

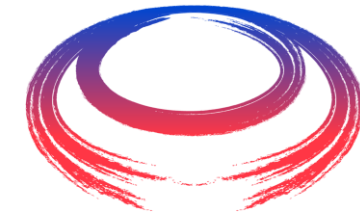
# New physics and hidden sectors at Muon Collider

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on behalf of the International Muon Collider Collaboration



HEP2023  
HAMBURG



International  
MUON Collider  
Collaboration



MuCol

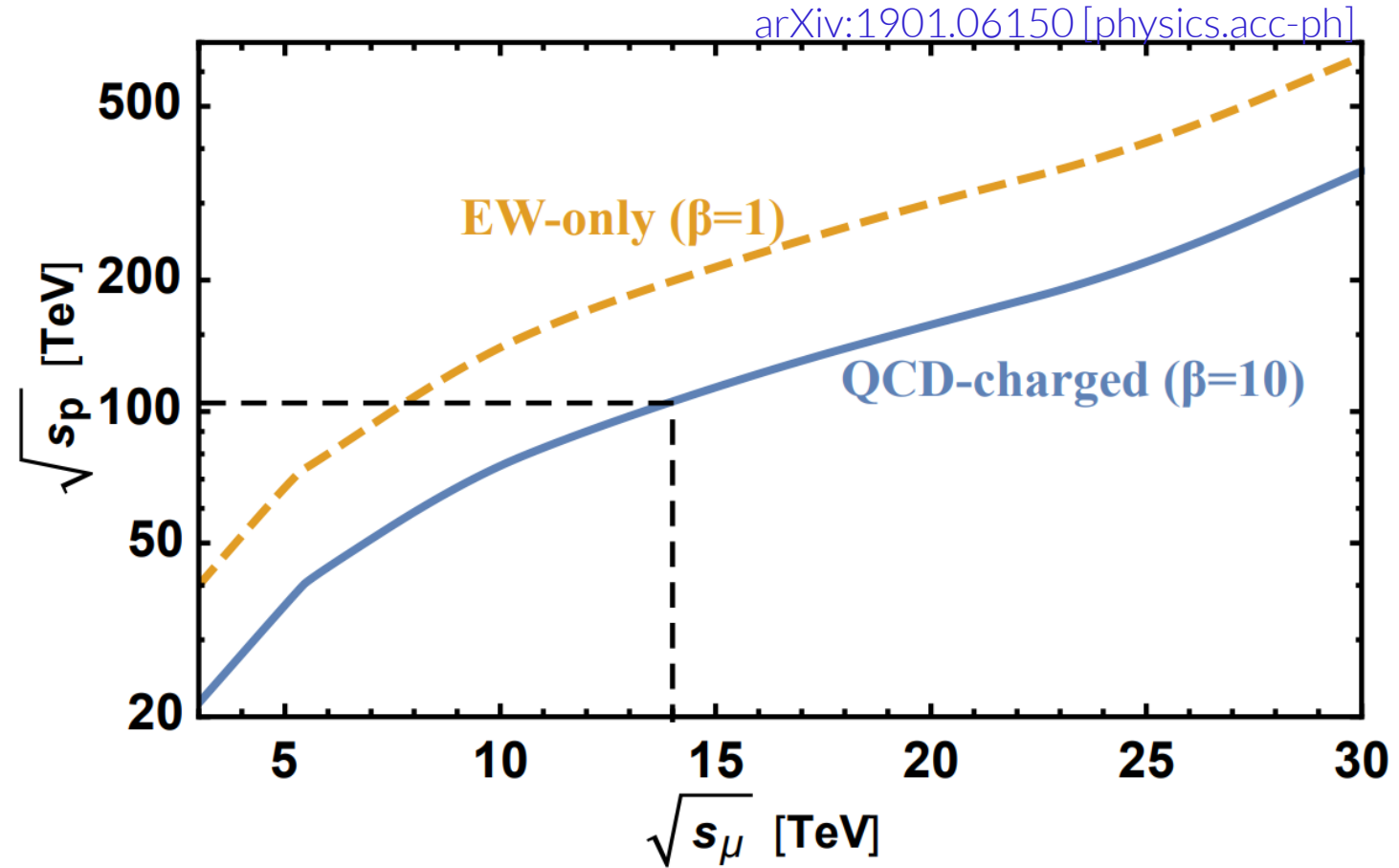
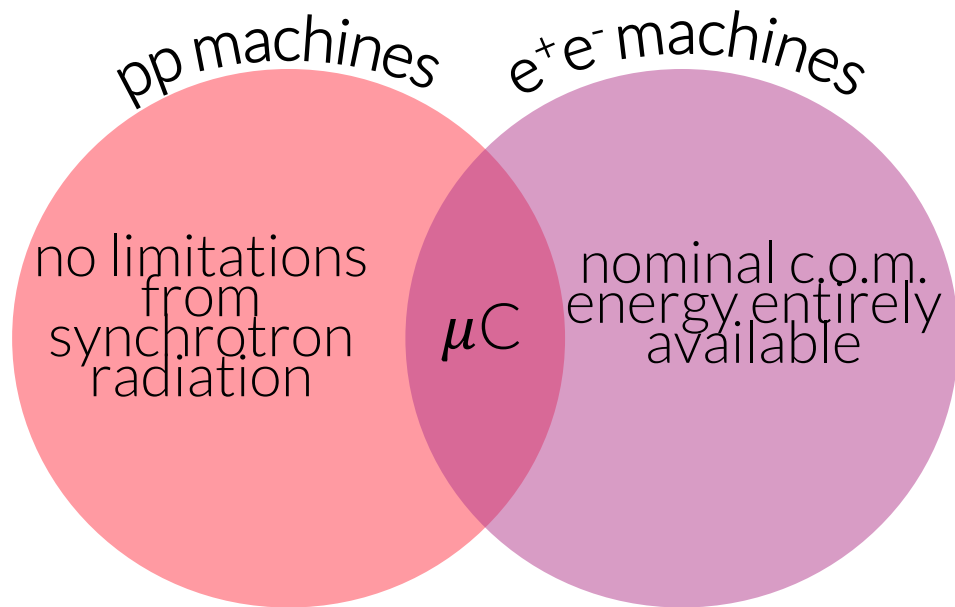


