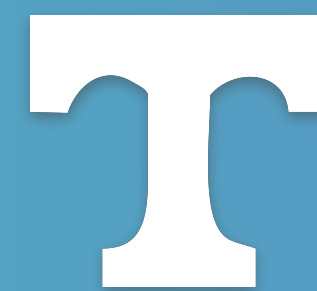




NEXT GENERATION BEAMS

EXPLORING THE POTENTIAL
OF MUON ACCELERATION



TOVA HOLMES, U. OF TENNESSEE
SLAC P5 TOWN HALL
MAY 4, 2023

What have we done so far?

Began with the logical choice: readily available, stable charged particles: **e, p**

can they continue to 10 TeV+?

*see [Patrick's talk](#) on why we care

circular e+e-:

$$P \approx 3 \times 10^{-7} \left(\frac{1 \text{ km}}{R} \right)^2 \left(\frac{E}{m} \right)^4 \text{ eV/s}$$

huge power loss,
need a giant ring

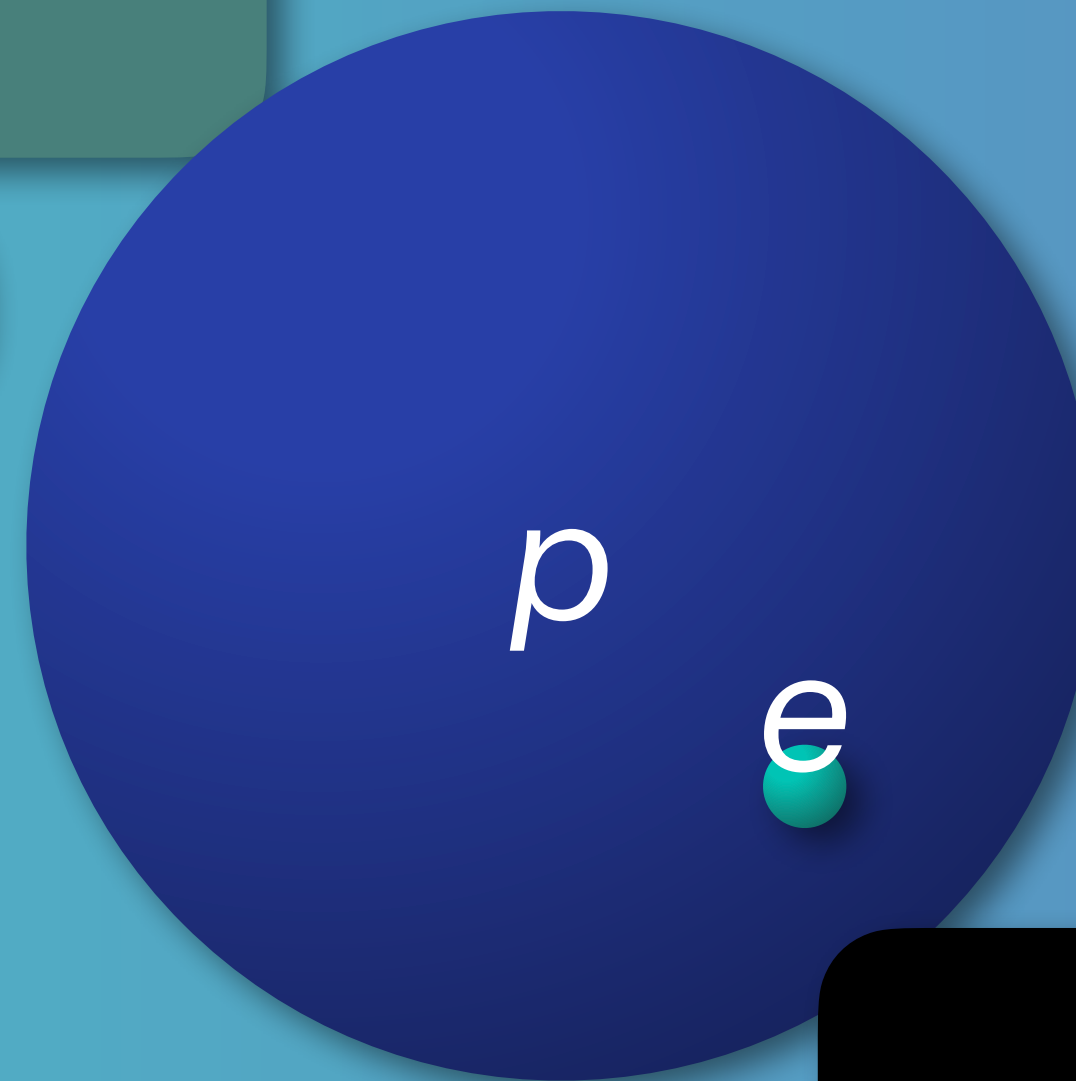
linear e+e-:

single pass; sufficient
luminosity requires high power

circular pp:

$$B \approx 3 \left(\frac{E}{1 \text{ TeV}} \right) \left(\frac{1 \text{ km}}{R} \right) \text{ T}$$

energy reach \ll beam energy
giant ring/powerful magnets



use of these particles fundamentally
limits our reach:

next machine - **hard**
machine after that - **impossible**

in the past: overcame this
with a paradigm shift

switch to superconducting magnets
Tevatron explored new energy
huge success for physics, spin-off technology

government money well spent!

