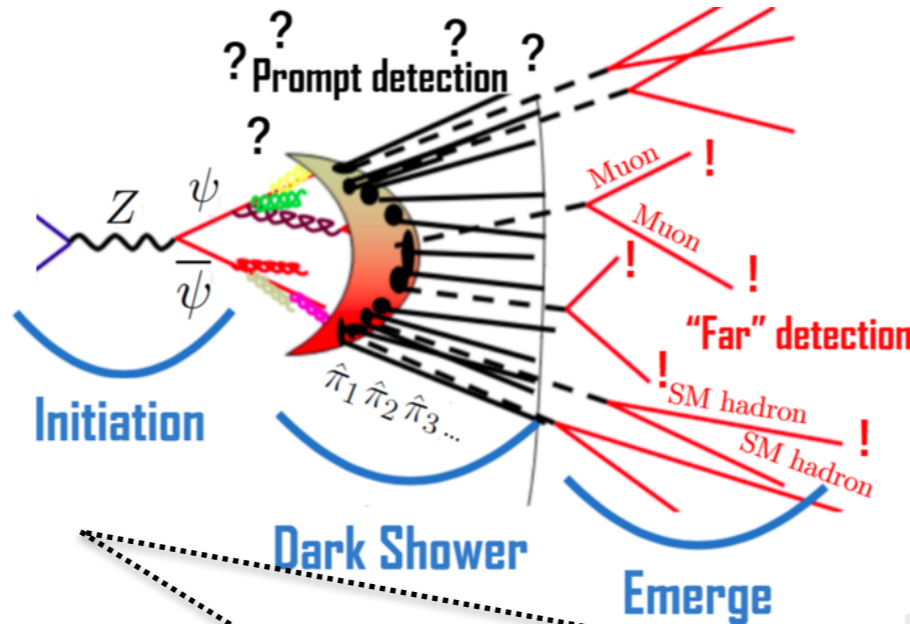
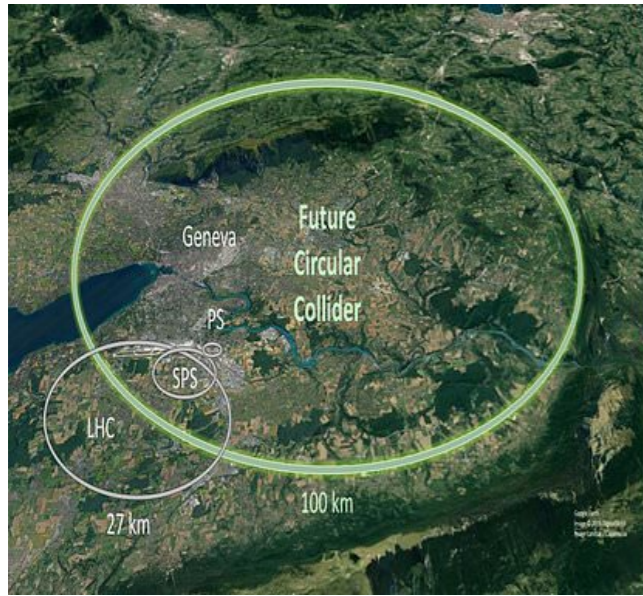


