Letter of Interest: physics potential with MEGII-fwd

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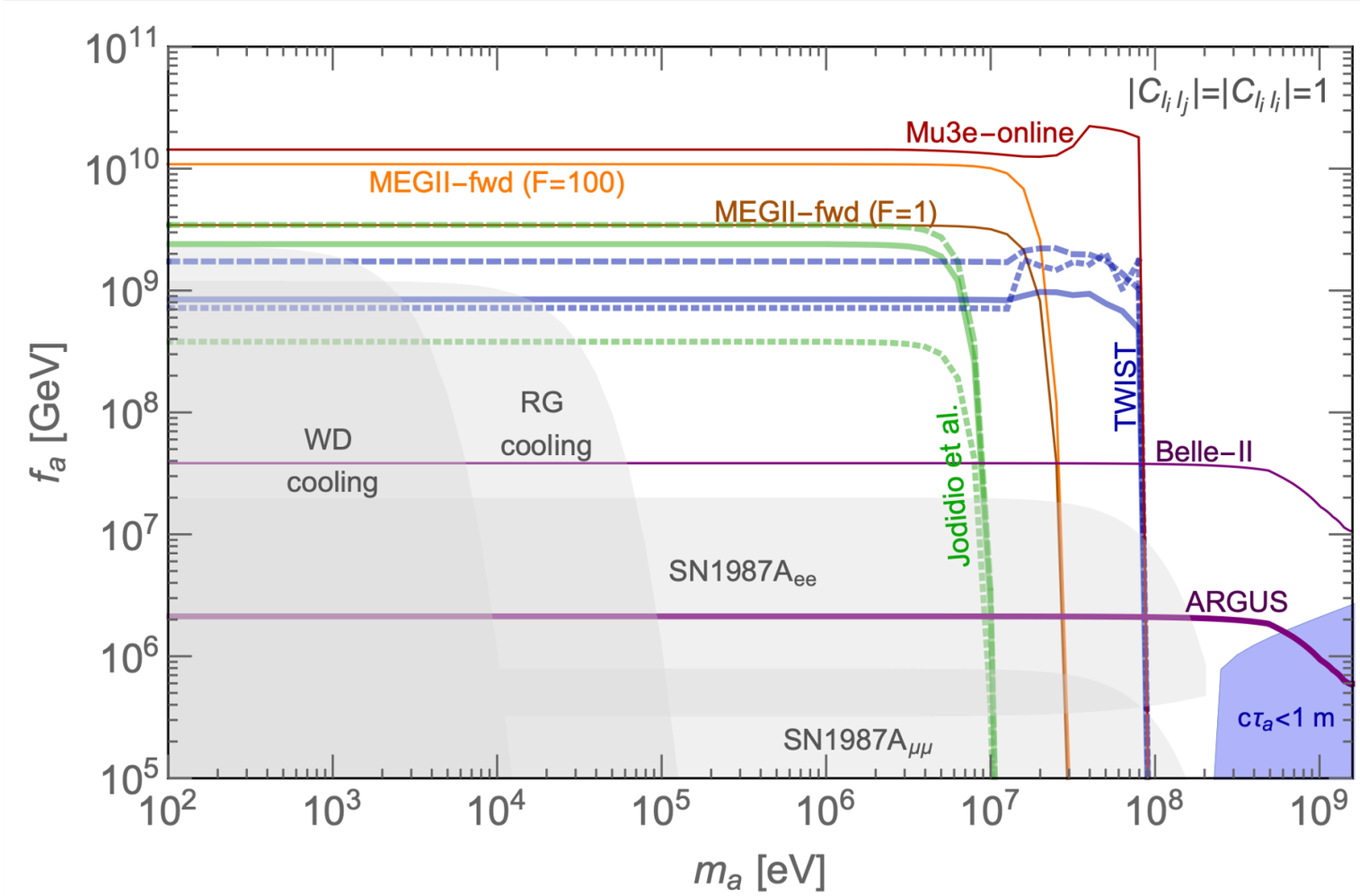
Rare Processes and Precision Frontier Townhall Meeting, Oct 2 2020

