

Muon Related Activities in China

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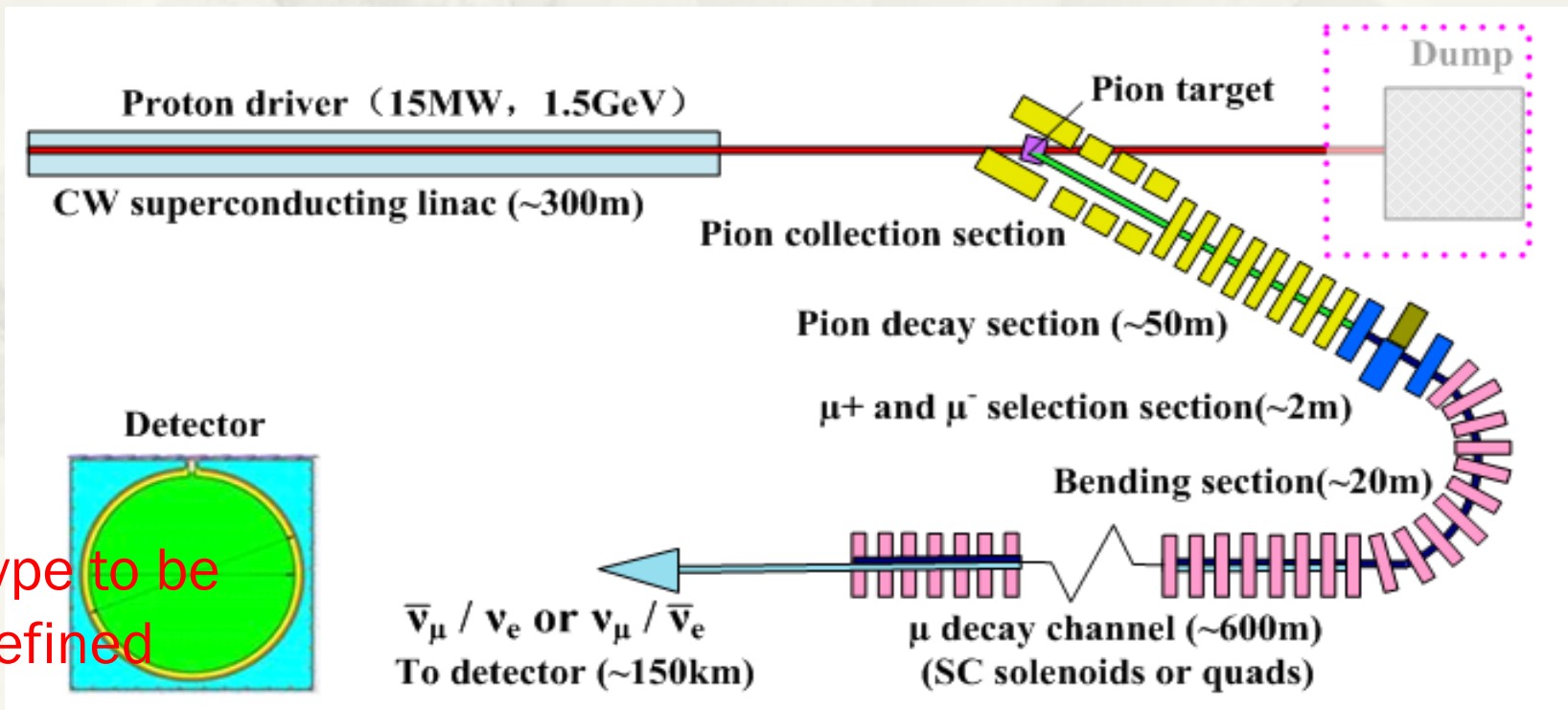
Muon Collider Workshop, CERN, 2019.10.9-11

Outline

- * MOMENT and synergy between neutrino beams and muon beams
- * Participation in COMET and Mu2e experiments
- * EMuS muon source at CSNS
- * Participation in the international studies on MICE and Muon Collider
- * Summary

