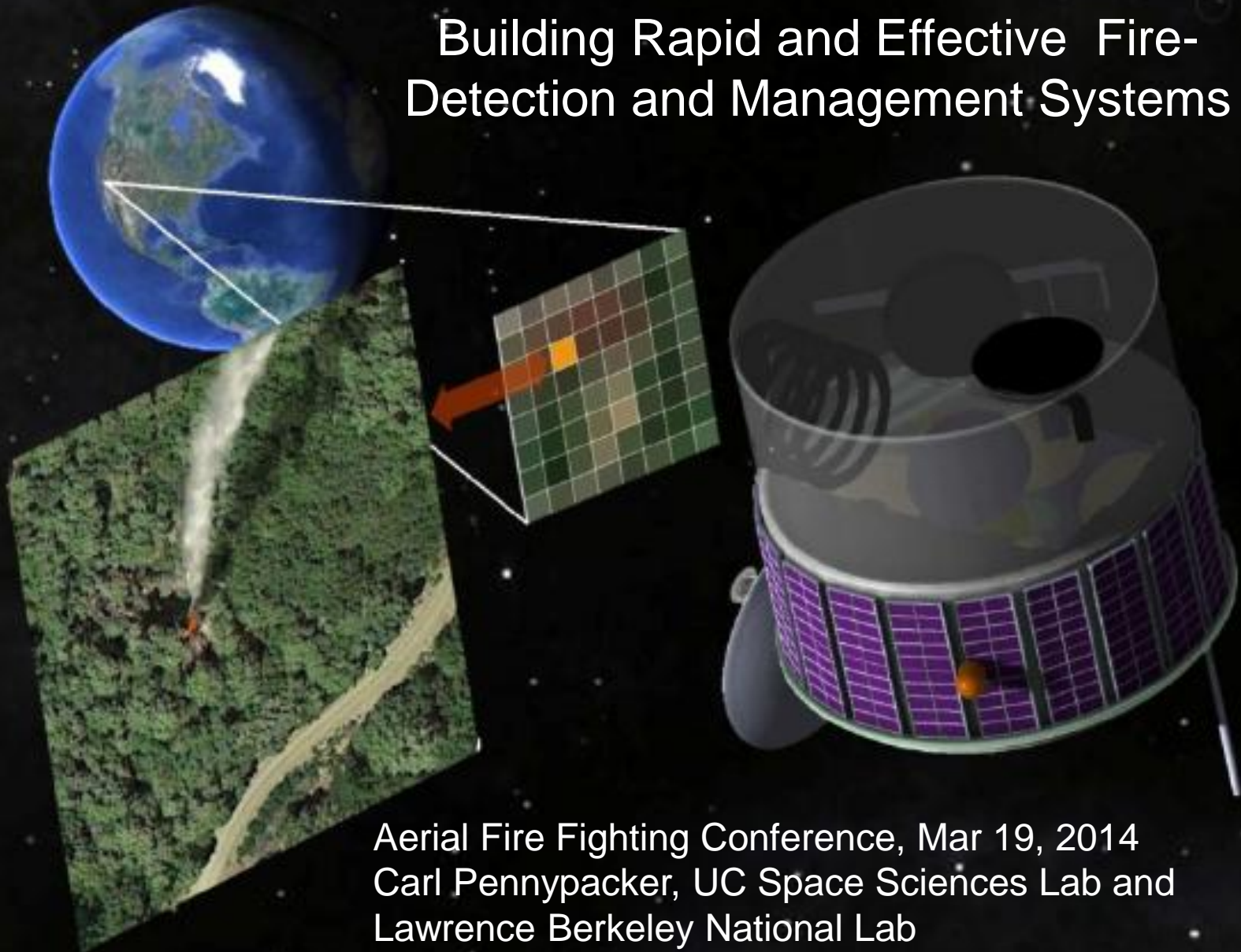


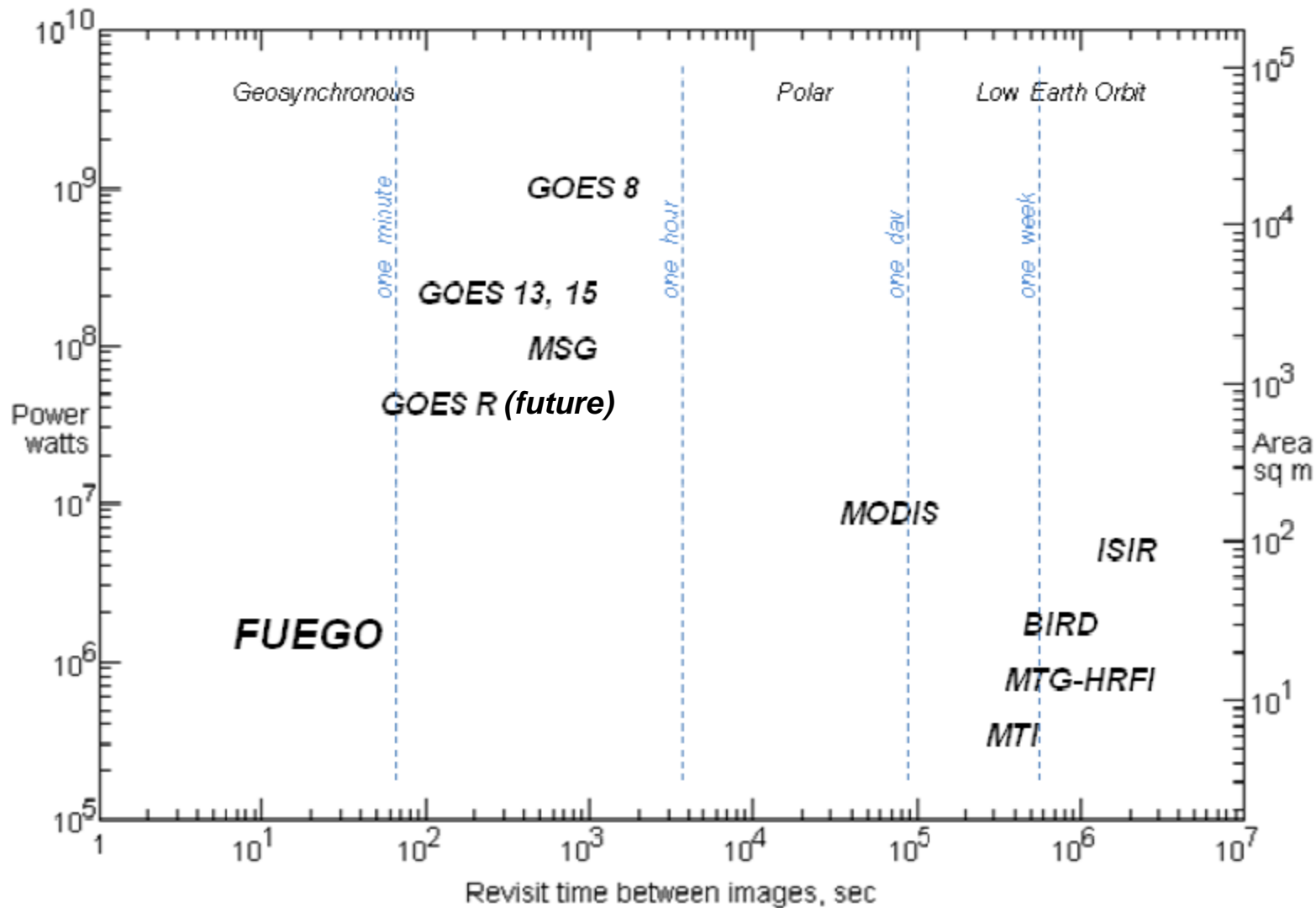
Building Rapid and Effective Fire-Detection and Management Systems



Aerial Fire Fighting Conference, Mar 19, 2014
Carl Pennypacker, UC Space Sciences Lab and
Lawrence Berkeley National Lab

Detecting Fires from Space

Pennypacker C.R., et al., 2013, Fig 4



What is *FUEGO*?

