Topological Solitons as Probes of New Physics

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Theory Fellows Meeting, 6th Dec 2023 @ DESY

About myself

born in Amagasaki
(next to Osaka)

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Bachelor's, Master's & PhD in Kyoto

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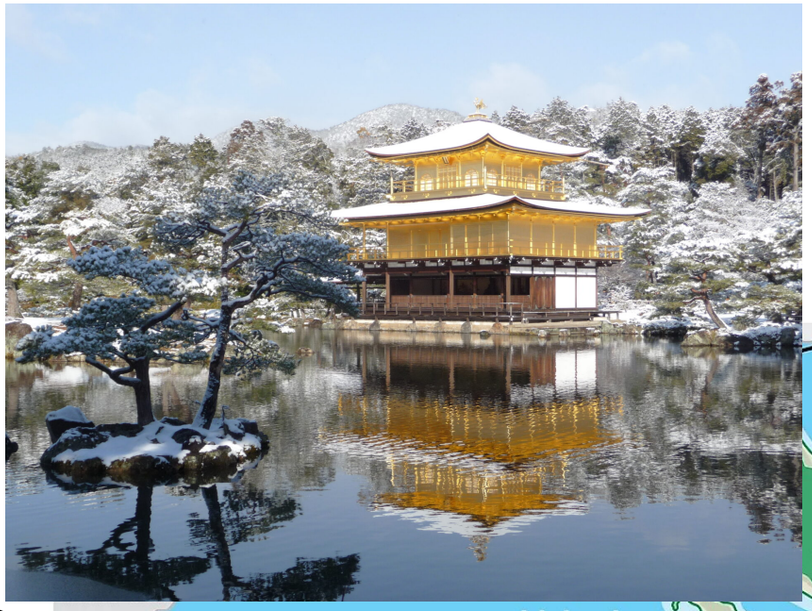

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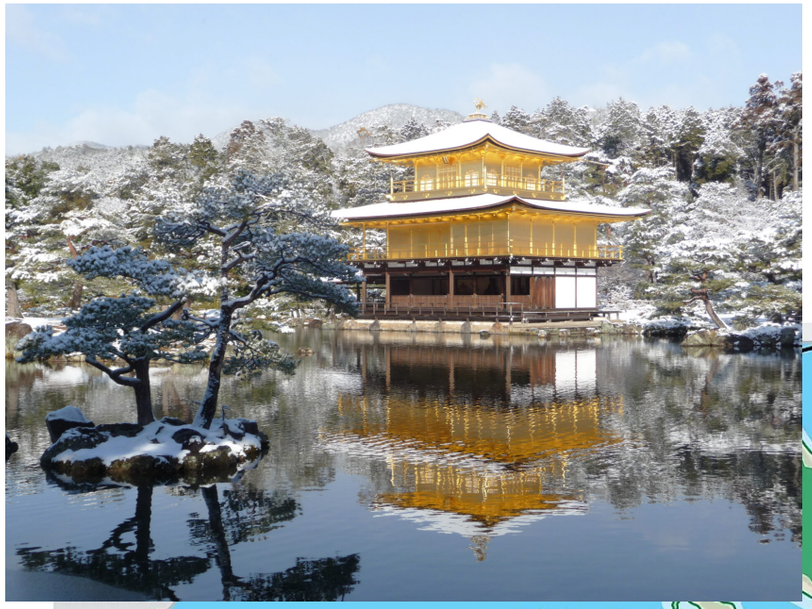

