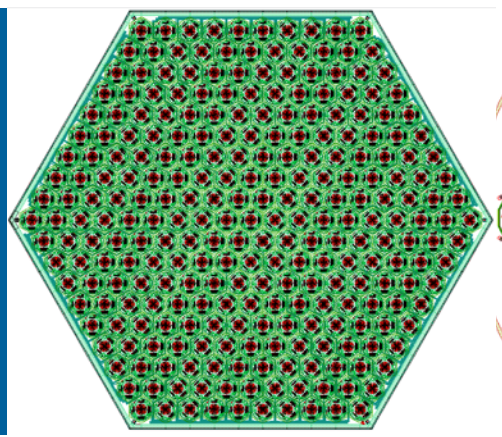
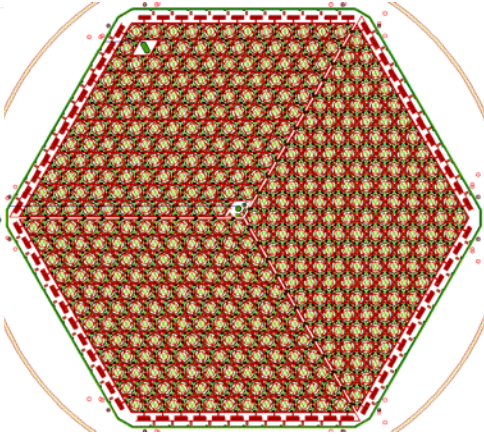
CMB-S4 Detector Layout Workshop

Progress on rhomboid layout





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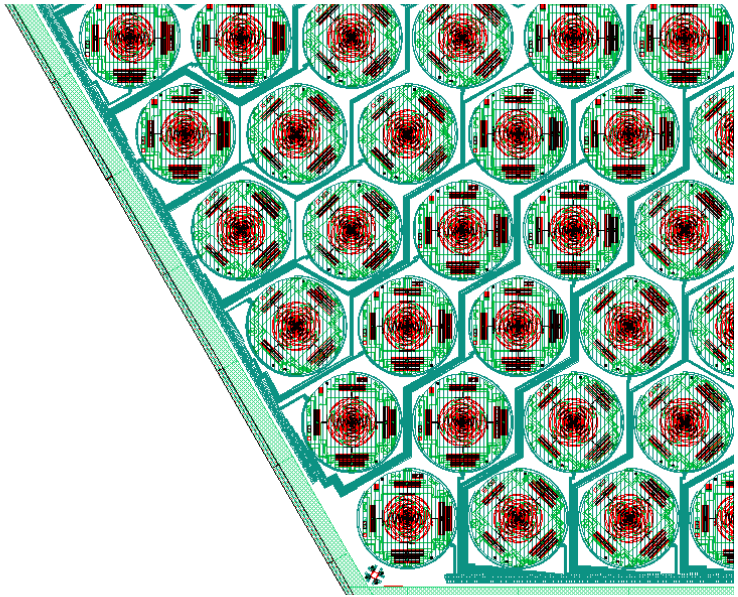
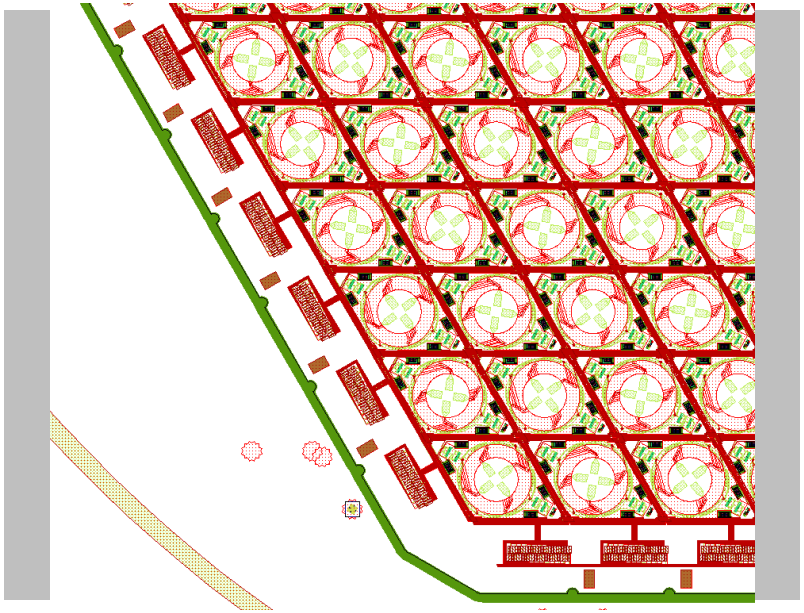
Wiring Patterns