MOMENT: a muon-decay medium-baseline neutrino beam facility

- * Based on ADS-type accelerator, muon decayed neutrinos (200-300 MeV), for LCPV and other neutrino physics
- * Study since 2013, as a part of the neutrino program in China

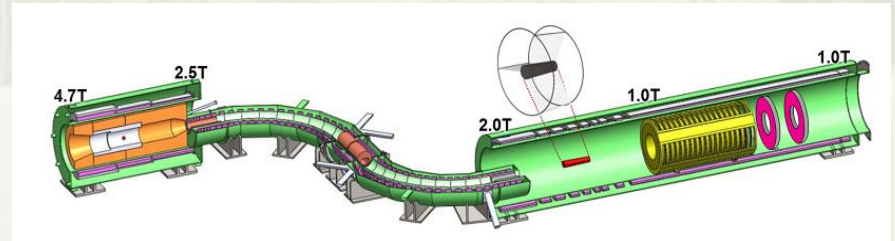
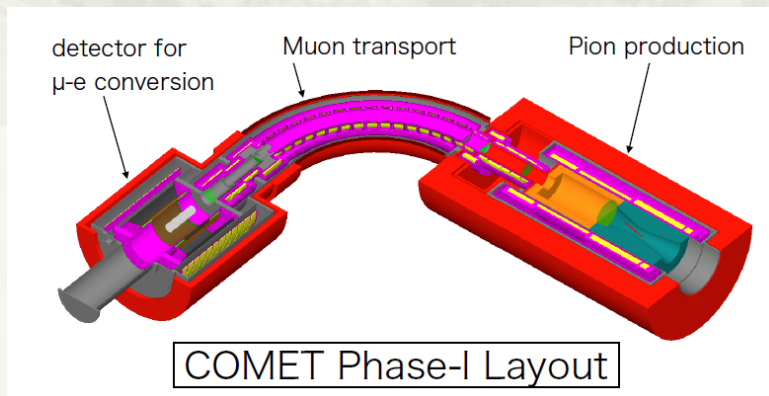


Synergy between neutrino beams and muon beams

- * Muon-decayed neutrinos are very good for neutrino experiments
 - * Neutrino Factory has been studied for more than two decades (together with Muon Collider)
 - * Under consideration: nuSTORM, MOMENT, ESSnuSB
- * EMuS muon source at CSNS will serve as R&D for MOMENT technology and neutrino cross-section measurement

Participation in muon physics experiments

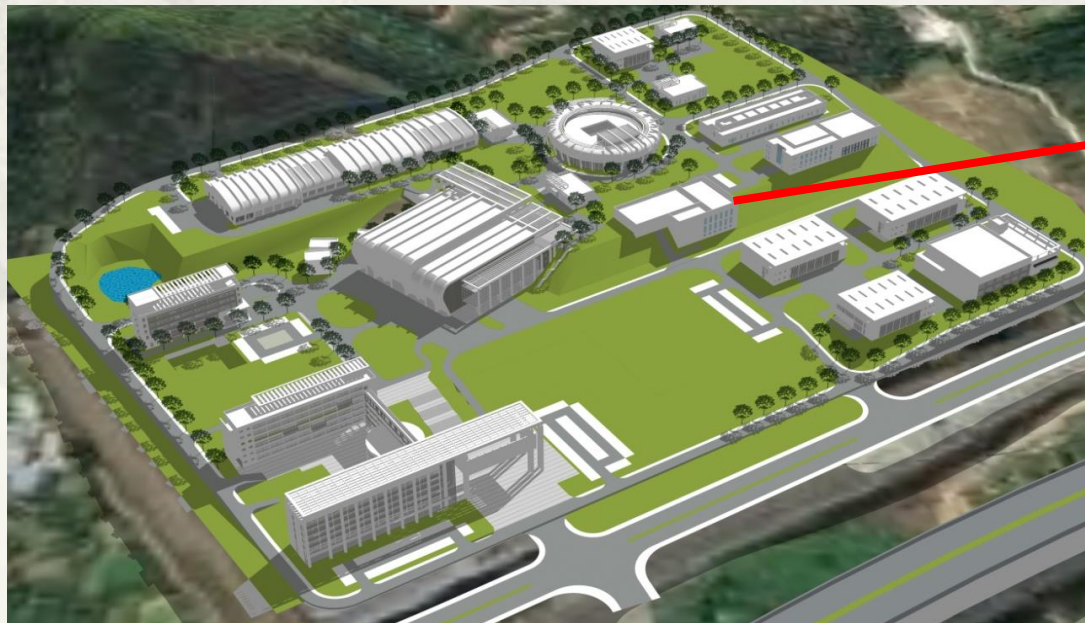
- * High intensity μ sources are very important in Muon physics: leptonic flavor violation experiments (Mu2e, COMET, MEG), μ g-2/EDM experiments
- * Chinese institutions participate in several muon experiments
 - * COMET and Mu2e: IHEP, Sun Yat-Sen U. (SYSU), Nanjing U. (NJU), Shanghai Jiaotong U. (SJTU)
 - * muCool: IHEP