Fire Urgency Estimation from Geosynchronous Orbit
and Associated Data Systems

(with hoped-for UAV steps in between...)

Supported by the Vice Chancellor for Research, UC Berkeley

- Early detection and continual management of wildland fires
 - natural; accidental; terrorist
 - The Fire Data Cube
- Potentially valuable for the United States
- Geosynchronous orbit for 24/7 coverage
- Supplement ground & air observations
- Provide real time input for models for prediction and resource allocation
- Supplement other spaceborne geo observatories
- Requires real-time assessment of **urgency**.
 - Urgency is the key ingredient! *Must* be made quantitative!
 - Requires tight integration with **Geographic Information Systems**

What we hope *FUEGO* can Provide to this *Community:*

- Digital alert to Aerial Tankers within a minute or two of a fire growing beyond 10 sq. meters in size
- Tracking of the fire size continuously, with resolutions approaching 10's of meters
- Temperatures, amount of fire, spread rate,
- Supplement ground & air observations
- Provide real time input for models for prediction and resource allocation – direct feed of FUEGO and other local data into models and advice for fire-fighters
- Supplement other spaceborne geo observatories

FUEGO Objectives :

- Develop a team of wildfire detection and suppression experts
- Create a movement for state-of-the-art effective detection, modeling, suppression, and follow-up systems, based on modern remote sensing, satellite, computing, and modeling technology.
- Solicit input from potential users, benefactors, and collaborators of FUEGO.

Study Team Members (partial list)

- Tom Coate – USAF, CHIRP Satellite
- William Derr, US Forest Service (Ret)
- Maggi Kelly, Geographic Information Systems, UC Berkeley
- Gen. Larry Grundhauser (Ret.), Boeing Aerospace
- Mike Lampton, UC Berkeley Space Sciences Lab
- Carl Pennypacker, UC Berkeley Space Sciences Lab
- Scott Stephens -- Wildland Fires, College of Natural Resources, UC Berkeley and Lawrence Berkeley Lab
- Chris Schmidt, U. Wisc, GOES Satellite Fire Team
- Robert Tripp, Lawrence Berkeley National Lab
- Donn Walklet, Terra-vista, Inc.

Our Univ. of Calif. Berkeley Paper:

- I humbly acknowledge wealth of expertise in room in many subjects
- We are not the first to employ (a bit) or suggest such a system.
- Assembled a bigger and better growing collaboration and many new ideas (ref. on handout)

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Article

FUEGO—Fire Urgency Estimator in Geosynchronous Orbit—A Proposed Early-Warning Fire Detection System

