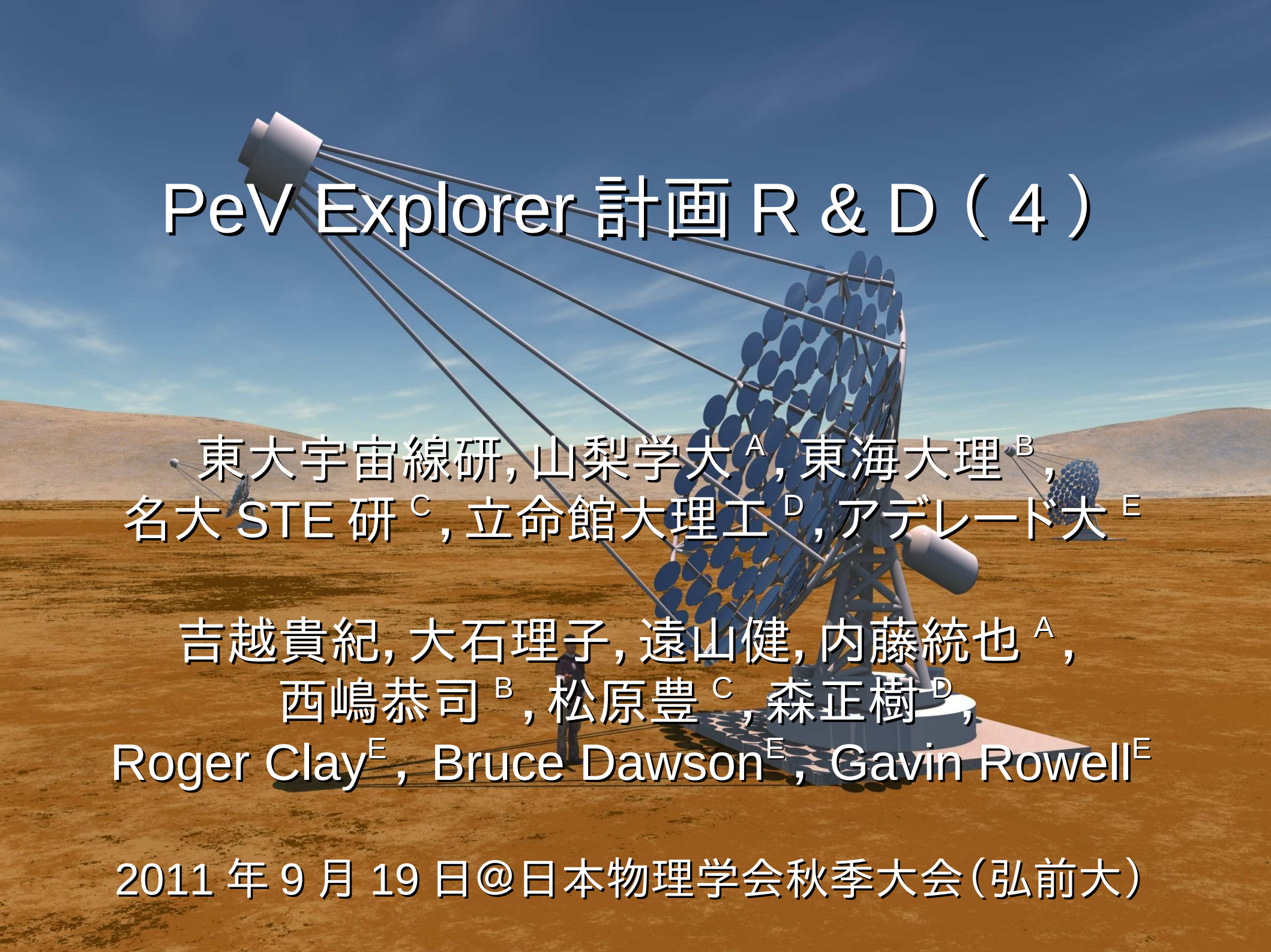

PeV Explorer 計画 R & D（４）

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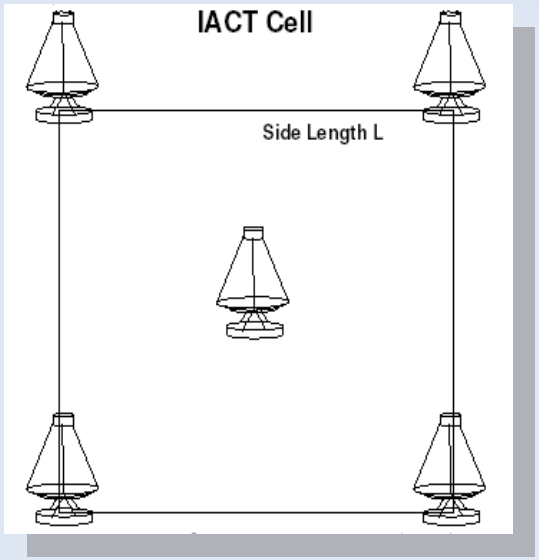
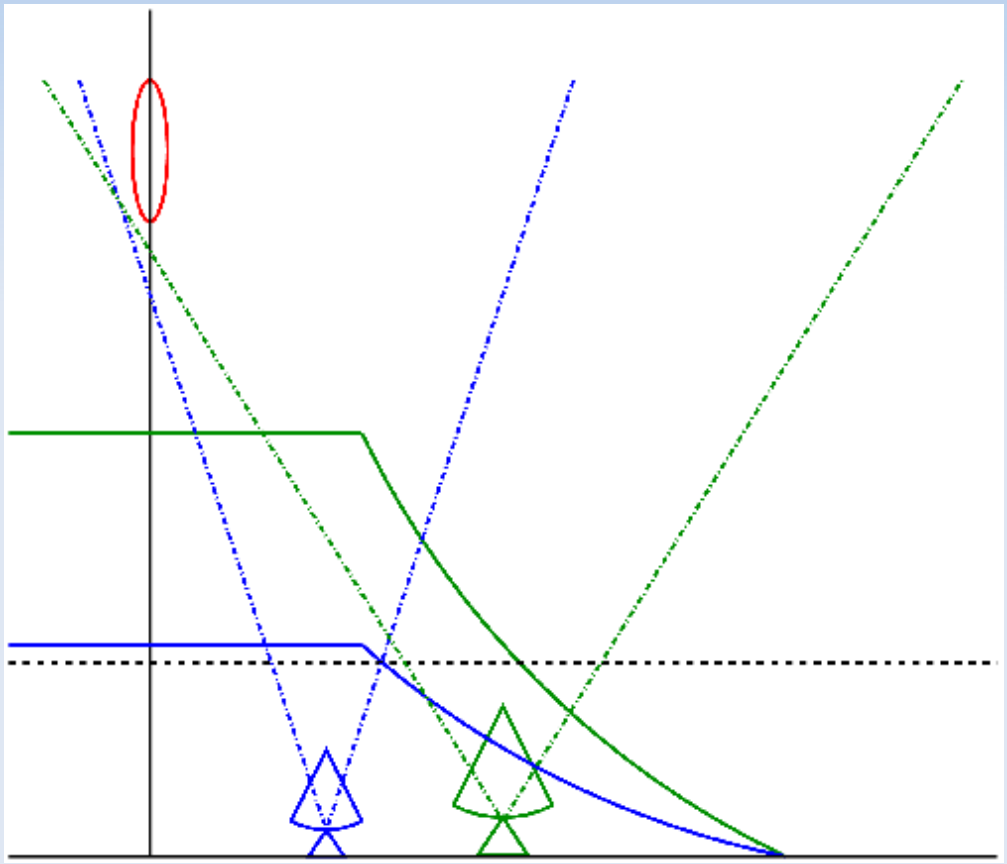
2011 年 9 月 19 日@日本物理学会秋季大会（弘前大）

PeV Explorer (PeX)

- TenTen Project
  - Effective area of 10 km^2 at energies > 10 TeV
  - Stereoscopic array of 30–50 telescopes
- PeV Explorer: one cell of TenTen
  - Cost-effective design:
    - Inter-telescope spacing > 300 m
    - Mirror diameter 3–5 m
    - Field of view ~ 8°
  - Long exposure (several 100 hr) → key science
    - Origin of Galactic cosmic rays up to the “knee”, etc.



