

Offbeat and Wacky Projects using a Video Meteor Camera

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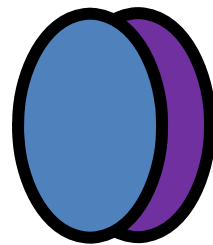
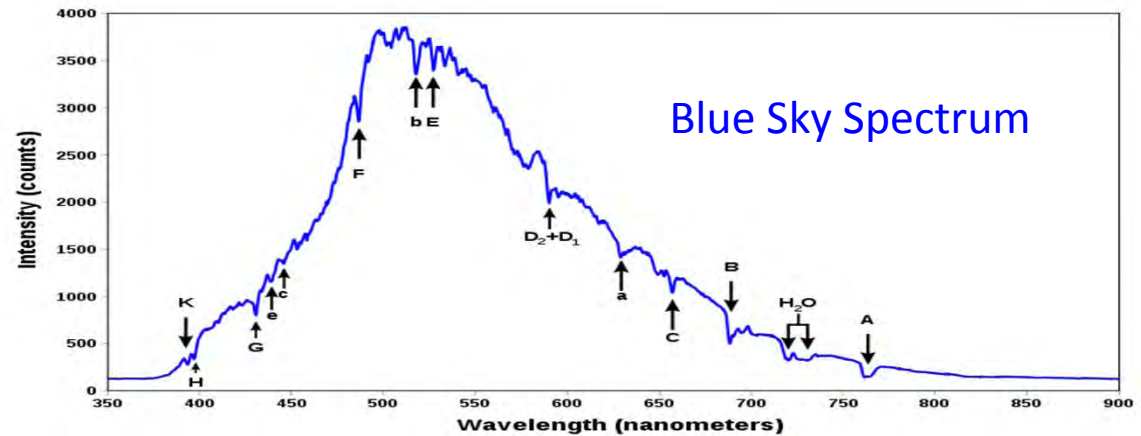
IMC 2014, Giron France



Outline

- Day/Night Bright Meteors
- Atypical Meteor Spectroscopy
- Telescopic Meteors
- Millisecond Light Curves
- Lunar Meteoroid Impacts
- Cosmic Rays, MACHOs, Birds
- Cameras & Digitizers

Meteors in Daylight



Narrow Pass Band Filter(s)
around
Dominant Emission Line(s)
Avoid the brightest sky bands

OR

Interference Filter
around a
Dominant Emission Line
Light rays must be near parallel

Robotic Meteor Acquisition

Nov. 2000 George Varros'
2-Axis Rocker Box
250 msec, 70° FOV

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2003 AIM-IT, 2005 CAMO
2-Axis Galvos w/Mirrors
10 msec, 40° FOV

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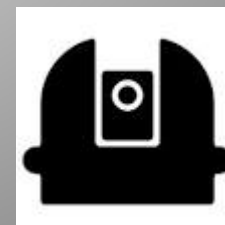
Pan / Tilt Servo Platforms
e.g. Robot Geek

Response?, All-Sky Cueing
Zoomed meteor imaging

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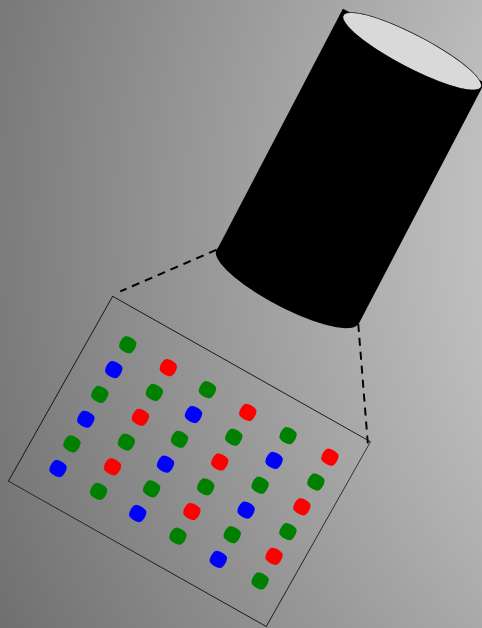
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Very Low Resolution Spectroscopy