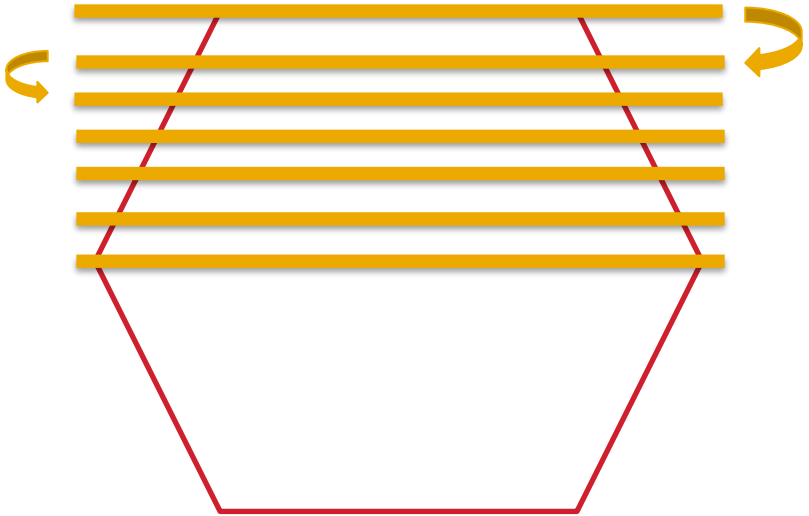
- Serial pattern
- Single layer



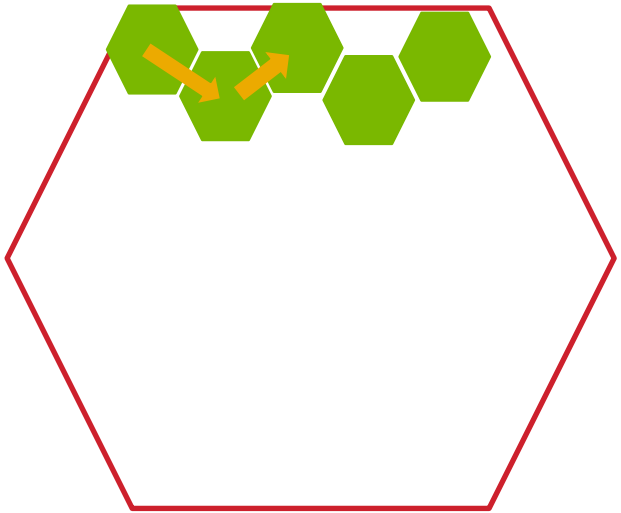
- Repetitive pattern
- Multiple layer

direct write vs Stepper

DIRECT WRITE - ~ 45MIN/WAFER



STEPPER - ~ 5MIN/WAFER

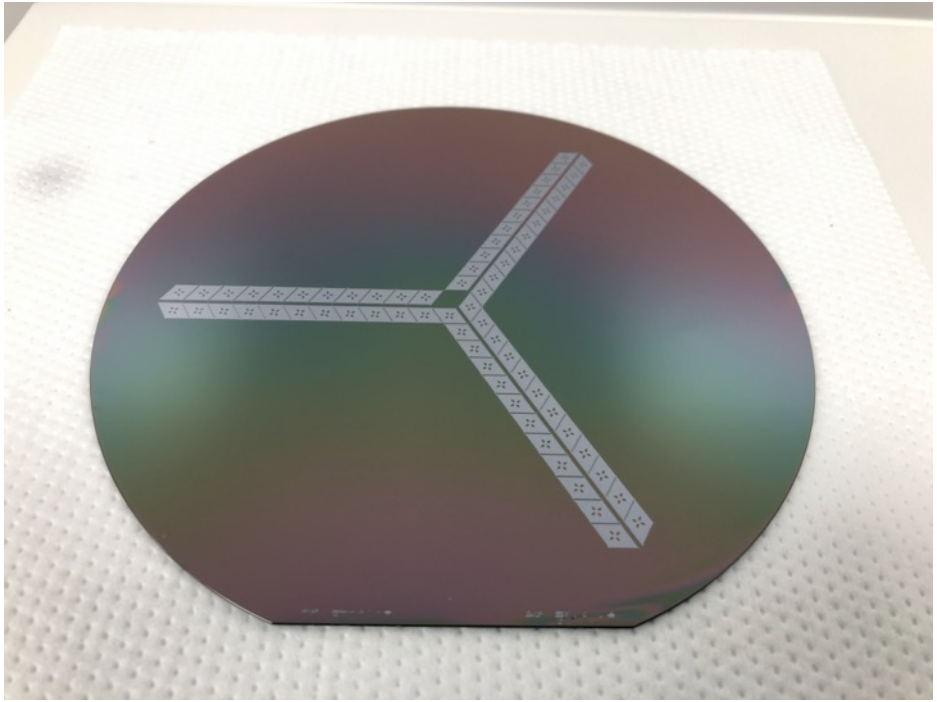


Questions / Concerns that have been raised

- Can the rhombus pattern be used on a stepper without wafer rotation?
- Can the rhombus pattern work with few/no crossovers and a single wiring layer?
- Can the readout wiring be directed to one side of the wafer for low pixel count layouts?