PeV Explorer Concept

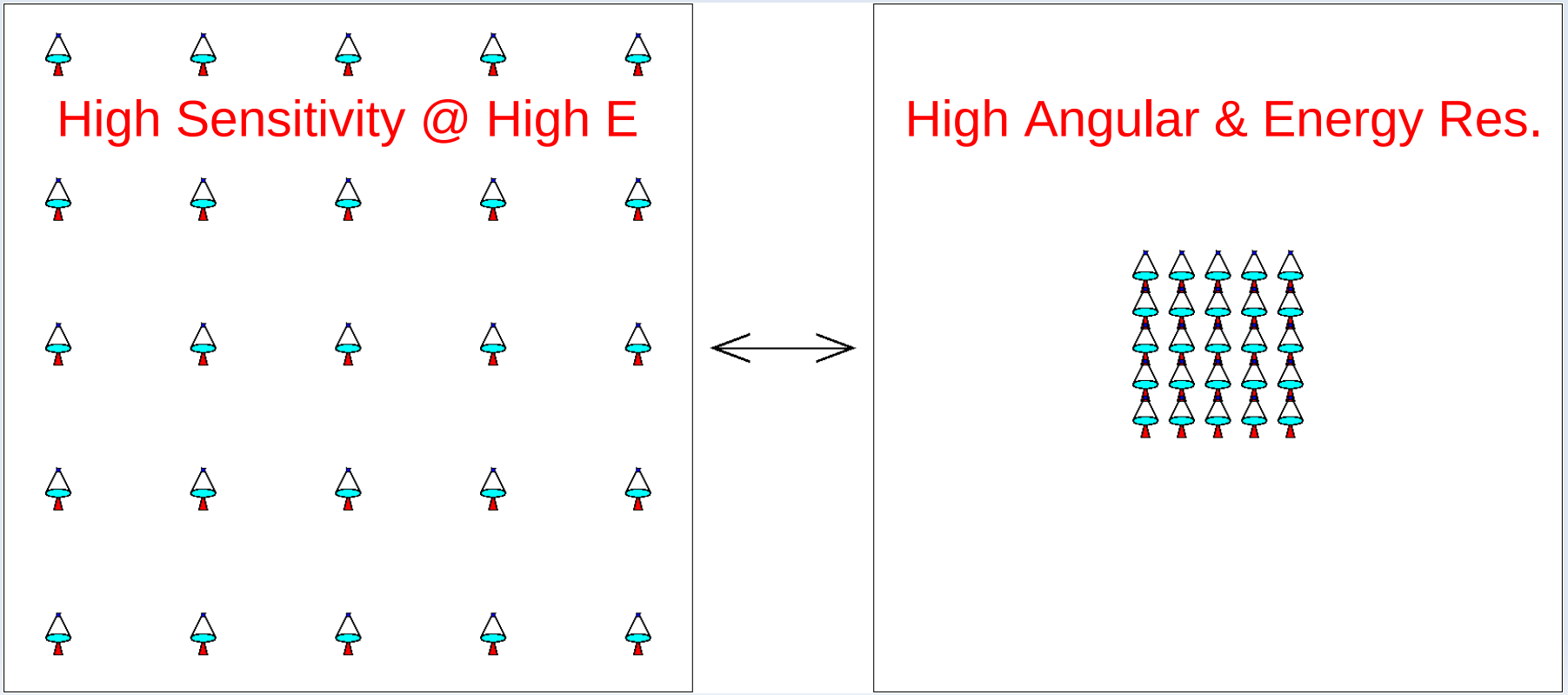


Plyasheshnikov et al. (2000)

- Cherenkov plateau
  - Radius ~ 150 m
- Cherenkov tail observ-able with larger aperture (or at high E)
  - Expand effective area
- Wider FoV necessary
- Effective area is a func-tion of:
  - Aperture, span, FoV

Expansion Plan

- “Mobile Telescope Array”
  - Reduce the risk in array optimization
  - Telescopes independent of power line needed

