
Houston Hall


Inn at Penn
(Walnut St side)


Inn at Penn
(Sansom St side)


(30th St Station)

CPAD 2025 at Penn

October 7th to 10th 2025
Tuesday to Friday

Inn at Penn
36th & Walnut St
Philadelphia PA 19104

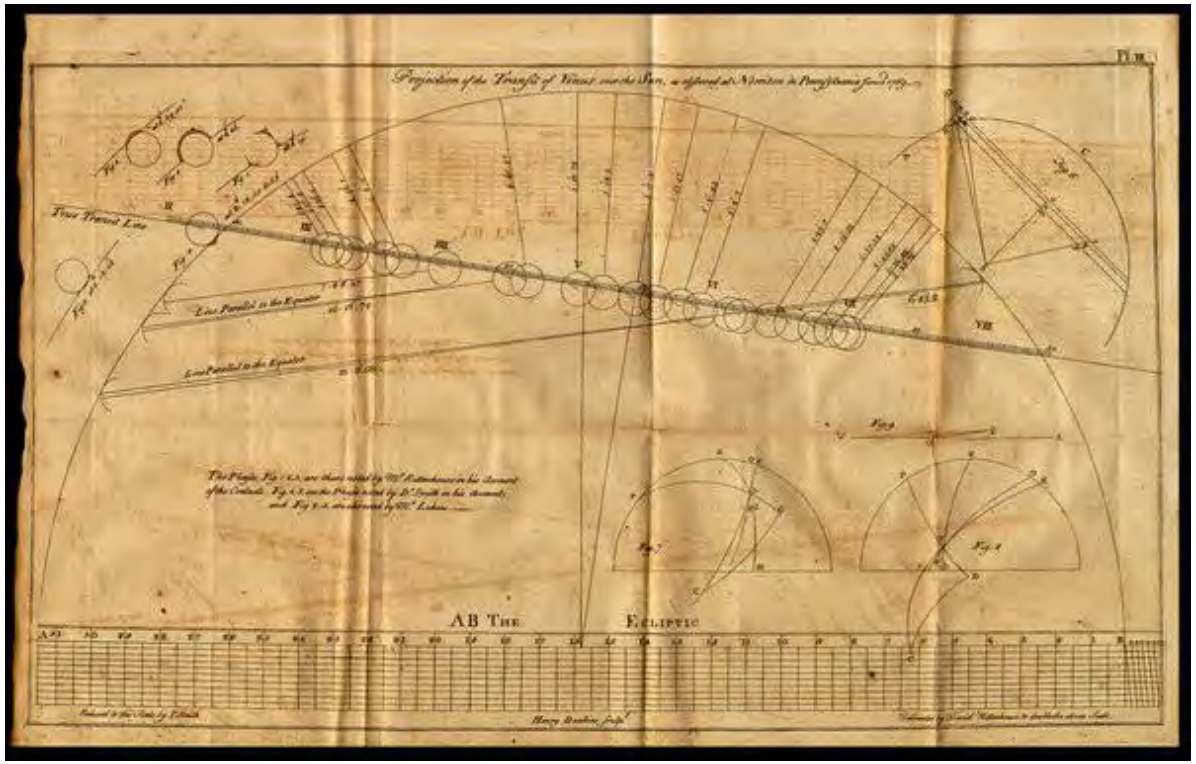

Ben Franklin Statue
College Hall

Ben Franklin

Electricity in 1752 with kite & key
+ and -, battery, pointed lightning rod
Founder of Penn
(Franklin Institute)

David Rittenhouse

Transit of Venus in 1769
Distance between the Sun & the Earth
Clockwork orrery (6th floor in Penn library)
(Penn Today)



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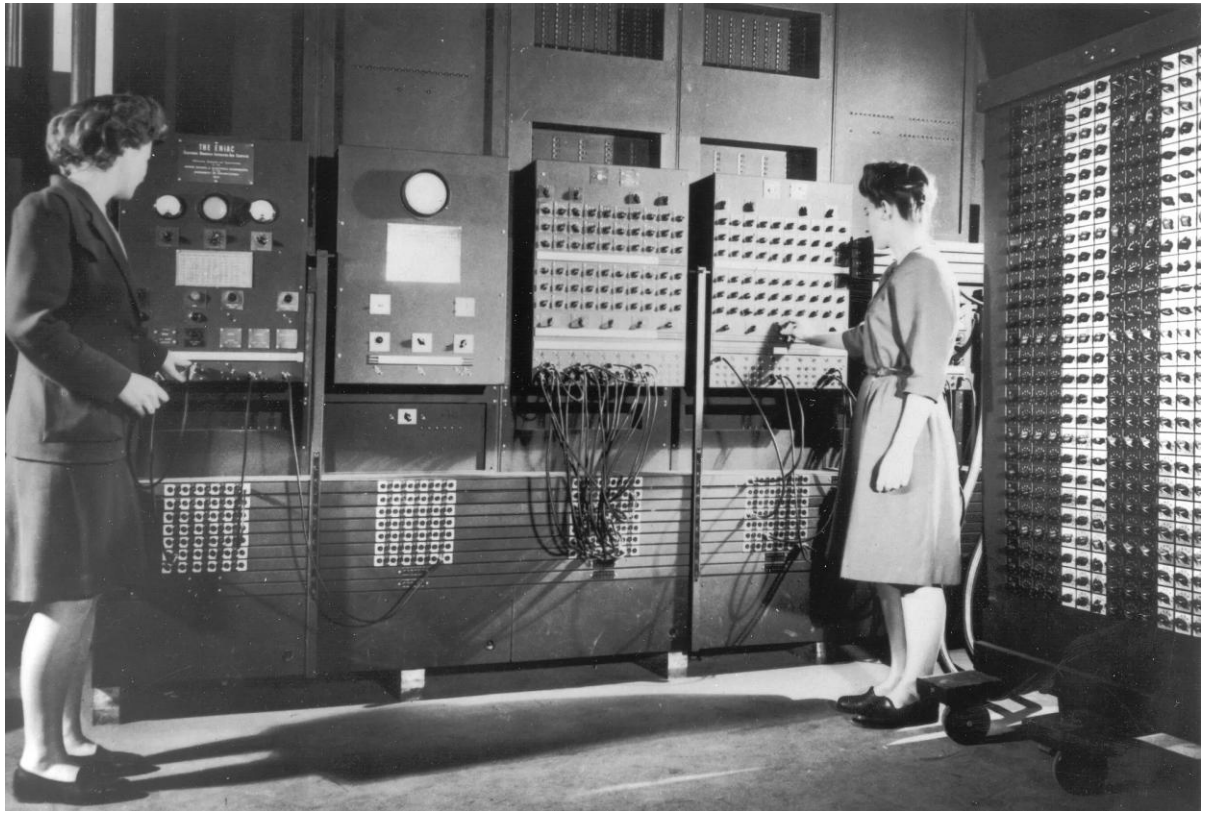
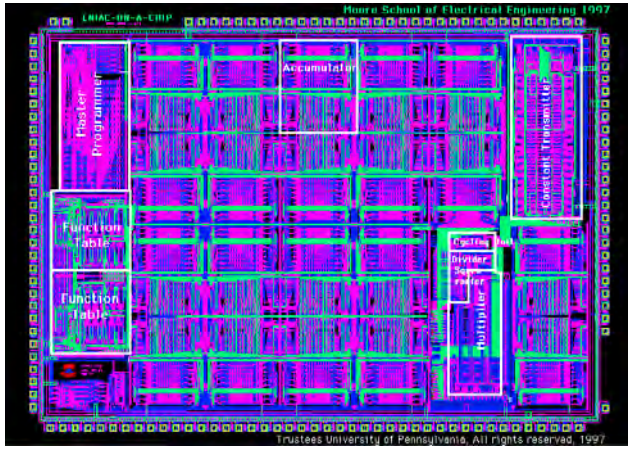
ENIAC