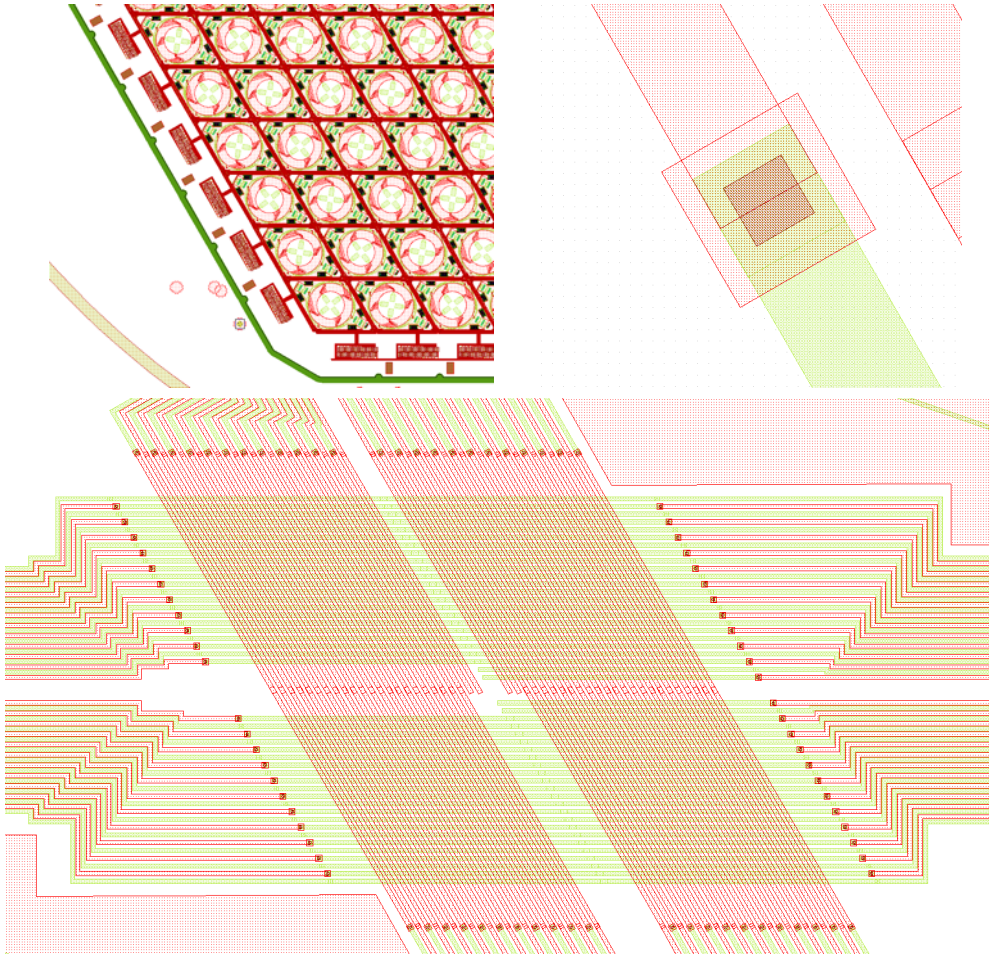
Rhombus on non-rotating Stepper

- NIST has a stepper that can rotate wafer
  - Pattern on rhombus, rotate wafer, and repeat
  - Only need one set of masks (stencils)
- Open question if rhombus pattern work on non-rotating stepper
- Demonstrated layout is possible and with minimal increase in mask (relative to SPT-3G)



Crossovers

- To pattern wiring on stepper, wire pattern must be repeatable
- Row/columns of wires crossing each other
- 10s of thousands of crossovers per wafer