Fermilab: Mu2e experiment

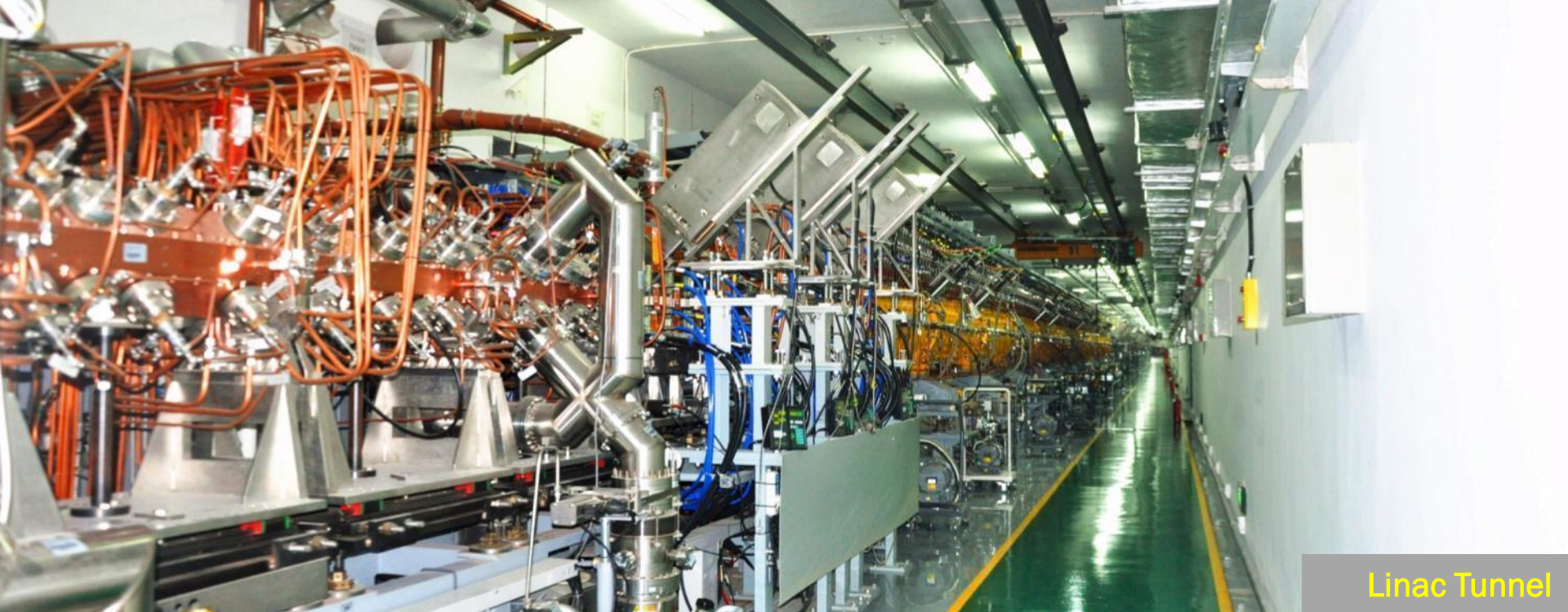
Experimental Muon Source (EMuS) at CSNS

- * CSNS (China Spallation Neutron Source) completed in March 2018, provides neutrons for multidisciplinary research
- * Proton Beam: 1.6 GeV, 100 kW, 25 Hz (**CSNS-II: 500 kW**)
 - * **Current operation: 80 kW**
- * It can also support other beam applications: protons, muons and neutrinos (EMuS is included in CSNS-II)