# Dark Showers From Z Portal

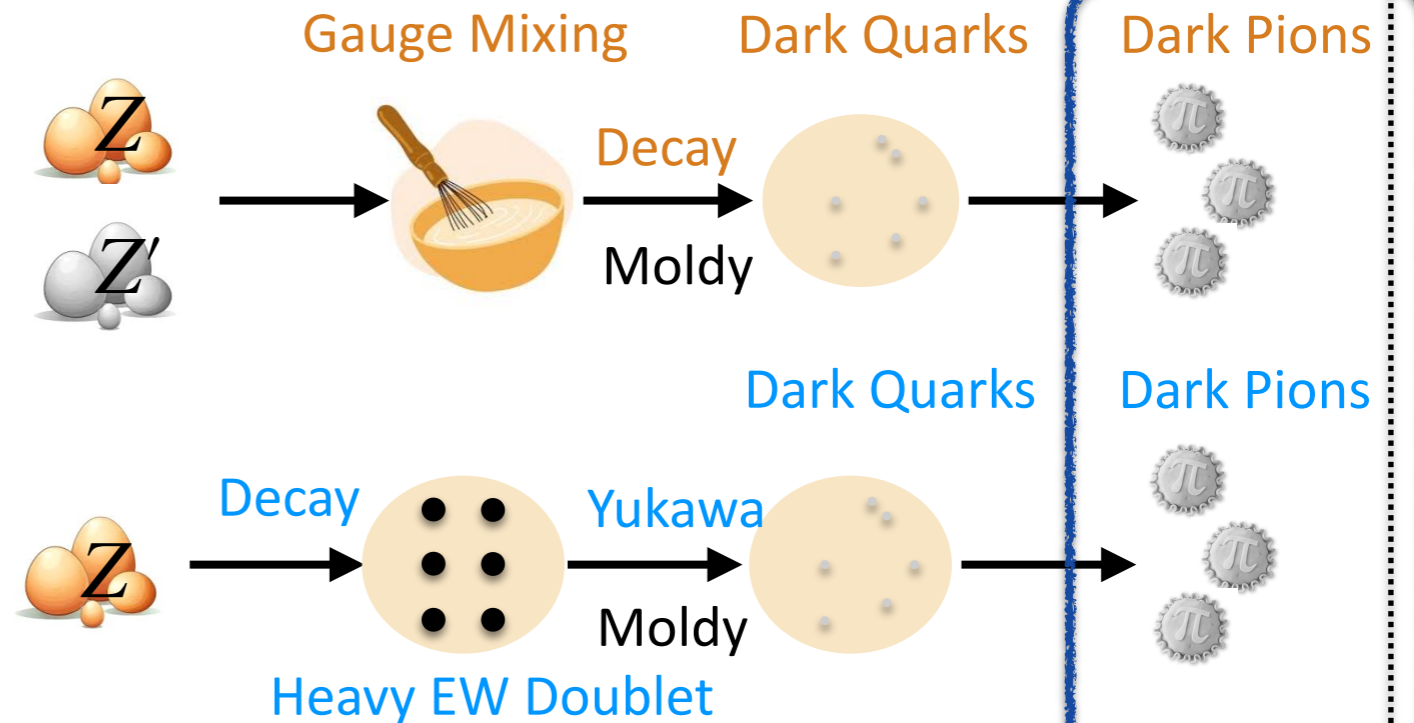


Based on:  
JHEP 04 (2024) 081,  
and, 2406.xxxx

## JIANG Xu-Hui

Long-lived

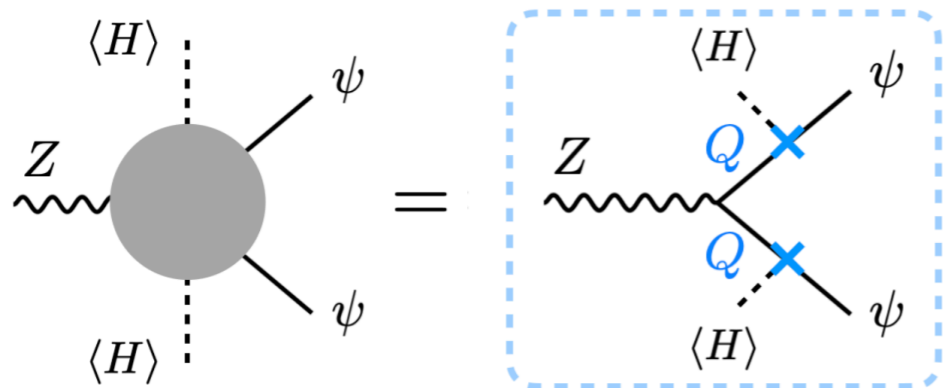
**F**utura **C**ulinary **C**ooker - **e**<sub>gg</sub> **e**<sub>gg</sub>