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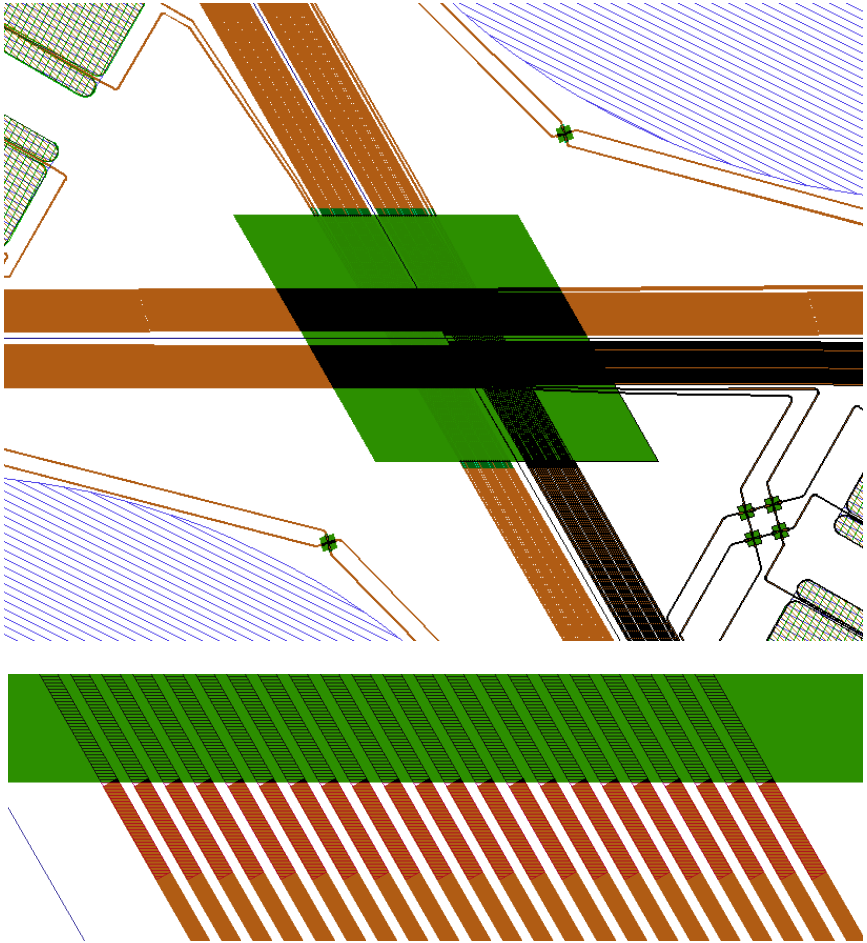
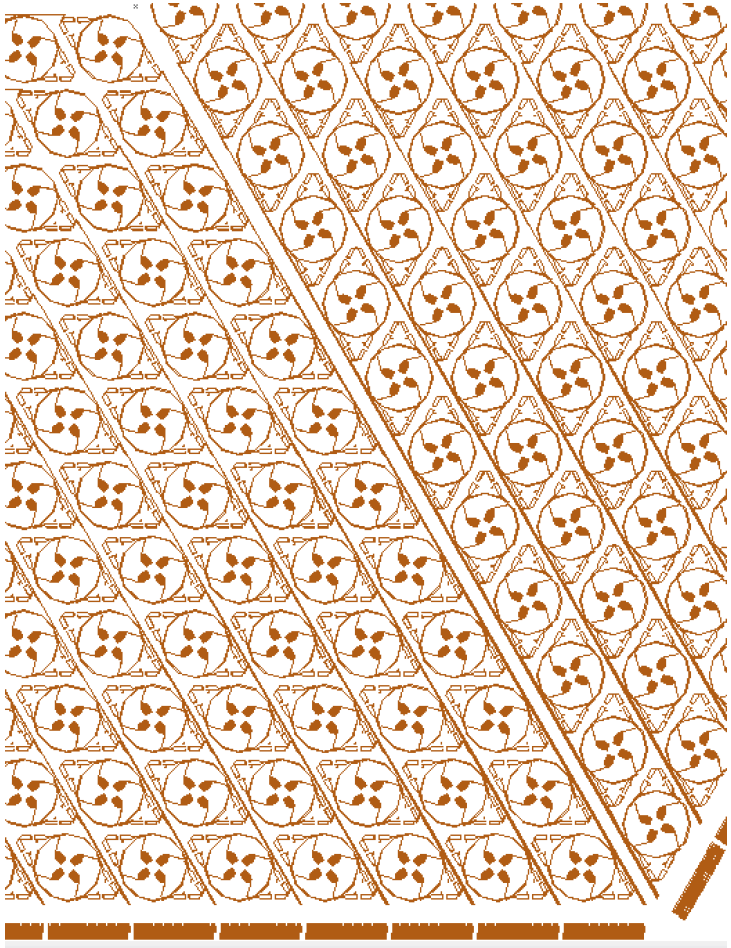