Calibbi, Redigolo, Ziegler, JZ, 2006.04795

PHYSICS MOTIVATION

- $\mu \to e\gamma, \mu \to 3e, \mu \to e$ conv., from dim-6 ops, will reach NP scales of $\sim 10^7 - 10^8$GeV
- $\mu \to ea$ from dim-5 ops., can reach NP scales $\sim 10^{10}$ GeV
  - higher than astrophysics constraints



cision Frontier Townhall
Oct 2 2020

FLAVOR VIOLATING AXION-LIKE PARTICLES

- any spontaneously broken global symmetry ⇒ (p)NGB
  - if "light enough" can be DM
- in general couplings to gluons, photons, SM fermions

$$\mathcal{L}_{\rm eff} = \frac{\alpha_s}{8\pi}\frac{a}{f_a}G\tilde{G} + \frac{E}{N}\frac{\alpha_{\rm em}}{8\pi}\frac{a}{f_a}F\tilde{F} + \frac{\partial_\mu a}{2f_a}\,\bar{f}_i\gamma^\mu(C^V_{f_if_j} + C^A_{f_if_j}\gamma_5)f_j$$

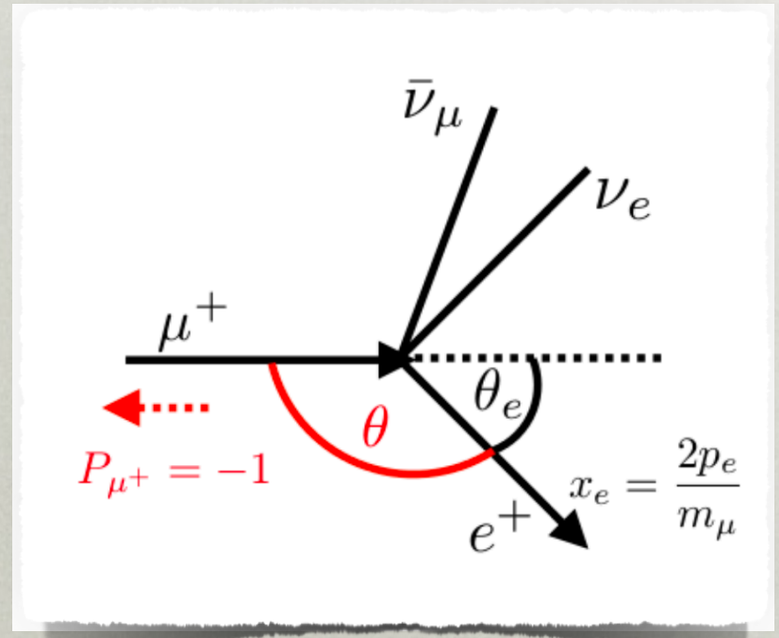
- implications of flavor violating couplings
  - do FCNC experiments probe interesting parameter space?
    ⇒ here focus on muon decays, $\mu \to ea$
  - possible improvements of search strategies?
    ⇒ MEGII-fwd, but also interesting what is the reach at Mu2e and Mu3e

