MINOS 1st SM Single-Layer Shield

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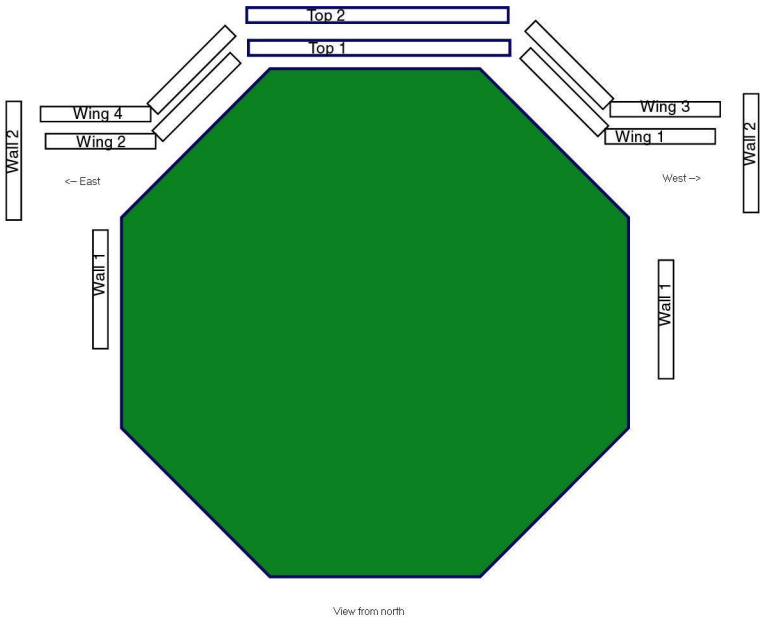
- Goals
  - Single-Layer shield covering 1st SM
    - Assume two sections lap slightly at end ($L \leq 16$ m)
  - Near-hermetic coverage $\leq 45^\circ$ from vertical
- Constraints
  - Use existing pmt and mux box hardware
  - Use minimum number of shield modules
- Can be done! But may need new mux boxes

Existing Shield

- Std 3-pmt mux pattern inappropriate, so
  - 2-pmt “Shield” mux boxes “gang” fibers
  - 12x20-fiber cables (12 modules) per mux box
- Single 8 m, 2 layer section (1 layer in spots)
- Cable/mux layout: 30 modules, []=not done
  - NE1/SE1 Top1:1-5, Wing4:1-5, [Wall2E:1-2]
  - NE2/SE2 Wing2:1-5, [Wall1E:1-4,Wall2E:3-4]
  - NW1/SW1 Top2:1-5, Wing3:1-5, [Wall2W:1-2]
  - NW2/SW2 Wing1:1-5, [Wall1W:1-4,Wall2W:3-4]

Existing Shield Layout



Notes: No walls installed; other coverage is *mostly 2*-layer
5-module top is too narrow, so offset to cover gap
5-module wings offset to provide additional width
One existing section covers south half of 1st SM

Mux Boxes Needs

- 8 muxes for 2-section 1-layer shield
  - NE1/SE1 Section 1 E side, N/S readout
  - NW1/SW1 Section 1 W side, N/S readout
  - NE2/SE2 Section 2 E/W side, N/S readout
  - NW/SW 2 Section 2 E/W side, N/S readout
- Can use existing (2-pmt) shield mux boxes?
  - Max: 2x16 pix/pmt x 8 fibers/pix = 256 fibers
  - Actual: 12 (20-fiber) cables/mux box
    - Hard limit: twelve modules per side, per section

