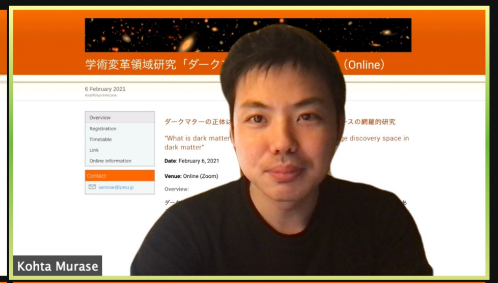
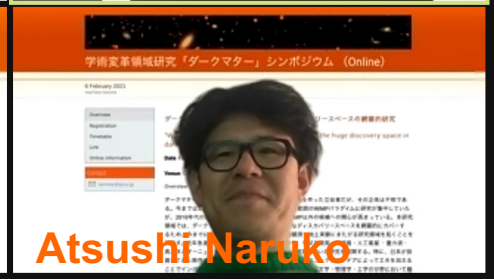
Multimessenger Study of Heavy Dark Matter
A02 Group Status Report

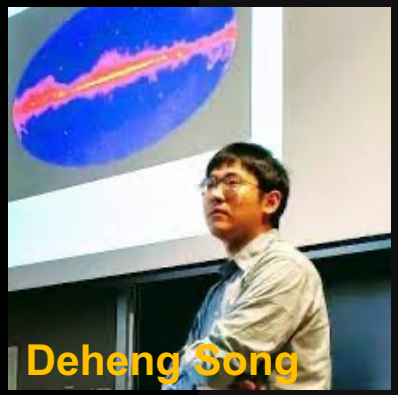

Bing Zhang


Toshihiro Fujii


Kohta Murase


Nagisa Hiroshima


Atsushi Naruko


Deheng Song

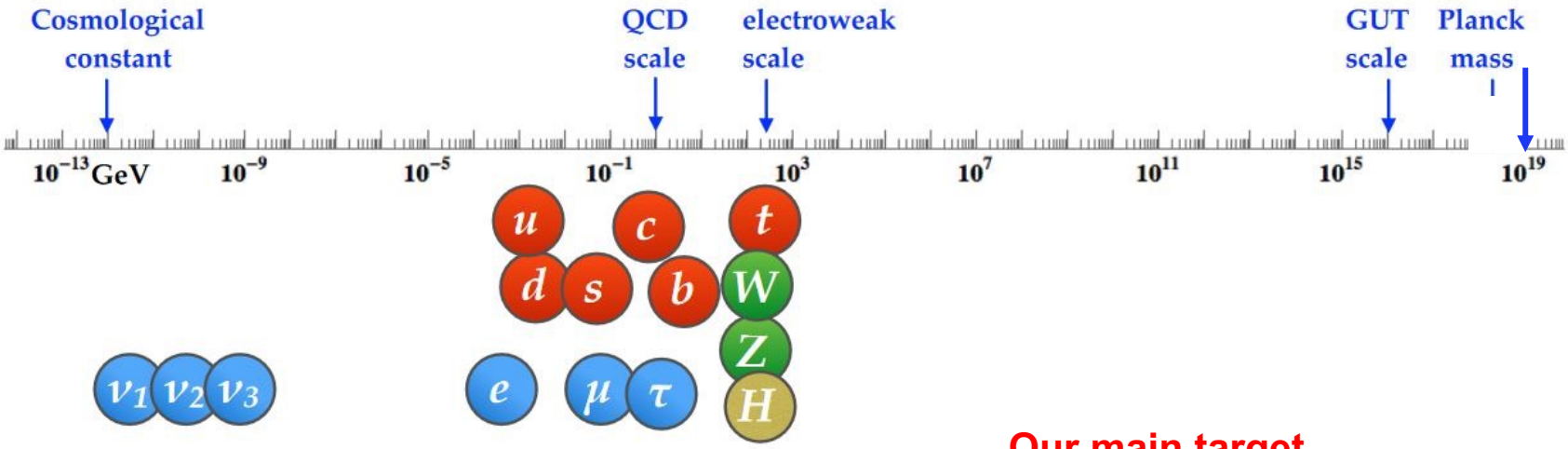

Masato Yamanaka


Saikat Das

“What is Dark Matter?”