First electronic computer designed and constructed at Penn
Vacuum tubes (4 out of 40 panels in Moore Building)
Room size: 30 feet x 50 feet
6 women programmers
(About ENIAC)



ENIAC on a chip for 50th Anniversary
500 micron CMOS
Chip size: 7.44 mm x 5.29 mm
(Dept of Electrical Engineering)



Highlights from Penn HEP Instrumentation

See talk by Brig Williams
in Wednesday Plenary session

- Kamiokande II
- SNO
- SNO+, T2K, DUNE
- CDF Central Outer Tracker
- CDF Time of Flight
- ATLAS Transition Radiation Tracker
- ATLAS upgrade silicon strips ASICs
- R&D in progress includes Analog Photon Processor ASIC, Qpix ASIC, serial power, dichroicons, and more

R&D

It's important to support instrumentation groups at universities and national labs. Experience and expertise matter. They are the catalyst for these amazing detectors we build and the experiments we conduct to test our understanding of the universe.

Universities provide key connections to Engineering schools and to students, especially MSEEs

Kamiokande II

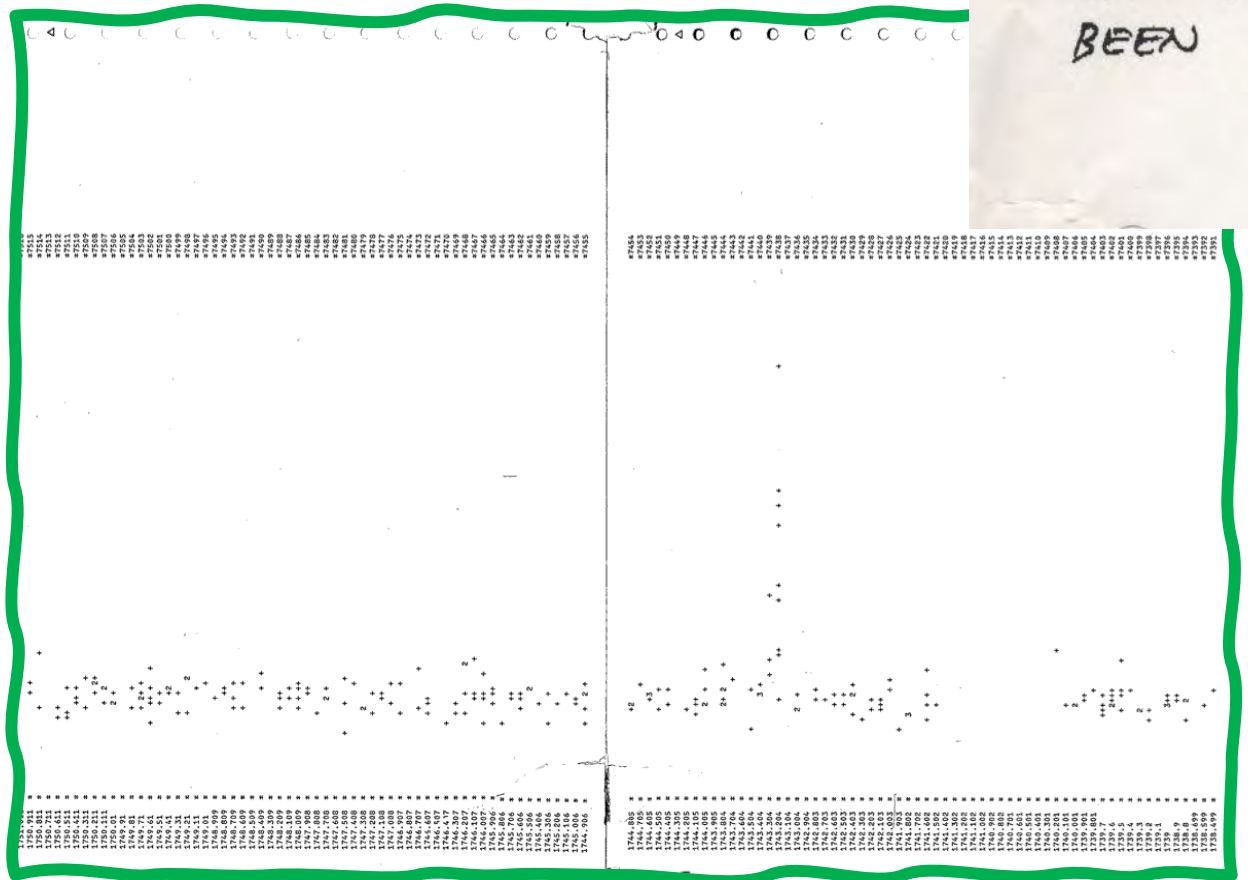
Neutrino burst from SN 1987A
([Kamioka Observatory])

UNIV OF PENN - DEPT OF PHYSICS P.01

TO: EUGENE BEIER

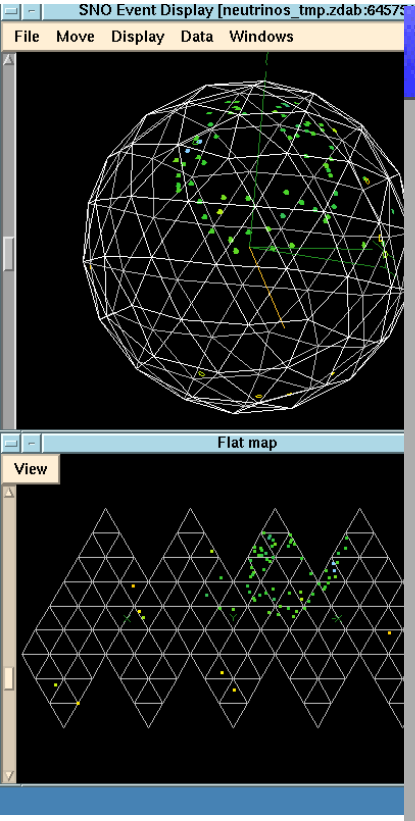
SENSATIONAL NEWS! SUPERNOVA WENT OFF 4-7 DAYS AGO IN LARGE MAGELLENIC CLOUD, 50 KPC AWAY. NOW VISIBLE MAGNITUDE 4N5, WILL REACH MAXIMUM MAGNITUDE (-1N0) IN A WEEK. CAN YOU SEE IT? THIS IS WHAT WE HAVE BEEN WAITING 350 YEARS FOR!

