High Energy Physics in China

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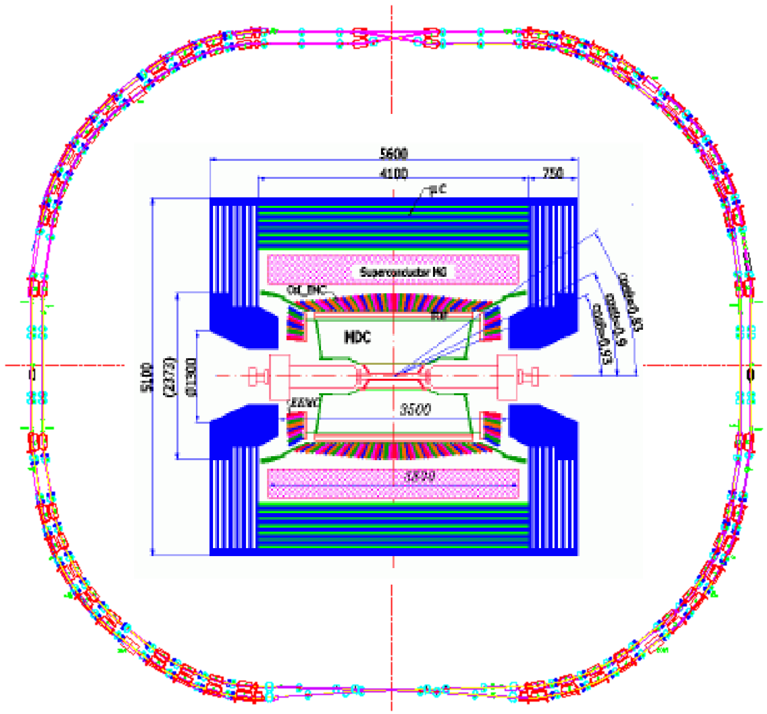
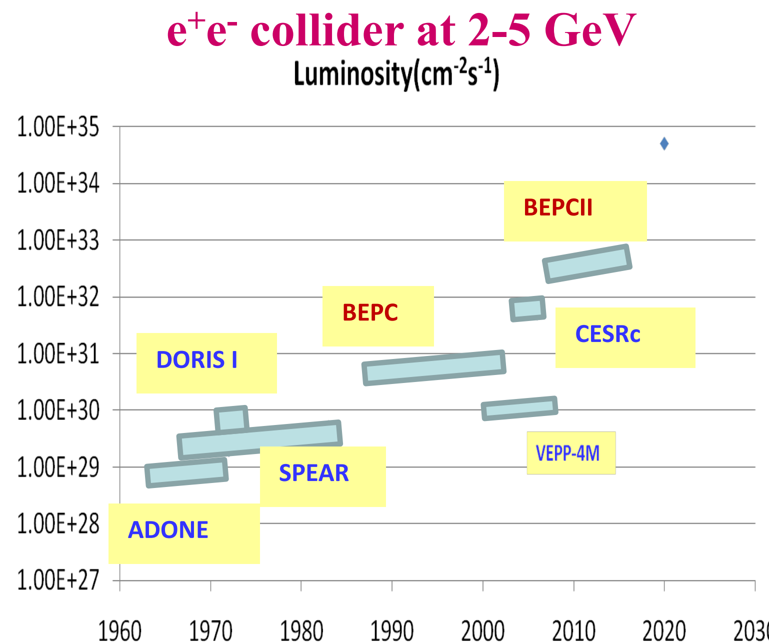
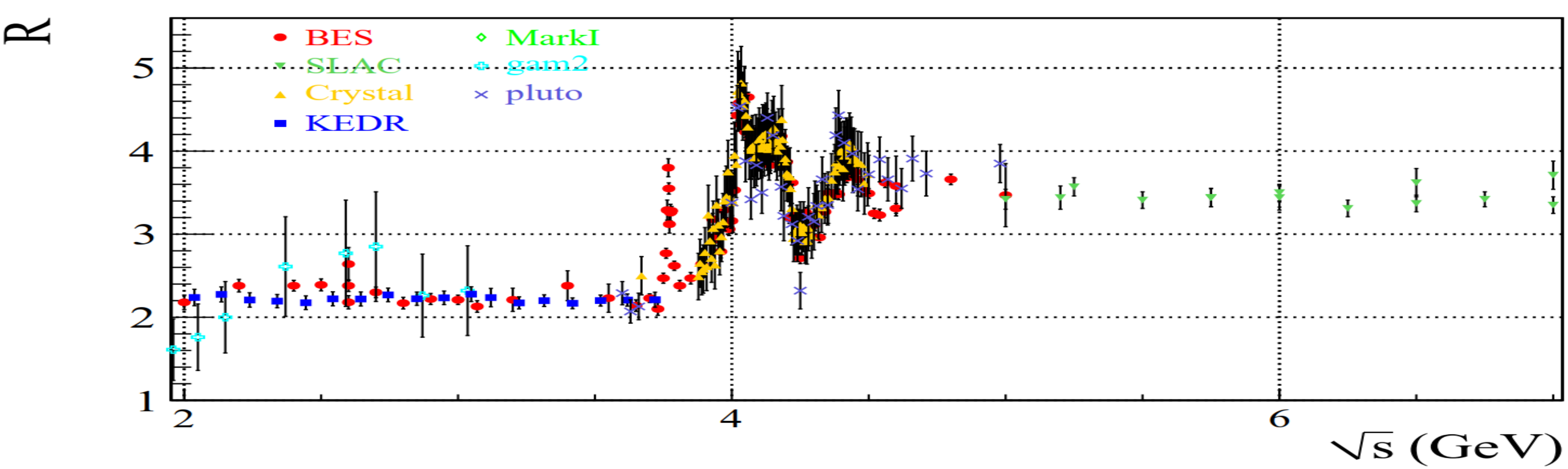
Outline

- Hadrons
- Higgs
- Neutrinos
- Astro-Physics & Dark matter searches
- Summary

Hadrons： BEPCII/BESIII



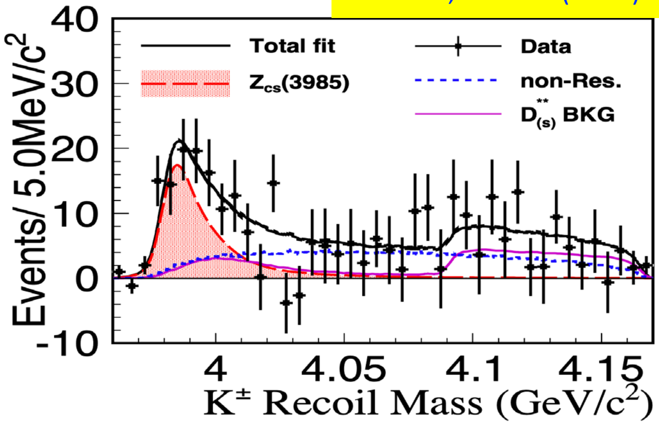


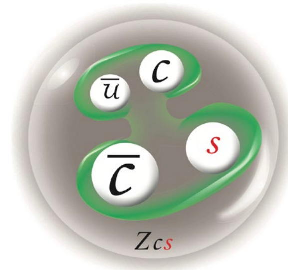


Latest Highlights from BESIII

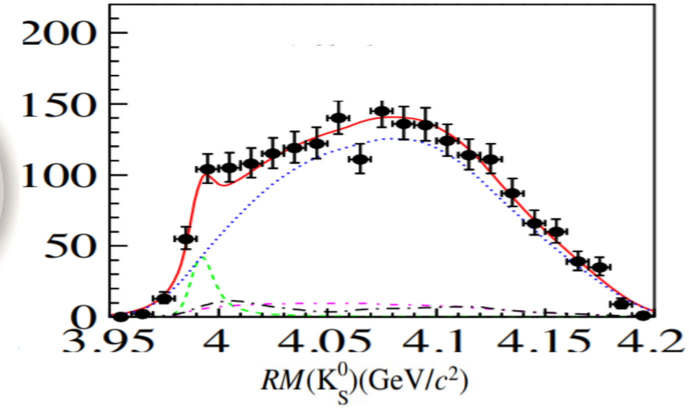
Observation of Isospin triplet Zcs(3985) strange four-quark meson

PRL 126, 102001 (2021)



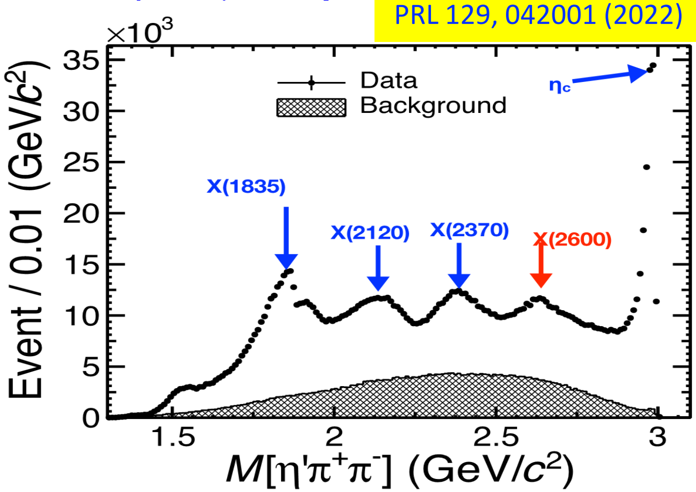


PRL 129, 112003 (2022)



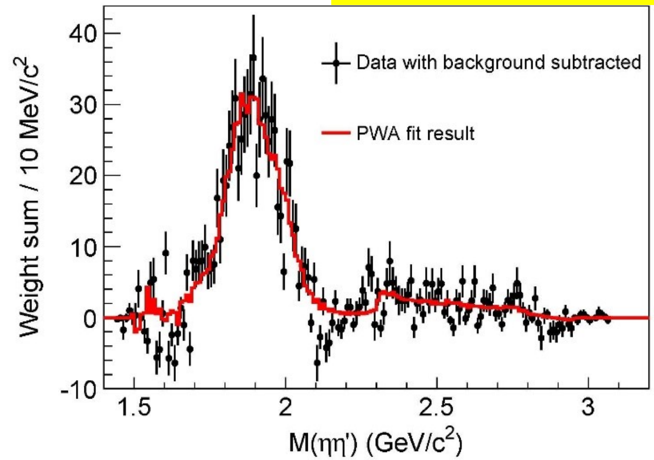
Rich structures observed in $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$

PRL 129, 042001 (2022)



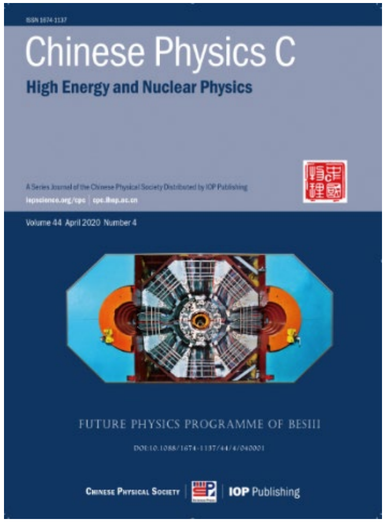
Observation of an exotic state with $J^{PC}=1^{-+}$

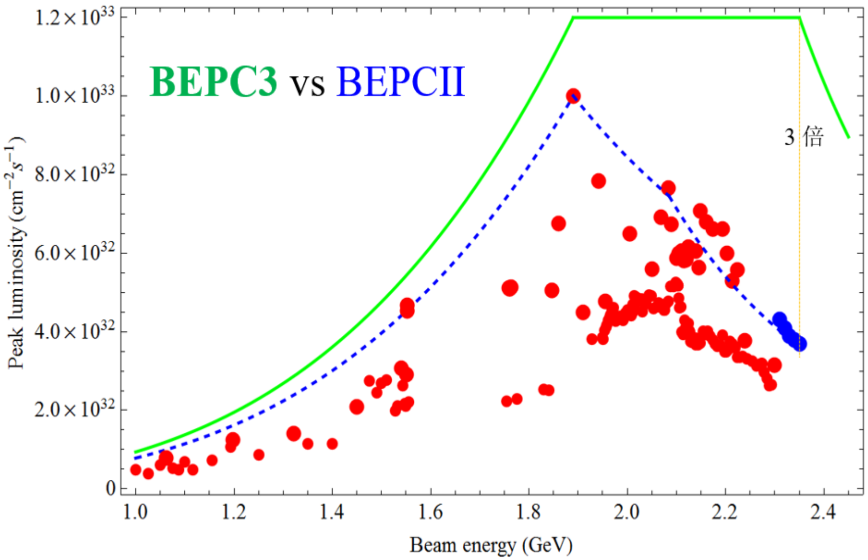
PRL 129, 192002 (2022)



Future Plan of BEPCII

- Rich physics program requiring $> 40\ fb^{-1}$, corresponding to 15 yrs of data taking at the present luminosity
- Upgrades
  - Luminosity × ~3 ➔ squeeze the beam size by adding a new RF cavity per beam
  - Replace the two SC quadrupole magnets near the IP to increase the maximum beam energy from 2.45 to 2.8 GeV
  - Both are a test of CEPC technologies
- Operation will continue until at least 2030





BESIII Collaboration

Europe (17/115)

Germany (6): Bochum University,
GSI Darmstadt, Helmholtz Institute Mainz, Johannes Gutenberg University of Mainz, Universitaet Giessen, University of Münster
Italy (3): Ferrara University, INFN, University of Torino
Netherlands (1): KVI/University of Groningen
Russia (2): Budker Institute of Nuclear Physics, Dubna JINR
Sweden (1): Uppsala University
Turkey (1): Turkish Accelerator Center Particle Factory Group
UK (2): University of Manchester, University of Oxford
Poland (1) National Centre for Nuclear Research

USA (4/8)

Carnegie Mellon University
Indiana University
University of Hawaii
University of Minnesota

South America (1/1)

Chile: University of Tarapaca

China (57/367)

Institute of High Energy Physics (146), other units (221): Beijing Institute of Petro-chemical Technology, Beihang University,
China Center of Advanced Science and Technology, Fudan University,
Guangxi Normal University, Guangxi University,
Hangzhou Normal University, Henan Normal University,
Henan University of Science and Technology,
Huazhong Normal University, Huangshan College, Hunan University,
Hunan Normal University, Henan University of Technology
Institute of modern physics, Jilin University, Lanzhou University, Liaoning Normal University, Liaoning University, Nanjing Normal University, Nanjing University,
Nankai University, North China Electric Power University,
Peking University, Qufu normal university, Shanxi University,
Shanxi Normal University, Sichuan University, Shandong Normal University,
Shandong University, Shanghai Jiaotong Univeristy, Soochow University,
South China Normal University, Southeast University, Sun Yat-sen University,
Tsinghua University, University of Chinese Academy of Sciences, University of Jinan,
University of Science and Technology of China,
University of Science and Technology Liaoning,
University of South China, Wuhan University, Xinyang Normal University,
Zhejiang University, Zhengzhou University, YunNan University, China University of Geosciences, Henan University