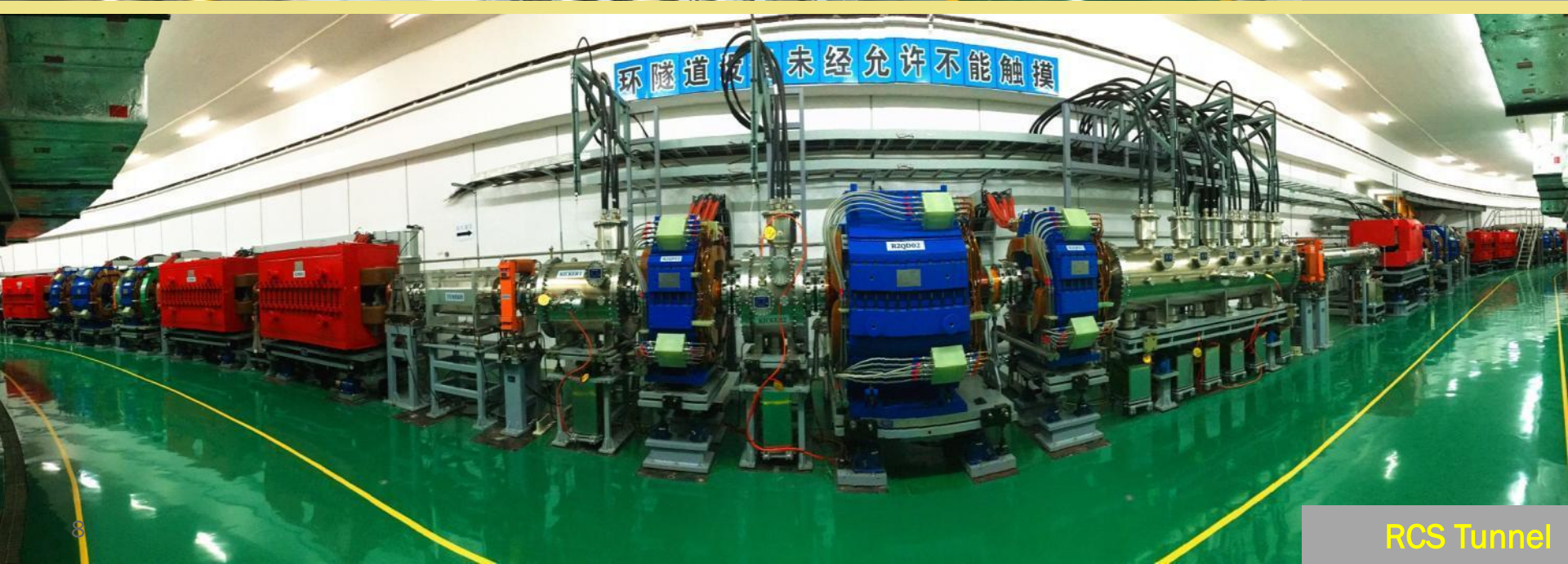


Target and experiment hall





Linac Tunnel



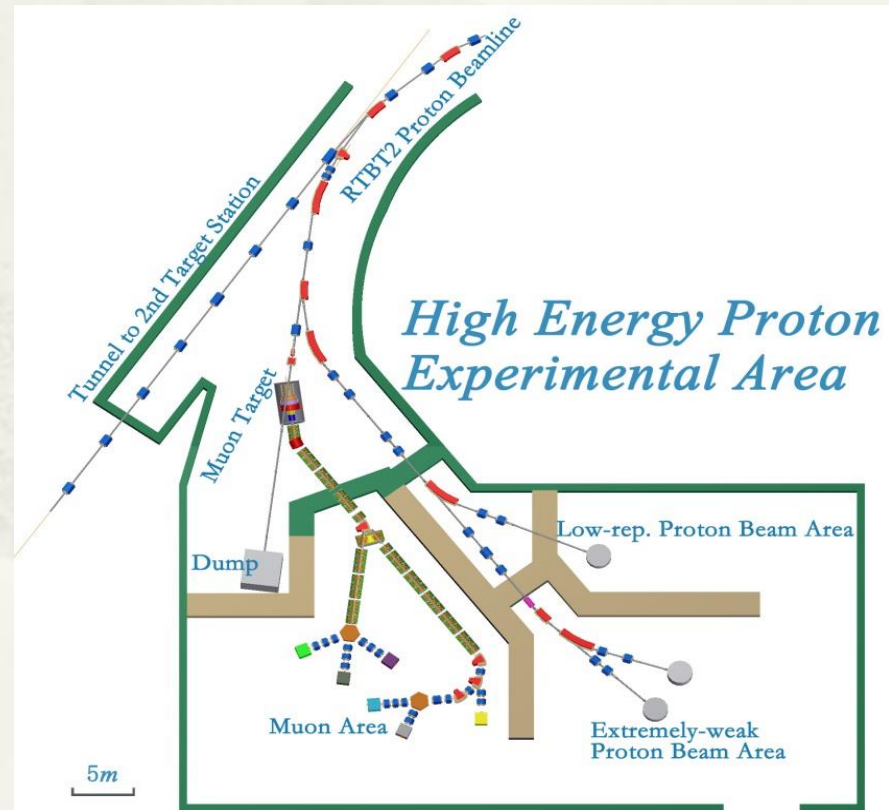
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RCS Tunnel

