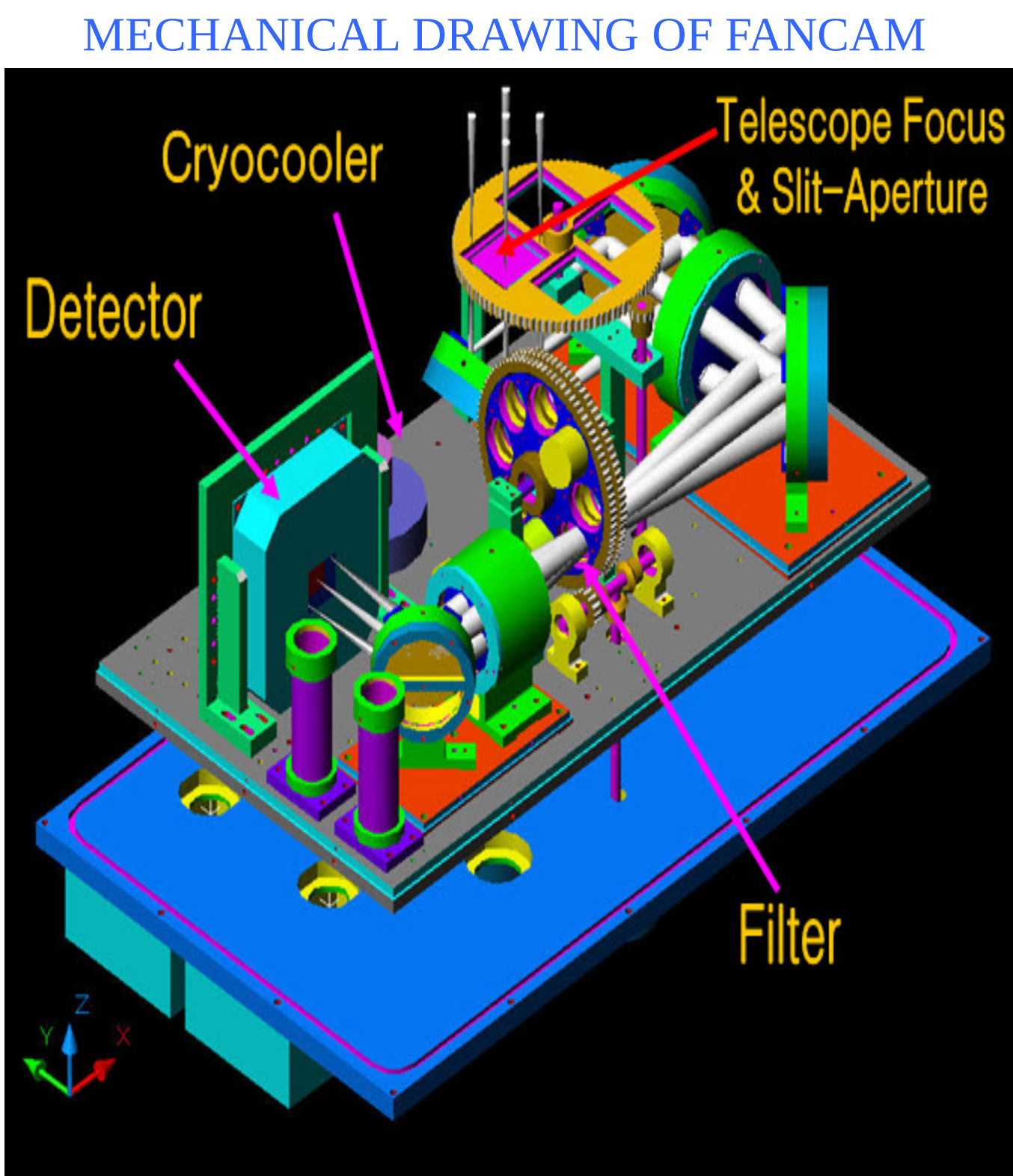


New Possibilities for Measuring Parallaxes at Fan Mountain Observatory

Jennifer Lynn Bartlett (US Naval Observatory), Chan Park (Korea Astronomy & Space Science Institute/University of Virginia), Srikrishna Kanneganti (University of Virginia), & Philip A. Ianna (University of Virginia)