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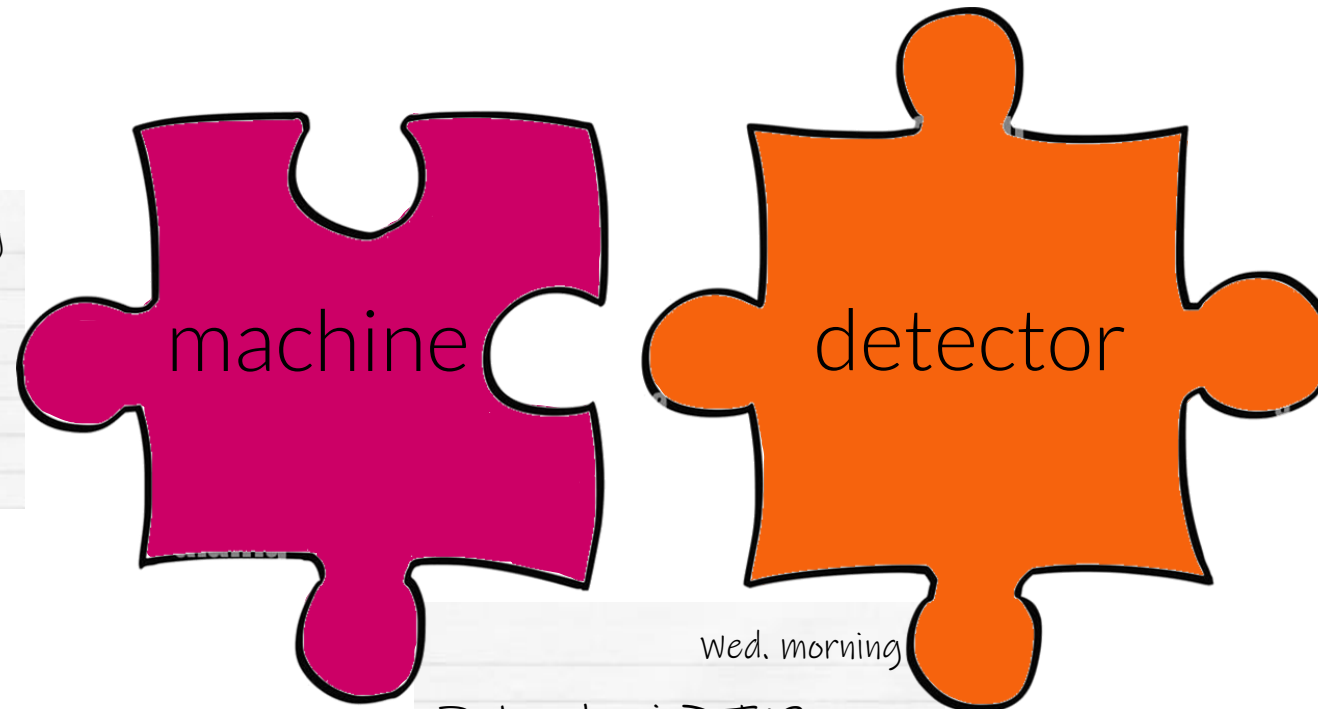
# Muon Collider potential



# Technological challenges

	3 TeV	10 TeV	14 TeV
luminosity	$1.8 \cdot 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$	$2 \cdot 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$	$4 \cdot 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$
# bunches	$2.2 \cdot 10^{12}$	$1.8 \cdot 10^{12}$	$1.8 \cdot 10^{12}$

$$L_{\text{int}} = 10 \text{ ab}^{-1} \left( \frac{E_{\text{cm}}}{10 \text{ TeV}} \right)^2$$



Wed. morning  
 K. Skoufaris @T13  
 Status of the international Muon Collider complex study at 10 TeV

