

The CCD is dead, Long Live the CCD

Steve Chambers



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Sony Announces End of CCD Sensor Production

February 25, 2015 No Comments

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KEYWORDS automated vision systems /
automated visual inspection / CCD / CCD
sensors / CMOS

have discovered that



Who killed the CCD

CCD

CMOS

EMCCD

sCMOS

Who killed the CCD

$$SNR = \frac{QE \times S}{\sqrt{F_n^2 \times QE \times (S+I_b) + (N_r/M)^2 + (D_n \times t)^2}}$$

The suspects

Sony ICX

sCMOS

EMCCD1

CCD KAI

EMCCD2

DSLR

Sony IMX

Imaging at the limit

	Sony ICX	sCMOS	EMCCD1	CCD KAI	EMCCD2	DSLR	Sony IMX
QE	0.8	0.72	0.93	0.5	0.5	0.4	0.75
Signal	1	1	1	1	1	1	1
Fn	1	1	1.4	1	1.4	1	1
BackGround	0	0	0	0	0	0	0
Read Noise	3	1.3	8	7	7	6	7
Mult	1	1	1000	1	30	1	1
Dark Sig	0.0001	0.02	0.00007	0.0005	0.0005	1.3	0.75
Exp Time	0.03	0.03	0.03	0.03	0.03	0.03	0.03
SNR	0.26	0.46	0.69	0.07	0.49	0.07	0.11

Normal Video Imaging

	Sony ICX	sCMOS	EMCCD1	CCD KAI	EMCCD2	DSLR	Sony IMX
QE	0.8	0.72	0.93	0.5	0.5	0.4	0.75
Signal	1000	1000	1000	1000	1000	1000	1000
Fn	1	1	1.4	1	1.4	1	1
BackGround	0	0	0	0	0	0	0
Read Noise	3	1.3	8	7	7	6	7
Mult	1	1	1000	1	30	1	1
Dark Sig	0.0001	0.02	0.00007	0.0005	0.0005	1.3	0.75
Exp Time	0.03	0.03	0.03	0.03	0.03	0.03	0.03
SNR	28.13	26.80	21.78	21.34	15.97	19.16	26.53

Astro Imaging (RGB)

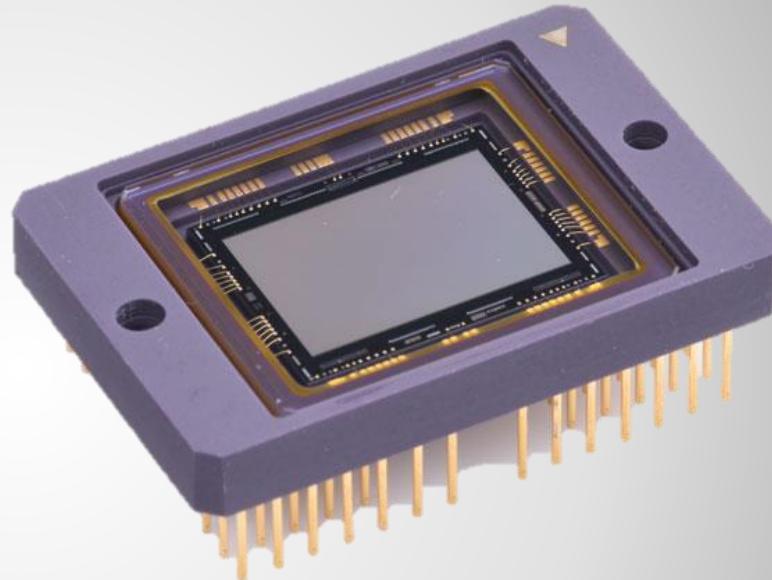
	Sony ICX	sCMOS	EMCCD1	CCD KAI	EMCCD2	DSLR	Sony IMX
QE	0.8	0.72	0.93	0.5	0.5	0.4	0.75
Signal	10	10	10	10	10	10	10
Fn	1	1	1.4	1	1.4	1	1
BackGround	100	100	100	100	100	100	100
Read Noise	3	1.3	8	7	7	6	7
Mult	1	1	1000	1	30	1	1
Dark Sig	0.0001	0.02	0.00007	0.0005	0.0005	1.3	0.75
Exp Time	300	300	300	300	300	300	300
SNR	0.81	0.77	0.66	0.49	0.48	0.18	0.40