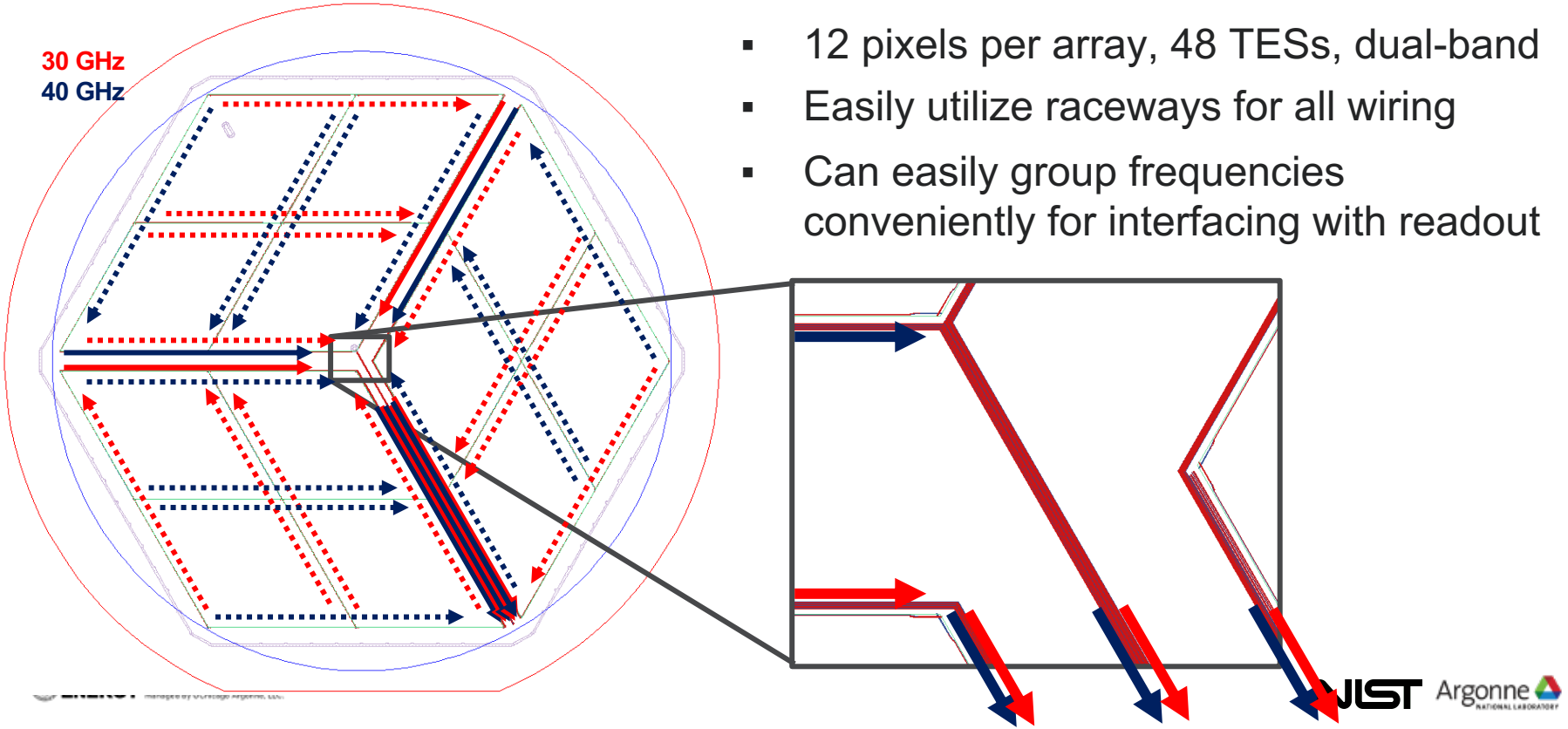
Alternative

Can direct write instead of stepper

- Single layer, direct write wiring layer for rhombus pixels
  - Takes longer, but can reduce (eliminate?) crossovers
- Key challenge is having enough room at edge of pixels for outer pixels
  - Go from 24 to 48 wires
- Initial layout looks promising
  - Can take advantage of raceways, so likely more options