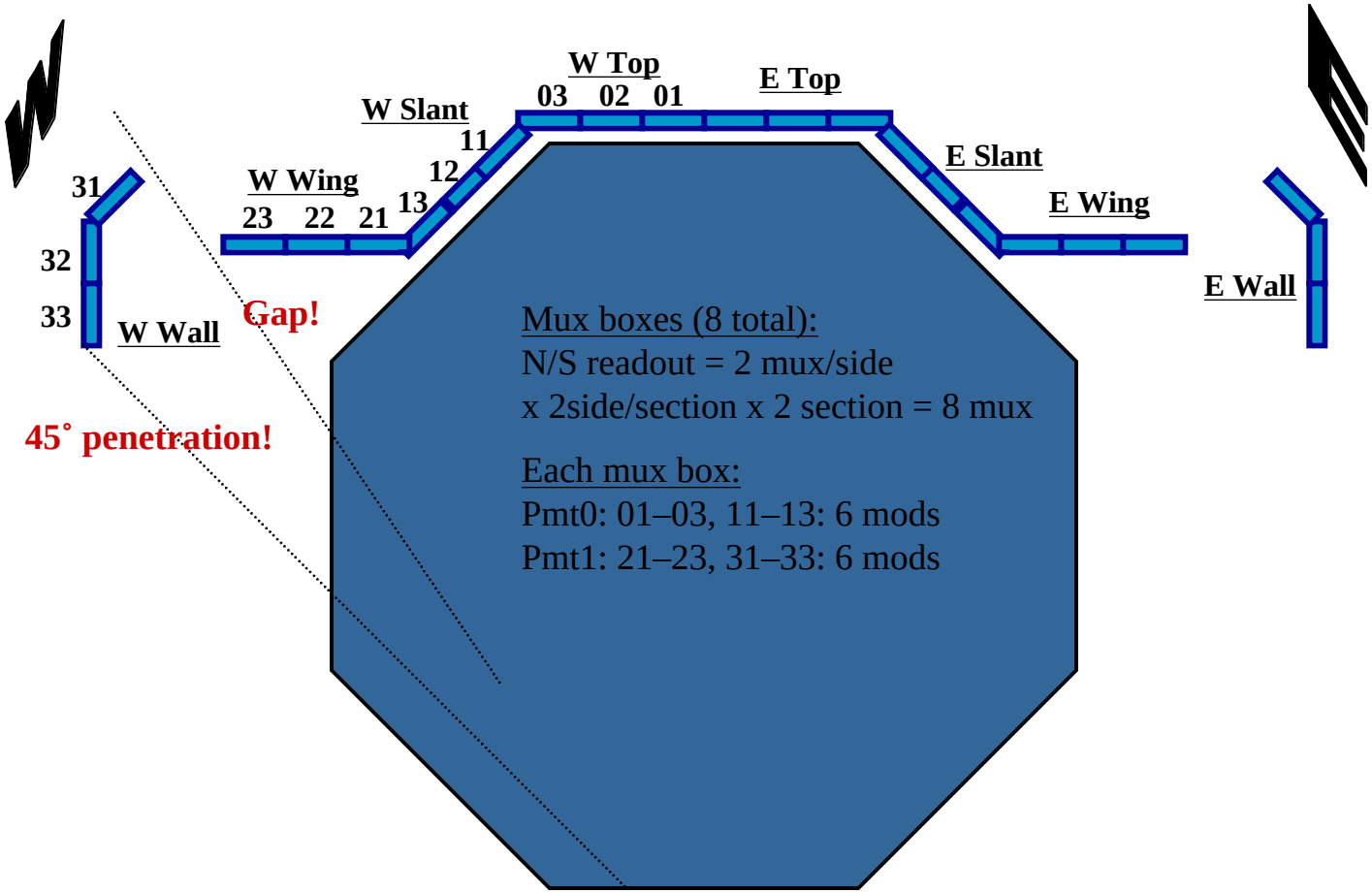
Shield Design Constraints

- Main issue: 12 mods/sec/side enough?
- Must lap 6 mods on top (5 are 15 cm short)
  - Cannot “bridge” mods across top/slant interface
  - 5 mods only helps 12 max on one side anyway!
- Must lap 3 modules on “slant,” but
  - Limited “bridge” may extend wing a bit
  - (Note: hard to show laps on figures!)
- Will give 2 “2-pmt” + 1 “3-pmt” options

Option 1: Short Wing, Short Wall

- Use 8 existing 2-pmt mux boxes
  - 12 (20-fiber) cables/mux box
  - 12 modules/section/side = 48 total modules
- 3 Top + 3 Slant + 3 Wing + 3 Wall
  - Won't keep *exact* pixel/plane map, but close
    - (Remember, this was done for a two-layer shield)
  - Gap between wing and wall?
  - 45° muon still hits bottom of detector?

