

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!



$$O(3)/O(2) = S^2$$

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 $H = +J \sum_{\langle i,j \rangle} \vec{s}_i \cdot \vec{s}_j$ 2 NGBs

$$\langle 0 | J_z^0 | 0 \rangle = 0$$

$$E \propto p$$



- ferromagnet $H = -J \sum_{\langle i,j \rangle} \vec{s}_i \cdot \vec{s}_j$ 1 NGB

$$\langle 0 | J_z | 0 \rangle = -i \langle 0 | [J_x, J_y] | 0 \rangle \neq 0$$

$$E \propto p^2$$



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