Outline

1. The theory projects.

2. The dream machine.

1) Theory projects - motivations

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1) Theory projects - motivations

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In absence of an hyper-computer to find what the question, we need to devote a part of the Science budget to

think.

1) Theory projects - motivations

- Some theory(ies) of everything have already been written.
- We are in a time where the NoLoose theorem is actually lost.
- The BSM energy scale is unknown. There is even nothing preventing the SM to be valid up to the Planck scale.
- The LHC Run II has not yet delivered a BSM signal. It might come. It may not.
- YET, there are intriguing indications of departures from SM predictions in the Flavour Physics at large (Please help Angelo to build his (g-2)-related experiment [I've personally offered a beer yesterday]).
- We need to come up with bottom-up approaches in which the interplay between theoreticians and experimentalists is more required than ever.

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- Theorists (and experimentalists) in HEP need on top of these fundings a large scale generalist experimental project aiming at tackling most of the outstanding questions of the field.

2) A dream machine

Muon Colliders @ 30 TeV

2) A dream machine - Physics.

- Muons will experience a first interesting threshold at 125 GeV.

$$\mu^+\mu^- \rightarrow H$$

- Measure branching fractions, measure the Higgs width by scanning.

- Upgrade the energy to Multi-TeV. Multi can be as large as 30 TeV. It is not necessary to change the layout of the experiment. The whole centre-of-mass energy is used for the Physics (in contrast with the proton machines). Any new excitation coupling to muons can be finely studied.

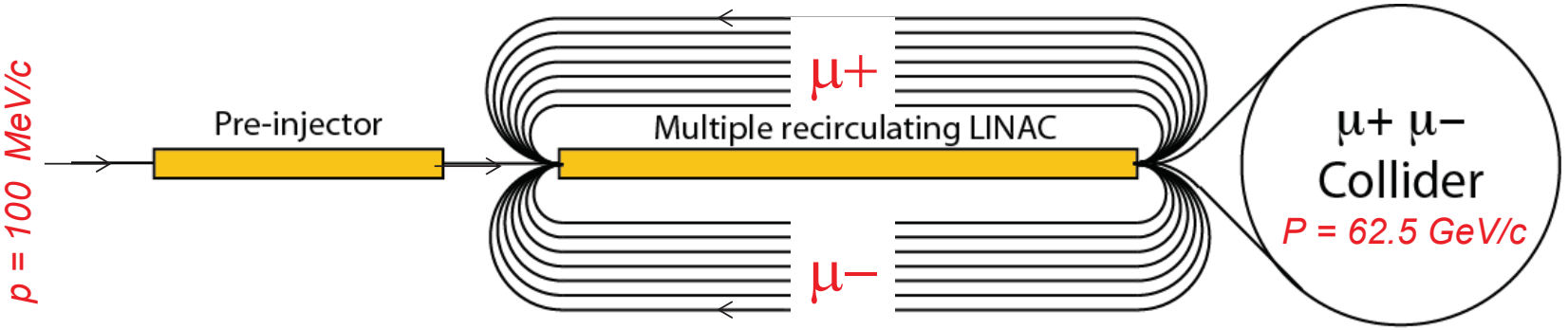
- To catch up with with the lectures you received: whether some lepton non-universality shows up at low energy from a new gauge boson coupling, this machine is the straightforward way to directly observe and accurately study it.

3) A dream machine: challenges

- Muons are long-living: $\tau_\mu = 2.19 \cdot 10^{-6}\ \mathrm{s}$
- If you accelerate them *fast enough*, you can keep them in a circular machine to get high luminosity collider.
- The problem is that particles are accelerated in bunches. They must have a small emittance (all momenta aligned in the lab, no dispersion in the phase space in the rest frame).
- Solution: produce them at rest.
- HW: what is the energy of a positron beam (annihilating on electrons at rest) required to produce a pair of muon-antimuon at rest? Answer: 45 GeV. You need to fund Johannes's project first.

3) A dream machine: how does it look like?

- Compact because of modest beamstrahlung



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- We are speaking of few hundred meters circumference.
- The budget is modest as far as the muon ring is concerned. The price is << ILC, e.g. << 15 billion Euros. The main challenge is the cooling facility.
- FCC-*ee* as the first step.