

MEGII実験の準備状況と

- 東京大学
- 日本物理学会2018年秋季大会@信州大学





今後の展望

素粒子物理国際研究センター 岩本敏幸 他MEG II コラボレーション 2018年9月14日



Introduction

- Flavor physics •
 - Why do we have three generations in the SM? •
- charged Lepton Flavor Violation •
 - FV happens in quark, neutral lepton sector •
 - Why not in charged lepton sector? •
- µ→eγ lacksquare
 - Long search history since the muon has been • discovered.
 - Negative results contribute to the SM formation •
 - In SM + neutrino oscillation, Br($\mu \rightarrow e\gamma$)~10⁻⁵⁰ •
 - Many new physics scenarios predict large • $Br(\mu \rightarrow e\gamma)$



Standard Model of Elementary Particles

From Wikipedia



- MEG/MEG II experiment
 - MEG/MEG II are designed to search for such • regions where new physics like SUSY-GUT, SUSYseesaw predict
 - Real chance to discover new physics

Start new physics search next year

- Target sensitivity : 6x10⁻¹⁴ •
- 10 times better sensitivity with three years data • taking than MEG
 - MEG sensitivity : 5.3x10⁻¹³ •
 - MEG final results : 4.2×10^{-13} @90%CL (Eur. Phys. J. C 76(8),434(2016))
- New μ -e conversion, μ -3e experiments will follow soon

MEG II Experiment



3

MEG II Experiment

Liquid Xenon y Detector

Better uniformity w/ VUV-sensitive 12x12mm² SiPM

Downstream

(e⁺

Gamma-ray (y)

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16aS41-7, 8 小林,小川

Radiative Decay Counter **Further reduction** of radiative BG Positron 16aS41-5 恩田

x2 resolution everywhere

COBRA SC Magnet 15pS28-5 家城 Upstream

7x10⁷/s

Positron Timing Counter 30ps resolution w/ multiple hits

Drift Chamber

Muon (µ⁺)

Single volume He:iC4H10 small stereo cells

15pS28-4 宇佐見







Yusuke@Last JPS meeting Current status

- All the detectors except for CDCH are constructed.
- Installation and commissioning in 2017.
- Pilot run with partial electronics was successfully carried out in Nov.—Dec.
- Struggle with the wire braking issue on CDCH. Struggle with the noise issue on the readout electronics.

\Rightarrow >2 years delay from the original (2013) schedule.

- This year all the detectors will get ready.
- Full electronics will be ready toward the end of the year.

⇒ Carry out **full engineering run**,

but not physics run this year.

Current status (update from 2018 spring)

- CDCH •
 - •
 - CDCH finally sent to PSI •
- WaveDREAM •
 - Still struggling with the noise issue, and the mass production has not started yet •
 - This year we can not start engineering run due to this problem •
- LXe detector •
 - Light yield was saturated at the half of the maximum level •
- Schedule ullet
 - Now Mu3e beam time at the upstream side of the experimental site •
 - In October, integration of all the detectors into the experimental site •
 - In November December, MEG II muon beam time is planned •

Wire breaking issue seems to be solved by humidity control, and the assembly is finished.



CDCH

- Chamber construction work finished
 - The problem of broken wires seems to be solved by careful control of humidity
- HV supply test
 - performed before bringing the CDCH from PISA to PSI
- However, we found another problem
 - current instability of many channels observed before reaching the nominal HV
 - three most inner layers are critical
 - Drift cell at center
 5.8mm (inner layer)
 -7.4 mm (outer layer)



ו**ed** solved



- Limited # electronics channels, and HV are supplied locally.
 - drift cell instabilities have • position dependence
 - Worse parallelism of • end plate? ~350µm
- Inner three layers had a worse situation
 - smaller drift cells, • lack of wire tension?

- Wire length checked again, and 1mm longer than what was measured before
- Decide to re-open the chamber and correct • the wire tension and the parallelism of the end plate





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- Making CDCH longer by 0.6mm •
 - no short circuit observed •
- Both endplate parallelized better •
 - uniformity recovered (sector 0, 11 relative to 5, 6) •
- Assembly work done again •
- Shipped to PSI on 31st/July •
 - He: Isobutane = 85 : 15 are supplied at PSI for the first time •
 - All the HV cards became available at Mid. Aug. •
- Now HV conditioning in progress outside the detector hut •
 - Up to now, $\sim 1000V$ are achieved (working condition will be $\sim 1500V$) •
- Beg. October installation into the MEG II experimental lacksquaresite if everything is ok