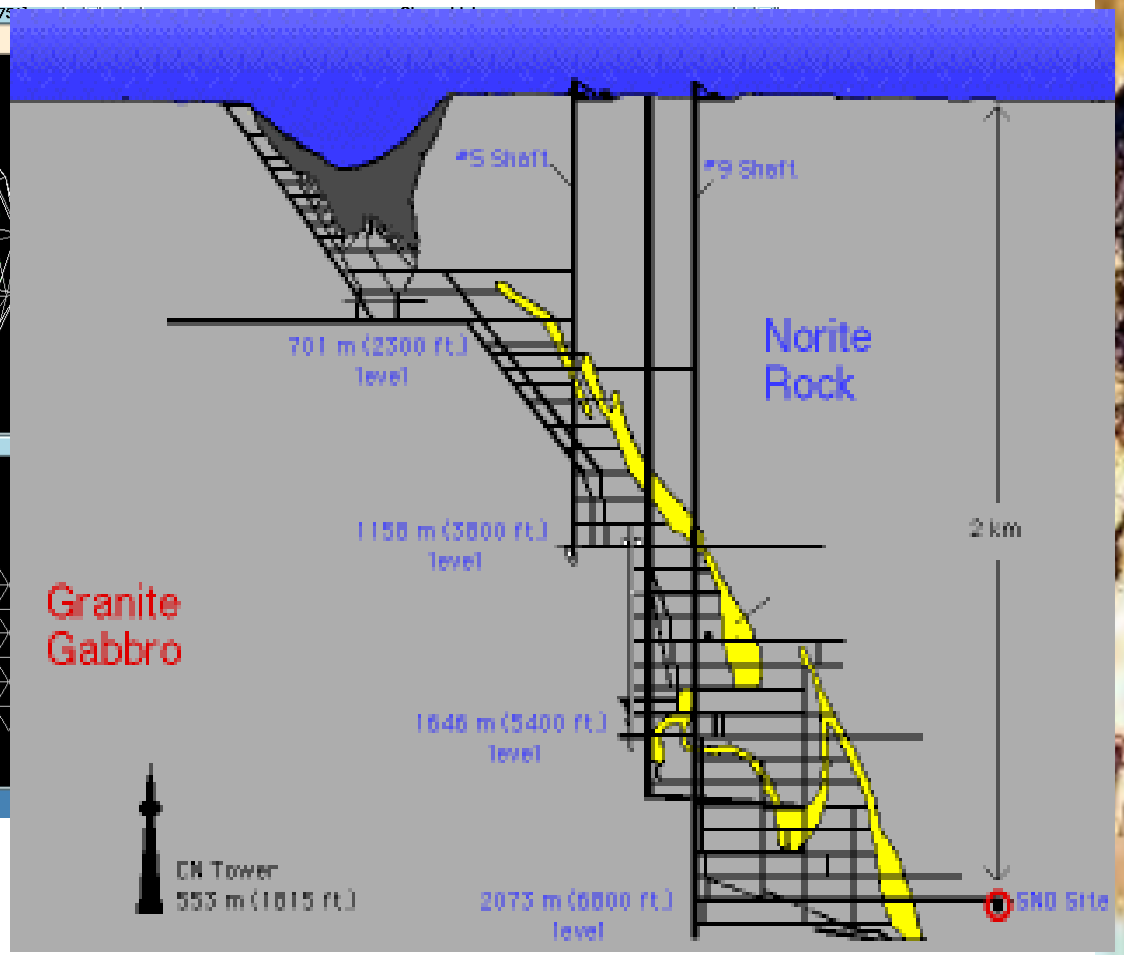
SID BLUDMAN



SNO

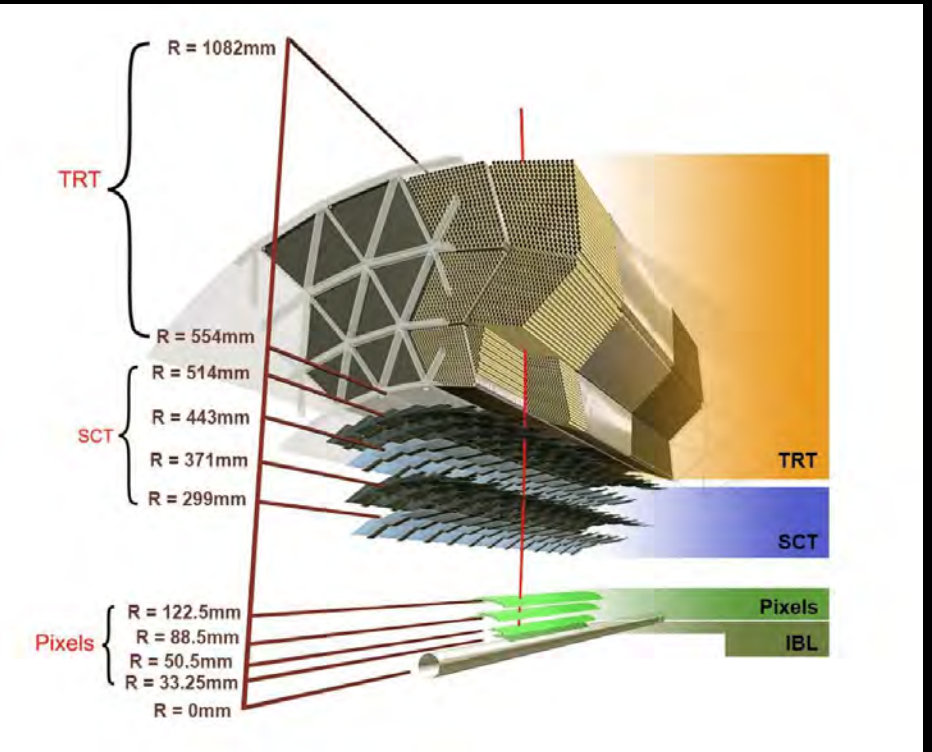
Solving the mystery of the missing solar neutrinos
From Ray Davis at Homestake to SNO at Sudbury

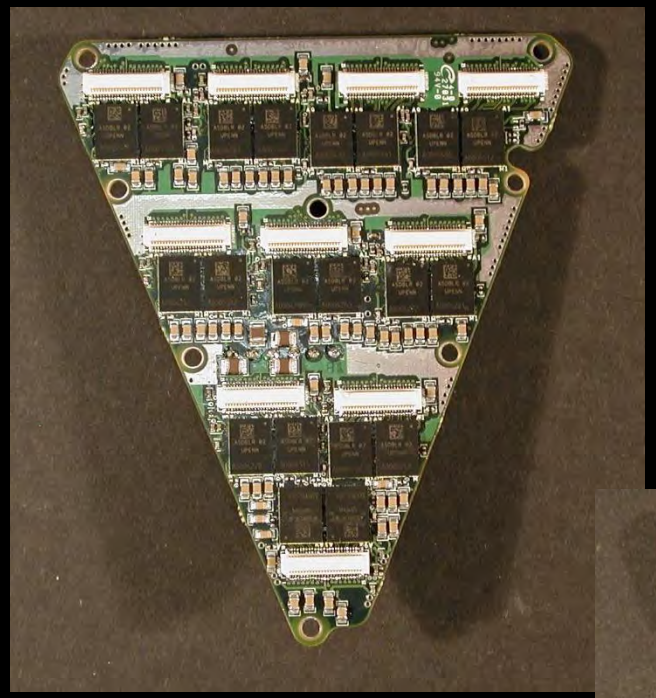


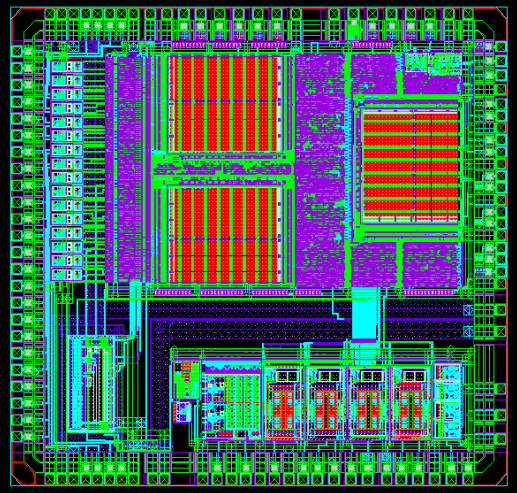


ATLAS Transition Radiation Tracker (2008-2026)