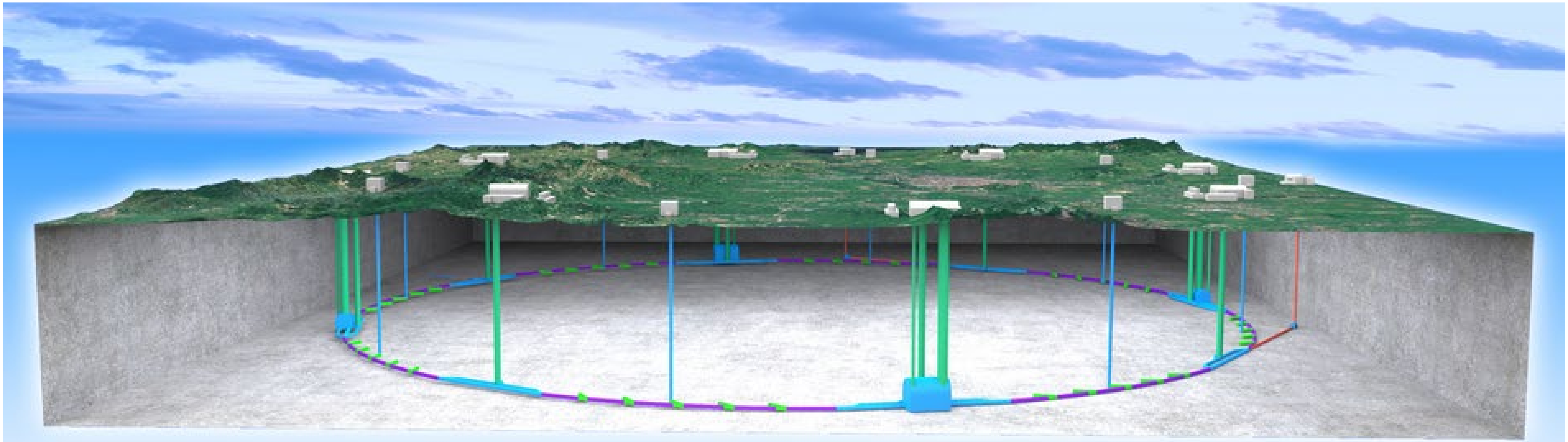
Asia (6/10)

Pakistan (2): COMSATS Institute of Information Technology
University of the Punjab, University of Lahore
Mongolia (1): Institute of Physics and Technology
Korea (1): Chung-Ang University
India (1): Indian Institute of Technology madras
Thailand (1): Suranaree University of Technology

More than 500 members from 84 institutes in 16 countries

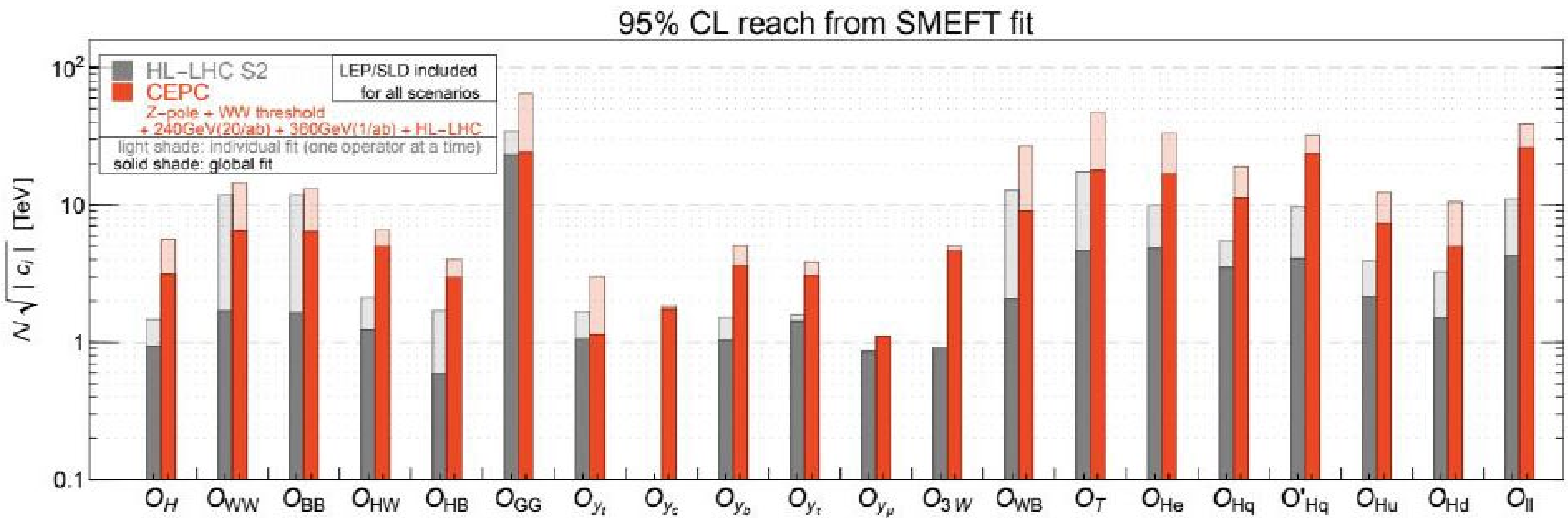
Higgs： CEPC

- The idea of a Circular e+e- Collider(CEPC) followed by a possible Super proton-proton collider(SPPC) was proposed in Sep. 2012, and quickly gained the momentum in IHEP and in the world
  - Higgs is the best portal to new physics:
    - Self-coupling ? Shape of the Higgs potential ? EW phase transition ?
    - Point-like particle ? More Higgs ? Unstable vacuum ?
    - Coupling with dark matter(Higgs mechanism also for dark matter) ?
    - Fine tuning ? Hierarchy ?
    - Flavor symmetry ?



The tunnel can be re-used for pp, AA, ep colliders up to ~ 100 TeV ➔ compatibility study needed now

Precision Higgs Physics at CEPC



Looking for hints of new physics :

$$\mathcal{L} = \mathcal{L}_{SM} + \sum_i \frac{c_i}{M^2}\mathcal{O}_{6,i}$$

$$\delta \sim c_i \frac{v^2}{M^2}$$

No signal at LHC:

Direct searches: M ~ 1 TeV

10% precision: M ~ 1 TeV

At CEPC/FCC:

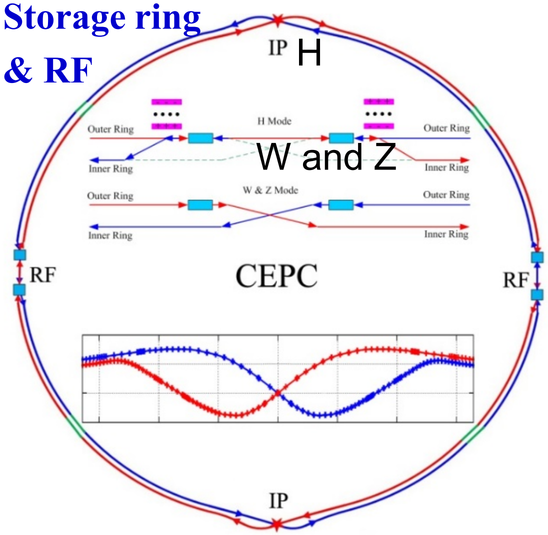
1% precision ➔ M ~10 TeV

Pressing questions best addressed by an e+e- Higgs factory (~1% precision)

CEPC Accelerator Design

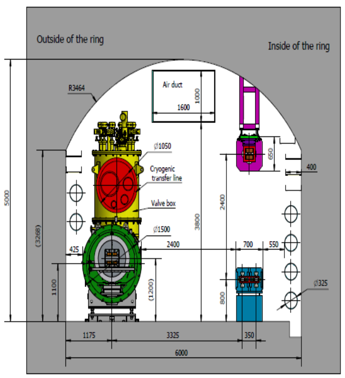
- Strong support from funding agencies at a level of > 40 M $
- CDR completed, TDR to be completed soon
- Internationally competitive performance thanks to the detailed design & studies, such as Dynamic aperture, beam-beam effects, etc.

Storage ring & RF



Tunnel

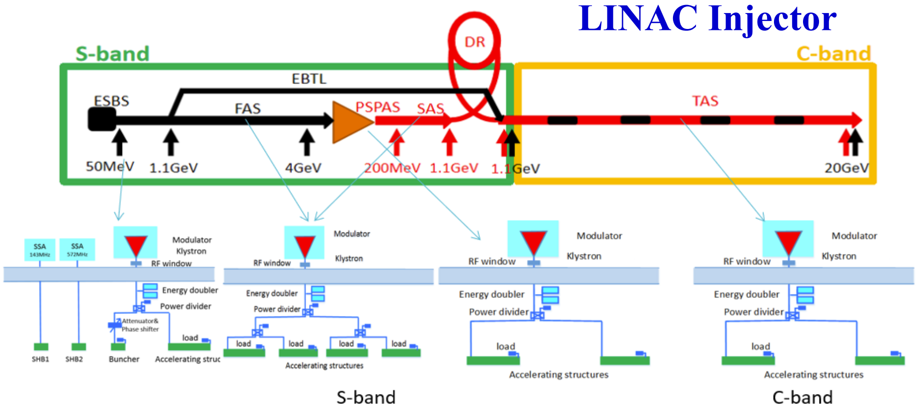
TUNNEL CROSS SECTION OF THE ARC AREA



Baseline design(100 km, 30 MW):

Operation mode		ZH	Z	W^+W^-	ttbar
$\sqrt{s}$ [GeV]		~240	~91.2	~160	~360
Run time [years]		7	2	1	7.7
CDR	L/IP[10^{34} cm^{-2}s^{-1}]	3	32	10	
Now	L/IP[10^{34} cm^{-2}s^{-1}]	5.0	115	15.4	0.5
	Events[2 IPs]	1.7×10^6	2.5×10^{12}	3×10^7	3×10^5

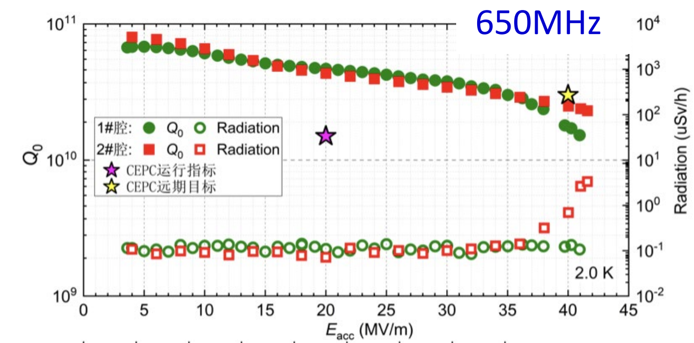
LINAC Injector

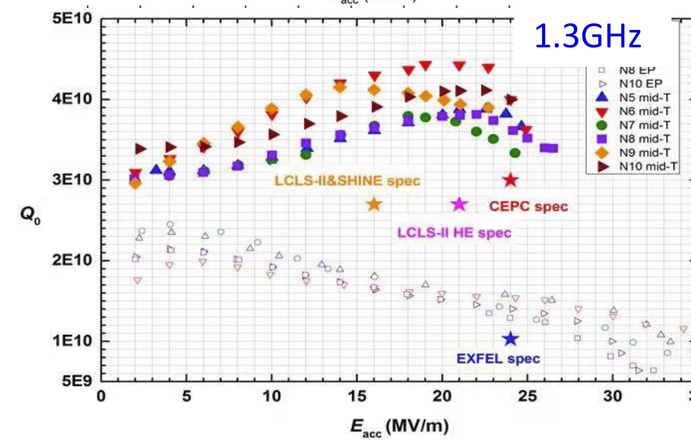


Upgradable to 50 MW, High Lumi Z, ttbar; Compatible to pp collider

Accelerator R&D and Prototypes

- SRF cavities: 1.3GHz for the booster and 650 MHz for collider rings
  - Prototypes successful, best in the world
- High efficiency Klystrons to save energy
  - Prototypes in progress, already highest eff.
- Magnets, vacuum pipes, beam diagnostics, polarized electron gun, positron source, …
  - Mostly successful, few remains to be finalized
- A lot of synergies with HEPS, a 6 GeV light source under construction by IHEP

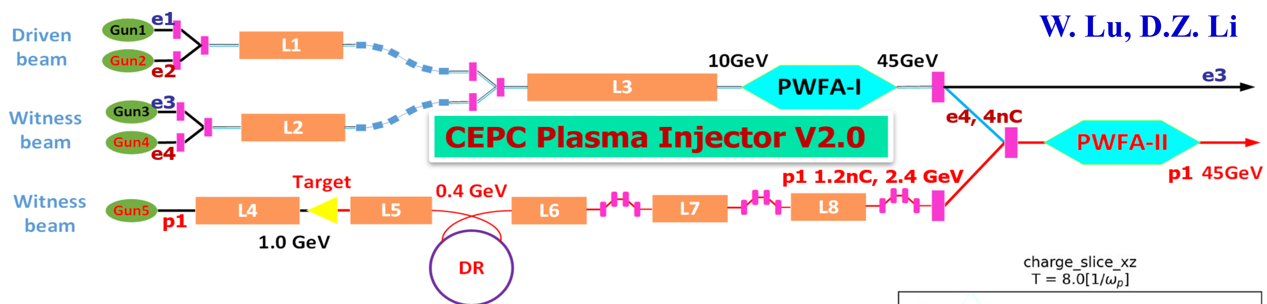




magnets

Klystrons

New: Plasma Injector



Booster Requirement	
Energy（GeV）	45.5
Bunch Charge（nC）	0.78
Bunch length (um)	<3000
Energy Spread (%)	0.2
ε_N (μm·rad)	<800
Bunch Size (um)	<2000

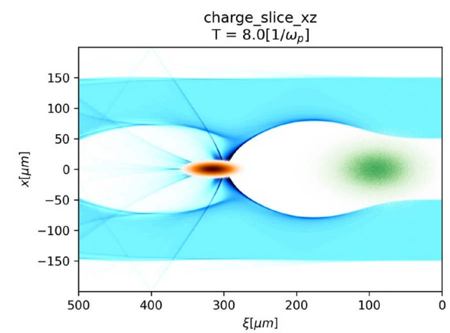
High eff. uniform wakefield acceleration of a positron beam using stable asymmetric mode in a hollow channel plasma

3D Quasi-static PIC simulations show:

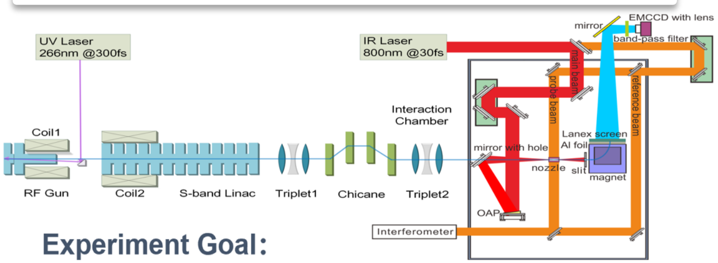
Energy extraction efficiency ~ 30%

Energy spread ~ 1%

PRL 127, 174801 (2021)

