FORWARD PHYSICS FACILITY AND SNOWMASS INPUT

Jonathan

FASER Collaboration General Meeting

15 May 2020

FASER 2

- The physics motivations for upgrading FASER and FASERν are strong.

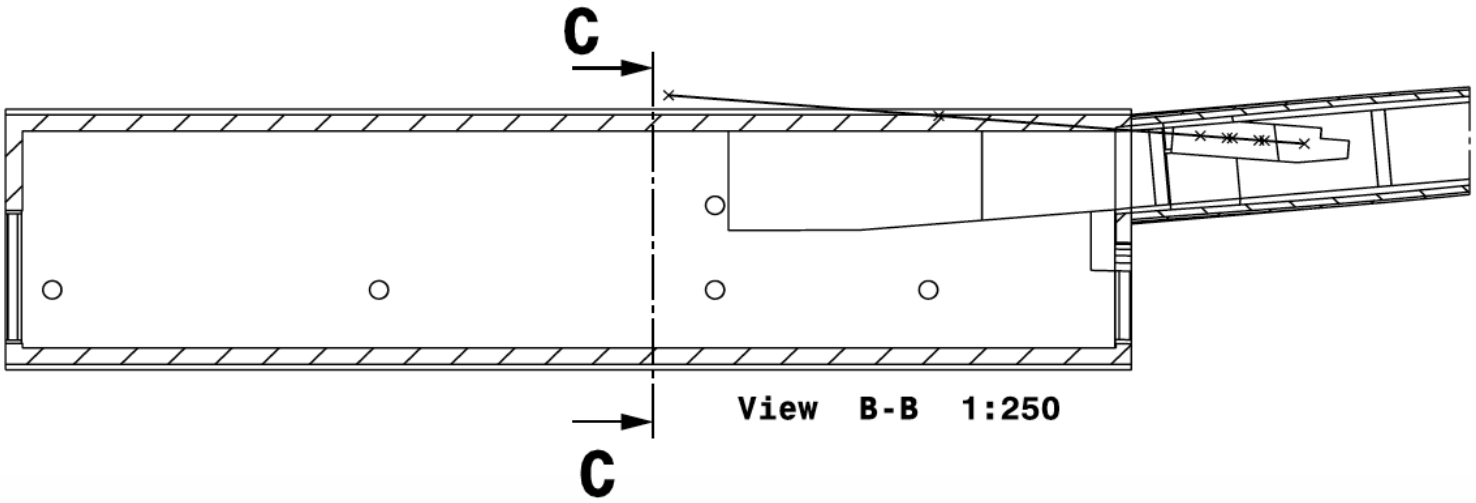
- FASER will extend sensitivity ~ (luminosity * decay volume) by 200 to 3000, FASER 2 could extend it by 10^6. This is for R=1m, L=5m at the far location; a near location also has good features.

Detector	Luminosity	Sensitivity (Lumi * Volume)
FASER	First fb^{-1} of Run 3	1
FASER	End of Run 3	200
FASER	End of HL-LHC	3000
FASER 2	End of HL-LHC	1,000,000

- FASERν: will discover 1st collider neutrino, eventually ~20,000 ν_μ at TeV energies. Discovery → study → precision measurements all in one experiment. FASERν 2 may be able to move tau neutrinos, the least understood SM particle, into the realm of precision studies.

FORWARD PHYSICS FACILITY

- At present, all future plans are severely limited by infrastructure that was created long before the physics potential of this space was appreciated.



Dougherty (2020)