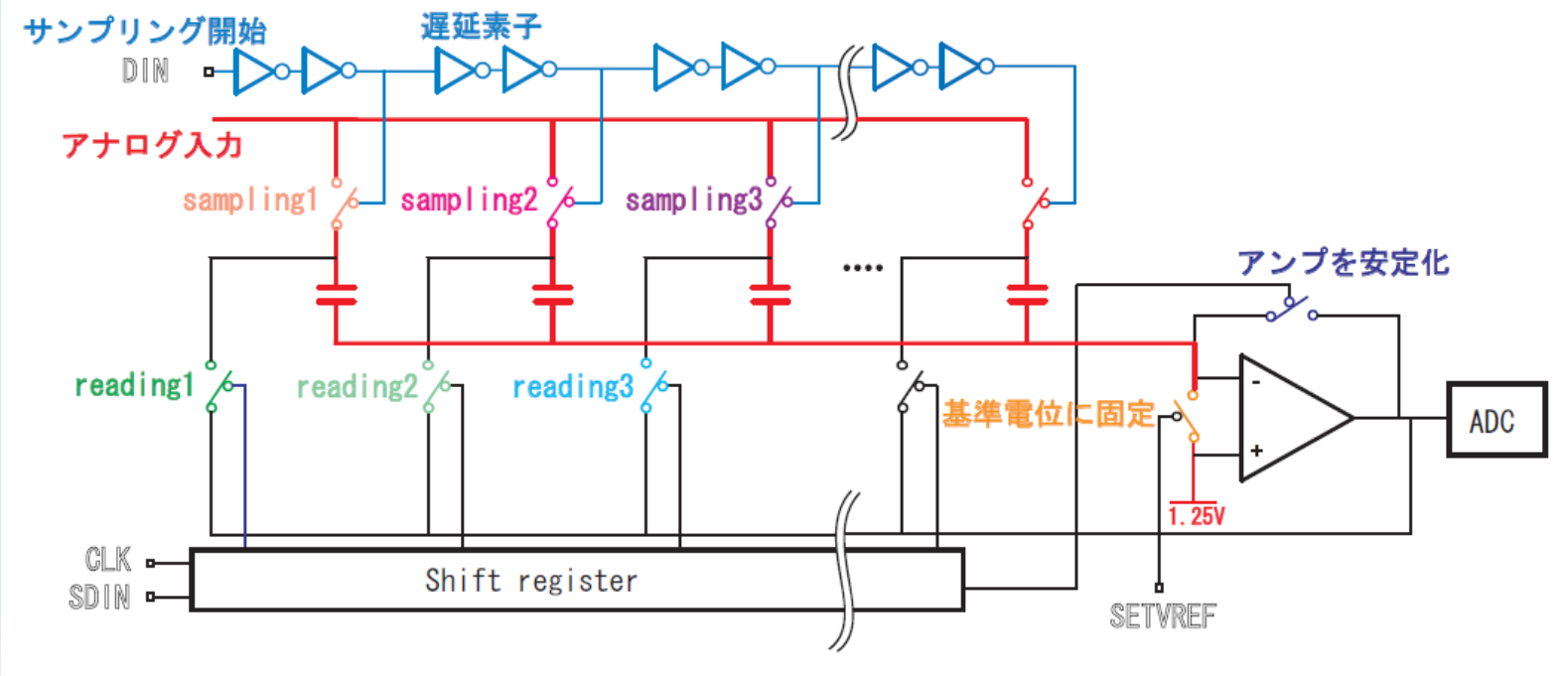


R & D

- Low power consumption system & high capacity battery
  - Make telescopes independent of the power line
  - Analog Memory Cell (AMC) ASIC
  - Compact analog delays
- Simulation study
  - Cherenkov image time gradient, etc.
- Test observations at Akeno
  - Reuse the Konan Cherenkov Telescope

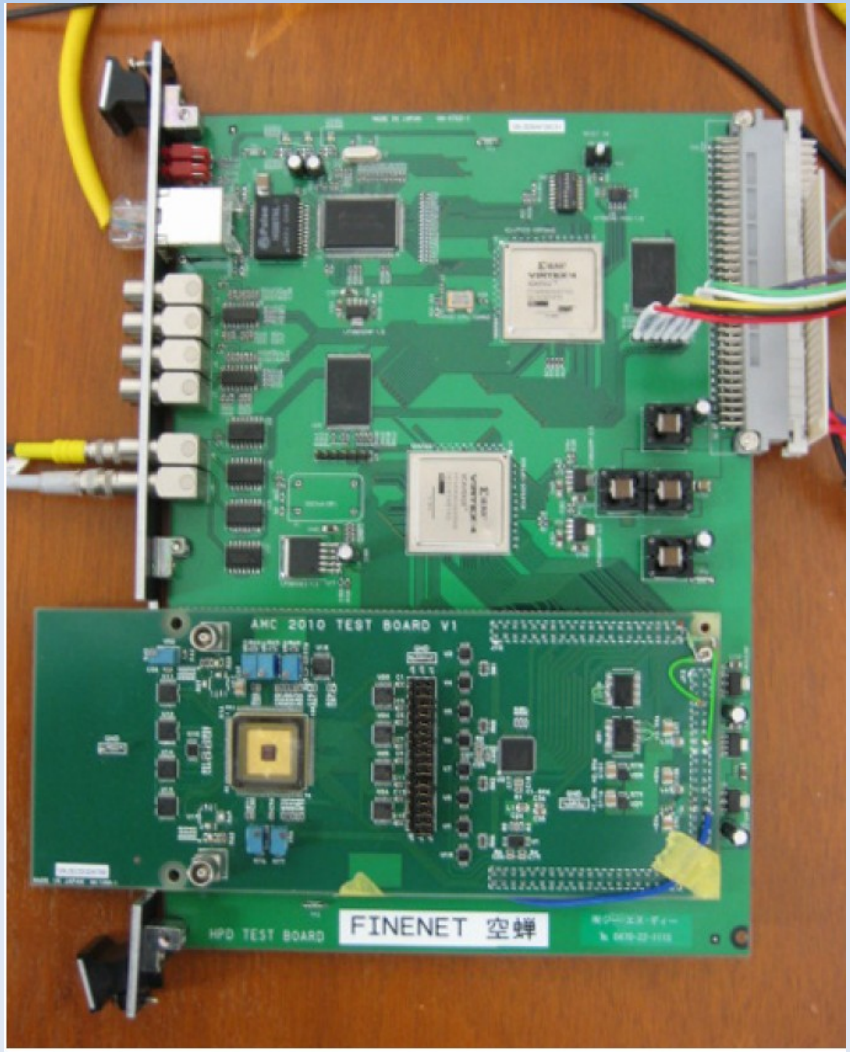
Analog Memory Cell

- Parallel circuit of capacitors and switches
  - Controlled by a delay line (~ 1 GHz sampling)
  - Signal voltages sequentially sampled by capacitors
- Developed with Open-It (KEK)