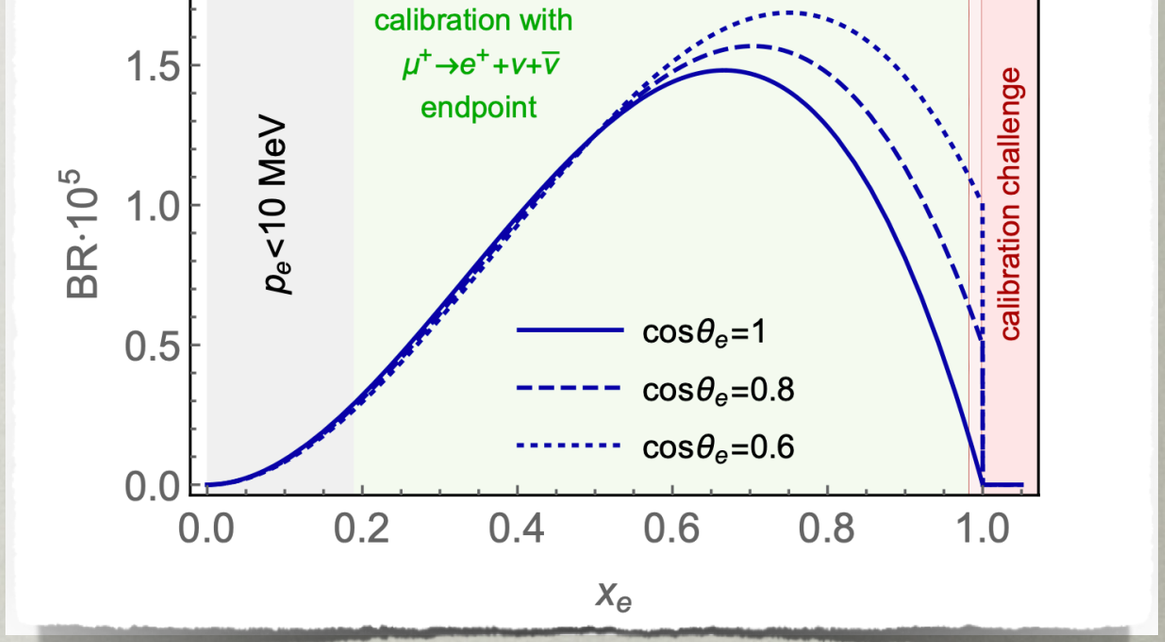
$\mu^+ \to e^+ a$ SEARCHES

- two types of searches for $\mu^+ \to e^+ a$ positron line
- suppress the SM bckg., $\mu \to e\nu\bar{\nu}$

Jodidio et al. 1986

  - use polarized muons $\langle P_\mu \rangle \simeq -1$, in the forward region SM suppressed
  - sensitive only to RH ALP





- do not suppress the SM, also sensitive to LH ALP, TWIST

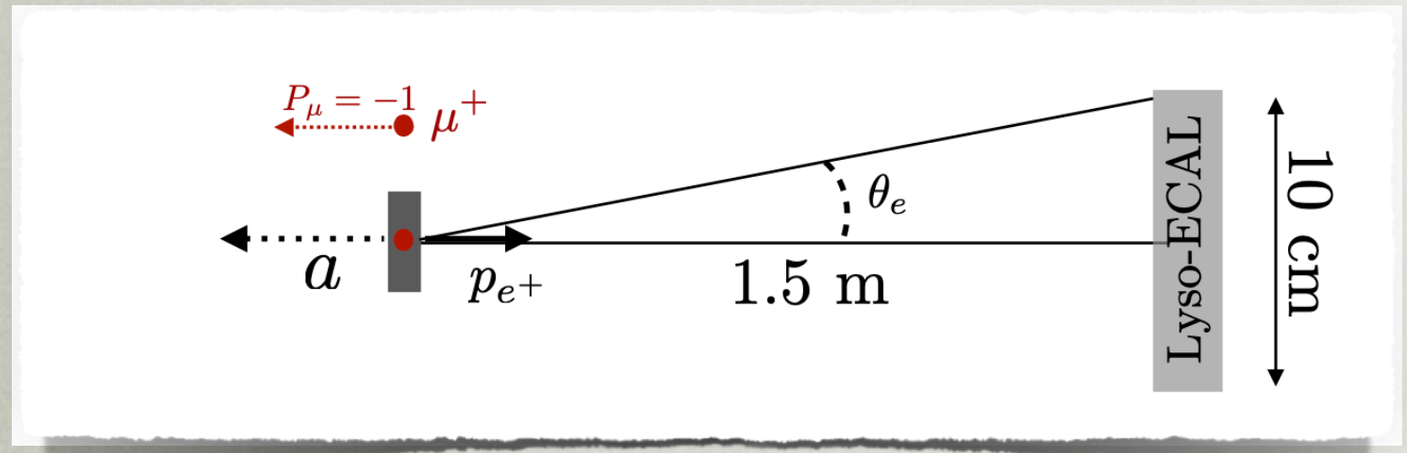
TWIST, 2015

MEGII-FWD

- MEGII is designed to search for $\mu \to e\gamma$
  - could be repurposed for $\mu^+ \to e^+ a$ search ⇒ MEGII-fwd
- already has polarized muons