Color Camera

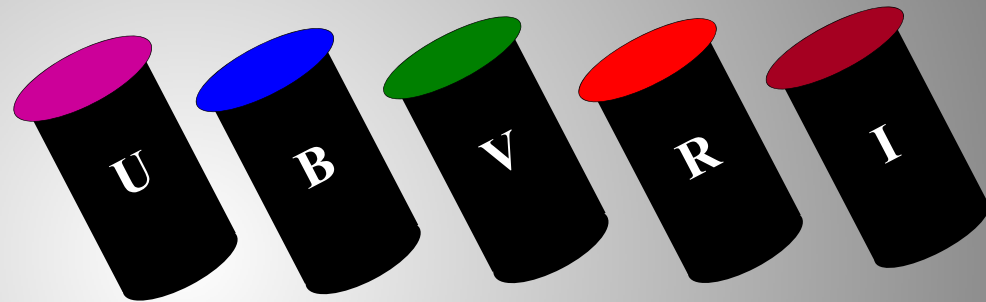
RGB Focal Plane



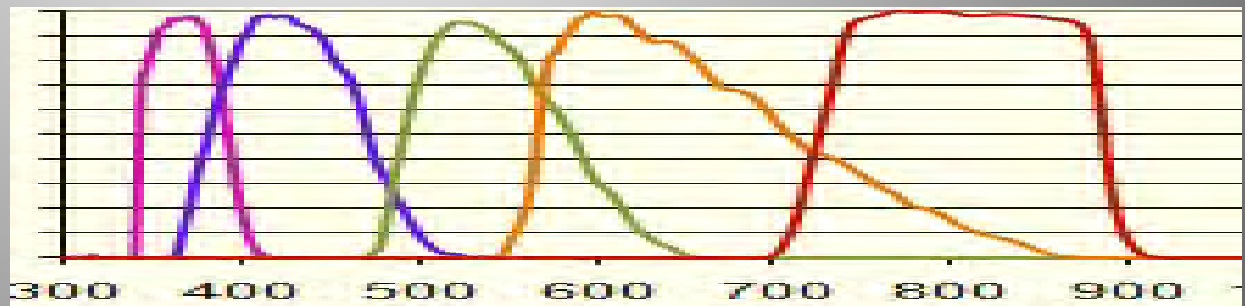
Sensitivity ?
Band Response ?

Multiple Monochrome Cameras

Johnson-Cousins Color Filters (or narrower pass bands)