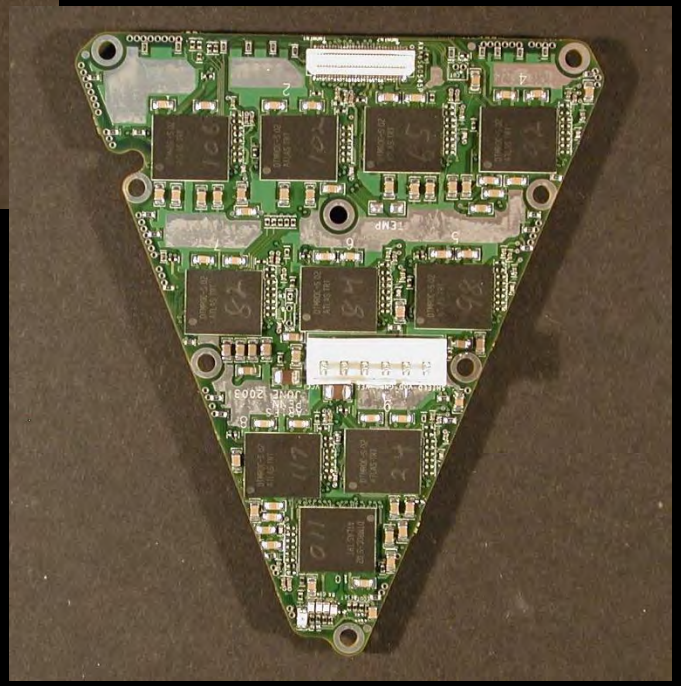
Over 300,000 readout channels
Straw radius 2 mm, gas Xenon/CO_2
Measure position < 130 microns
Ternary readout
Low threshold for tracking
High threshold for transition radiation







Double-sided Electronics!
Analog signal femtoCoulombs
(Amplifier/shaper/discriminator/baseline)
and on other side
Digital electronics
(record every 3.125 ns)



ATLAS Upgrade Inner Tracker Silicon Strips

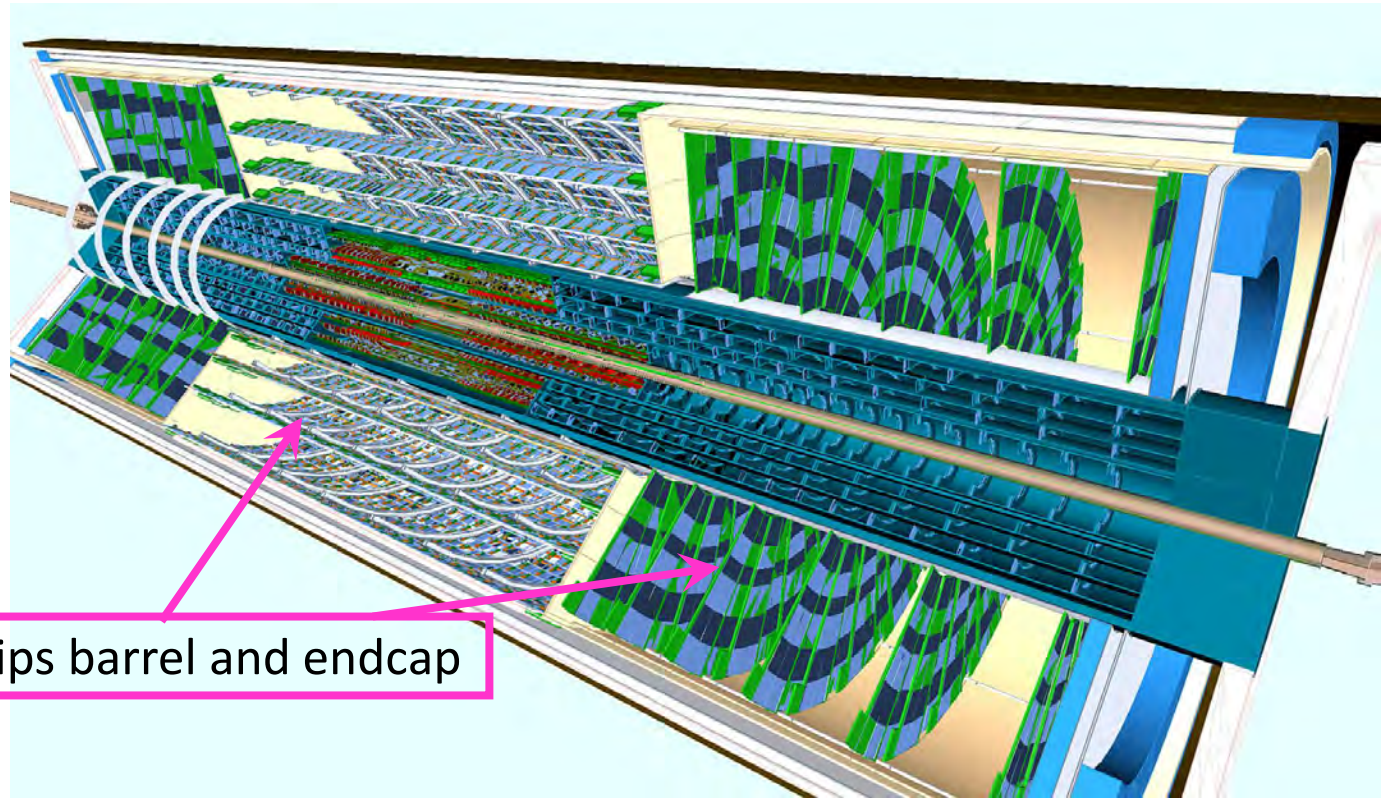
Penn led design of 2 of 3 ASICs for readout electronics of new silicon strip tracker in much harsher radiation environment (60 Mrad)

