NP SBIR and Microelectronics

Streaming Readout Workshop XIV

September 29–October 1, 2026

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DOE Office of Science • Office of Nuclear Physics



U.S. DEPARTMENT of ENERGY | Office of Science

science.osti.gov/np

DOE SBIR/STTR Program

SBIR: Small Business Innovation Research STTR: Small Business Technology TRansfer

- **SBIR**: Established in 1982 as a set-aside program for U.S. small businesses (SB) to engage in Federal Research and Development (R&D) with potential for commercialization. FY 2026 set aside: 3.20%
- **STTR**: Established in 1992 as a set-aside program to facilitate cooperative R&D between SB and U.S. Research Institutions (RI) such as universities with potential for commercialization. FY 2026 set aside: 0.45%
- Congressionally-mandated programs, funded by a small percentage of the extramural R&D budget set aside within each DOE technical program that participates.
  - For NP, funding comes from the Research Division PM's budgets
  - This motivates the creation of the solicitation topics and the recommendations for awards
- Effective April 13, 2026, SBIR/STTR was reauthorized through September 30, 2031.
- DOE-wide program administration was managed by the Office of Science and is now managed by the Office of Technology Commercialization.

DOE Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) | Department of Energy.

DOE SBIR/STTR Phases

PHASE I: FEASIBILITY, PROOF OF CONCEPT
- Award Amount: Up to $250,000
- Project Duration: Up to 12 months



PHASE II: CONTINUE R/R&D FOR PROTOTYPES OR PROCESSES
- Award Amount: up to $2,000,000
- Project Duration: Up to 2 years



SEQUENTIAL PHASE II.2: CONTINUE R/R&D FOR PROTOTYPES OR PROCESSES
- Business may receive multiple sequential Phase II awards to continue developing promising products
- Award Amount: up to $2,000,000
- Project Duration: Up to 2 years

PHASE III: COMMERCIALIZATION
- Federal or Private Funding (non-SBIR/STTR funds)
- No dollar or time limits



Nuclear Physics Mission

Discovering, exploring, and understanding all forms of nuclear matter

The Scientific Challenges

- The existence and properties of nuclear matter under extreme conditions, including that which existed at the beginning of the universe
- The exotic and excited bound states of quarks and gluons, including new tests of the Standard Model
- The ultimate limits of existence of bound systems of protons and neutrons
- Nuclear processes that power stars and supernovae, and synthesize the elements
- The nature and fundamental properties of neutrons and the neutrino and their role in the evolution of the early universe

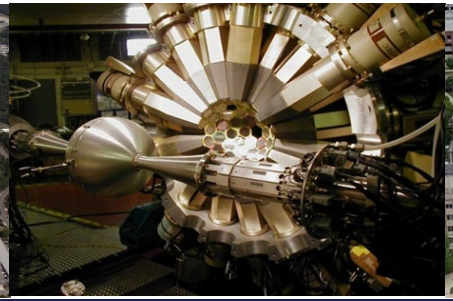
RHIC



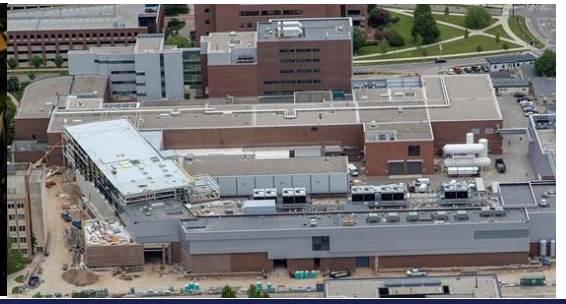
CEBAF



ATLAS



FRIB



How the NP Mission translates into subprograms

- NP's subprogram areas are:
  - Experimental QCD
  - Nuclear Structure-Nuclear Astrophysics
  - Fundamental Symmetries
  - Nuclear Theory
  -

Experimental QCD, Nuclear Structure-Nuclear Astrophysics → Heavy Ion Nuclear Physics

Nuclear Structure-Nuclear Astrophysics → Medium Energy Nuclear Physics

Fundamental Symmetries, Nuclear Theory → Low Energy Nuclear Physics

- Accelerator Science and Technology is a major component that facilitates many of the NP subprograms.
- Within the subprogram areas are two other subprograms, Nuclear Physics Computing and Nuclear Data, with communities we seek to serve.
- Funding also comes from Office of Science Crosscutting Initiatives: Quantum Information Science (QIS), Artificial Intelligence (AI), and Microelectronics.