CDCH HV map (DS endplate)

CDCH







TC

- Full counters were tested under • muon beam, and expected performance was confirmed (~30ps)
- Radiation damage can be • mitigated by low temperature operation
 - 30% time resolution deterioration at 100μ A • at 30°C becomes 5% at 10°C
- Cooling test performed at open • space
 - 20°C was already achieved
 - Water chiller system plus cooled dry air
 - Cool down test down to 10°C will be done in the detector hut with air conditioning system







- Last year •
 - light yield reached 90% of expected by gaseous/liquid • purification
 - After some readout PMTs are modified, it changed to 70% of • expected
- This year •
 - Started detector operation • in June
 - unexpectedly • the light yield is saturated at 50% of expected
 - Molecular sieves have some • problem? Replacement work in progress



dsum



LXe purification







- X-ray measurement again this year
 - Measure MPPC positions in LXe directly ٠
 - Absolute MPPC position comparison with more • lead strips
 - last year, ~1mm discrepancy was observed
 - Stability of MPPC position after thermal cycle •
- Waveform data are taken •
 - last year only event rate (scaler) was used.
 - Online trigger can veto cosmic ray events •
 - S/N improved from 1 to 5 •
- Results •
 - No significant displacement from the thermal cycle
 - Again, the laser survey and the lead strip data show discrepancy. Careful checks are in progress.



- High/low frequency coherent noises are observed for both PMT and MPPC
- High frequency noise
 - mainly coming from waveform digitizer
 - Related to 80MHz system clock •
 - Try to remove the high frequency noise • by offline analysis
- Low frequency noise •
 - dominant source for charge estimation •
 - Still limited number of channels, but already 1% contribution • to charge RMS
- Energy resolution will be checked by CW Li • 17.6MeV y monochromatic calibration







- Downstream RDC •
 - In 2017 RDC + LXe data taking was performed, and radiative muon • decay events are successfully observed
 - Data analysis and the comparison with MC in progress •
- Upstream RDC
 - Considering the possibilities to use silicon sensor, RPC etc. •

LXe Event Display



RDC





DCH mockup

WaveDAQ

- New DAQ/Trigger system
 - Waveform digitizer, amplifier, SiPM voltage supply, • trigger are integrated in a card
 - 6 crates (=1500ch.) are now available for test •
- Noise study from hardware point of view
 - Test of common mode choke : mainly to remove • high frequency noise
- Baseline slope •
 - Drop caused by temperature dependent leakage • current in DRS
 - Cells at right are read out later \rightarrow more time for • leakage →slope
 - Need to keep the temperature constant •
- Next year mass production for all ch.

Common mode chokes







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Prospects 2018



Summary

- All the MEG II detectors are finally at PSI, and will be installed into the experimental site in October.
- Muon beam time is scheduled with all the detectors and limited number of readout electronics in November-December.
- Next year after the mass production of the readout electronics, engineering run and physics run will be started.







Beam time in 2018

Last update: Feb 14th, 2018, S. Ritt <stefan.ritt@psi.ch></stefan.ritt@psi.ch>						У		J	une		July August							September					October					Nove	embe	er		Dec	cemb	er	
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		PSP	Availability																																
PiM3	MuSR (GPS<F)		Amato (coord.)																																
PiE3	MuSR high field		Scheuermann (coord.)																																
MuE1	MuSR (GPD)		Amato (coord.)																																
MuE4	MuSR (LEM)		Prokscha (coord.)																																
PiE1-1	MuSR (Dolly)		Amato (coord.)																																
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	CMS Diamond Detectors	5203.85763.010	Hits																																
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Beam time in 2018 for MEG II is allocated as requested (by Stefan)

PSI 590 MeV Program 2018



HIPA operation

Betrieb Protonen-Anlagen 2018-2020

	2018													2019												2020												
	Jan Feb Mrz Apr Mai Jun Jul Aug Sep Okt Nov Dez									Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez					
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Beamdump			neuer	BHE1																	Dauen	einsatz																
Target E									40	m											slanted o	der 6cm							slanted oder 4cm (zeitweise 6					e 6cm?)	.m?)			
SINQ Betrieb			Shute	lown					Betr	ieb				SINQ Upgrade										SINQ Upgrade Betrieb														
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Klaus Kirch, PSI

Stand: 28.09.2017

BVR Feb 13, 2018 – page 13



<u>Reconstructed Eγ Spectrum (BG γ)</u>

Positron analysis

Target preparation