76 micron pitch, 2.4 or 4.8 cm long in barrel

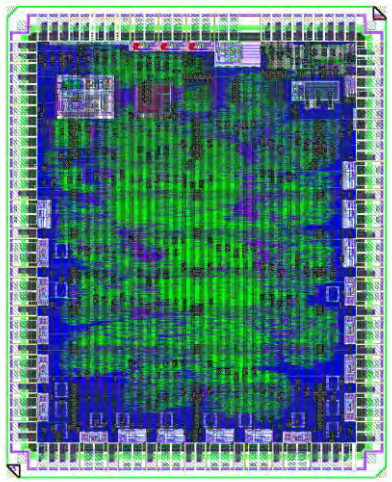
Position resolution below 20 microns

60 million channels, occupancy below 1%

165 square meters of silicon strips

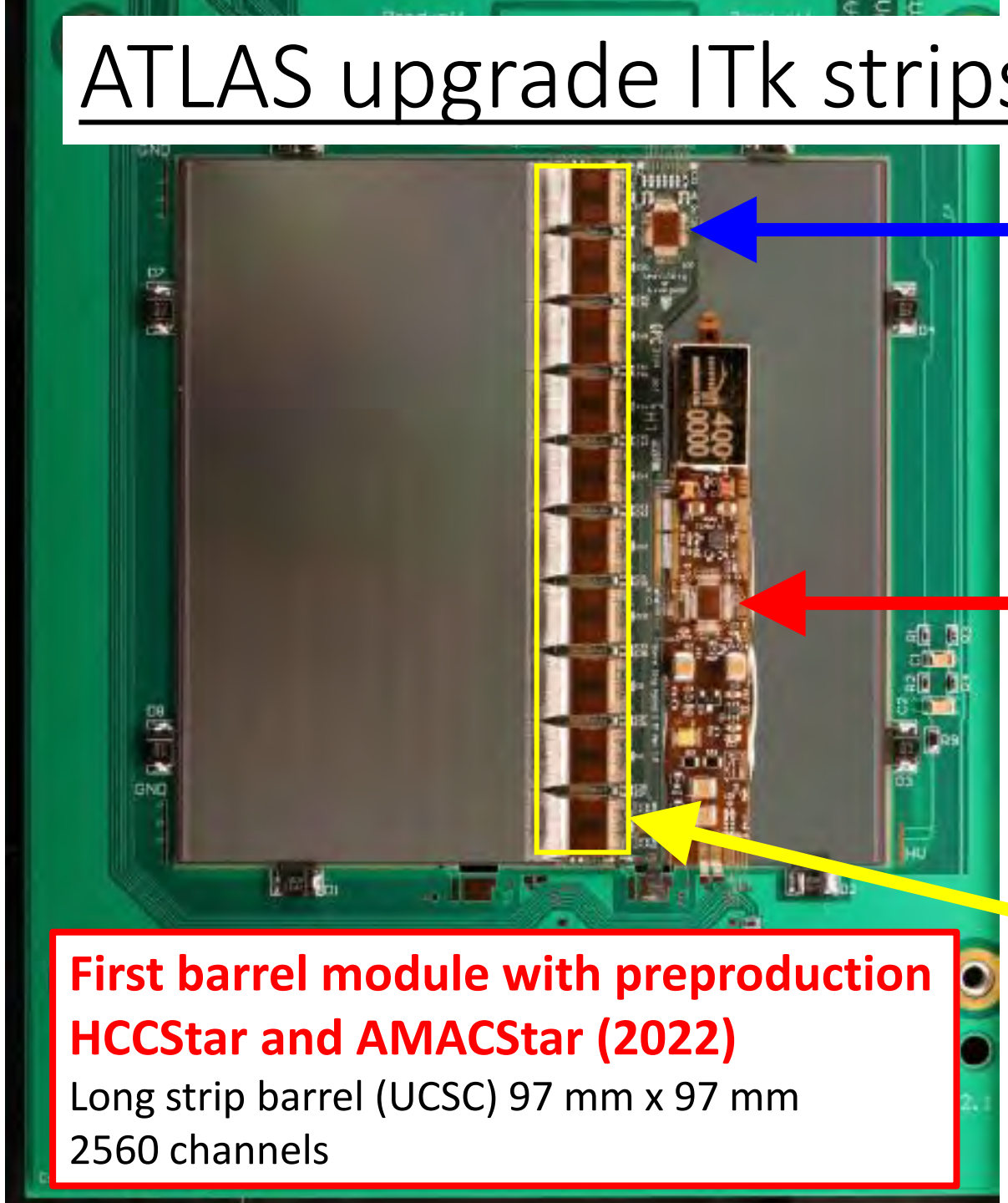


HCCStar



AMACStar

ATLAS upgrade ITk strips readout electronics



First barrel module with preproduction HCCStar and AMACStar (2022)

Long strip barrel (UCSC) 97 mm x 97 mm
2560 channels

HCCStar (Hybrid Control Chip)

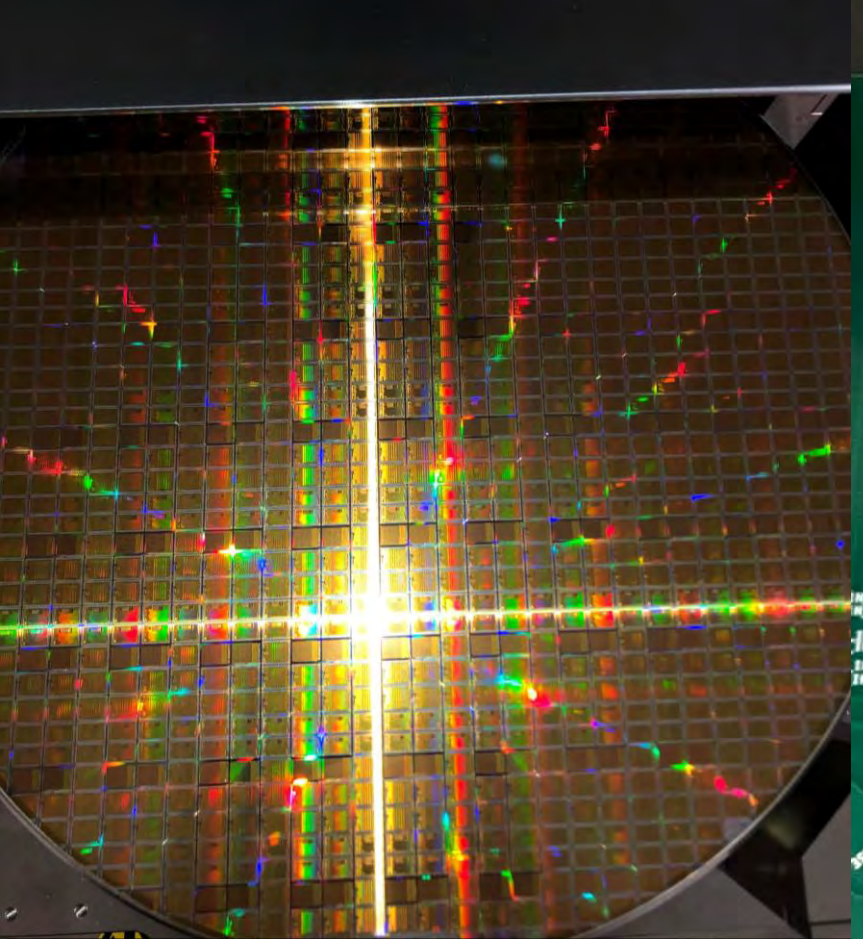
- **Star layout has direct connection to each ABCStar**
- Builds events from 10 ABCStars in barrel, up to 11 ABCStars in endcap
- Receives clock and control signals (TTC) & sends to ABCStars
- Sends events to EoS at 640 Mbps

