Theory is great

• Discovery of “a Higgs boson” is a great example that a deep theoretical insight ends up being the correct description
• being able to move ideas from one area (superconductivity) to another (weak interaction) is a true strength of theory
• should pursue cross-pollination further among different areas of theory
• should avoid defining areas to get “boxed-in”

need “academic freedom” in theory!
Heisenberg models

\[ \mathcal{L}_{\text{eff}} = c_a(\pi) \dot{\pi}^a + \bar{g}_{ab}(\pi) \dot{\pi}^a \dot{\pi}^b - g_{ab}(\pi) \nabla_i \pi^a \nabla_i \pi^b \]

- **anti-ferromagnet**
  \[ H = +J \sum \bar{\sigma}_i \cdot \bar{\sigma}_j \]
  \[ \langle 0 | J^0_z | 0 \rangle = 0 \]

- **ferromagnet**
  \[ H = -J \sum \bar{\sigma}_i \cdot \bar{\sigma}_j \]
  \[ \langle 0 | J_z | 0 \rangle = -i \langle 0 | [J_x, J_y] | 0 \rangle \neq 0 \]

\( J_x \) and \( J_y \) canonically conjugate to each other cf. \([x, p] = i \hbar\)

describing the single degree of freedom together
Theory loses talents

• one of my students recently left field despite a good offer
• lack of physics beyond the standard model made him lose interest
• we should encourage culture of working on different related areas beyond the narrowly defined “particle physics”
• condensed matter, astro, bio, math, etc
America is losing edge

- The best jobs in the world:
  - Wilson fellow in experimental particle
  - Hubble fellow in astronomy
- I’ve seen people turning them down and came to Kavli IPMU due to more attractive projects
- particle theory looks better in that respect
- but probably not forever