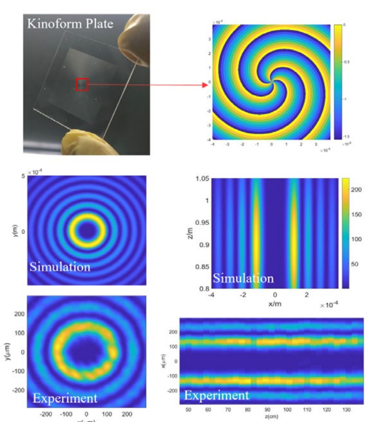


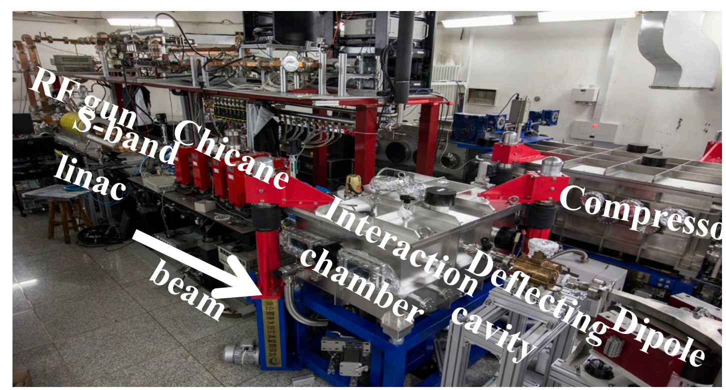
Plasma dechirper exp at SXFEL



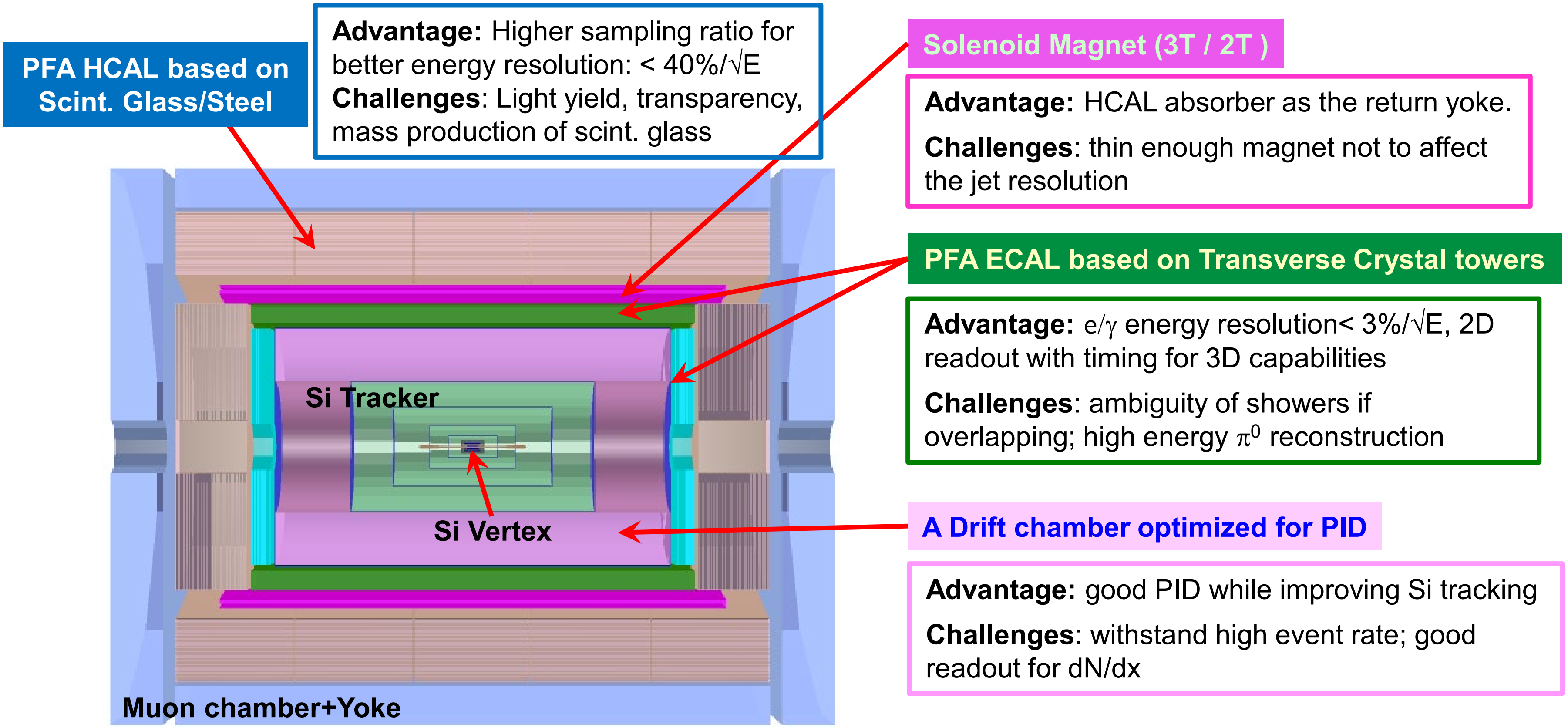
Experiment Goal:

1. Decrease the energy spread from 1% to 0.1%
2. Study Hollow channel impact on beam quality



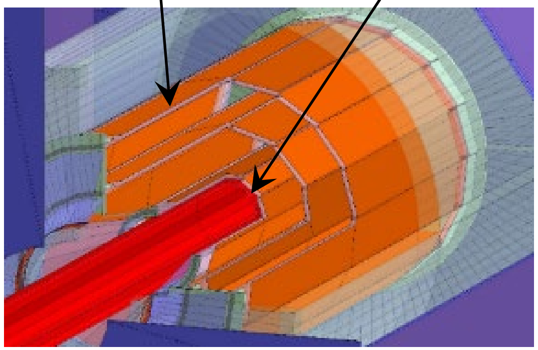


CEPC Detector Design and R&D



- Silicon pixel sensors and readout chips for better resolution and lower power
- TPC or draft chambers for higher event rate and faster readout(dN/dX & waveform)
- Reconstruction algorithm for showers in Long crystal bars using timing for 3D info.
- Scintillation glass development for higher density and light yield
- Thin solenoid superconducting magnet

R&D of Silicon Pixel Chips



Goal: σ(IP) ~ 5 μm for high P track

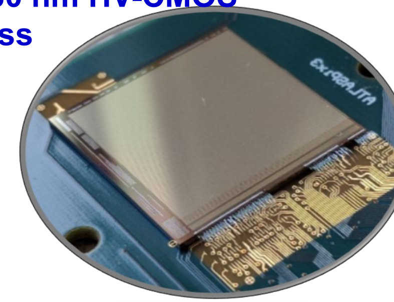
CDR design specifications

- Single point resolution ~ 3μm
- Low material (0.15% X_0 / layer)
- Low power (< 50 mW/cm^2)
- Radiation hard (1 Mrad/year)

Silicon pixel sensor develops in 5 series:
JadePix, TaichuPix, CPV, Arcadia, CEPCPix

Develop CEPCPix for a CEPC tracker basing on ATLASPix3 CN/IT/UK/DE

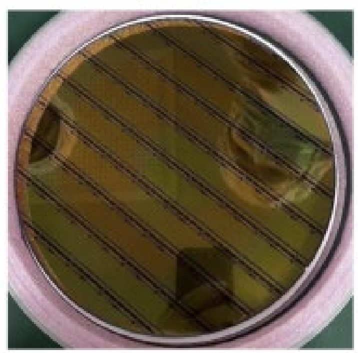
TSI 180 nm HV-CMOS process



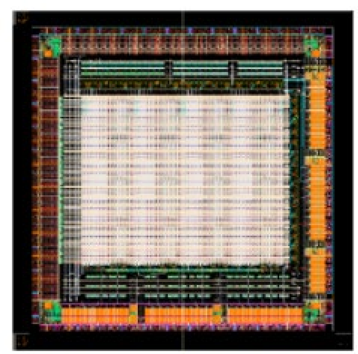
JadePix-3 Pixel size ~16×23 μm^2

Tower-Jazz 180nm CiS process
Resolution 5 microns, 53mW/cm^2

TaichuPix-3, FS 2.5x1.5 cm^2
25×25 μm^2 pixel size

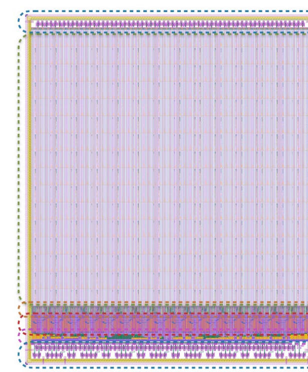


CPV4 (SOI-3D), 64×64 array
~21×17 μm^2 pixel size

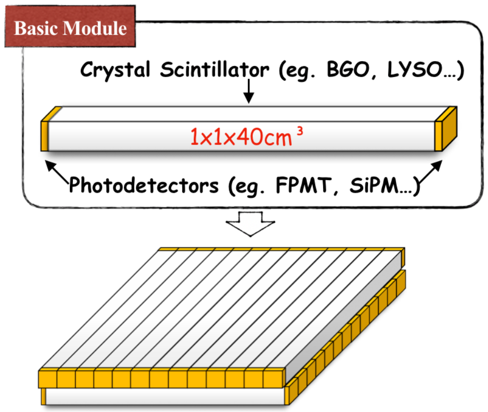


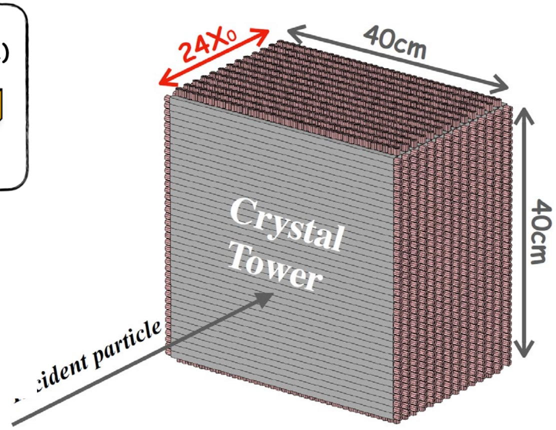
Arcadia by Italian groups for IDEA vertex detector

LFoundry 110 nm CMOS



3D Crystal Calorimeter with PFA





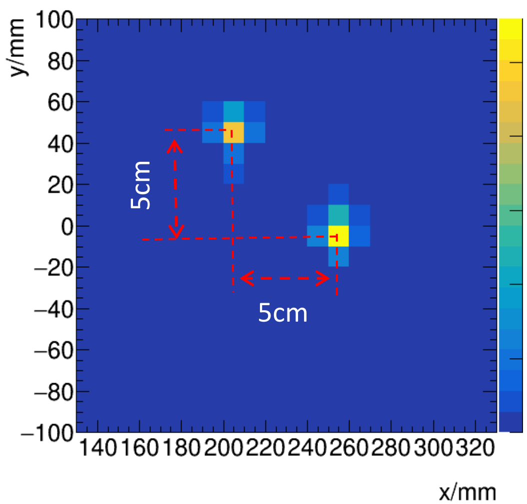
Energy resolution $\frac{\sim 3\%}{\sqrt{E}} \oplus \sim 1\%$

Advantages:

- Good energy resolution
- 3D shower info. with limited readout channel
- Effective Moliere Radius similar to that of W-Si

Reconstruction: Ambiguity removal

- ✓ Time match of two ends
- ✓ Energy and position match in adjacent Layers



We are working on

- 3D shower reconstruction
- Jet reconstruction & PFA algorithm

A possible detector concept also for ILC

New HCAL with Scintillating Glass

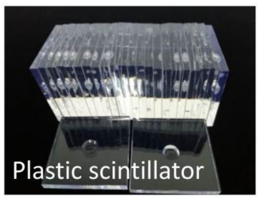
Full simulation studies

Goal

- Better hadronic energy resolution
- To further improve BMR

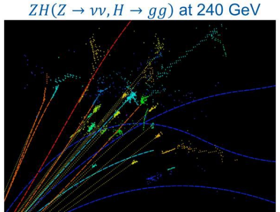
Scintillating Glass R&D

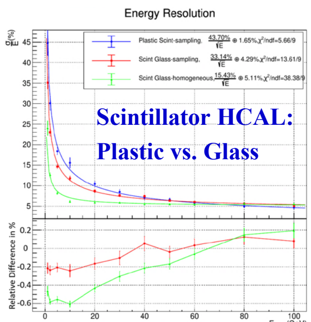
Tiles for AHCAL (30x30x3mm)



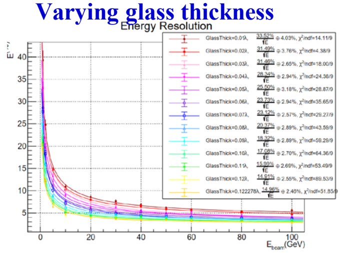
"SiPM-on-Tile" design for HCAL

$ZH(Z \to \nu\nu, H \to gg)$ at 240 GeV

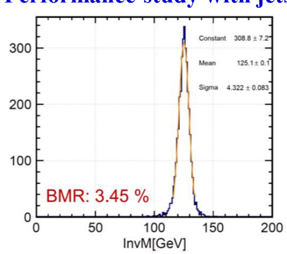




Varying glass thickness



Performance study with jets



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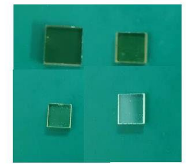
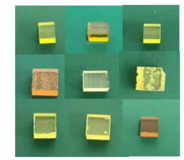


2021.10.11



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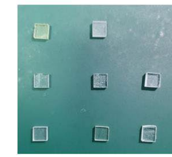

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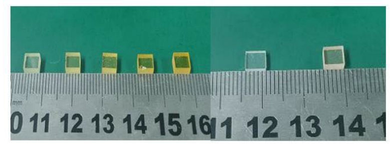

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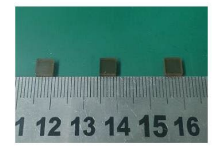

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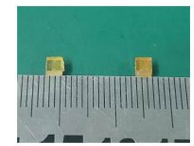
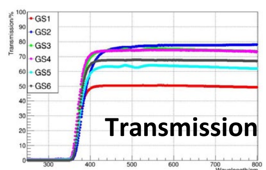
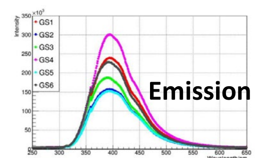
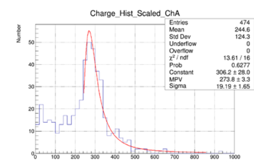


