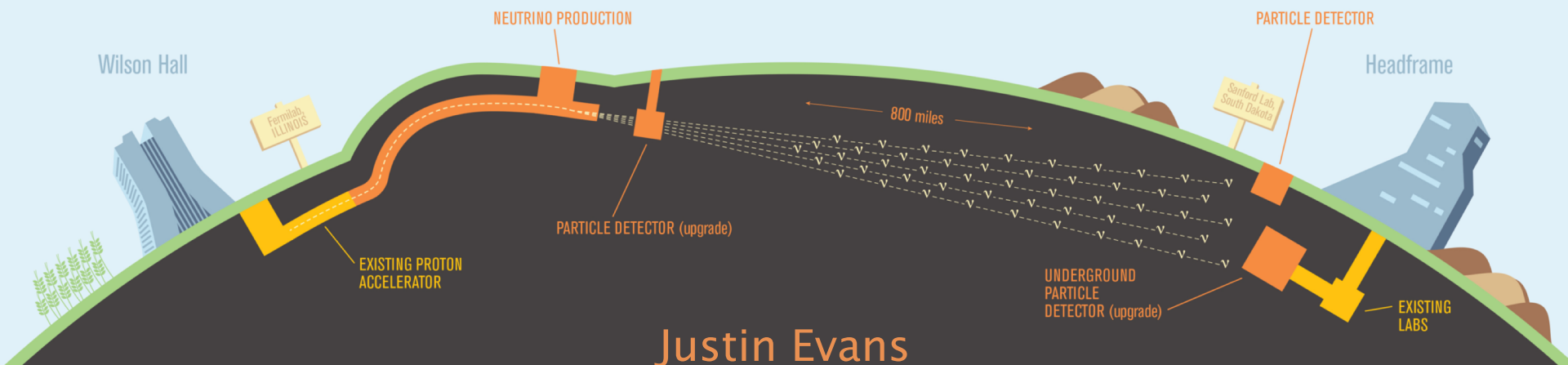


# Frames and boards in the UK



Justin Evans  
University of Manchester

# APA frames in the past

Previously we have made

- Three APA frames for ProtoDUNE (with the old 3" steel profile)
- Two 2.4x4 m APA frames for SBND

These were made by Portobello

- An engineering company near Sheffield

ProtoDUNE APAs are taking data and the SBND APAs are ready for installation in the TPC at Fermilab