Astro Imaging Ha

	Sony ICX	sCMOS	EMCCD1	CCD KAI	EMCCD2	DSLR	Sony IMX
QE	0.8	0.72	0.93	0.5	0.5	0.4	0.75
Signal	3	3	3	3	3	3	3
Fn	1	1	1.4	1	1.4	1	1
BackGround	20	20	20	20	20	20	20
Read Noise	3	1.3	8	7	7	6	7
Mult	1	1	1000	1	30	1	1
Dark Sig	0.0001	0.02	0.00007	0.0005	0.0005	1.3	0.75
Exp Time	300	300	300	300	300	300	300
SNR	0.46	0.44	0.43	0.19	0.31	0.06	0.13

Its still alive!

- Sony CCDs still offer great performance
- Alternative technologies including CMOS and EMCCD are getting more interesting for amateur astronomy.



Atik Cameras



- Range cameras designed for astronomy

Atik Cameras

Optimised for astronomical image quality



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Evangelos Souglakos 314L+

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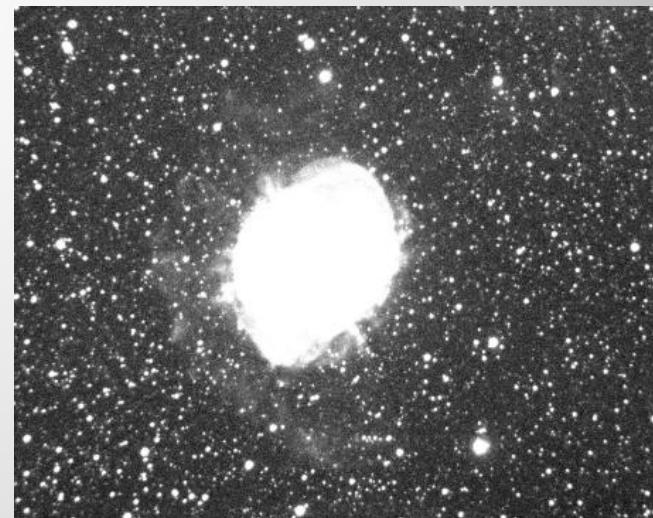
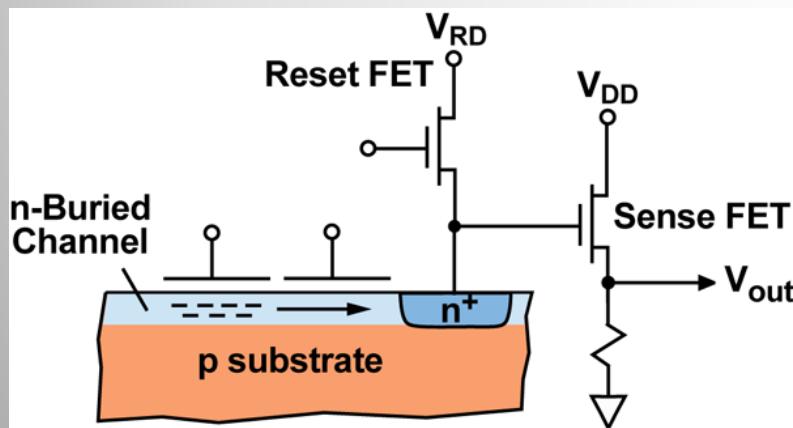
Atik Cameras