March 7 2024

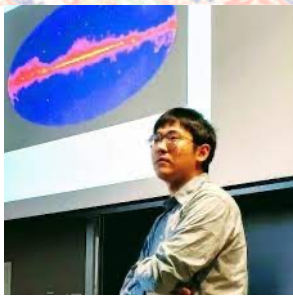
Focus of A02 Group



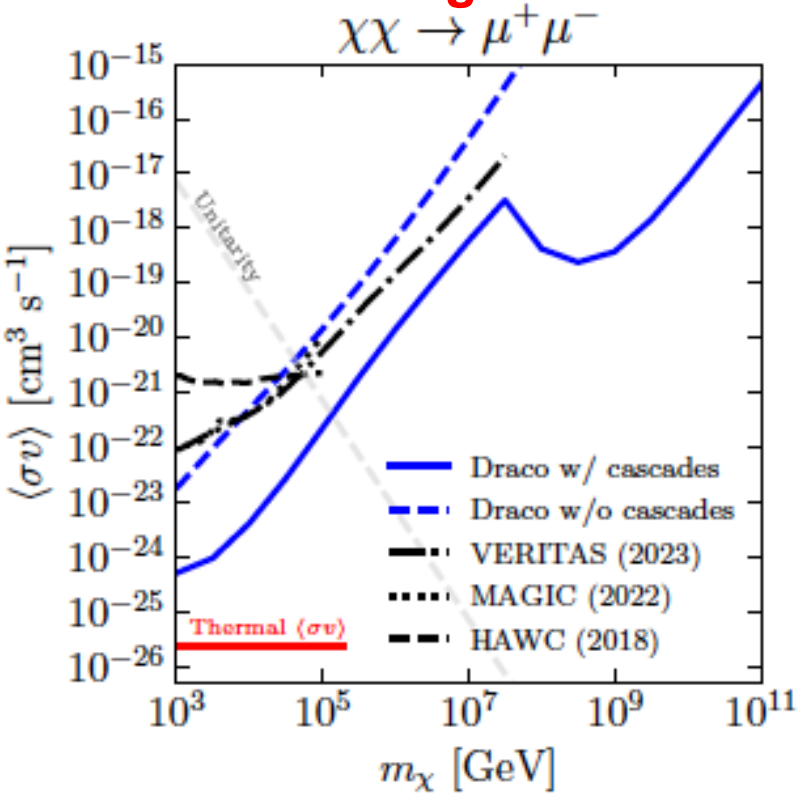
- >10 orders of magnitude in energy (above TeV)
  It may not be a desert
- Beyond LHC energies: “energy frontier"
- Usually more challenging for direct detection
- Indirect searches → “multi-messenger” approach
  - VHDM searches with nearby halos
  - Cosmic-ray detection & DM searches w. all-sky particles
  - VHDM production mechanisms

VHDM Searches with Gamma Rays from Nearby Halos

- Extending gamma-ray search beyond TeV energies
- Electromagnetic cascades are crucial
- Analyzing 14 yr Fermi-LAT data for dwarf galaxies and clusters
- Better than existing constraints by Fermi/IACTs w.o. cascades

