

# Mu2E at Trieste? A rare opportunity

CSN1 TS meeting June 25, 2025



**RARE**

**MEDIUM-RARE**

**MEDIUM**

**MEDIUM-WELL**

**WELL-DONE**

# Science

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A search for charged lepton flavor violation using the (coherent) conversion of a muon into an electron in the proximity of a nucleus

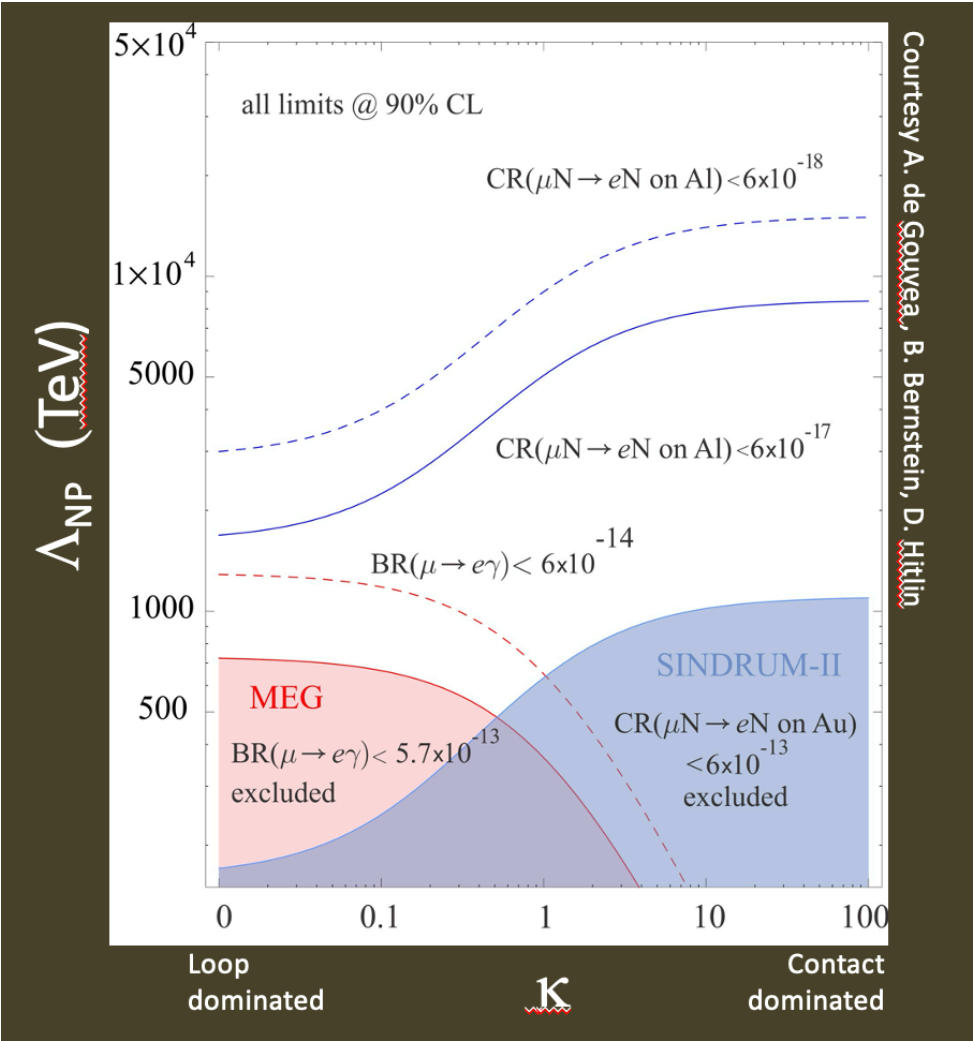
$$\mu^- N \rightarrow e^- N$$

Uses current Fermilab complex to target a sensitivity 10 000 times better than current world best

Discovery sensitivity over a broad and generic swath on non-SM parameter space

A 250 people collaboration (25 students and 25 postdocs)