Optimised for astronomical image quality

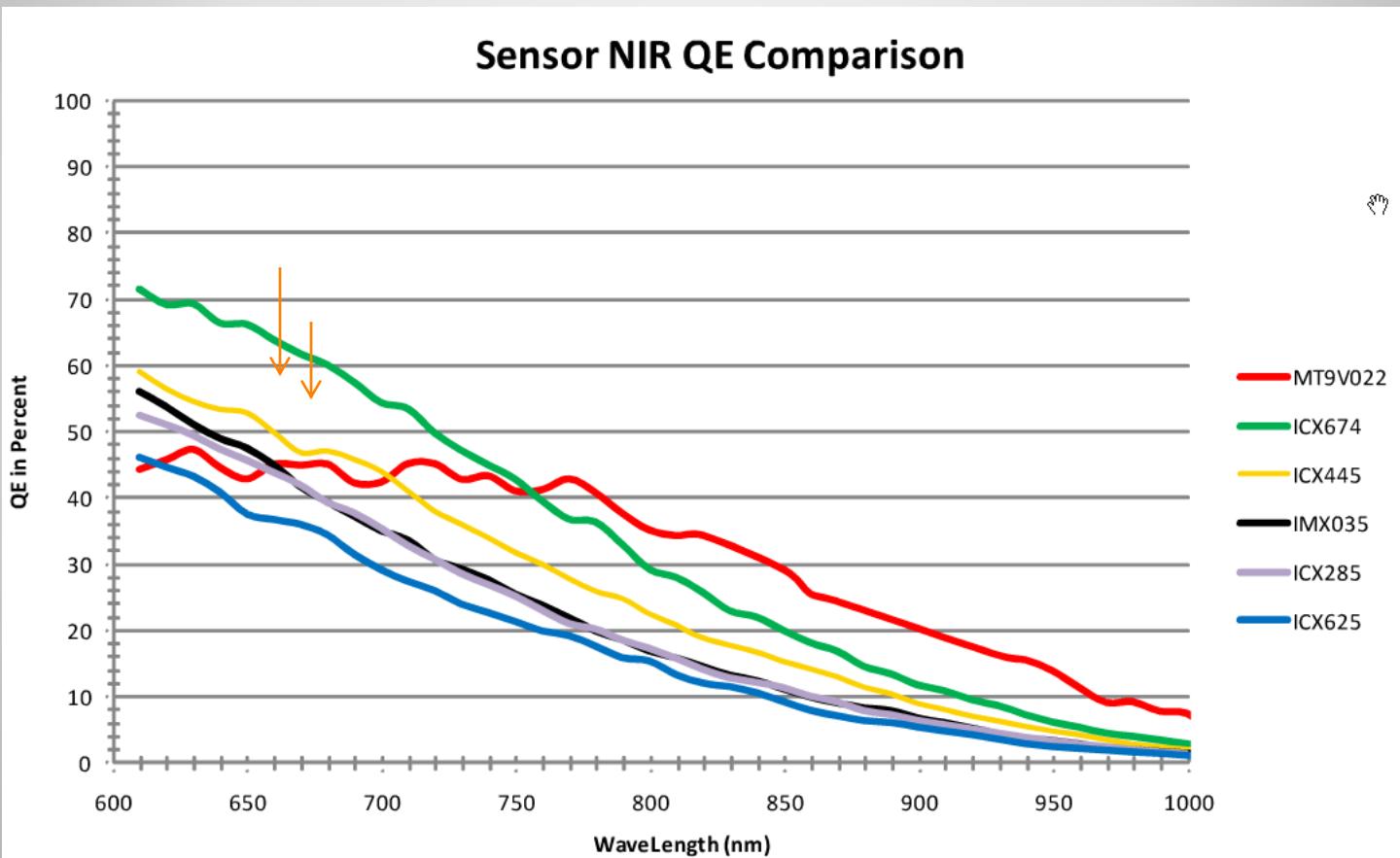
- The image quality of an astro image is most often limited by noise in the faint parts of an image.
- 3 Sources of noise
 - Read Noise / Signal
 - Thermal Noise
 - Shot Noise

Read Noise

- Noise associated with the electronics of the camera.
- The challenge is to not significantly add to the noise inherent in the CCD amplifier
- Independent of exposure length.
- The most significant factor near the detection limit



Signal - Quantum Efficiency



Thermal Noise

- Noise associated with the dark current
- Noise = Square root of dark current
- Eg Atik 314L+ has 0.0005 e/s/p dark current at 0 degrees.
- So in 20 min Sub we are still below 1 electron on average.
- Thermal noise will always be negligible compared with the other sources of noise.

