Arms Control, Monitoring and Treaty Verification; National Technical Means & Intelligence

by

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Neutrinos and Arms Control workshop
University of Hawaii Moana
February 5, 2004

- **Instrumentation for particle physics, scintillation counters, and wavelength-shifting light pipes**
- **Nuclear weapons (LANL) and arms control (PSAC)**
- **Intelligence and monitoring of nuclear and other programs**
- **Treaty verification based on monitoring and other information**
- **All-source (including HUMINT and open-source) intelligence.**
- **…**

National technical means (NTM) include imaging and radio satellites and other sensors outside the national boundaries and sensible airspace.

- **CORONA 1960-1972 film return, 2-m res.**
- **Sensors such as those for CTBT monitoring—hydroacoustic, infrasound, seismic, radionuclide**
- **FORTE, Old VELA satellites**
- **Radio sensing of ionospheric motion**
- **…**

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A Useful Fast Coincidence Circuit

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February 17, 1950

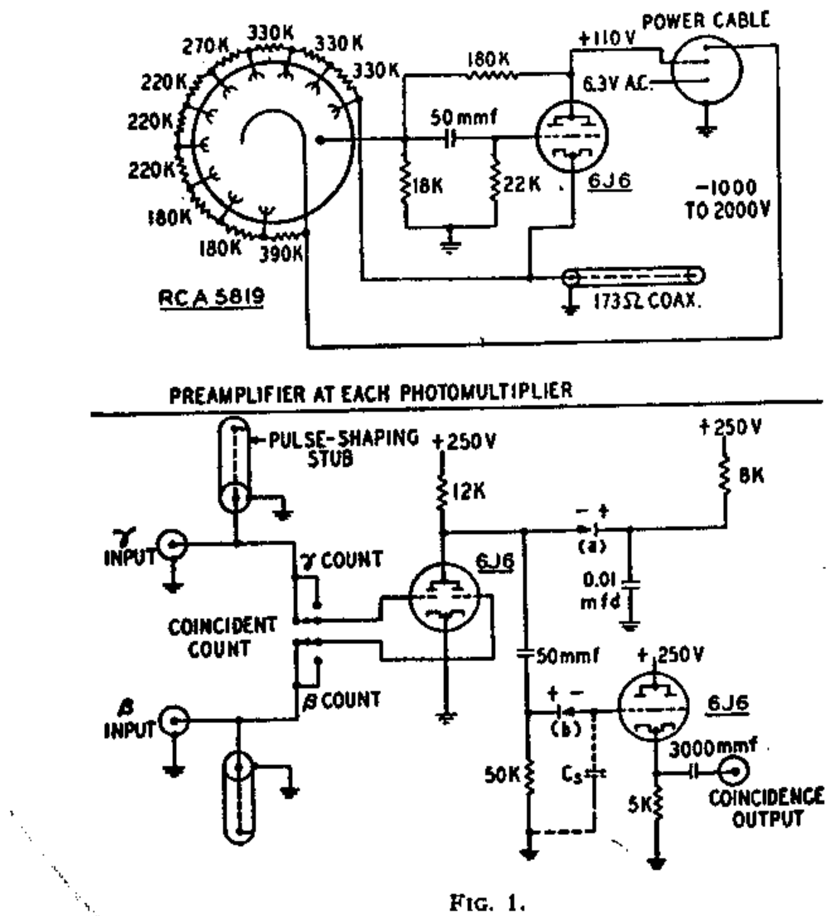

FIG. 1.

he Collection of Light from Scintillation Counters

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(Received June 14, 1960)

imposed by
he collection
ular, without
nnot arrange
emitted light
photocathode
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clear that a
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will eventu-
in the tank,