Wed. afternoon  
 L. Sestini @T12  
 R&D towards the detector of a Muon Collider

Wed. morning  
 D. Lucchesi @T13  
 Machine detector interface for a multi-TeV Muon Collider

# Physics reach

## Direct searches

pair production  
resonances  
VBF  
dark matter

## High-energy measurements

single Higgs  
self coupling  
exotic Higgs decays  
top quarks

## High-energy probes

di-boson & di-fermion  
tri-boson  
EFT  
compositeness

## Muon physics

lepton flavor universality  
muon  $g-2$   
 $b \rightarrow \mu\mu s$

Thur. morning

M. Casarsa @T09

Higgs physics prospects at Muon Collider with detailed detector simulation

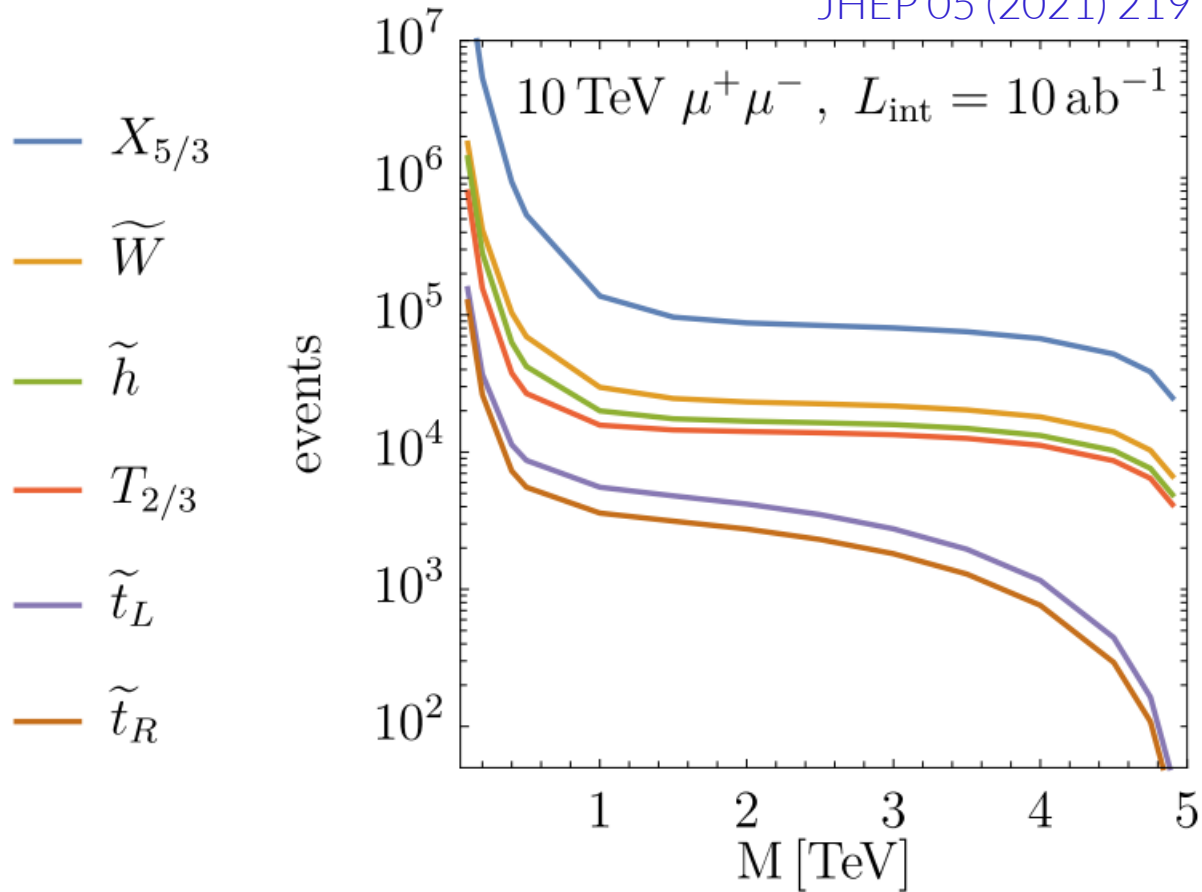
Soon after

F. Meloni @T10

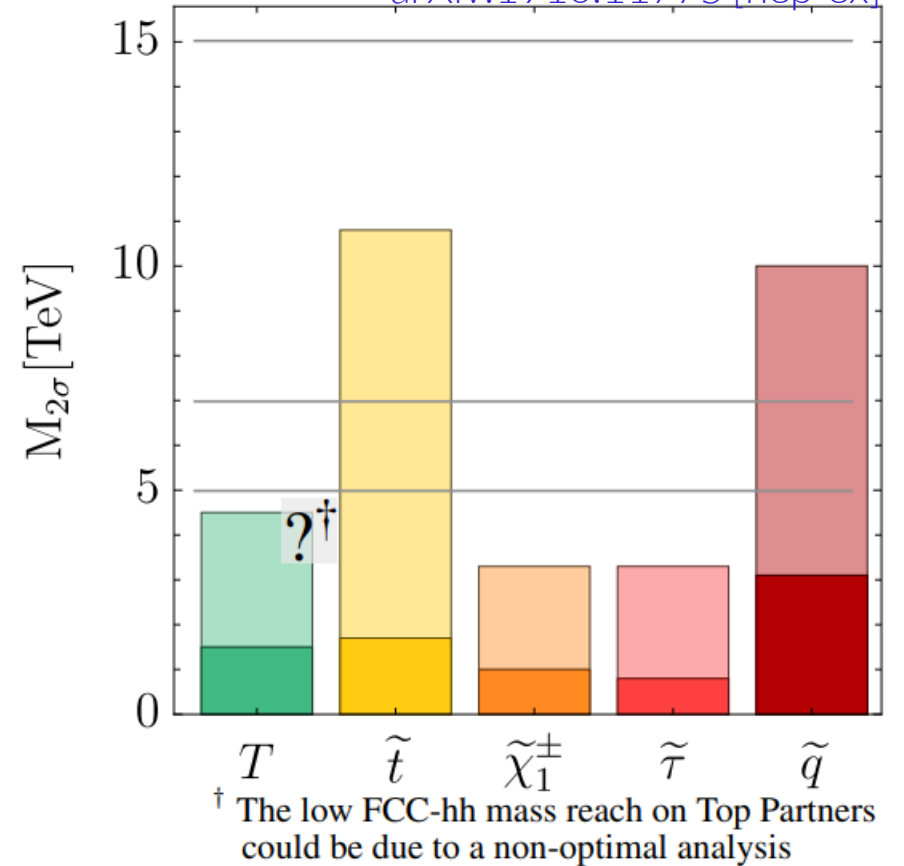
Detecting disappearing tracks and other exotica at a Muon Collider

# Direct search: beyond Standard Model

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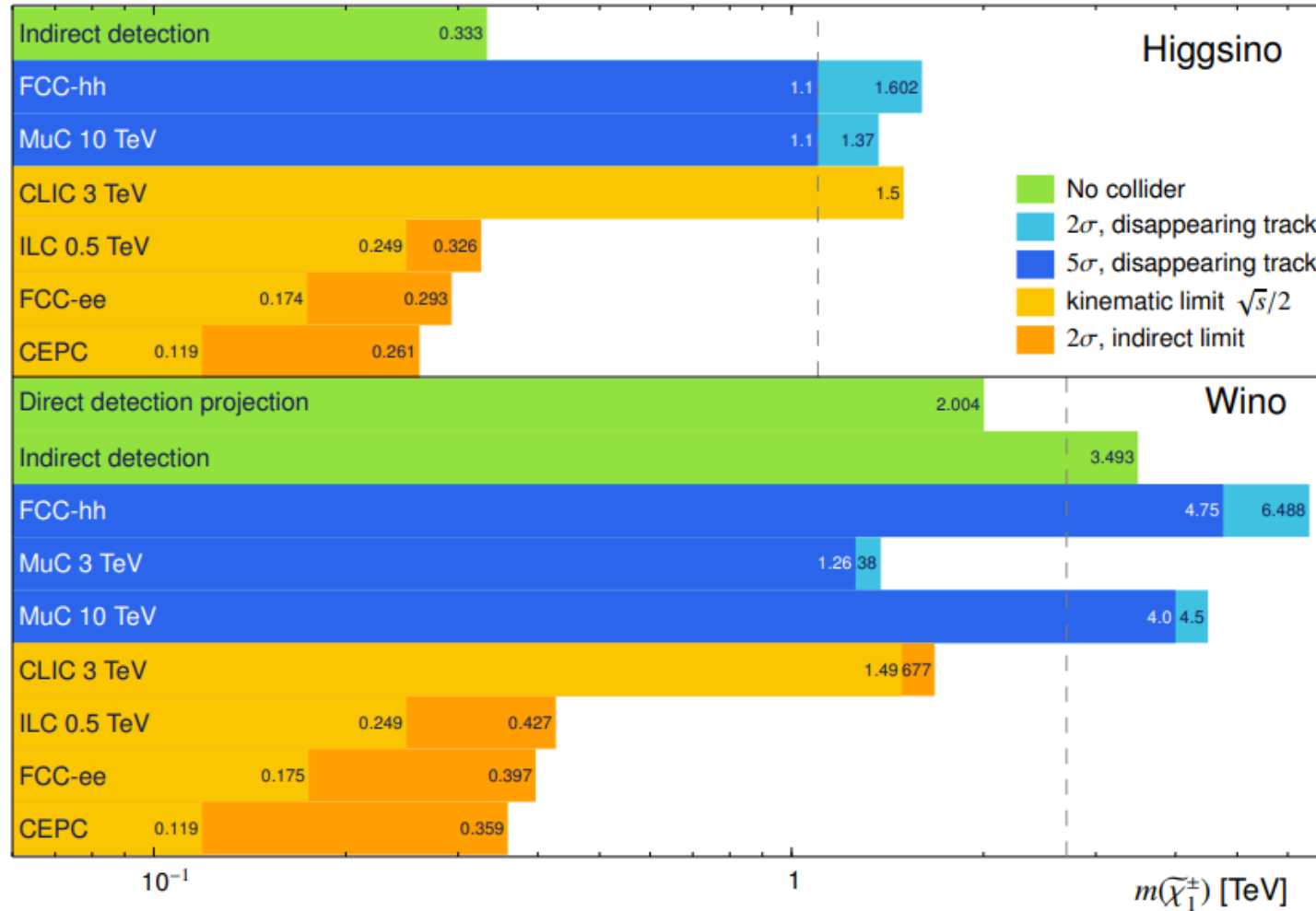
arXiv:1910.11775 [hep-ex]



