

The Current Effort

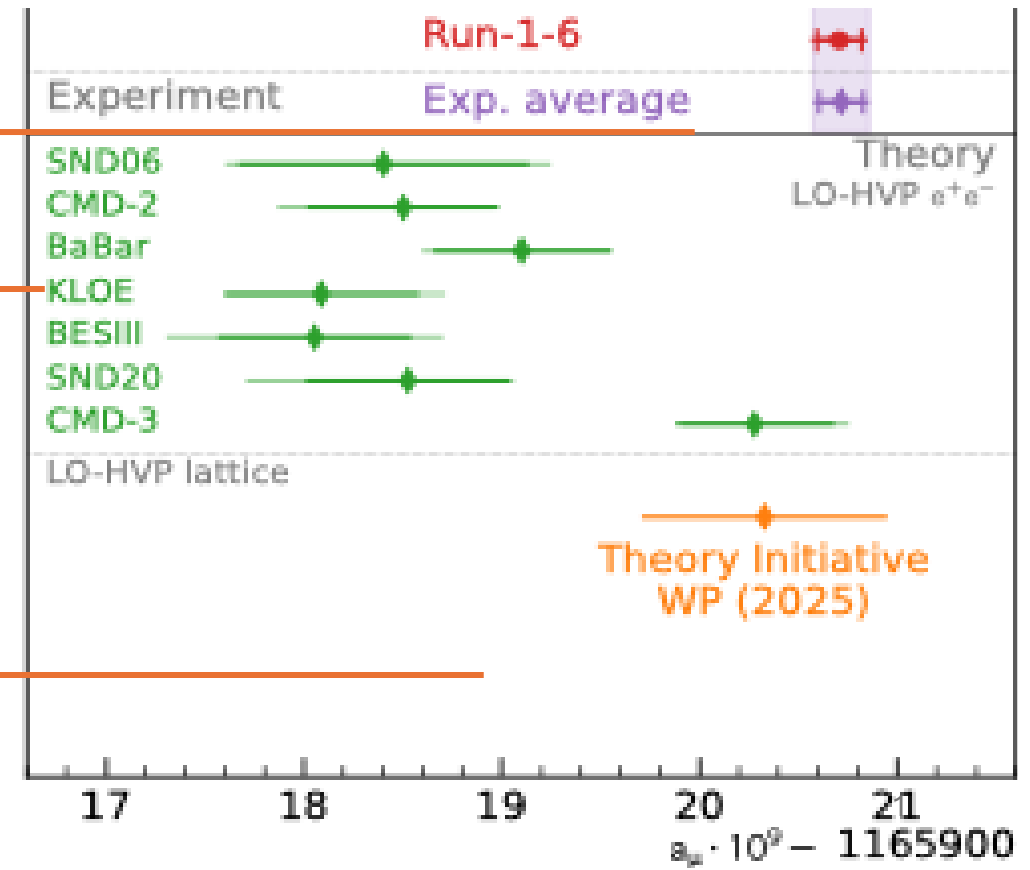
The Leverhulme Trust grant which was awarded to Graziano Venanzoni in 2022 has funded a large group in Liverpool (12 postdocs and 8 PhD students) with the aim of clarifying the muon $g-2$ puzzle.

LEVERHULME
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Muon $g-2$ Experiment at
Fermilab Run 4+5+6

New KLOE hadronic cross
section measurement

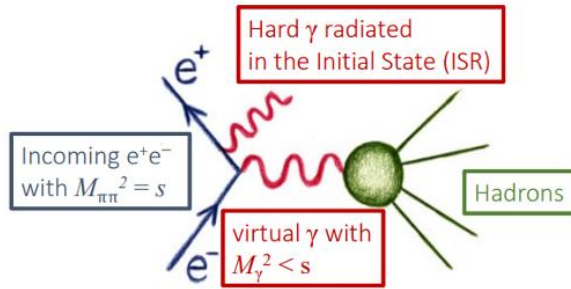
MUonE experiment: a new
approach to determining a_μ^{HLO}



The current effort

There is a current experimental effort to **discern tensions in the dispersive approach** to determining the muon g-2 SM prediction