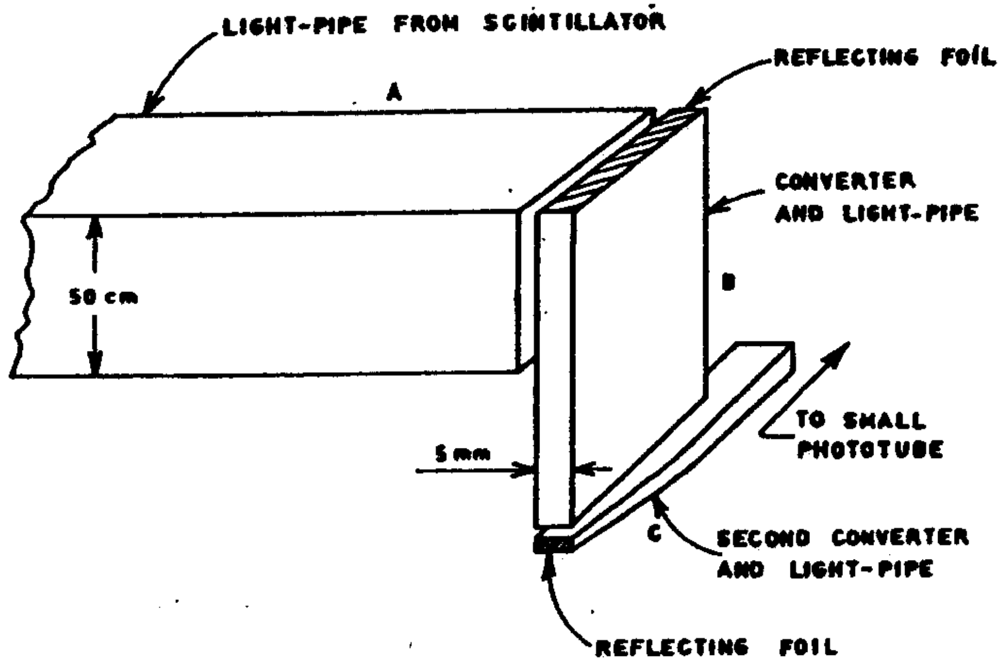

Fig. 1. Light from the light-pipe or scintillating vat (A) strik
converter (B), in which it produces fluorescent light of slightly
photon energy. Some of this light, being isotropic, can now be
along the converter without further loss; and, in principle, c
used a second time to produce fluorescence in the second con
(C) to concentrate further the light onto a small phototube.

Founders of National Reconnaissance and their contributions (NRO 09/27/2000):

- William Baker, AT&T Bell Laboratories. Served as scientific counselor to the National Security Agency, CIA, Navy and NRO on overhead reconnaissance systems.
- Merton Davies, RAND. Invented a rotating, panoramic camera and worked on designs for a family of film-based reconnaissance satellites that led to CORONA.
- Sidney Drell, theoretical physicist and presidential advisor. Served as a key scientific consultant to the CIA's satellite reconnaissance program and was instrumental in securing congressional approval for several NRO special projects.
- Richard Garwin, physicist and presidential advisor. Established standards and found solutions for electro-mechanical design of modern spacecraft.
- Amrom Katz, RAND (deceased). Performed the first experimental simulation of electro-optical satellite imaging and co-directed projects that eventually led to CORONA.
- James Killian, Massachusetts Institute of Technology (deceased). Served as MIT president and chaired the panel that recommended building the U-2 aircraft and reconnaissance satellites.
- Edwin "Din" Land, Polaroid (deceased). Served as CEO of Polaroid, advised President Nixon on the capabilities of electro-optical imaging and advised NRO of new and existing overhead systems.
- Frank Lehan, presidential advisor (deceased). Instrumental in the decision to proceed with an important high-altitude signals-intelligence satellite system and contributed to the reflector design for that system.
- William Perry, former Secretary of Defense. Advised the National Security Agency and the CIA on programs to intercept and evaluate Soviet missile telemetry and communications intelligence.
- Edward Purcell, Harvard Nobel Laureate (deceased). Developed methods to make reconnaissance satellites difficult, if not impossible to observe with radar.

Antineutrinos and Arms Control?

- From nuclear explosions? Fission-product decay after fission of nominal 17 kt of high-explosive equivalent ($17 \times 4.2 \times 10^{12}$ J) or one kg of Pu or U^{235}.
- One 3000 MWt power reactor fissions one tonne per year, so 17 kt is thus 8 hr of a reactor. Half of beta decays in a few seconds?... (A. Bernstein: at 24 m, one event/MWd-ton).
- Fission explosive: gun-type, ~ 60 kg of U^{235}; implosion weapon, ~20 kg U^{235} or "6" (maybe 4) kg of Pu^{239} or 6-8 kg of "reactor grade" Pu.
- Pu produced from U^{238} in reactors at rate of 1 kg/day per GWt, so 3000-GWt power reactor produces 3 kg/day of Pu^{239}. Burns most of it, though, at 50 GW-day/ton of fuel. A "production reactor" will operate at 1 GW-d/ton and waste almost none of the Pu^{239}. ILL (France) is 57 MWt at full power.

- North Korea's 5MWe (25 MWt) reactor thus can produce about 25x365x0.7 = ~6.4 kg Pu/year. 1998 Rumsfeld Comm. judged that NK had built 1 or 2 nuclear weapons. 8000 additional fuel rods may have been reprocessed to yield Pu for ~6 more nuclear weapons.

Questions:

- Can the proposed antineutrino detector see a 25 MWt production reactor (1% of a commercial power plant)?
- What does it offer in comparison with Landsat or other infrared satellite estimates of thermal power generation of a 3000 MWt nuclear plant?
- Overall intelligence budget estimated at $30 B/yr, but there are many interests and problems. Cheaper to use rewards and bribes?

See

Garwin, Richard L. and Georges Charpak *Megawatts and Megatons: The Future of Nuclear Power and Nuclear Weapons*. 412 p., 55 halftones, 16 tables. 6 x 9_1/4, 2002

More technology:

Gas detectors for ν elastic scatter. Can sweep local ionization events to a small Micromegas or other detector…