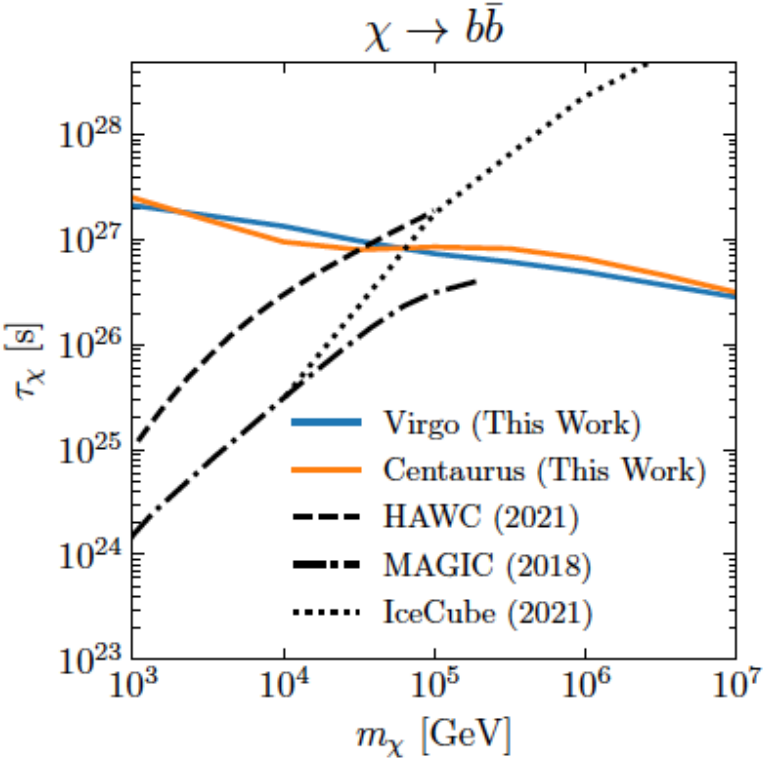


Dwarf galaxies



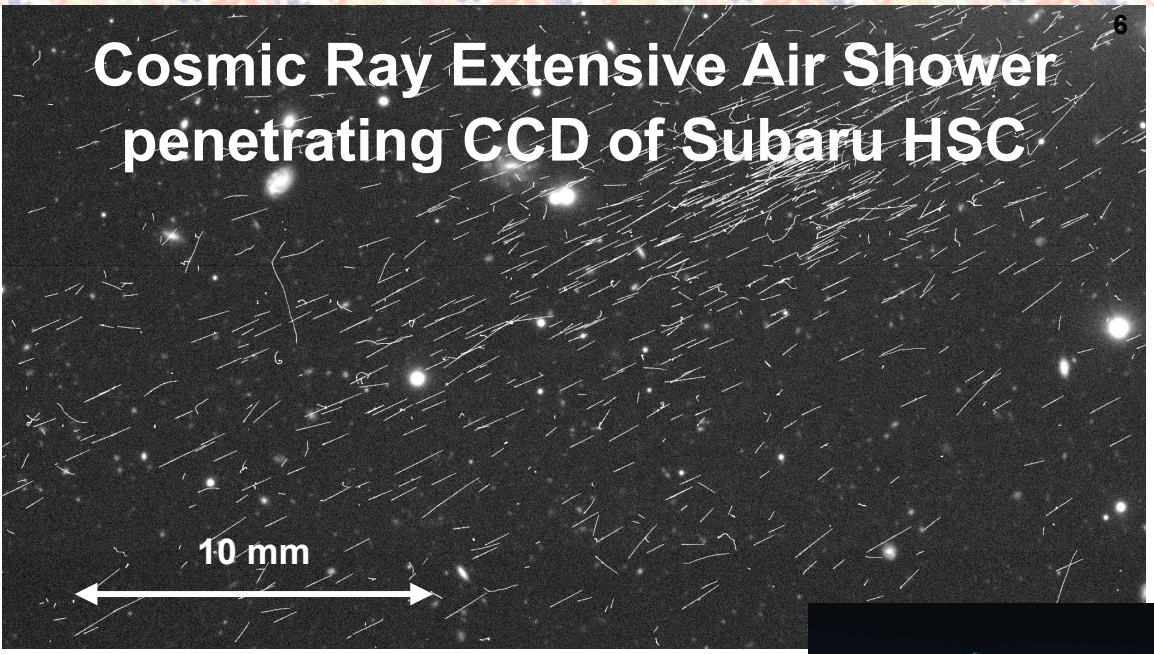
Song, Hiroshima & KM 2401.15606

Galaxy clusters



Song, KM & Kheirandish 2308.00589

