

Reports of Mini-symposia

2023.12.15

Texas in Shanghai

MS 1: GW Astrophysics -- 23 talks

- Waveform modeling
 - 2-body problem: BBHs in vacuum (ZC)
 - Environmental effects: 3rd body/dark matter cloud/accretion disk (WB/HY/JS/BL/JZ)
- EM counterparts
 - BNSs (AB/DS), SMBHBs (ZH/LK/KI/XL), EMRIs (ZP)
- Binary formation: LIGO sources (YB/JL/XL/ER/YL/HL)
- Stochastic GWs: nanoHz (SC/ML)
- GWs as a probe: fundamental laws/cosmology (YL/LS)

MS 2: Particle Astrophysics (conveners: G. Giacinti, D. Xu, H. Zhou)

- Key open questions:
 - - **Particle acceleration** mechanisms and sites? (**PeV** in Galaxy; UHE beyond)
 - - **Cosmic-ray propagation** in the Galaxy / Universe?
 - - What are the origins of **IceCube neutrinos**?
- We are now on the verge of answering century-old questions:
- **Gamma-ray astronomy** already very successful at TeV energies
- ... Now, the **PeV** window is opening, thanks to **LHAASO**!
- First **PeVatrons** detected in gamma-rays (Z. Cao's talk): Protons / electrons (?)
- Conclusive for Cygnus region

MS 2: Particle Astrophysics

- Pulsar Wind nebulae:
 - - All stages of development (J. Hinton)
 - - PeV from Crab: Theoretical limit; Asymmetry of Geminga TeV halo (R.-Y. Liu)
 - - Different acceleration mechanisms at different E / PWNe. IXPE: X-ray polarimetry!
 - Still open: e- escape, TeV halos, Crab flares (N. Bucciantini)
- Galactic PeVatrons?:
 - - We are closing in: Cygnus Cocoon, SNR G106.3+2.7 (K. Fang)
 - - NEW: Diffuse Galactic neutrinos - IceCube -> LHAASO diffuse hadronic (K. Fang)
 - - SS433: e- acceleration at base of the outer jet! (L. Olivera-Nieto)
 - - Stellar Clusters (S. Celli) and Galactic BHs as PeVatrons (S. Kimura)

MS 2: Particle Astrophysics

- Extragalactic sources and UHECRs:
 - - LHAASO detection of the BOAT GRB: Narrow jet (X.-Y. Wang)
 - - UHECRs from transients in normal Galaxies: Amaterasu event!; New GMF model
 - (G. Farrar)
- Neutrino astronomy:
 - - Extragalactic IceCube sources: Opaque to gamma-rays: NGC1068, Production at
 - $<100 R_s$ (K. Murase);
 - - Possibility to study physics BSM with flavor ratio (C. Argüelles)
 - - MeV to TeV neutrinos from supernovae (Y.-Z. Qian)

MS3: Accretion process (prepared mainly by **Yosuke Mizuno**)

- Conveners: **Yosuke Mizuno** (TDLI, SJTU), Feng Yuan (SHAO), Shuang-Nan Zhang (IHEP, CAS), Dong Lai (Cornell/TDLI)
- This mini-symposium covers the topic of accretion and outflowing processes from stellar-mass black holes, pulsars to supermassive black holes.
- Take 5 parallel sessions
- Had 29 oral talks (10 invited talks) + 17 poster flash talk
- Although we had a problem of the display (first day) but actively discussed all talks.

MS3: Accretion process (prepared mainly by Yosuke Mizuno)

- Insight HXMT provides many interesting new features from XRBs that bring more puzzles (disk corona geometry, jet/outflow, high-E (>200 keV) QPOs, outburst features)
- Changing look AGNs show rapid state change. Does it explain the state transition in XRBs?
- EHT provides polarimetry images (linear and circular) of M87 and intensity shadow images of Sgr A* from 2017 observations. More observation data will come soon.
- Observational evidence of hot winds in low-luminous AGNs & ULXs which will be important for understanding the feedback
- New/improved theoretical models & numerical simulations for explaining observations, e.g., super-Edd, jet/outflow/wind, L-T pressesion, GW connection, BBH merger in AGNs...