→ Color Index for fainter meteors



Ca

Fe

Mg

O_f

Na

N

O

All Aspect Meteor Spectroscopy

Burn all ones to media *(well maybe not...)*

→ **Circular Axially Symmetric Grating**

**Spiral pattern of pits
with nominal ring spacing:**

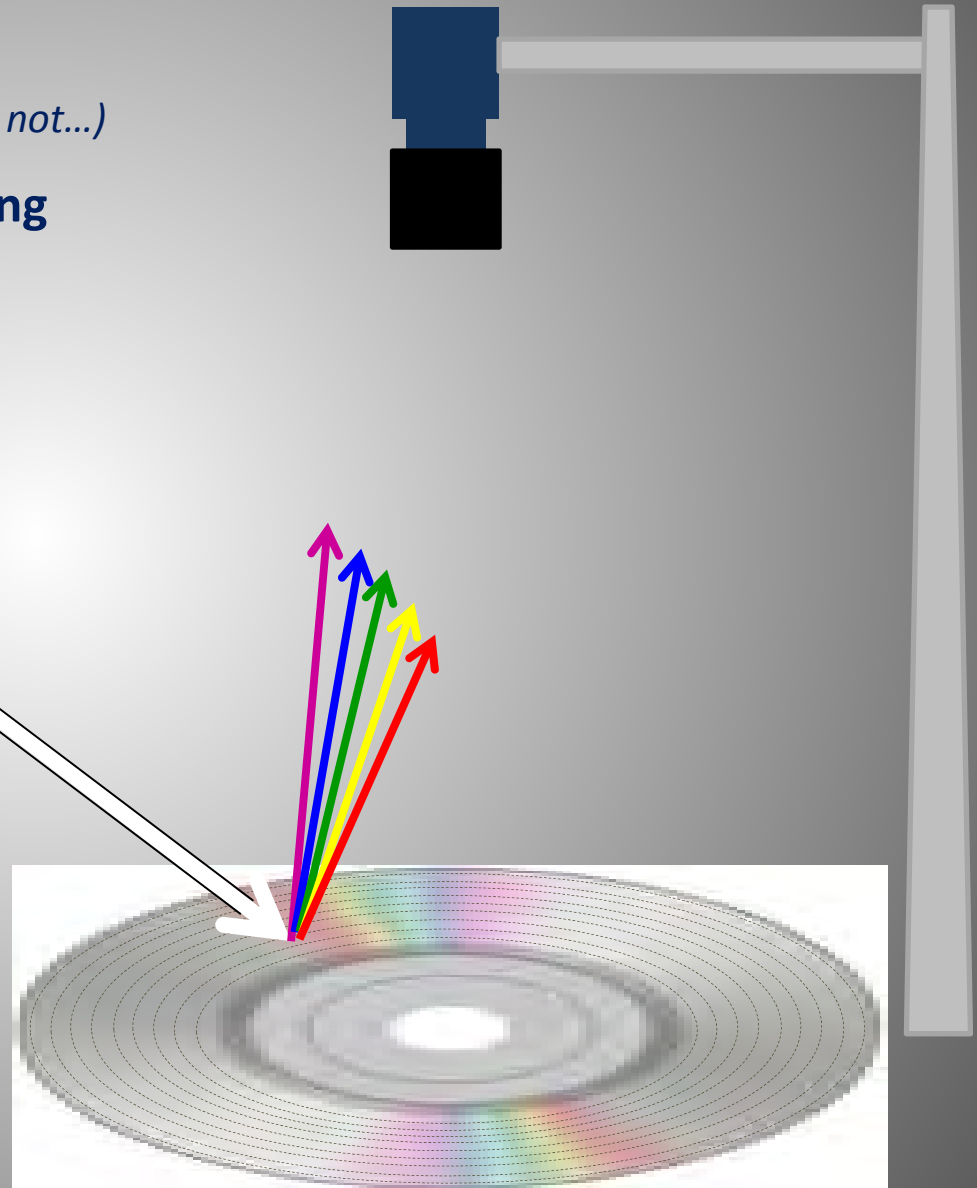
CD = 1.60 μ

DVD = 0.74 μ

HD-DVD = 0.40 μ

Blu-Ray = 0.32 μ

CAMSS = 0.73 μ



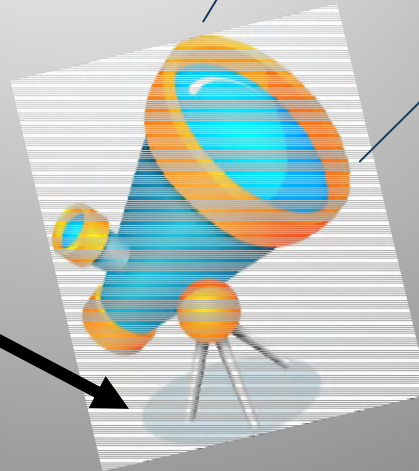
Telescopic Video Meteors + Orbits

High spatial resolution provides more accurate orbits

Desire long focal length and low f-ratio system

Big and heavy glass !