CHARACTERISTICS OF FANCAM		
Parameter	Value	Reference
FPA	Rockwell Scientific HAWAII-1 HgCdTe thick, back-illuminated, coated	Farris 2004
FOV	8.7 arcmin ²	KC09
Detector Size	1,024 x 1,024 pixels	Farris 2004
Pixel Size	18.5 μm ²	Farris 2004
Resolution	0.51” pixel ⁻¹ 27.56” mm ⁻¹	KC09
Spectral Response	0.85–2.5 μm	
Field Curvature	<50 μm	KC09
Distortion	<0.1 pixel over 90% of field 0.5 pixel at corners	KC09
Detector Gain	4.6 e ⁻ DN ⁻¹	KC09
Read Noise	17 e ⁻ rms	KC09
Dark Current	<0.1 e ⁻ s ⁻¹	Beletic et al. 2008
Well Capacity	>97 ke ⁻	Farris 2004
Quantum Eff., K	58.10 %	Farris 2004
Operating Temp.	80 K	Farris 2004



AVERAGE STANDARD DEVIATIONS FOR INDIVIDUAL FRAMES COMPARED TO TRAIL PLATES				
Frame Batch	X-Coordinate (μm)	Y-Coordinate (μm)	XY-Averaged (μm)	Comment
All	1.31 ± 0.67	1.34 ± 0.77	1.32 ± 0.72	
Jan. & Nov. Early	1.27 ± 0.80	1.24 ± 0.79	1.26 ± 0.79	Frames within 15 minutes of meridian
Feb. & Nov. Late*	0.73 ± 0.34	1.33 ± 0.43	1.03 ± 0.48	Frames greater than 50 minutes west
Jan. Only	2.02 ± 0.88	1.88 ± 0.88	1.95 ± 0.75	2- and 5-s exposures
Feb. Only	1.02 ± 0.57	1.73 ± 0.77	1.38 ± 0.75	Frames greater than 160 minutes west, 5-s exposures
Nov. Only*	0.58 ± 0.58	0.83 ± 0.39	0.71 ± 0.32	All frames for November
Nov. Early*	0.57 ± 0.15	0.57 ± 0.15	0.69 ± 0.33	Frames within 15 minutes of meridian
Nov. Late*	0.60 ± 0.16	1.03 ± 0.22	0.82 ± 0.29	Frames greater than 50 minutes west

NOTE: *Astrometric evaluation star 7 dropped from these batches because it saturated in the Nov. frames averaged for a “trail plate.”

COMPARISON OF ASTROMETRIC PRECISION				
Program	Average m.e.1		Median m.e.1	
	(μm)	(mas)	(μm)	(mas)
UVa FanCam, all	1.3	40	1.1	30
UVa FanCam, Nov. only	0.7	19	0.6	16
USNO ASTROCAM (Vrba 2006)	0.2	3	...	...
ESO NTT SofI (TBK03)	...	...	0.78	12.1

COMPARISON OF PIXEL SCALES		
Detector	Pixel Size (μm ²)	Pixel Scale (” pixel ⁻¹)
FanCam (Farris 2004, KC09)	18.5	0.51
IRCAM (Vrba 2006)	40	0.54
ASTROCAM (Vrba et al. 2004)	27	0.3654
ESO NTT SofI (ESA 2008, TBK03)	18.5	0.28826

31-inch TINSLEY DOME AT FAN MOUNTAIN



Fan Mountain Observatory

- Dark site outside of Charlottesville, VA
78° 41.6' E
37° 52.7' N
556 m elevation

- Operated by UVa since mid-1960s

- Median seeing 1.5”

31-inch TINSLEY CONTROL ROOM



Results

FanCam infrared parallax program is feasible

- Resulting astrometric precision overall

- x (α): 1.3±0.7 μm (0.04”±0.02”)

- y (δ): 1.3±0.8 μm (0.04”±0.02”)

- xy-averaged: ±1.3 μm (±0.04”)

- comparable w/ ESO NTT program (TBK03)

- better than photographic plates (Guinan & Ianna 1983)

FanCam could contribute to Solar Neighborhood Census (25 pc)

- 1,131 stellar systems identified in northern hemisphere (K. Slatten 2009, priv. comm.)

- 3,125 systems expected in northern hemisphere (K. Slatten 2009, priv. comm.)

- New members probably intrinsically faint stars and brown dwarfs, λ_{peak} ≥ 0.9 μm (Drilling & Landolt 2000)

FanCam could contribute to brown dwarf studies

- 752 L and T dwarfs, 86 have parallaxes (Gelino, Kirkpatrick, & Burgasser 2004)

- 119 northern brown dwarfs are possible solar neighborhood members (K. Slatten 2009, priv. comm.)