MS4: Cosmic explosions (Conveners: Bing Zhang, Dong Lai, Shuai Zha)

Transient studies with multi-wavelength/messenger observations

- Supernovae
 - CC: multi-D effects, fast neutrino flavor oscillation; Ia: Single/Double degenerate?
 - Mass loss prior to explosion? shock breakout, supernluminescent SN
 - Confirmed binarity with a 12.4 day period in supernova
- Tidal disruption events
 - Origin of optical signals?
 - X-ray and radio after 100's days after optical, why?
 - BH demographics, how to determine the BH mass accurately?
- Gamma-ray bursts
 - Long/short classification, origins of IGRB w KiloNova and sGRB w SuperNova?

MS5: Neutron stars (Conveners: Bing Zhang, Dong Lai, Shuai Zha)

- NS interiors, new constraints on EOS for high density
- Vortices dynamics and superfluidity
- Magnetar with strong B fields, explain a lot?
- New understanding of pulsar emission with plasma simulations
- PTA for nano-Hz GW, stay tuned for new results
- Fast radio bursts
 - Surge of obs. by CHIME, APERIO+LOFAR, MeerKAT, FAST ...
 - Diversity: repeat (apparent) non-repeating, polarize/de-polarize, magnetized environments; similar statistics with earthquake and solar flares
 - Origins: all magnetar? diverse origin? perhaps in-between; magnetic explosion
 - How can FRBs be used for cosmology? Dispersion due to Galactic/Cosmological?

MS 6: Dark Matter

(conveners: L. Visinelli, S.-F. Ge, J. Liu, L. Dai)

- Three parallel sessions (Monday, Tuesday, Thursday)
- 18 talks total + 5 posters from students.
- Key open questions:
 - - **Nature of the dark matter.**
 - Particle or compact objects? Formation processes?
 - - **Detection strategies.**
 - Searches on Earth & in the sky through (in)direct detection.
 - - **Relation between dark matter and large-scale structures.**

MS 6: Dark Matter: Theoretical models

- Light bosonic DM (Yin, Huang, Ma, Zhang, Ge, Addazi, Li)
- Self-interacting DM (Yu), self-interacting BEC (Feng)
- Primordial black holes as DM (Tada)
- Profiles and multimessenger signals from DM around SMBHs (Qiang Yuan, GuanWen Yuan, Kenji Kadota)

MS 6: Dark Matter: Fingerprints and strategies

- Ultralight DM & interferometry (Fengwei Yang, Yong Tang)
- WIMPs and small-scale structures (Sten Delos)
- Novel production mechanisms of PBH as DM in the early Universe (Michael Zantedeschi)
- Connection with inflation and gravitational waves (Anna Tokareva)

MS7: Cosmology with large-scale structure

- **Latest updates from:** **Hyper Supreme-Cam** (Takada), **Dark Energy Spectroscopic Instrument** (Hou), **Meerkat/SKA** (Santos), and **China Space Station Telescope** (Zhan).
- **Emulating the Universe:** **ELUCID** reconstruction (Mo), **Differentiable** simulation (Y. Li), **Cosmic-Enu** (Upadhye), & **Aemulus(-nu)** emulator (Zhai)
- **Advanced methods for extracting cosmology:** **S8 Tension** (Terasawa, Shao), Lya **IM** (Renard), Memory of **reionization** (Montero-Camacho), Photometric **BAO** (Chan), Hybrid **RSD** (Zheng)
- **Prospects for detecting new physics:** **JWST** high-z galaxies (Yan), **Parity Violation** (Hou, Zhu), **shear stress & lifetime of Neutrinos** (Wong), **Dynamical Dark Energy** (Zhao), **T-duality & H0q0 tension** (van Putten), **Torsion** (Jawad)

(un)fortunately, Λ CDM so far remains alive and well.