*More volume
overlap with
short baseline*



Hi-Res → Triangulation is
feasible with only a 5 km baseline

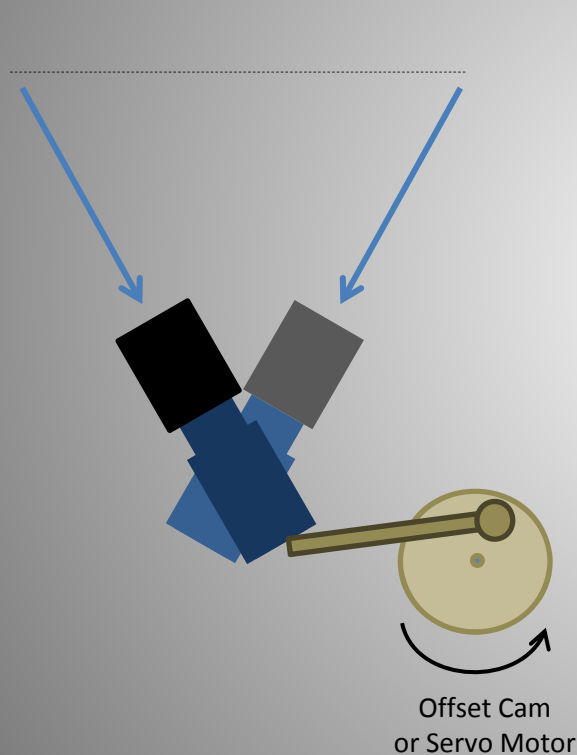


**Large angular
velocity loss**

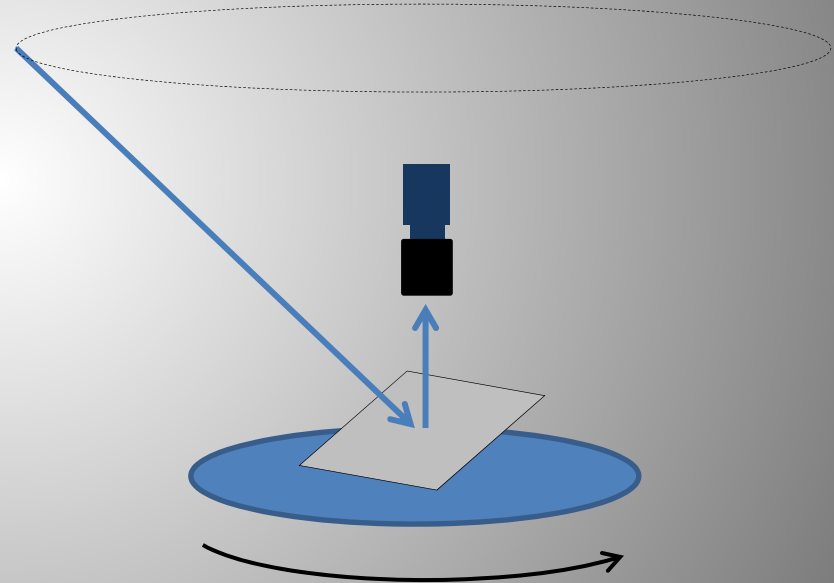
Rockin' & Rollin' Faint Sporadic Detector

Minimize angular velocity loss by *slewing* the telescopic camera

Only catches faint meteors in one direction + astrometry challenge



Rocking camera



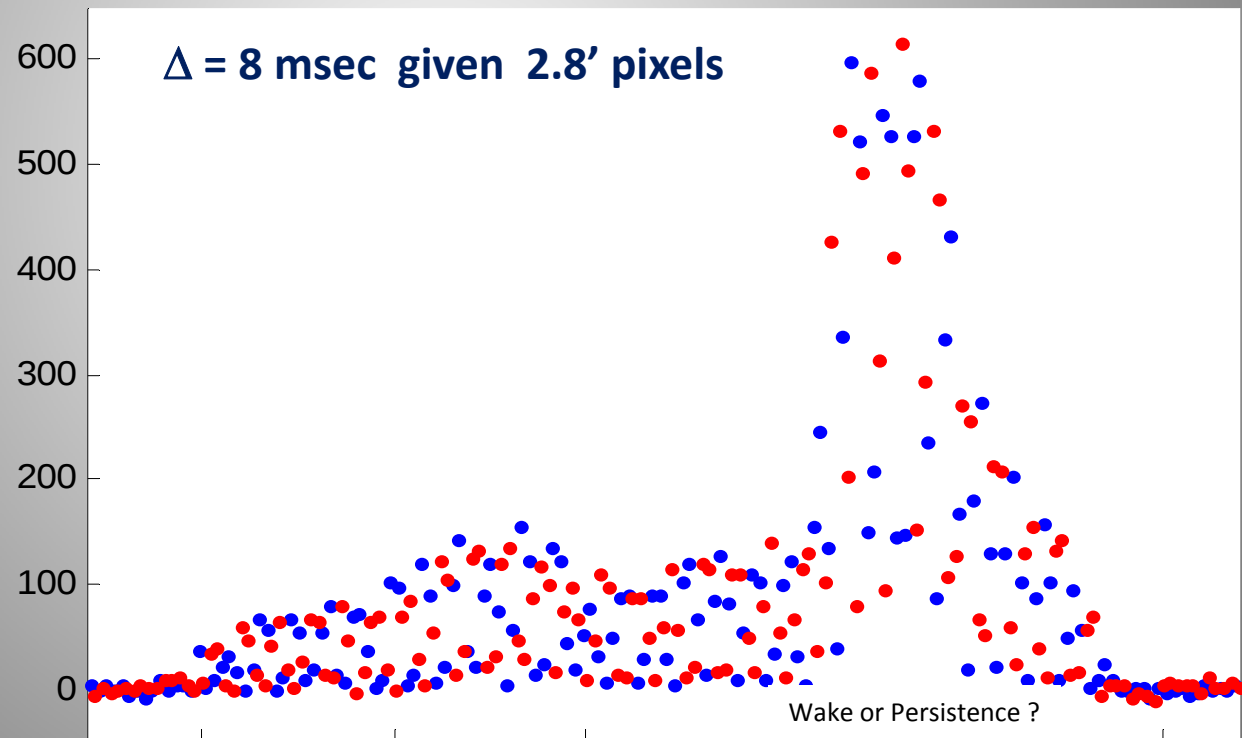
Spin the camera or a reflector

Millisecond Resolution Light Curves

Existing video meteor data contain higher temporal resolution

Better than the interleave field rate of 50 fps PAL (60 NTSC)

Example: Medium Speed Meteor ~50 km/sec



~10x Higher Resolution in Telescopic !

Lunar Impacts at High Frame Rate & Spectra

Boulder Sized Meteoroids Smashing into the Moon !