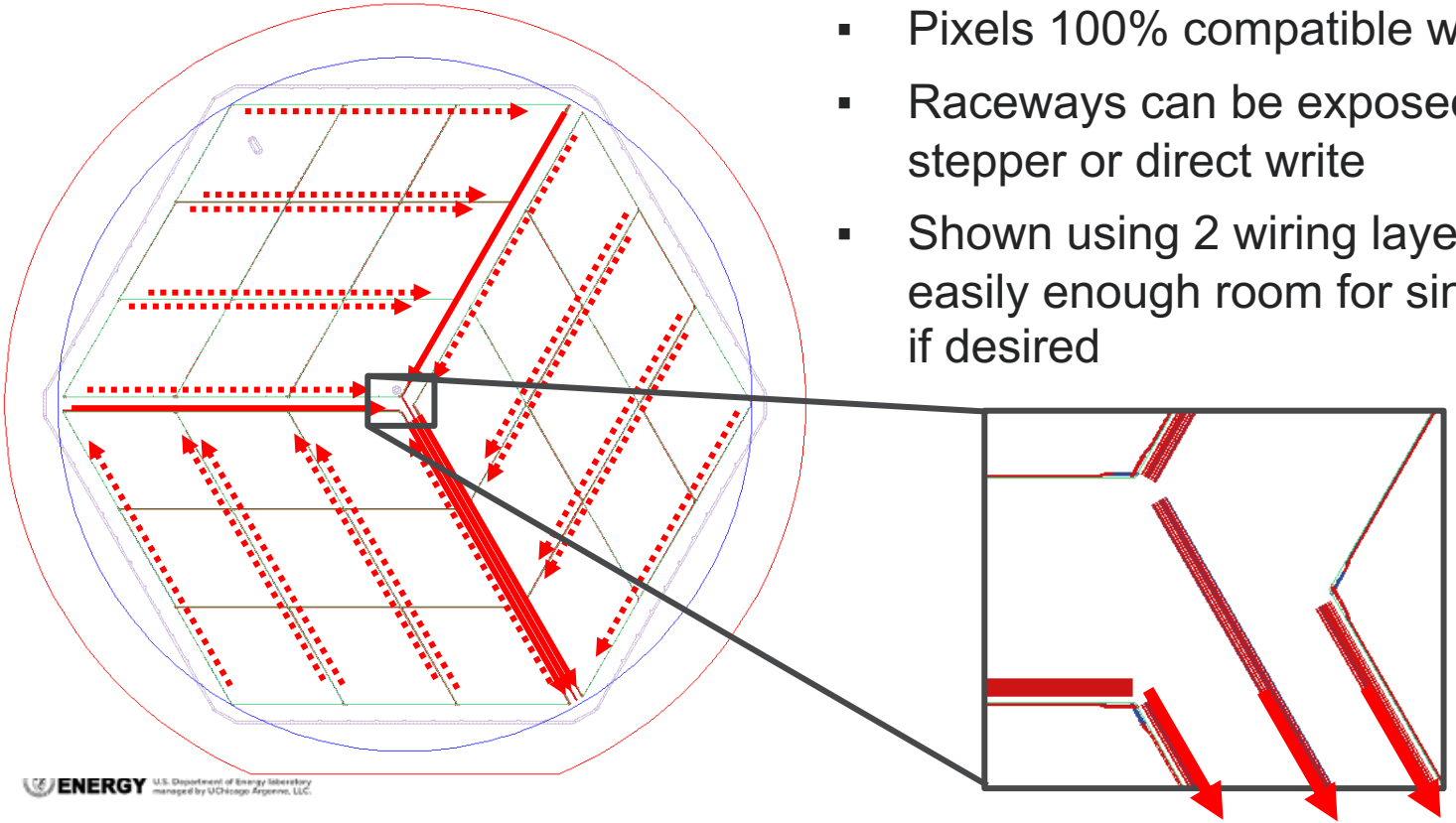
Simplest example: SAT LF 30/40 GHz



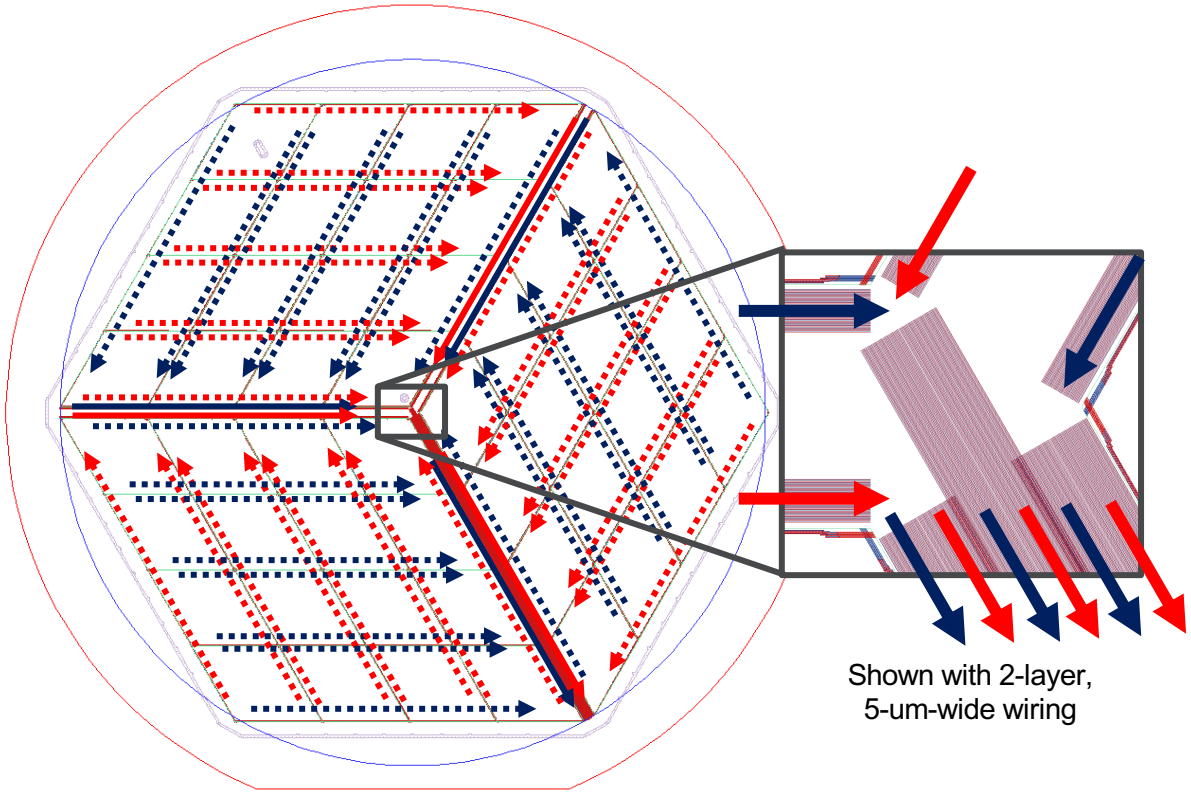
- 12 pixels per array, 48 TESs, dual-band
- Easily utilize raceways for all wiring
- Can easily group frequencies conveniently for interfacing with readout

LAT LF 20 GHz

- 27 pixels per array, 54 TESs, single-band
- Easily utilize raceways for all wiring
- ZERO crossovers required
- Pixels 100% compatible with stepper
- Raceways can be exposed either with stepper or direct write
- Shown using 2 wiring layers, but there is easily enough room for single layer wiring if desired



Trickiest example: LAT LF 27/39 GHz



Shown with 2-layer, 5-um-wide wiring

- 48 pixels per array, 192 TESs, dual-band
- ~2157-um-wide raceway gap
- For 2-layer, 5-um-wide wiring need 2304 um, therefore not wide enough for standard wiring
- For 2-layer, 4-um-wide wiring need 1920 um, so there is enough room for all bias lines
- Alternative wiring approaches could include
  - Route wiring somewhat inside pixel boundary
  - Wrap some wiring around outer edges
  - Implement microstrip-like wiring

Current status/thinking

Making progress w/ rhomboid layout

	Rhomb	HCP
Stepper pixel	Y	Y
Stepper wiring (lots of xovers)	Y	N
Stepper wiring (few xovers)	*N*	*N*
DW wiring (lots xovers)	*Y*	*Y*
DW wiring (few xovers)	Y	Y

Ideal, but doesn't seem possible

Possible, but not ideal

Looking into direct writing wiring to one side for –LF layouts.
Initial studies look okay.

FIN