- **Abundance of bright galaxies as early as $z \sim 17$ from JWST:**

Haojing Yan (observer) said it's a surprise, Simon White (theorist) said it's not, then the question boils down to whether a single first-generation star counts as a galaxy.

- **S8 Tension between CMB at $z=1100$ and LSS at $z < 0.5$:**

Masahiro Takada reported tension using cosmic shear, Simon White thinks galaxy shapes are messy, Zhiwei Shao found messy galaxies are still consistent with the CMB.

- **Potential detection of Parity Violation:**

Takada asked ~ 4 ppl during the banquet if he/she's left-handed, demonstrating an efficient method of detecting parity violation. Jiamin Hou (also Hongmin Zhu) applied a similar method to the real data and claimed a 7-sigma detection.

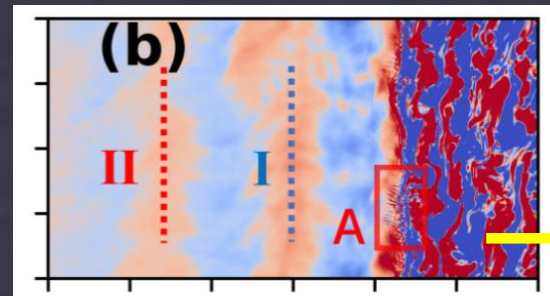
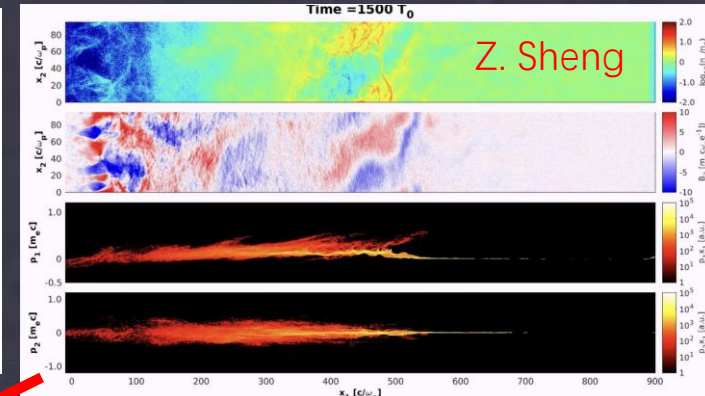
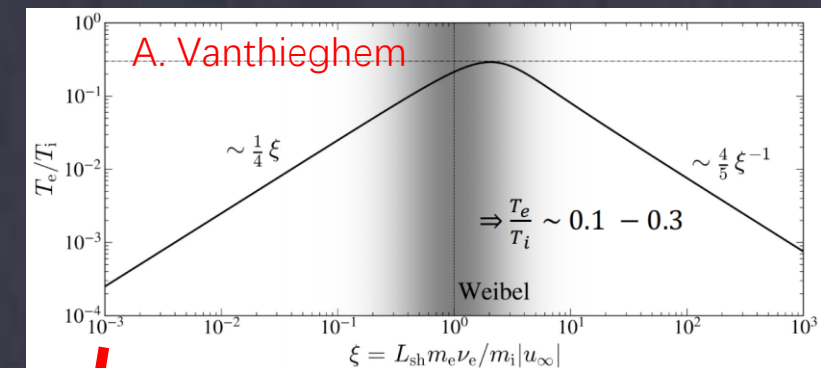
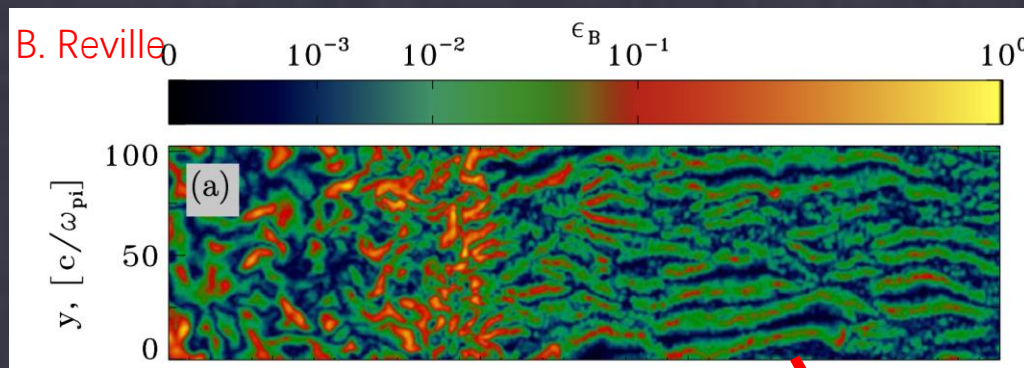
MS8: Gravitational lensing