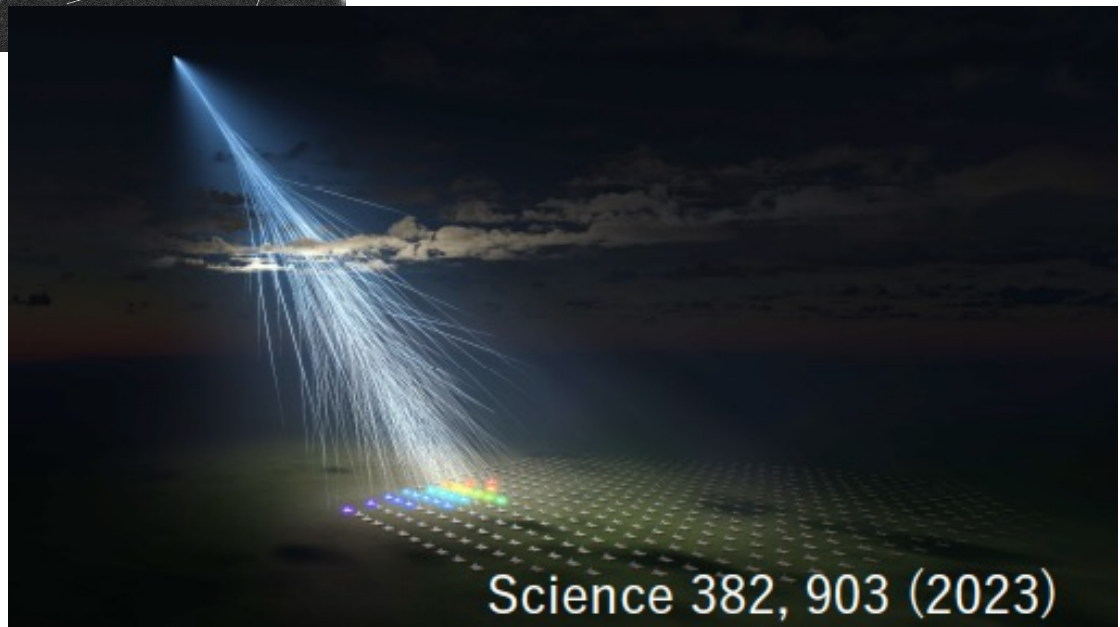
Cosmic-Ray Detection



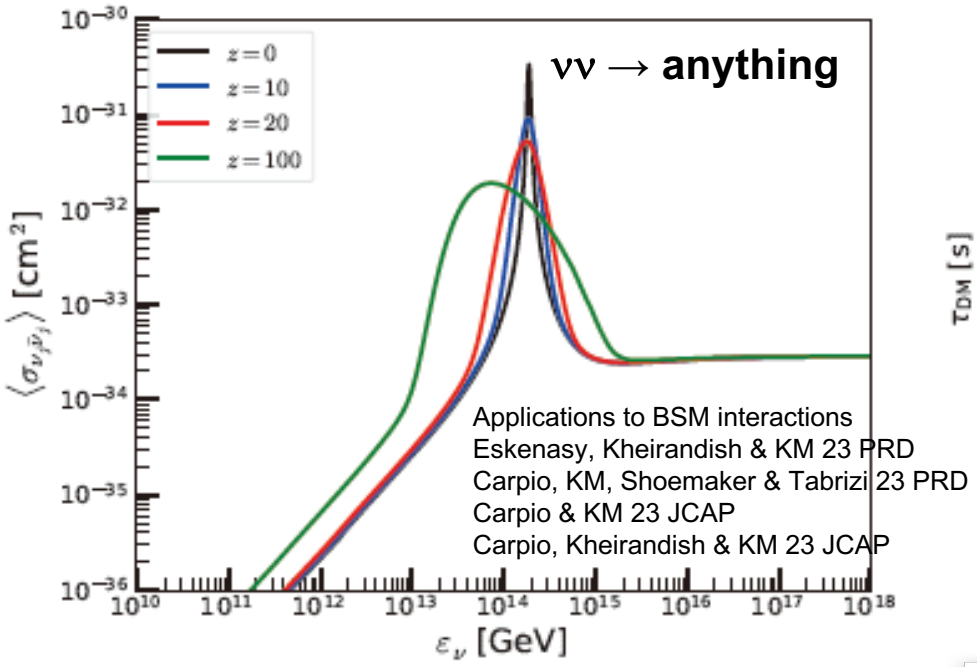
Scientific Reports 13, 16091 (2023)
in collaboration w. B03 group