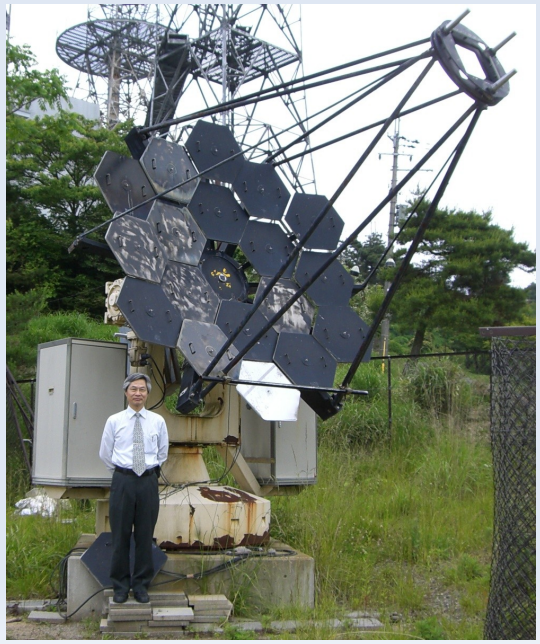
Performance of AMC

- 1st TEG
  - C = 75 & 400 fF, etc.
- Performance (75 fF):
  - Dynamic range ~ 2.2 V
  - Resolution 10 bits
  - Analog bandwidth ~ 200 MHz
  - Power consumption ~ 180 mW / pixel
    - Sampling depth 64 ns
    - AMC + external ADC
- 2nd TEG now tested