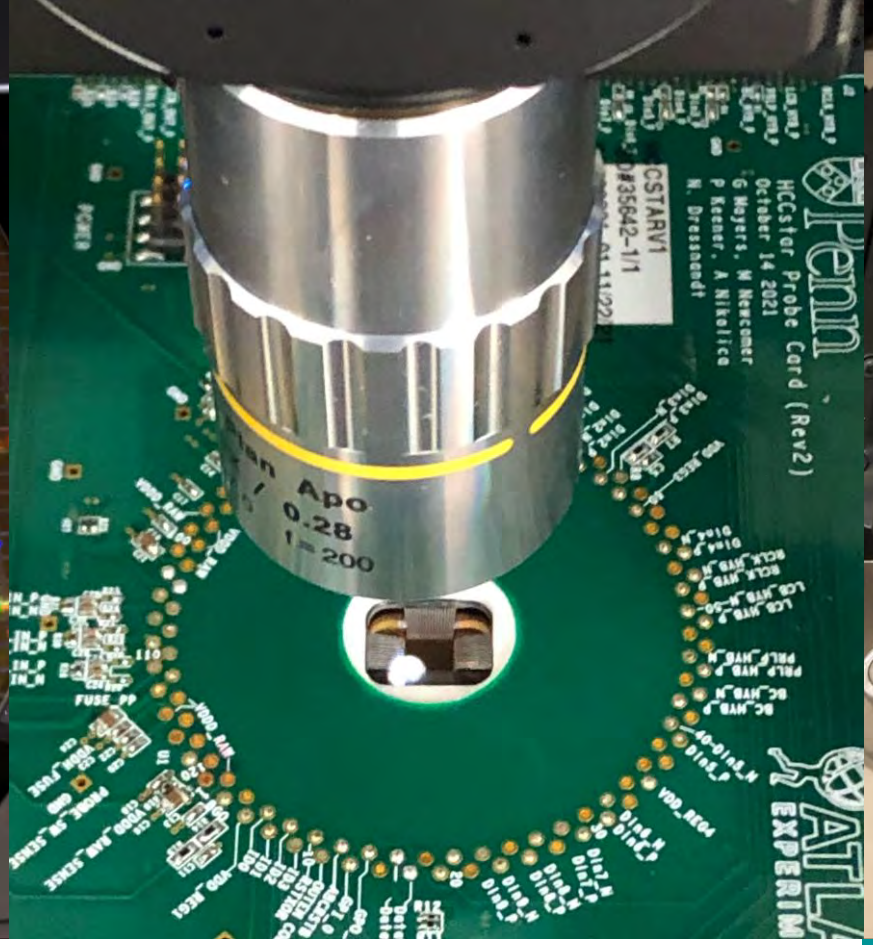
AMACStar (Autonomous Monitor & Control)

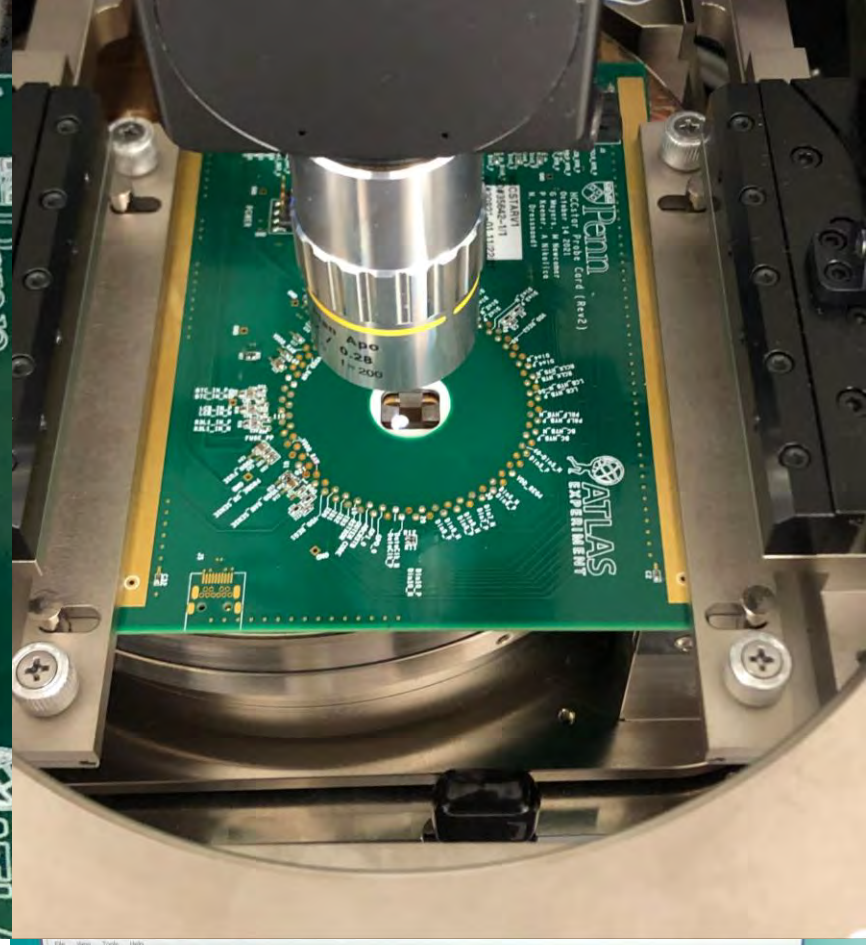
- On densely-packed integrated powerboard
- Autonomous: only power required to work
- Precision voltage and current monitoring over wide range (10 nA to 10 mA)
- Control of other ICs: ABCStar, HCCStar, HV-mux, bPOL12V

ABCStars (ATLAS Binary Chip)

- Wire-bonded to 256 channels, with amplifier, shaper, discriminator
- Finds clusters, 160 Mbps output to HCCStar (max 4 clusters/packet = 68 bits)