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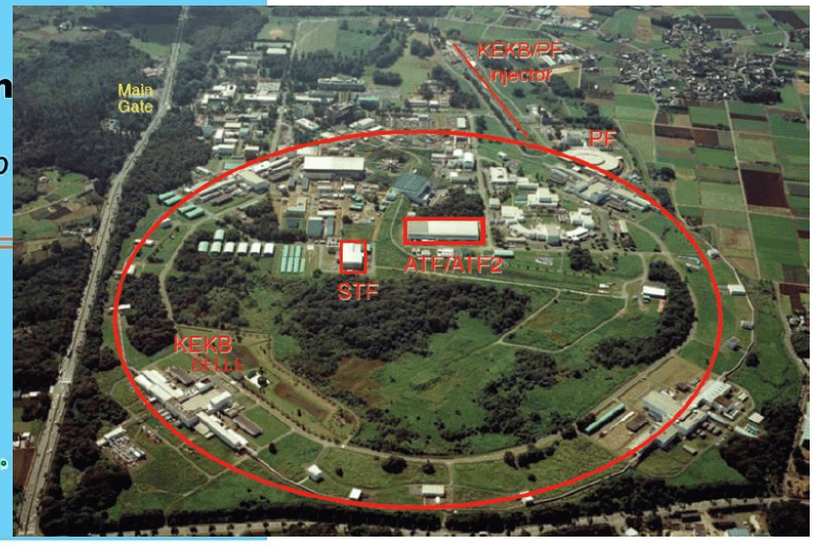
1st postdoc in
KEK, Tsukuba



About physics...

Although the SM is established by discovery of Higgs boson, there are still many problems.

- **Dark matter**
- **Neutrino mass**
- **Baryon asymmetry**
- **strong CP problem**

etc.

There must be new physics beyond SM!

Research topics

- **Functional (Wilsonian) renormalization group in QFT**
- **DM phenomenology (pseudo Nambu-Goldstone DM)**
- **μ^+ collider (μTRISTAN)**
- **Topological soliton**

seems like random...

but all of them are aimed to discover new physics

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Topological **Soliton**

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Tsunami

KdV soliton: solution of non-linear wave eq.

``Collision of KdV solitons'' (from YouTube)

Topological Soliton

- **Topology ≃ rough structure independent of details**

Topological Soliton

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Topological soliton
= soliton whose existence is ensured by topology of theory

Topological Soliton

popular examples:

- **GUT monopole**

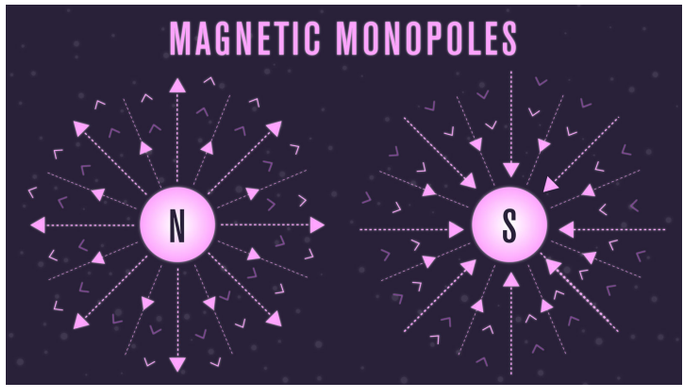
  exists when $G \to U(1) \times G'$

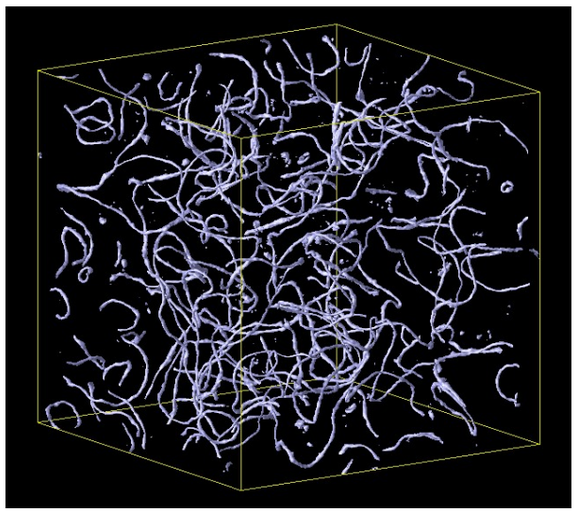
- **Cosmic string** (e.g. axion string)