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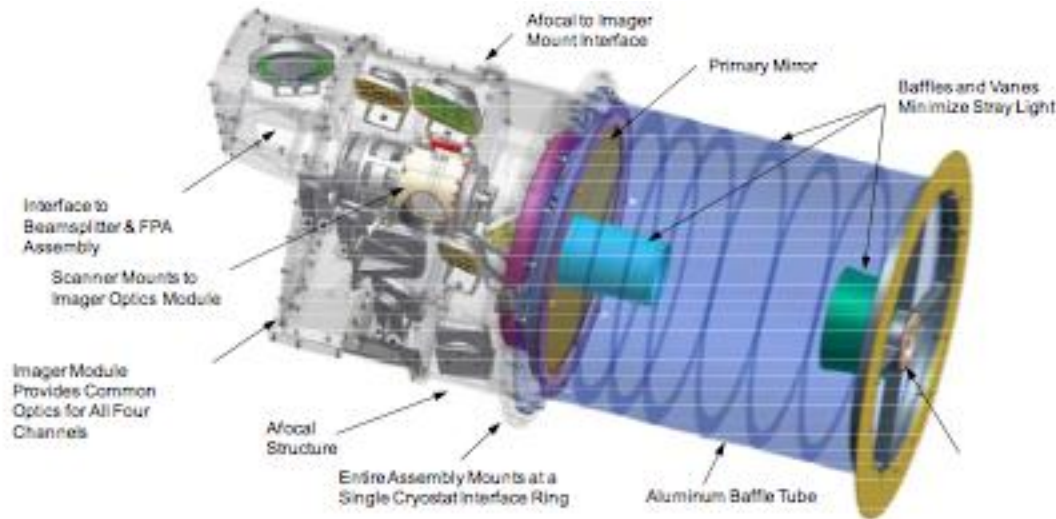
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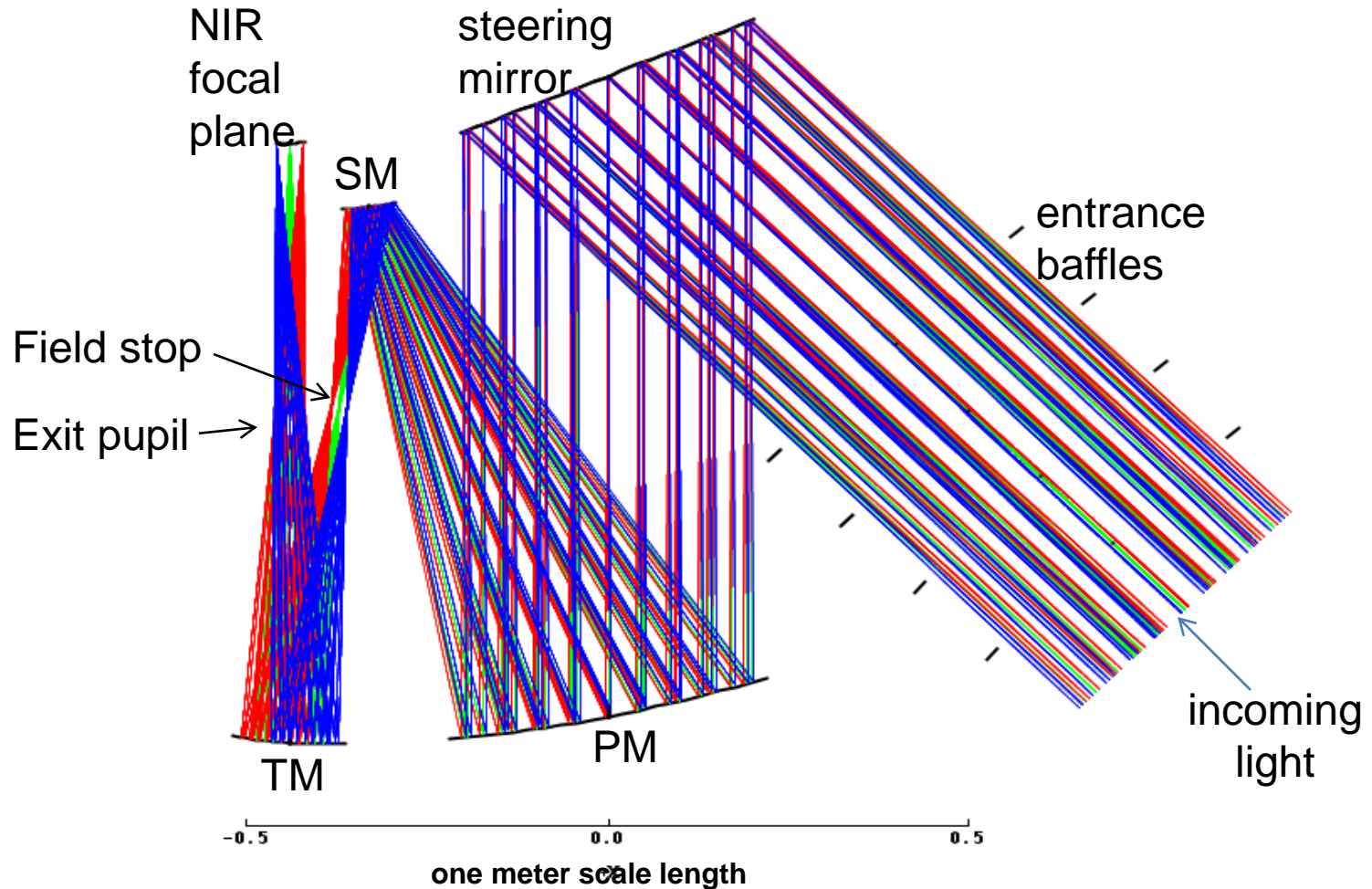
FUEGO Predicate: WISE Satellite