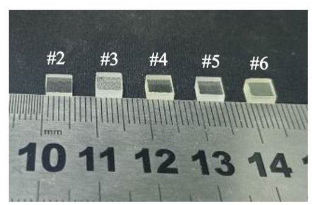
2021.11.23

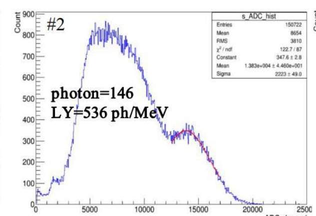
Sample Testing

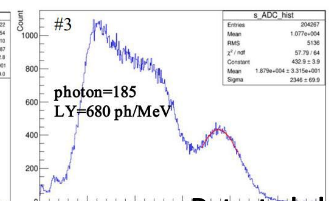




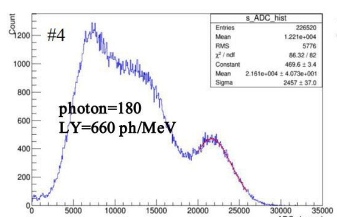


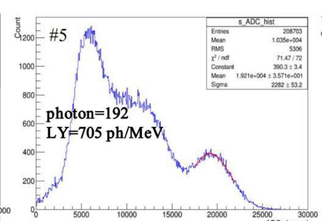


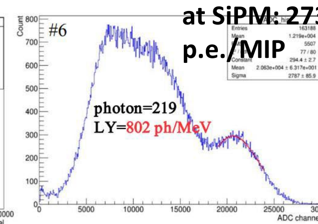




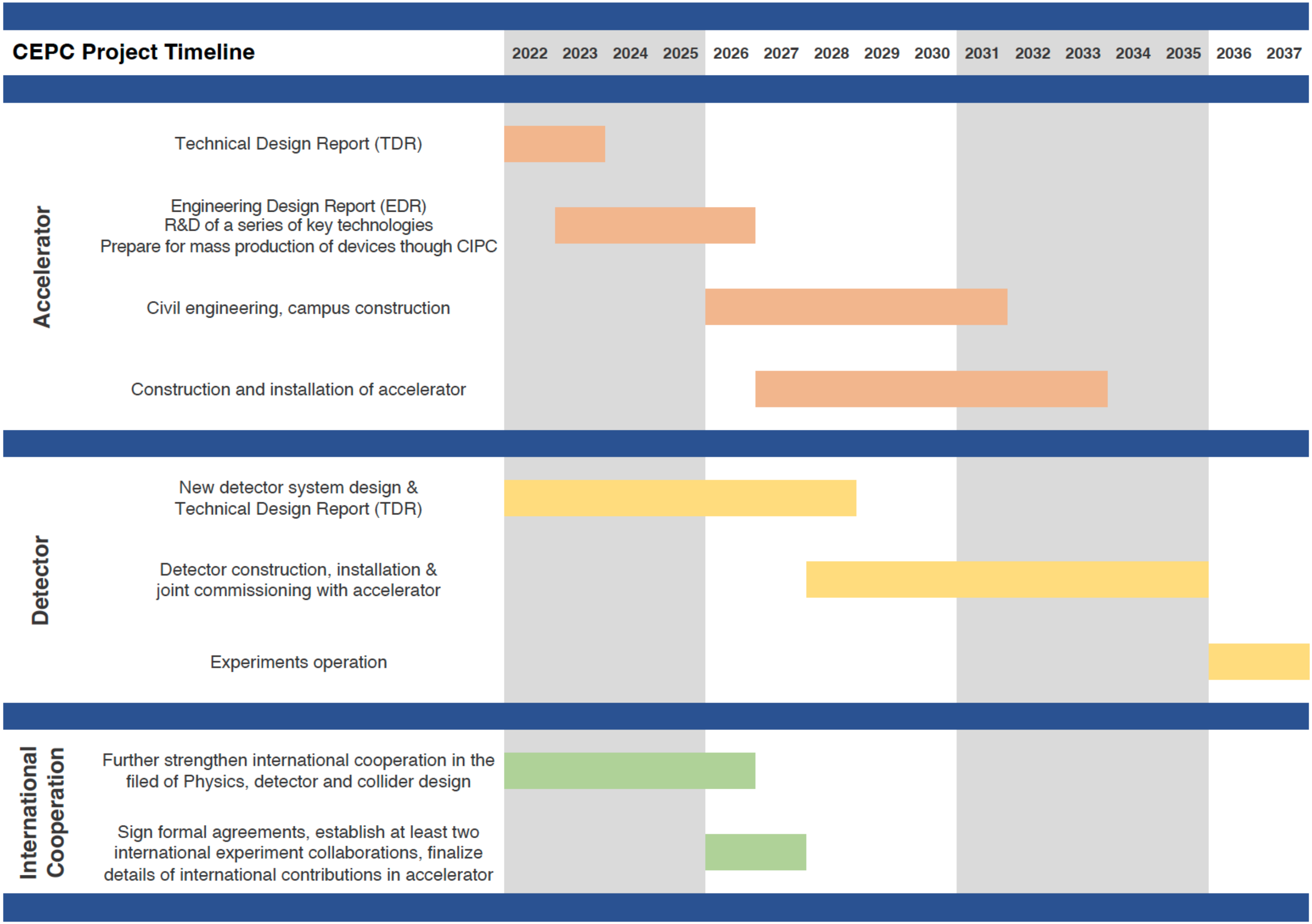
Detected photons at SiPM: 273.8 p.e./MIP



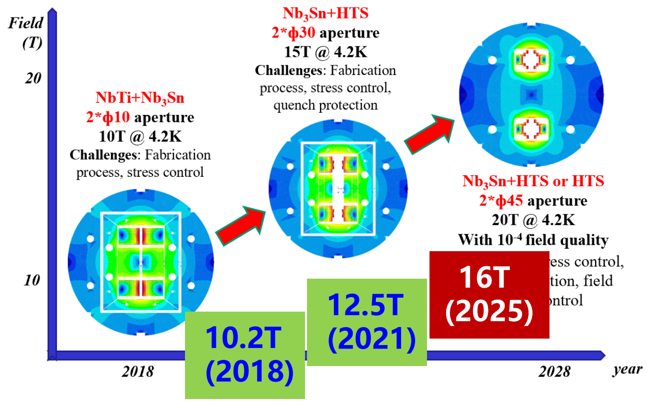


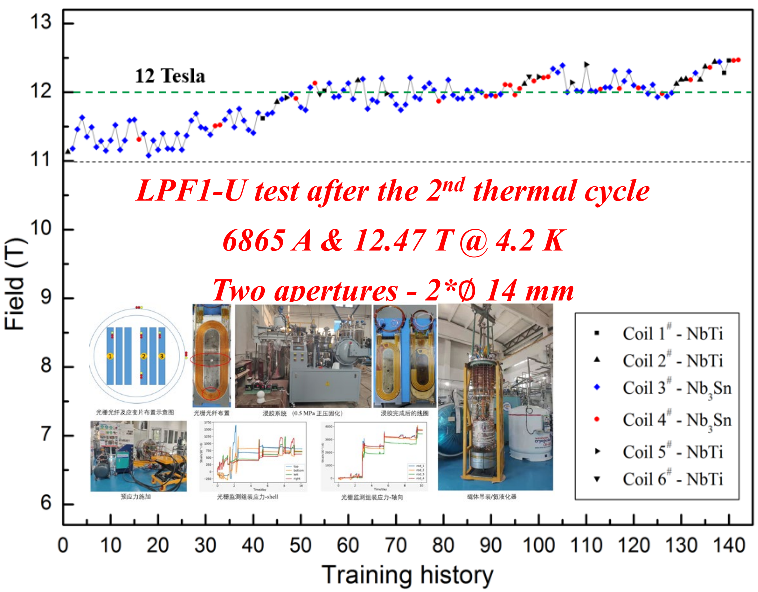


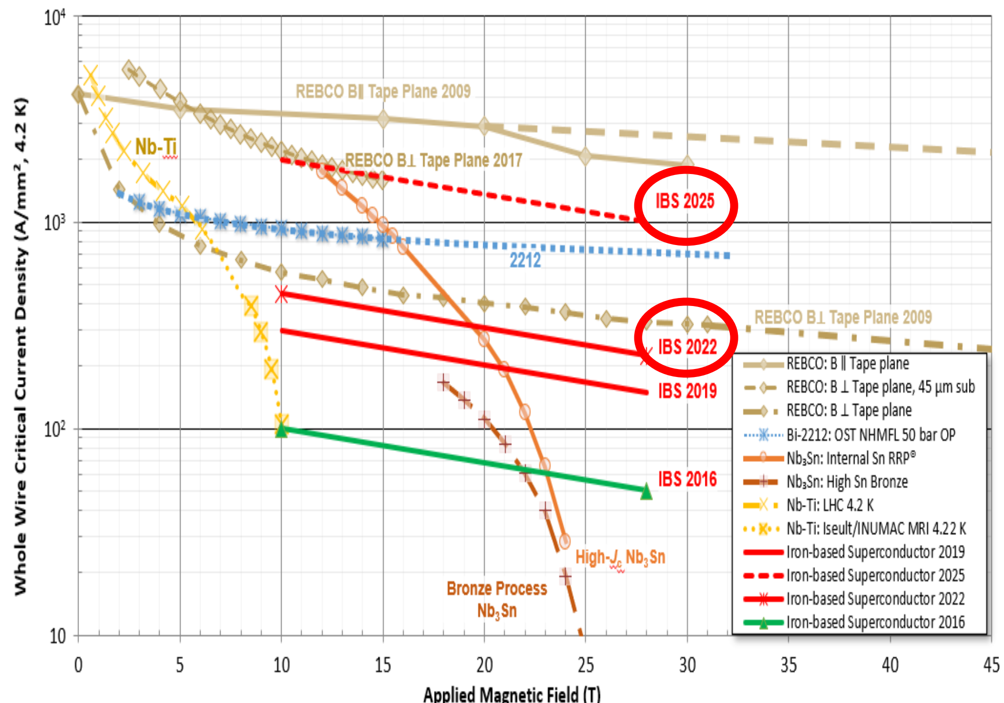
Ideal Schedule



Far Future: HTS SC Magnet and Iron-Based Superconductor





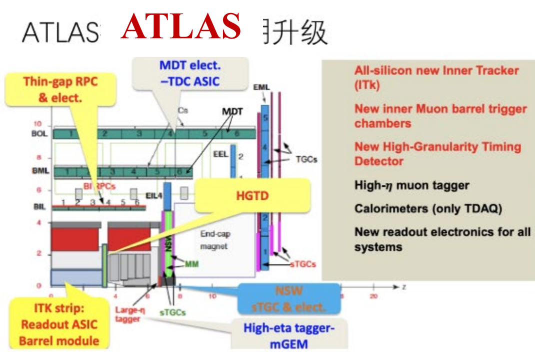


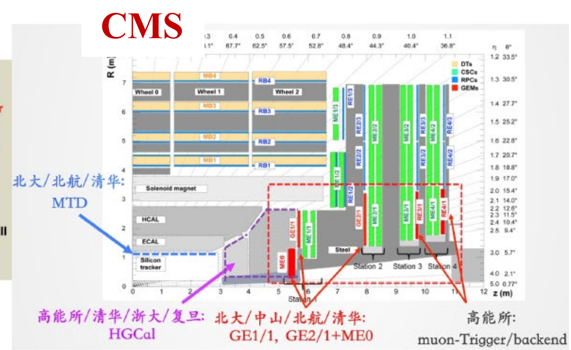
Q XU, Advances in Superconducting Accelerator Magnets

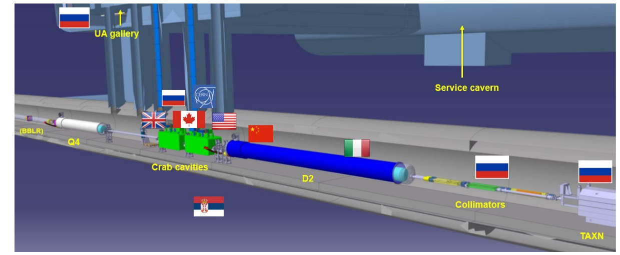
- **Steadily improved Jc**
- **Stainless-steel stabilized IBS tape achieved the highest J_e in 2022**
- **Highly probable to achieve our goal in 5-10 years**

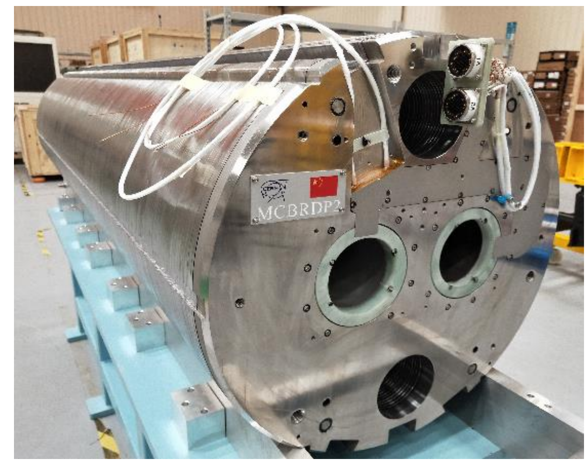
Higgs: International Projects

- China is a member of LHC
  - HL-LHC CCT magnets(by IHEP+IMP)
  - LHC experiments: ATLAS, CMS upgrade and physics analysis

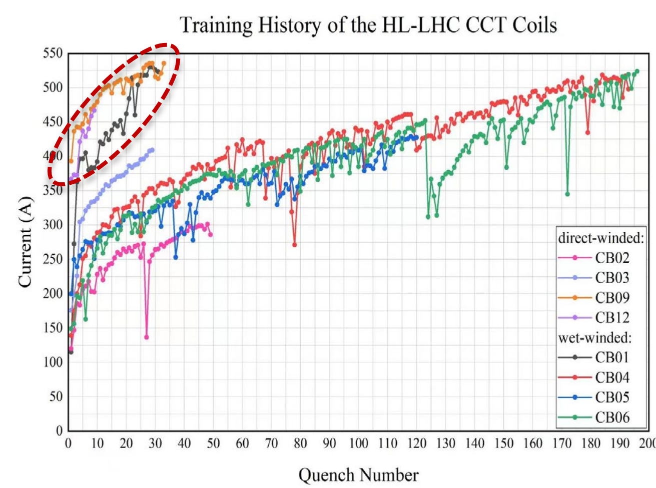




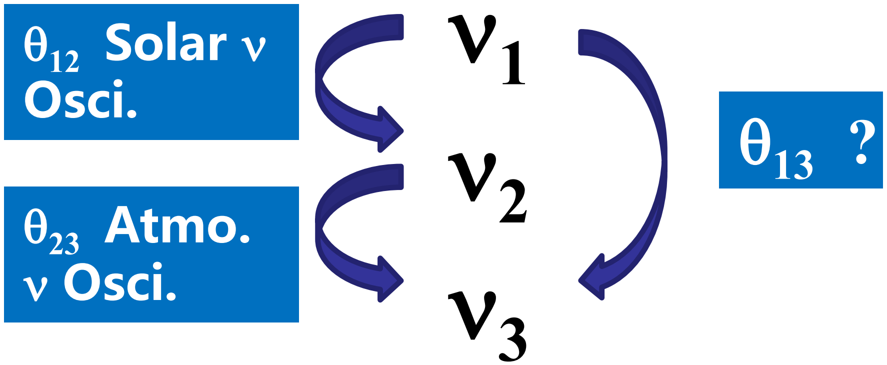


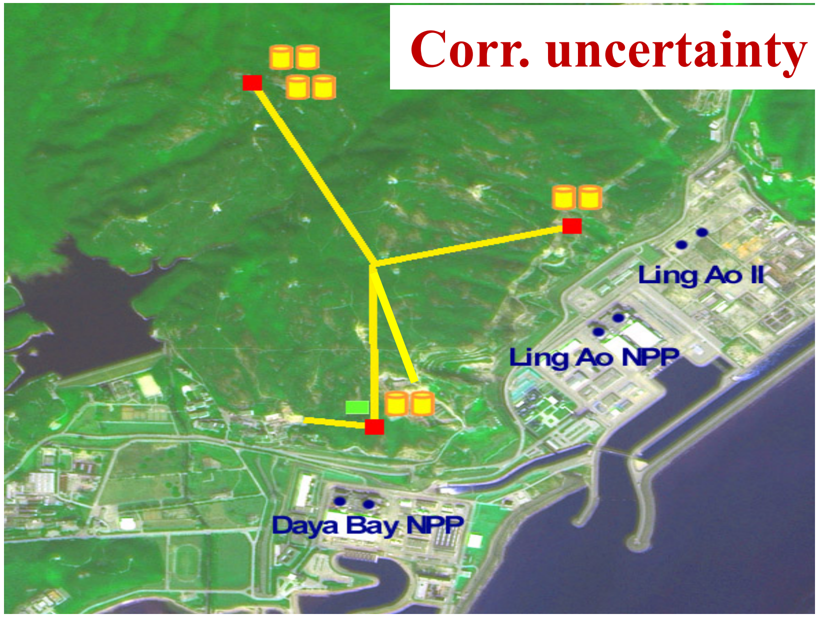


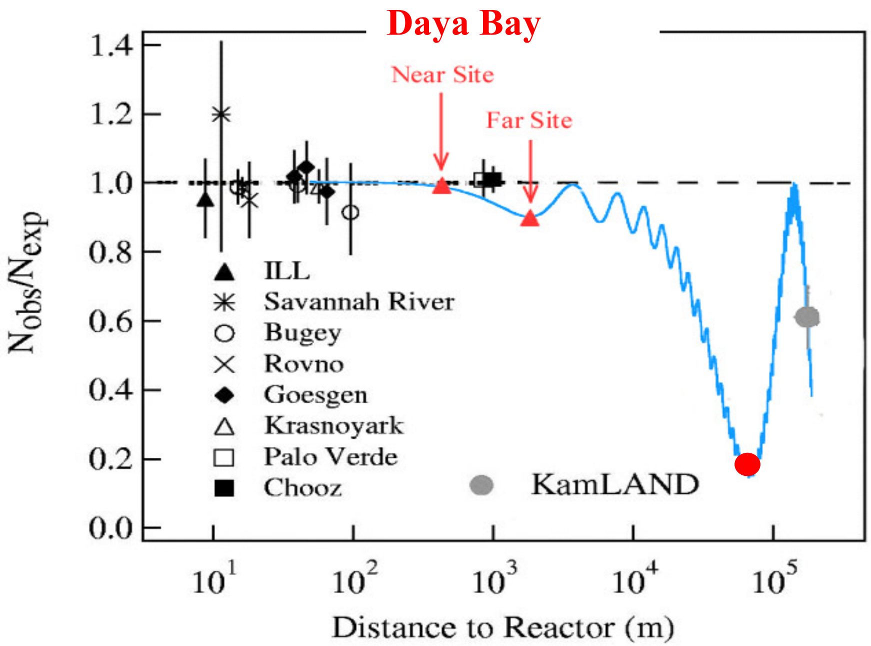
- China is eager and happy to join international projects, ILC, FCC, etc.
- China will be happy to join any US-leading major HEP projects, if possible

