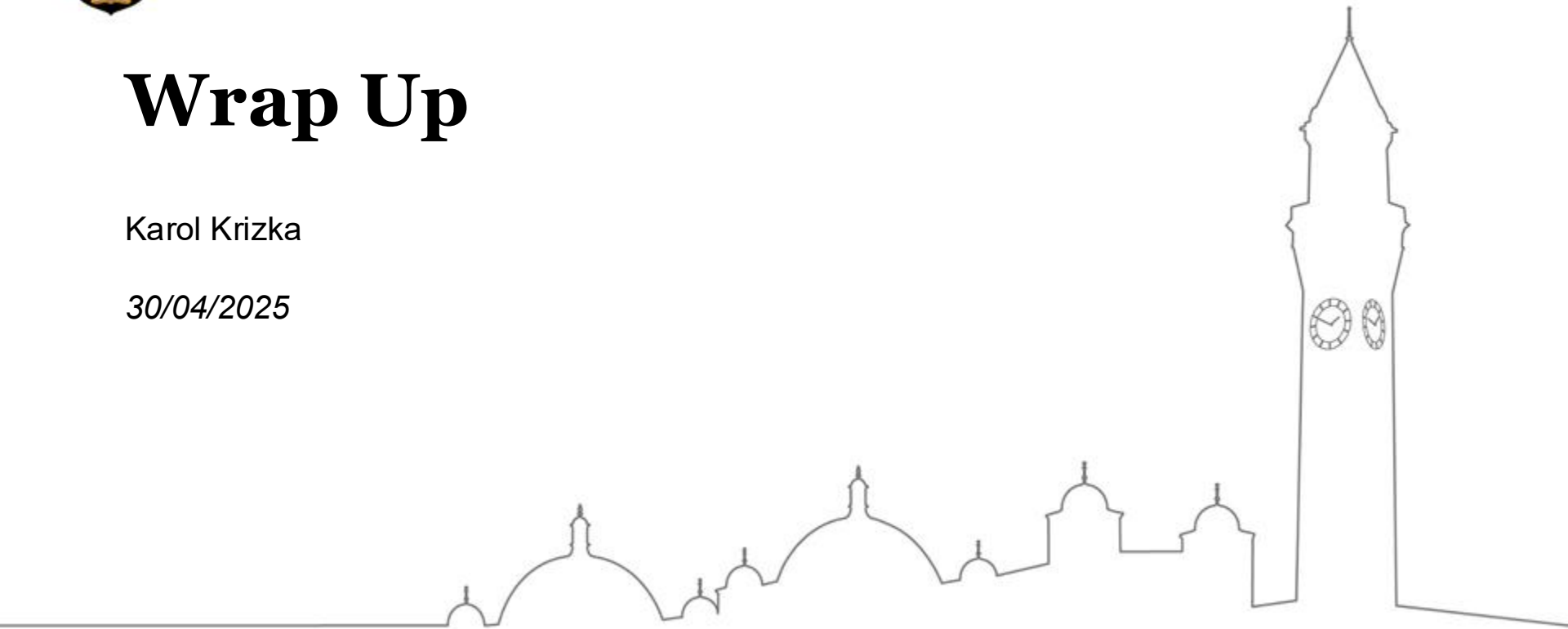
UNIVERSITY OF BIRMINGHAM

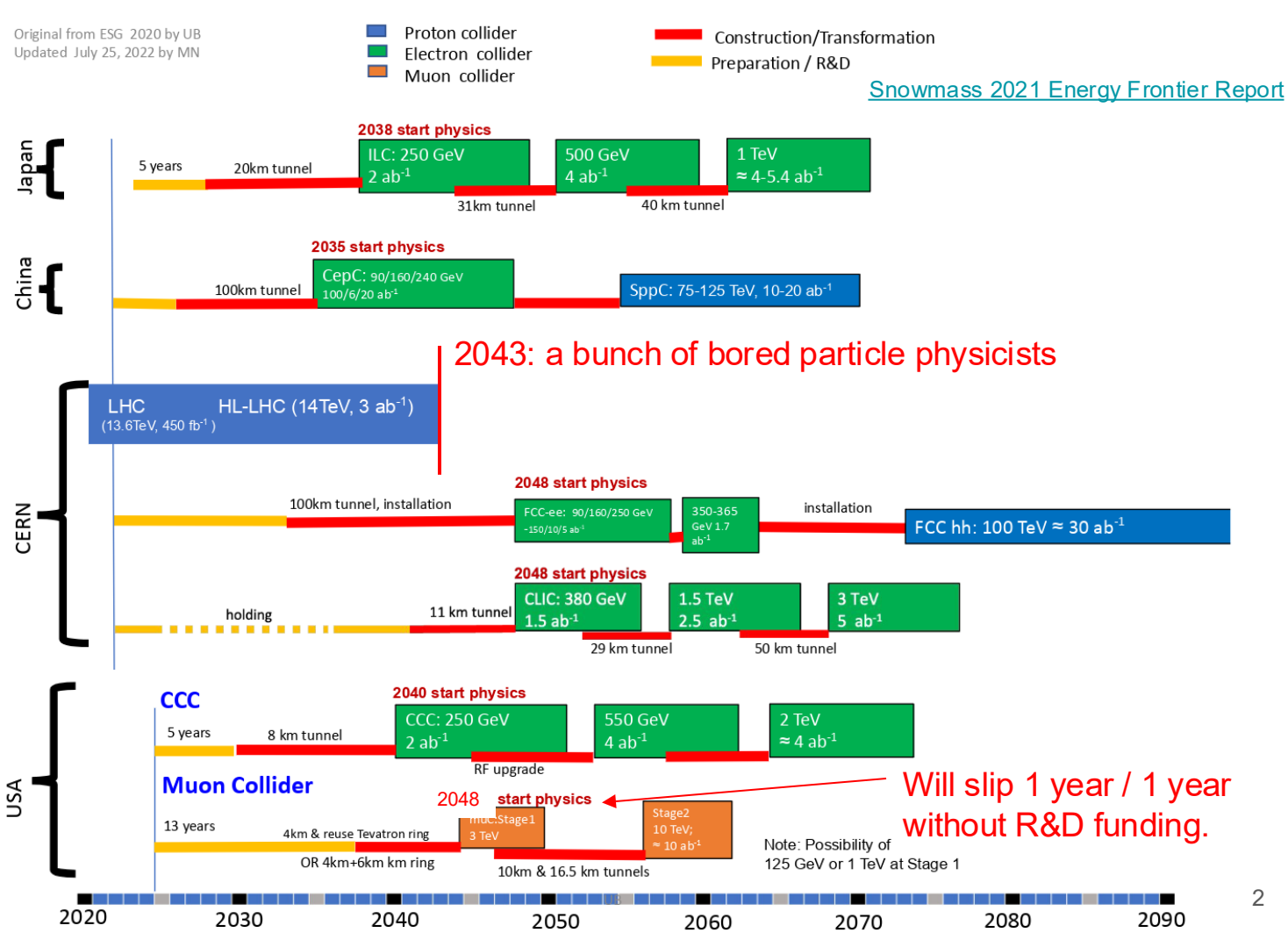
Wrap Up

Karol Krizka

30/04/2025



Timelines


Original from ESG 2020 by UB
Updated July 25, 2022 by MN
Proton collider
Electron collider
Muon collider
Construction/Transformation
Preparation / R&D
Snowmass 2021 Energy Frontier Report
Japan
2038 start physics
5 years
20km tunnel
ILC: 250 GeV
2 ab-1
31km tunnel
500 GeV
4 ab-1
40 km tunnel
1 TeV
≈ 4-5.4 ab-1
China
2035 start physics
100km tunnel
CepC: 90/160/240 GeV
100/6/20 ab-1
SppC: 75-125 TeV, 10-20 ab-1
2043: a bunch of bored particle physicists
CERN
LHC
(13.6TeV, 450 fb-1)
HL-LHC (14TeV, 3 ab-1)
2048 start physics
100km tunnel, installation
FCC-ee: 90/160/250 GeV
-150/10/5 ab-1
350-365 GeV 1.7 ab-1
installation
FCC hh: 100 TeV ≈ 30 ab-1
2048 start physics
holding
11 km tunnel
CLIC: 380 GeV
1.5 ab-1
29 km tunnel
1.5 TeV
2.5 ab-1
50 km tunnel
3 TeV
5 ab-1
USA
CCC
2040 start physics
5 years
8 km tunnel
CCC: 250 GeV
2 ab-1
RF upgrade
550 GeV
4 ab-1
2 TeV
≈ 4 ab-1
Muon Collider
2048 start physics
13 years
4km & reuse Tevatron ring
OR 4km+6km km ring
Stage1
3 TeV
Stage2
10 TeV;
≈ 10 ab-1
10km & 16.5 km tunnels
Note: Possibility of
125 GeV or 1 TeV at Stage 1
Will slip 1 year / 1 year
without R&D funding.
2020
2030
2040
2050
2060
2070
2080
2090

Life After HL-LHC

Hopefully the on-going ESPPU will say something concrete!