NP SBIR/STTR awards support these programs

- Every year there is topic revision, based on community input.
- NP Program Managers are also given the opportunity to provide input or edit topics.
- Requests are for perceived needs 5-7 years in the future.
- Providing hardware and methods to advance initiatives recommended in the Long Range Plan for Nuclear Science are also important.

SBIR/STTR commercialization strategy

Community need
5–7 years ahead

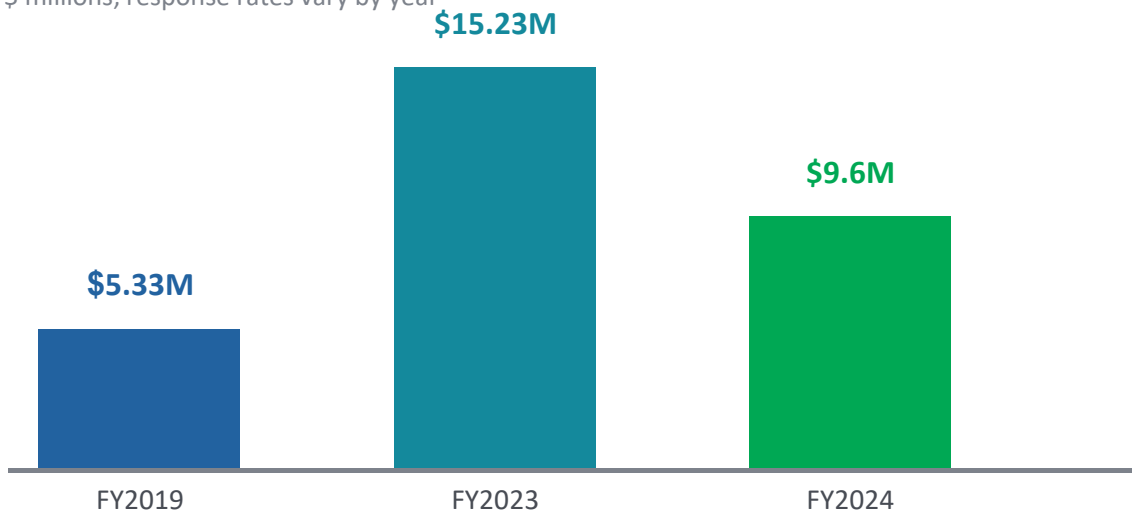
Phase I
Design/proof of concept

Phase II
Prototype/test

Phase III
adoption

NP annual survey of Phase III sales for select years

$ millions; response rates vary by year



What the surveys indicate

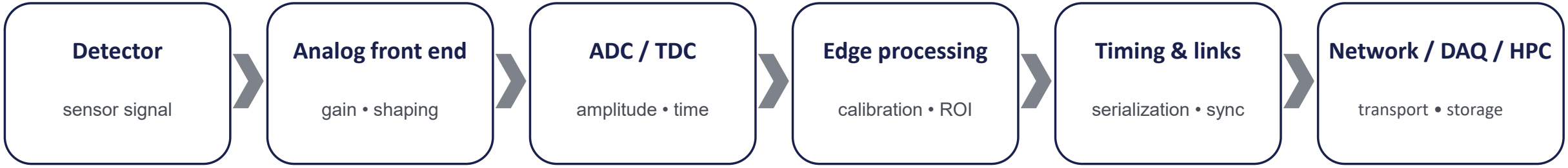
- Electronics and instrumentation tend to dominate reported sales.
- Most companies report product sales five or more years after Phase II begins.
- Adoption, integration, distribution, and support are part of the commercialization plan.

Commercialization is part of the overall strategy—not an afterthought.

Sales are voluntary self-reports to a NP annual request.

