Low cost robotic imaging system for high precision photometry

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System characteristics / summary

Experimental system, main goals are:

- **test cost-effective approach to surveys (unit cost = $14000 with labor)**
- **test suitability of mass produced CMOS arrays for science**
- **test new efficient algorithm for exoplanet transit detections**

150 sq degree FOV, 7cm aperture (etendue = 1m telescope, 1deg diam FOV)
10” per pixel
photon-noise limited on sky background

Low cost, use of mass-produced commercial components:

- Canon DSLR camera
- Atlas EQ-G mount
- 85mm F1.2 lens

No dome, No custom electronics or machining
Open source software, running under conventional linux
All information available on public website, to encourage duplication & improvements:
www.naoj.hawaii.edu/staff/guyon

Fully robotic, robust to weather, hardware failures, software errors
automatic decision making (flats, darks, observe, choose target)

Easy to duplicate and upgrade, low cost – scalable to multiple units, higher angular resolution (with longer focal length lens)

Installed Dec 30, 2010 – working robotically now
New algorithms for high precision photometry (looking for exoplanet transit)

Key components

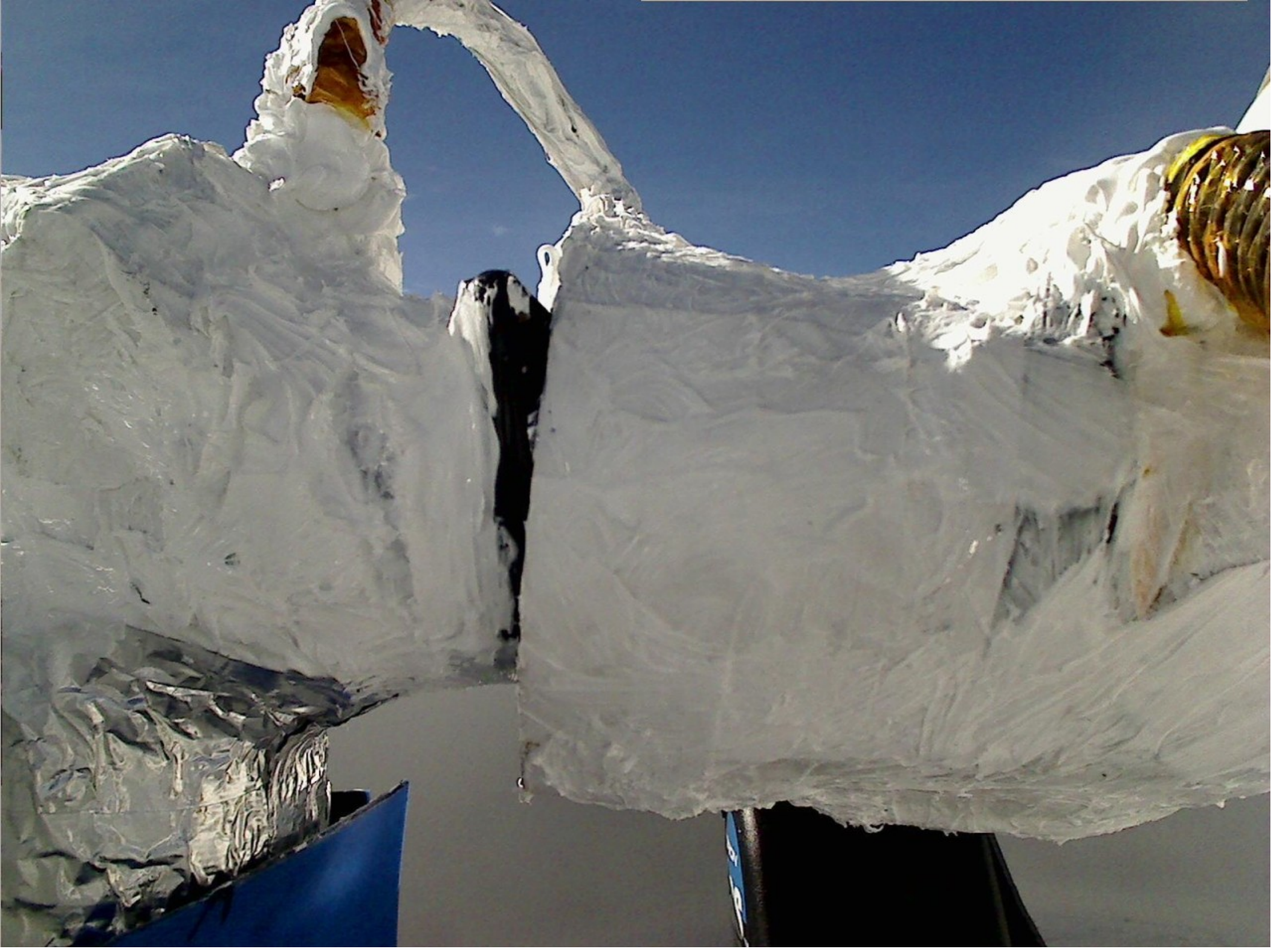
$1920

$550

$1400

Laptop

$800



New high precision photometric algorithm for transiting exoplanets

Exoplanet transit hypothesis tested for each transit period/phase/duration
→ more optimal than conventional process: light curve → transit identification

For each test of transit, use data around transit time to build optimal linear combination of field stars which reproduces target star image (spatial and temporal)
- optimally takes into account color effects, subpixel effects
- good correction for variable extinction

Overcomes disadvantages of color array, and uses color information to reach higher precision

Conventional process (light curve → transit identification) does not work well because the algorithm used to compute light curve should be a function of the transit parameters

This approach is required for transit detection with color array, and will also benefit projects using conventional B/W CCDs