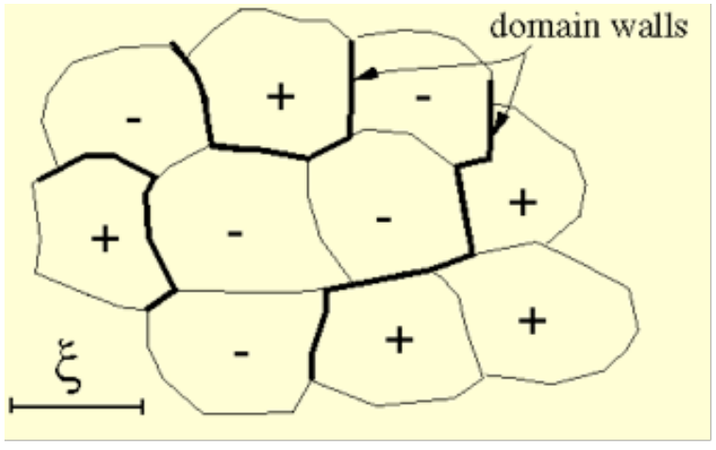
  exists when $U(1) \to 1$

- **Domain wall**

  exists when $\mathbb{Z}_n \to 1$





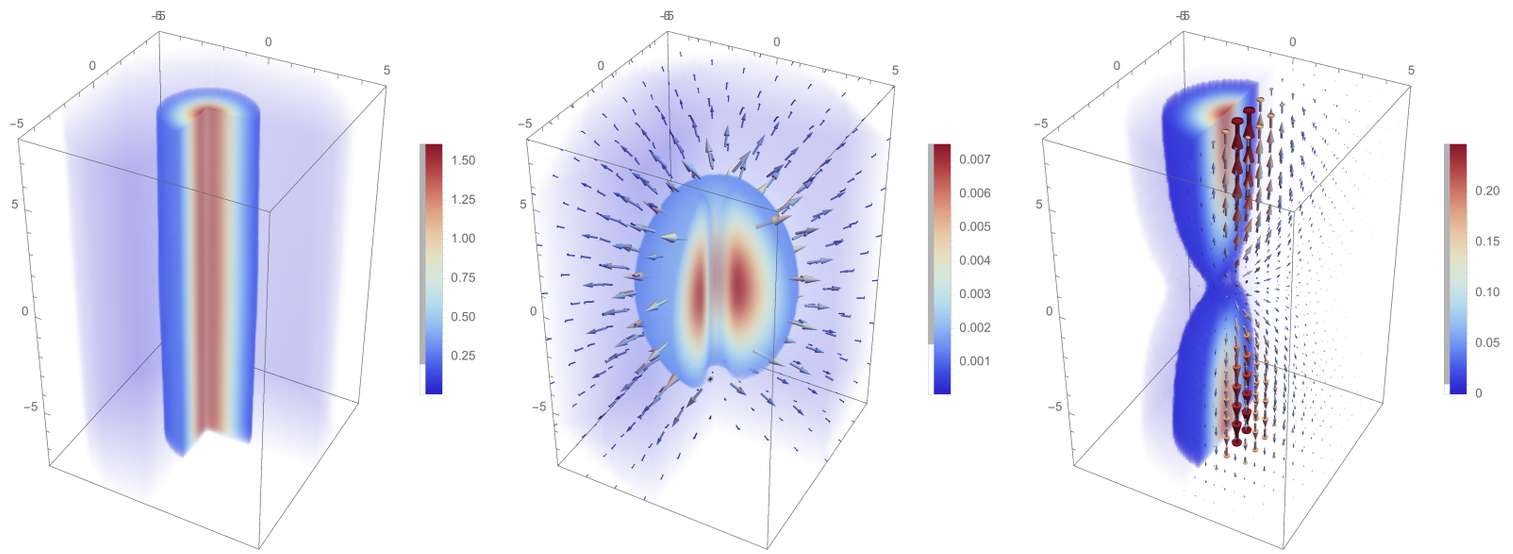


might remain in the universe

→ **probes of new physics!**

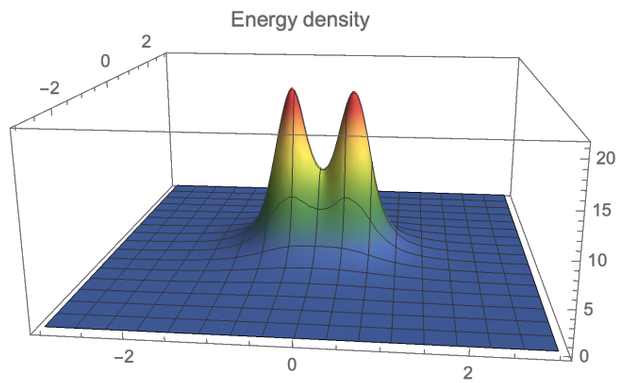
Some of our works

