

A. BLONDEL, A. K. ICHIKAWA, A. MINAMINO,  
H. A. TANAKA, M.O. WASCKO, M. ZITO

# T2K UPGRADE SUMMARY

Post-T2K, T2K2, T2Kextention, T2Kmore, T2K\*3

# KEY POINTS

- T2K run with  $\sim 2.5 \times 10^{22}$  POT raises sensitivity of CPV in favorable cases from  $\sim 90\%$  CL to  $\sim 3\sigma$  level
  - expect  $> 3\sigma$  significance for 30% of  $\delta_{CP}$  values if MH is known
  - significant impact from systematics if they are at the  $\sim 5\%$  level or larger
  - 2–3% level is desirable
- Major beam line elements are already designed for  $\sim$ MW operation
  - necessary upgrades mainly relate to cooling and radiation handling
  - preparations underway for 320 kA horn operations
    - 10% increase in flux and reduction of wrong-sign component
  - Further NA61 analysis can bring absolute flux uncertainty to  $< 5\%$
- T2K–SK selection improvements may enhance effective statistics by up to  $\sim 50\%$ 
  - new strategy of *ab initio* detector systematics is likely necessary to achieve desired uncertainty
  - (possibility to expand inner volume of SK to get  $\sim 40$  kT of useable volume?)
- Neutrino interaction systematics likely to be dominant source of error
  - near detector strategy should be re-evaluated (proton reconstruction, H<sub>2</sub>O target, acceptance)
  - continued collaboration with theorists is essential to achieve model improvements
  - External data (other  $\nu$ -int, more  $\pi$  scattering, etc.) may be needed

# DISCUSSION POINTS -1-

- Is there a compelling case for an extended T2K run to  $\sim 2.5 \times 10^{22}$  POT?
- If it is important, what is the proper time scale to make a LOI/proposal?

# DISCUSSION POINTS – MORE –

- We should consider how to improve  $\theta_{23}$  measurement and role of external  $\theta_{23}$  measurements (e.g. PINGU) in our sensitivity.
- Credible strategy for systematic error must be formulated
- Important systematic is  $(\nu_e/\nu_\mu):(\nu_e/\nu_\mu)$  cross section ratio. What is our strategy?
- More manpower is needed for further NA61 data and analysis.
- Some beam line components are nominally rated for  $\sim 750$  kW operation but should be reevaluated to start R&D if necessary
- Connections to other areas (e-scattering,  $\pi$ -scattering,  $\tau$  decays) may play important role in understanding some  $\nu$ -int systematics.
- Can varying off-axis angle play a role in understanding systematics?
- We must motivate accelerator upgrades and improvements with physics.
- Connection and importance of an intermediate program for future program (HK) should be articulated.