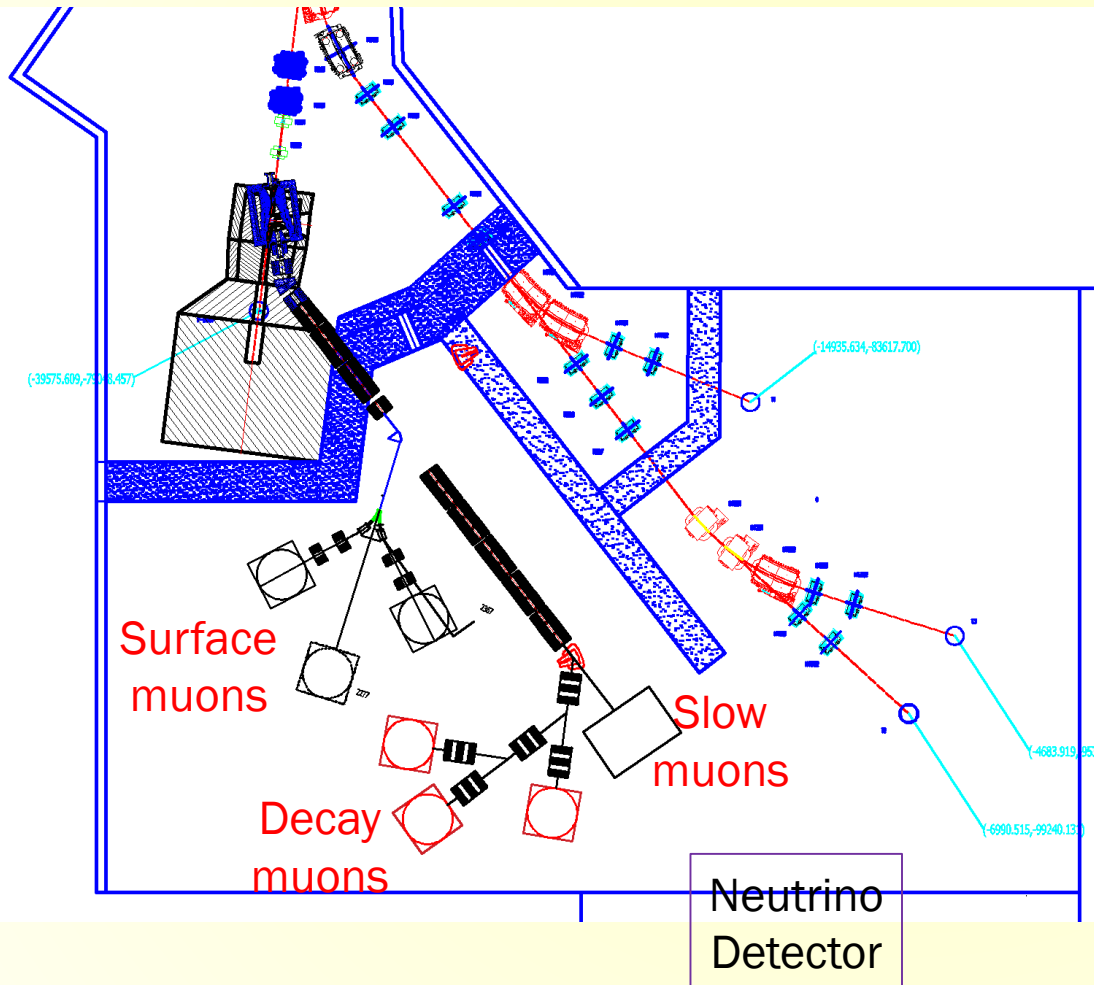
EMuS design scheme and science

- * CSNS EMuS located in the high-energy proton application hall, together with other direct proton beam applications

- ◆ Proton beam: 1.6 GeV, 25 kW (5% of total, CSNS-II), single bunch per pulse (2.5Hz)
- ◆ Target: carbon, 300 mm in length, **conical shape, forward extraction**
- ◆ Capture solenoid: 1-5 T (Al-based NbTi wires)