- Lensing is alive and kicking! Lots of new ideas for taking advantage of existing and upcoming data
- Theory: lensing by black holes; degeneracies in strong lensing
- Transients: gravitational waves, caustic-crossing events, astrometric lensing
- New experiments: SuperBIT, Earth 2.0
- Cosmology: beyond 2-pt weak lensing, lensed SNe

MS9: Plasma Astrophysics

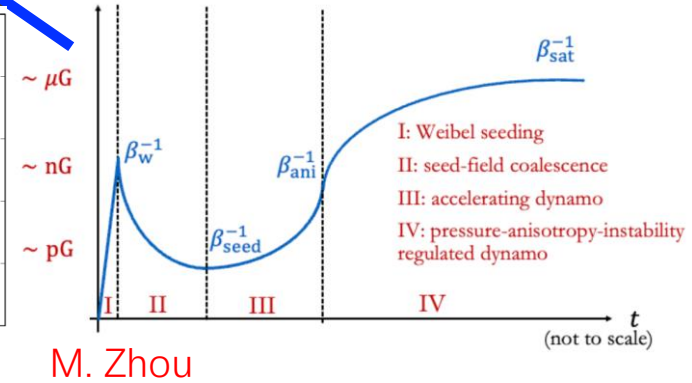
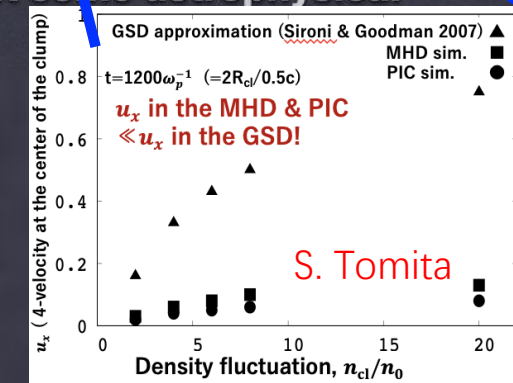
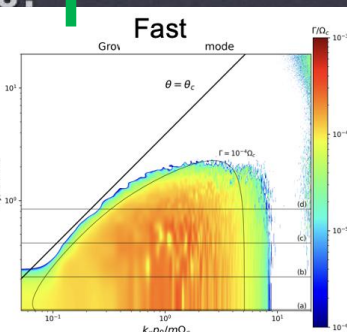
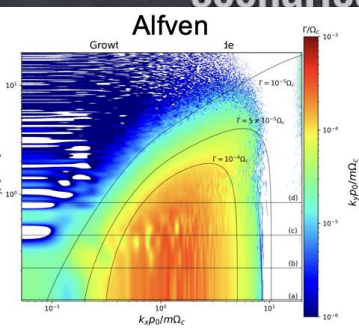
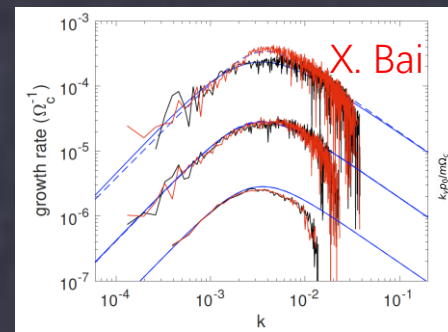
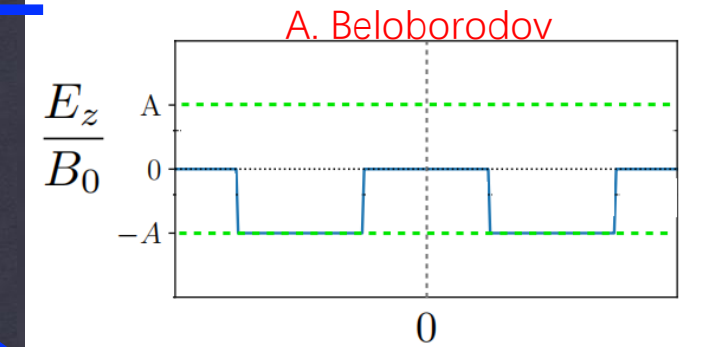
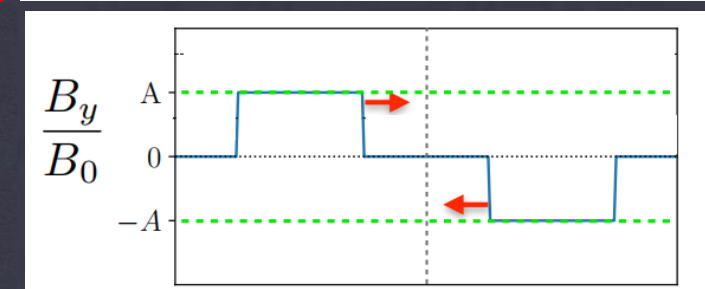
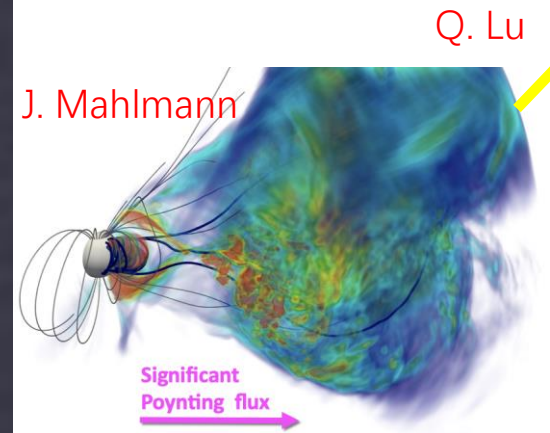
Overarching questions:

- ✦ **How are particles accelerated to high energies in astrophysics?**
- ✦ **How do plasmas behave in strong magnetic fields and gravity?**
- ✦ **How are magnetic fields created and dissipated?**
- ✦ **How does emission from macroscopic objects depend on microscopic physics?**
- ✦ **How do we simulate multi-scale plasmas?**
- ✦ **Can we use plasma physics to rule out some astrophysical scenarios?**



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Opportunity: Lab Astro

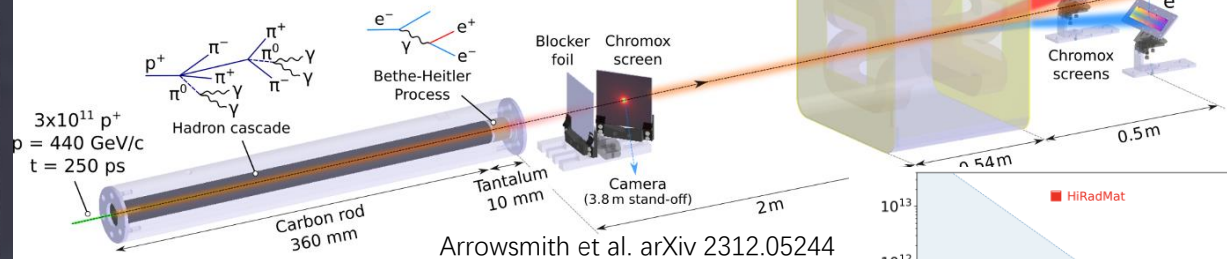
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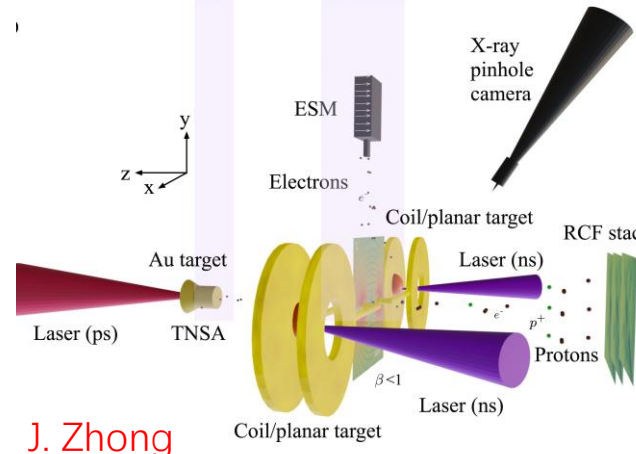
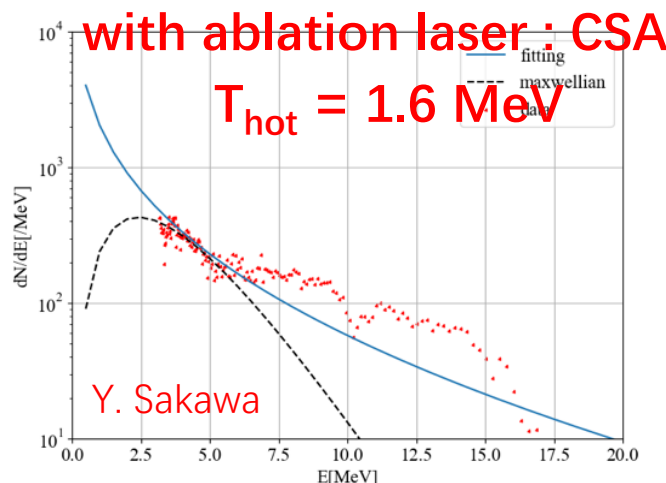
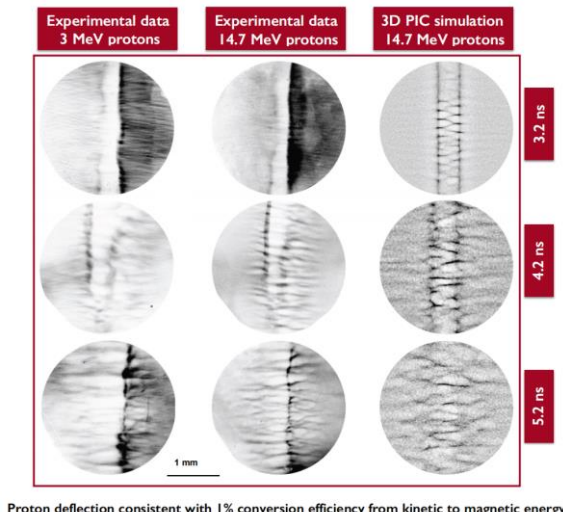
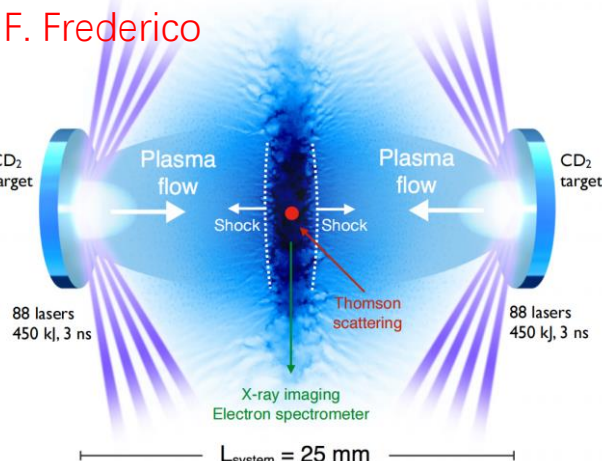
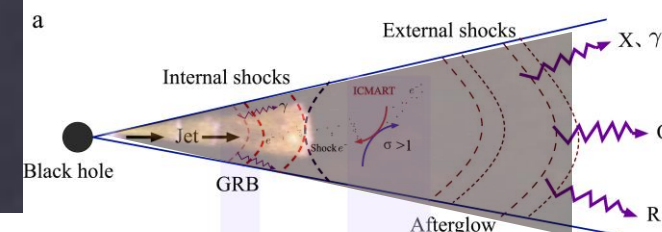
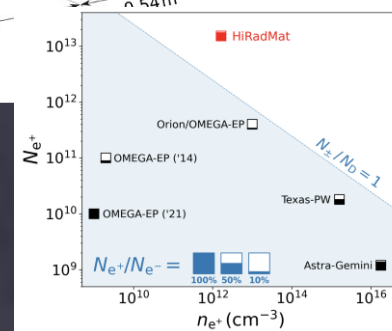
Opportunity: Lab Astro