- ❖ A 10 TeV  $\mu\text{C}$  can produce BSM particles abundantly
- ❖ The  $\mu\text{C}$  reach exceeds FCC-hh for many particles

# Direct search: dark matter

JHEP 06 (2021) 133

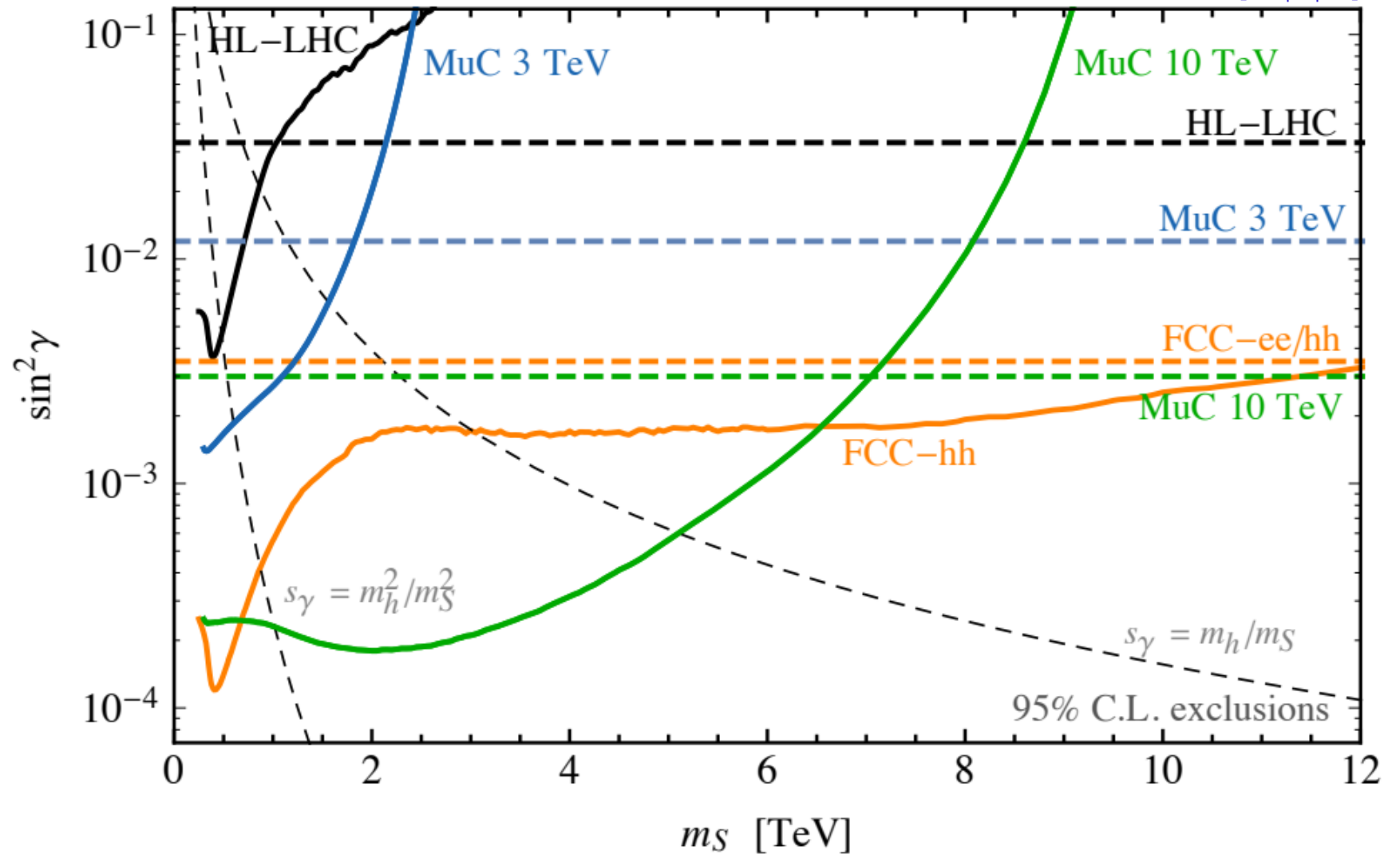


❖ A 10 TeV  $\mu$ C reaches the thermal mass

# Direct search: VBF

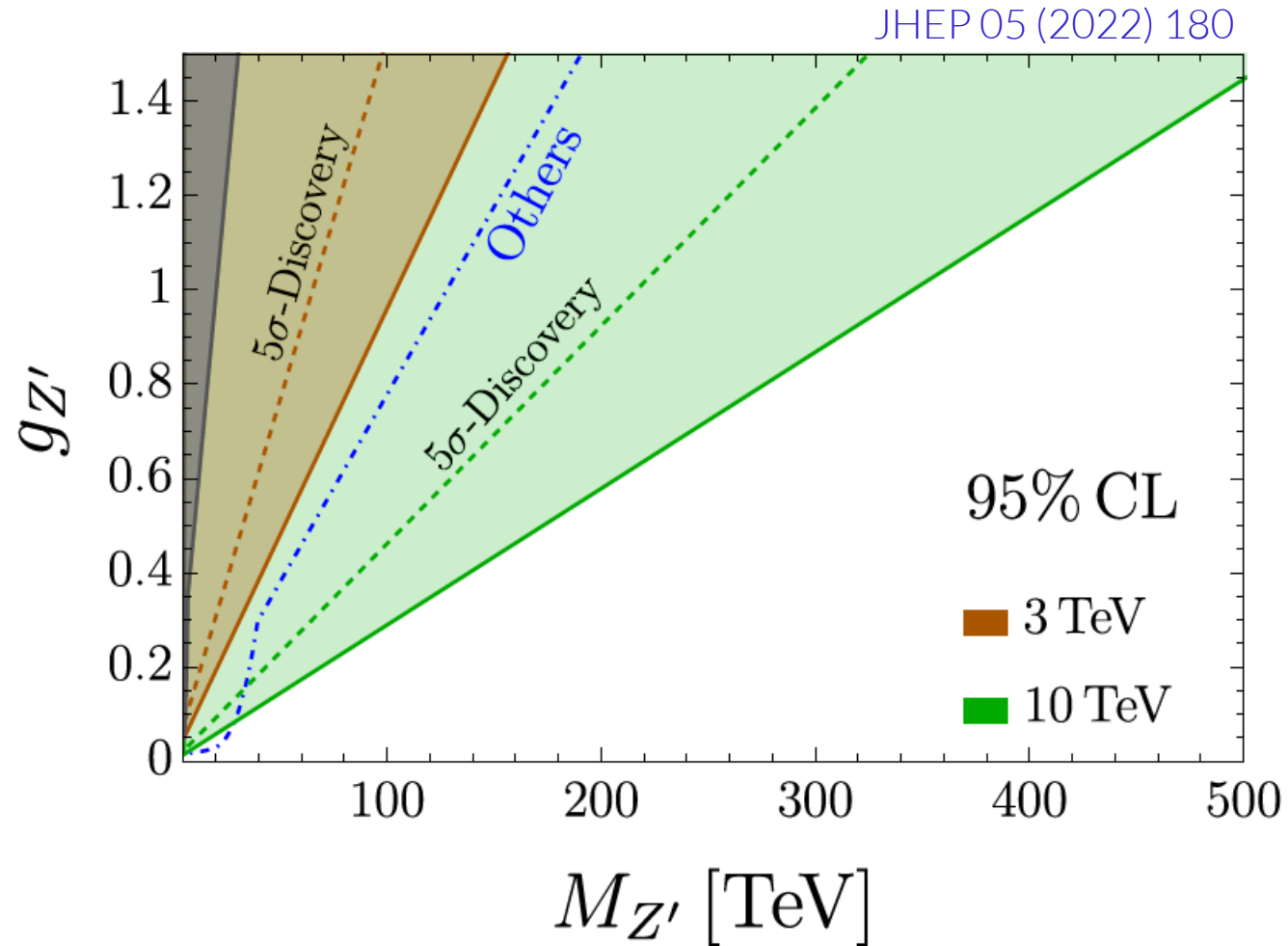
arXiv:2103.14043 [hep-ph]