ECR input

- Early Career Researcher Input to the European Strategy for Particle Physics Update
  - 936 participants, December 2024–January 2025.
  - Some emphasis on career prospects, DEI and mental health, communication, sustainability
  - A significant majority of ECRs (79%) support the development of a next flagship collider
  - Future collider selection should be guided by technological innovation as the driving factor.
  - Deliberately refrain from recommending any specific collider facility
  - Urge for a clear recommendation on the next European flagship collider from ESPPU process

Slide from Josh McFayden's ESPPU input summary. UK-EPSSU, April 28, 2025

- US ECR input
  - 105 participants, February–March 2025
  - 70% preferred to prioritize Muon Collider R&D over Higgs factory construction
  - Even split between direct to FCC-hh vs full FCC-ee+hh program
  - Physics program of the FCC-hh was rated as more exciting
  - Excitement for all projects increases if they are brought about sooner.

UK ESPPU Input

3.a Which is the preferred next major/flagship collider project for CERN?

There is strong support in the UK for a new large-circumference tunnel at CERN, the FCC tunnel, as a major infrastructure for the future of collider particle physics. The community has a large contingent

UK took the risk averse position..

Possible ”risks” brought up, not including technical risks.

i If Japan proceeds with the ILC in a timely way?

ii If China proceeds with the CEPC on the announced timescale?

iii If the US proceeds with a muon collider?

iv If there are major new (unexpected) results from the HL-LHC or other HEP experiments?

Some good news…

Significant scientific advancement is historically due to disruptive technology. To innovate and lead, Europe must commit to funding R&D in disruptive accelerator technologies, including but not limited to: muon acceleration, plasma based acceleration, high-energy recovery linacs, and terahertz acceleration. Novel acceleration techniques

The Three Pillars

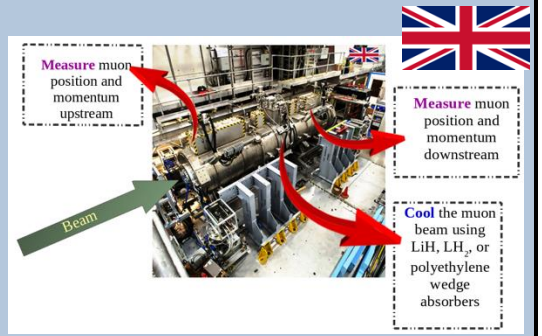
The Physics

Will a Muon Collider satisfy the physics goals?

Snowmass: A 10 TeV muon Collider is competitive with FCChh.

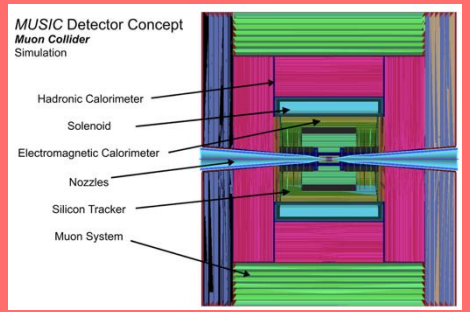
The Accelerator

What technology is required to build a Muon Collider?



The Detector

Is the collision environment clean for precision physics?