NP's SBIR/STTR program's supported R&D that's provided *in toto* end-to-end instrumentation solutions

Consider a generic detector to storage flowchart



- Here are several NP SBIR/STTR funded companies that illustrate how NP supports elements of this chain

ALPHACORE — custom silicon ADCs & video ROICs: front end rad hard → high-speed serial

NALU — waveform SoCs: sensor integration → GbE modules

SKUTEK — digitizers + timing + end-to-end networked DAQ

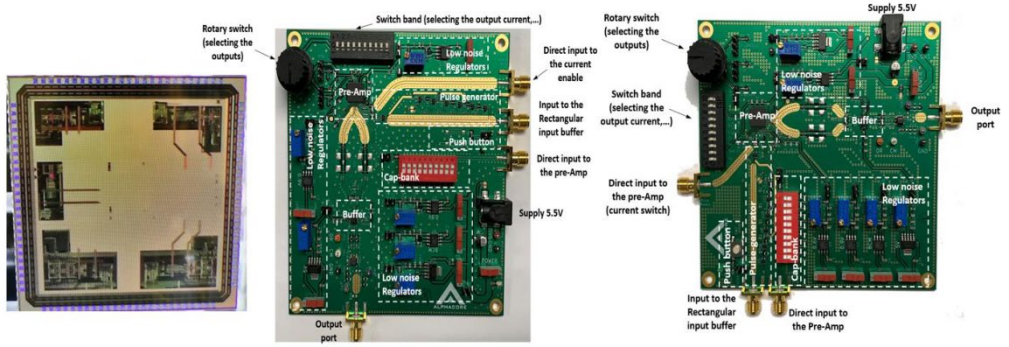
Alphacore: reusable IP blocks and ICs to build customer-ready ASICs

Build a library once; configure many detector readout ASICs.

- DOE NP/HEP programs funded creation of versatile detector-readout IP blocks and ICs: preamplifiers, ADCs, serializer and PLL blocks.
- Silicon-evaluated blocks let Alphacore configure compact, application-specific readout ASICs without restarting from zero.
- Provides packaged chips, bare die, test boards, and evaluation boards.

Program R&D → **Silicon-evaluated IP** → **Boards & chips** → **Customer-specific ASIC**

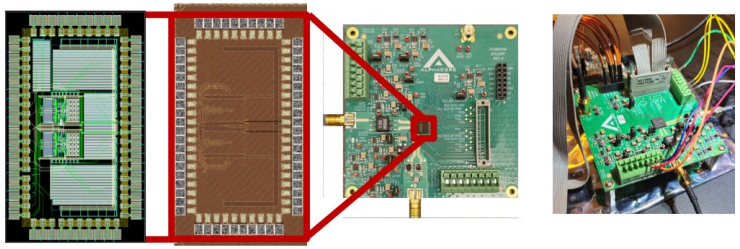
CSA evaluation boards and/or packaged chips are available for customers. 16-ch preamplifiers are available as bare die.



Die micrograph | CSA evaluation board 1 | CSA evaluation board 2

Charge-sensitive amplifier die and evaluation boards

The Versatile Readout ASIC (VERA)

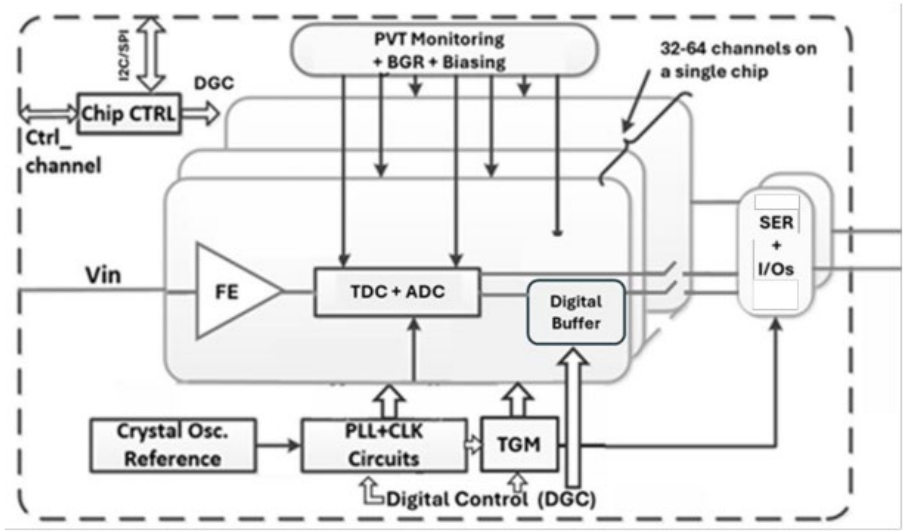


ADC Test Chip 1 Layout and Micrograph | ADC Test Chip 1 Test Board and Setup

VERA Phase I ADC test chip and test setup

Sources: Alphacore SRO VIII (2021), slides. 3–5, 12, 17; Alphacore SRO XIII (2025), slide. 5.