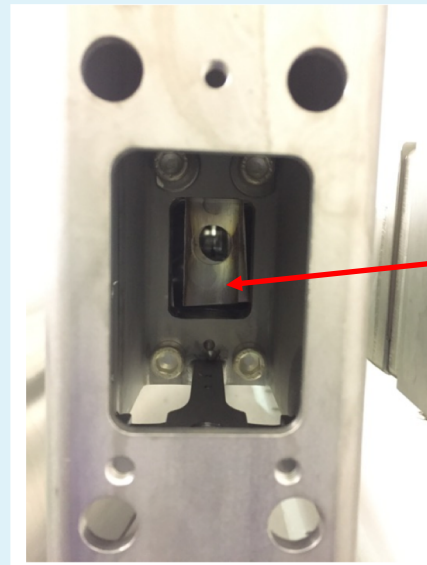
# ProtoDUNE APA frames

ProtoDUNE frame production was overall smooth

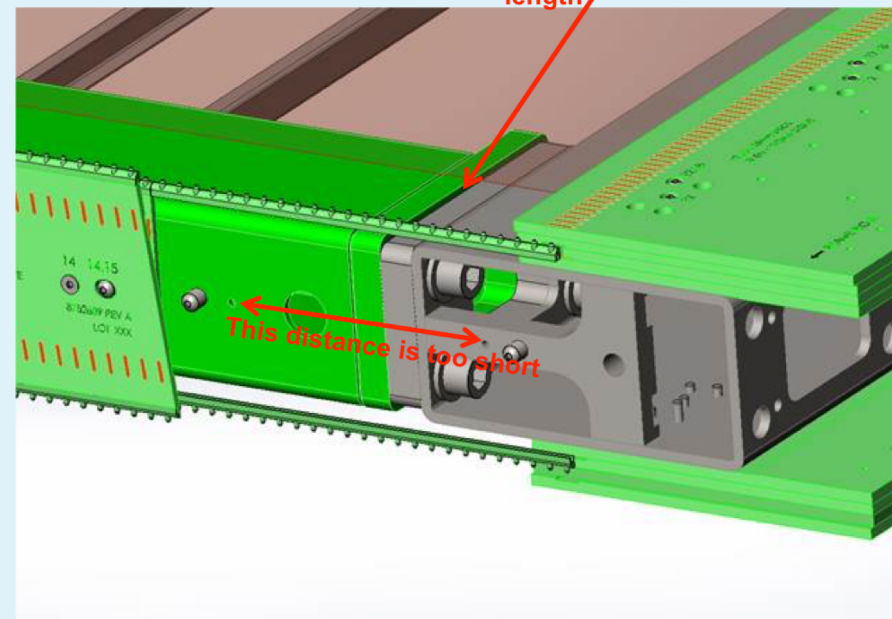
Two minor, rectifiable issues

- Shims protruding into holes in one frame
- One frame shimmed incorrectly to be a few mm too short, meaning that PCB-attachment holes had to be realigned

Steel sourced from Atlantic Steel (the same supplier that PSL use)



Shim blocking the hole



A shim in this joint would correct the length

This distance is too short

# SBND APA frames

- These were more challenging as the flatness was constrained to 0.5 mm tolerance
- Overcome by shimming the surface of the frame and installing leveling bars onto which the geometry boards were mounted



# DUNE APA frames

Since we have experience with one supplier (Portobello), we are trying out a second supplier for the first two DUNE APAs

- Durham Sheet Metal (DSM)
- Frames will be received late in March

Steel (imperial dimensions) is being sourced in Europe by Richard Austin Alloys, in Manchester

- Will receive the first shipment this week

The full production run will go thorough a tender process to select the supplier(s)