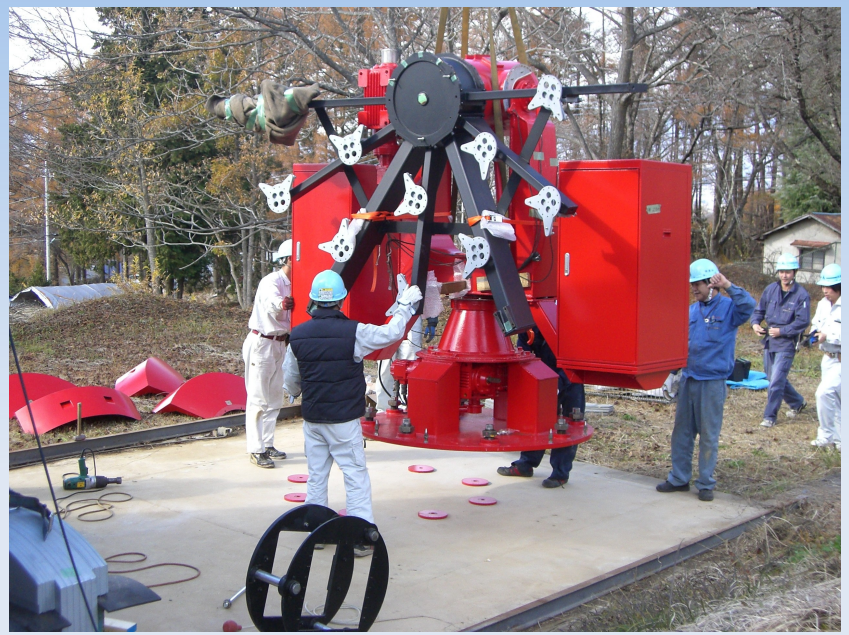


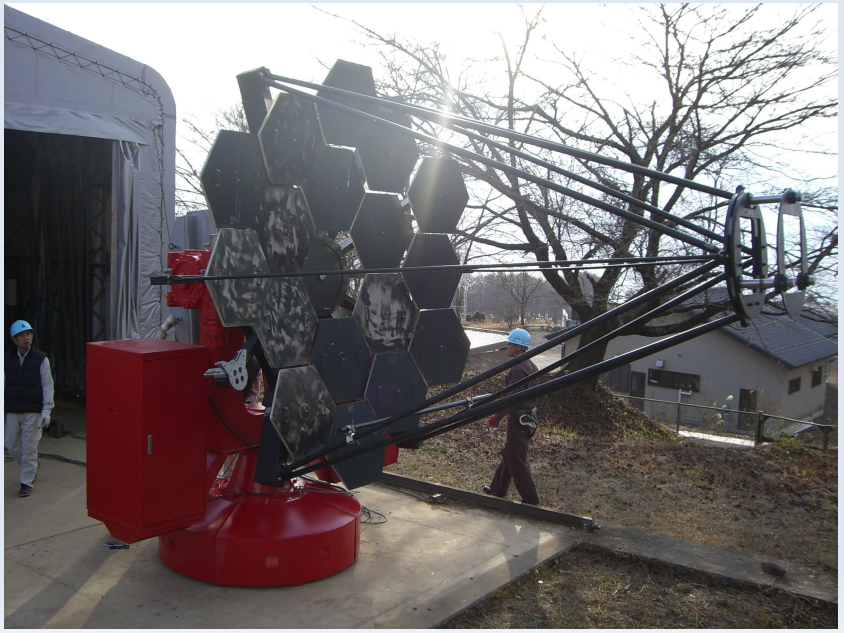
Reuse of the Konan Telescope

- Test bench of Cherenkov telescope systems
  - No Cherenkov telescope operable in Japan
- Davies-Cotton optics
  - 3 m aperture, f/d = 1
- Re-installation at the Akeno Observatory

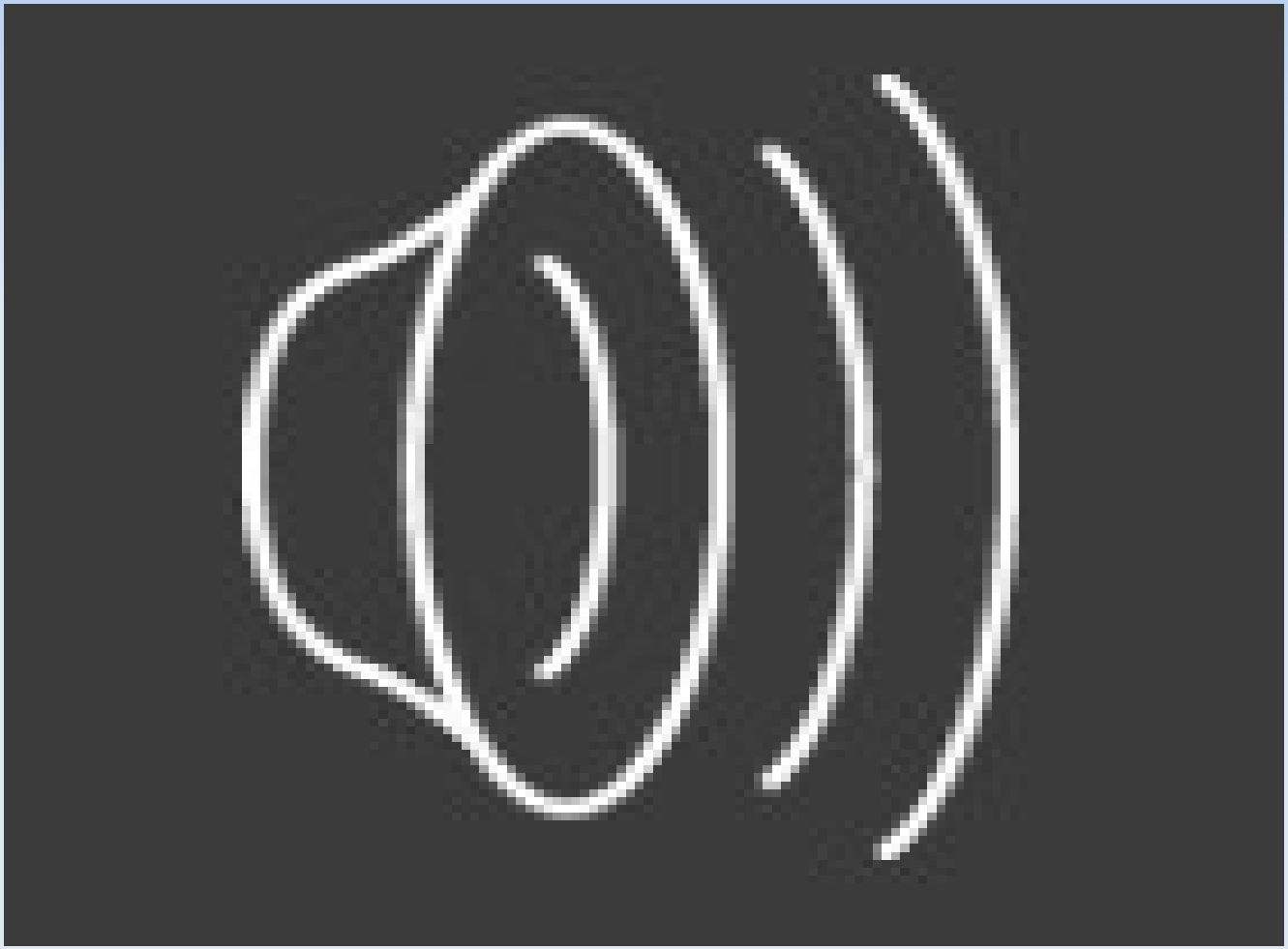


Installation (Nov 2010 @ Akeno)