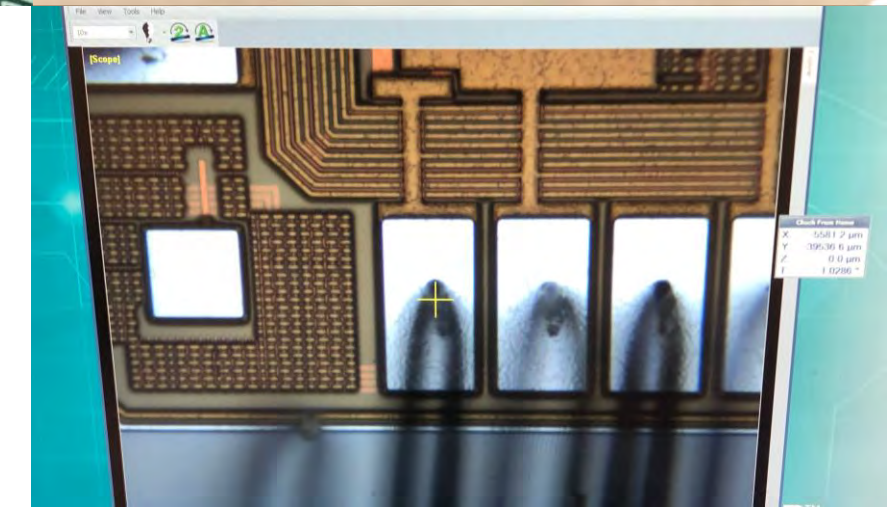






Wafer probing at Penn

86 total wafers
Over 40,000 ASICs of two types
Yield over 90%



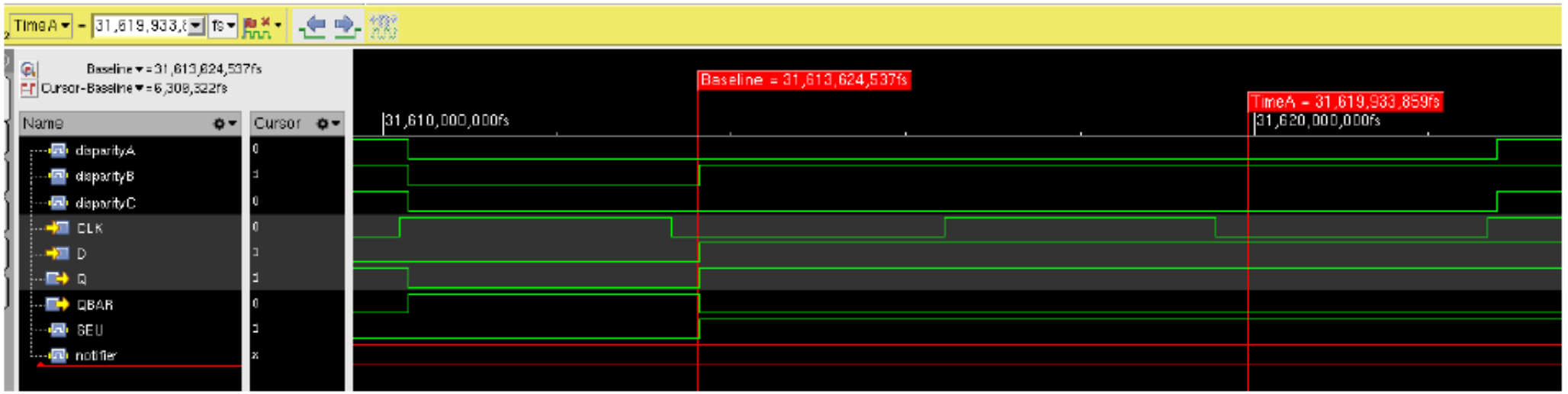
ASIC design verification

Extensive simulation & verification with Python-based testbench used to verify actual HCCStar and AMACStar designs (cocotb)

- Single chip, hybrid, and module all simulated
- Hundreds of tests to verify design, continuous integration to verify updates to design
- Randomized 1 MHz triggers for highest-occupancy module for realistic simulations
- Simulation target of 25 million SEEs (~100 per logic/wire) well exceeded

Pioneering technique developed at Penn for SEE tests, potentially very useful to verify other ASIC designs

- Triplicated signals should be updated by majority voter 1 clock after SEE
- Automatic check that all 3 copies of signal agree after 1 clock cycle to detect voting errors
- Helped catch problems without waiting for top-level observables to change



Highlights from Penn HEP Instrumentation

- R&D in progress includes Analog Photon Processor ASIC, Qpix ASIC, serial power, dichroicons, and more

NSF-DOE Vera C. Rubin Observatory

Penn, Harvard, BNL, France
"Noise 8 equivalent electrons instead of 22"

R&D

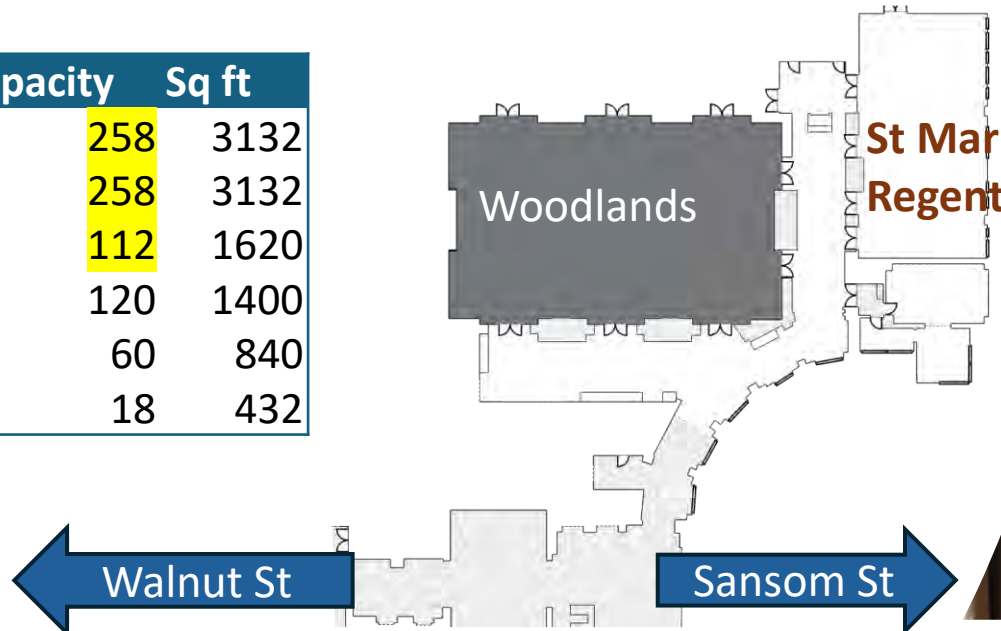
It's important to support instrumentation groups at universities and national labs. Experience and expertise matter. They are the catalyst for these amazing detectors we build and the experiments we conduct to test our understanding of the universe.

Universities provide key connections to Engineering schools and to students, especially MSEEs

CPAD 2025 Schedule at a glance

Day/Room	Woodlands AB	Woodlands CD	St Marks	Regent
Tues 9am	Plenary			
Tues 11am	Plenary			
Tues 2pm	RDC 8	RDC 1	RDC 3&4	RDC 9
Tues 4:30pm	RDC 8	RDC 1	RDC 4	RDC 9
Wed 8:30am	Plenary			
Wed 11am	RDC 8	RDC 6	RDC 3	RDC 9
Wed 2pm	RDC 7	RDC 6	RDC 3&4&11	RDC 2
Wed 4:30pm	RDC 8	RDC 7	RDC 3&4&11	RDC 2
Thurs 9am	Plenary			
Thurs 11am	RDC 1&2&7	RDC 4	RDC 3	RDC 6
Thurs 2pm	RDC 7&8	RDC 2	RDC 4&5	RDC 10
Thurs 4:30pm	RDC 8	Cross-cutting topics		RDC 4 in McNeil 150
Fri 9am	Plenary			
Fri 11am	Plenary			

Session	Room	Capacity	Sq ft
Plenary	Woodlands AB	258	3132
Breakout 1	Woodlands AB	258	3132
Breakout 2	Woodlands CD	112	1620
Breakout 3	St Marks	120	1400
Breakout 4	Regent	60	840
Small	Chancellor	18	432



Useful info CPAD 2025 website

- Coffee/Tea/Snacks
  - 10:30am
  - 4:00pm
- Reception (snacks)
  - Tuesday evening
  - 1 drink ticket with your name-badge
- Poster session (snacks)
  - Wednesday evening
  - Talk with poster presenters for drink tickets
- Banquet (capped at 120 guests)
  - Thursday evening
- Pedestrian safety
  - Please look out for electric bikes and scooters when crossing the street
- Registration fee receipt
  - This will be sent to your email
- Lunch – many places nearby for 90 minute lunch break

Local Organizing Committee

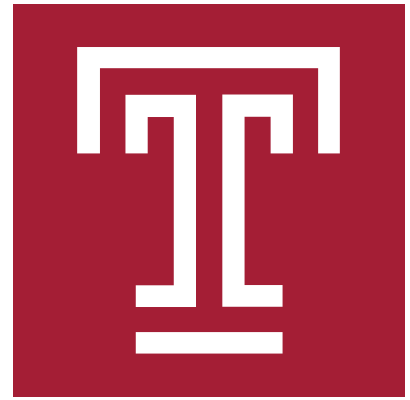
Penn: Evelyn Thomson (chair), Joe Kroll, Mitch Newcomer, Ari McManus, Mike Reilly