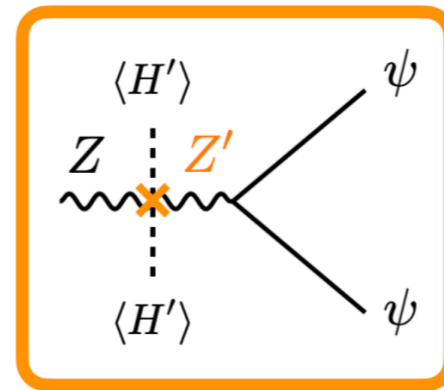
with:  
Hsin-Chia Cheng (Davis),  
Lingfeng Li (Brown), and,  
Ennio Salvioni (Padua and Sussex)

# Theory

- fermionic/gauge mixing



Cheng et al., *A theory of dark pions*  
arXiv:2110.10691 [JHEP 01 (2022) 122]



this work

EWPO bounds:  
 $m_\gamma < m_{Z'} < m_Z$

- dark showers:  $Z(Z') \rightarrow \bar{\psi}\psi \implies \hat{\pi}_1 \hat{\pi}_2 \dots$

BR of exotic Z decays

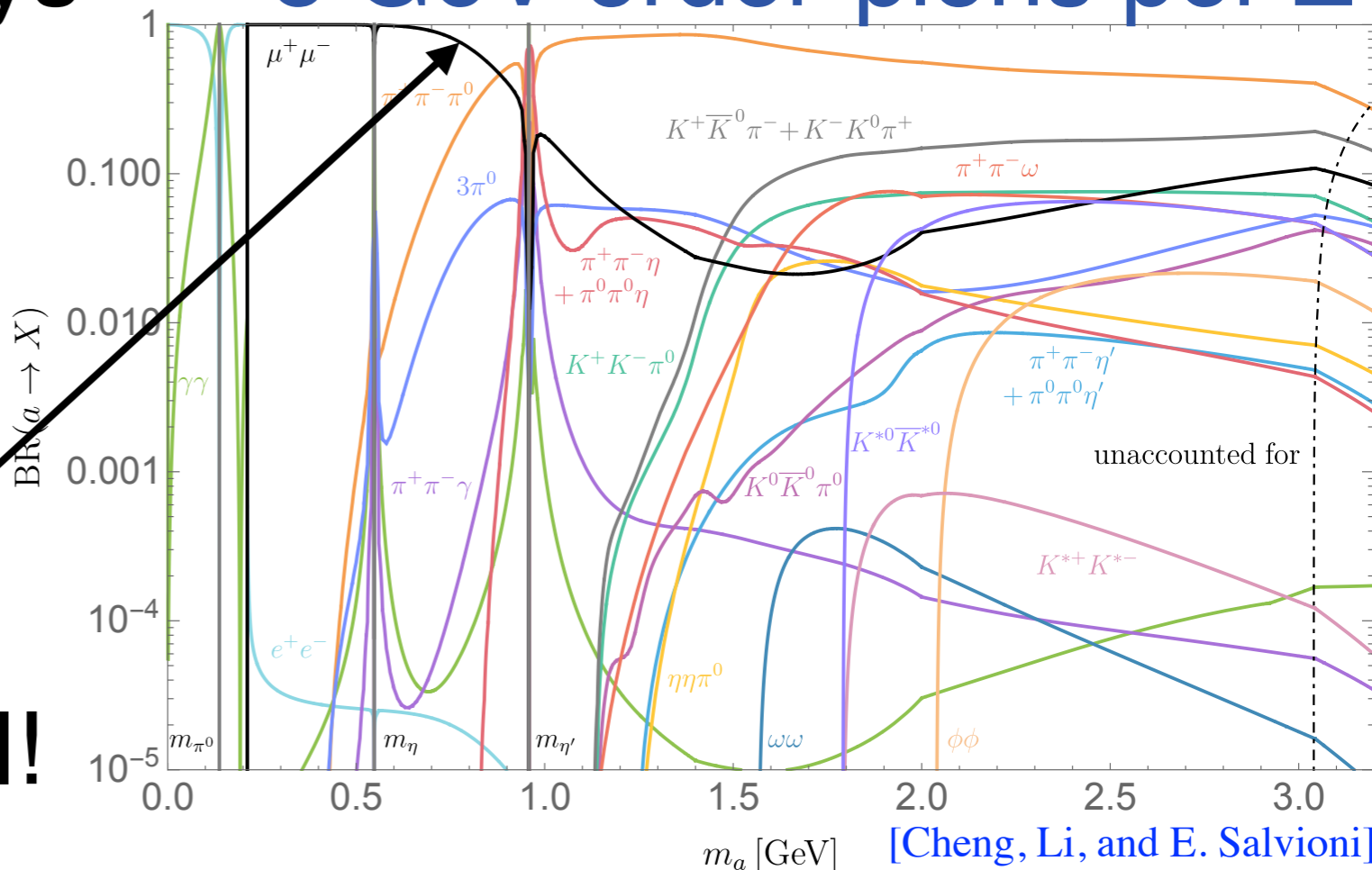
$\sim 5$  GeV-order-pions per Z

- CP-odd:

$$\mathcal{L} = -C_f \frac{\partial_\mu \hat{\pi}}{f_a} \bar{f} \gamma^\mu \gamma_5 f$$

$$\hat{\pi} \rightarrow \mu^+ \mu^-$$

an excellent channel!