# Durham Sheet Metal

DSM have previously made

- The T2K ND basket
- SBND CPA
- The big yellow cranes in the winding factory

Machining is subcontracted out to LH Quarry Plant

- Peter has met with this company



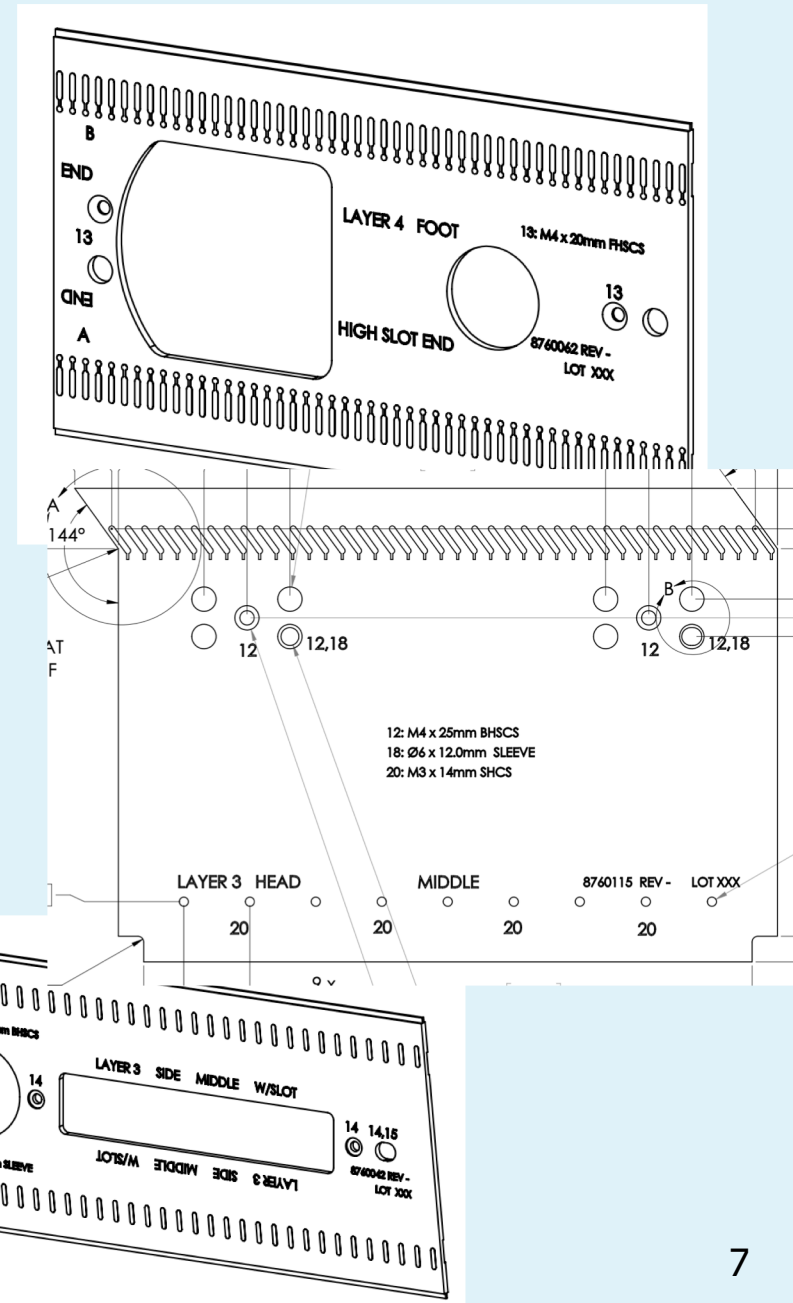
# PCBs

For ProtoDUNE, PSL provided us with all geometry boards (and CR, SHV, etc)

- For DUNE we need to learn to produce these ourselves

We are obtaining quotes for a trial run of boards

- 30x G high slot end (2-layer): 8760062
- 30x U middle head (1-layer): 8760115
- 30x U side with PDS slot (4-layer): 8760042



# Positions of features



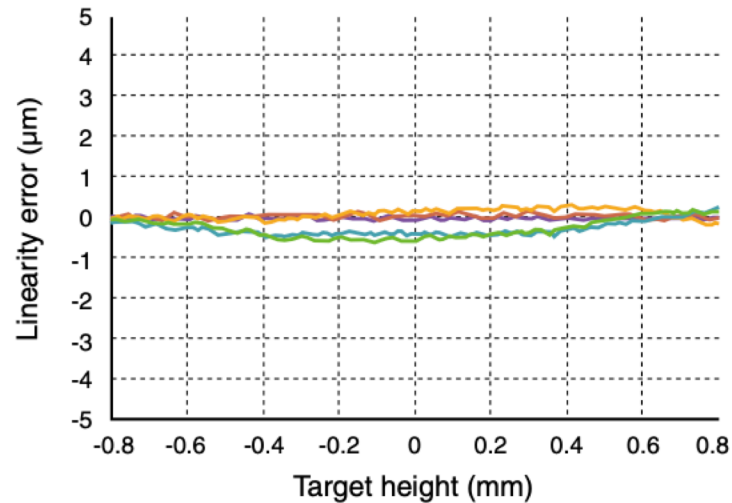
Keyence IM-7000 image dimension measurement system

- Image recognition software determines the position of all surface features within seconds and produces a pass / fail report with all information
- Makes up to 99 measurements on each board to  $\pm 5 \mu\text{m}$
- Can measure objects up to 30 cm in length, but doing the one longer board-type in two goes is trivial
- Also has a  $\pm 7.5 \mu\text{m}$  accuracy contact probe for vertical measurement



## CL-3000 Series

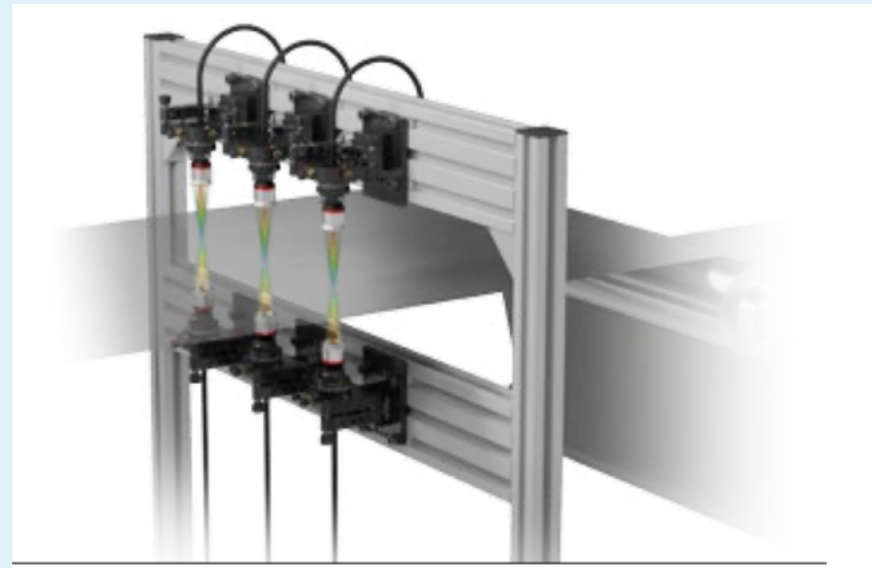
For CL-L015 / CL-L015G (Typical)