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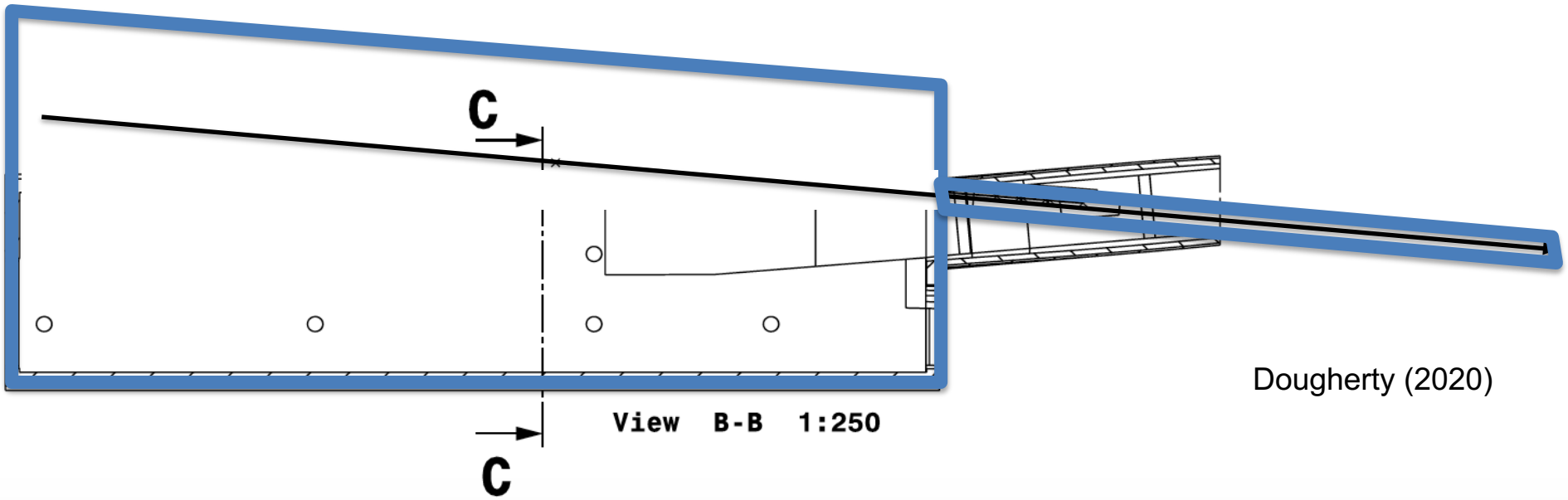


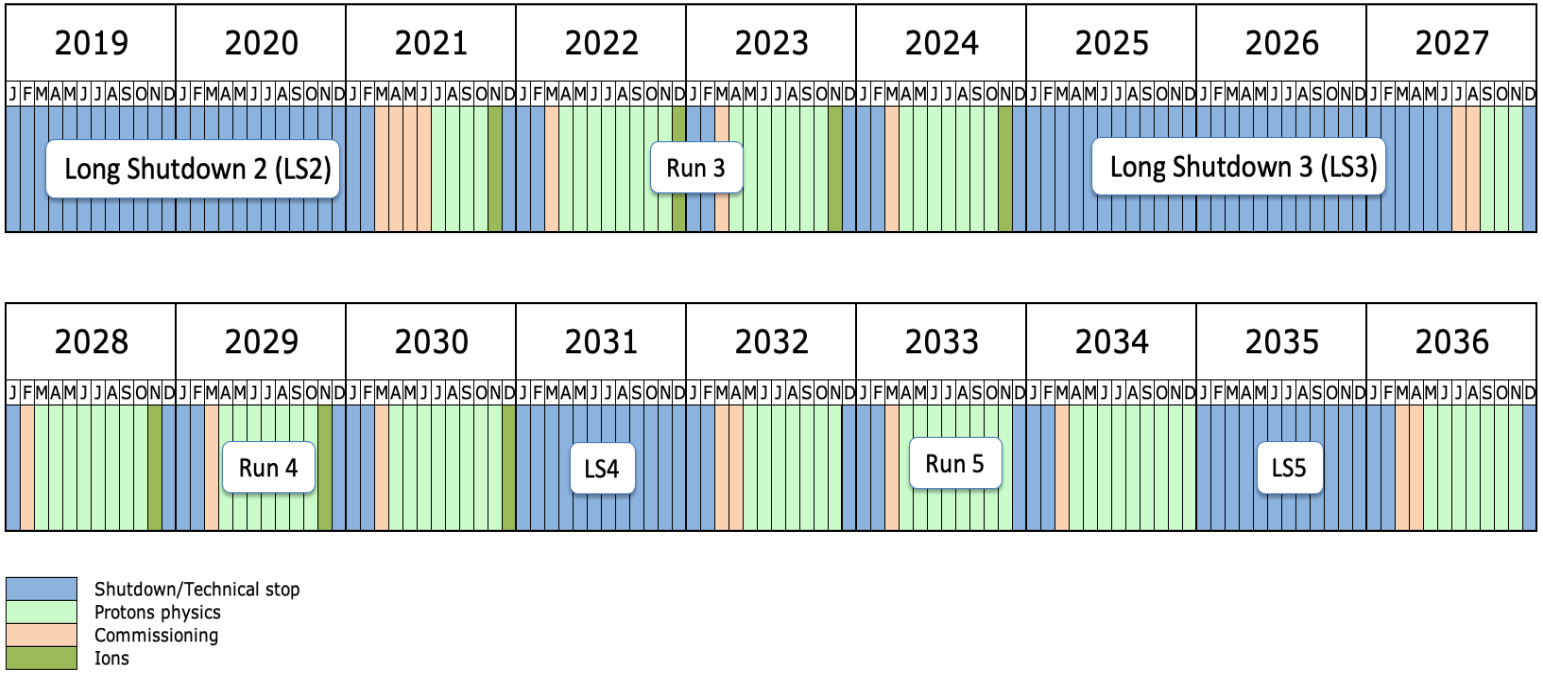
Dougherty (2020)

- A new "Forward Physics Facility," similar to CERN's North Area or to an underground lab, prepared specifically for a suite of forward physics experiments, would lead to a huge gain in sensitivity to new physics, neutrino studies, hadronic physics, etc.

