

WORKSHOP OF MELODY2023

**Muon station  
for sciEnce technoLOgy and  
inDustrY (MELODY)  
@CSNS II**

Yu Bao

On Behalf of MELODY Collaboration

2023.4.15 @ TDLI

# Outlines

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- Introduction on CSNS and CSNS II project
- MELODY design
  - Target station
  - Muon beamlines
  - $\mu$ SR Spectrometer
  - Beam measurement
- Prospect of MELODY II:
  - Muon beam technology
  - Muon physics? - future muon facility?
- Summary

# Birth of muon

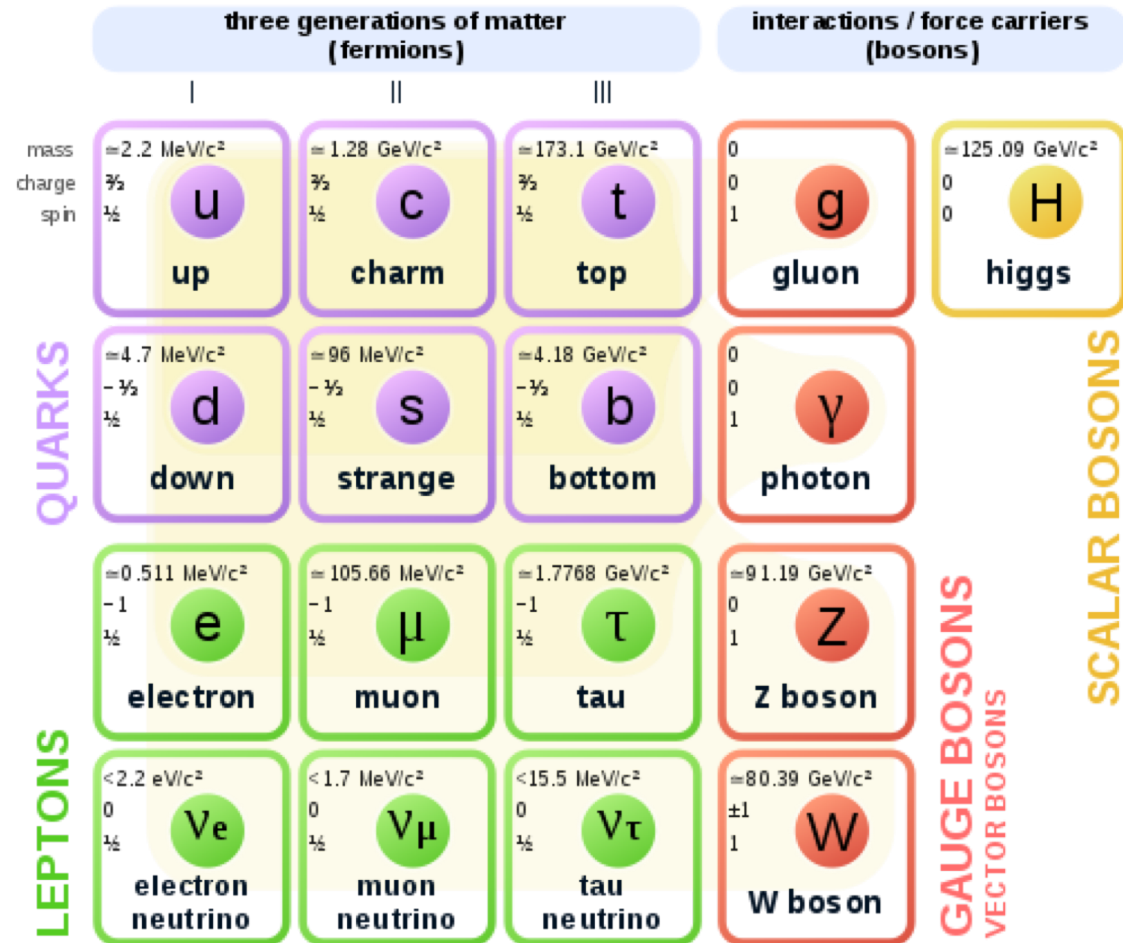


Carl Anderson  
Nobel Price 1936

I. I. Rabi  
Nobel Price 1944

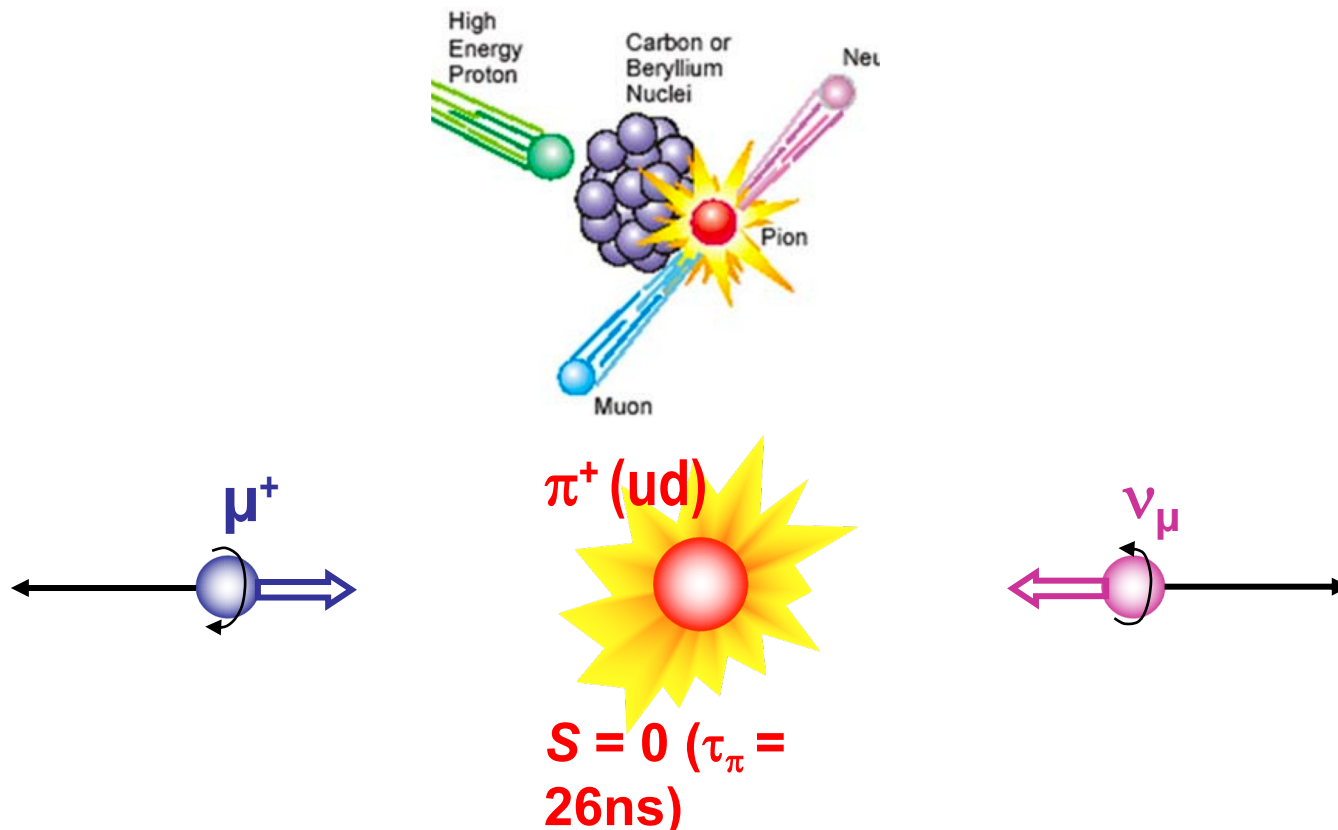


## Standard Model of Elementary Particles



- Mass:  $106 \text{ MeV}/c^2$
- Charge:  $\mu^-$ ,  $\mu^+$
- Life:  $2.2 \mu\text{s}$

# Production of Muons



Two-body decay reference



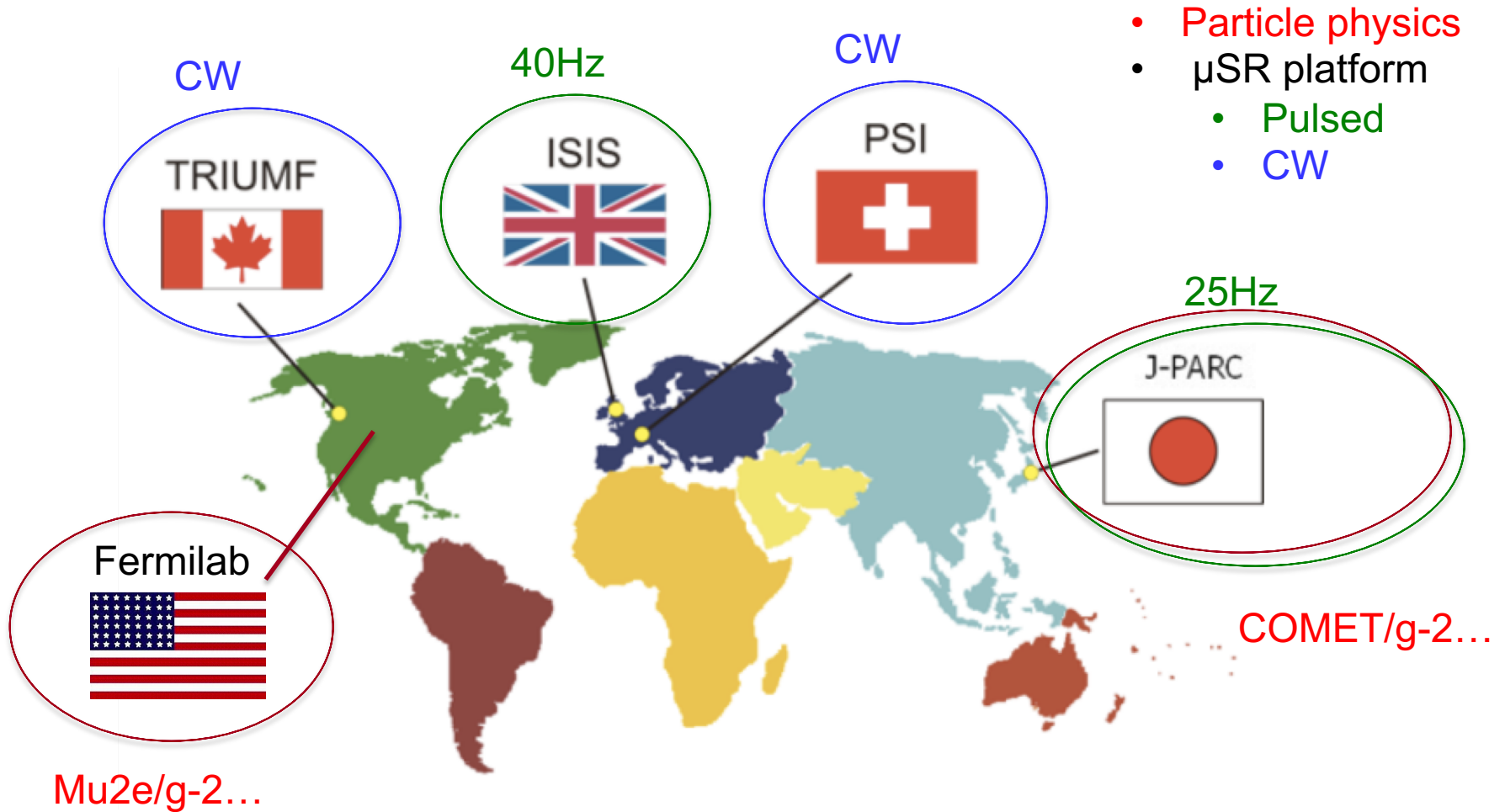
muon has always the energy 4.1 MeV in the frame of the pion (assuming  $m_\nu = 0$ )

Spin pion = 0



Muon has a spin 1/2 and is 100% polarized (as only left-handed neutrinos are produced)