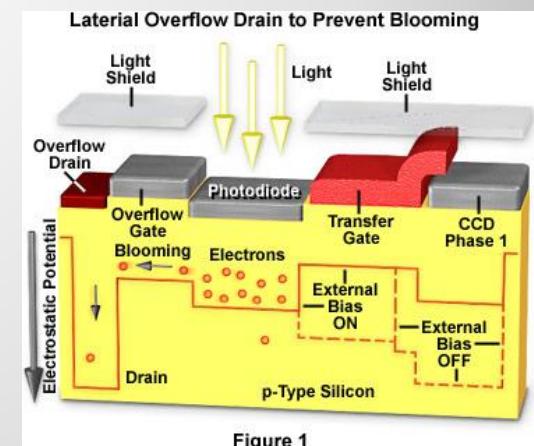


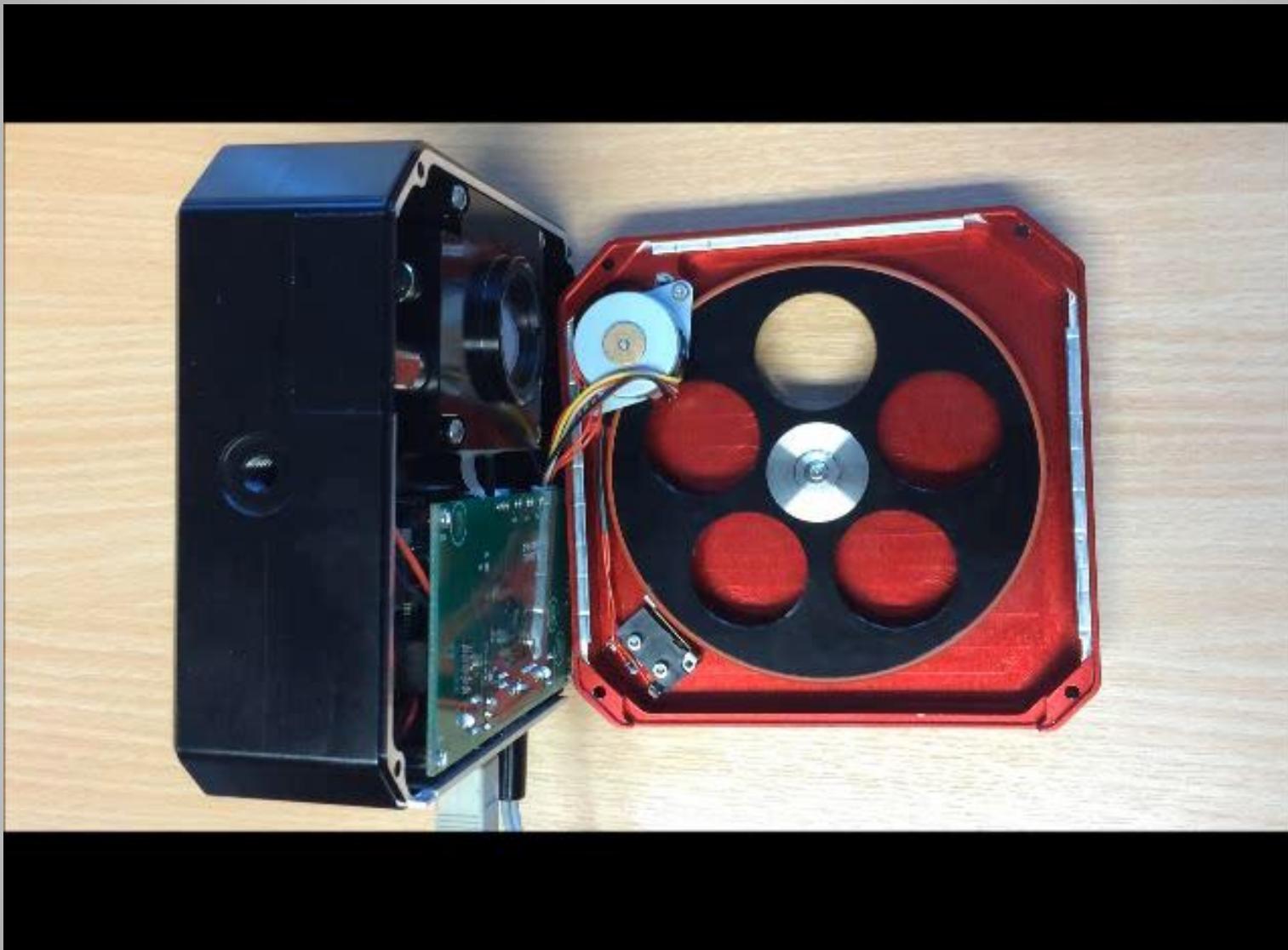