B. Reville's talk

FLUKA Particle Transport Monte-Carlo Simulations:
 $>10^{13} e^-/e^+, 10^{11} p^+$
 plus additional secondaries
 (hadrons and γ -rays)



Arrowsmith et al. arXiv 2312.05244

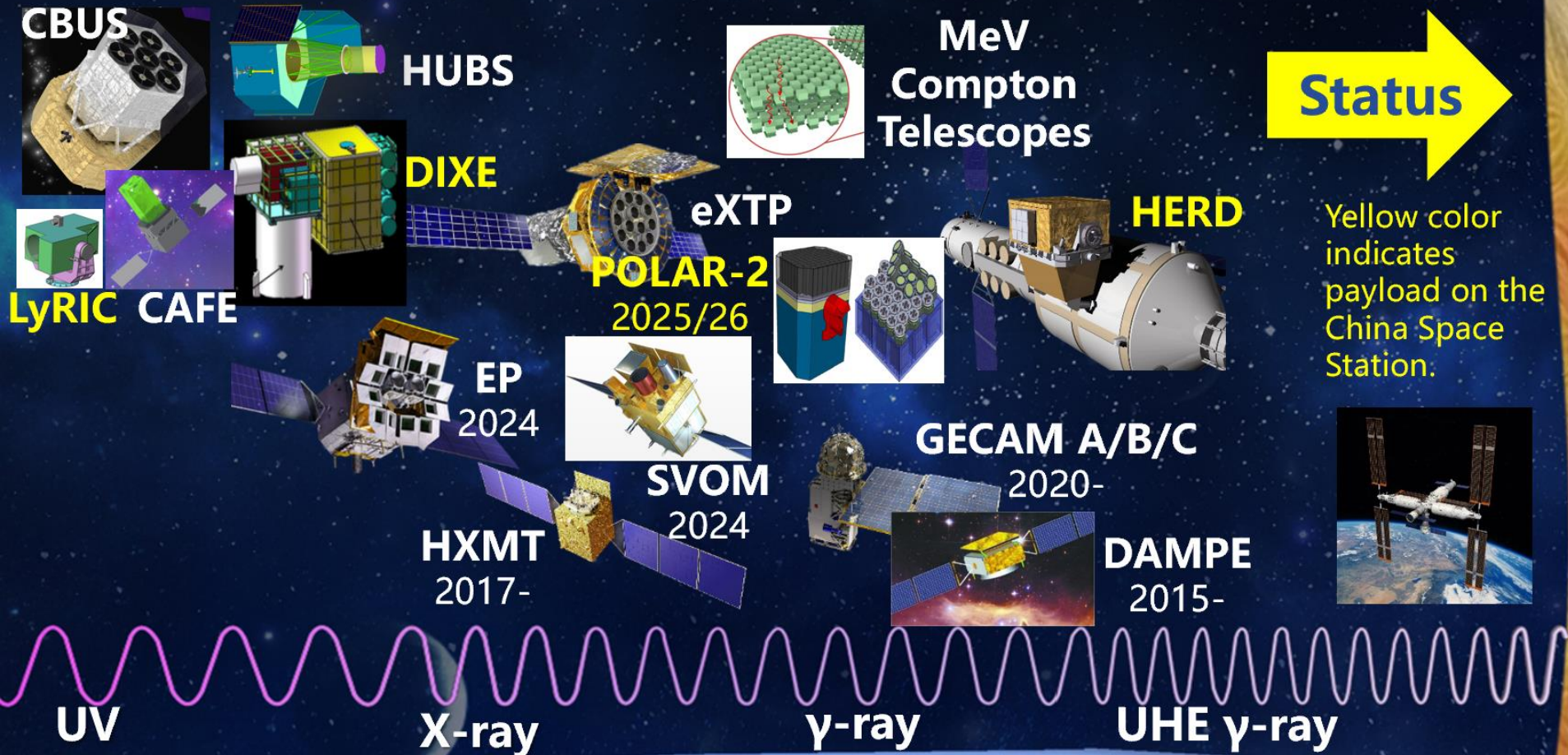


J. Zhong

MS 10: High-E Astro Missions

- On the near-term (5-10 years) high-energy and gravitational-wave astrophysics missions/projects in China and beyond.
- Conveners: Shuang-Nan Zhang, Dong Lai
- Two parallel sessions with nine presentations on > 10 missions in different stages (not all future missions included): soon-to-be launched, in different phases (O-A-B-C), R&D, conceptual