Calibbi, Redigolo, Ziegler, JZ, 2006.04795

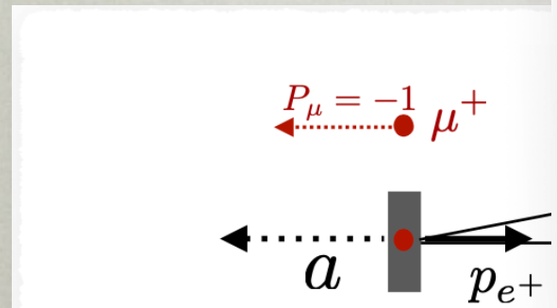
- place a Lyso ECAL downstream



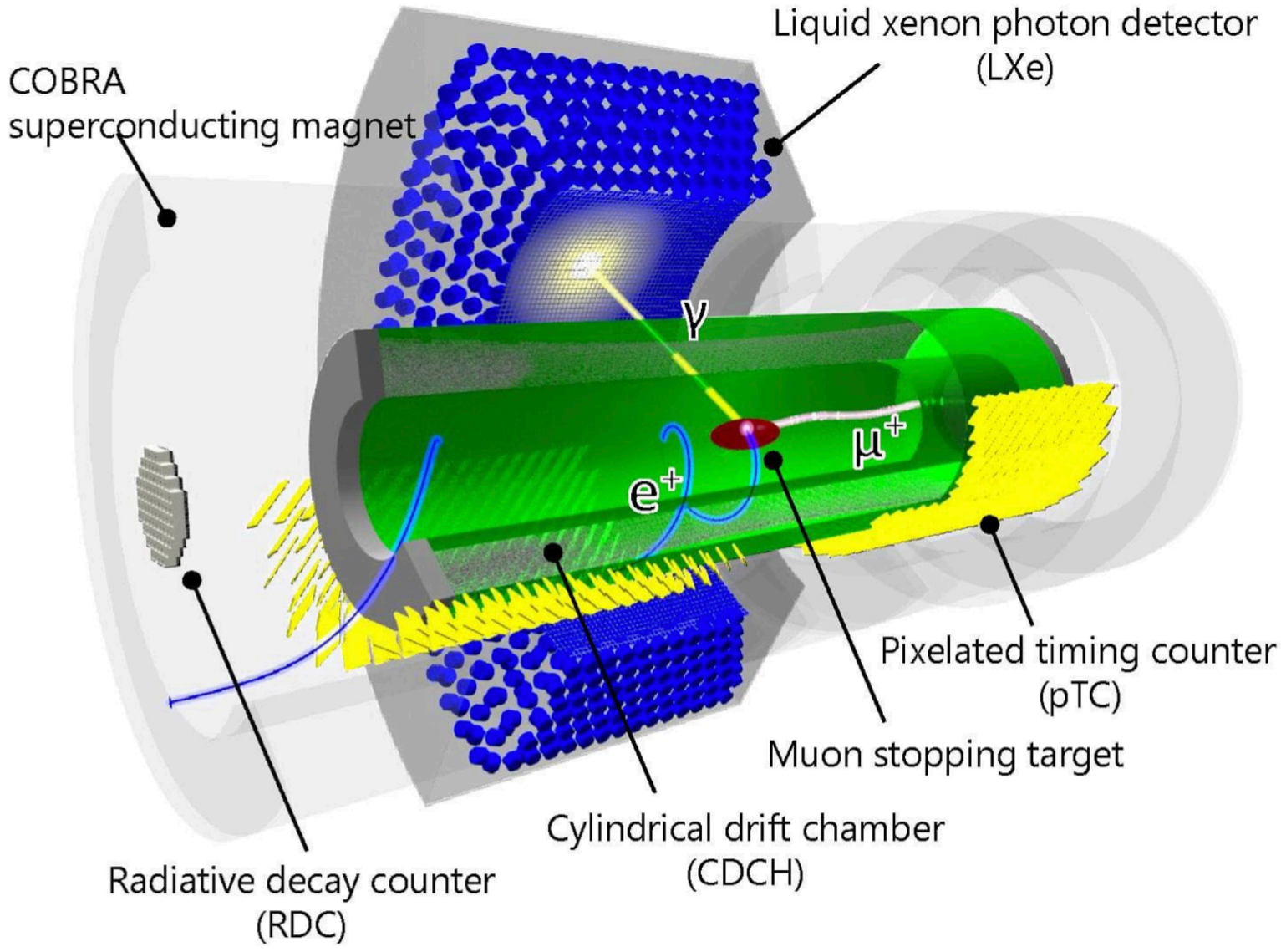
- need to reconfigure the magnetic field
  - most conservative no focusing, F=1
  - possibly more realistic F=100
- interesting reach already with 2weeks of running*

* projections done for $10^8 \mu^+/s$, PSI $\pi E5$ beamline potentially $10^{10} \mu^+/s$ in 2025+

- MEGII is c
  - could b
- already ha
- place a Ly



MEG-II, 1801.04688



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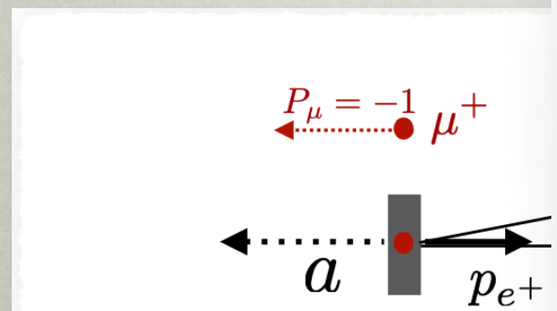

