the experimental environment

• Detector optimisation and the development of full simulation software are closely connected

• We have experience in these areas from the CLIC (and FCC) detector studies → examples on the following slides

• Depending on available resources and structured involvement of the CERN EP department, including dedicated funding for students and fellows, we would be willing to take a role in setting this up for the muon collider

• Too early for dedicated detector R&D (also needs better understanding of specific requirements)
Software and computing

Current CLIC software chain:
- Marlin framework
- LCIO event data model
- Whizard 2 and other MC generators
- DD4hep detector description
- Cellular automaton in conformal space for track finding
- Calorimeter clustering and particle flow analysis: PandoraPFA
- Flavour tagging and optimised jet clustering
→ Already being used for the muon collider studies

Development of Key4hep:
- Low-maintenance common stack for future collider studies
- Gaudi framework
- EDM4hep/PO Dio event data model
- CLIC / linear collider reconstruction tools will be ported

Distributed computing with iLCDirac:
- High-level interface between users and distributed resources
- Automated MC production system
- Setup dedicated VO for muon collider studies?

\[
u = \frac{x}{x^2 + y^2} \\
v = \frac{y}{x^2 + y^2}
\]


from DIRAC.Core.Base import Script
Script.parseCommandLine()
import UserJob, Marlin, DiracILC
d = DiracILC()
j = UserJob()
j.setOutputData("recEvents.slcio")
m = Marlin()
m.setVersion("ILCsoft-01-17-09")
m.setInputFile("Steering.xml")
j.append(m)
j.submit(d)
**CLIC detector optimisation**

**CLICdet**: CLICdp-Note-2017-001, arXiv:1812.07337  
→ examples on this slide

**CLD** (variant for FCC-ee): arXiv:1911.12230

**Optimisation of FCC-hh detector using CLIC software**:  
LCD-Note-2018-001, LCD-Note-2018-002, LCD-2018-003
**Event Reconstruction and benchmark analyses**

**CLIC and the muon collider share a common energy stage at 3 TeV**
→ muon collider could benefit from CLIC experience with reconstruction challenges such as:

- **Beam-induced backgrounds** to be mitigated through combination of detector design and analysis techniques

- The **forward direction** becomes increasingly important with rising energy

- **Hadronic final states** are crucial as the EW production cross sections are small → needs good jet energy resolution in the presence of backgrounds

- **b-jets at high energy** (large secondary vertex decay lengths, very collimated b- and c-hadron decay products)

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Thank you!

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Higgs: EPJ C 77, 475, 2017
Top-quark: JHEP 11, 003, 2019
New physics: CERN-2018-009M