# Muon facilities

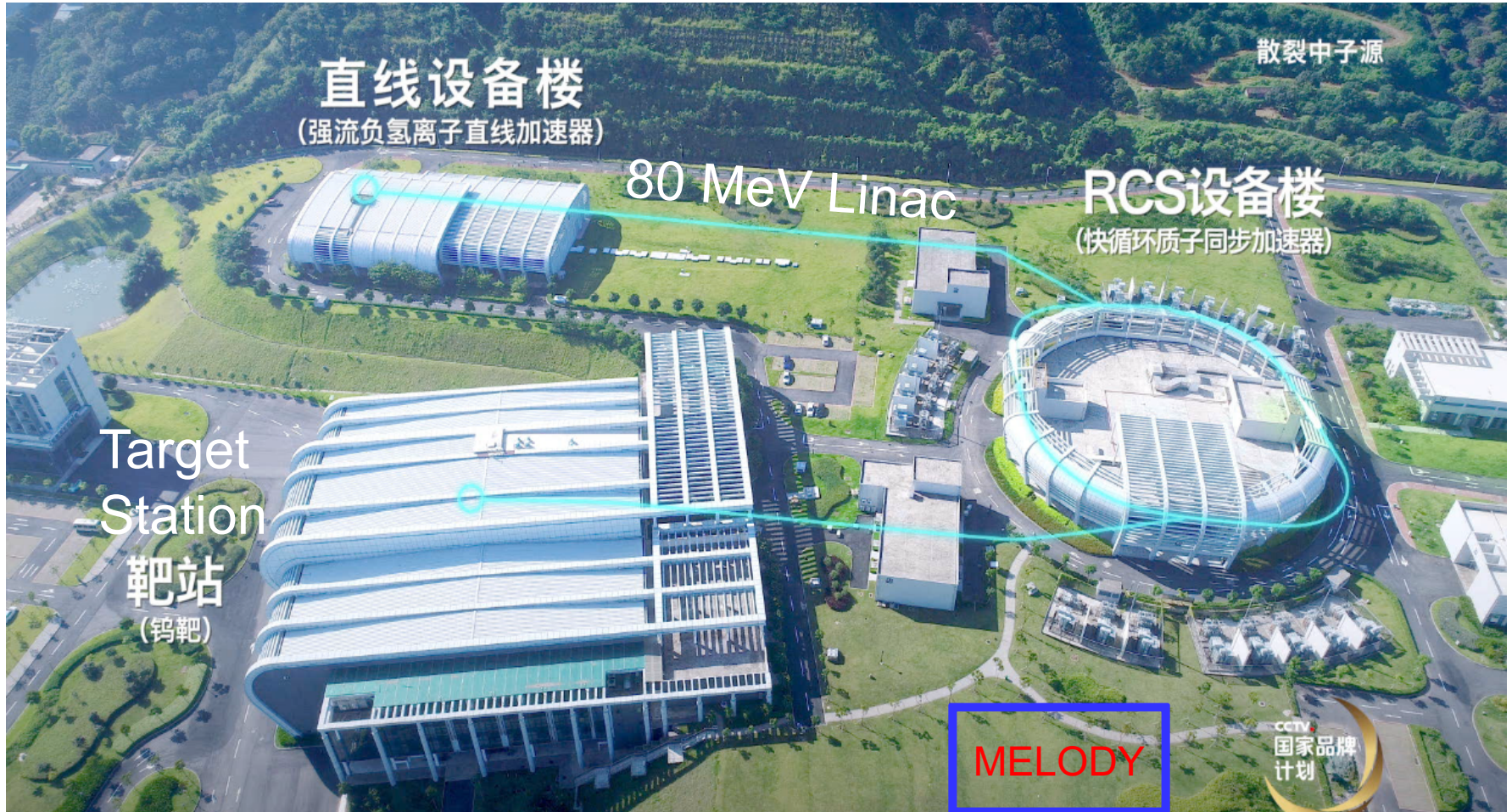


- Particle physics
- $\mu$ SR platform
  - Pulsed
  - CW

# China Spallation Neutron Source



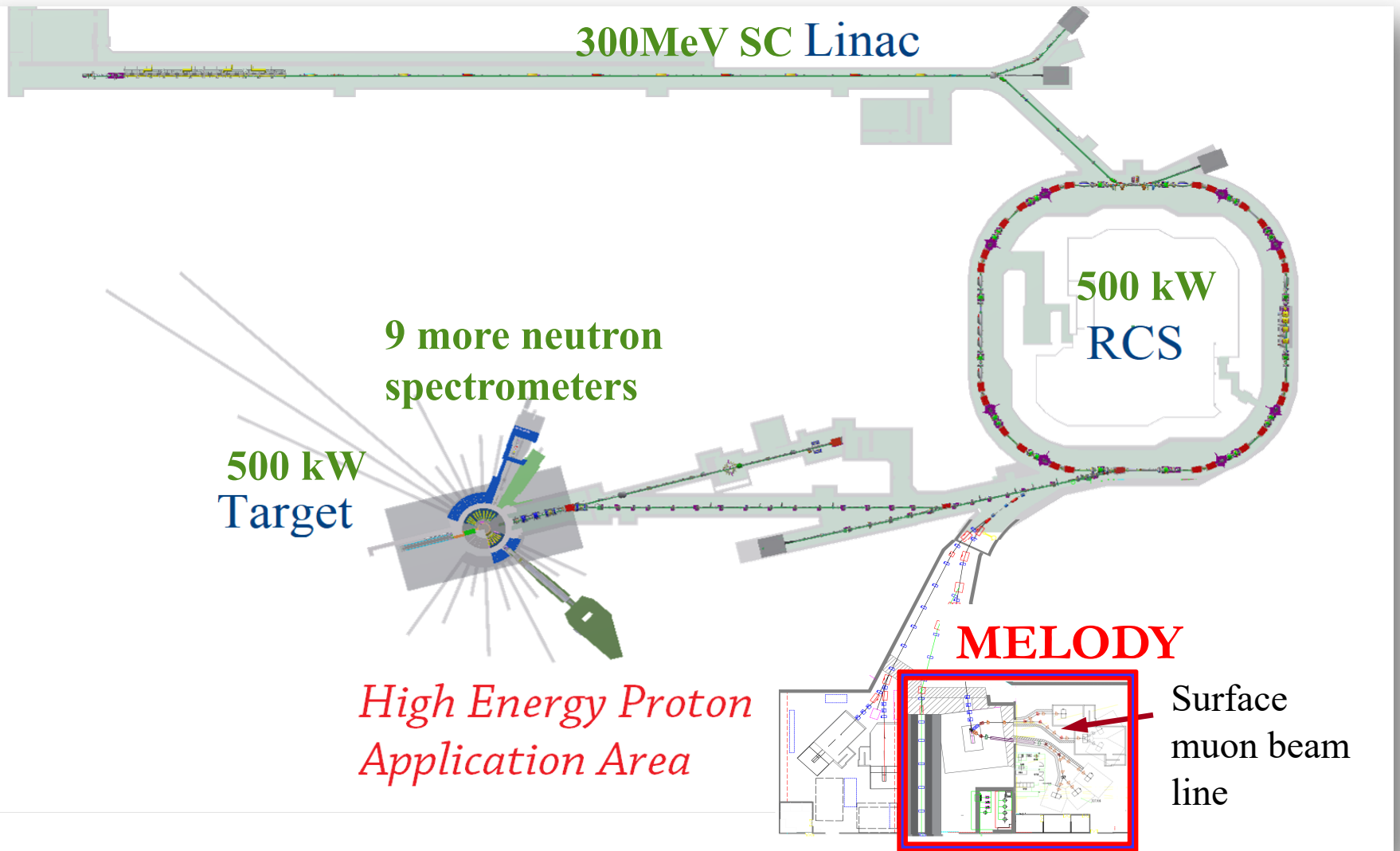
# China Spallation Neutron Source ( CSNS )



Accelerator: 100kW 25Hz 1.6GeV proton beam  
Neutron Spectrometers: 7 built and 3 under construction



# CSNS II Project

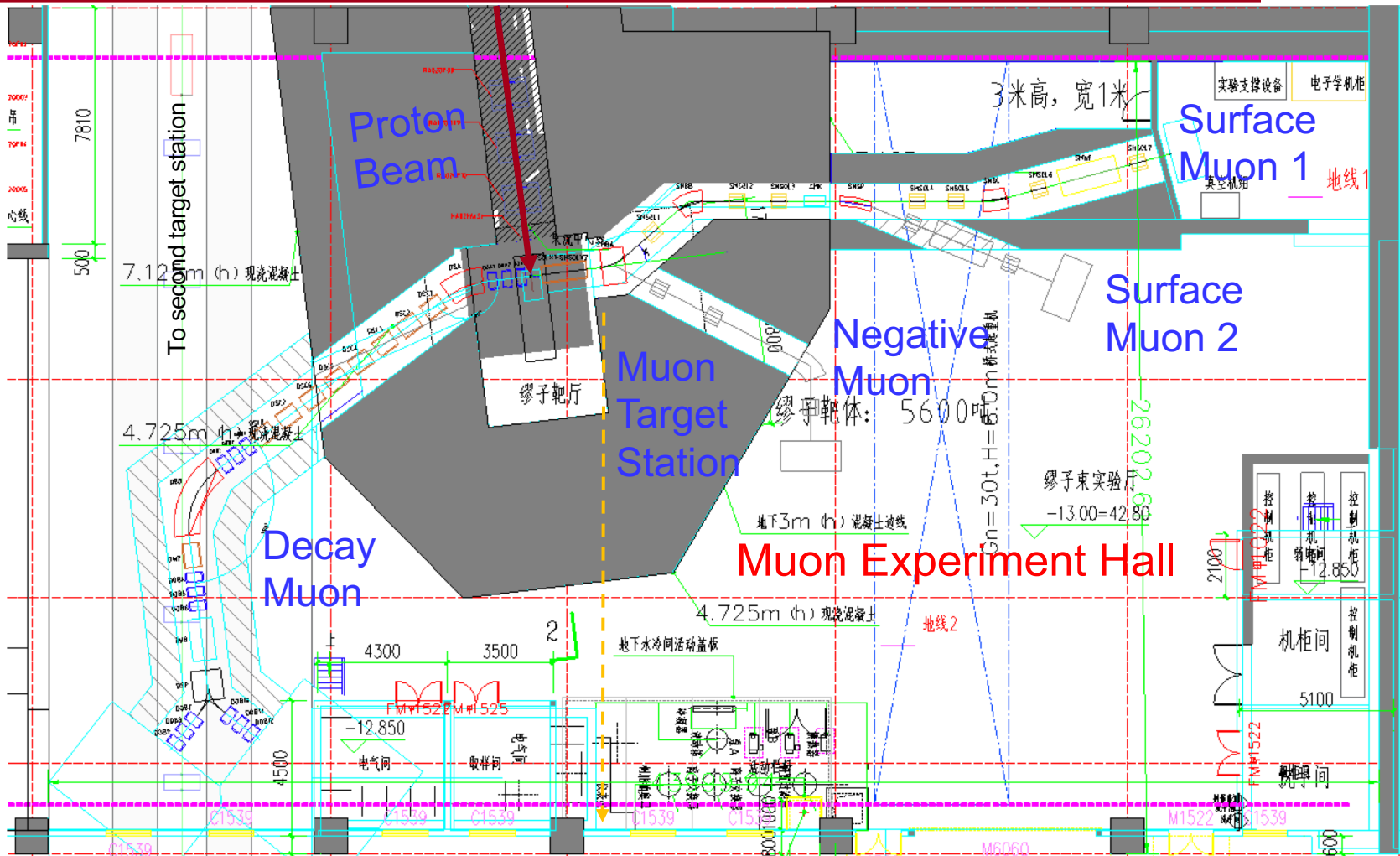


# Architectural Design of MELODY

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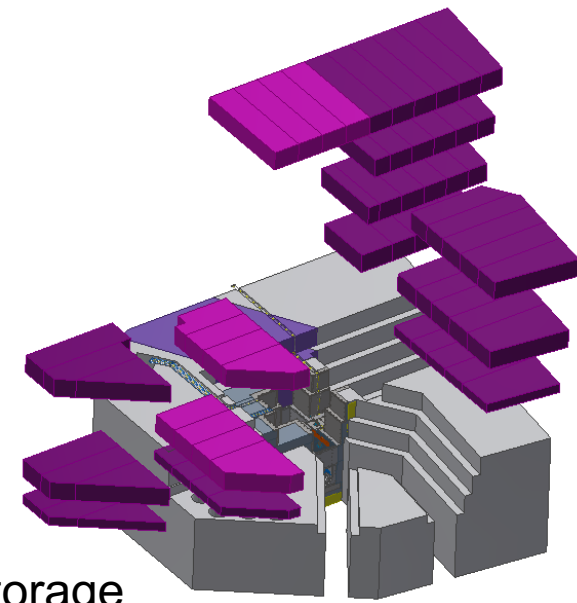
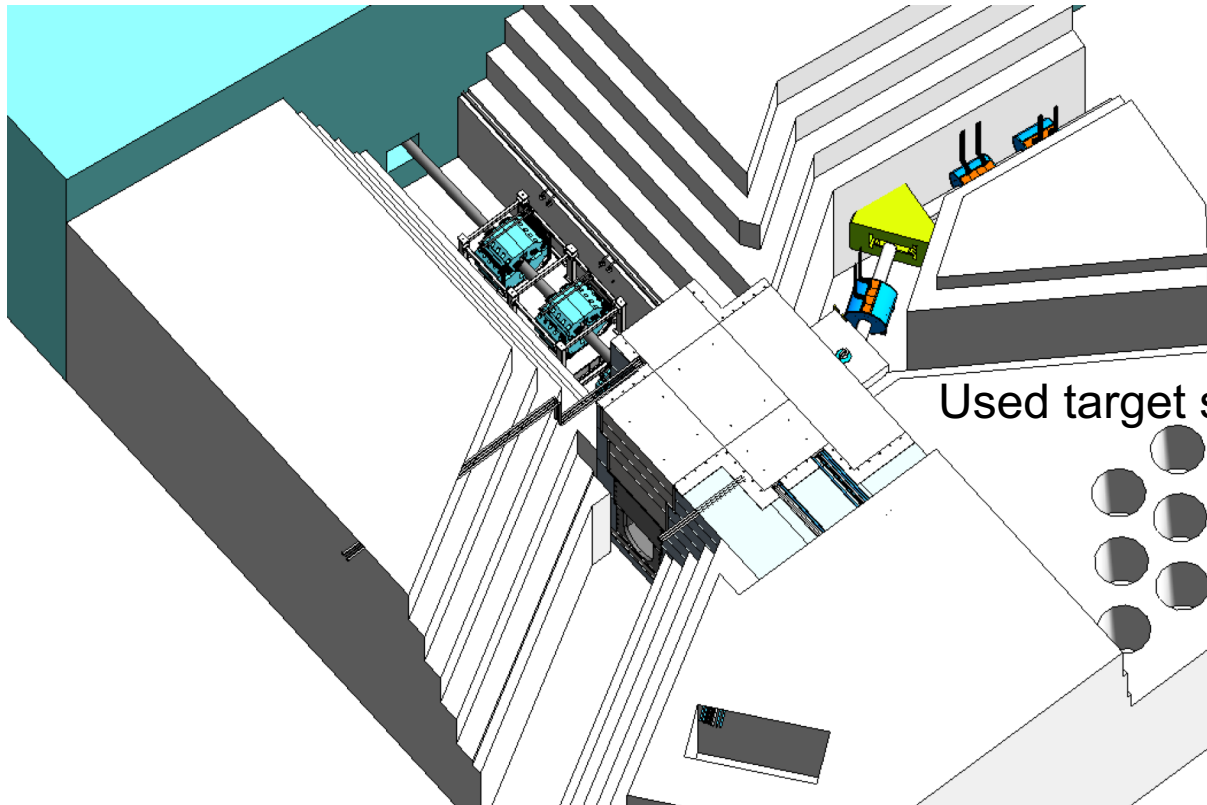


# MELODY Design



- Protons: 1.6GeV, 1 Hz (up to 5Hz), 130ns double pulses
- Muon beamlines: one **surface muon** and one decay muon beam
- Spectrometers: **1  $\mu$ SR spectrometer** and more...

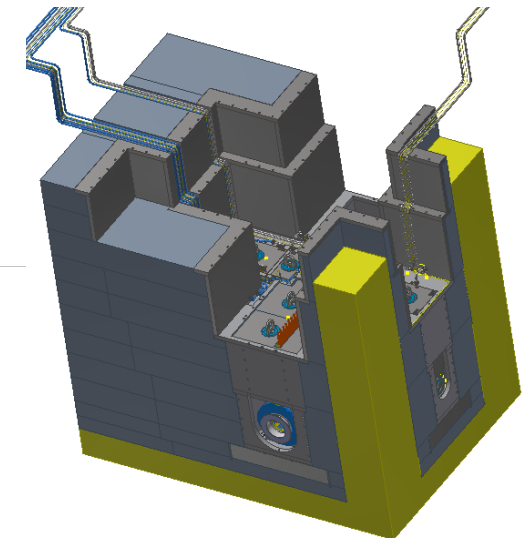
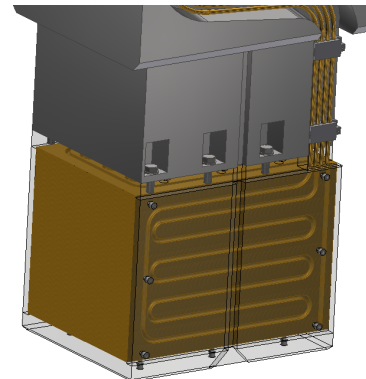
# Muon Target Station



Used target storage

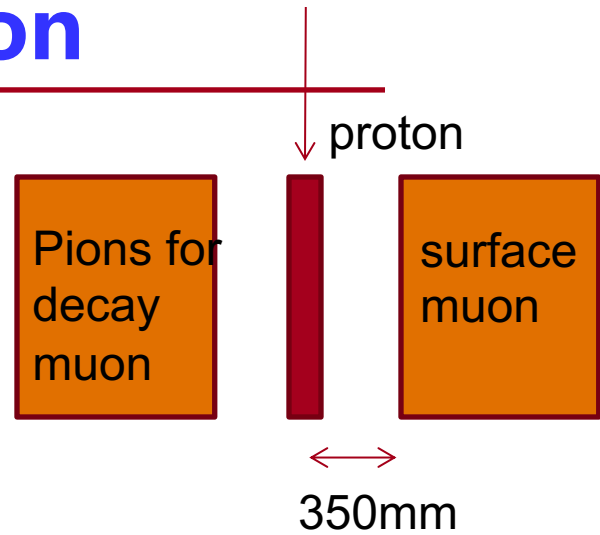
**Shielding:** Iron 5m\*4m\*4m  
Concrete 5.5\*5.5m\*1m

**Beam absorber:** Copper



# Muon Target Optimization

- Use **Copper/Graphite** as target
- Optimize the surface muon production with rotation of  $11^\circ$
- Optimum:  $240 \times 240 \times 11$  mm for Cu  
 $240 \times 240 \times 14$  mm for C

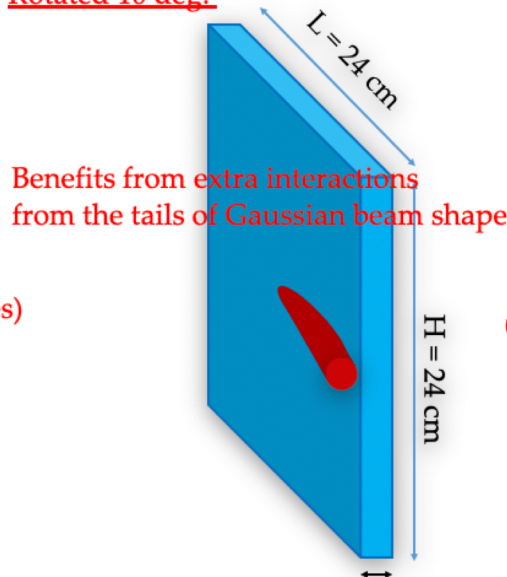


Semi-interaction



Schematics

Rotated 10 deg.