- Doesn't take much: extend UJ12 or UJ18 by a few meters; bore a long, narrow hole toward the IP; prepare a near site along the beamline.

QUESTIONS TO ANSWER

- What combination of experiments would be best?
- What is the cost? Could it be done in LS3 or LS4?



- What is the physics potential of Forward Physics Facilities at future colliders?

SNOWMASS 2021

- In the U.S., prioritization for the next 10 to 20 years has started.
- Snowmass community input (https://snowmass21.org)
  - 1 April 2020 – 31 August 2020: **2-page Letters of Interest** due. The primary purpose is to help conveners prepare for the Snowmass Planning Meeting.
  - 4-6 November 2020: Snowmass Planning Meeting (kickoff meeting at Fermilab).
  - 1 April 2020 – 31 July 2021: **Contributed Papers** due. These are posted on arXiv and become part of the Snowmass proceedings.
  - 11-21 July 2021: Snowmass Community Study (final meeting at University of Washington, Seattle, LOC chairs: Shih-Chieh Hsu and Gordon Watts).
- P5 DOE/NSF prioritization panel expected 2021-22.

NOTES ON SNOWMASS 2021

- Snowmass/P5 is a rare opportunity in the U.S. for physicists to direct funding.
- Snowmass doesn't decide anything. Snowmass sets the menu, P5 chooses what to order.
- But Snowmass can be a good opportunity to think about fresh ideas, do studies, and build support.
- Proposed input to Snowmass
  - LOIs for FASER 2 (FASER Collaboration), FASERν 2 (FASER Collaboration), Forward Physics Facility (all interested); purpose is to propose interesting possibilities (far and near locations, etc.) for community study.
  - All FASER collaborators will be invited to be authors, but should feel free to opt out.
  - Contributed papers to be decided later.

SNOWMASS WORKING GROUPS

DPF Chair Line (Kim, Han, Butler)

Energy Frontier (Narain, Reina, Tricoli)

EF01: EW Physics: Higgs Boson properties and couplings

EF02: EW Physics: Higgs Boson as a portal to new physics

EF03: EW Physics: Heavy flavor and top quark physics

EF04: EW Precision Physics and constraining new physics

EF05: QCD and strong interactions: Precision QCD

EF06: QCD and strong interactions: Hadronic structure and forward QCD

EF07: QCD and strong interactions: Heavy Ions

EF08: BSM: Model specific explorations

EF09 – BSM: More general explorations

EF10: BSM: Dark Matter at colliders

Neutrino Frontier (Huber, Scholberg, Worcester)

NF01: Neutrino Oscillations

NF02: Sterile Neutrinos

NF03: BSM

NF04: Neutrinos from natural sources

NF05: Neutrino properties

NF06: Neutrino Interaction Cross Sections

NF07: Nuclear safeguards and other applications

NF08: Theory of Neutrino Physics

NF09: Artificial Neutrino Sources

NF10: Neutrino Detectors

Rare Processes (Artuso, Bernstein, Petrov)

RP1: Weak Decays of b and c quarks

RP2: Weak Decays of strange and light Quarks

RP3: Fundamental Physics in Small Experiments

RP4: Baryon-Lepton Number Violation

RP5: Charged Lepton Flavor Violation

RP6: Dark Sector at Low Energies

From conversations with the top-level conveners, it seems the highlighted subgroups are the ones most relevant for FASER (but these are early days and there are also other frontiers).

Cosmic Frontier (Chou, Soares-Santos, Tait)

CF1. Dark Matter: Particle-like

CF2. Dark Matter: Wave-like

CF3. Dark Matter: Cosmic Probes

CF4. Dark Energy and Cosmic Acceleration: The Modern Universe

CF5. Dark Energy and Cosmic Acceleration: Cosmic Dawn and Before

CF6. Dark Energy and Cosmic Acceleration: Complementarity of Probes and New Facilities

CF7. Cosmic Probes of Fundamental Physics

FASER Subgroups in Blue

FASERν Subgroups in Green