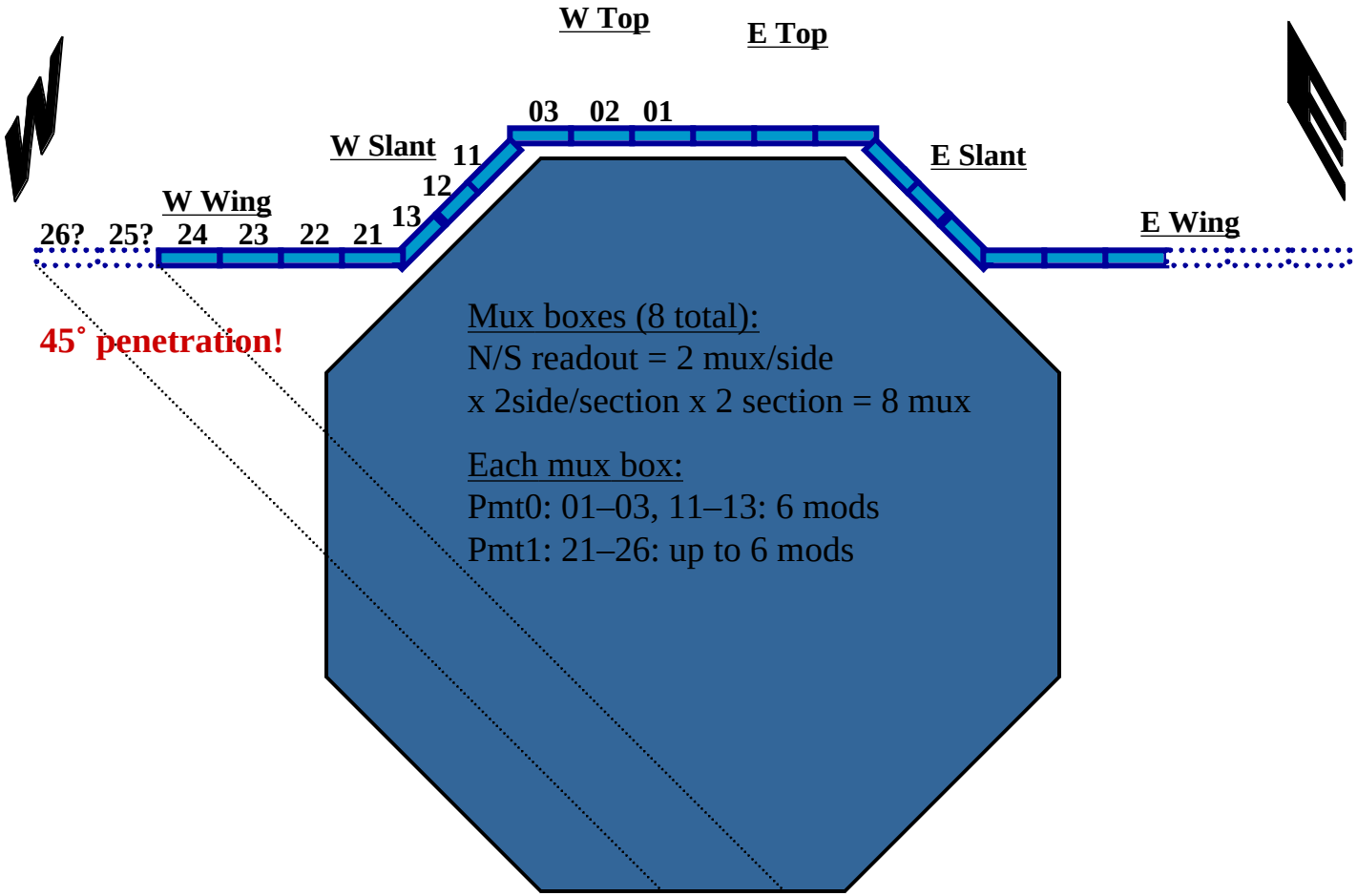
Option 1: Short Wing, Short Wall



Option 2: Big Wing, No Wall

- Use 8 existing 2-pmt mux boxes
  - 12 (20-fiber) cables/mux box
  - 12 modules/section/side = 48 total modules
- 3 Top + 3 Slant + 4,5, or 6 Wing
  - Won't keep *exact* pixel/plane map, but close
  - Extends wing, but exact amount unknown
  - Even in best case, 45° muon penetrates