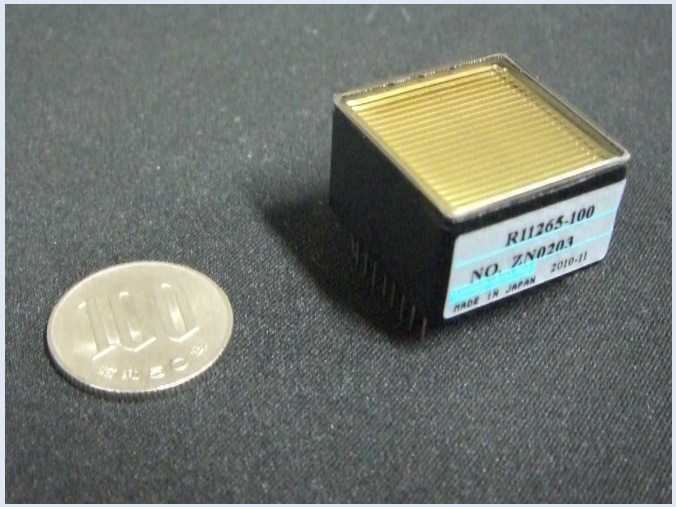


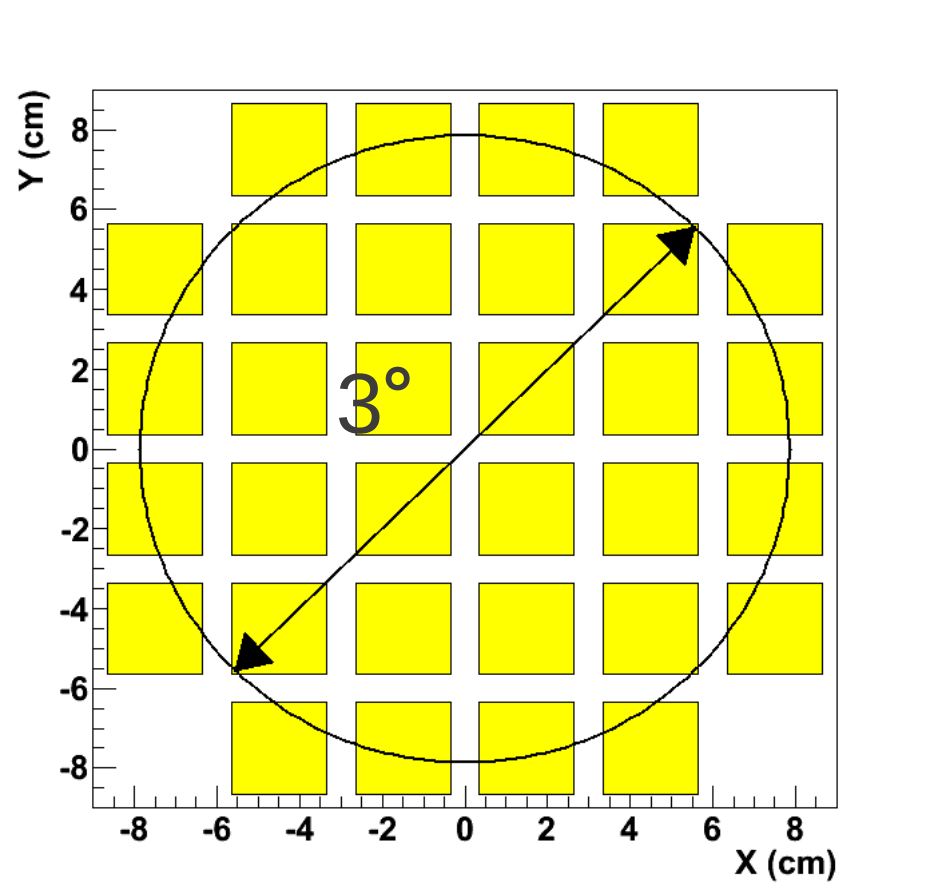
Completed! (Nov 25, 2010)