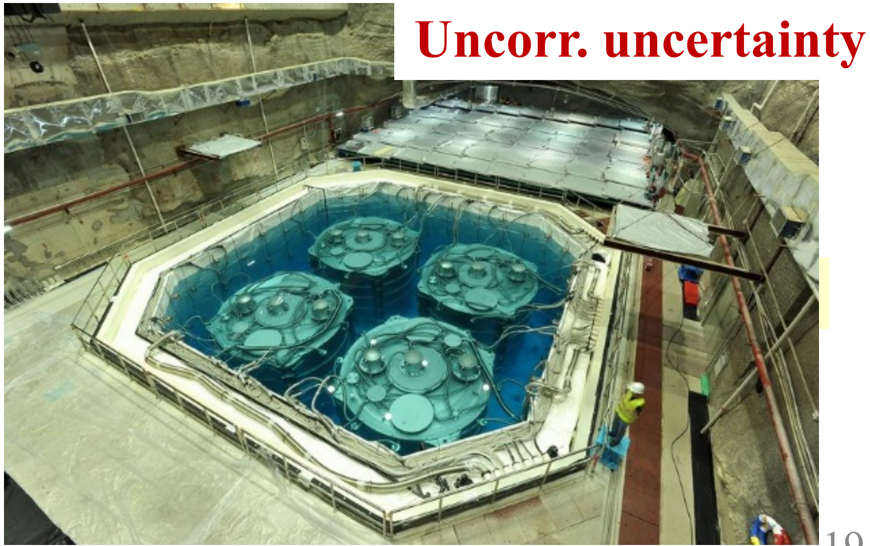


Neutrinos: Daya Bay Experiment







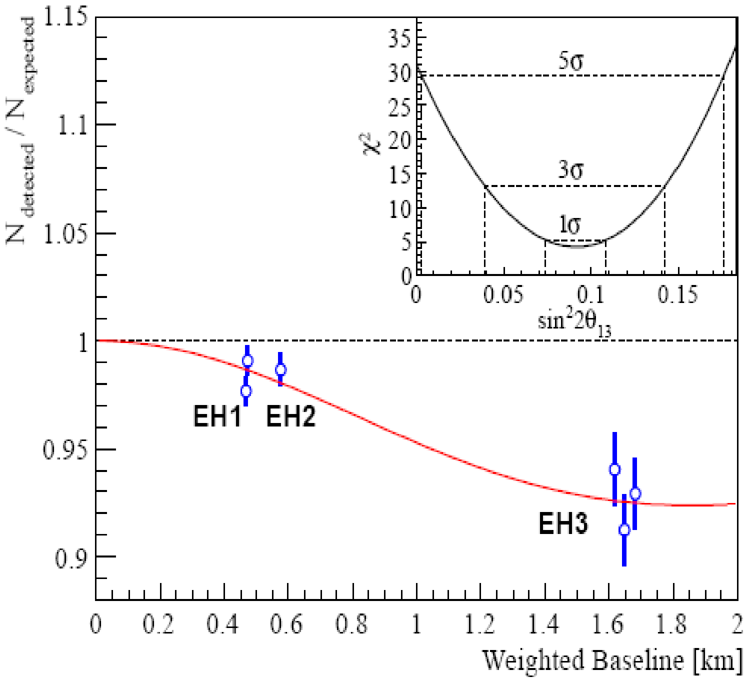


Daya Bay Reactor Neutrino Experiment

$\mathbf{Sin^2 2\theta_{13} = 0.092 \pm 0.016(stat) \pm 0.005(syst)}$

$\mathbf{\chi^2/NDF = 4.26/4}$, **5.2 σ for non-zero** $\mathbf{\theta_{13}}$

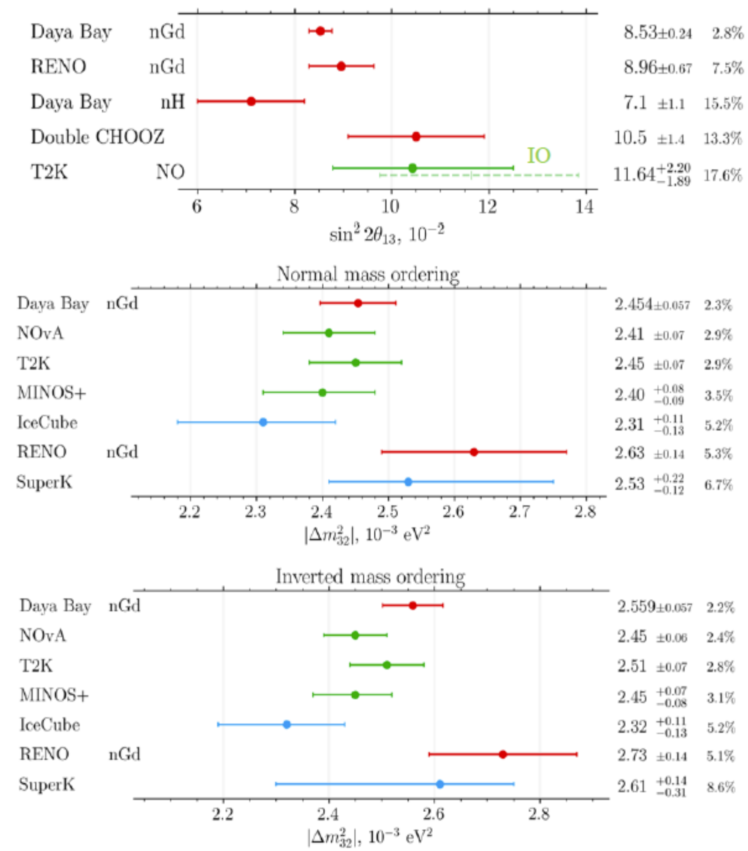
F.P. An et al., Phys. Rev. Lett. 108, (2012) 171803;
Citation > 2680



$\sin^2 2\theta_{13}$

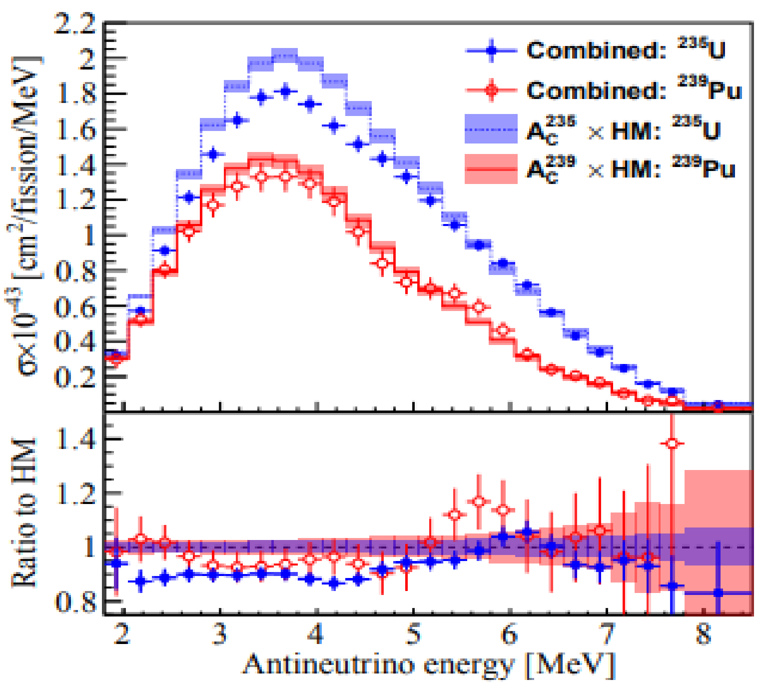
Δm^2_{32} (NO)

Δm^2_{32} (IO)

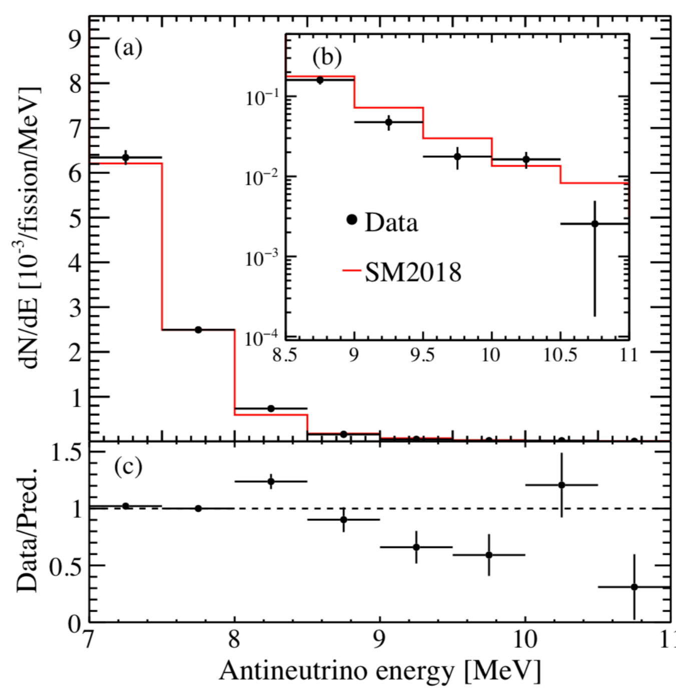


Latest Results from Daya Bay

- Neutrino energy spectrum by a joint analysis of Daya Bay and PROSPECT
  arXiv:2106.12251, PRL 128 (2022) 081801
- First measurement of high-energy reactor antineutrinos at Daya Bay
  arXiv:2203.06686, PRL 129 (2022) 041801
- Precision measurement of reactor antineutrino oscillation at kilometer-scale baselines by Daya Bay



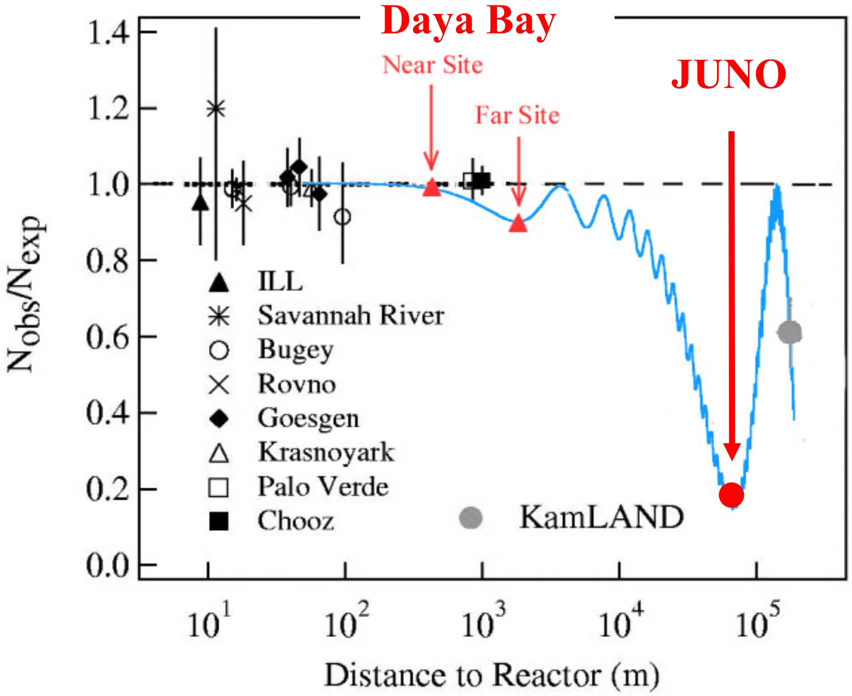
Joint analysis of neutrino spectrum from U235 and Pu239 with Prospect



First Measurement of High-Energy Reactor Antineutrinos

Neutrinos: JUNO Experiment

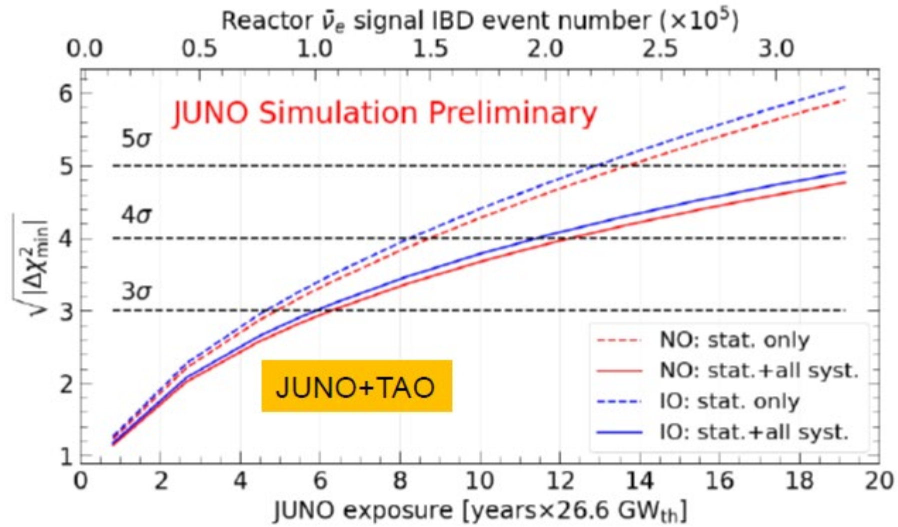
- Continue reactor neutrino experiments using the liquid scintillator: mainly for the neutrino mass hierarchy
- Preparation started in 2008



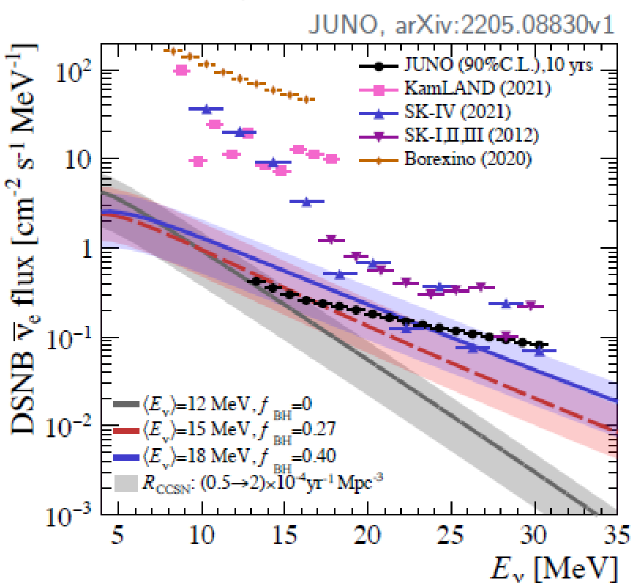
	Target mass [t]	energy resolution
JUNO	20,000	3% @ 1 MeV
Borexino	300	5% @ 1 MeV
KamLAND	1,000	6% @ 1 MeV
Daya Bay	20	8% @ 1 MeV