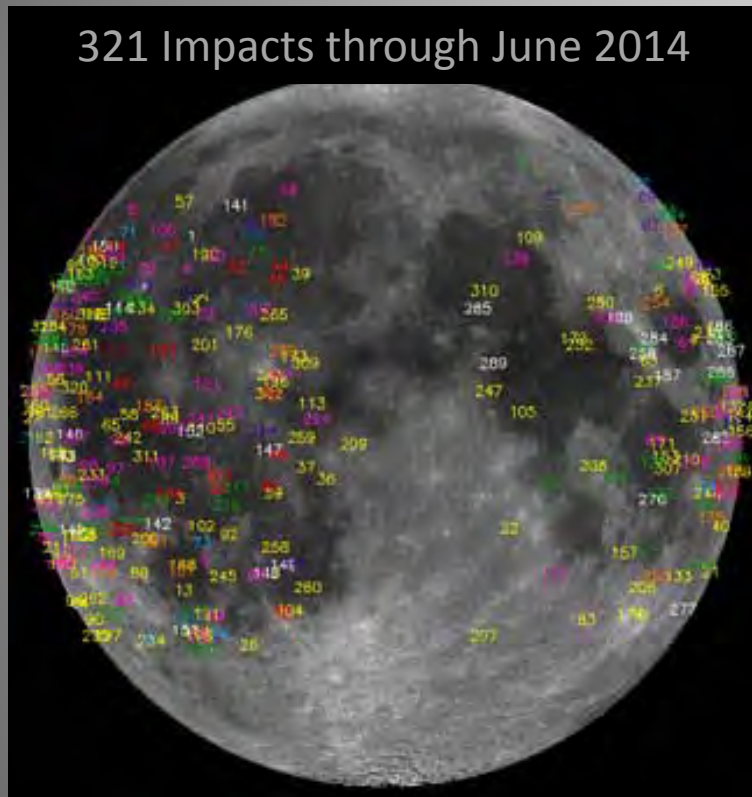


Image Credit: NASA Meteoroids Environment Office

Hypervelocity impact creates a $\sim 5^{\text{th}}$ mag flash of duration typically a few tens of milliseconds (only 1 or 2 video frames).

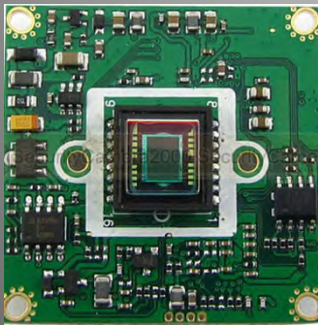
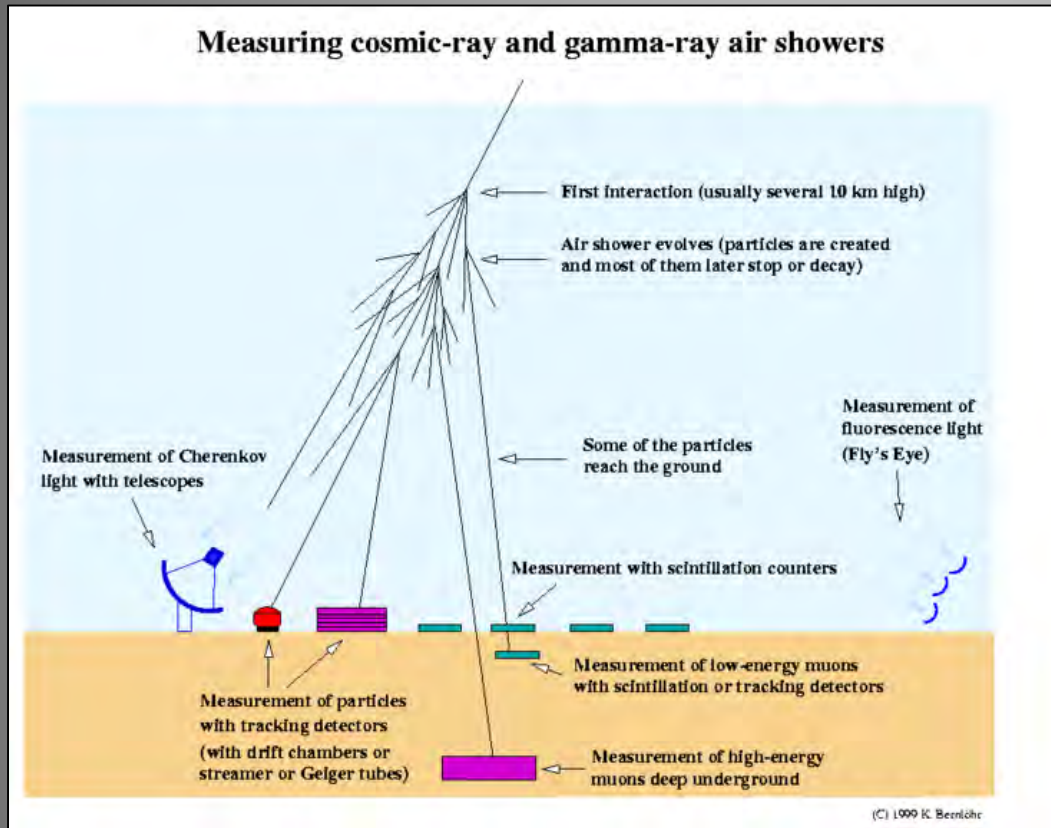
Monitor the moon with ≥ 300 fps video