# Z-Factory: Tera-Z

- Z abundance:  $\sim \mathcal{O}(10^{12})$

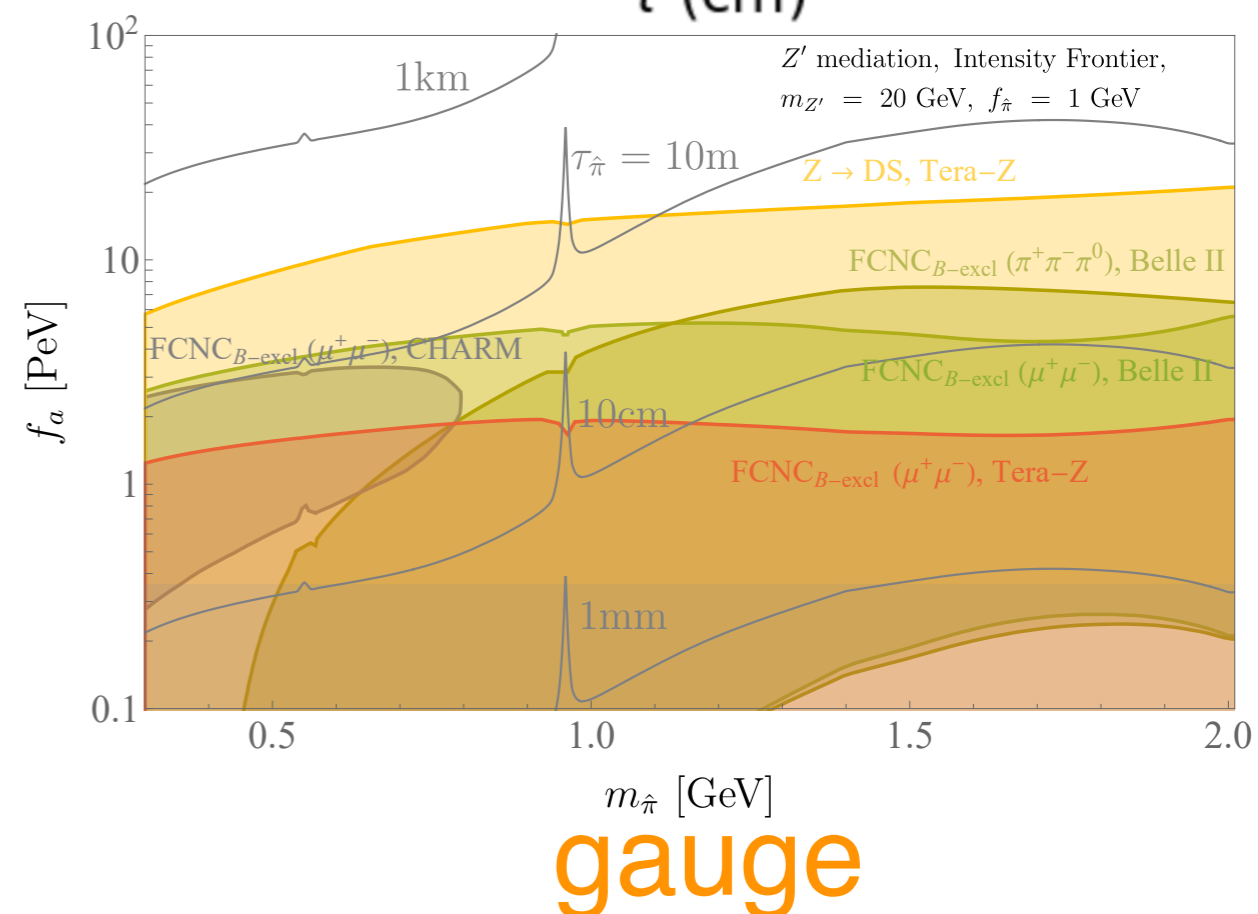
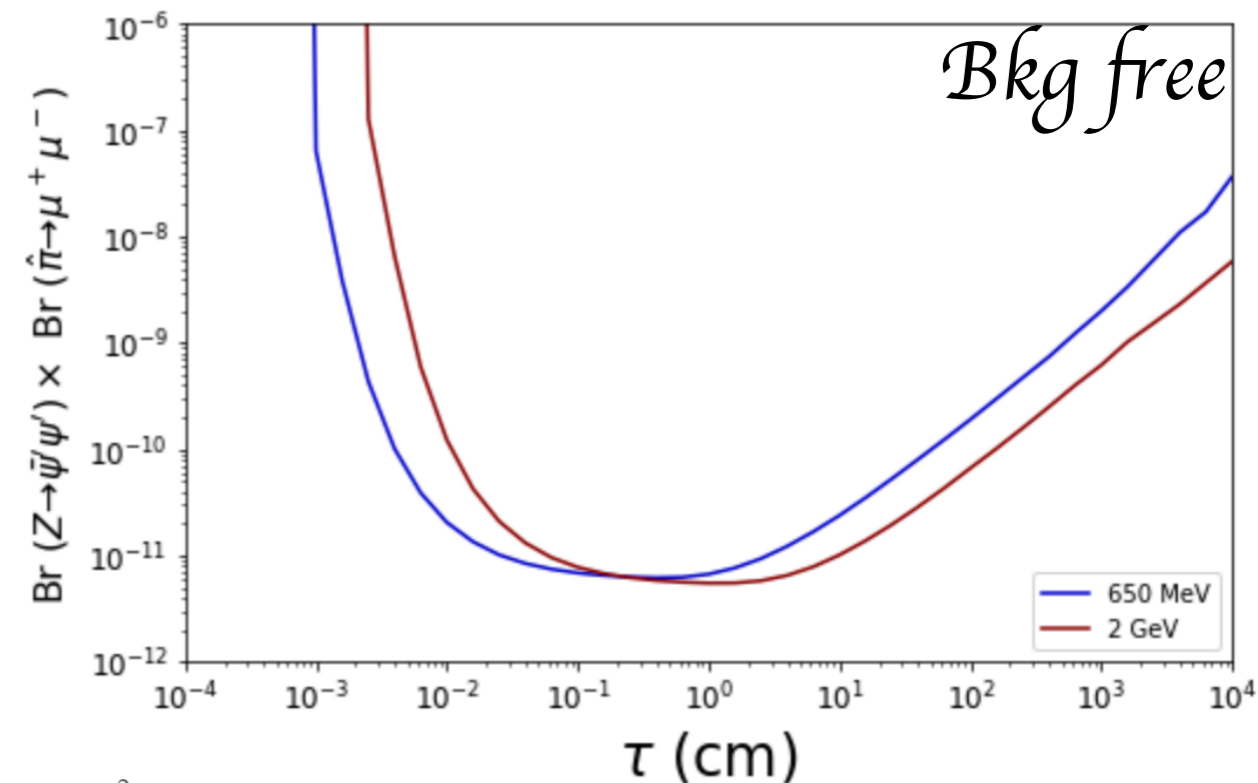
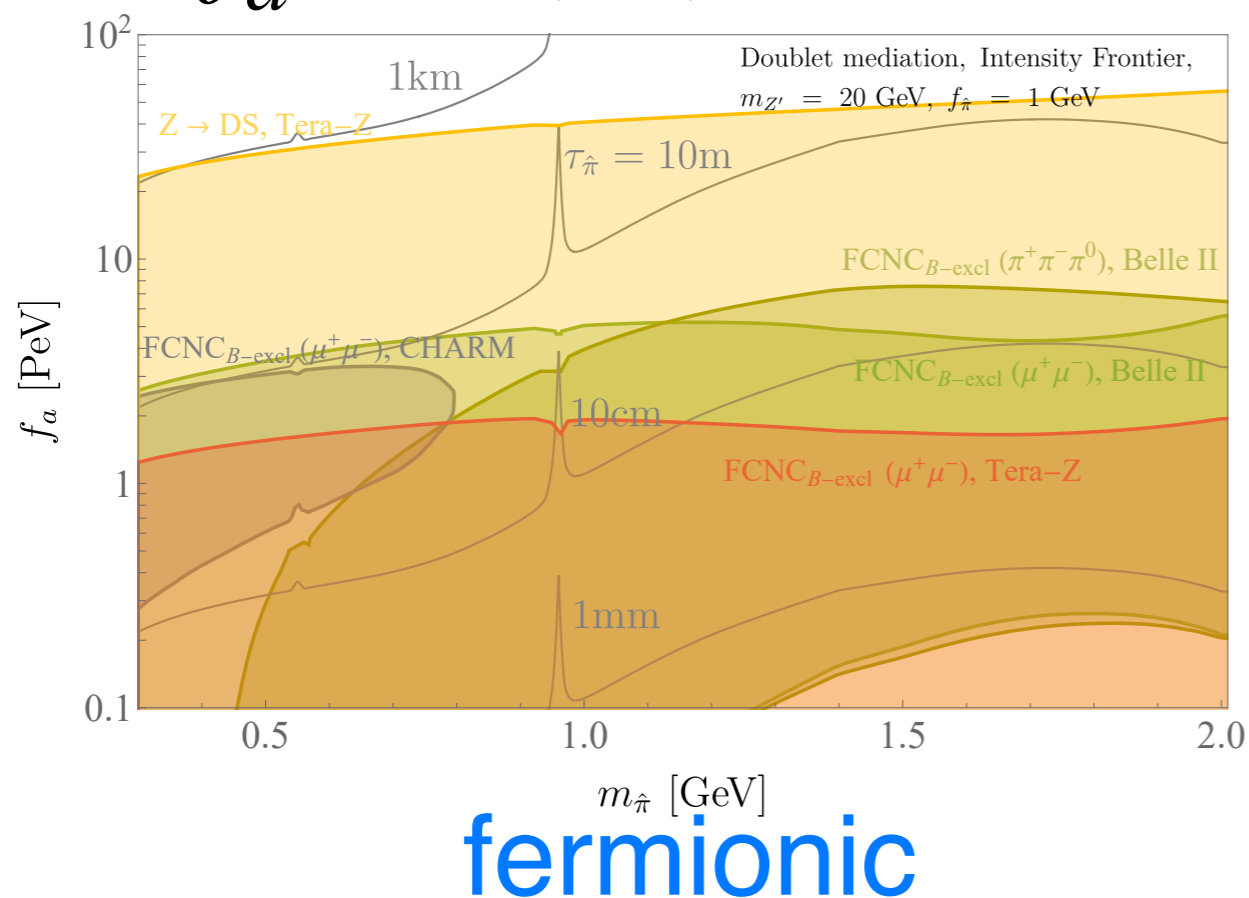
- Dark showers with

$$p_t^{\mu\mu} > 2 \text{ GeV}, \quad |\eta^{\mu\mu}| < 5$$

$$|p|^{\mu_i} > 10 \text{ GeV}, \quad p_t^{\mu_i} > 0.5 \text{ GeV}, \quad |\eta^{\mu_i}| < 5 \quad (i = 1, 2)$$

$$0.5 < l_{xy} < 100 \text{ cm}$$

- $f_a \sim \mathcal{O}(10) \text{ PeV!}$



- Improvements with far detectors at FCC-ee