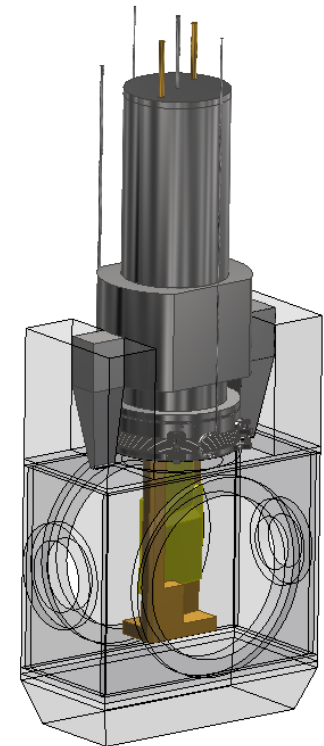
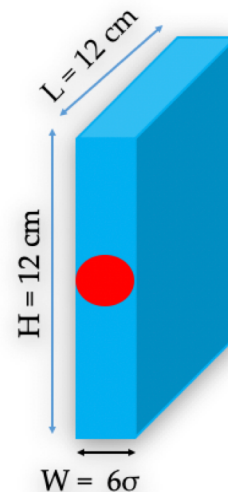


Benefits from extra interactions from the tails of Gaussian beam shape

$\approx$   
(muon rates)

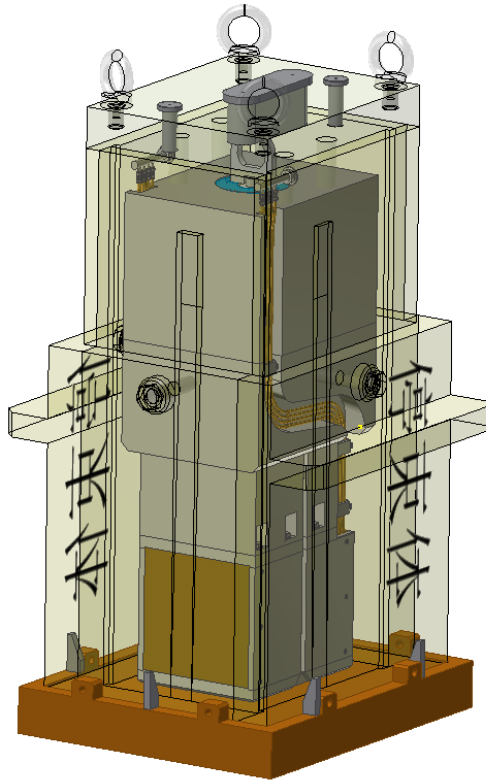
$>$   
(muon rates)

Classic

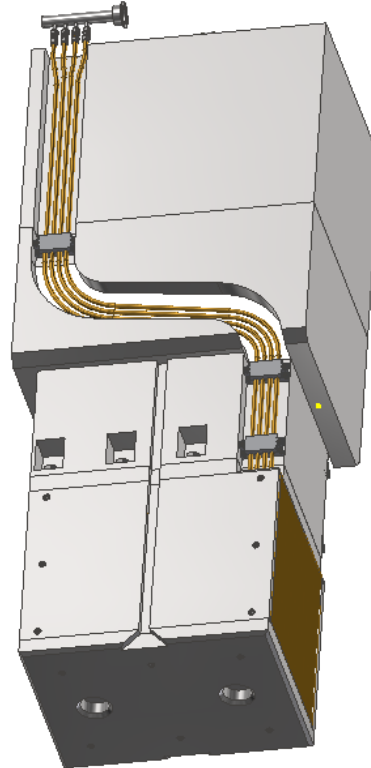


# Maintenance

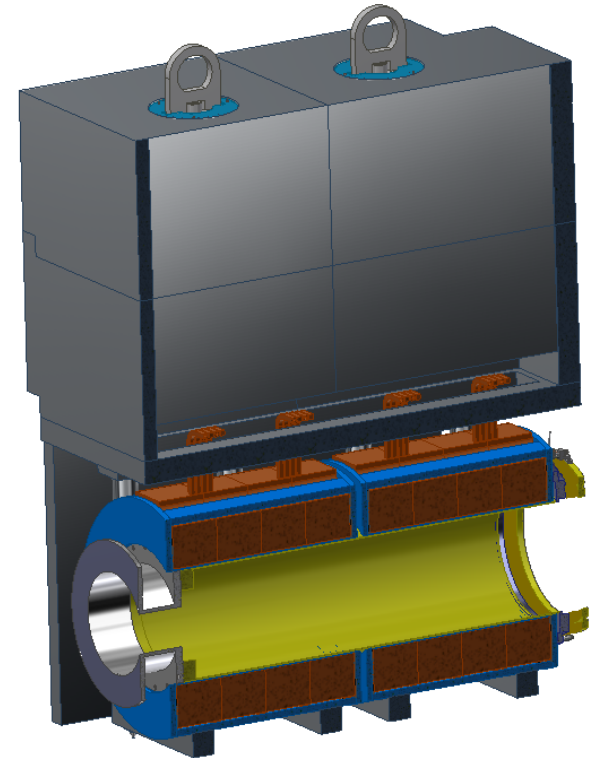
Target flask



Beam dump

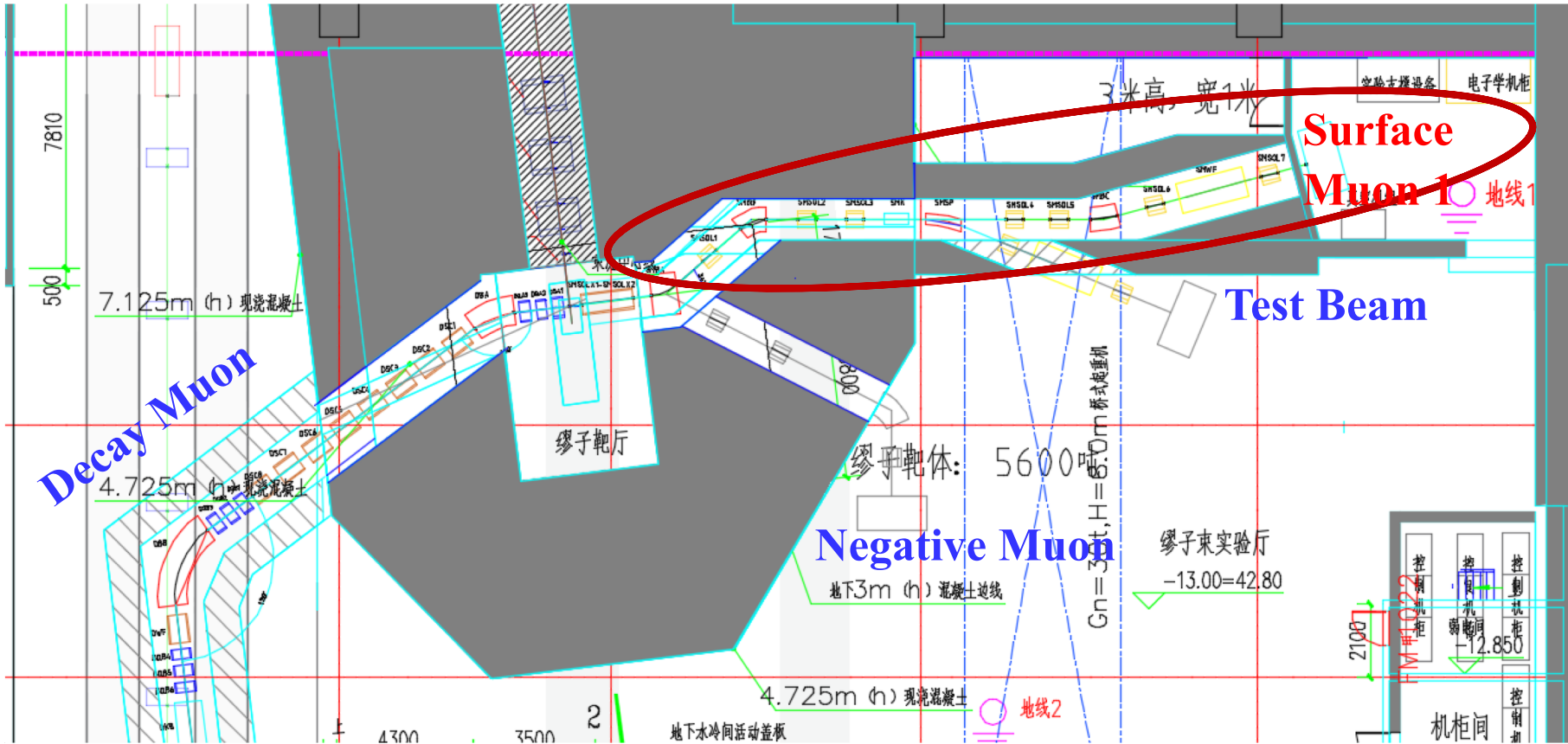


First solenoid



- Remote maintain from the top
- Target/magnets/absorber/flange
- Water cooling system

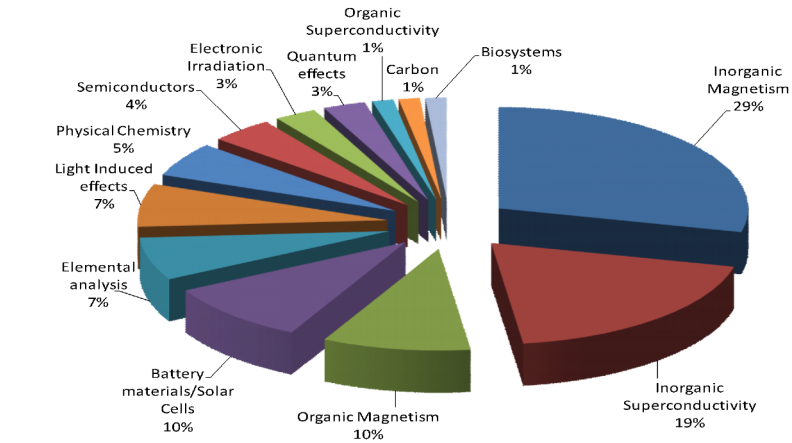
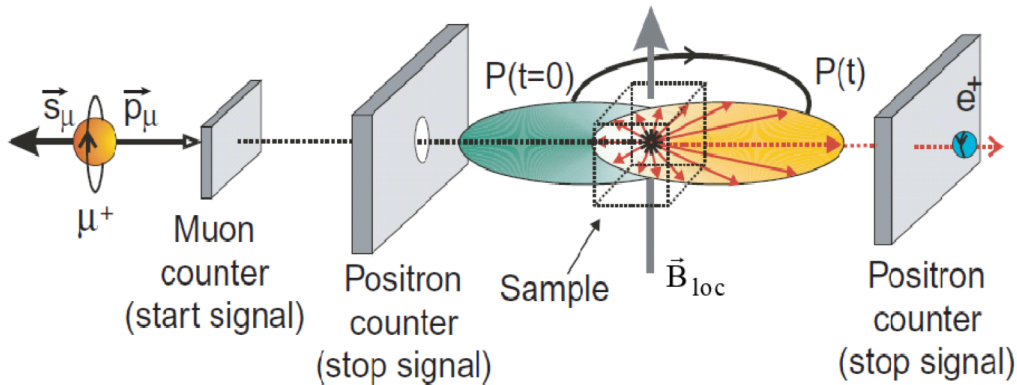
# Surface Muon Beam



- **Energy : 4 MeV**
- **Intensity :  $10^5 \sim 10^7 \mu^+ / s$**
- **Polarization: >95%**
- **Time Resolution: 120ns**

# Surface Muon application

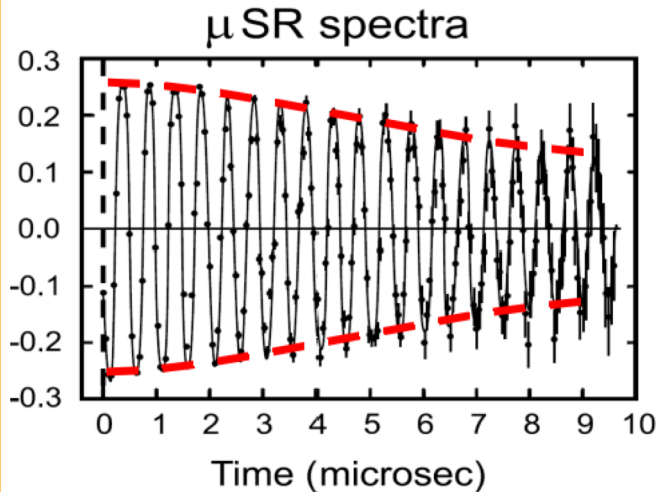
## Principle of MuSR



**MuSR** : Magnetic material, superconductivity, battery, semiconductor

**Advantage** : high magnetic sensitivity, short range magnetic order, all element

$A_0 P(t) \sim$  Muon Spin Polarization



$A_0 P(t)$  contains the physics:

**frequency**:  $\omega_L = \gamma_\mu B_{loc}$ , value of field at muon site

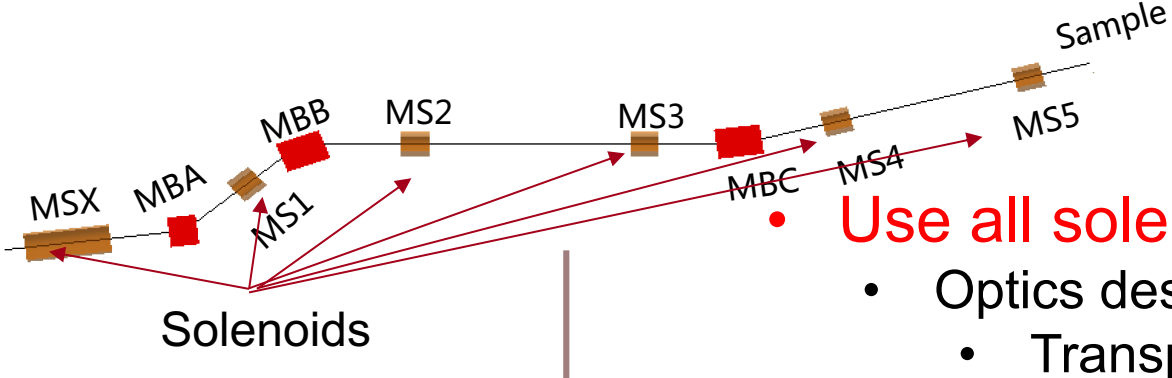
**damping**: width of field distribution, fluctuations

**amplitude**: magnetic/non-magnetic volume fraction, or Mu fraction

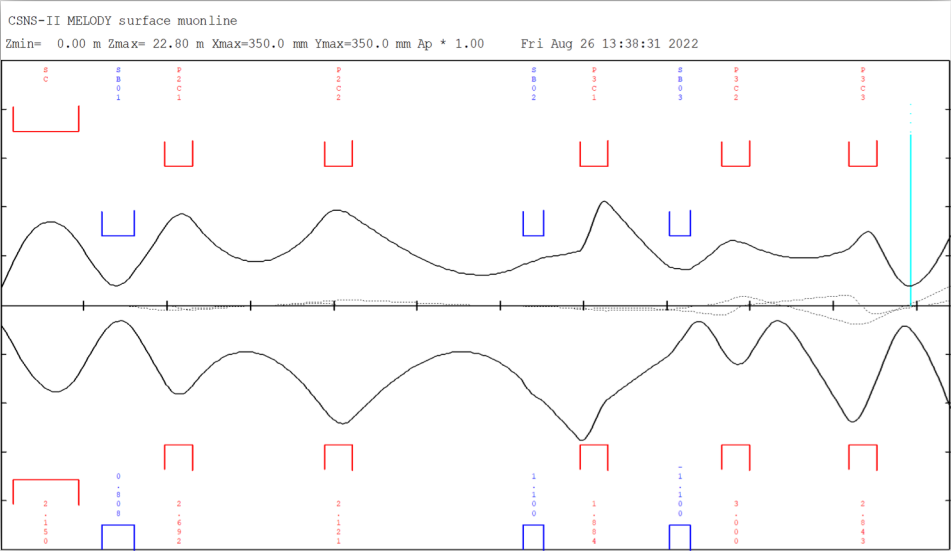
$$A_0 P(t) = [F(t) - B(t)] / [F(t) + B(t)]$$



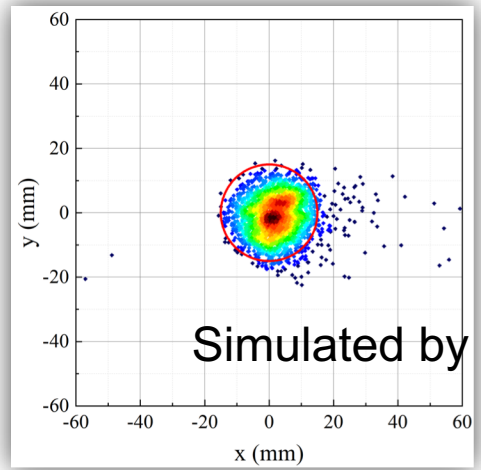
# Surface Muon Beamline Design



- Use all solenoids for focusing
- Optics design :
  - Transport
- Simulation:
  - G4beamline with  $10^{11}$  POT
- Fringe field shielding:
  - Reduce the fringe field at sample position