Try to obtain spectrum of impact flash

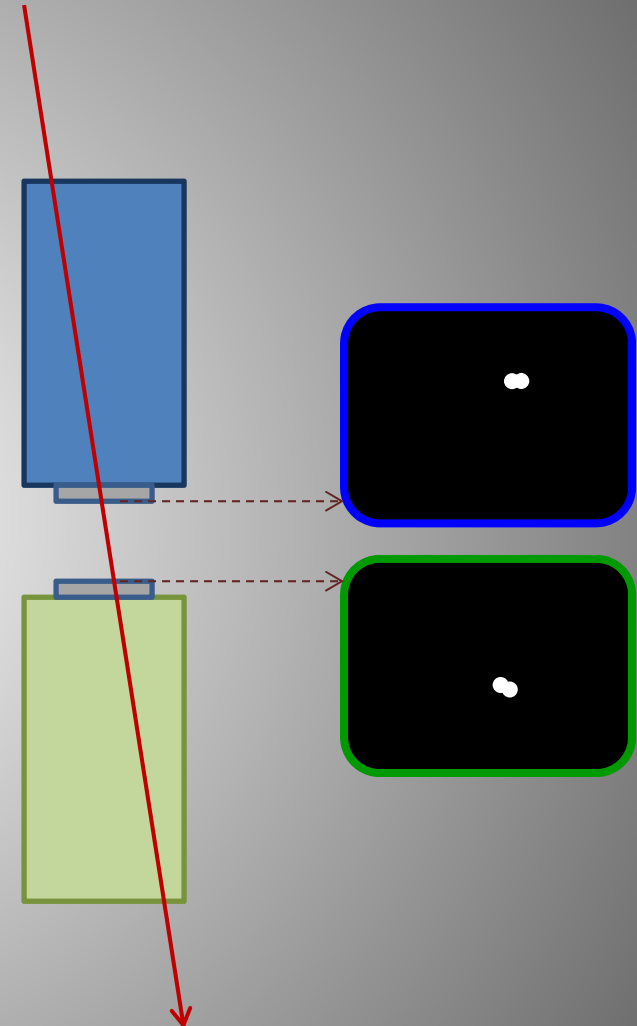
Got a 1 meter doing nothing during first and last quarter ?

