Japanese Contributions to Fermi(GLAST) Gamma-ray Space Telescope

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Brief History of Japanese Participation

* W.B. Atwood presented " Gamma-ray Large Area Silicon Telescope" at The 1st HSTD symposium (1993)
* At that stage, UCSC and J-SSD group were deeply involved in the SSC-SDC project to develop a SSD for the central tracking detector.
* At 1994 SSC project was canceled.
* Continue R&D of SSD for CDF-II and LHC (HPK kindly continued to collaborate with us: 1994 – 1999)
* 1996, T. Kamae and myself got into SSD R&D of GLAST
* 1998: T. Kamae and myself formed Japanese group to propose the GLAST project to the US-Japan.

W.B. Atwood GLAST Talk at 1st HSTD

(1993. 5 at Hiroshima)

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NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH
Section A

Gamma Large Area Silicon Telescope (GLAST) Applying silicon strip detector technology to the detection of gamma rays in space *

W.B. Atwood

GLAST Collaboration +

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The recent discoveries and excitement generated by space satillite experiment EGRET (presently operating on the Compton Gamma Ray Observatory (CGRO)) have prompted an investigation into modern detector technologies for the next generation of space based gamma ray telescopes. The GLAST proposal is based on silicon strip detectors as the "technology of choice" for space application: no consumables, no gas volume, robust (versus fragile), long lived, and self-triggerable. The GLAST detector basically has two components: a tracking module preceding a calorimeter. The tracking module has planes of crossed strip (x, y) 300 μm pitch silicon detectors coupled to a thin radiator to measure the coordinates of converted electron–positron pairs. The gap between the layers (~ 5 cm) provides a lever arm for track fitting resulting in an angular resolution of $< 0.1°$ at high energy. The status of this R & D effort is discussed including details on triggering the instrument, the organization of the detector electronics and readout, and work on computer simulations to model this instrument.

Technical breakthrough to make GLAST feasible

- GLAST was the plan to be composed of 70–80 m^2 SSD , while an existing device was few square meter at that time.

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- Impossible to demonstrate 70 m^2 prototype.
- To compensate this scale gap, we have to jump up more than factor 20 in comparison with the quality and reliability of existing SSD .

1) For designs and structures of SSD, refinement of every part
2) New 6-inch wafer processing line introduced in HPK

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Dead channel rate: few % → 0.08% $\geq$ 20 improved
Leakage current : 50nA/cm^2 → 2.5nA/cm^2 = 20

Great thanks to HPK (K. Yamamura and K. Yamamoto)

Other Breakthrough

∗ SSD Size: 3 x 6 =18 cm^2 → 9 x 9 ~ 80 cm^2

∗ SSD price: down to 1/20 per cm^2

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∗ Improvement of Production Yield

make possible above two issue

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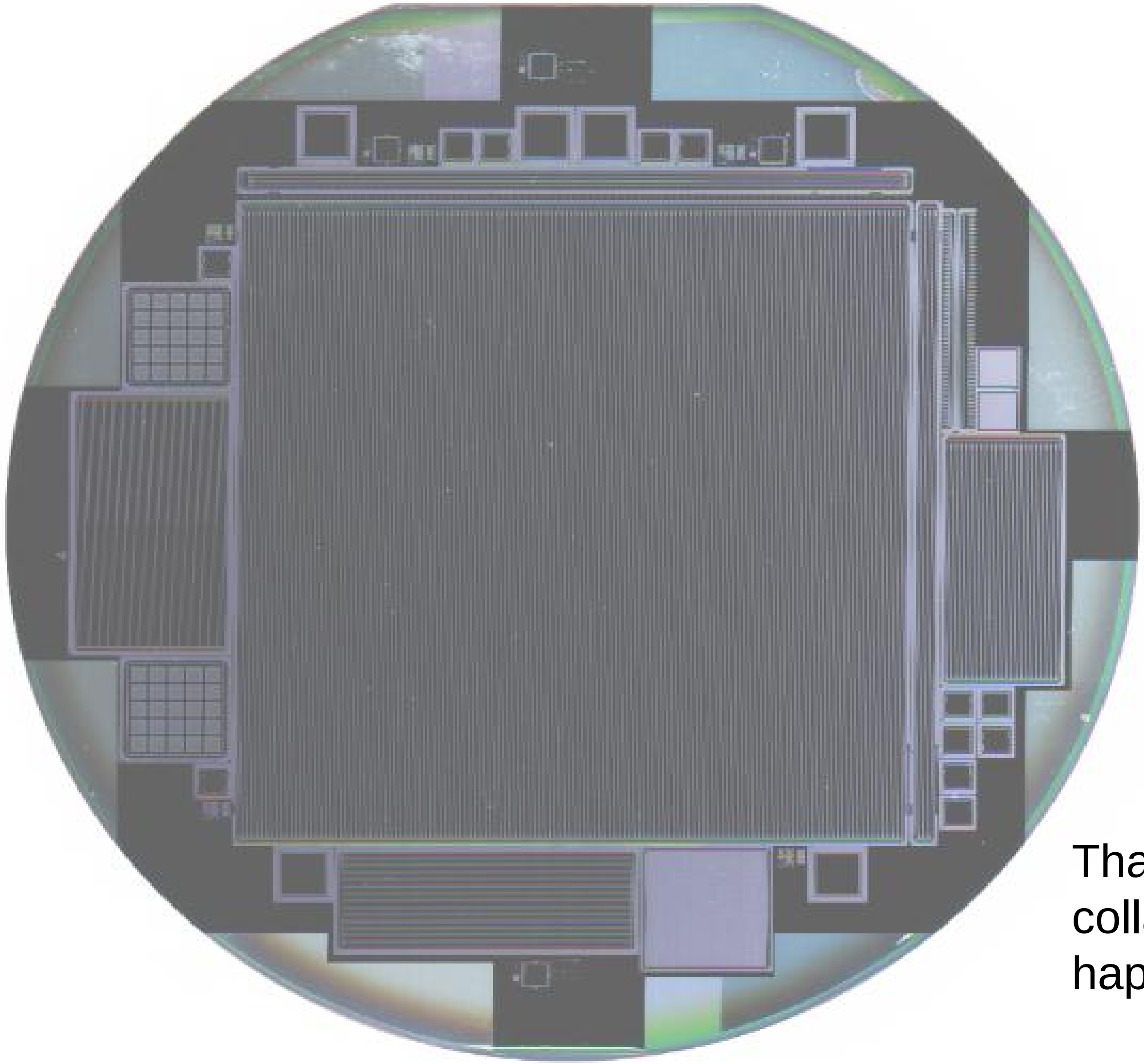
∗ optimization of design

the improvement of HPK silicon process

High quality wafer

Thanks again to HPK engineer and manager!

Flight Model of GLAST SSD



Thanks to all of collaborators for happy collaboration

High quality SSDs were produced in time!