Alphacore: dense conversion, precise time, serial output



VERA block diagram (public SBIR-data-rights slide)

VERA — Phase II status, December 2025

64 channels • 14-bit, 250 MSPS ADC in every channel

<1 ps time-stamping TDC • high-speed serial I/O

On-chip processing and buffering • <10 mW/channel

Radiation hardness >10 Mrad(Si) • TSMC 28 nm

10.2 ENOB

14-bit, 250 MS/s test chip
7.3 mW

4 GS/s

VERA-B: 16–32 ch, 12 bit
100 MS/s–4 GS/s

SRO relevance: put conversion, timing, buffering, and the link in the same radiation-tolerant platform.

Source: Alphacore SRO XIII (2025), slides 4–8..

Nalu Scientific: DOE-funded SoCs became COTS



DSA C10-8+ compact 8-channel, 10 GSa/s module

5
Phase I/II SBIRs transitioned

COTS
Microchip via CAEN

3
U.S. patents issued

>$3M
Non-SBIR sales reported as of 2024*

Commercialization record reported in August 2024

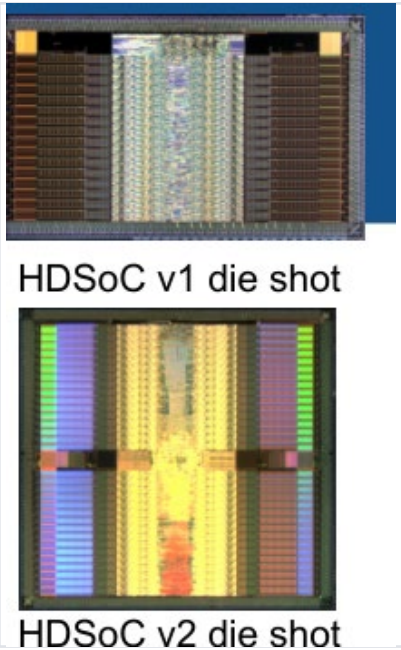
- Vertically integrated: ASIC → PCB → FPGA/CPU → firmware/software → product support.
- DSA C10-8+: 8 channels, 10 GSa/s, built-in amplifier, USB/UART and Gb Ethernet (UDP); offered through CAEN.
- The same core technology supports custom sensor integration and experiment-specific readout systems.

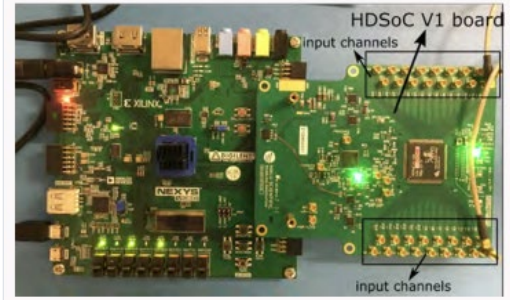
Waveform SoC → **Evaluation board** → **Firmware + software** → **COTS / custom system**

Sources: Nalu DOE NP Exchange (2024), Slides. 3–4; Nalu SRO XI (2023), slide. 19. *Sales figure is company-reported as of Aug. 2024. Not all sales to NP funded communities).

Nalu: intelligence at the detector edge

Move data reduction to the front end.



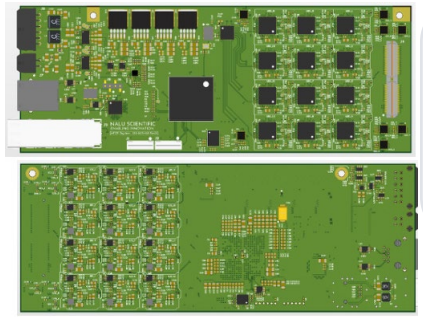


HDSoC die revisions and Ethernet-connected evaluation setup

HDSoC specs

32/64 ch	1–2 GS/s	12 bit	80–120 ps
high density	waveform sampling	digitization	timing target

- Self-trigger plus region-of-interest digitization and zero suppression per channel.
- Window-level control keeps sampling while previous events are processed.
- On-chip TIA and feature extraction; pipelined serial trigger/data streams.
- Eval boards + NaluScope + 1 GbE complete the DAQ.