Directional Cosmic Ray Detector

Concept by Damir Segon



Can use low cost board cameras
e.g. Effio-E w/Exview HAD II



Massive Compact Halo Object (MACHO) Detection

Concept by Dr. Robert Hawkes



Jupiter sized objects wandering the galaxy

A star briefly winks out from occultation

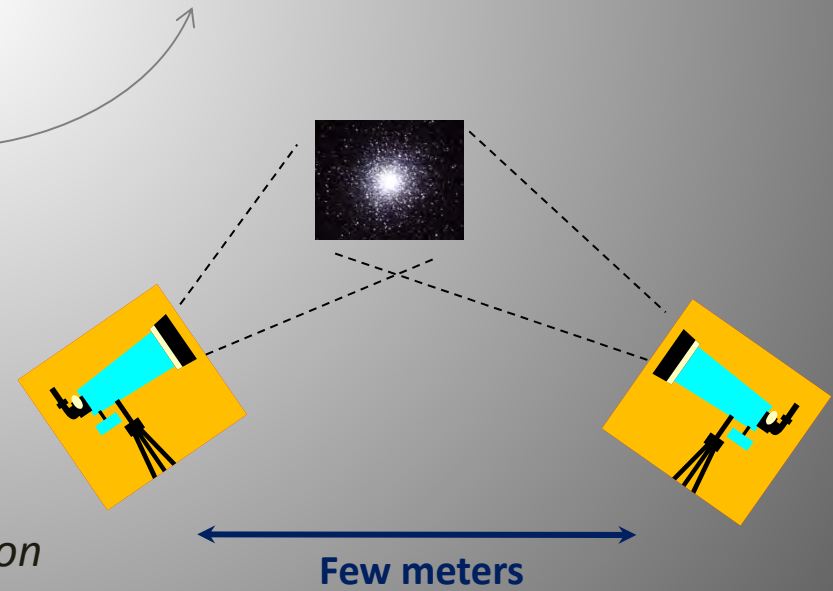
Collection CONOPS

Pair of dense common star field videos

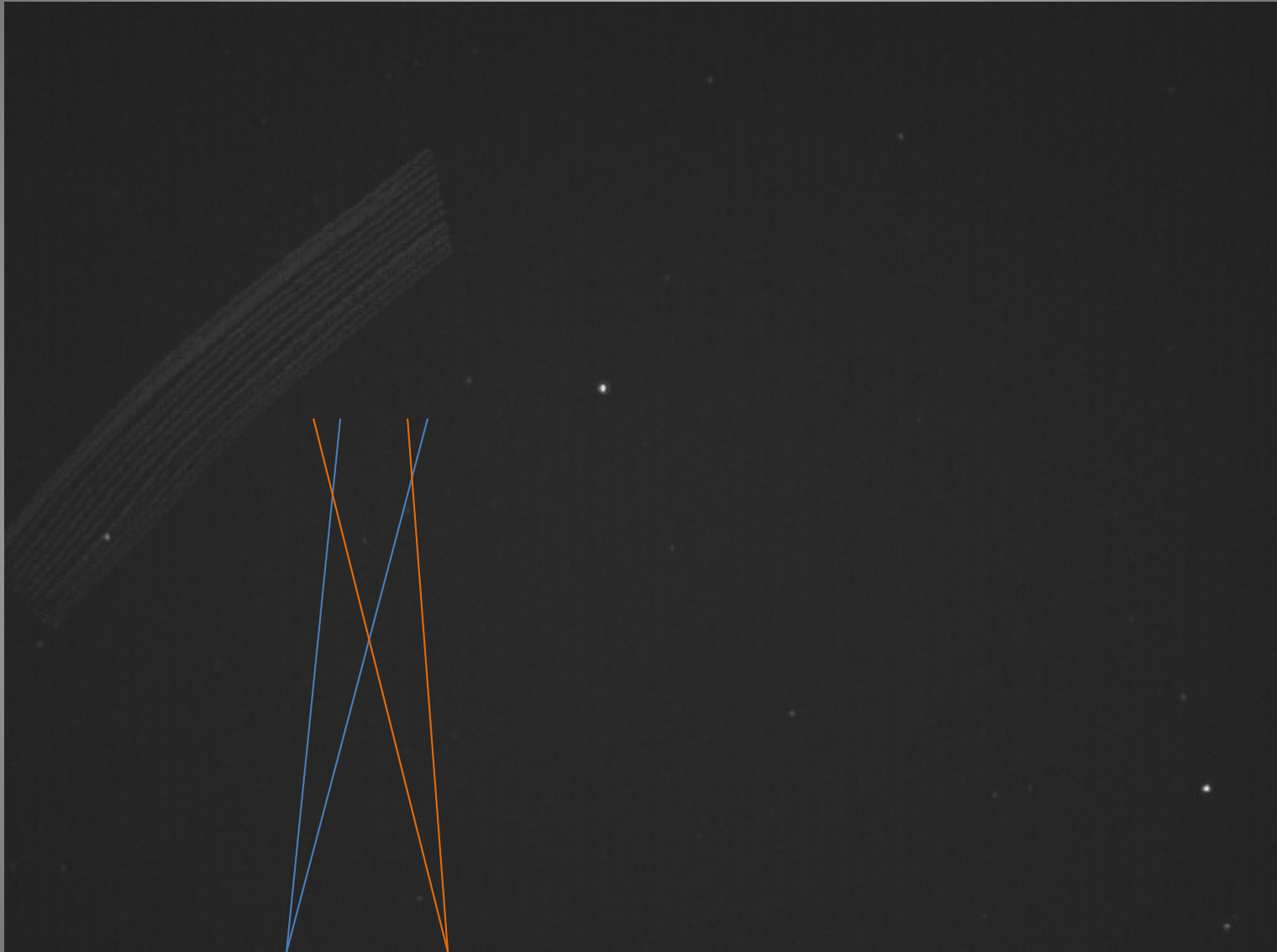
Globular, open cluster, or any field

Search for short timescale occultation

Space/time coincidence to rule out scintillation



Ornithology - Bird Migration



Obtain Height and Number Count – Correlate to Radar Returns

Low-Medium Cost Video Meteor Cameras & Digitizers

Meteor Video Cameras

Watec 902H2 Ultimate us\$342

Exview HAD II 1/2"

Mintron 12V6HC us\$425

Exview 1/2"

MallinCam Jr. Pro us\$700

Exview HAD 1/2"