- Cross very wide "high"-E band (~ 10 eV to $\sim 10^{15}$ eV), with multi-messengers (EM, GW, CR, Neutrino) and on different platforms (ocean/lake, mountain, satellite, space station...)
- Many exciting scientific topics: Galactic ecology, missing baryons, dark matter, origin of high-E cosmic rays, extreme physics in extreme universe, exotic matter and new physics...

MS 10: The fleet of high-E facilities of China



Conceptual, R&D

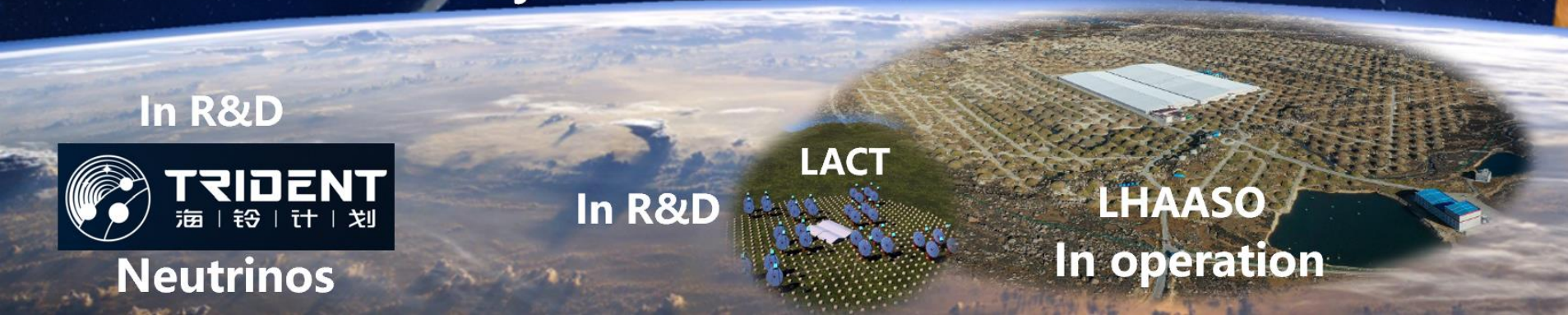
Mission study (Phase 0-A)

In development (Phase B-C)

To be launched soon

In operation

kHz GW detector & CNGO



In R&D

TRIDENT
海 | 铃 | 计 | 划

Neutrinos