Reusable backend architecture supported ALERT ATOF (ran at CEBAF in 2025)and other NP/EIC concepts.

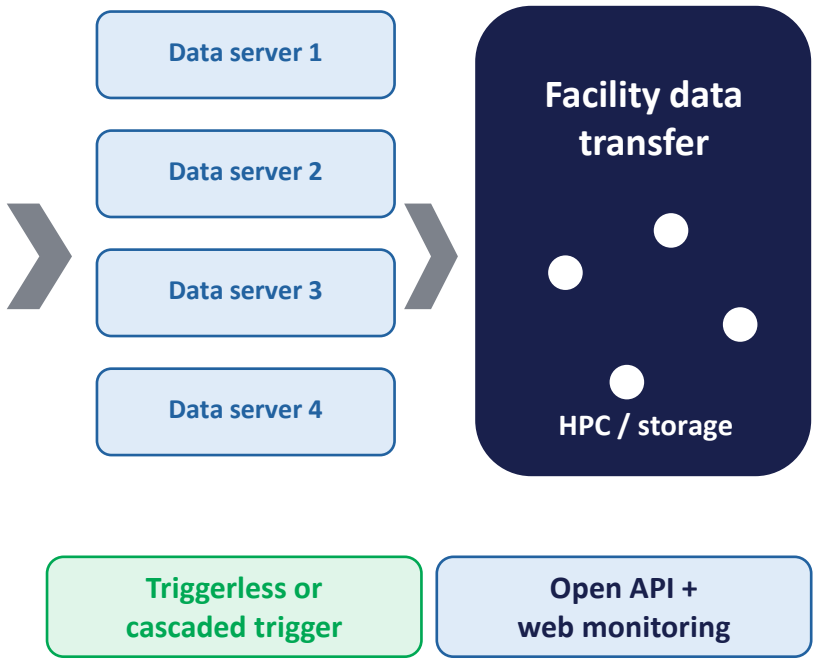
Sources: Nalu SRO XI (2023), Slides. 7–8, 17, 20; Nalu DOE NP Exchange (2024), Slides. 16–20, 37.

SkuTek: commercializing the detector-to-HPC path

Productize not only the digitizer, but the output system.



32-channel self-triggered digitizer



- Scalable from 16/32 channels to thousands.
- LUX-ZEPLIN DAQ sited at 1,359 channels.
- Triggerless operation or cascaded Trigger Master logic.
- Digitizers, collection computers, stream software, open control API, and web monitoring.
- End-to-end solution developed under NP award.

Detector → digitizer → data servers → facility network / HPC

Source: SkuTek Instrumentation TWG presentation (2026), Slides. 2–8.

SkuTek: networking and synchronization are products



Solidago UDP Cannon and browser-based control

1 / 10 GbE
per digitizer

0–160 Gbps
programmable stream

512 ch
16 digitizers

~100 ps
channel timing

- Realistic event structure and timing; GRETA packet formats.
- Streams can be synchronized or independent; patterns are programmable and randomized.
- Web interface and REST API reduce software tuning during network development.
- White Rabbit support was implemented in response to the FRIB community.

Networking can be stressed before the detector hardware is ready.

Source: SkuTek Instrumentation TWG presentation (2026), pp. 5–9 and 13–14.

Summary and Outlook

- NP used its SBIR/STTR Program to provide its research communities solutions to mid-term microelectronics needs
- This is done by strategically using SBIR/STTR funds to de-risk US-developed microelectronics technologies
- NP's process is to define the need 5–7 years ahead → test early by requiring a prototype at award's end → spurs commercial adoption → annually feed experience back into topics.
- Adoption also happens through increased visibility → NP has an annual PI Exchange Meetings to bring Ph II awardees, DOE and other agency representatives, and those communities together https://science.osti.gov/np/Benefits-of-NP/SBIR-STTR#meetings
  - Visibility also occurs by active company participation at workshops and conferences like this one
- NP continues investment in streaming readout through this SBIR/STTR – download spreadsheets at SBIR Awards | U.S. DOE Office of Science (SC) and choose NP has the funding Office to learn more
- The FY26 Phase I and Phase II solicitations will be announced in the coming months. Check the Office of Technology Commercialization SBIR/STTR website to look for announcements DOE Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) | Department of Energy