Benchmark model:  
real scalar singlet with  
Higgs portal coupling



❖ A  $\mu$ C is extremely sensitive to VBF production

# High-energy probes: $Z'$

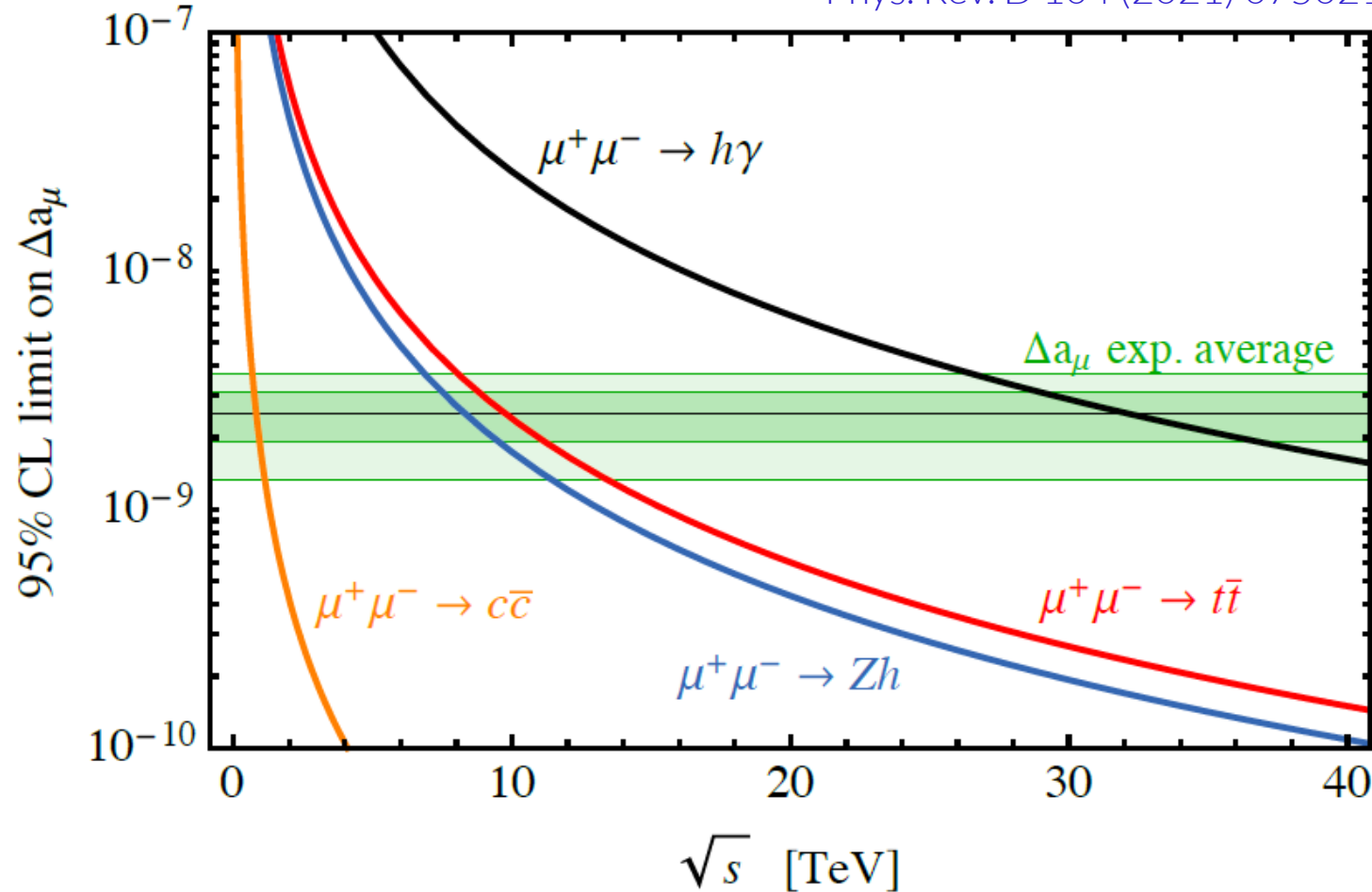


❖ In the simple benchmark  $Z'$  model the  $\mu\text{C}$  is superior to other future colliders