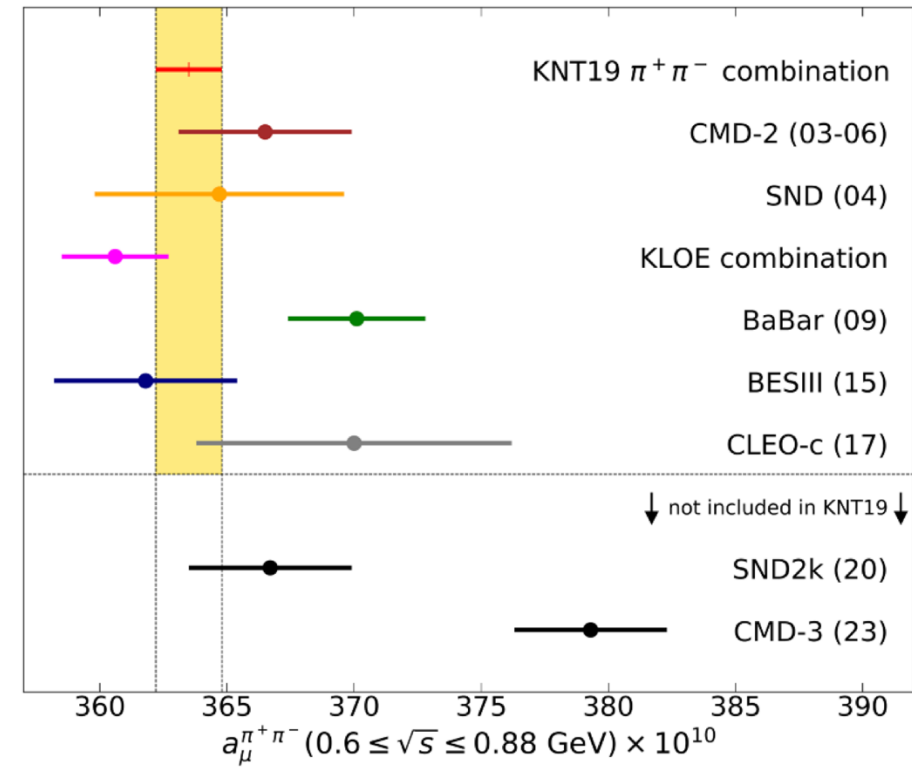
The main contribution to the evaluation of the hadronic contribution to the muon anomaly (a_μ^{HLO}) is taken from the $e^+e^- \rightarrow \text{hadron}$ cross section



A long-standing tension ($\simeq 2.8\sigma$) exists between KLOE cross section measurements and BaBar

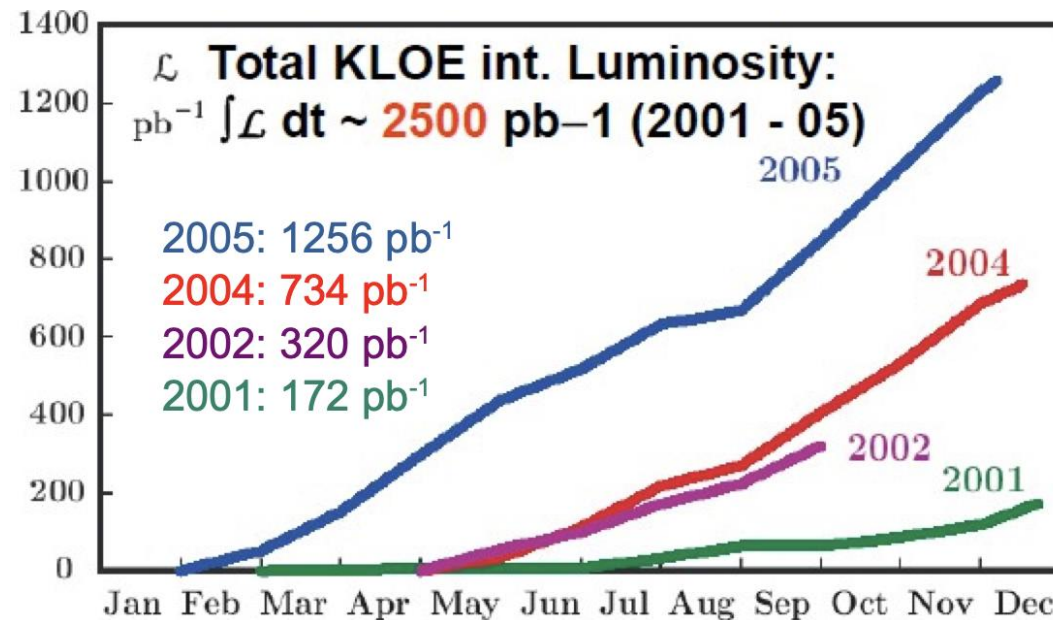
The new CMD-3 $e^+e^- \rightarrow \pi^+\pi^-$ cross section measurement is in tension with both BaBar ($\simeq 2.3\sigma$) and KLOE ($\simeq 5.1\sigma$)