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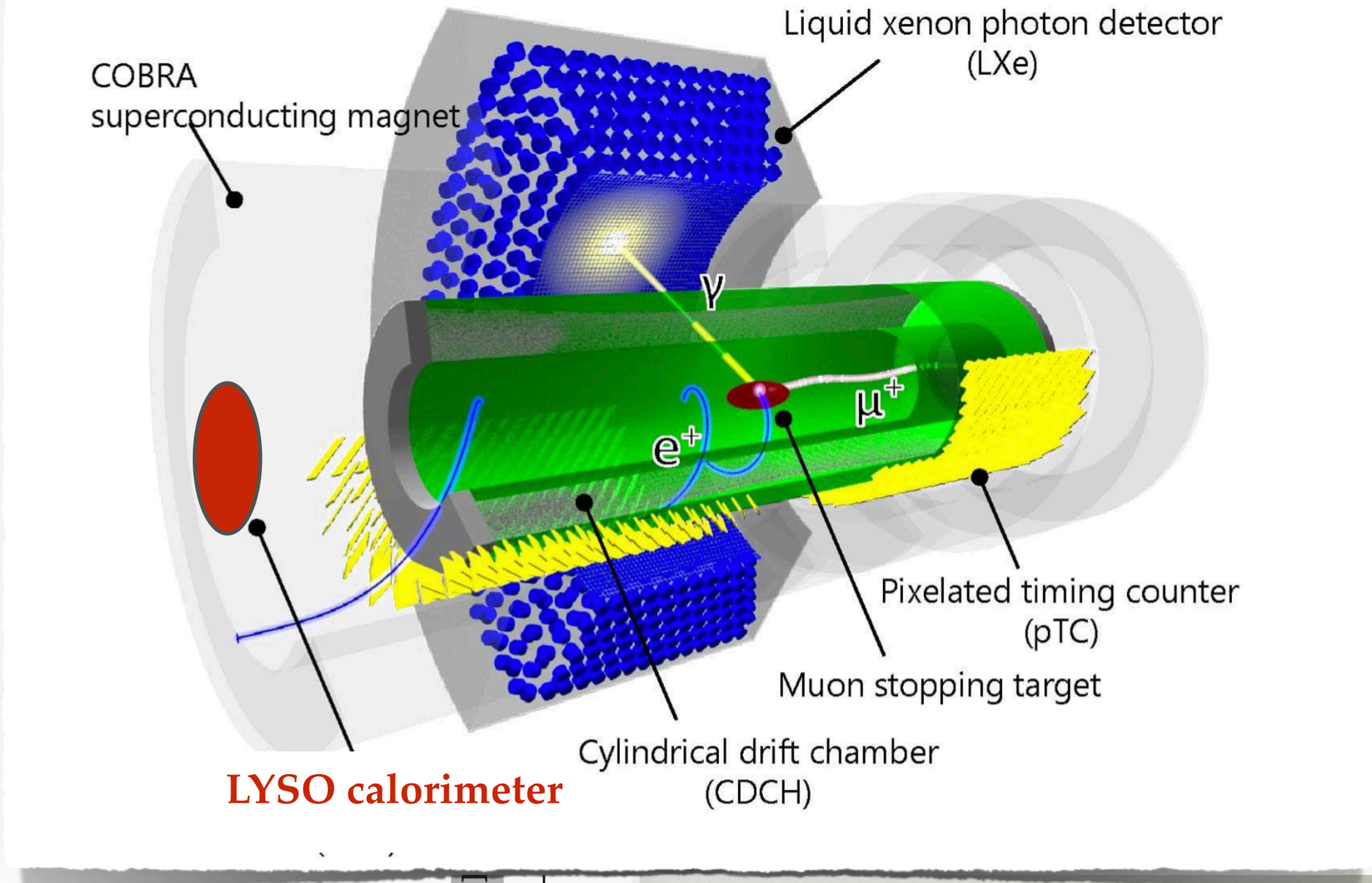