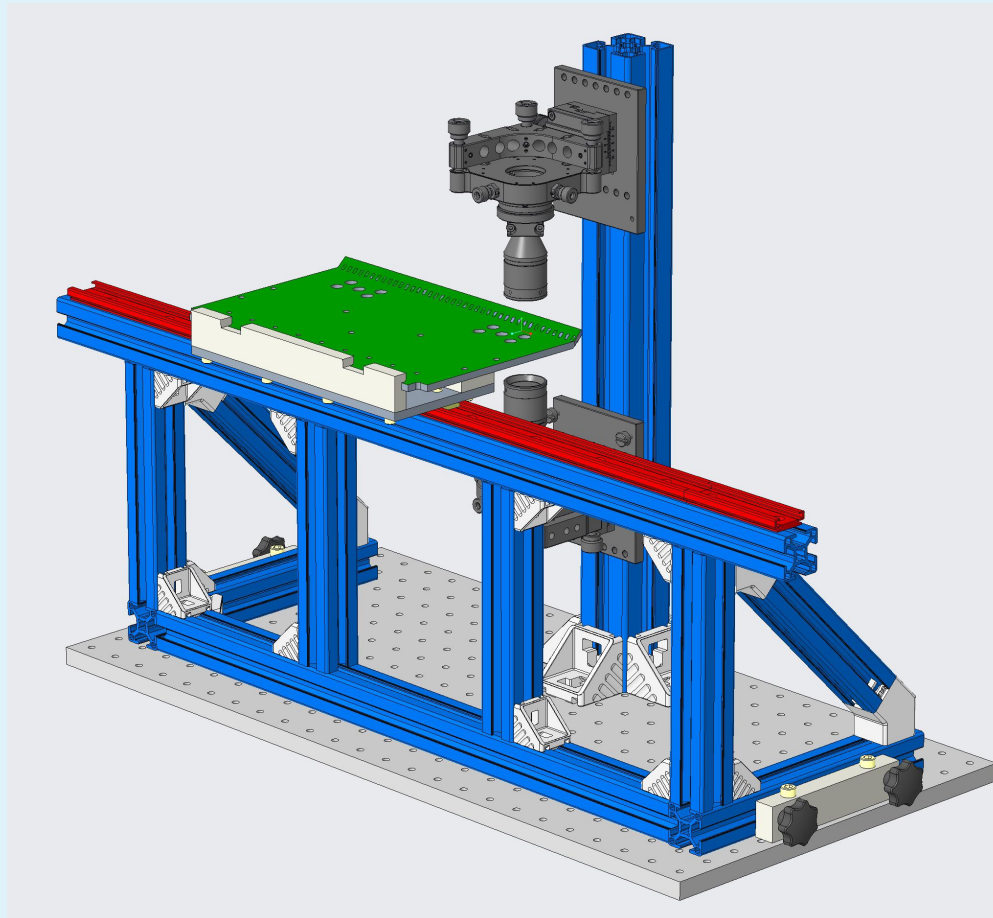
- : Transparent or mirrored targets
- : White ceramic
- : Unfinished metal
- : Black rubber
- : White resin

## Keyence CL-3000 confocal displacement sensor

- Takes a few seconds to swipe a board through and profile flatness to  $\sim 1 \mu\text{m}$
- Data can easily be exported, e.g. as csv



# Thickness metrology



- Designing a system to allow boards to be quickly and easily slid through the confocal displacement sensor

# Other components

## Mill-max pins

- PSL are sending us some to play with
- We'll likely have to source these from the same vendor as PSL (as they are bespoke)

Sheffield are looking into getting the tooth strips injection molded

We are holding off on looking at CR boards and focusing on the geometry boards for now

# Summary

Receiving steel from a European supplier this week

Two frames to be made by DSM over the next two months

Board metrology system being set up

First boards to be purchased to allow us to test out this system

- From this, we will learn how close to tolerance boards are supplied by 'default'