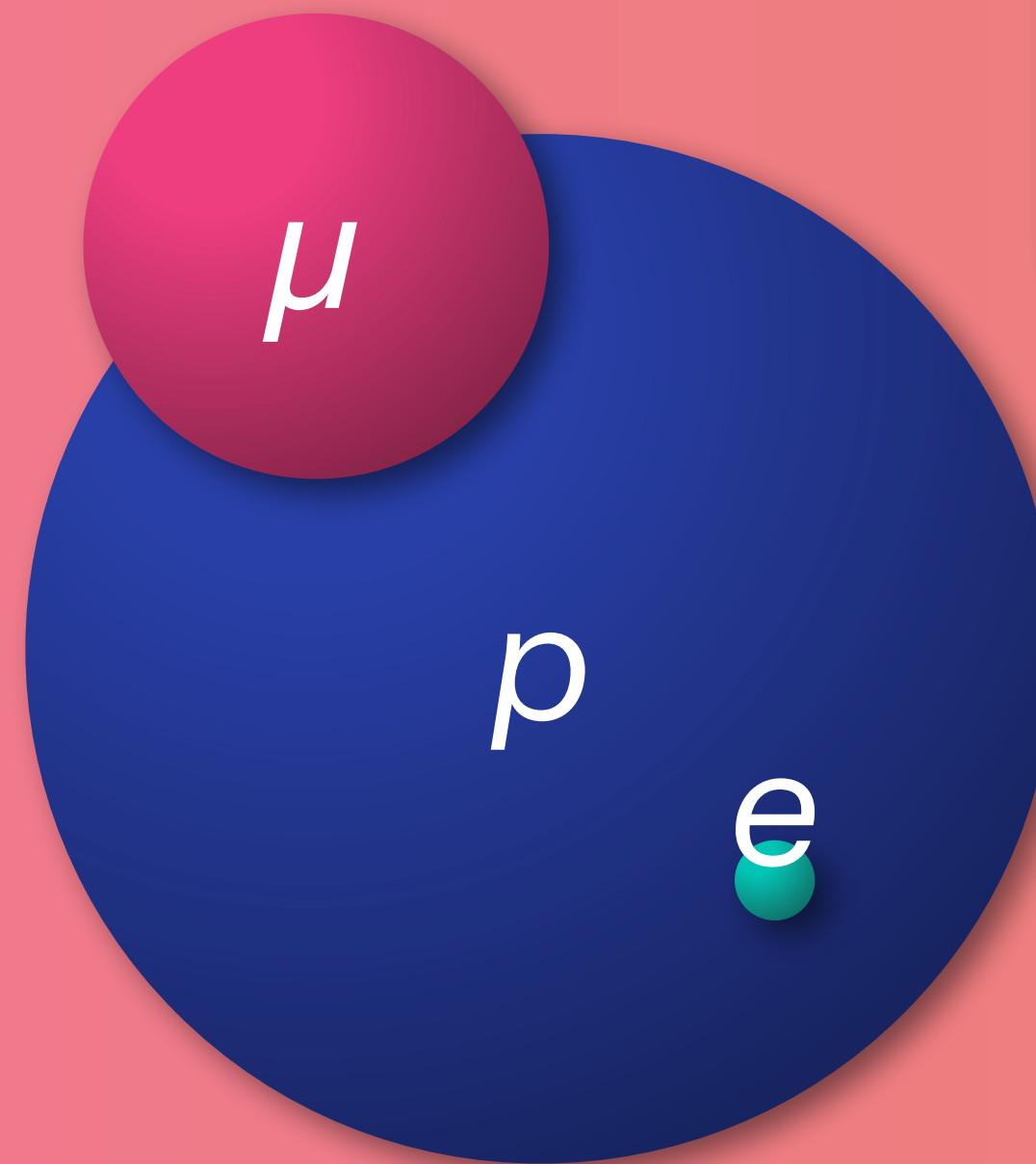
How do we go forward?

we need more paradigm shifts
if we don't want to reach a **dead end**

one option:
a **muon collider**

Not a starter beam!