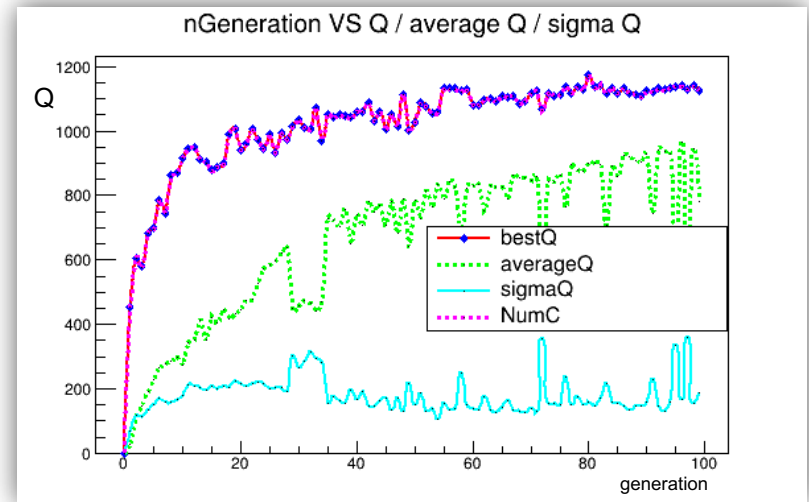
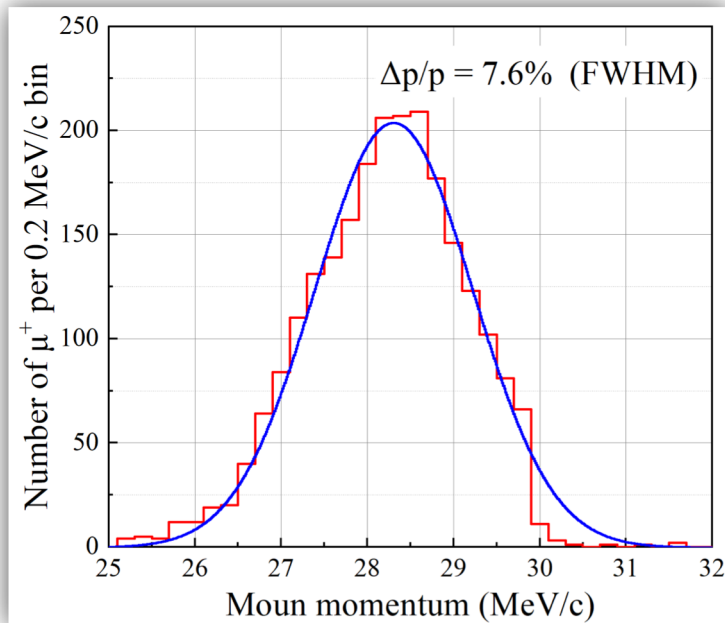
Designed by Transport



Simulated by G4beamline

# Optimization by A.I.

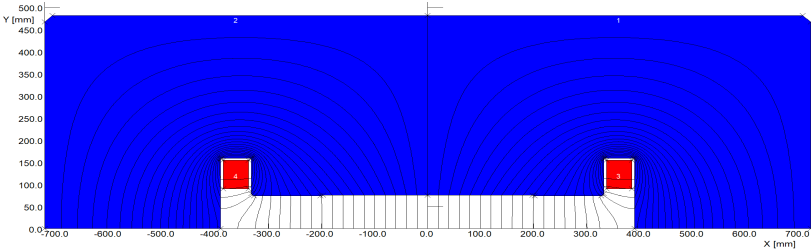
- Maximize the number of muons in the  $\Phi=30\text{mm}$  sample area
- Set the strength and positions of the 6 solenoids as tune parameters
- Start from a set of random parameters



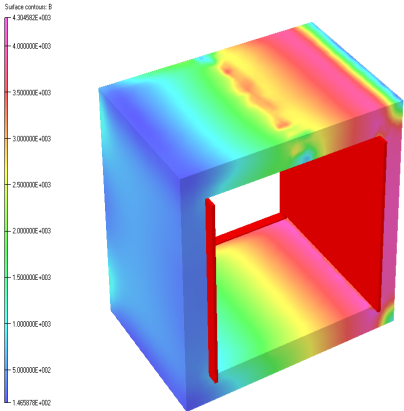
Parameters	G4bl simulation
x (FWHM)	1.64 cm
y (FWHM)	1.84 cm
$\Delta p/p$ (FWHM)	$\sim 7.6\%$
$\mu^+$ rate	$18.2 \times 10^5 \mu^+/s$
<b><math>\mu^+</math> rate on <math>\phi 30</math> mm</b>	<b><math>15.7 \times 10^5 \mu^+/s</math></b>
Core ratio	91.24%
<b>Polarization</b>	<b><math>\sim 95\%</math></b>
$e^+/\mu^+$	$< 0.01$

# Technique design of the magnets

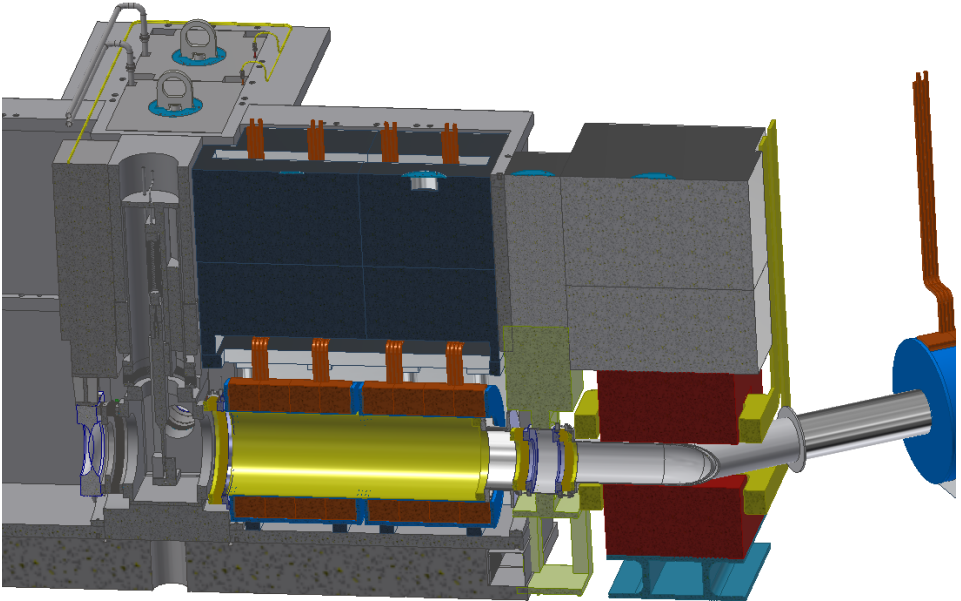
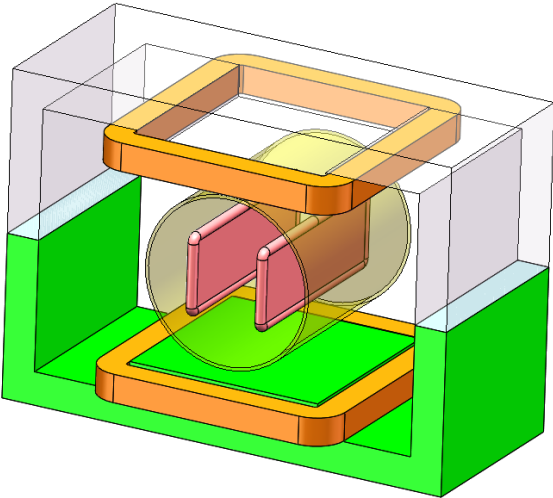
Dipole



Kicker

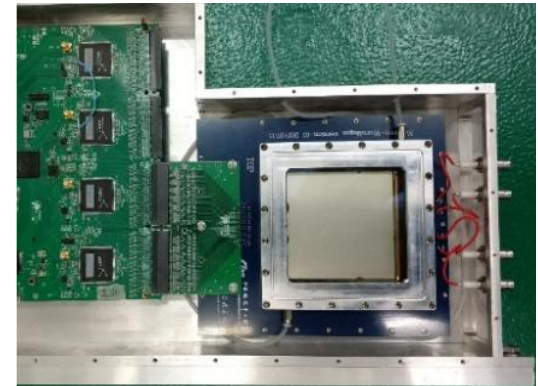
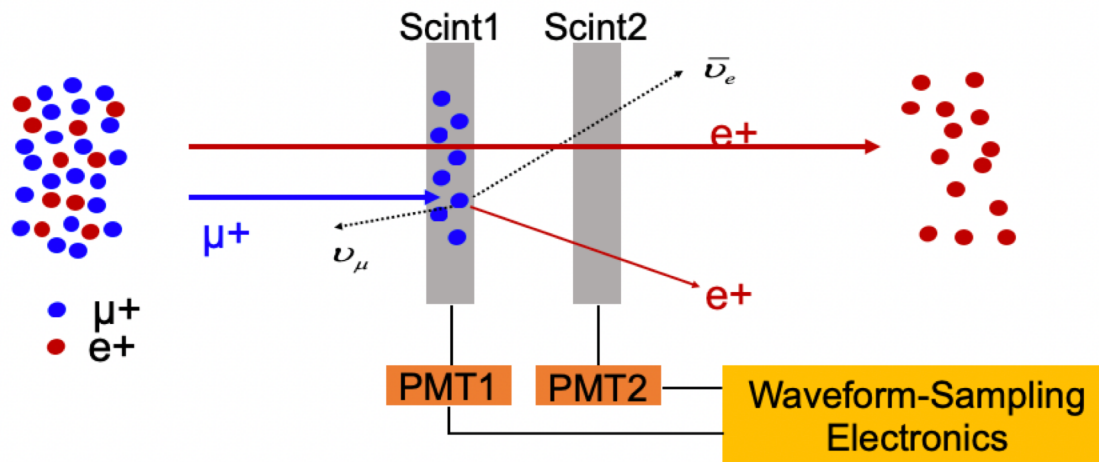


Wein filter



Mechanical design of the magnets

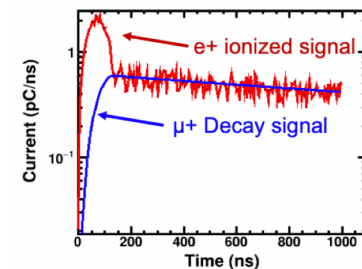
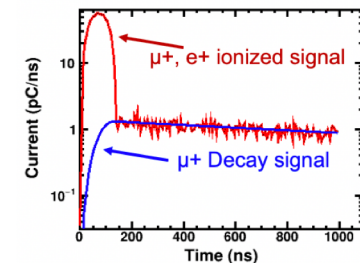
# Beam measurement



Beam spot monitor

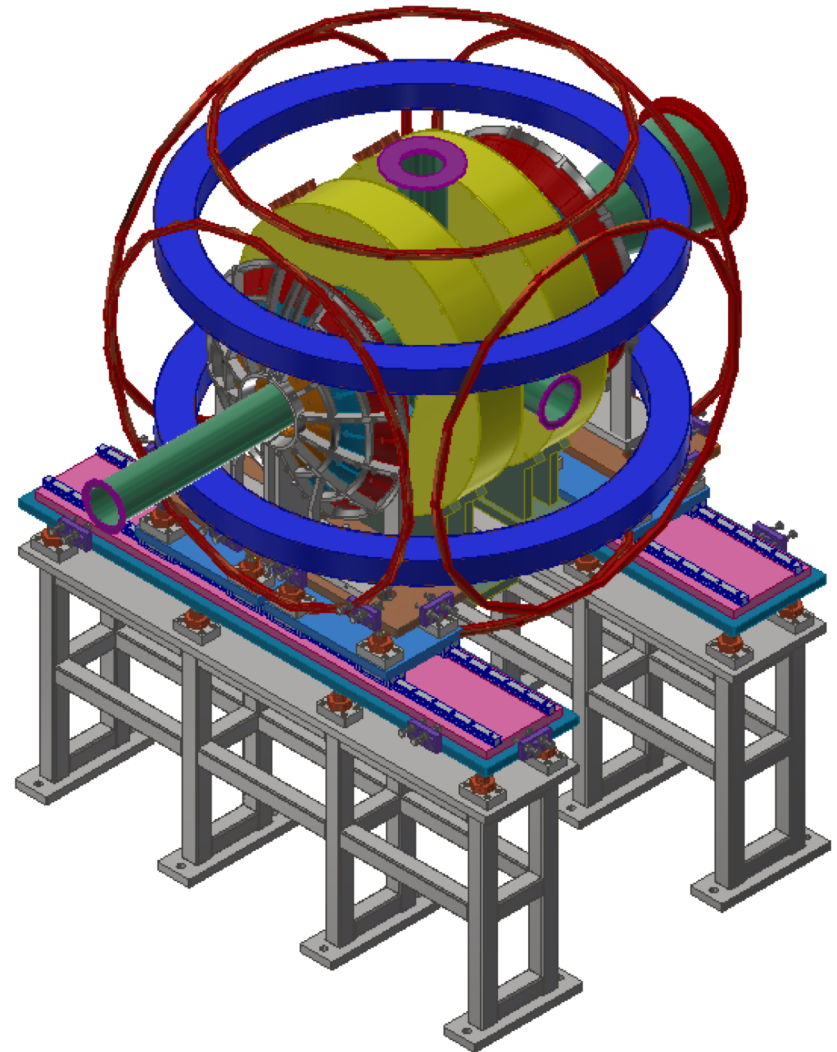
Beam intensity  
measurement

- Measure muon beam intensity by double scintillators
  - Distinguish positron content
- Measure beam spot size with a MicroMegas detector
- Challenge: high intensity in one pulse
  - Need more online tests



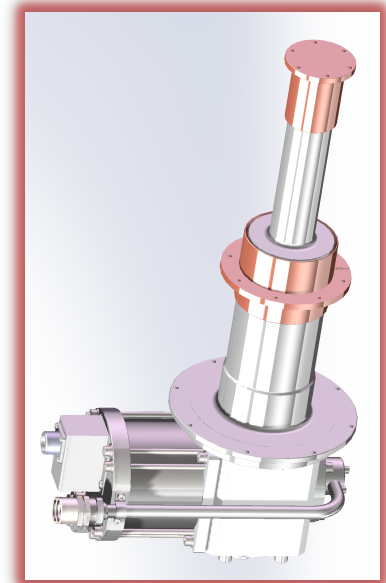
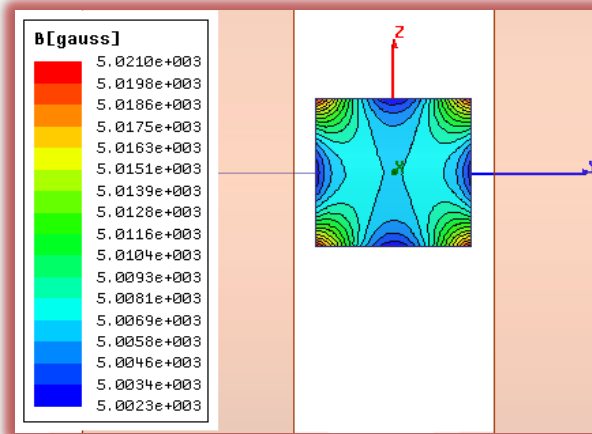
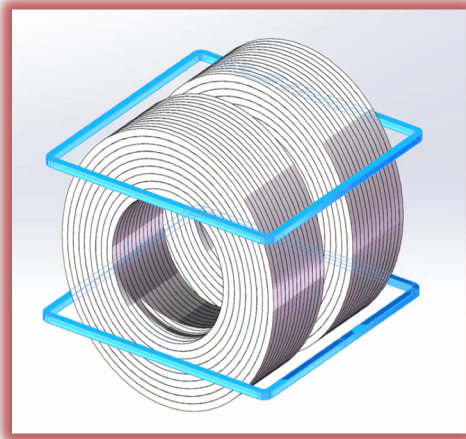
# $\mu$ SR Spectrometer

