EMPHATiC detector development
Blair Jamieson <bl.jamieson@uwinipeg.ca>
for the EMPHATIC collaboration

Outline

• EMPHATIC?
• Physics motivation
• Neutrino flux prediction
• Detector development
• Outlook
Experiment to Measure Proton Hadron Production in A Testbeam In Chicagoland Collaboration

T. Akaishi$^{10}$, L. Aliaga-Soplin$^2$, H. Asano$^{11}$, L. Bellantoni$^2$, W-C. Chang$^{12}$, L. Fields$^2$, T. Fukuda$^5$, D. Harris$^2$, M. Hartz$^{1,4}$, R. Honda$^{13}$, T. Ishikawa$^{14}$, B. Jamieson$^7$, M. Komatsu$^5$, Y. Komatsu$^{15}$, A. Konaka$^1$, T. Lindner$^{1,7}$, Y. Ma$^{11}$, N. Naganawa$^5$, M. Naruki$^{16}$, H. Noumi$^9$, K. Ozawa$^{15}$, J. Paley$^2$, F. Sakuma$^{11}$, T. Sawada$^{17}$, O. Sato$^5$, T. Sekiguchi$^3$, K. Shirotori$^9$, A. Suzuki$^{18}$, M. Tabata$^8$, T. Takahashi$^9$, N. Tomida$^9$, R. Wendell$^6$, and T. Yamaga$^{11}$

$^1$TRIUMF, Vancouver, BC V6T 2A3, Canada
$^2$Fermi National Accelerator Laboratory, Batavia, Illinois 60510, USA
$^3$KEK, Tsukuba, Ibaraki 305-0801, Japan
$^4$IPMU, Kashiwa, Chiba 277-8583, Japan
$^5$Nagoya University, Nagoya, Aichi 464-8601, Japan
$^6$Kyoto University, Yoshidahonmachi, Kyoto, Kyoto 606-8501, Japan
$^7$University of Winnipeg, Winnipeg, MB R3B 2E9, Canada
$^8$Chiba University, Chiba, Chiba 263-8522, Japan
$^9$Research Center for Nuclear Physics (RCNP), Osaka University
$^{10}$Department of Physics, Osaka University
$^{11}$RIKEN
$^{12}$Institute of Physics, Academia Sinica
$^{13}$Physics Department, Tohoku University
$^{14}$Research Center for Electron Photon Science (ELPH), Tohoku University
$^{15}$Institute of Particle and Nuclear Studies (IPNS), High Energy Accelerator Research Organization (KEK)
$^{16}$Kyoto University, Yoshidahonmachi, Kyoto, Kyoto 606-8501, Japan
$^{17}$Department of Physics, Osaka City University
$^{18}$Kobe University, Kobe, Hyogo 657-8501, Japan
Motivation: next generation long-baseline search for CP violation in neutrinos will be systematics limited

260 kton Water Cherenkov Detector
H = 60 m
φ = 74 m
40,000 50 cm PMTs (40% photo-coverage)
High QE box and line

Upgrade J-PARC neutrino beam to 1.3 MW beam power
New/upgraded near detectors
Systematic Uncertainties in HK Era

- Reaching 5σ C.L. for maximal CP will require improved systematic uncertainty estimates
- Will require improved understanding of:
  - Hadron-production distributions
  - ν cross-section
  - Detection efficiencies
Neutrino beam flux uncertainties

- Large contribution from hadron production uncertainty
- Also from pion and kaon re-scattering in target and in magnetic focusing horns
EMPHATIC experiment

- Reduce neutrino flux prediction uncertainties in long-baseline neutrino oscillation
- Compact spectrometer to measure hadron production uncertainties
- Reduce flux uncertainties by factor of two
- Detector development: this poster!

Fall 2018 results coming soon:
- Session R2-10 Thu 13:40 Matej Pavin “Measurements of proton-carbon differential cross-sections at 20, 30 and 120 GeV/ν in EMPHATIC experiment”

Preliminary results
EMPHATIC Spectrometer

• Poster will discuss
  • design of permanent magnet
  • Design of aerogel RICH
Thanks for your attention!

• Questions? Come see poster number 62 this evening.