Physics at JUNO

- Energy resolution of ~3%@1 MeV leads to a sensitivity of NMO at 3σ@ 6 yrs*26.6 GW
- Atmospheric neutrinos contribute another ~ 1 σ @ 6 yrs
- Most of neutrino oscillation parameters can be improved to a sub-percent level
- Solar, supernova and geoneutrinos



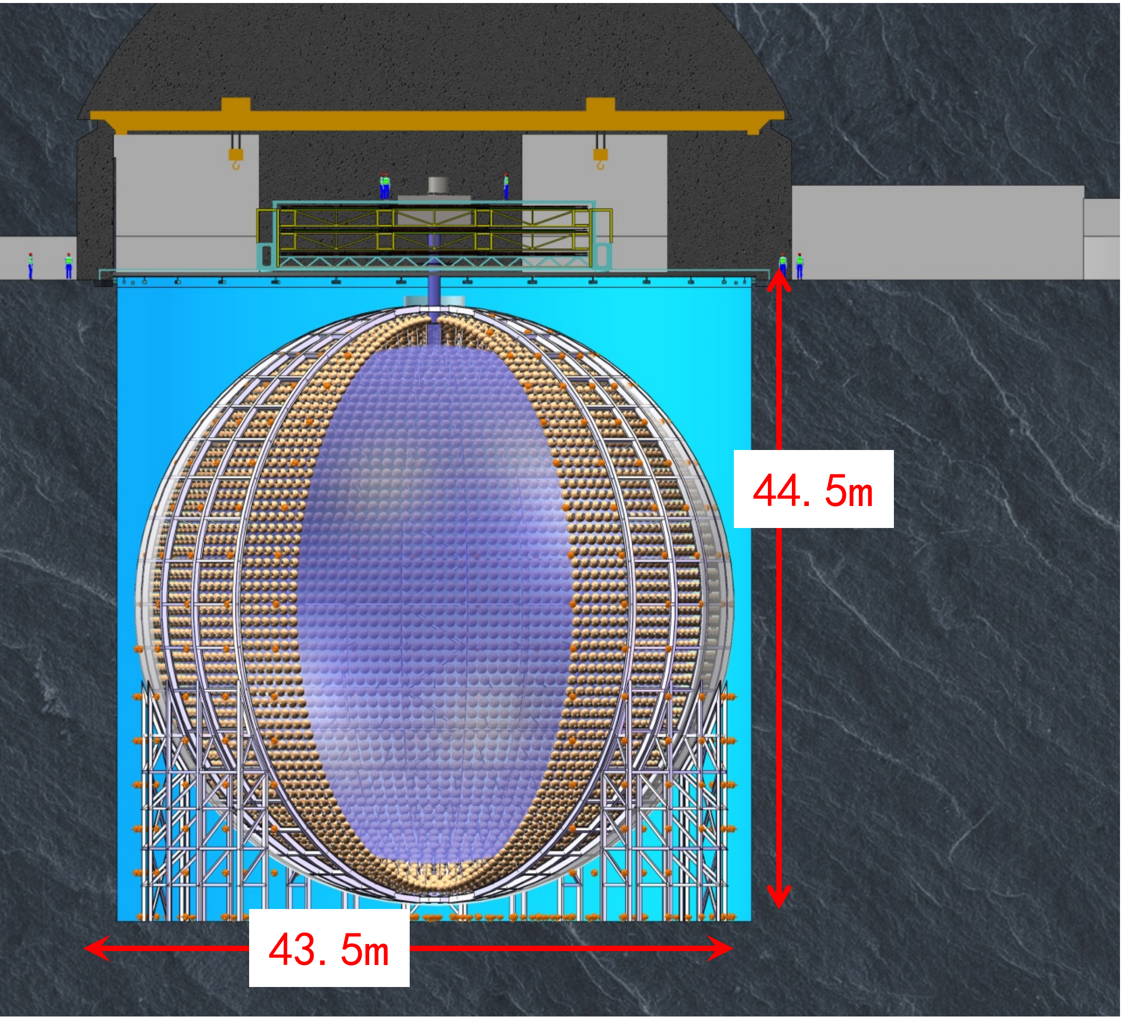
- ➢ huge stat. if burst SNν nearby
- ➢ high prob. to discover diffused SNν



	Current (PDG2020)	JUNO (100 d)	JUNO (6 y)
Δm^2_{31} Δm^2_{32}	1.3%	0.8%	0.2%
Δm^2_{21}	2.4%	1.0%	0.3%
$\sin^2\theta_{12}$	4.2%	1.9%	0.5
$\sin^2\theta_{13}$	3.2%	47.9%	12.1%

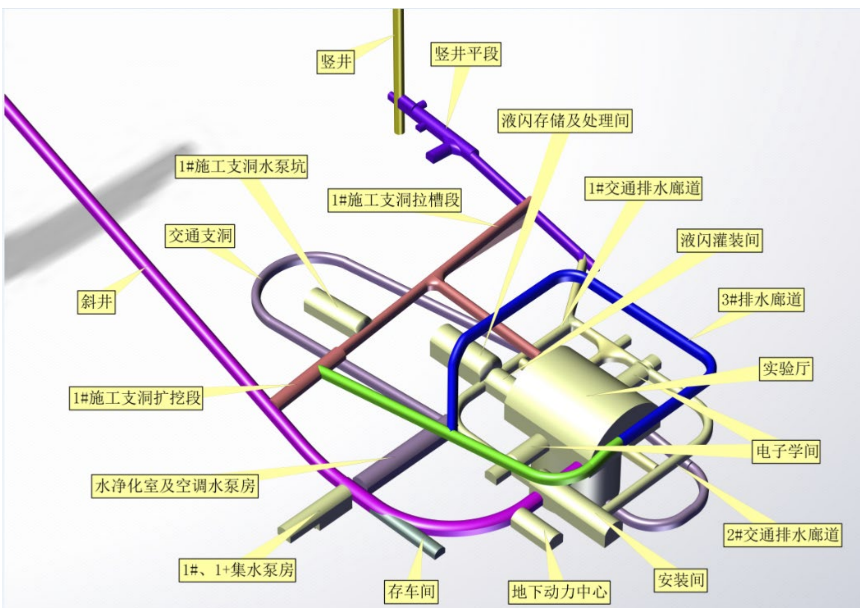
JUNO Detector and Challenges

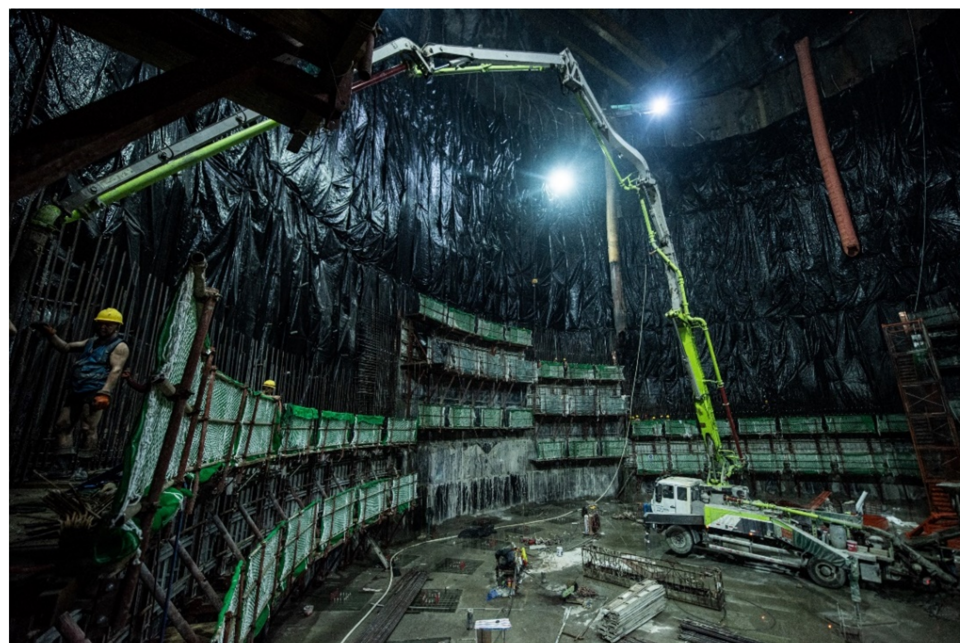
- Largest LS detector → × 20 KamLAND， × 40 Borexino
- Highest light yield → × 2 Borexino， × 5 KamLAND



- Hugh cavern:
  - ~ 50m× 70m
- Largest Acrylic tank:
  - Φ 35.4m(13m@SNO)
- 20 kt LS
  - Best attenuation length: 25m (15m @ Daya Bay)
- 20000 20” PMT
  - Highest photon detection efficiency : 30%*100% = 30%（25%*60%=15% @ SuperK）

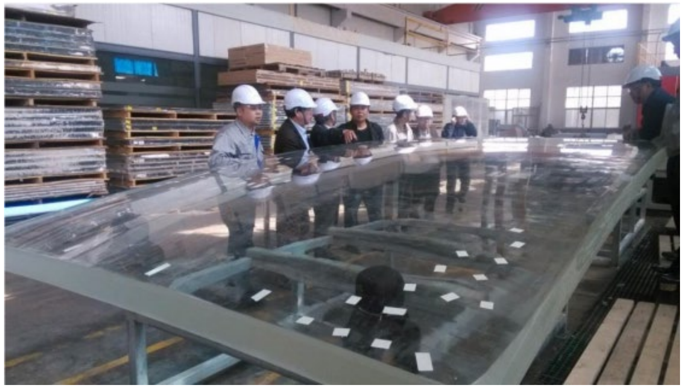
~ 600m vertical shaft, ~1300m sloped tunnel
All blasting completed on Dec. 30, 2020,
water pool construction on the way

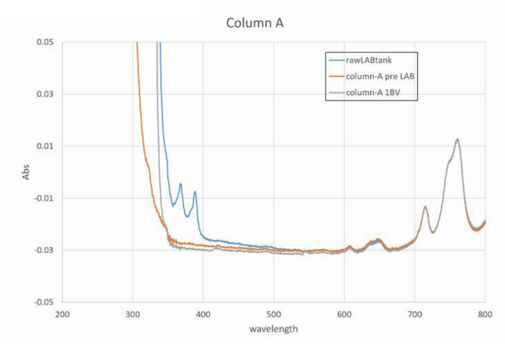




JUNO detector construction

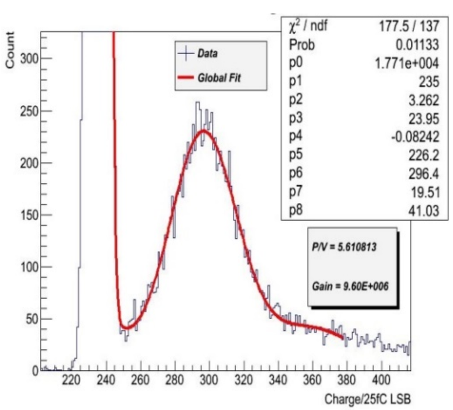
- Production of detector components in good shape, no major technical issues
  - Acrylic panels and SS structure all produced
  - All PMTs delivered, tested, and instrumented OK
  - Electronics all produced and tested
- Liquid scintillator
  - LS raw material production in good shape, ~20t PPO delivered (<0.1ppt)
  - Equipment for purification and mixing installed, commissioning in progress, test run OK

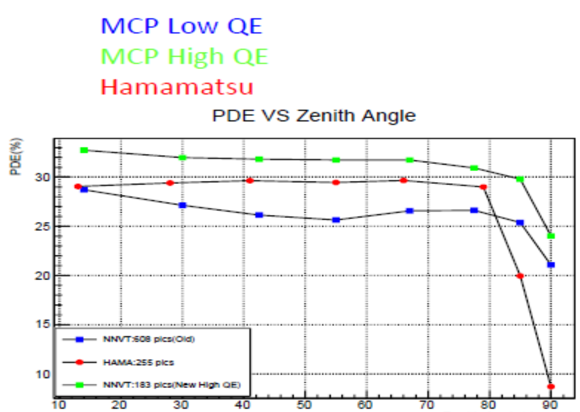




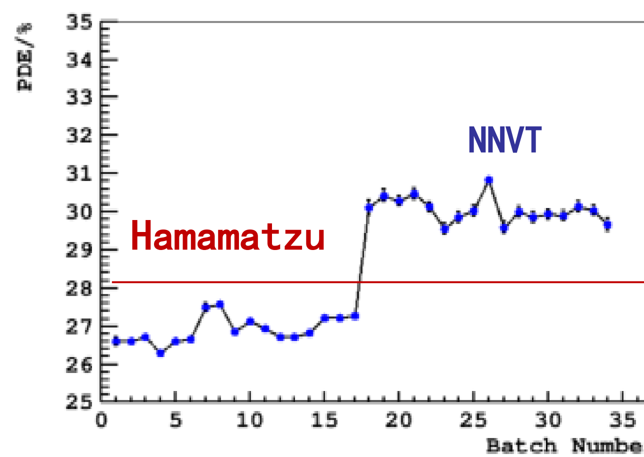
20” PMTs

- A new type of PMT developed by IHEP & NNVC based on MCP to collect photoelectrons:
  - ⇨ Intrinsically high collection efficiency
  - ⇨ Easy for mass production
- Successful development:
  - ⇨ NNVC: QE(30%)*DE(100%) > 30%
  - ⇨ Hamamatsu: QE(30%)*DE(90%) > 27%
- Based on performance, cost, risk, etc.
  - ⇨ MCP-PMT: 15000, Dynode: 5000
- All PMTs delivered, tested and instrumented OK,