- **Feature:** High single-pulse intensity
- **Detector unit:**  $\sim 3000$  detectors (scintillator+SiPM) pointed to sample
- **Electronics:** ASIC based FEE + multi-stop TDC
- **Fly-pass structure**



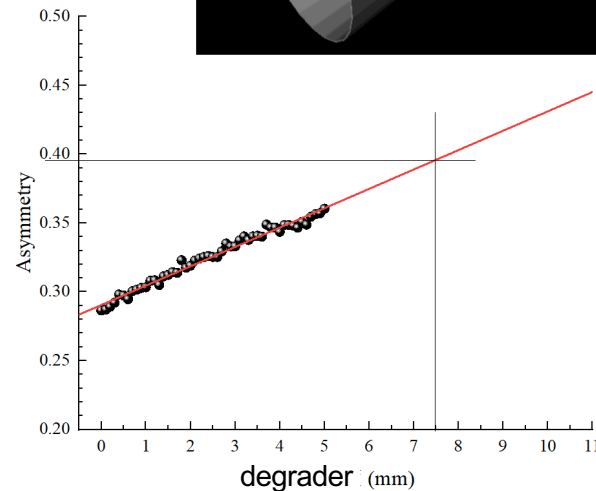
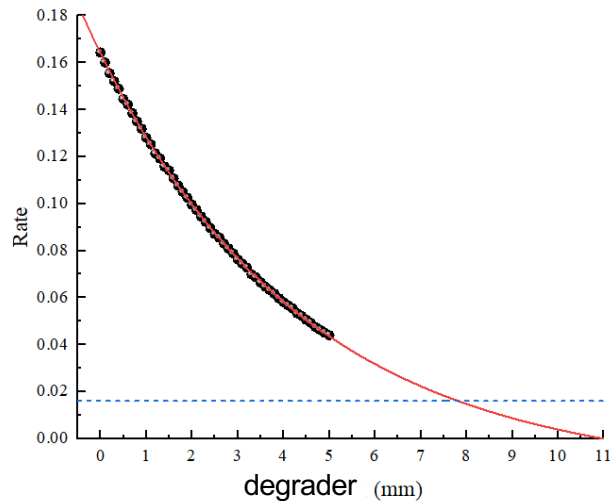
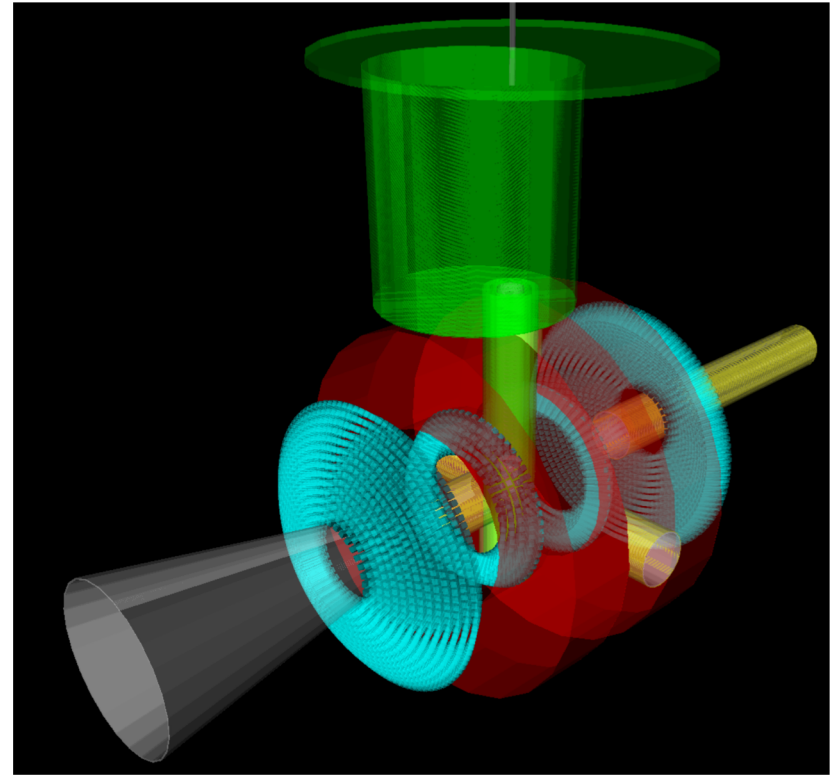
# Sample Environment

- **Magnetic field :**
  - LF:5000G , TF:400G
  - Homogeneity < 100ppm @ 40\*40\*10mm sample area
- **Low temperature :**
  - CCR: 10 K ~ 600K (Start-up)
  - Cryostat: 2 K ~ 300K (Future)
  - Upgrade to 300mK (Future)



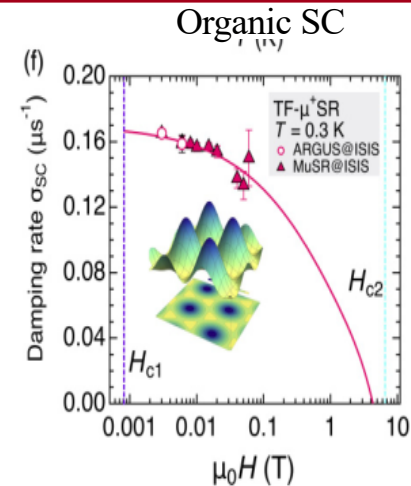
# Simulation

- Investigated the boundary conditions:
- Use thick degrader to increase the Asymmetry
- Simulated results:
  - Counting rate: 80 Mevents/h
  - Asymmetry: 0.31



# Pros and cons

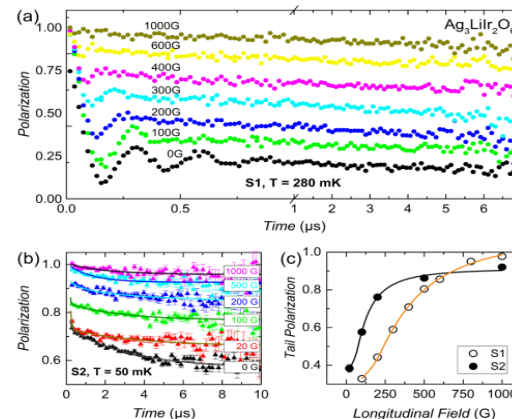
- **High single pulse intensity :**
  - Weak relaxing signal detection
  - Small beam spot
  - Beam slice to 10ns
- **High asymmetry :**
  - High precision



*Phys. Rev. B* **103** (2021) 125202

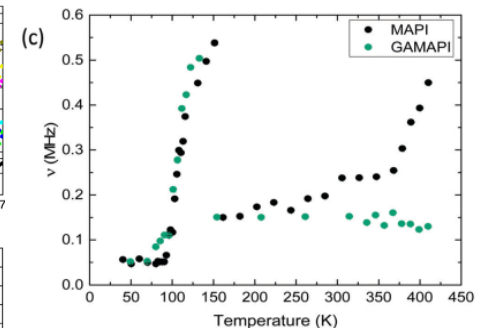
- **Low repetition rate :**
  - Low counting rate
  - More detectors
- **Large pulse width :**
  - Low time resolution
  - Beam slicing

## Spin Liquid



*Phys. Rev. B* **103**, (2021) 94427

## Batteries

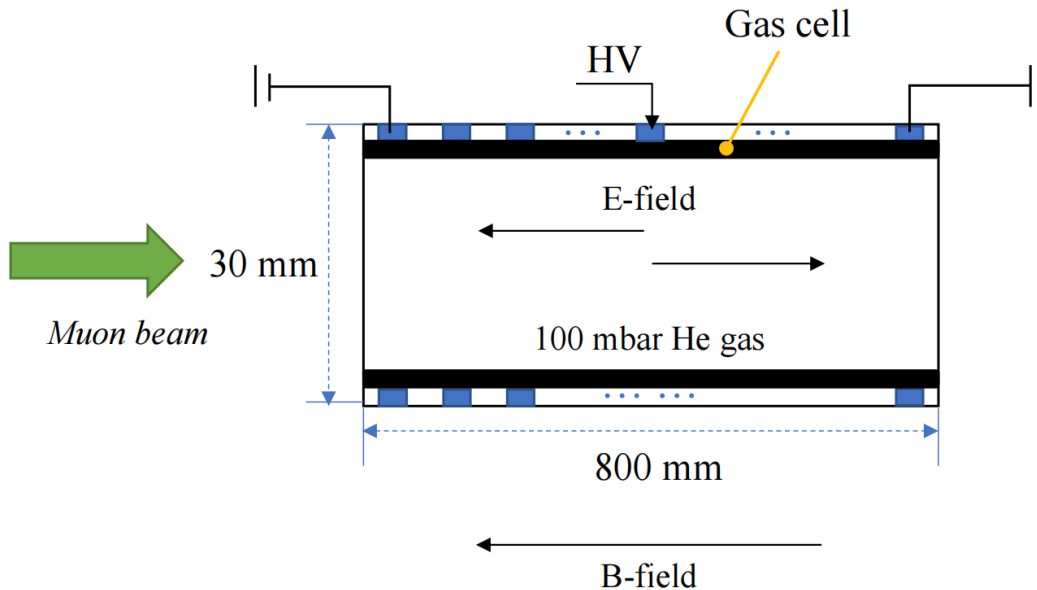


*Energy Environ. Sci.* **12**, (2019) 2264





# Muon moderation technology



- Use helium gas to stop muons
- Use electric field to steer muon out of the gas cell
- Bring 0.1% muons to 300 eV

- $\mu^+$  beam: 28 MeV/c,  $\frac{\Delta p}{p} = 8\%$  (FWHM),  $10^6 \mu^+$
- Beam spot size:  $\phi 10$  mm
- Energy degrader: 0.78 mm-thick carbon foil
- He gas: 100 mbar, 293 K
- Gas cell:  $\phi 30$  mm, length 800 mm
- Electric field:  $\sim 0.11$  kV/mm; HV applied at the center of the gas cell, i.e., decelerating (accelerating) E-field for the first (second) half
- Magnetic field: 5 T

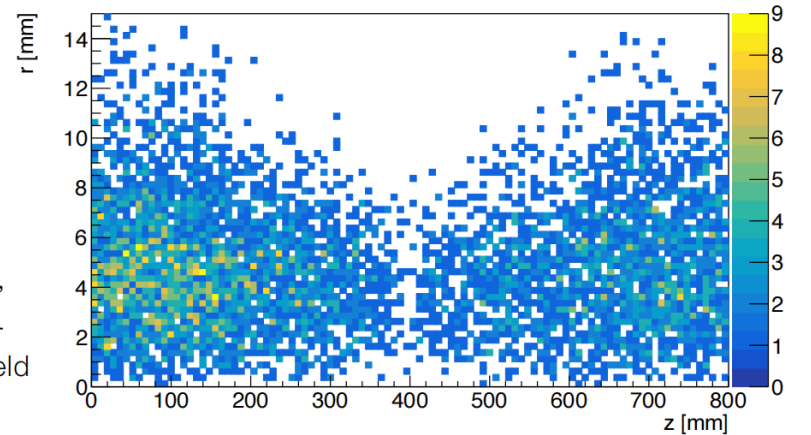
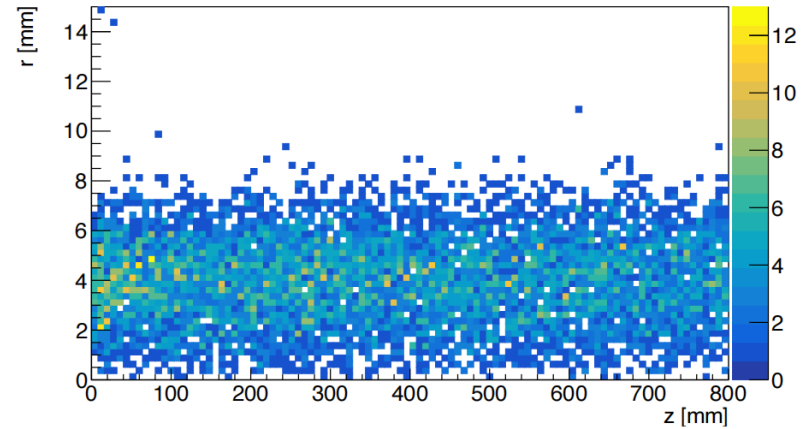
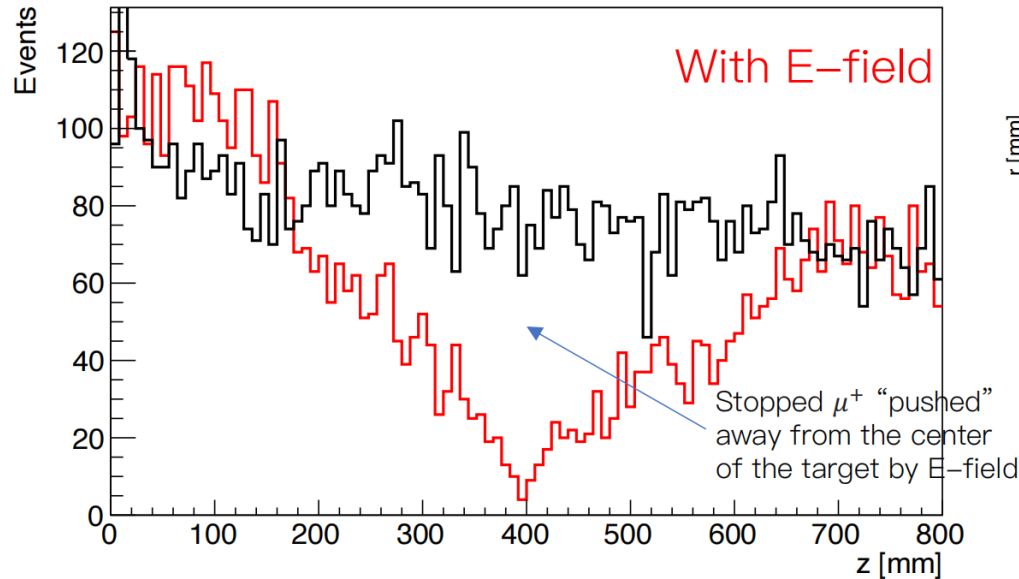
Key: use ESD material to remove the charge and to avoid breakdown in helium gas

# Muon moderation technology

## Simulation

$\mu^+$  stopped in He gas

No E-field



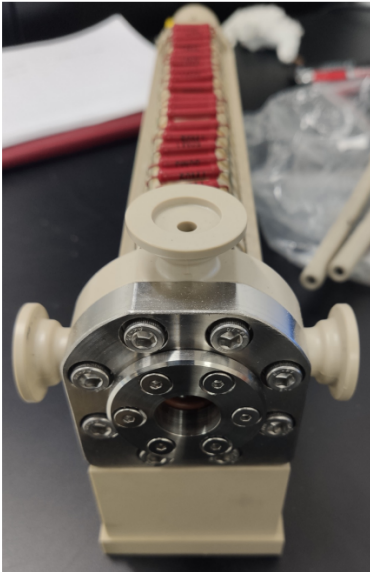
3

Going to be tested at ISIS...