-- we could probably build FUEGO for about \$60M and put on “hosted geo-sync platform system” – cheaper then \$400M :



Unobscured “Fuego12” Optical Concept:

Provides clearances for baffling, esp. secondary and tertiary mirrors



Background on some UCB/LBNL Expertise

- We are good at finding small signals in noise
(from particles in Bubble Chambers to Supernovae at 12 billion light years to genes that can convert grass into car fuel to fixing old records so you can hear them...)
- Good at taking good ideas with a small team into a production scale process. Very interesting and supportive ecology for this.
- Fire signals are huge – background rejection is key art!

Carl Pennypacker's Background:

1968-1972: Undergrad UC Berkeley, worked with Luie Alvarez Group, Senior Thesis: "Geomagnetic Cutoff of Cosmic Rays Near Palestine Texas," JGR

1972-78: Graduate School Physics, Harvard, on "Infrared Studies of Pulsars." Built almost whole system – detectors, software, electronics myself. Co-authored a paper on Interstellar Dust with Ed Purcell (Inventor of Nuclear Magnetic Resonance)

1978-present: Supernova Studies. Helped lead development of first working automated Supernova search system.

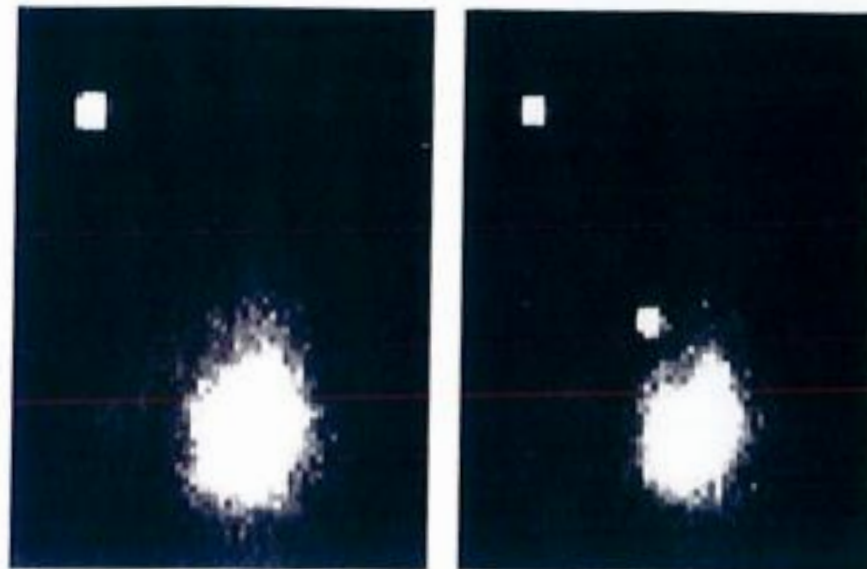
1982-1992: Lead developer of Distant Cosmological Supernova Search – turned management over to Saul Perlmutter. Led to discovery of Dark Energy and Nobel Prize.



1992-present: Leader of Global Hands-On Universe, a modern astronomy outreach system. Have reached 20,000 teachers worldwide.

What is a supernova?

- End of a star's life, which can be seen across the Universe! Supernova can be as bright as a whole galaxy!



Left: A photograph of M99 taken on May 8, 1986, by the Berkeley group shows no sign of any unusual activity. Right: An image made nine days later reveals the unmistakable evidence of a supernova.

This was the first supernova we saw, in M99 galaxy.

Look ahead to fire subtractions...