Option 2: Big Wing, No Wall



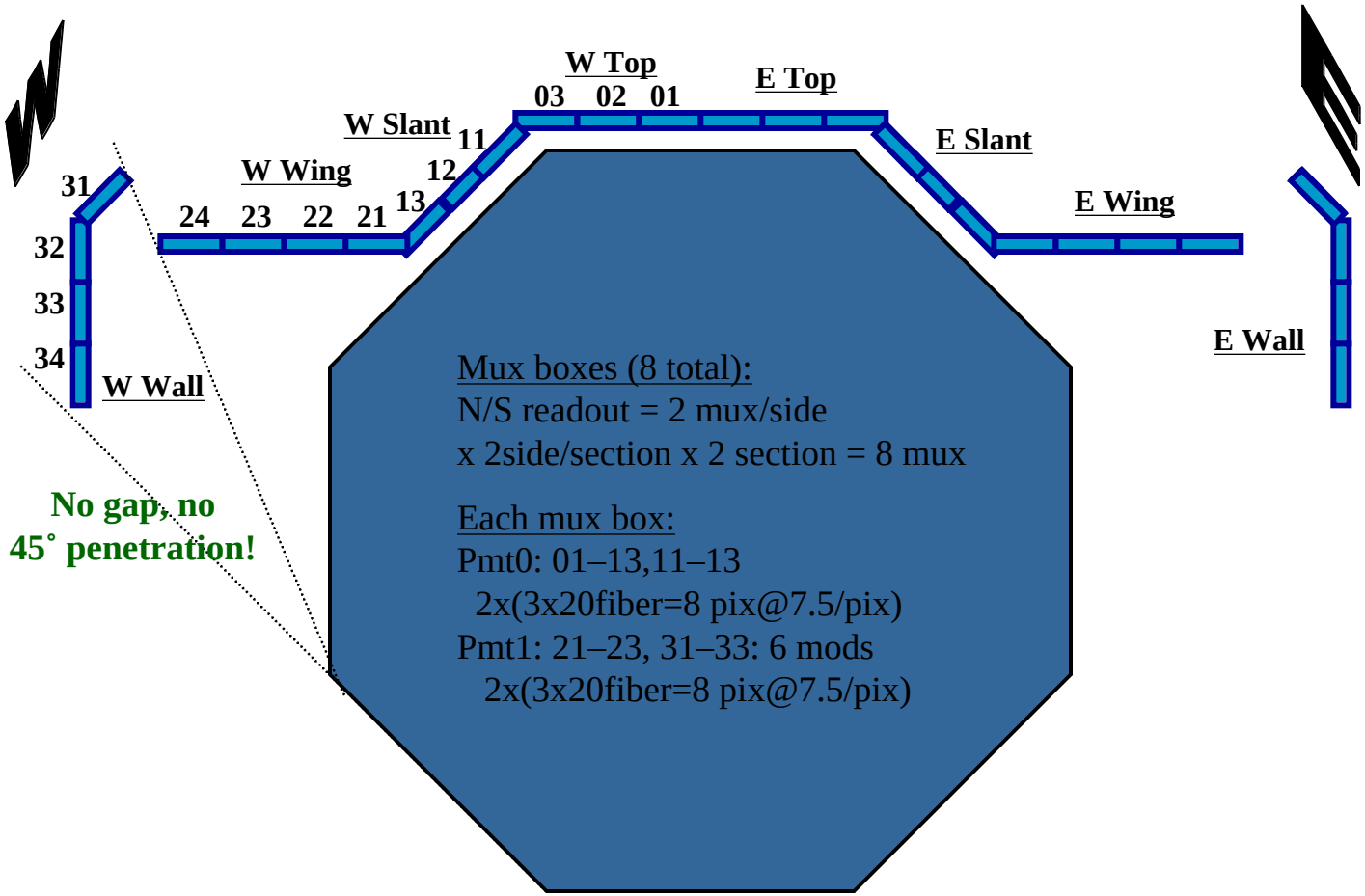
Do We Need New Mux Boxes?

- Create 8 “new” 3-pmt mux boxes?
- New pixel/fiber mapping:
  - 3 module “plane”: 3x20 fibers = 8 pix @7.5/pix
    (or 2 module “plane”: 2x20 fibers = 5 pix @8/pix)
  - 1 pmt = 6 modules (2x3 mod *or* 3x2 mod)
- Note: 16 (not 18) cable connectors/box
  (But we only need 14 anyway)
- Nice results, but is feasible? New or rehab?

Option 3: New Muxes, Full Shield

- Requires 8 “new” 3-pmt mux boxes
  - 14 (20-fiber) cables/mux box
  - 14 modules/section/side = 56 total modules
- 3 Top + 3 Slant + 4 Wing + 4 Wall
  - Covers gap between wall and wing
  - Tags 45˚ muons throughout detector
  - Rational pixel/plane map guaranteed
  - Note: same plan as seen in Aug, w/o lower wall
  - Nice, but needs additional 8 mods, 8 pmt & mux rehab!

Option 3: New Muxes, Full Shield



Summary

- Why can't we do *better* w/existing hardware?
- Complete coverage tough @ 12 mod/side!
  - Limit forced by existing 2-pmt mux boxes
- Hard to fill gaps!
  - Option 1&2 gap figs only approx, but they exist
- Option 3 "best" coverage looks good, but
  - Need careful survey to assure "best" coverage
- Question: new muxes, less coverage, or… ?