# Why



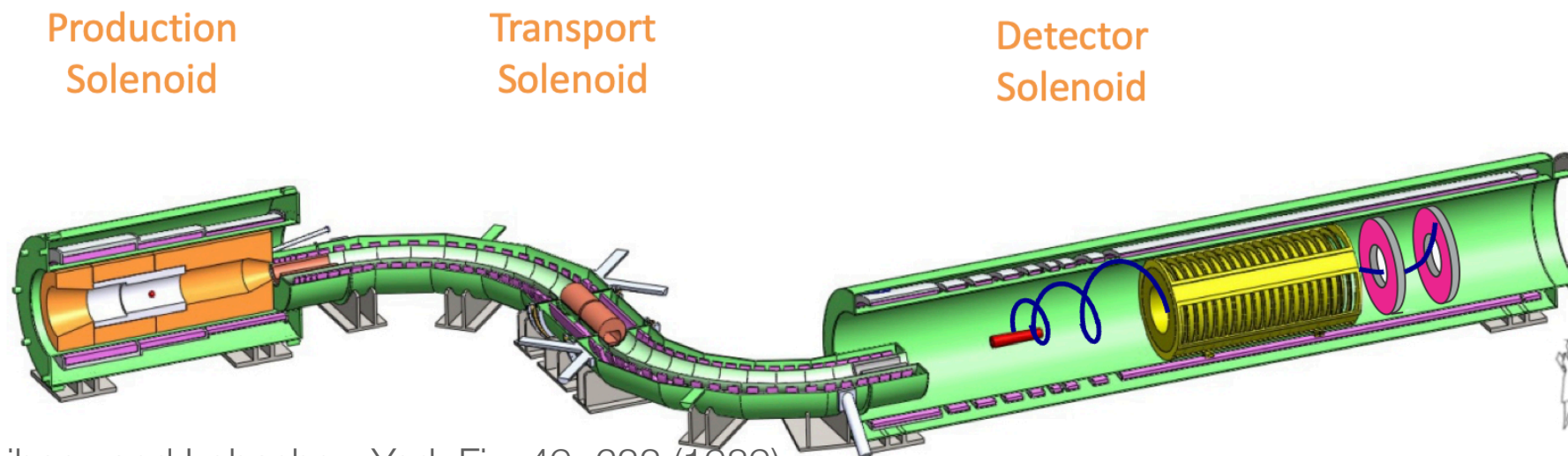
W. Altmannshofer, A.J.Buras, S.Gori, P.Paradisi, D.M.Straub

	AC	RVV2	AKM	$\delta$ LL	FBMSSM	LHT	RS
$D^0 - \bar{D}^0$	★★★★	★	★	★	★	★★★★	?
$\epsilon_K$	★	★★★★	★★★★	★	★	★★	★★★★
$S_{\psi\phi}$	★★★★	★★★★	★★★★	★	★	★★★★	★★★★
$S_{\phi K_S}$	★★★★	★★	★	★★★★	★★★★	★	?
$A_{CP}(B \rightarrow X_s \gamma)$	★	★	★	★★★★	★★★★	★	?
$A_{7,8}(B \rightarrow K^* \mu^+ \mu^-)$	★	★	★	★★★★	★★★★	★★	?
$A_9(B \rightarrow K^* \mu^+ \mu^-)$	★	★	★	★	★	★	?
$B \rightarrow K^{(*)} \nu \bar{\nu}$	★	★	★	★	★	★	★
$B_s \rightarrow \mu^+ \mu^-$	★★★★	★★★★	★★★★	★★★★	★★★★	★	★
$K^+ \rightarrow \pi^+ \nu \bar{\nu}$	★	★	★	★	★	★★★★	★★★★
$K_L \rightarrow \pi^0 \nu \bar{\nu}$	★	★	★	★	★	★★★★	★★★★
$\mu \rightarrow e \gamma$	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
$\tau \rightarrow \mu \gamma$	★★★★	★★★★	★	★★★★	★★★★	★★★★	★★★★
$\mu + N \rightarrow e + N$	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
$d_n$	★★★★	★★★★	★★★★	★★	★★★★	★	★★★★
$d_e$	★★★★	★★★★	★★	★	★★★★	★	★★★★
$(g-2)_\mu$	★★★★	★★★★	★★	★★★★	★★★★	★	?

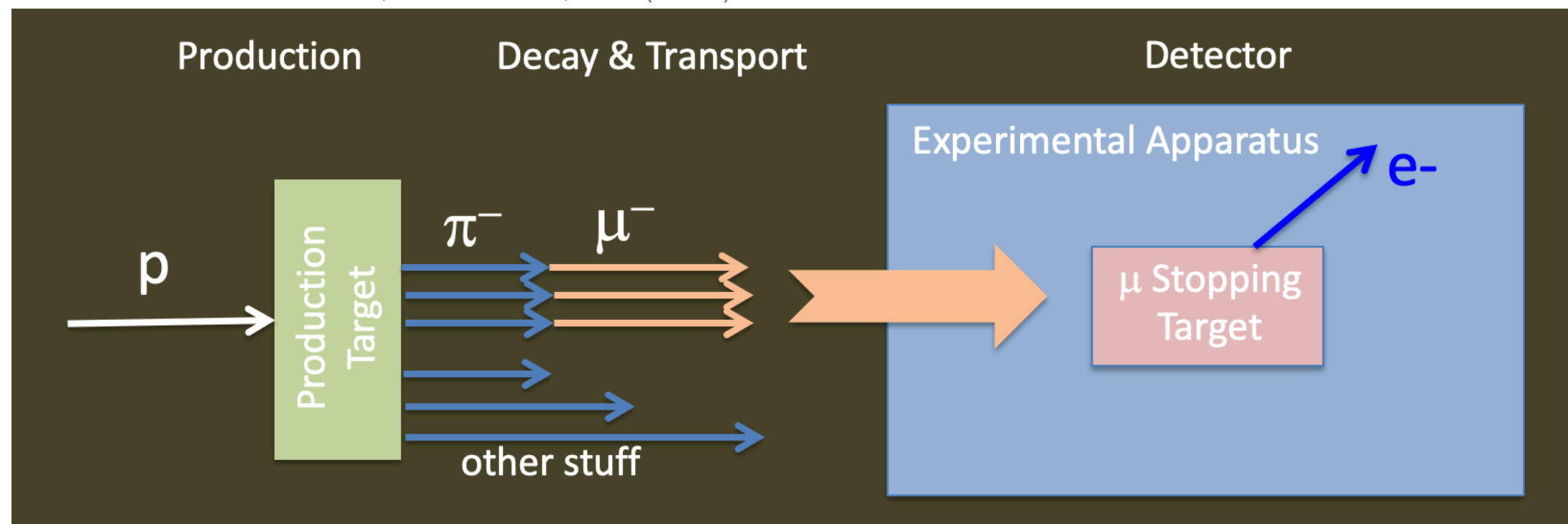
Table 8: “DNA” of flavour physics effects for the most interesting observables in a selection of SUSY and non-SUSY models ★★★★★ signals large effects, ★★ visible but small effects and ★ implies that the given model does not predict sizable effects in that observable.