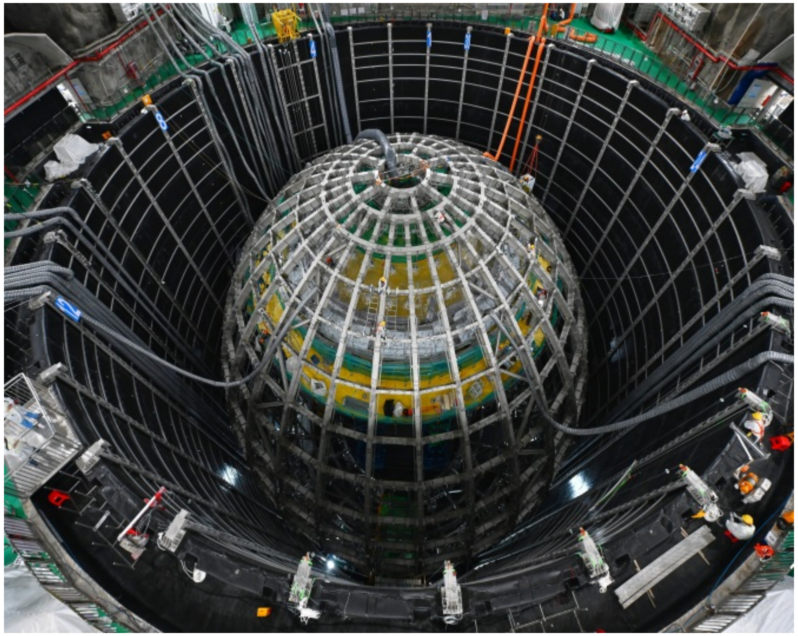


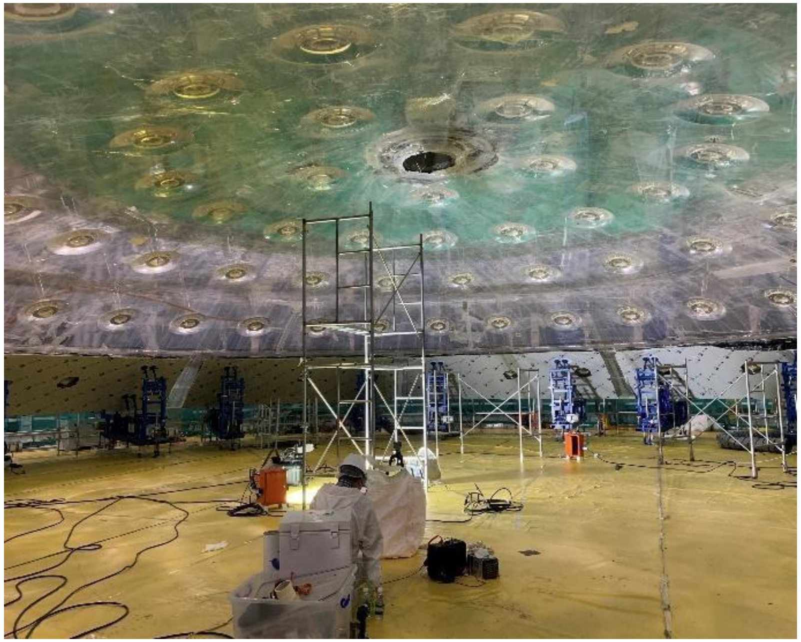
Detection eff. of all MCP-PMTs

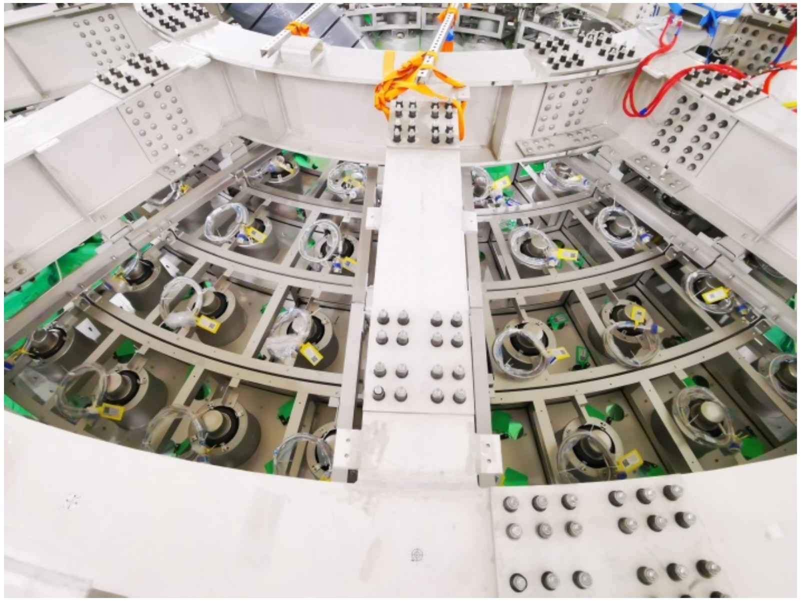


JUNO installation

- Installation in progress:
  - SS structure completed
  - Acrylic sphere bonding in progress
  - PMT installation and function test successful
- Cleanness and backgrounds under control, goal: 10^{-17} g/g
- Good energy resolution(3%@1MeV) seems realizable

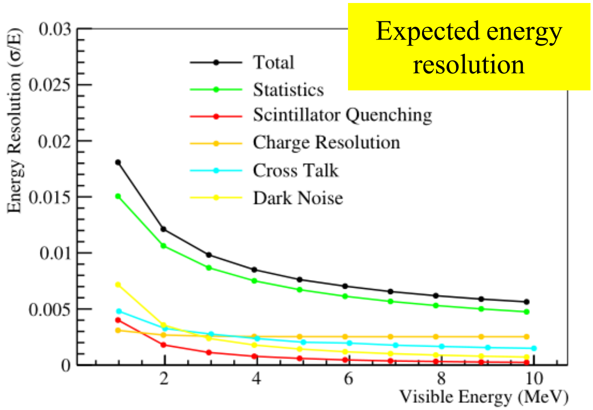


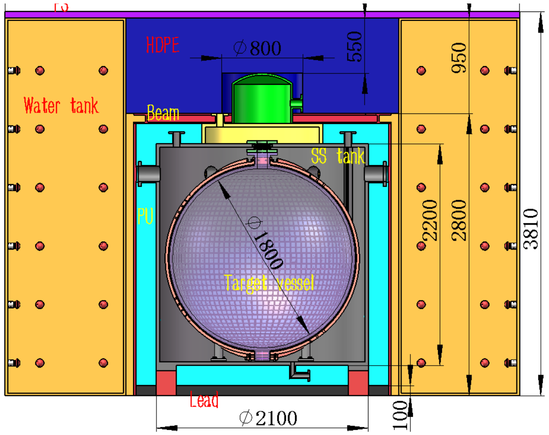


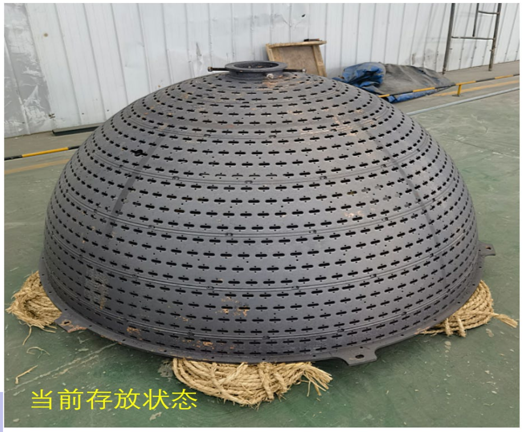


JUNO-TAO: a LS detector at -50℃

- A high precise neutrino detector located at the Taishan Nuclear Power Plant, ~30m from a 4.6GW reactor core
  - ⇨ A reference neutrino spectrum to improve MH and constrain uncertainties(arXiv:2005.08745)
  - ⇨ Sterile neutrino searches
  - ⇨ Nuclear data
- Highest possible energy resolution ~ 1.5%/√E:
  - ⇨ Large area SiPM:
    - PDE > 50%, >90% coverage, 10 m²
    - 4500 p.e./MeV ➔ × 3 JUNO;
  - ⇨ Operate at -50℃ to reduce SiPM dark noise by 3 orders of magnitude to 100 Hz/mm²
  - ⇨ Gadolinium-doped liquid scintillator working at -50℃ ➔ a new recipe
- ~2000 IBD/day with ~2% bkg
- To be operational in 2023





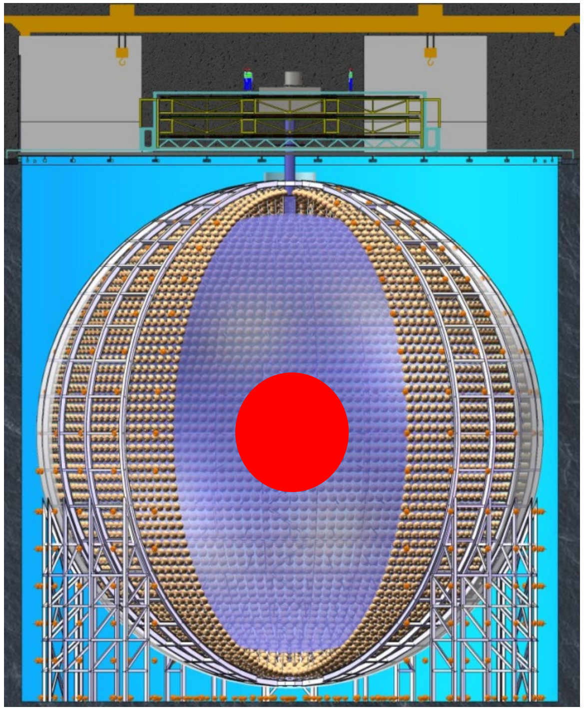


JUNO-ββ

- In ten years from now, oscillation will be mostly understood.
- 0ν ββ decay will be the next major breakthrough

> - Hints from cosmology: $m_\nu < \sim 1$ eV
> - Guess from Oscillation: $m_\nu \sim 1$ meV
> - Katrin will probe to $m_\nu \sim 0.2$ eV
>
> $$(m_{\nu_e})^{eff} = [\Sigma_i \, |U_{ei}|^2 \, m^2_{\nu_i}]^{1/2}$$
>
> - 0ν ββ decay should target for ~ 1 meV
>
> $$\langle M_{ee} \rangle = |\Sigma_i \, (U_{ei})^2 \, m_{\nu_i}|$$

	核素	质量(吨)	$\langle m_{\beta\beta} \rangle$,meV
KamLAND-Zen	^{136}Xe	1	61-165
EXO	^{136}Xe	0.2	93-286
nEXO	^{136}Xe	5	7-22
GERDA/Majorana	^{76}Ge	1	10-40
SNO+	^{130}Te	8	19-46
JUNO-ββ	^{136}Xe	50	4-12
	^{130}Te	100-200	2-6 ?

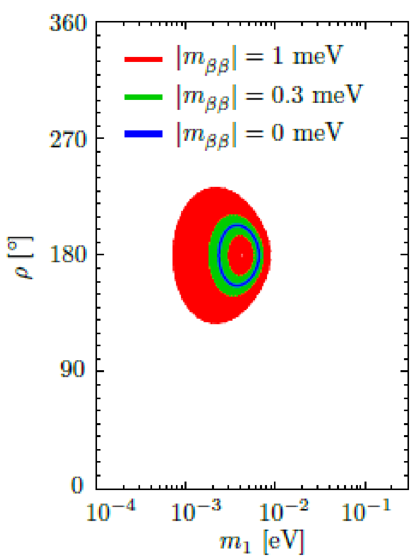


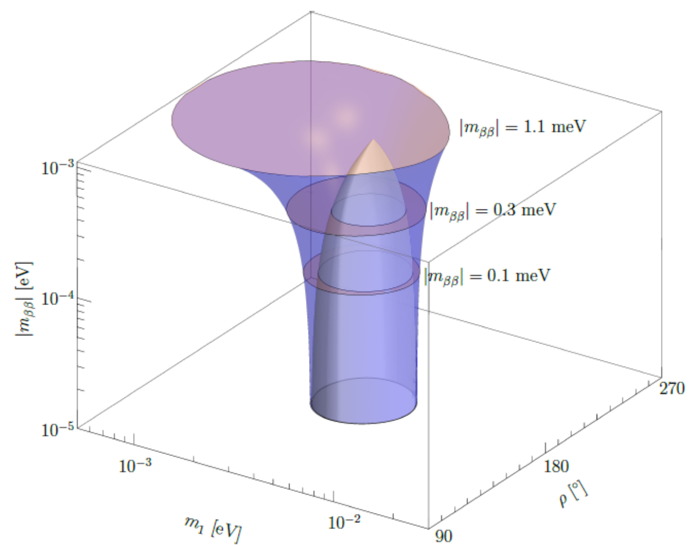
Insert a balloon filled with ^{136}Xe-loaded LS(or ^{130}Te) into the JUNO detector

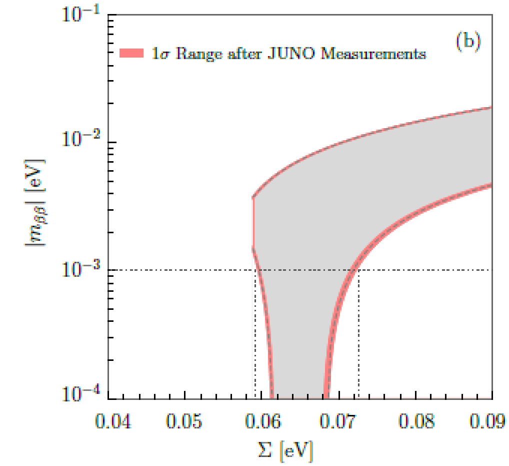
Zhao et al., arXiv: 1610.07143, CPC 41（2017）5

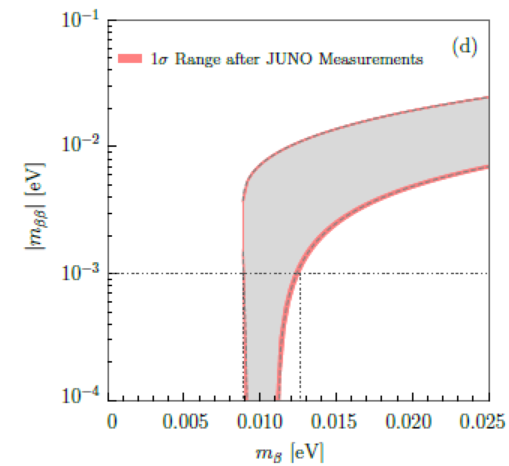
Aim for $|m_{\beta\beta}| < 1$ meV

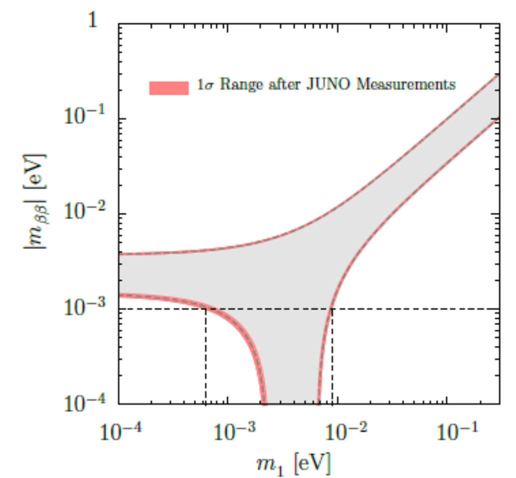
- $\Sigma_i m_i$ and m_β determined
- m_1 determined ➔ m_2 and m_3 determined
  ➔neutrino mass problems solved !
- Majorana phase ρ determined
- Almost no parameter space for $m_{\beta\beta} < 0.1$ meV
  ➔ $0\nu\beta\beta$ can be seen or ruled out