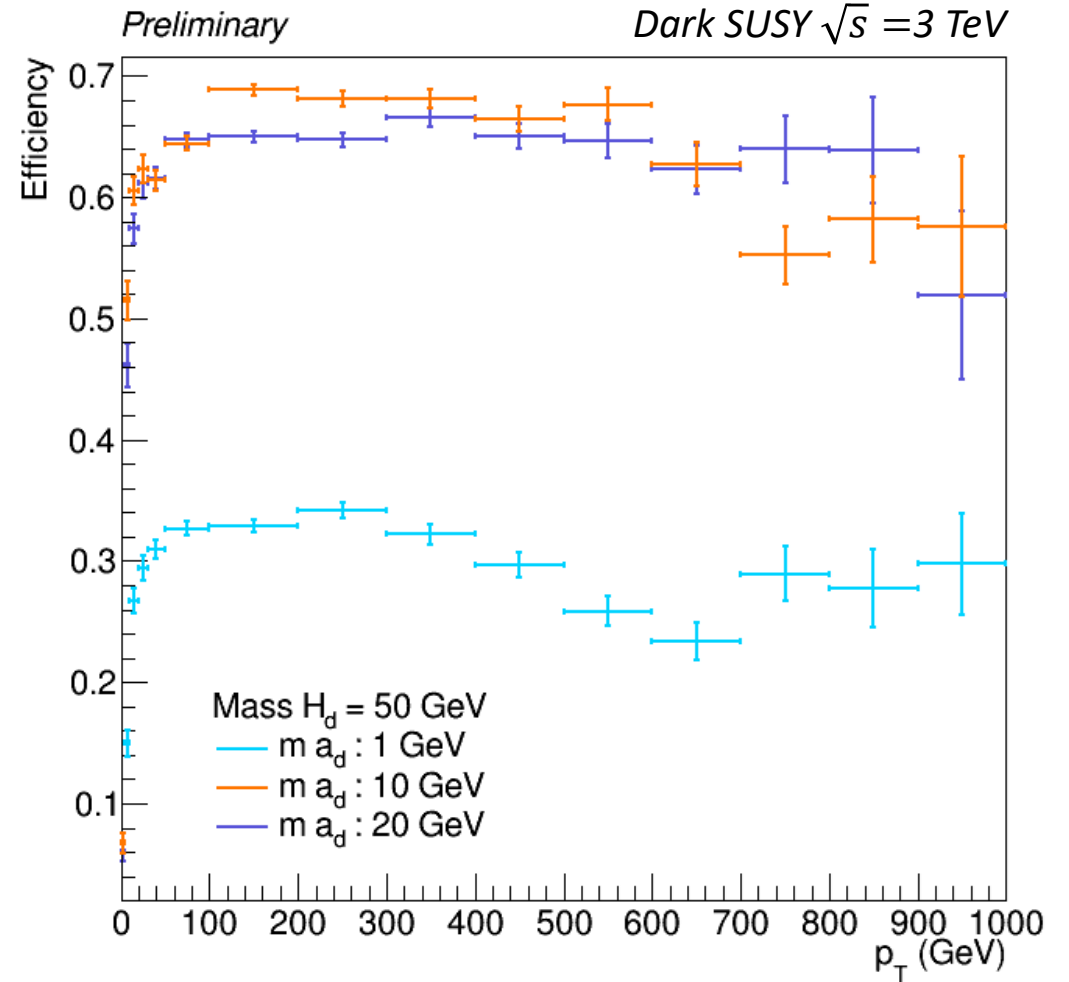
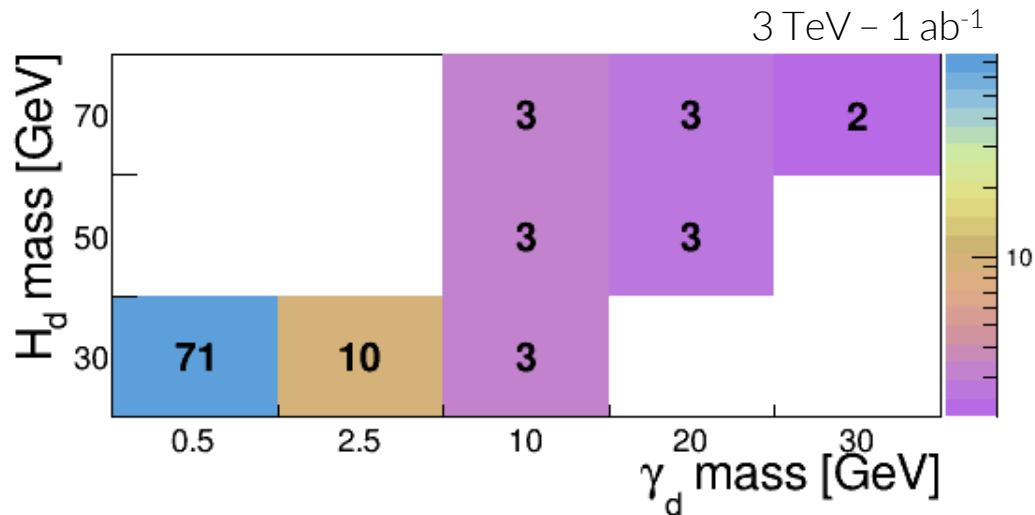
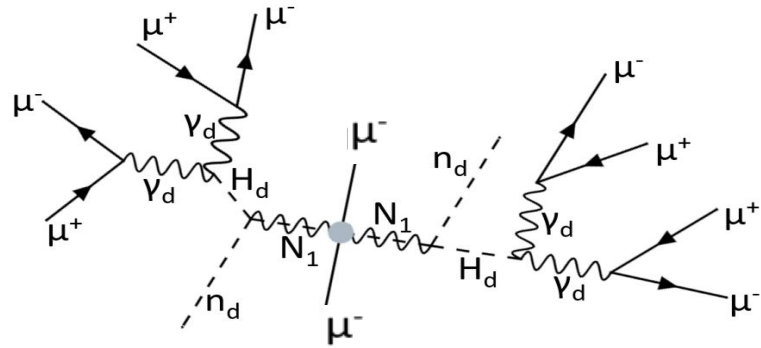
# Muon physics: g-2

Phys. Rev. D 104 (2021) 075021



❖ A 3 TeV  $\mu$ C can already provide hints on g-2 anomaly

# Hidden sectors



❖ Muon reconstruction is a challenge for new physics

# Conclusions

The  $\mu\text{C}$  pushes to face the technological challenges to reach an unprecedented physics potential

- BSM particles
- dark matter
- $g-2$  anomaly
- hidden sectors
- ....