Muons aren't stable:
have to **produce** them
they **decay** in flight



but: fundamental
challenges get **easier** with energy

lifetime increases:

$$\tau'_\mu = 21 \text{ ms} \times \left(\frac{E}{1 \text{ TeV}} \right)$$

big consequences:

luminosity increases with E
beam **decays** decrease with E

*see [MCF report](#)

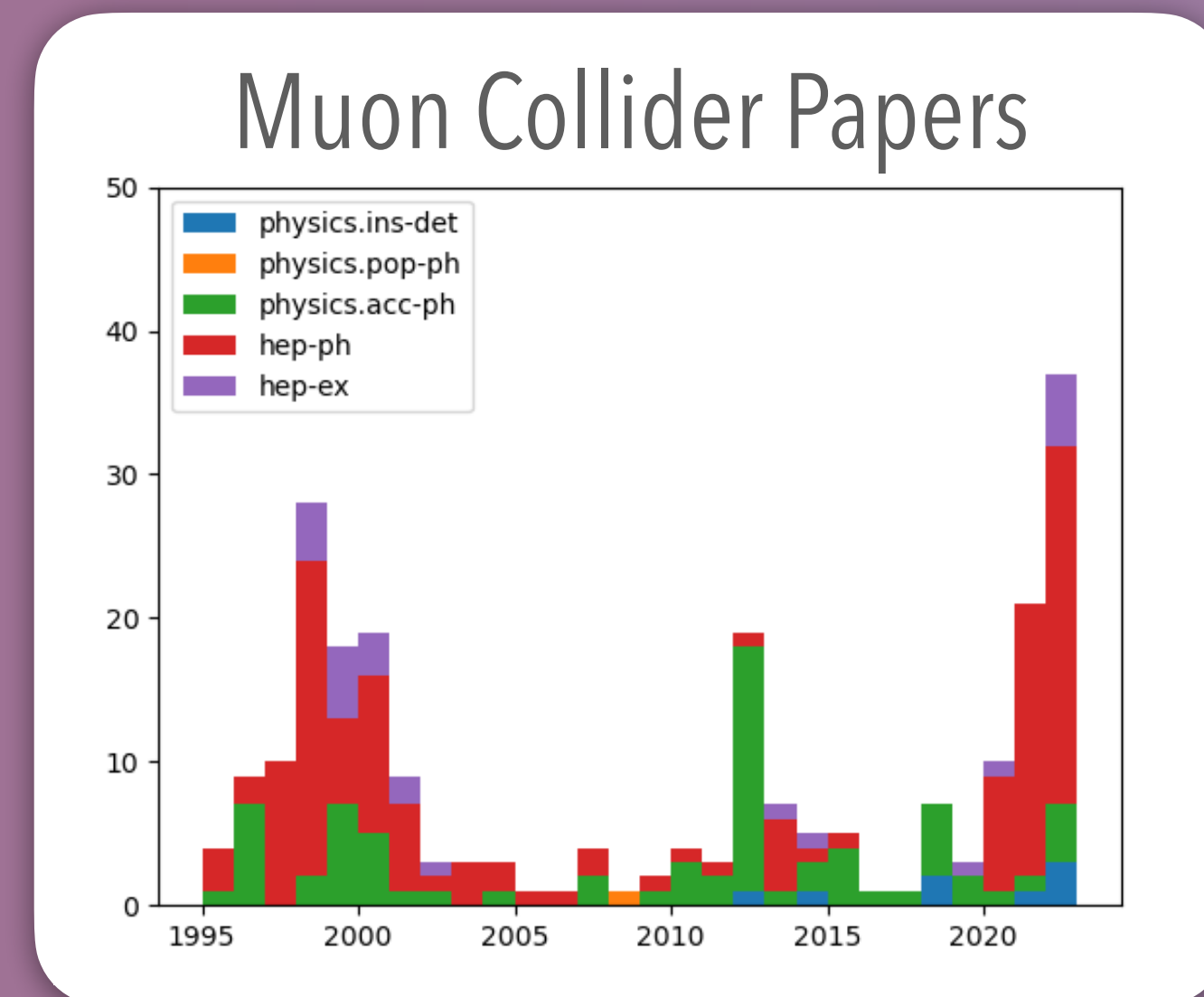
as we contemplate higher energies, muons gain an advantage

Can muon colliders take us to 10+ TeV?

Since last P5: targeting higher energies, huge progress* on all key technologies

*see [S26](#)

Engagement from theory, experiment, accelerator, instrumentation



from arxiv

There is huge potential here:

for a future even beyond 10 TeV *

for a CO₂-responsible approach **

for a project fueled by new technology *

for a global project hosted in the US *

*see [MCF report](#) **see [ITF](#)

It's our responsibility to explore it today

the ask: R&D funding for a collaborative effort across AF, EF, TF, Inst.F with strong synergies with NF

today: seed funding to explore feasibility

tomorrow: expansion to demonstrators, full system if feasibility is shown
see [Sergo](#) and [Ditkys's](#) talks for detailed funding profiles