Method

- Used FanCam mounted on UVa 31-inch Tinsley reflector

- Observed NGC 2420, open cluster

- 68 J-band frames

- 16 astrometric evaluation stars

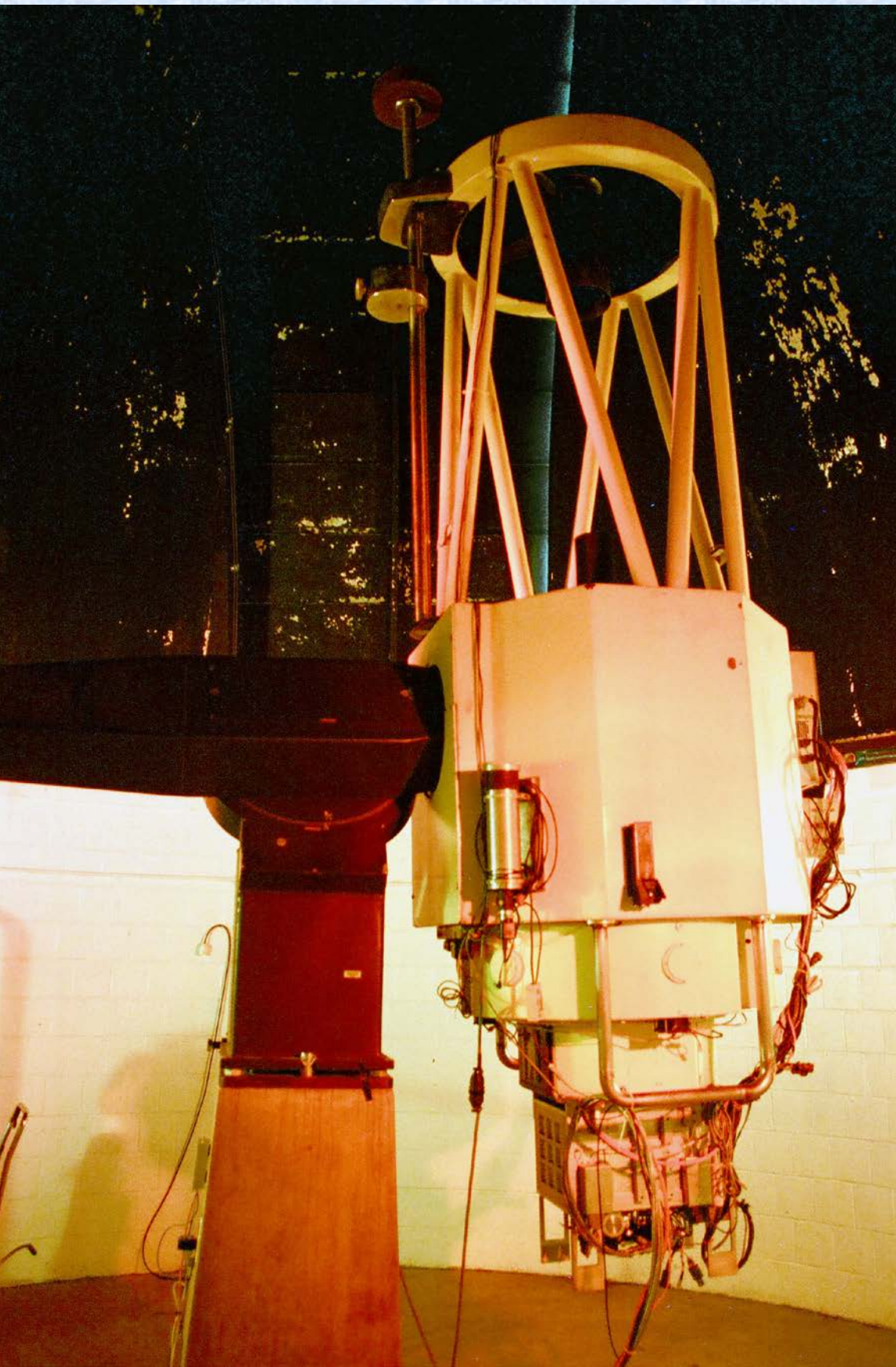
- Jan., Feb., & Nov. 2005

- Range of hour angle

- Flattened NGC 2420 images using custom IRAF tasks

- Measured positions of NGC 2420 stars using Southern Parallax Program pipeline (Begam, Ianna, & Patterson 2010, in prep)