# Muon moderation technology

## FCD Experiment

Gas cell

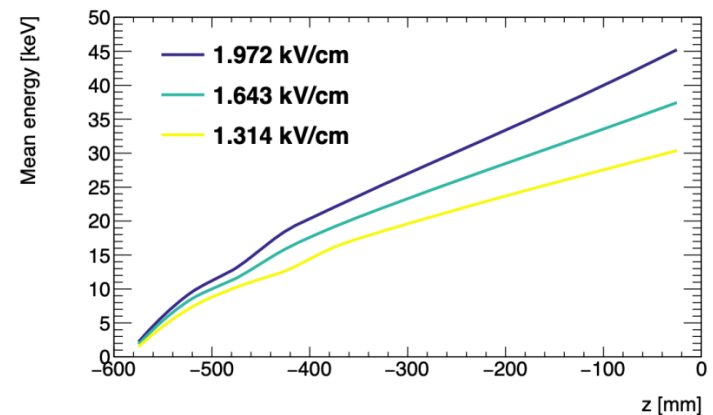


Proton source:  
Am-241 + Mylar foil

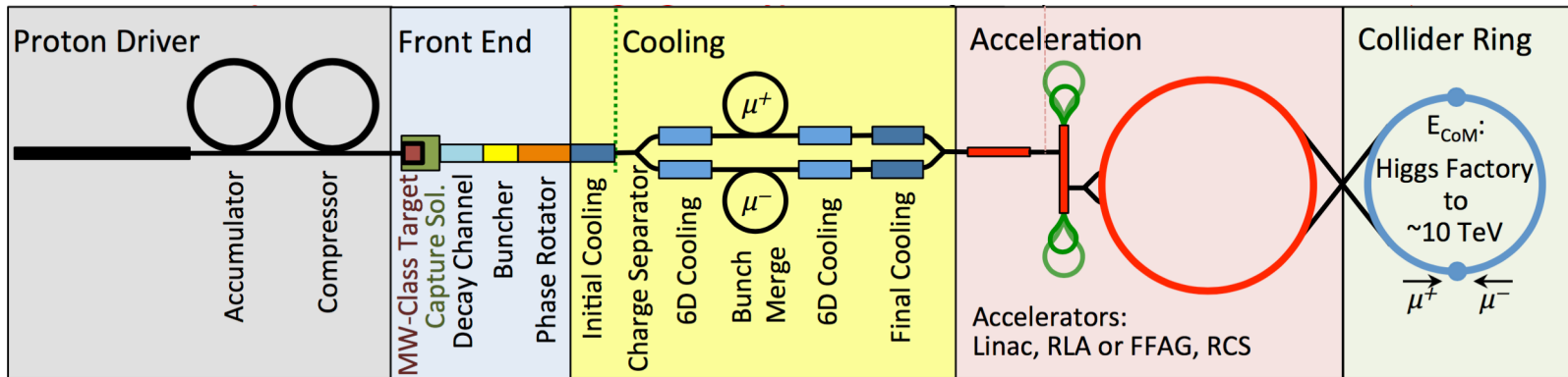
Frictional cooling demonstration experiment with proton



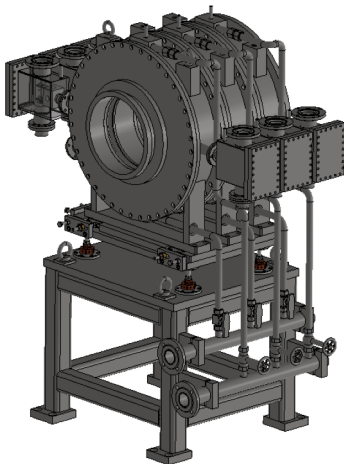
G4bl simulation  
He gas: 1 mbar, 293 K  
Proton initial energy: 1 eV  
Proton initial  $z \sim -600$  mm



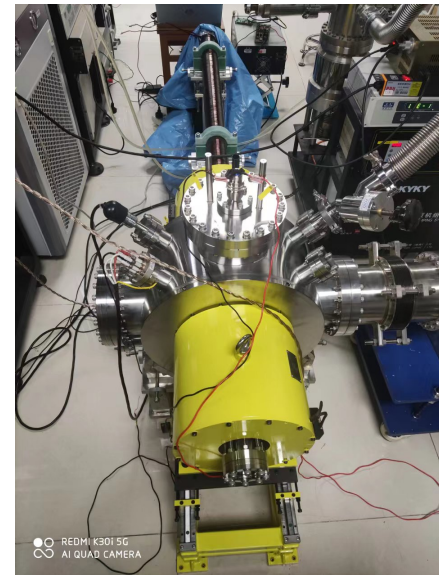
# Muon de/acceleration/cooling



- Develop technologies for Muon Collider/Neutrino factory
  - Muon cooling
  - Phase rotation
  - Muon acceleration



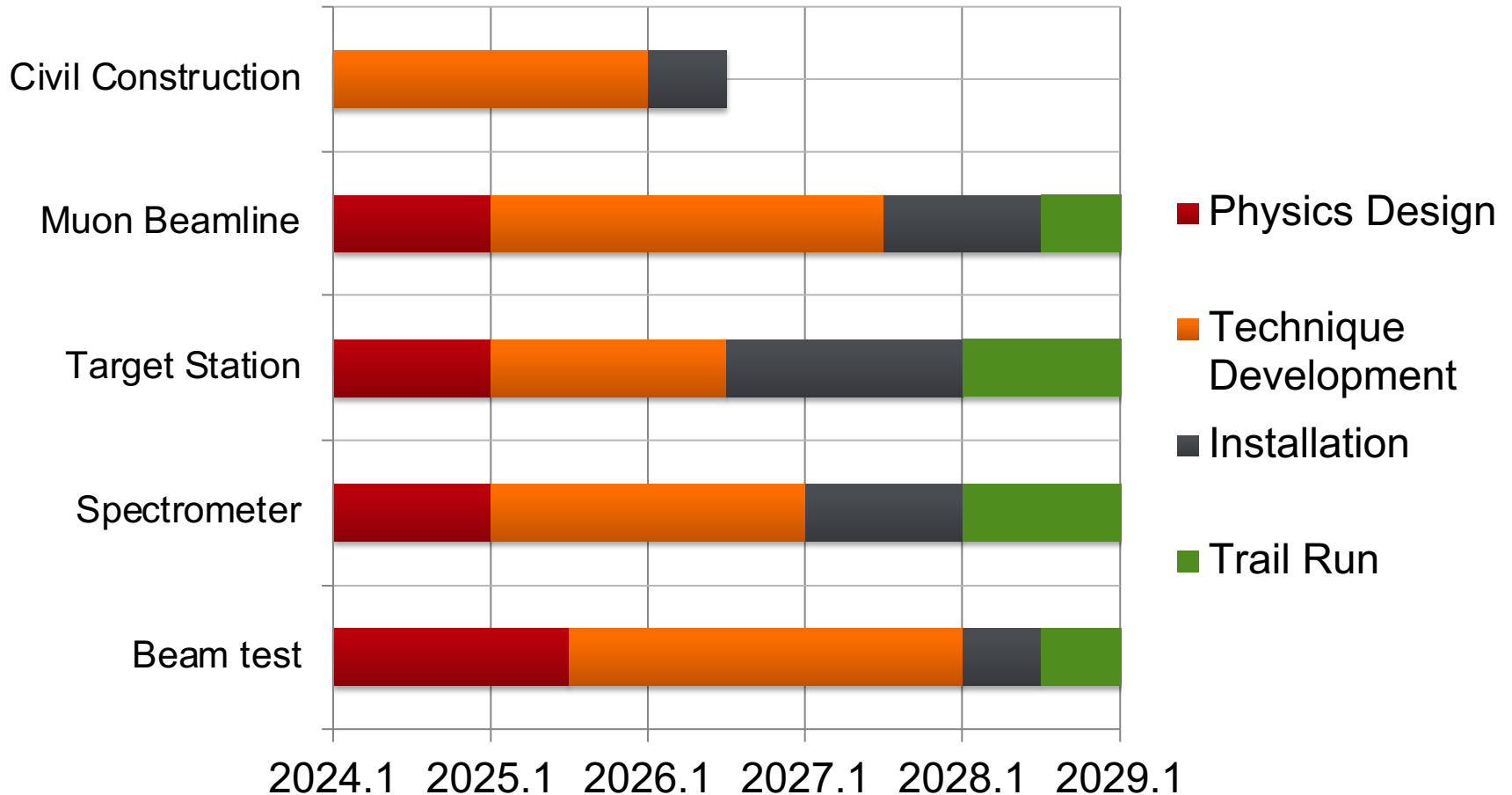
Induction cavity for phase rotation



Magnetic mirror for muonium physics

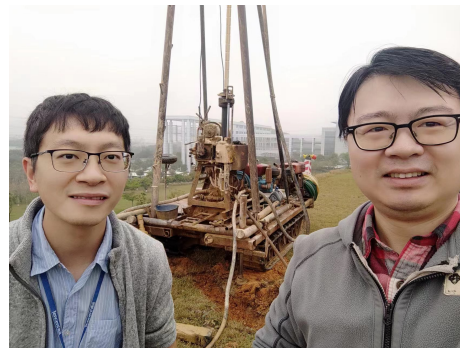
# Timeline of MELODY

Project has been approved and will be built in 5 years.

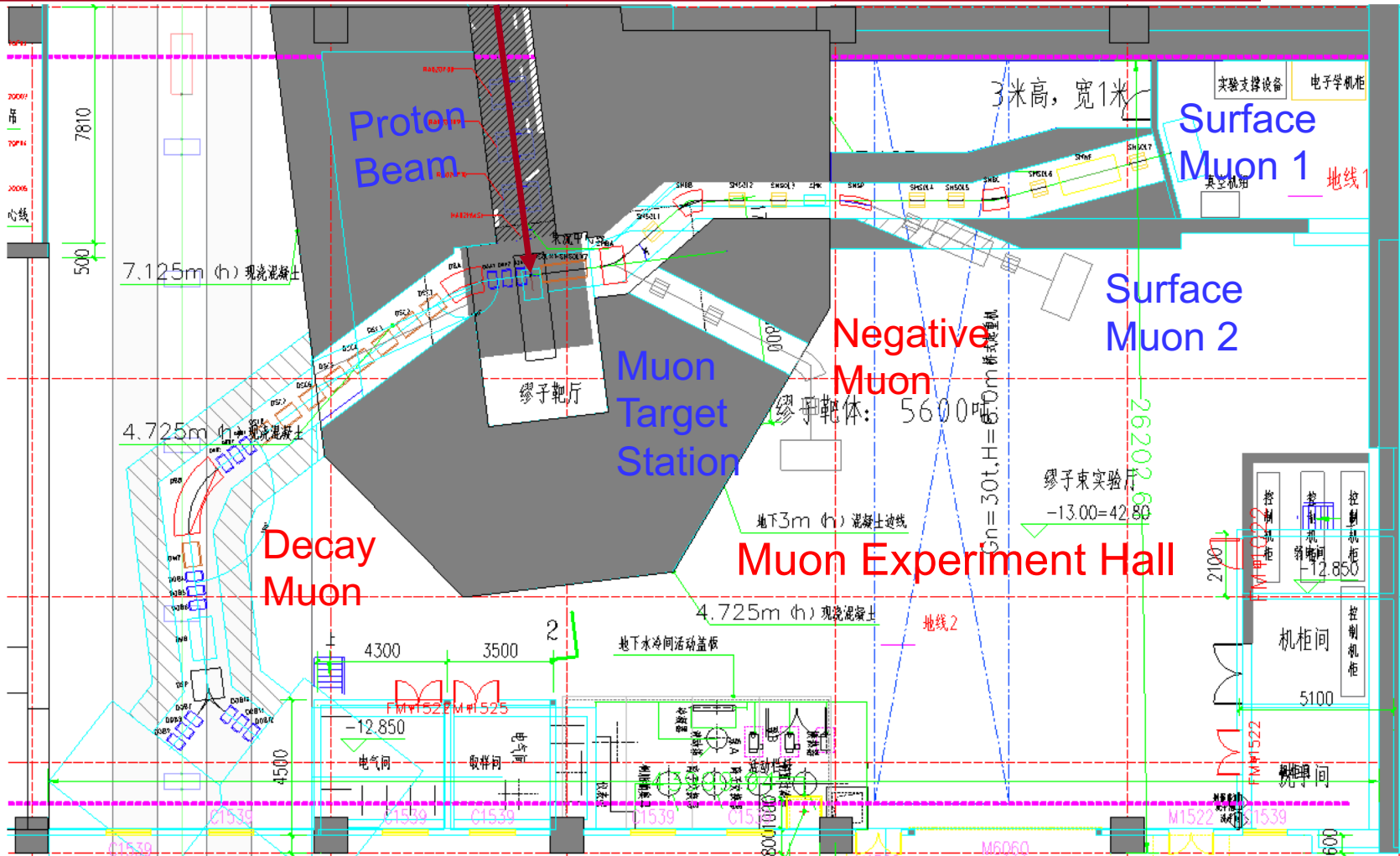


# First Geosurvey

First Geosurvey has been carried out at the muon hall



# Prospect with MELODY II



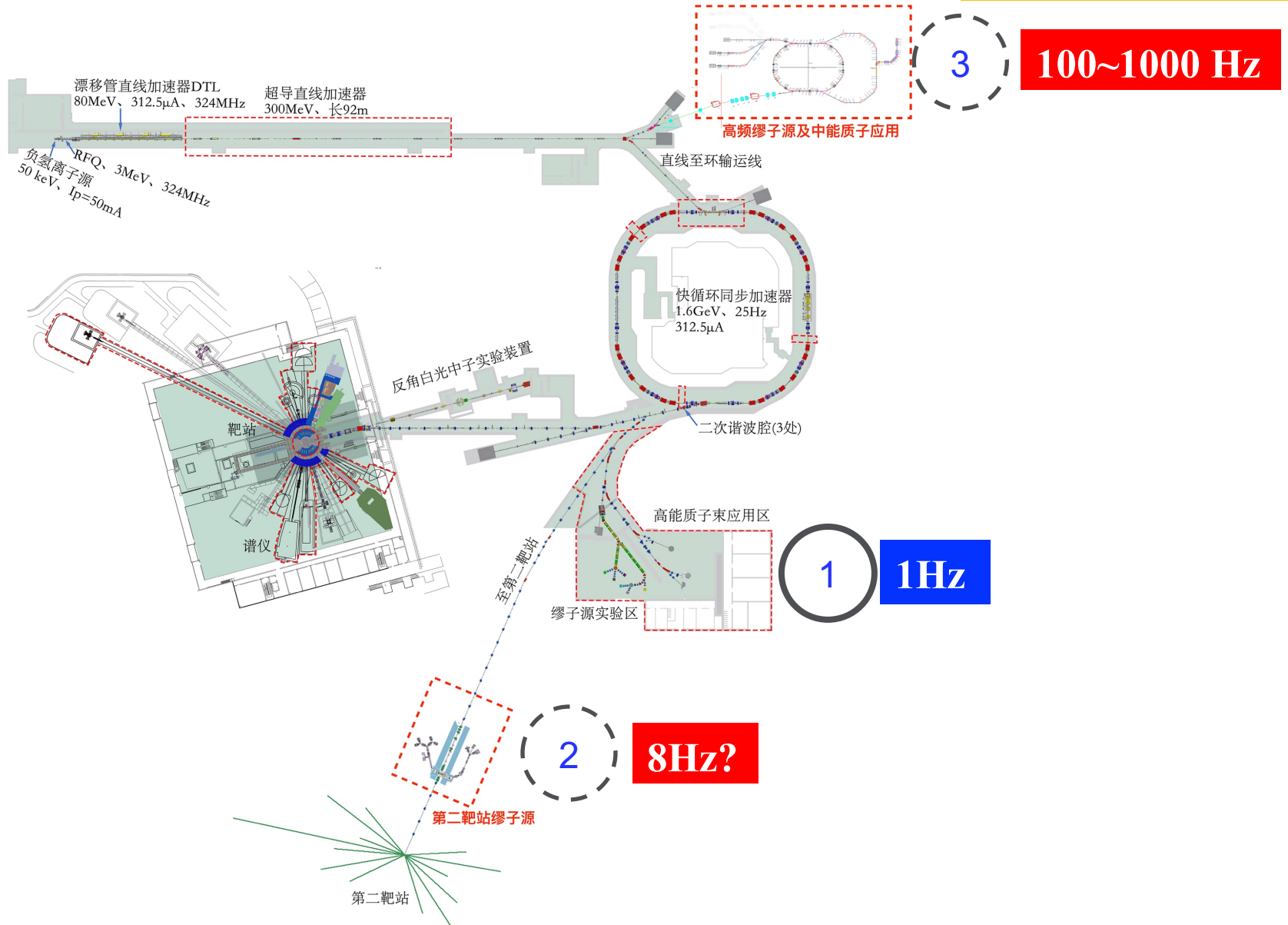
- Pion/Decay muon beam : 120MeV/c
- Negative muon beam: 30MeV/c
- Higher repetition rate: up to 5 Hz
- More terminals :
  - Various spectrometers
  - Muon imaging
  - Muonic X-ray



# Muon Beam Parameters

	Surface Muon	Negative Muon	Decay Muon
Proton Power ( kW )	20	Up to 100	Up to 100
Pulse width ( ns )	130 to 10	500	130 to 10
Muon intensity ( /s )	$10^5 \sim 10^6$	Up to $5 \cdot 10^6$	Up to $5 \cdot 10^6$
Polarization ( % )	>95	>95	50~95
Positron ( % )	<1%	NA	<1%
Repetition ( Hz )	1	Up to 5	Up to 5
Terminals	2	1~2	2
Muon Momentum ( MeV/c )	30	30	Up to 120
Full Beam Spot ( mm )	10 ~ 30	10 ~ 30	10~30