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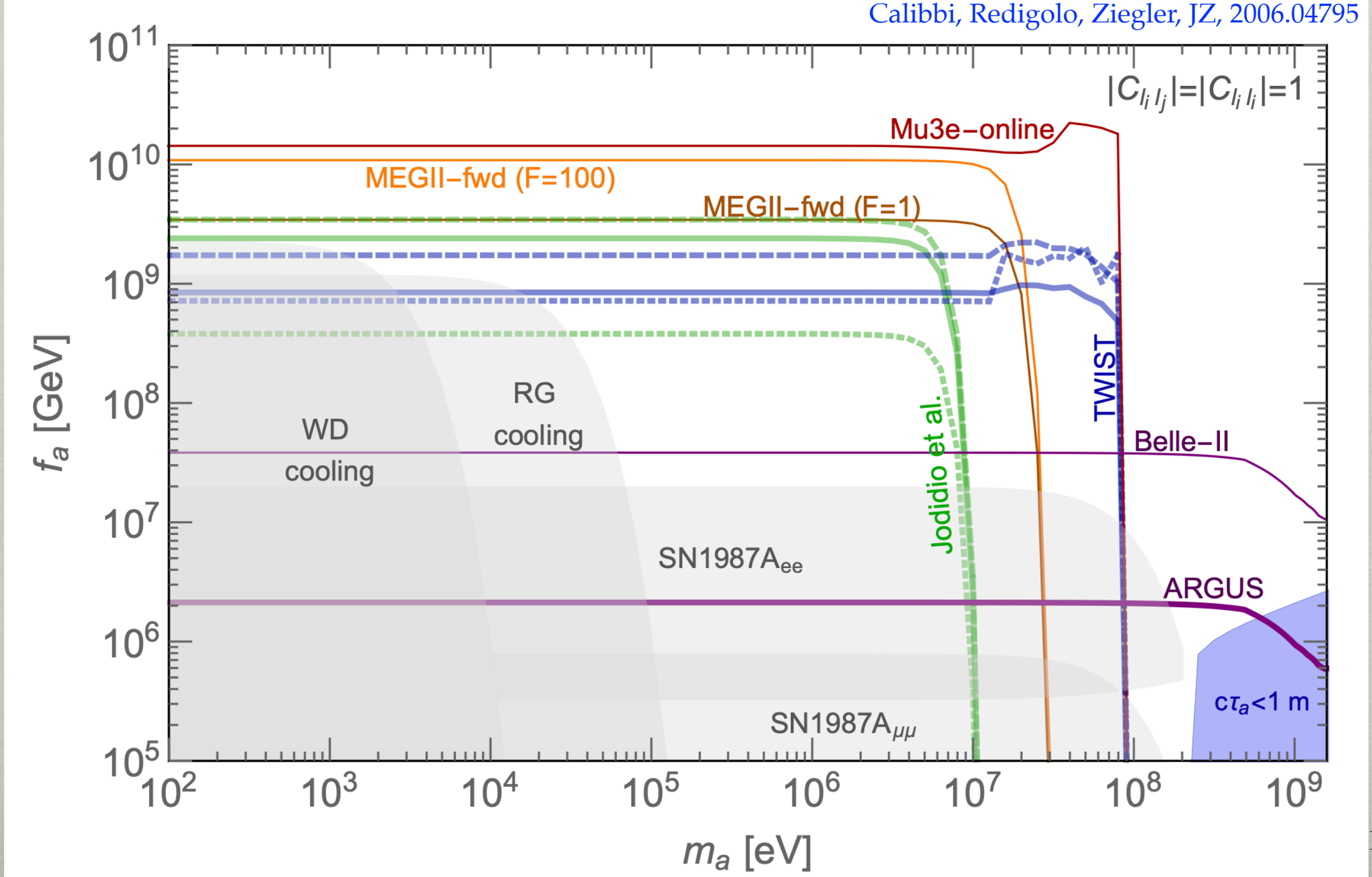

TIMELINE FOR SNOWMASS

- *What will you work on between now and Snowmass, and what is your schedule for developing a contributed paper?*
  - need to perform more detailed/realistic detector simulation
  - optimization of detector size, realistic estimates of background
  - assesment of realistic magnetic focusing
  - endgoal: realistic estimates of the MEGII-fwd reach
- timeline: ~6months

SNOWMASS OUTCOMES

- *What common data sets, joint efforts, etc. do you need?*
  - not clear, but open for suggestions
- *What would you like to come out of the Snowmass process?*
  - a better understanding of the reach for $\mu \to ea$ at MEGII-fwd, Mu2e and Mu3e

BACKUP SLIDES