Orion Star Shoot us\$500

Mintron 72S85HN-EX-R COLOR 1/2"

→ **Effio-E box with OSD** us\$65

Exview HAD II 1/3"

Effio-E board us\$39

Exview HAD II 1/3"

Video Capture Devices

→ **Ezcap.tv dongle** us\$32

Orion dongle us\$50 (*de-interlaced*)

Dazzle USB us\$70

ADVC-55 USB us\$175

Sensoray Models

#2255 = 4 channel USB us\$472

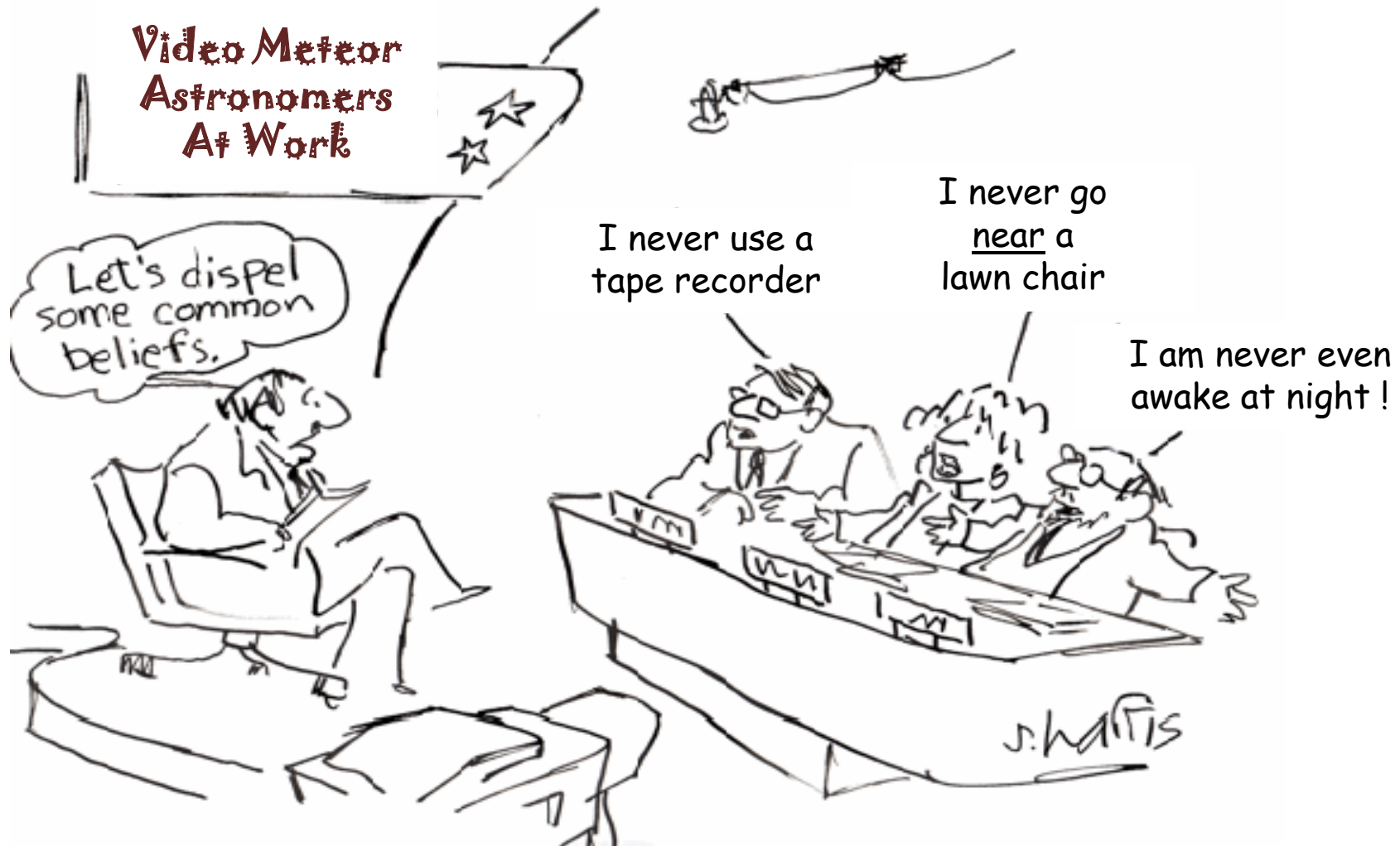
→ **#812 = 8 channel PCI 1x** us\$199

#817 = 16 channel PCI 1x us\$1058

PAL and NTSC

Have not researched HD pricing

Video Meteor Astronomers At Work



... so get out there and innovate !