- ◆ Science goals: μ SR applications, muon beam techniques, MOMENT R&D, Neutrino cross-section meas.



EMuS Layout and Working Modes

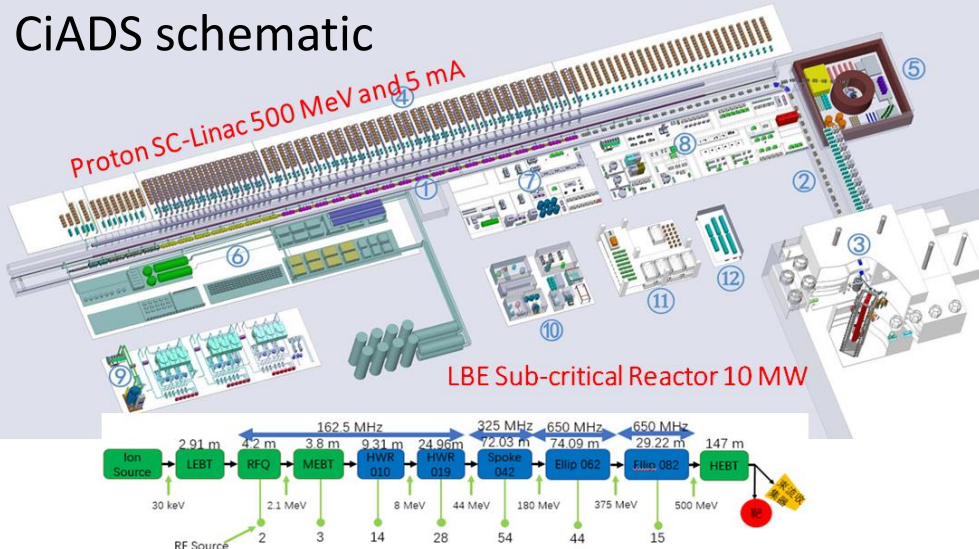


Working modes (indep.):

1. **Surface μ mode**
 - a) $\Delta p/p: < \pm 4\%$
 - b) Ref. $P_\mu = 29 \text{ MeV}/c$
2. **Decay μ SR mode**
 - a) $\Delta p/p: < \pm 5\%$
 - b) Ref. $P_\mu = 40-150 \text{ MeV}/c$
3. **High-momentum μ mode**
 - a) μ imaging, neutrinos
 - b) Ref. $P_\pi = 200-450 \text{ MeV}/c$