arXiv:0909.1333[hep-ph]

# What



Dzhilkibaev and Lobashev, Yad. Fiz. 49, 622 (1989)



1. Generate a beam of low-momentum muons
2. Stop em in a target, around whose nuclei  $\mu$  orbitate for a “long” time (suppress bckg)
3. Look for a signal signature: one 105 MeV electron and nothing else — high precision tracking, pulsed beams



- ✓ Good news or, at least, good expectation for the next steps
  - PS, CALO, CRV, TRACKER .... should be soon moving to the Mu2e Hall
- This is exciting**
- ✓ DAQ, DQM, DCS ... we see a lot of progress. Commissioning is becoming a reality
  - We are ready to see a good transition in OFFLINE reconstruction from simulated-only to collected data. This will make a huge difference.
  - Good advancement on reconstruction and analysis tools
  - Beam has been sent to the Muon Campus!!!

However, time is passing by .. Schedule for Run-I is getting narrower

- Have the detector on the floor and running, i.e. CR commissioning
- Complete the solenoids
- Investigate backup options, EB team charged with this

# More pragmatically

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In the past few years we established a strong physics analysis group in Belle II

More recently, I thought to revamp/expand it with a parallel instrumentation/hw activity: Belle II upgrades could be a natural cradle for that

SuperKEKB difficulties make perspectives for a Belle II upgrades uncertain and fluid

I have been looking around for opportunities and Mu2e seems to check several marks

- The physics is exciting, ambitious, and synergic with my traditional interests
- A relatively small (and understaffed) collaboration: a small team can integrate itself on some initially small hw project to be gradually evolved/growed toward more ambitious goals
- Current timeline (short engineering run in late 2027, then pause, then longer run, then upgrade offers a staggered extended path toward consolidating contributions in hw
- Strong italian component with which there is mutual scientific trust since the early 2000s
- Hosted in lab I was an employee of: I understand the culture, I know people and procedures
- *Significant schedule setbacks due to difficulties in manufacturing of magnets.*
- *In the US and as such subjected to Trump 2.0's tantrums and cupio dissolvi*
- *A factor 10000 improvement is a lot — reality might be much less rosy*
- *We built a good thing in Belle II, which I don't want to spoil.*

# Who? What?

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Initially Benigno (30%) and myself (30-40%) with some help from Matteo Copetti (and Pietro?)

Clearly project relies on the capability/possibility to attract soon more people from current Trieste staff and/or postdocs/students.

Started talking opportunities of involvement with the spokepersons/italian groups. Nothing conclusive so far but a few interesting options

- firmware
- slow controls
- contribute ideas (and devices?) to proton-extinction system

This means that I cannot make as yet any meaningful hw requests beyond metabolism.

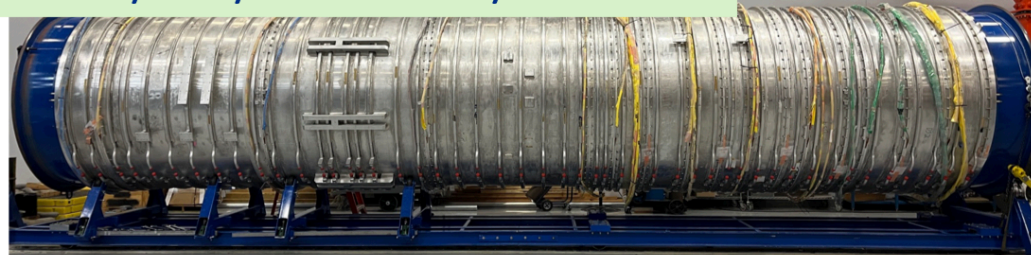
My initial thinking was to ask funds for moderate travel (two/three 10-days trips at Fermilab, plus two/three 3 day trips in Italy)

But it's the first time I do this, so I welcome your suggestions/advices.



# The end

- ✓ DS coils (11) completed
- ✓ Cold mass mechanical assembly completed
- ✓ Assembly of cryostat underway



- ✓ PS Magnet completed
- ✓ Transportation planning
- ✓ Delivery is foreseen in September