Drexel: Naoko Kurahashi Neilson, Russell Neilson, Michelle Dolinski

Temple: Bernd Surrow

Thank you to Penn Department of Physics & Astronomy and US DoE for support

Thank you to Drexel University for support of poster session



Welcome to CPAD 2025 at Penn in Philadelphia

Photo credit: We Film Philly

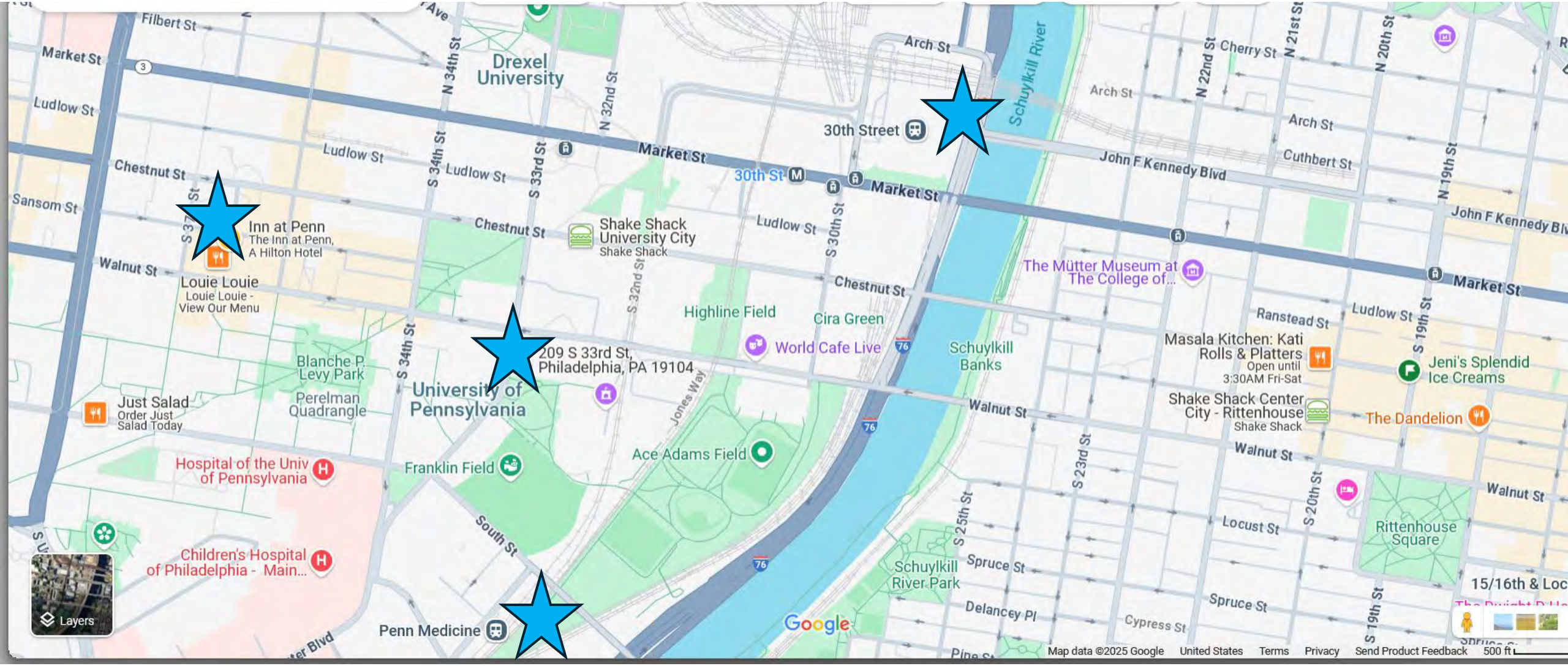
Welcome to CPAD 2025 at Penn in Philadelphia

Library

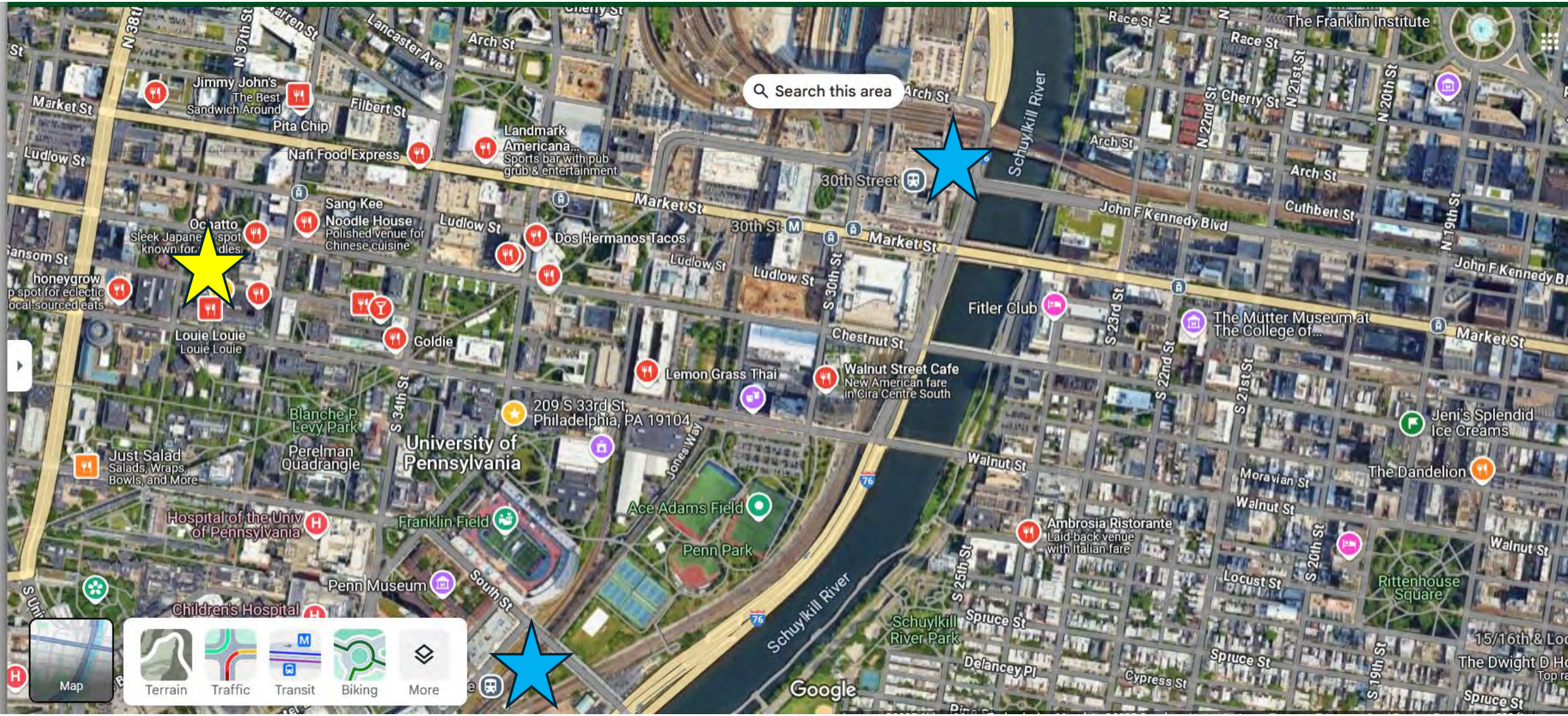
Walnut Street

Inn at Penn

University City Philadelphia



University City Philadelphia



South Street Bridge