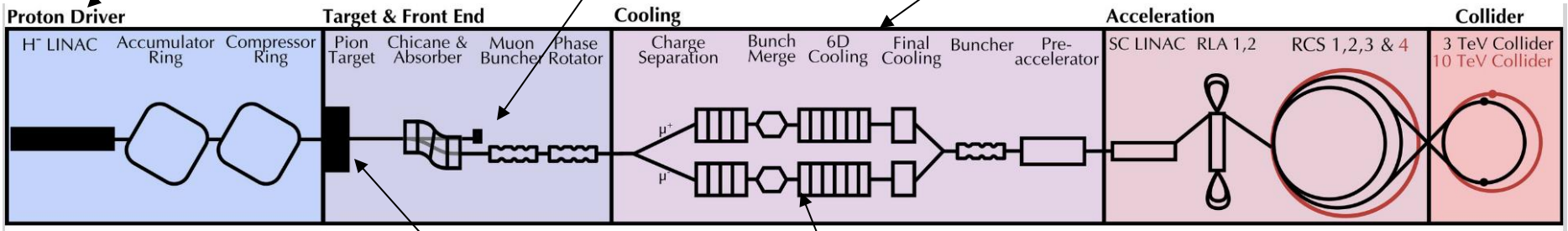
Synergies: Rhea Stewart

Accelerator Technology

Jean-Baptiste Lagrange

Paul-Bogdan Jurj

Alexander Spelling



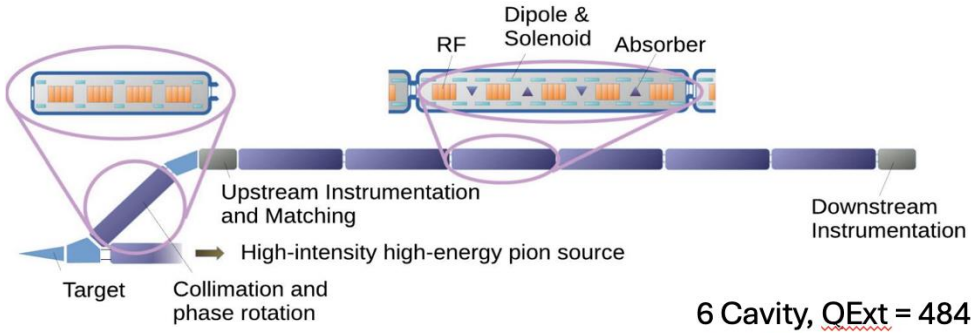
Will Bishop, Ben Suitters

Rohan Kamath

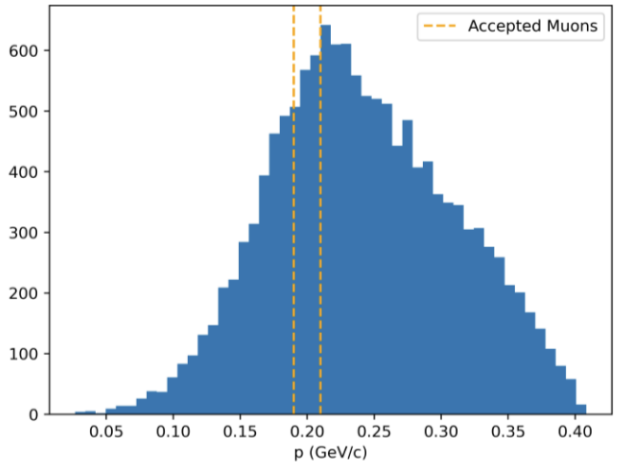
- Feasibility is key to convincing the particle physics community.
- A physical cooling demonstrator will be an important milestone.
- Most of the Muon Collider would be UK technology.
  - Talks today are evidence of this statement.

Cooling Demonstrator

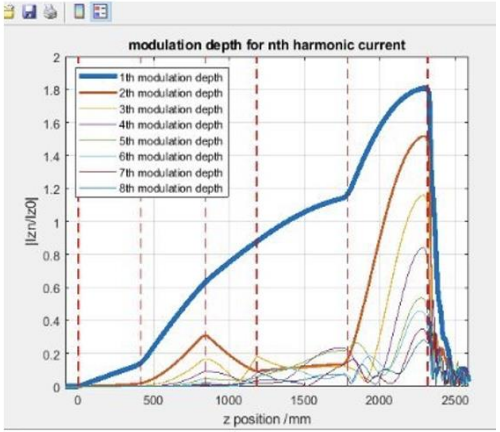
Needed to convince the PP community that μC is viable.



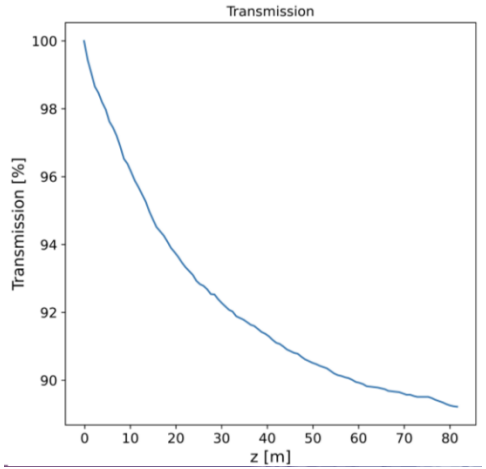
Simulation is a key step to secure funding in a constrained environment.



6 Cavity, QExt = 484



Eff. 82.29%



Closing Thoughts

- μC is the disruptive machine to stop us “doing the same thing, but bigger”.
  - More and more are starting to agree on the relevance.
- A physical Cooling Demonstrator is the key to demonstrate feasibility.
  - Great work shown today. Please keep pushing!
- Need ways to interleave PP and accelerator communities.
  - Instrumentation for demonstrator? Machine learning? Joint projects? Seminars?