J. Cao et al., arXiv:1908.08355

JUNO Collaboration

19 countries & regions
74 institutions
709 members

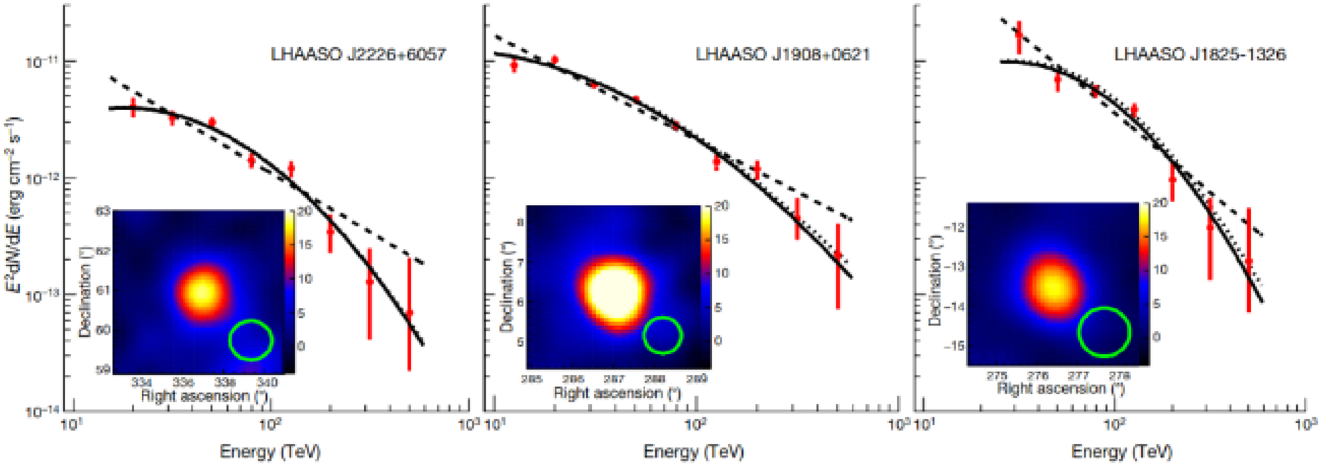
Country	Institute	Country	Institute	Country	Institute
Armenia	Yerevan Physics Institute	China	Tsinghua U.	Germany	U. Tuebingen
Belgium	Universite libre de Bruxelles	China	UCAS	Italy	INFN Catania
Brazil	PUC	China	USTC	Italy	INFN di Frascati
Brazil	UEL	China	U. of South China	Italy	INFN-Ferrara
Chile	PCUC	China	Wu Yi U.	Italy	INFN-Milano
Chile	SAPHIR	China	Wuhan U.	Italy	INFN-Milano Bicocca
China	BISEE	China	Xi'an JT U.	Italy	INFN-Padova
China	Beijing Normal U.	China	Xiamen University	Italy	INFN-Perugia
China	CAGS	China	Zhengzhou U.	Italy	INFN-Roma 3
China	ChongQing University	China	NUDT	Latvia	IECS
China	CIAE	China	CUG-Beijing	Pakistan	PINSTECH (PAEC)
China	DGUT	China	ECUT-Nanchang City	Russia	INR Moscow
China	Guangxi U.	Croatia	PDZ/RBI	Russia	JINR
China	Harbin Institute of Technology	Czech	Charles U.	Russia	MSU
China	IHEP	Finland	University of Jyvaskyla	Slovakia	FMPICU
China	Jilin U.	France	IJCLab Orsay	Taiwan-China	National Chiao-Tung U.
China	Jinan U.	France	LP2i Bordeaux	Taiwan-China	National Taiwan U.
China	Nanjing U.	France	CPPM Marseille	Taiwan-China	National United U.
China	Nankai U.	France	IPHC Strasbourg	Thailand	NARIT
China	NCEPU	France	Subatech Nantes	Thailand	PPRLCU
China	Pekin U.	Germany	RWTH Aachen U.	Thailand	SUT
China	Shandong U.	Germany	TUM	U.K.	U. Warwick
China	Shanghai JT U.	Germany	U. Hamburg	USA	UMD-G
China	IGG-Beijing	Germany	FZJ-IKP	USA	UC Irvine
China	SYSU	Germany	U. Mainz		

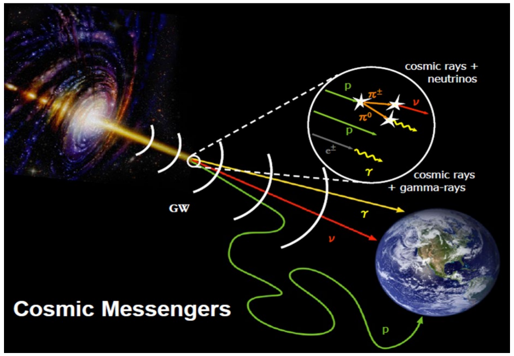
AstroPhysics: Cosmic-Rays and γ-astronomy

— Large High Altitude Air Shower Observatory(LHAASO)

- World largest air shower array(with e, μ, water Č detectors and Č telescope) for the high energy γ-astronomy and cosmic-ray physics
- Construction just completed and interesting results obtained:
  - Highest γ-rays from the Milky Way: 1.4 PeV
  - many γ-ray sources up to ~1 PeV identified → PeVatrons in Milky Way
- Future
  - Large Array of Cherenkov Telescopes （LACT）
  - Under-water neutrino telescope

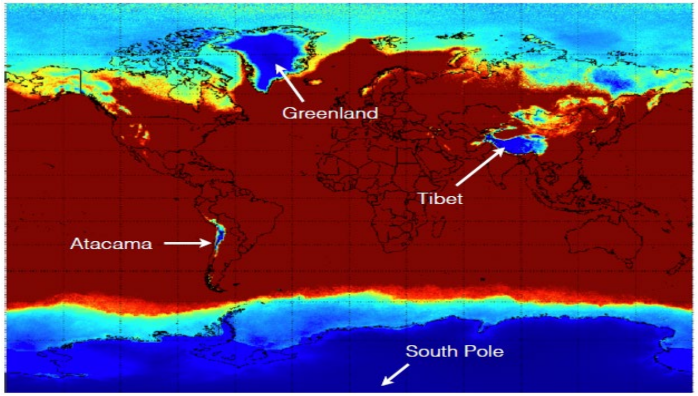
Sichuan, 4410m above the sea

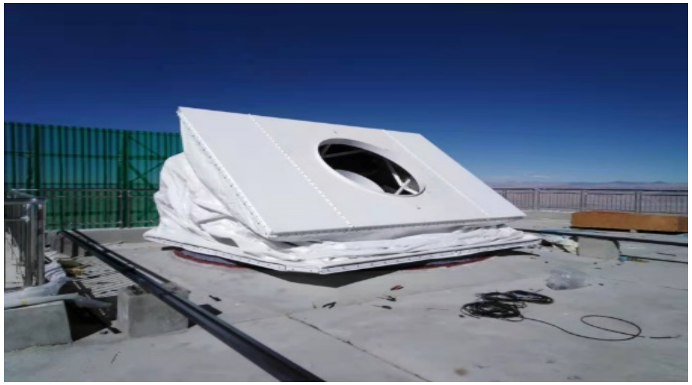




CMB: ALICPT

- located in Ali, Tibet with an altitude of 5250m
  - Best site in the north hemisphere for CMB
  - can be a very important node of an international network
- a collaboration with the Stanford University and other international partners
- Hopefully to start the observation next year with 1 module (the telescope can house 19 modules)

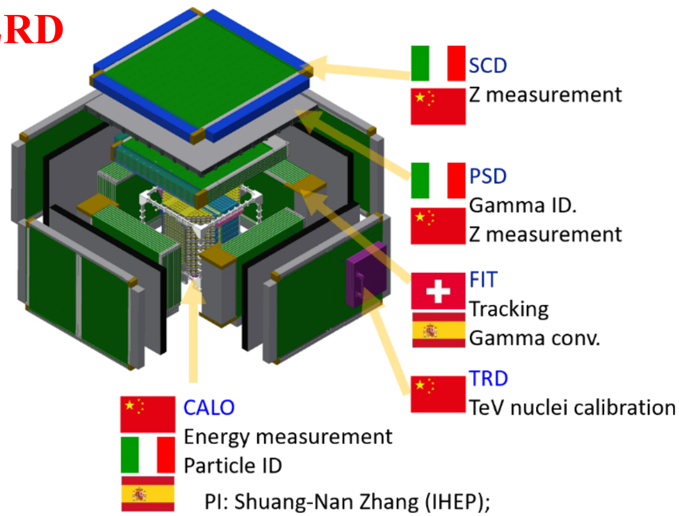




Future Space Programs

- A 3D crystal calorimeter for ×10 acceptance and ×10 higher energy on board of the Chinese Space Station, to be launched in ~2027
  - dark matter searches
  - Gamma-ray sky survey
  - Precise cosmic ray spectrum and composition to calibrate LHAASO
- Large international collaboration

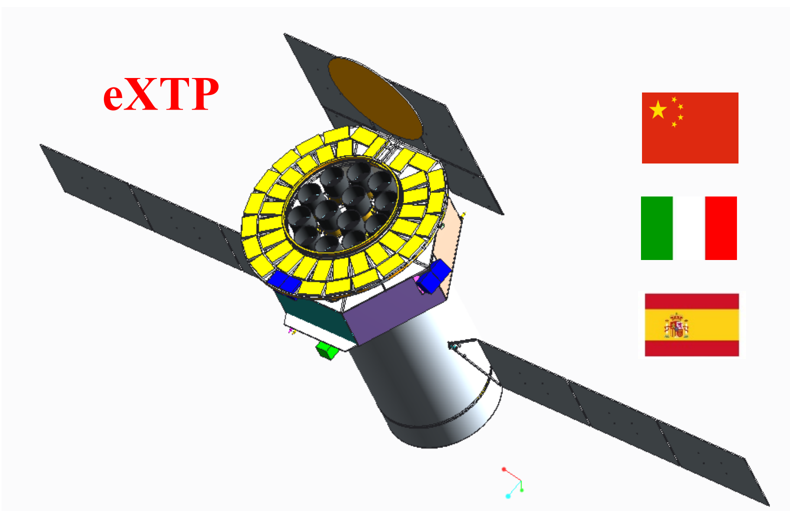
HERD



PI: Shuang-Nan Zhang (IHEP);
Europe led by Italy: G. Ambrosi (Perugia/INFN)

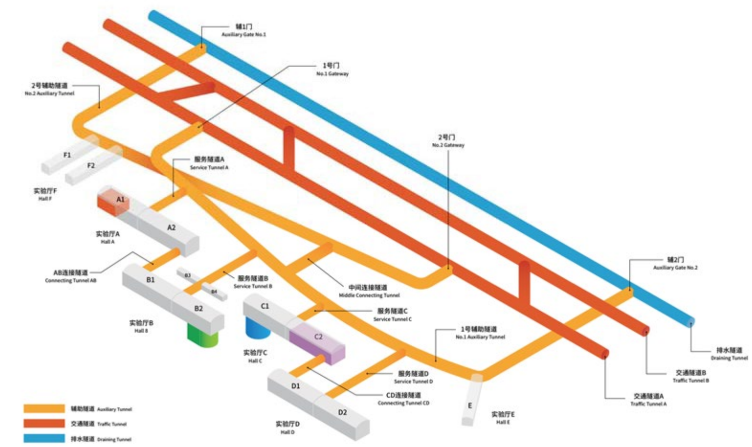
- Enhanced X-ray Timing and Polarimetry satellite for
  - Neutron stars, black holes, etc. to study extreme gravity, magnetism, density, etc.
- With cutting-edge technologies:
  - Large eff. Area (~3.5 m^2@6 keV)
  - High spectral resolution (<180 eV@6 keV)
  - Polarimetry
- Large international collaboration

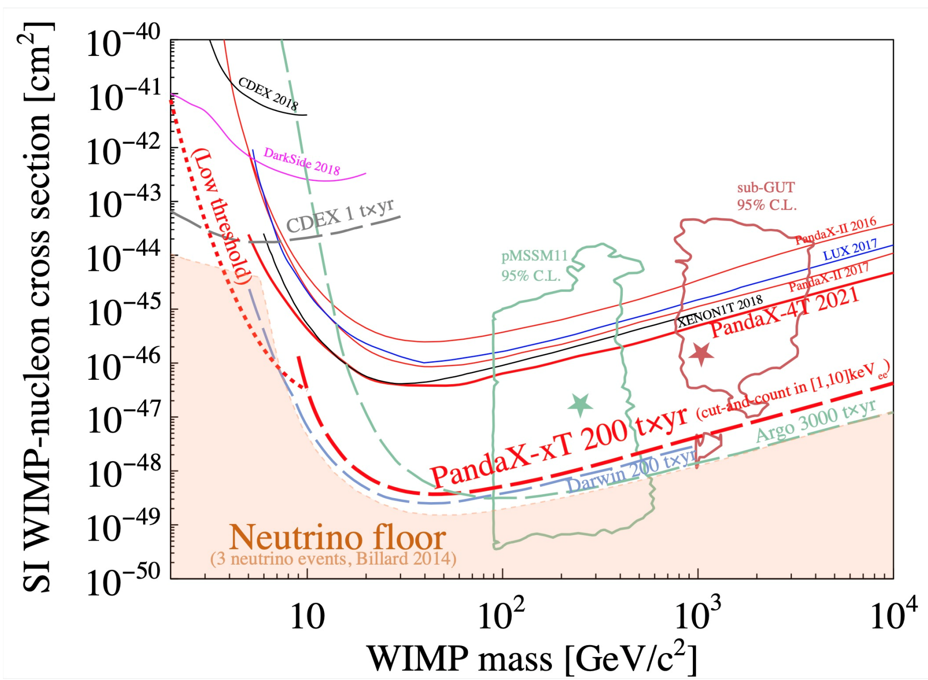
eXTP

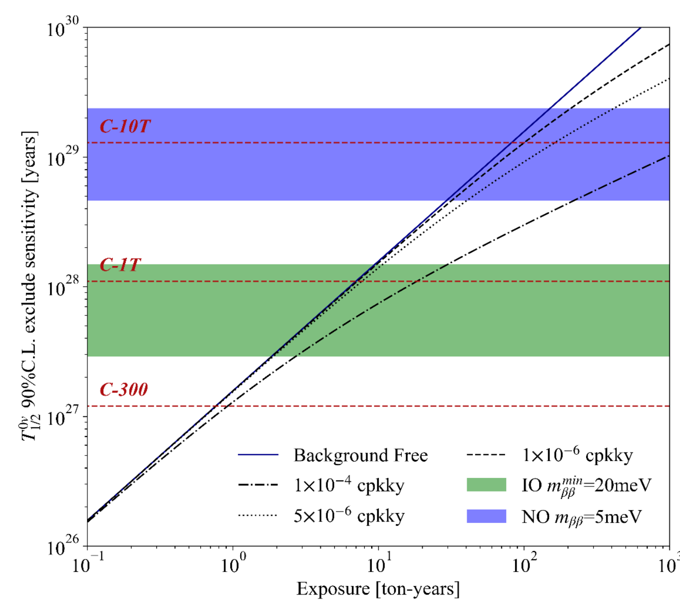


Dark Matter：JinPin Underground Lab

- The deepest underground laboratory in the world with an overburden of 2400 m
- Current experiments: dark matter searches and 0νββ searches
  - Xe-based PandaX-4t (4t LXe)
  - Ge-based CDEX-300 (300 kg)
- Future：
  - PandaX-xT (~50t LXe)
  - CDEX-1T (1t ^{76}Ge)







Applications

- High Energy Photon Sources(HEPS) in north of Beijing is under construction, operational in 2025
  - 6 GeV, 0.036nm·rad emittance, 1260m Circumference,
  - Brilliance: $>10^{22}$phs/s/mm^2/mrad^2/0.1BW
- China Spallation Neutron Source(CSNS) operational since 2018 at 100 kW beam power, to be upgraded to 500 kW with more beamlines
- A possible light source(SAPS) next to CSNS
- Shanghai hard X-ray free electron laser(SHINE) with 8GeV e- beam under-construction
- Possible new ideas:
  - Table top photon sources based on wake-field acceleration
  - Laser+beam facilities

Summary: Current and Future

		Current	Future
Accelerator -based	Precision frontier	BESIII	ILC, FCC CEPC
		LHCb, Belle II, PANDA, COMET, GlueX,…	
	Energy frontier	CMS、ATLAS	
Non-accelerator-based	Underground	Daya Bay, JUNO	JUNO-ββ
		EXO, Darkside	nEXO, ARGO
		PANDAx, CDEX	Panda-xT, CDEX-1T
	Surface	ARGO/Asγ, LHASSO	LACT
	Space	AMS, SVOM	HERD eXTP
		HXMT,Polar,DAMPE	