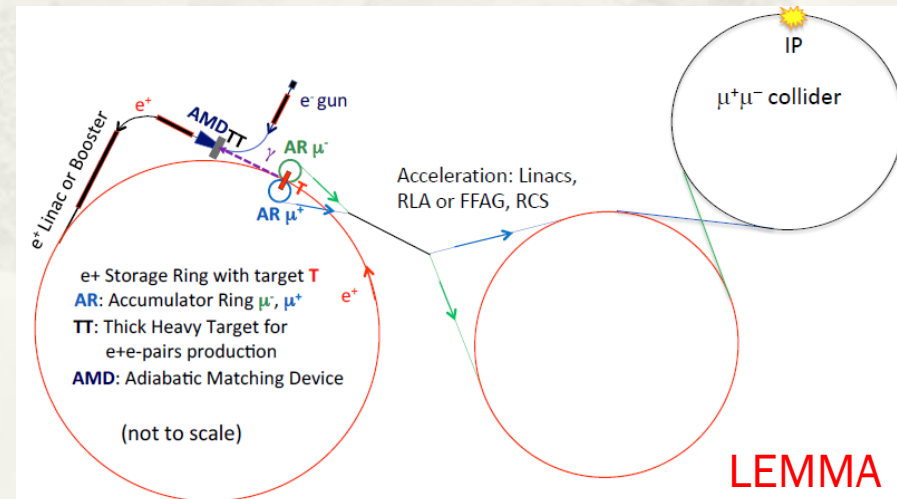
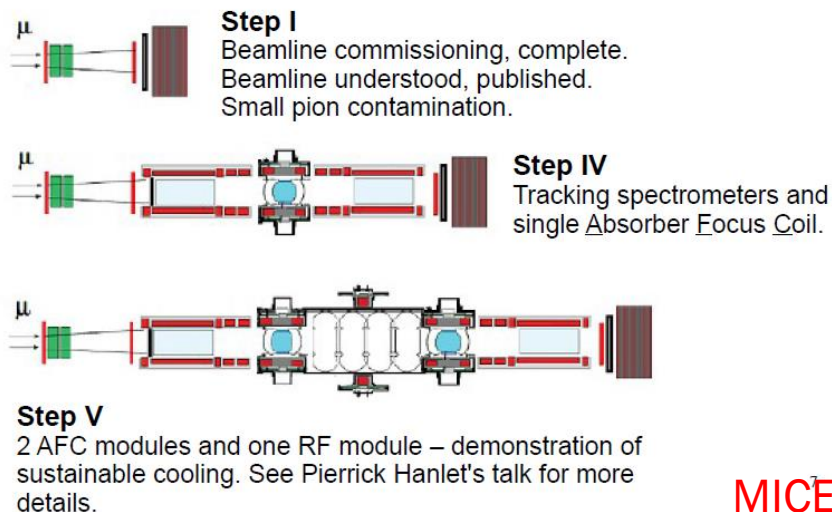
Possible Muon Facility at CiADS

- * CiADS project (ADS Phase-II) was approved and the construction is to start soon in Huizhou (not far from DYB): **500 MeV, 2.5 MW** (CW Beam)
(by Institute of Modern Physics, CAS)
- * There has been discussions about adding a muon facility at CiADS, mainly for muon physics (using chopped beam)



Participation in MICE and Muon Collider Studies

- * IHEP has participated in MICE collaboration since Feb 2015.
- * IHEP can contribute the undergoing studies in Europe, including nuSTORM, ESSnuSB and Muon Collider (especially LEMMA scheme)



Summary

- * China is working on different muon programs or studies: MOMENT, EMuS, muons@CiADS
- * Several Chinese groups are participating in international muon physics experiments: COMET, Mu2e etc.
- * We are willing to contribute to international studies like nuSTORM, ESSnuSB and Muon Collider

Thanks for your attention!