Combined theoretical prediction for the dispersive approach is limited by tensions between KLOE and BaBar measurements. Even without including CMD-3



Current KLOE hadronic cross section analysis

Previous KLOE analyses were done on 240 pb^{-1} (~ 3.5 million $m\mu\gamma$ events) of data taken in 2002 and 232 pb^{-1} from 2006



This ongoing analysis aims to use **2004/2005 KLOE data** to carry out a new measurement. The $\sim 1.7 \text{ fb}^{-1}$ includes ~ 25 million $m\mu\gamma$ events which have **never been used** before in such an analysis. 2006 off-peak data will be used for additional cross checks and systematic studies

Current KLOE hadronic cross section analysis

KLOE12 KLOE-next
(expected)

Syst Errors (%)	$a_{\mu}^{\pi\pi}$ ratio	$a_{\mu}^{\pi\pi}$ ratio
Background Filter (FILFO)	negligible	negligible
Background Subtraction	0.6	0.2
Trackmass	0.2	0.2
Particle ID	negligible	negligible
Tracking	0.1	0.1
Trigger	0.1	0.1
Unfolding	negligible	negligible
Acceptance ($\theta_{\pi\pi}$)	negligible	negligible
Acceptance (θ_{π})	negligible	negligible
Software Trigger (L3)	0.1	0.1
Luminosity	-	-
$\sqrt{s}$ dep. of H	-	-
Total exp. systematics	0.7	0.3
Vacuum Polarisation	-	-
FSR treatment	0.2	0.2
Rad. function H	-	-
Total theory systematics	0.2	0.2
Total systematic error	0.7	0.4

Analysis group is tackling different aspects using new techniques with the intention of reducing the larger systematic uncertainties.

$$\text{KLOE12: } 0.3\%_{\text{stat}} \oplus 0.2\%_{\text{th}} \oplus 0.7\%_{\text{syst}} \Rightarrow \sim 0.8\%_{\text{tot}}$$

$$\text{KLOE-next}_{\text{(goal)}}: 0.1\%_{\text{stat}} \oplus 0.2\%_{\text{th}} \oplus 0.3\%_{\text{syst}} \Rightarrow \sim 0.4\%_{\text{tot}}$$

There will be a factor 7 statistical improvement making the statistical uncertainty negligible wrt systematics.

There will be dedicated work on the background subtraction procedure to achieve a **x3 reduction of the background subtraction uncertainty.**

		Schedule in November 2024				
		11/24	12/24	01/25	02/25	03/25
Binning						
Blinding	Define procedure					
	Produce samples blinding root-tuples					
FILFO + L3	Disable FILFO filter but keep info					
Data Quality						
Linux	Linux development					
GEANT	GEANT3 studies + GEANT4 dev					
Colinear	Measurement of Assymetry and Form Factor					
Radiative	Measurement of Assymetry					
Bkg subtraction	BDT - instead of Mtrk cut + other bkg					
	add other variables to the bkg fitting					
	use sigma_mtrk cut to clean the sample					
	Kinematic fit ? - Peter Lukin OR other methods					
	Different Mtrk cuts or none (e.g. fit instead)					
	different radiative correction generators					
PID algorithm	Develop PID algorithms					
Data MC tuning	pos - neg tracks (s-t relations)					
	Data MC comparisons					
Tracking	Reproduce old result					
	Develop selection cuts + PID					
Trigger						
Unshifting						
Unfolding						
Documentation	Baseline performance					
	10% unblinding approval					
	Publication					

A substantial number of resources and person-power have been stalled over the past two years due to the tape library computing issues

- It is important for the scientific impact of this result that we keep to the timeline.
- It is crucial that this analysis be finished before the end of the Leverhulme grant in 18 months to maintain the expertise needed throughout.

We need access to all the data as a matter of urgency and the lab's support to solve ongoing tape library issues and maintain smooth running of computing operations.