- Considered various combinations of frames

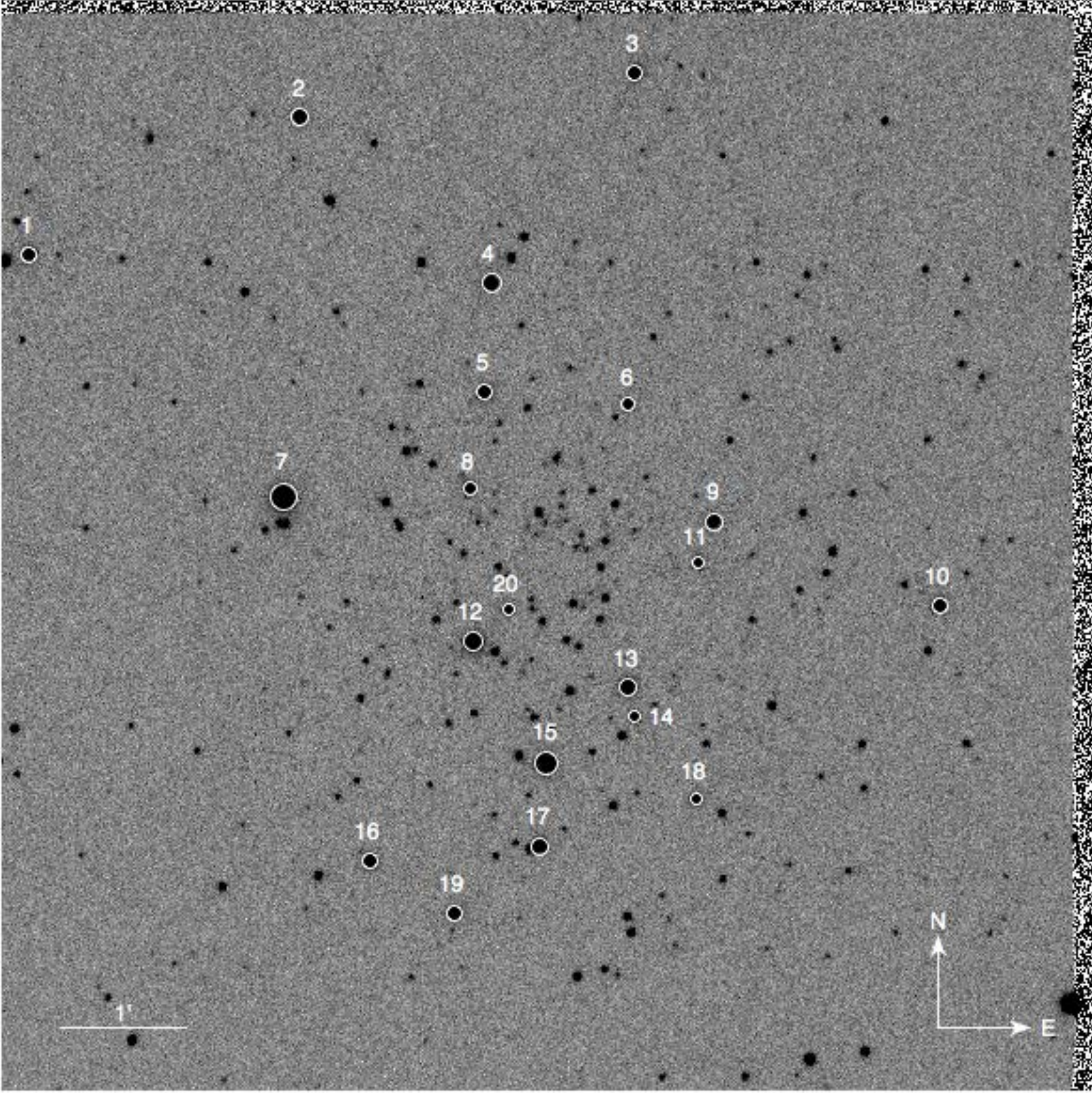


31-inch (0.8-m) TINSLEY REFLECTOR

Parameter	Value
Objective Size	0.7810 m 30.75 in
Optics	classical Cassegrain
Focal Ratio	f/15.484
Effective Focal	12.19 m
Length	480.0 in
Focal Plane Scale	16.92” mm ⁻¹

REFERENCE: Tinsley Lab., 1963

FANCAM J-BAND IMAGE OF NGC 2420



NGC 2420
Open Cluster for Astrometric Evaluation

- 10-s, J-band frame on 2005 May 9

- 2MASS Prototype J filter

- Passband 1.105–1.395 μm

- Central wavelength 1.250 μm

- Transmittance 75% (ave)

- Limiting magnitude 19.0 (KC09)

- Astrometric evaluation stars identified

- Star 20 treated as parallax star by reduction software, used to grade frames and estimate seeing

- Stars 1, 2, 3, and 10 dropped because they do not appear in Jan. “trail plate”

- Star 7 dropped from several batches because it saturated in some Nov. frames

- FanCam misalignment with focal plane aperture apparent

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FOR MORE INFORMATION

Contact authors at jennifer.bartlett@usno.navy.mil
Visit facility webpage at www.astro.virginia.edu/research/observatories/31inch

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