PMT Camera

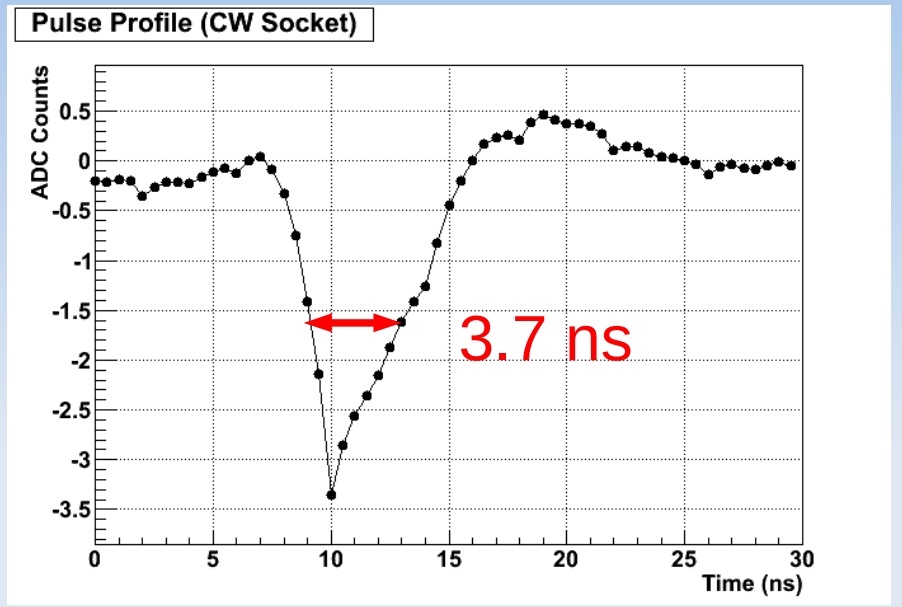
- 32 pixels (planned)
  - FoV ~ 3°
- Hamamatsu R11265-100
  - 1 inch square
  - SBA photocathode

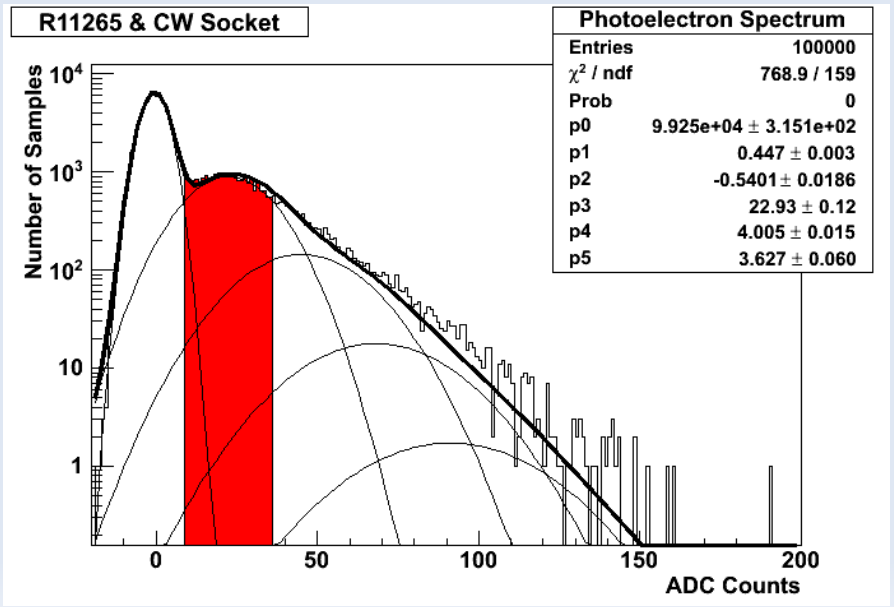




Tests of R11265-100

- Conditions:
  - Gain ~ 10^6 (~ 900 V, CW)
  - No preamplifier
  - Blue LED + diffuser
- Single photoelectron pulse width ~ 3.7 ns
  - Mean profile of the single photoelectron ± 1 σ
- Poissonian * Gaussian well fits the photoelectron spectrum





Current Status & Plan

- Mass production
  - PMTs, preamplifiers, E/O & O/E converters, …
- Simple trigger system
  - FPGA evaluation board (KEK)
- Li-ion battery tested @ Ritsumeikan
  - Battery developed for a solar car
- Akeno Cherenkov Telescope
  - Mirror recoating @ Okayama Astrophysical Observatory (NAOJ)
    - 6 / 18 mirrors recoated in Sep 2011
  - Telescope drive control by a PC
  - Used for R & D (PeX, CTA, …)

Recoating @ OAO (NAOJ)

Summary

- PeV Explorer (PeX) aims to explore:
  - Origin of Galactic cosmic rays up to the “knee”
  - Astrophysics at energies > 10 TeV
- R & D for PeV Explorer
  - Development of the system ongoing
  - First battery-powered IACT system (?)
- Akeno Cherenkov Telescope installed
  - Usable for various R & D
  - Test observations with the developed system