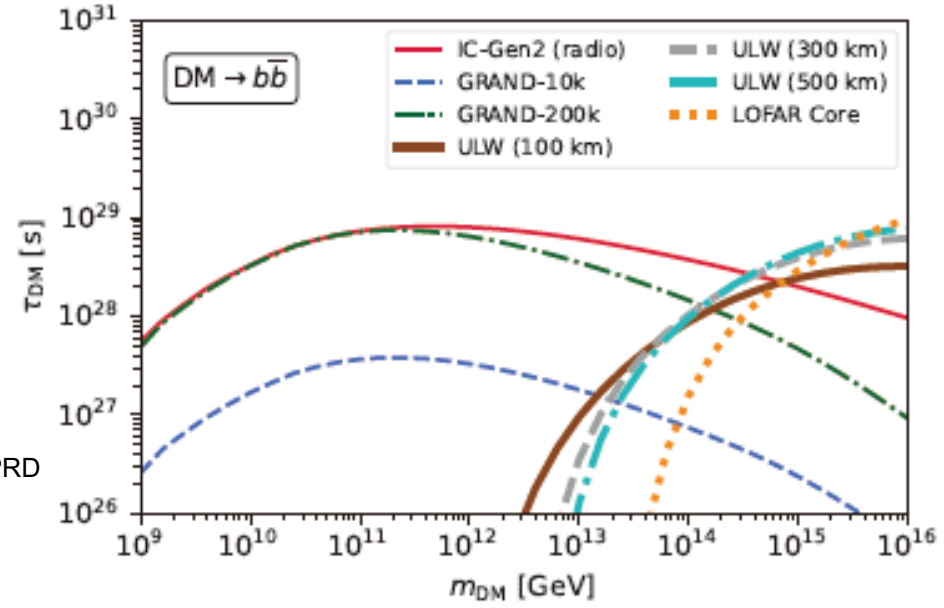
Discovery of the Amaterasu particle

E=2.44x10^{20} eV

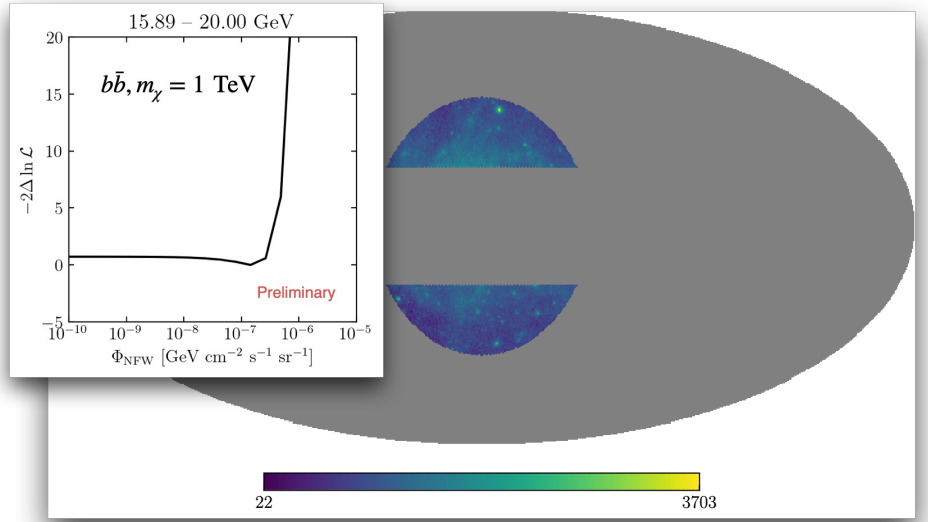


VHDM Searches with All-Sky Particle Fluxes

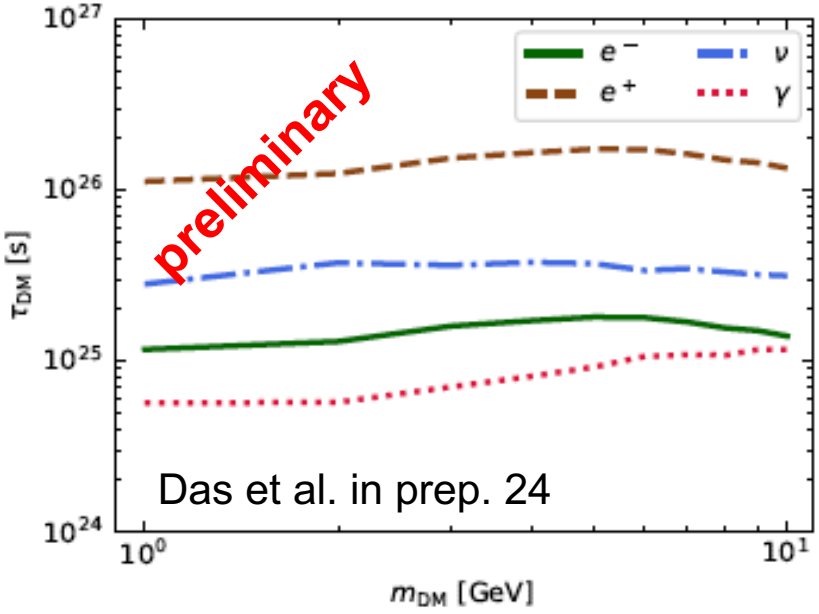




- Developing propagation codes for neutrinos, gamma rays & CR nuclei
- Applications to VHDM
- Lunar radio observations are important for GUT-scale DM
- Updated gamma-ray search for the Milky Way halo is going on
  → see talk by Song