# High rEpetition Muon Source (HEMS)



# Summary

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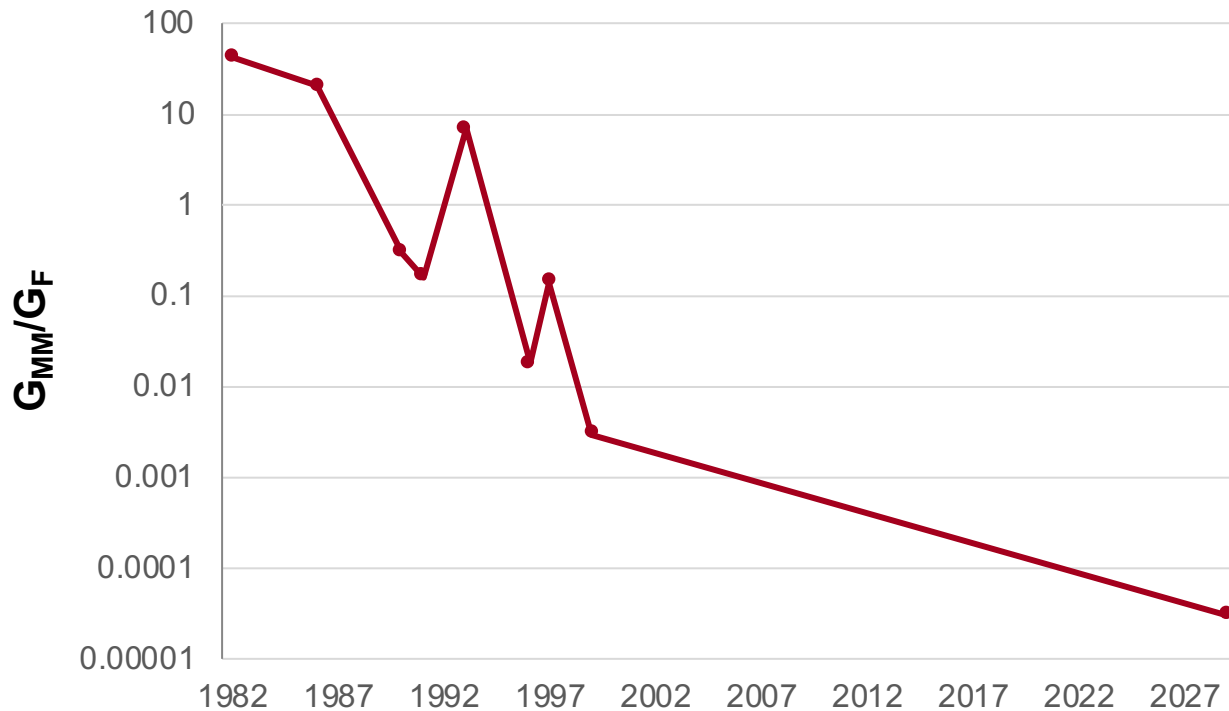
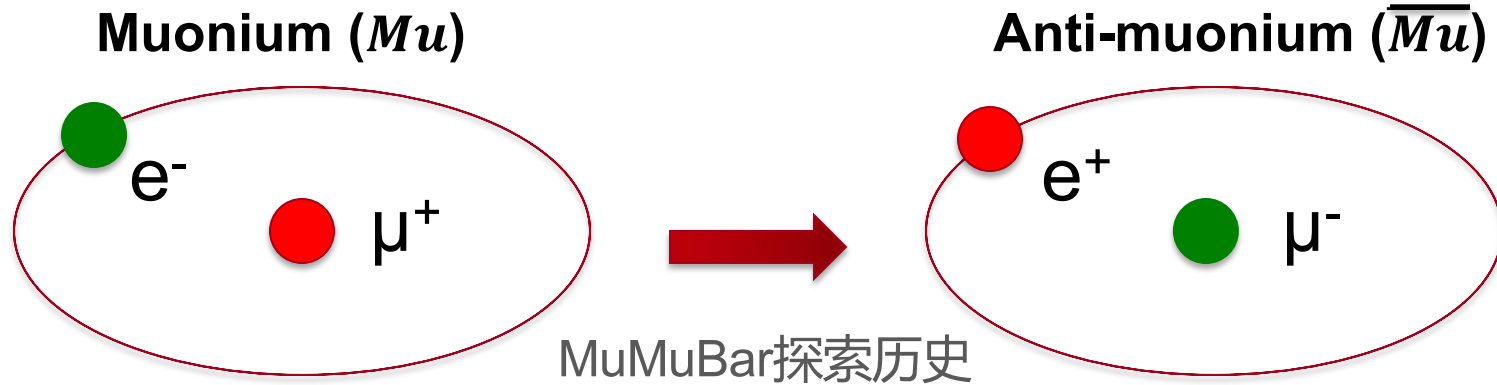
- MELODY has been approved by the government, and will start construction soon.
- Phase I of MELODY will build a target station with one surface muon beam and one muSR spectrometer.
- A negative muon beam and a decay muon beam will be built in the future.
- A high repetition muon source is under consideration.

All collaboration is welcome!

**THANK YOU !**

# backups

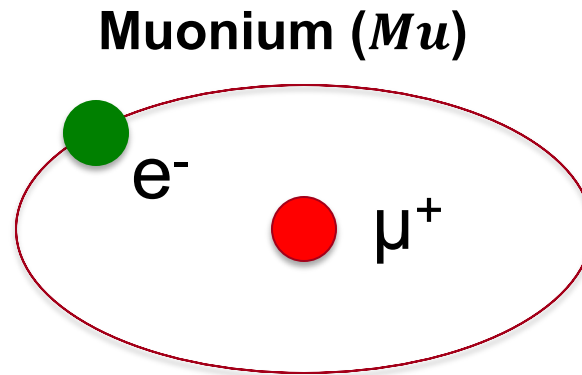
# Potential muon physics - MuMuBar?





# MuMuBar requires High Repetition Muons

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Total intensity :  $> 2 \cdot 10^8 \mu^+/\text{s}$

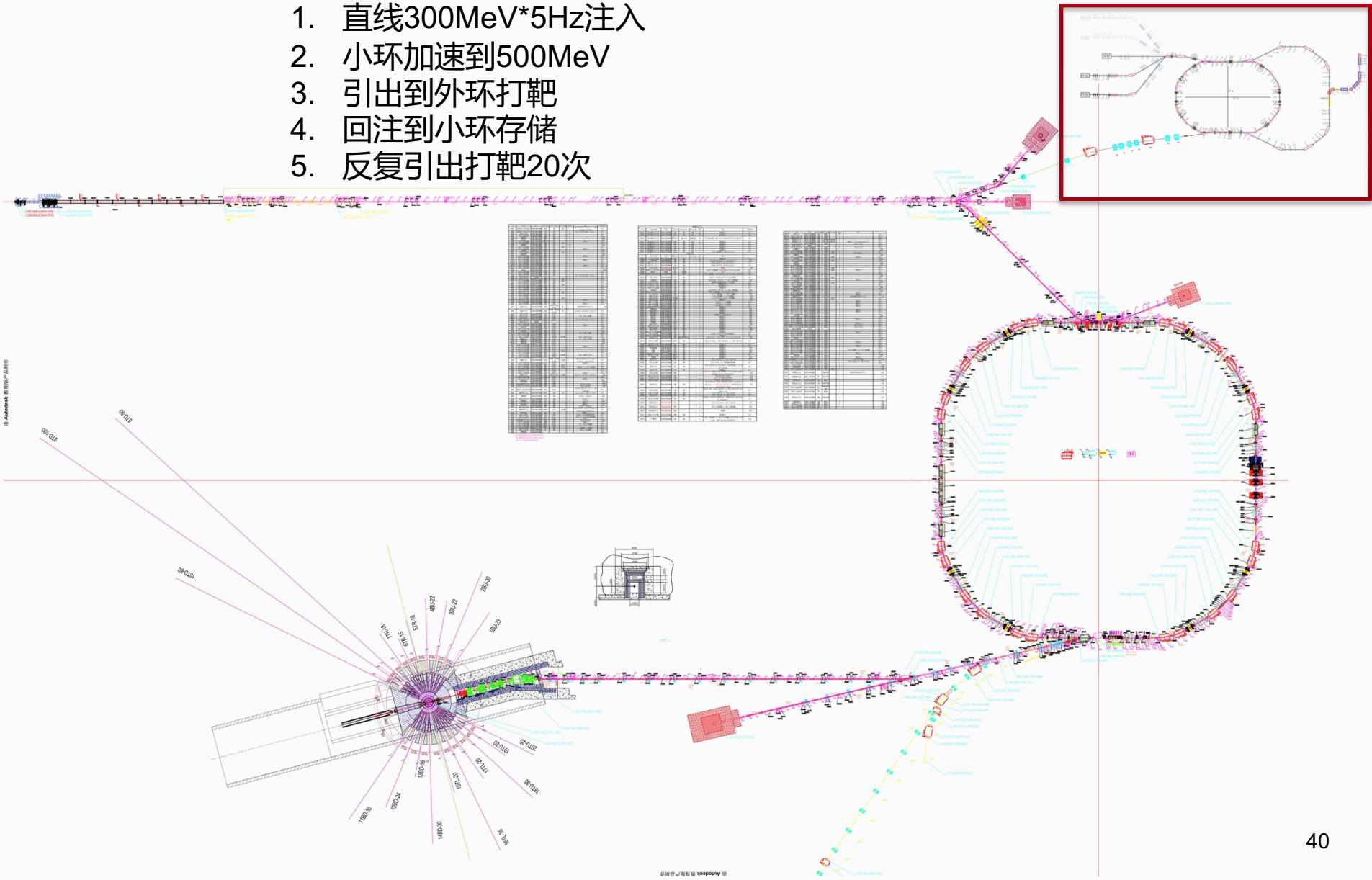
Single Pulse intensity :  $< 5 \cdot 10^6$



Repetition  $> 40\text{Hz}$

# High repetition Muon Source - HEMS

1. 直线300MeV\*5Hz注入
2. 小环加速到500MeV
3. 引出到外环打靶
4. 回注到小环存储
5. 反复引出打靶20次



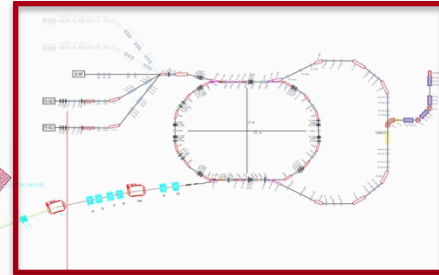


# High rEpetition Muon Soure - HEMS

不影响大环/  
中子靶运行

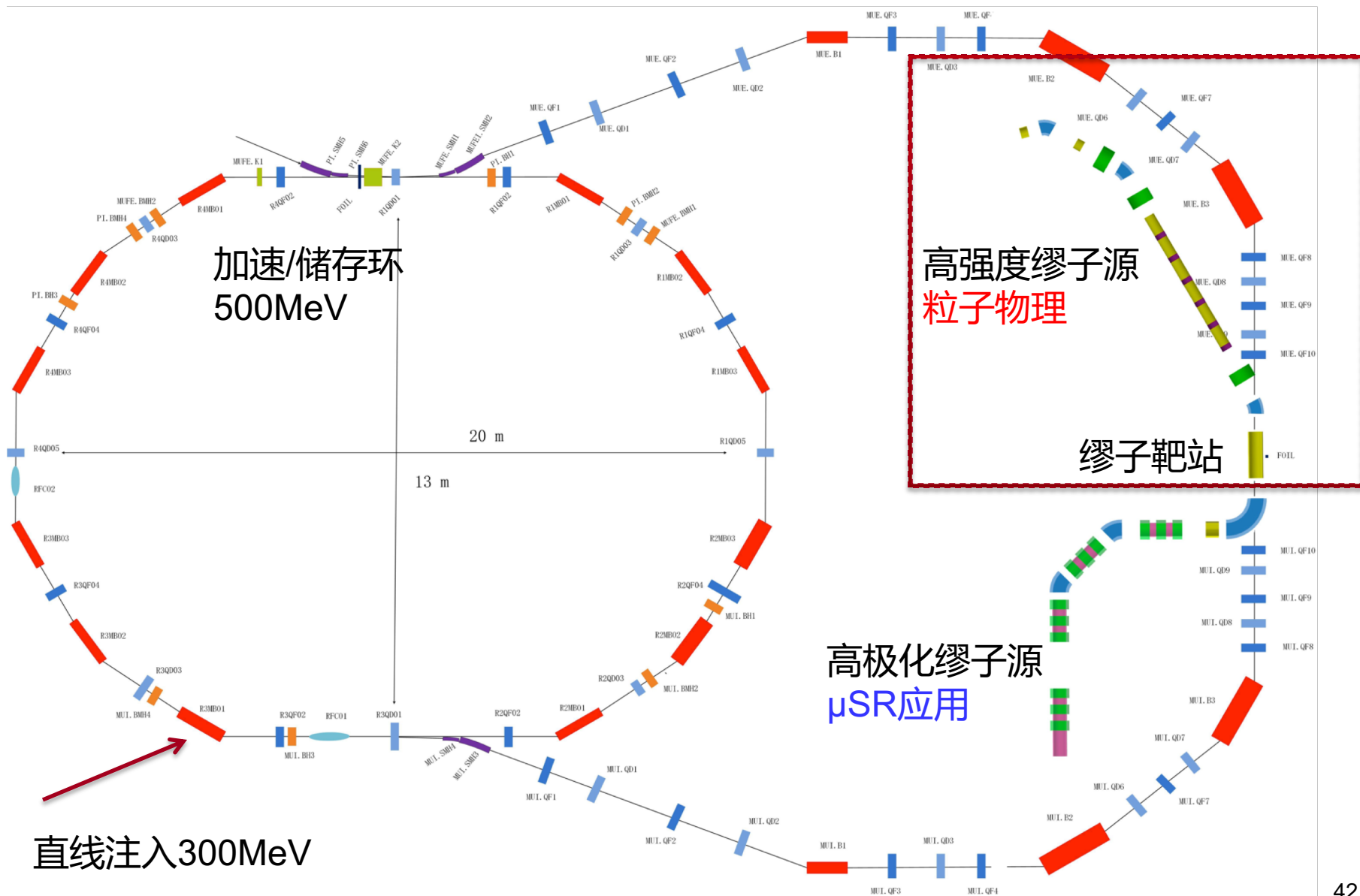
1. 直线300MeV\*5Hz注入
2. 小环加速到500MeV
3. 引出到外环打靶
4. 回注到小环存储
5. 反复引出打靶20次