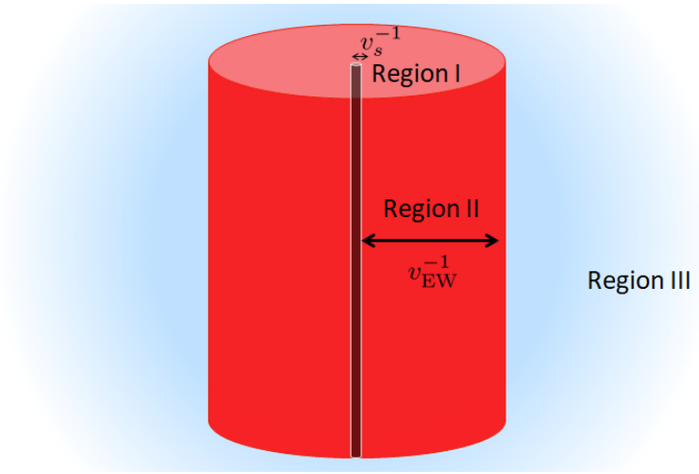
magnetic monopole in 2HDM



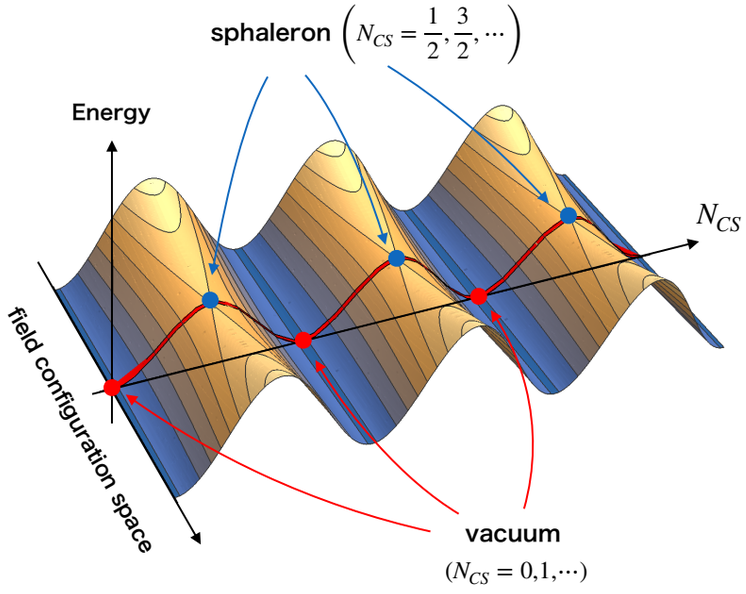
(a) energy density (b) magnetic flux (c) Z flux

polarized cosmic string in 2HDM

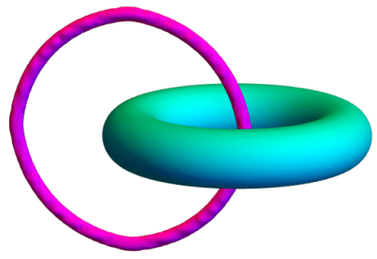




electroweak axion string w/ superconductivity



sphaleron



knot soliton