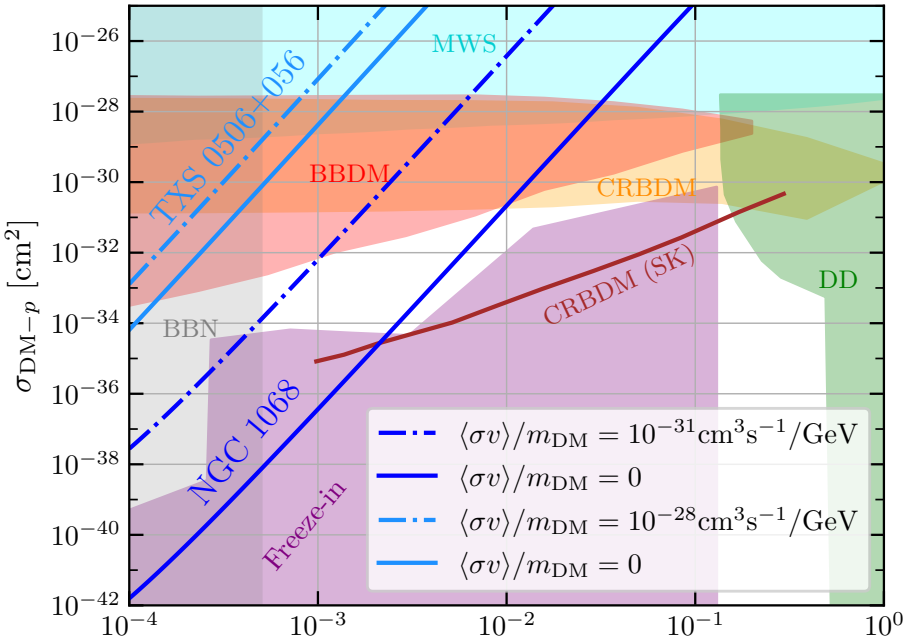


Applications to Sub-GeV Dark Matter



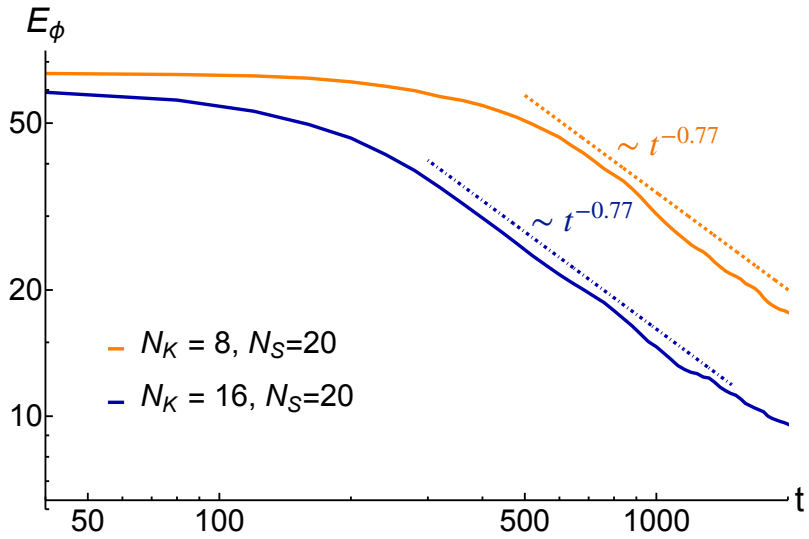
- Composite asymmetric DM accompanied by dark nucleon decay
- γ, ν, CR constraints are complementary (ex. EGRET, Super-K, AMS-02)
  → see talk by Das

- IceCube evidence for neutrinos from a nearby active galaxy
- BSM cosmic-ray cooling should be sufficiently inefficient
- Novel constraints on DM-p/DM-e scattering
  (better than boosted DM limits)



Herrera & KM 2307.09460

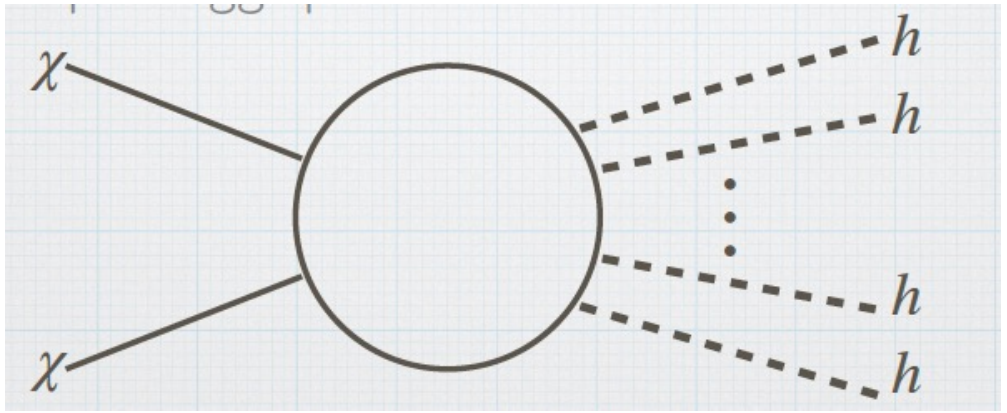
DM Production Mechanisms



- Quantum annihilation of kink-antikink networks
- Background field ϕ coupled to a massive field ψ
- Implications for VHDM production?

Mukhopadhyay, KM, Naruko & Zahariadec 24 in prep.

- Higgsplosive dark matter
  → see talk by Yamanaka



Collaboration with Other Groups

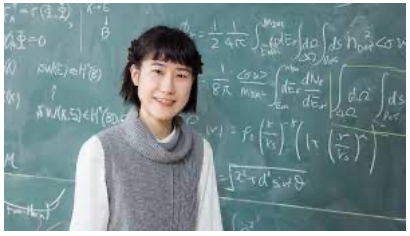
Extreme Mass Dark Matter Workshop:

yeV zeV — ZeV YeV

Superlight → Superheavy

Date : 2024/3/4—3/22
Venue : Panasonic Auditorium, Room K202, Yukawa Institute for Theoretical Physics, Kyoto University

Organized by
Shu-Yu Ho, Kohta Murase, Atsushi Naruko, Fuminobu Takahashi, Takahiro Terada, Masahiro Kawasaki, Naoya Kitajima, Masaki Yamada, Wen Yin, Saikat Das, Deheng Song, Bing Zhang, Masato Yamanaka, Toshihiro Fujii, Nagisa Hiroshima



see Hiroshima's talk (in collaboration with C02 group)


Thank you!!!