重复频率  
100Hz



Station ID	Station Name	Station Type	Station Length (m)	Station Position (m)
01-01	Injection Linac	Linac	100	0
01-02	Transfer Line	Transfer	50	100
01-03	Small Ring	Storage	100	150
01-04	Transfer Line	Transfer	50	250
01-05	Large Ring	Storage	1000	300
01-06	Transfer Line	Transfer	50	1300
01-07	Target Station	Target	10	1350
01-08	Transfer Line	Transfer	50	1400
01-09	Small Ring	Storage	100	1450
01-10	Transfer Line	Transfer	50	1550
01-11	Large Ring	Storage	1000	1600
01-12	Transfer Line	Transfer	50	2600
01-13	Target Station	Target	10	2650
01-14	Transfer Line	Transfer	50	2700
01-15	Small Ring	Storage	100	2750
01-16	Transfer Line	Transfer	50	2850
01-17	Large Ring	Storage	1000	2900
01-18	Transfer Line	Transfer	50	3900
01-19	Target Station	Target	10	3950
01-20	Transfer Line	Transfer	50	4000
01-21	Small Ring	Storage	100	4050
01-22	Transfer Line	Transfer	50	4150
01-23	Large Ring	Storage	1000	4200
01-24	Transfer Line	Transfer	50	5200
01-25	Target Station	Target	10	5250
01-26	Transfer Line	Transfer	50	5300
01-27	Small Ring	Storage	100	5350
01-28	Transfer Line	Transfer	50	5450
01-29	Large Ring	Storage	1000	5500
01-30	Transfer Line	Transfer	50	6500
01-31	Target Station	Target	10	6550
01-32	Transfer Line	Transfer	50	6600
01-33	Small Ring	Storage	100	6650
01-34	Transfer Line	Transfer	50	6750
01-35	Large Ring	Storage	1000	6800
01-36	Transfer Line	Transfer	50	7800
01-37	Target Station	Target	10	7850
01-38	Transfer Line	Transfer	50	7900
01-39	Small Ring	Storage	100	7950
01-40	Transfer Line	Transfer	50	8050
01-41	Large Ring	Storage	1000	8100
01-42	Transfer Line	Transfer	50	9100
01-43	Target Station	Target	10	9150
01-44	Transfer Line	Transfer	50	9200
01-45	Small Ring	Storage	100	9250
01-46	Transfer Line	Transfer	50	9350
01-47	Large Ring	Storage	1000	9400
01-48	Transfer Line	Transfer	50	10400
01-49	Target Station	Target	10	10450
01-50	Transfer Line	Transfer	50	10500
01-51	Small Ring	Storage	100	10550
01-52	Transfer Line	Transfer	50	10650
01-53	Large Ring	Storage	1000	10700
01-54	Transfer Line	Transfer	50	11700
01-55	Target Station	Target	10	11750
01-56	Transfer Line	Transfer	50	11800
01-57	Small Ring	Storage	100	11850
01-58	Transfer Line	Transfer	50	11950
01-59	Large Ring	Storage	1000	12000
01-60	Transfer Line	Transfer	50	13000
01-61	Target Station	Target	10	13050
01-62	Transfer Line	Transfer	50	13100
01-63	Small Ring	Storage	100	13150
01-64	Transfer Line	Transfer	50	13250
01-65	Large Ring	Storage	1000	13300
01-66	Transfer Line	Transfer	50	14300
01-67	Target Station	Target	10	14350
01-68	Transfer Line	Transfer	50	14400
01-69	Small Ring	Storage	100	14450
01-70	Transfer Line	Transfer	50	14550
01-71	Large Ring	Storage	1000	14600
01-72	Transfer Line	Transfer	50	15600
01-73	Target Station	Target	10	15650
01-74	Transfer Line	Transfer	50	15700
01-75	Small Ring	Storage	100	15750
01-76	Transfer Line	Transfer	50	15850
01-77	Large Ring	Storage	1000	15900
01-78	Transfer Line	Transfer	50	16900
01-79	Target Station	Target	10	16950
01-80	Transfer Line	Transfer	50	17000
01-81	Small Ring	Storage	100	17050
01-82	Transfer Line	Transfer	50	17150
01-83	Large Ring	Storage	1000	17200
01-84	Transfer Line	Transfer	50	18200
01-85	Target Station	Target	10	18250
01-86	Transfer Line	Transfer	50	18300
01-87	Small Ring	Storage	100	18350
01-88	Transfer Line	Transfer	50	18450
01-89	Large Ring	Storage	1000	18500
01-90	Transfer Line	Transfer	50	19500
01-91	Target Station	Target	10	19550
01-92	Transfer Line	Transfer	50	19600
01-93	Small Ring	Storage	100	19650
01-94	Transfer Line	Transfer	50	19750
01-95	Large Ring	Storage	1000	19800
01-96	Transfer Line	Transfer	50	20800
01-97	Target Station	Target	10	20850
01-98	Transfer Line	Transfer	50	20900
01-99	Small Ring	Storage	100	20950
01-100	Transfer Line	Transfer	50	21050
01-101	Large Ring	Storage	1000	21100
01-102	Transfer Line	Transfer	50	22100
01-103	Target Station	Target	10	22150
01-104	Transfer Line	Transfer	50	22200
01-105	Small Ring	Storage	100	22250
01-106	Transfer Line	Transfer	50	22350
01-107	Large Ring	Storage	1000	22400
01-108	Transfer Line	Transfer	50	23400
01-109	Target Station	Target	10	23450
01-110	Transfer Line	Transfer	50	23500
01-111	Small Ring	Storage	100	23550
01-112	Transfer Line	Transfer	50	23650
01-113	Large Ring	Storage	1000	23700
01-114	Transfer Line	Transfer	50	24700
01-115	Target Station	Target	10	24750
01-116	Transfer Line	Transfer	50	24800
01-117	Small Ring	Storage	100	24850
01-118	Transfer Line	Transfer	50	24950
01-119	Large Ring	Storage	1000	25000
01-120	Transfer Line	Transfer	50	26000
01-121	Target Station	Target	10	26050
01-122	Transfer Line	Transfer	50	26100
01-123	Small Ring	Storage	100	26150
01-124	Transfer Line	Transfer	50	26250
01-125	Large Ring	Storage	1000	26300
01-126	Transfer Line	Transfer	50	27300
01-127	Target Station	Target	10	27350
01-128	Transfer Line	Transfer	50	27400
01-129	Small Ring	Storage	100	27450
01-130	Transfer Line	Transfer	50	27550
01-131	Large Ring	Storage	1000	27600
01-132	Transfer Line	Transfer	50	28600
01-133	Target Station	Target	10	28650
01-134	Transfer Line	Transfer	50	28700
01-135	Small Ring	Storage	100	28750
01-136	Transfer Line	Transfer	50	28850
01-137	Large Ring	Storage	1000	28900
01-138	Transfer Line	Transfer	50	29900
01-139	Target Station	Target	10	29950
01-140	Transfer Line	Transfer	50	30000
01-141	Small Ring	Storage	100	30050
01-142	Transfer Line	Transfer	50	30150
01-143	Large Ring	Storage	1000	30200
01-144	Transfer Line	Transfer	50	31200
01-145	Target Station	Target	10	31250
01-146	Transfer Line	Transfer	50	31300
01-147	Small Ring	Storage	100	31350
01-148	Transfer Line	Transfer	50	31450
01-149	Large Ring	Storage	1000	31500
01-150	Transfer Line	Transfer	50	32500
01-151	Target Station	Target	10	32550
01-152	Transfer Line	Transfer	50	32600
01-153	Small Ring	Storage	100	32650
01-154	Transfer Line	Transfer	50	32750
01-155	Large Ring	Storage	1000	32800
01-156	Transfer Line	Transfer	50	33800
01-157	Target Station	Target	10	33850
01-158	Transfer Line	Transfer	50	33900
01-159	Small Ring	Storage	100	33950
01-160	Transfer Line	Transfer	50	34050
01-161	Large Ring	Storage	1000	34100
01-162	Transfer Line	Transfer	50	35100
01-163	Target Station	Target	10	35150
01-164	Transfer Line	Transfer	50	35200
01-165	Small Ring	Storage	100	35250
01-166	Transfer Line	Transfer	50	35350
01-167	Large Ring	Storage	1000	35400
01-168	Transfer Line	Transfer	50	36400
01-169	Target Station	Target	10	36450
01-170	Transfer Line	Transfer	50	36500
01-171	Small Ring	Storage	100	36550
01-172	Transfer Line	Transfer	50	36650
01-173	Large Ring	Storage	1000	36700
01-174	Transfer Line	Transfer	50	37700
01-175	Target Station	Target	10	37750
01-176	Transfer Line	Transfer	50	37800
01-177	Small Ring	Storage	100	37850
01-178	Transfer Line	Transfer	50	37950
01-179	Large Ring	Storage	1000	38000
01-180	Transfer Line	Transfer	50	39000
01-181	Target Station	Target	10	39050
01-182	Transfer Line	Transfer	50	39100
01-183	Small Ring	Storage	100	39150
01-184	Transfer Line	Transfer	50	39250
01-185	Large Ring	Storage	1000	39300
01-186	Transfer Line	Transfer	50	40300
01-187	Target Station	Target	10	40350
01-188	Transfer Line	Transfer	50	40400
01-189	Small Ring	Storage	100	40450
01-190	Transfer Line	Transfer	50	40550
01-191	Large Ring	Storage	1000	40600
01-192	Transfer Line	Transfer	50	41600
01-193	Target Station	Target	10	41650
01-194	Transfer Line	Transfer	50	41700
01-195	Small Ring	Storage	100	41750
01-196	Transfer Line	Transfer	50	41850
01-197	Large Ring	Storage	1000	41900
01-198	Transfer Line	Transfer	50	42900
01-199	Target Station	Target	10	42950
01-200	Transfer Line	Transfer	50	43000
01-201	Small Ring	Storage	100	43050
01-202	Transfer Line	Transfer	50	43150
01-203	Large Ring	Storage	1000	43200
01-204	Transfer Line	Transfer	50	44200
01-205	Target Station	Target	10	44250
01-206	Transfer Line	Transfer	50	44300
01-207	Small Ring	Storage	100	44350
01-208	Transfer Line	Transfer	50	44450
01-209	Large Ring	Storage	1000	44500
01-210	Transfer Line	Transfer	50	45500
01-211	Target Station	Target	10	45550
01-212	Transfer Line	Transfer	50	45600
01-213	Small Ring	Storage	100	45650
01-214	Transfer Line	Transfer	50	45750
01-215	Large Ring	Storage	1000	45800
01-216	Transfer Line	Transfer	50	46800
01-217	Target Station	Target	10	46850
01-218	Transfer Line	Transfer	50	46900
01-219	Small Ring	Storage	100	46950
01-220	Transfer Line	Transfer	50	47050
01-221	Large Ring	Storage	1000	47100
01-222	Transfer Line	Transfer	50	48100
01-223	Target Station	Target	10	48150
01-224	Transfer Line	Transfer	50	48200
01-225	Small Ring	Storage	100	48250
01-226	Transfer Line	Transfer	50	48350
01-227	Large Ring	Storage	1000	48400
01-228	Transfer Line	Transfer	50	49400
01-229	Target Station	Target	10	49450
01-230	Transfer Line	Transfer	50	49500
01-231	Small Ring	Storage	100	49550
01-232	Transfer Line	Transfer	50	49650
01-233	Large Ring	Storage	1000	49700
01-234	Transfer Line	Transfer	50	50700
01-235	Target Station	Target	10	50750
01-236	Transfer Line	Transfer	50	50800
01-237	Small Ring	Storage	100	50850
01-238	Transfer Line	Transfer	50	50950
01-239	Large Ring	Storage	1000	51000
01-240	Transfer Line	Transfer	50	52000
01-241	Target Station	Target	10	52050
01-242	Transfer Line	Transfer	50	52100
01-243	Small Ring	Storage	100	52150
01-244	Transfer Line	Transfer	50	52250
01-245	Large Ring	Storage	1000	52300
01-246	Transfer Line	Transfer	50	53300
01-247	Target Station	Target	10	53350
01-248	Transfer Line	Transfer	50	53400
01-249	Small Ring	Storage	100	53450
01-250	Transfer Line	Transfer	50	53550
01-251	Large Ring	Storage	1000	53600
01-252	Transfer Line	Transfer	50	54600
01-253	Target Station	Target	10	54650
01-254	Transfer Line	Transfer	50	54700
01-255	Small Ring	Storage	100	54750
01-256	Transfer Line	Transfer	50	54850
01-257	Large Ring	Storage	1000	54900
01-258	Transfer Line	Transfer	50	55900
01-259	Target Station	Target	10	55950
01-260	Transfer Line	Transfer	50	56000
01-261	Small Ring	Storage		

# HEMS 高强度缪子束线



# HEMS parameters

参数	HEMS	PSI	ISIS	JPARC
μSR应用				
重复频率[Hz]	100	CW	40	25
μ+强度[μ+/s]	5E6	1.5E7~4E8	5E5	3E6
动量范围[MeV/c]	20-200	10-350	20-200	20-300
计数率[MEvent/h]	Up to 800	~20	20-200	180
粒子物理实验				
MuMuBar	3E8 μ <sup>+</sup> /s	8E6 μ <sup>+</sup> /s	NA	NA
μ-EDM	5*10 <sup>6</sup> μ <sup>+</sup> /s	<5*10 <sup>4</sup> μ <sup>+</sup> /s	NA	

in the far future, but who knows...

- **MELODY has been approved!**
- **Now:** We are going to build a surface muon beam and a muSR spectrometer.
- **Future:** We reserve the space for more applications in the future.
- **Far future:** We expect muon physics and HEMS
- We welcome all kinds of suggestions and collaborations.

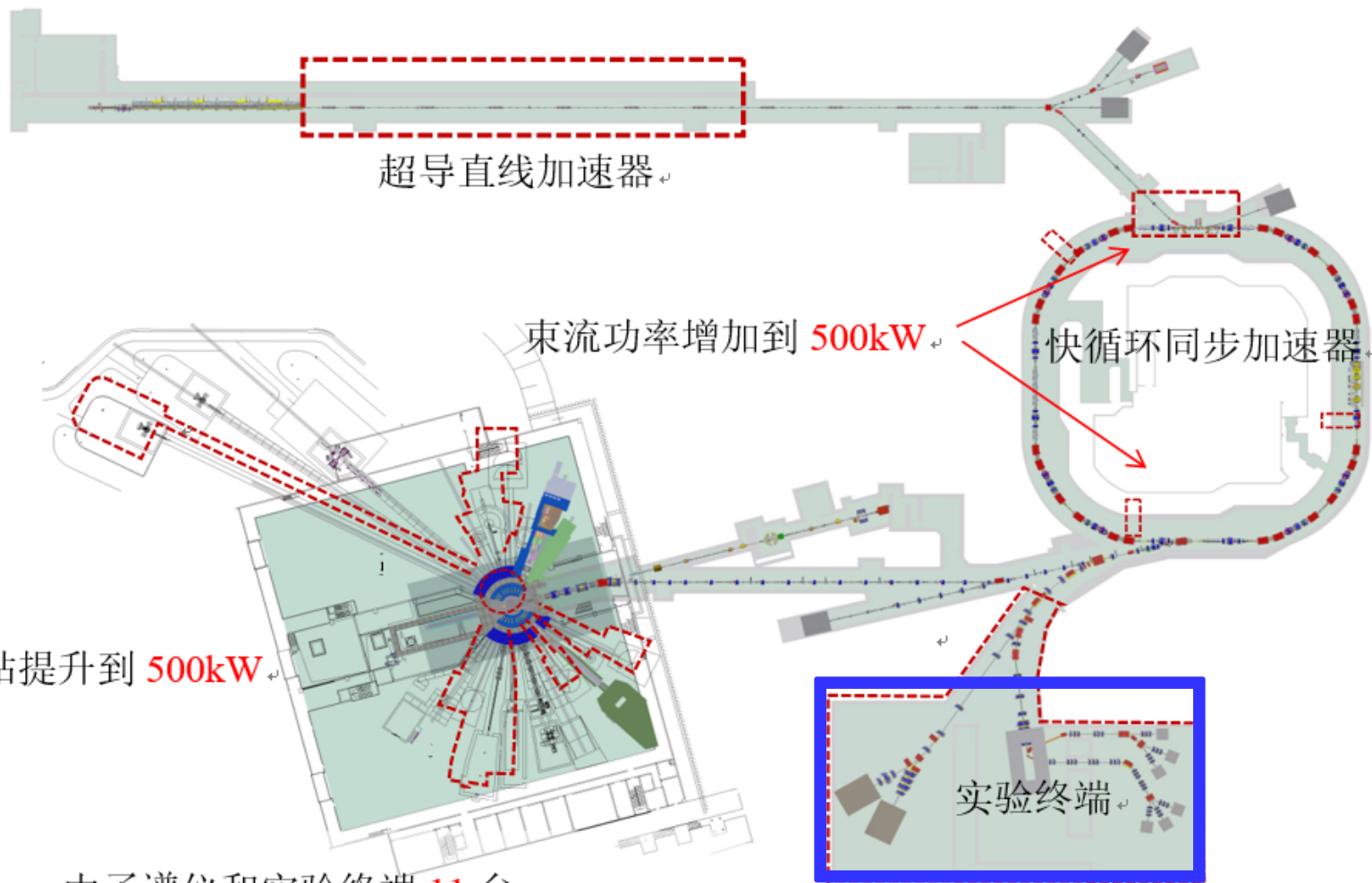
**Thank you!**

# backups

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# CSNS II Project

直线加速器能量提升到 **300MeV**



超导直线加速器

束流功率增加到 **500kW**

快循环同步加速器

靶站提升到 **500kW**

实验终端

中子谱仪和实验终端 **11** 台

Muon and Proton  
Station