Figure 1

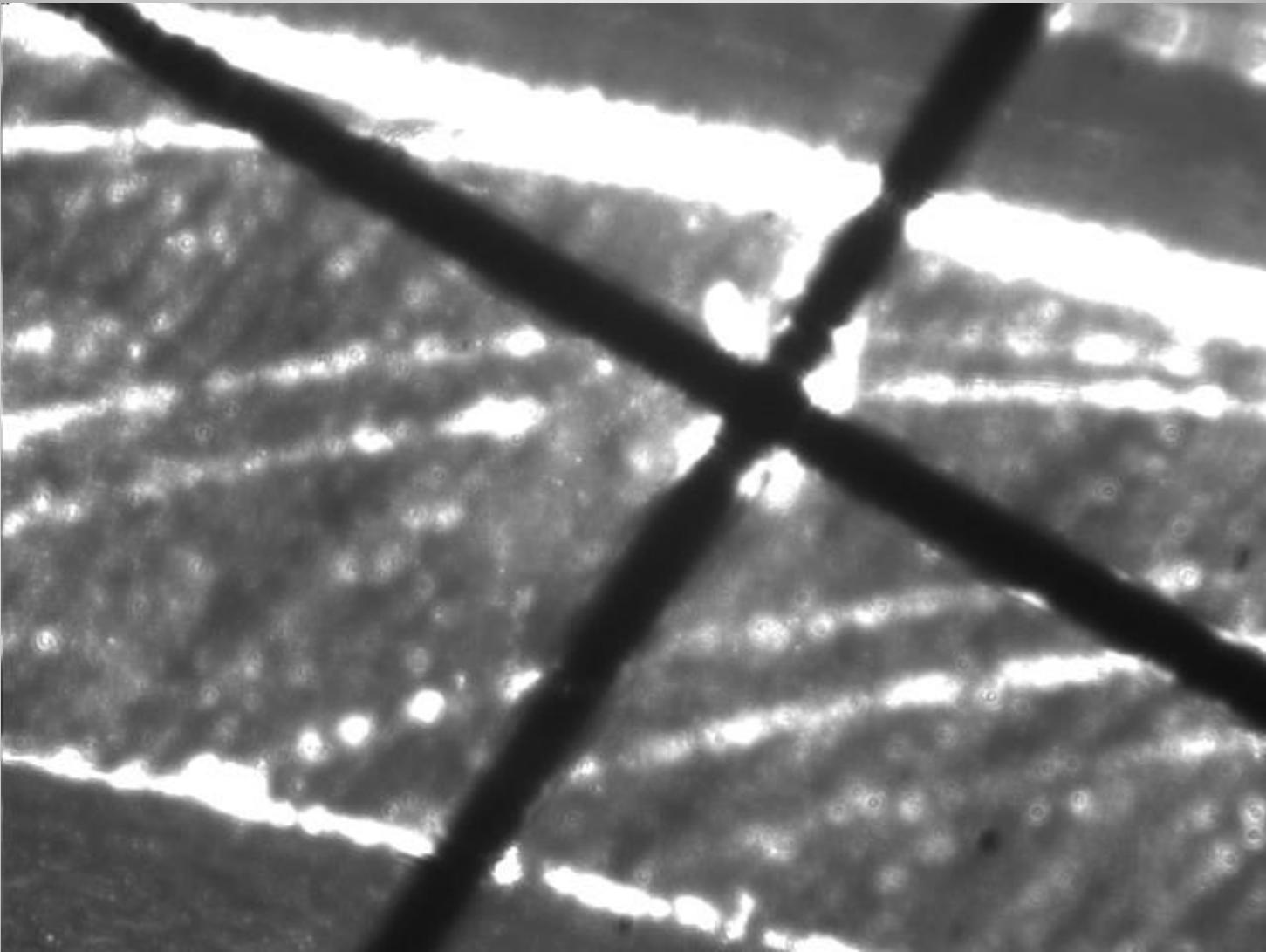
Shot Noise

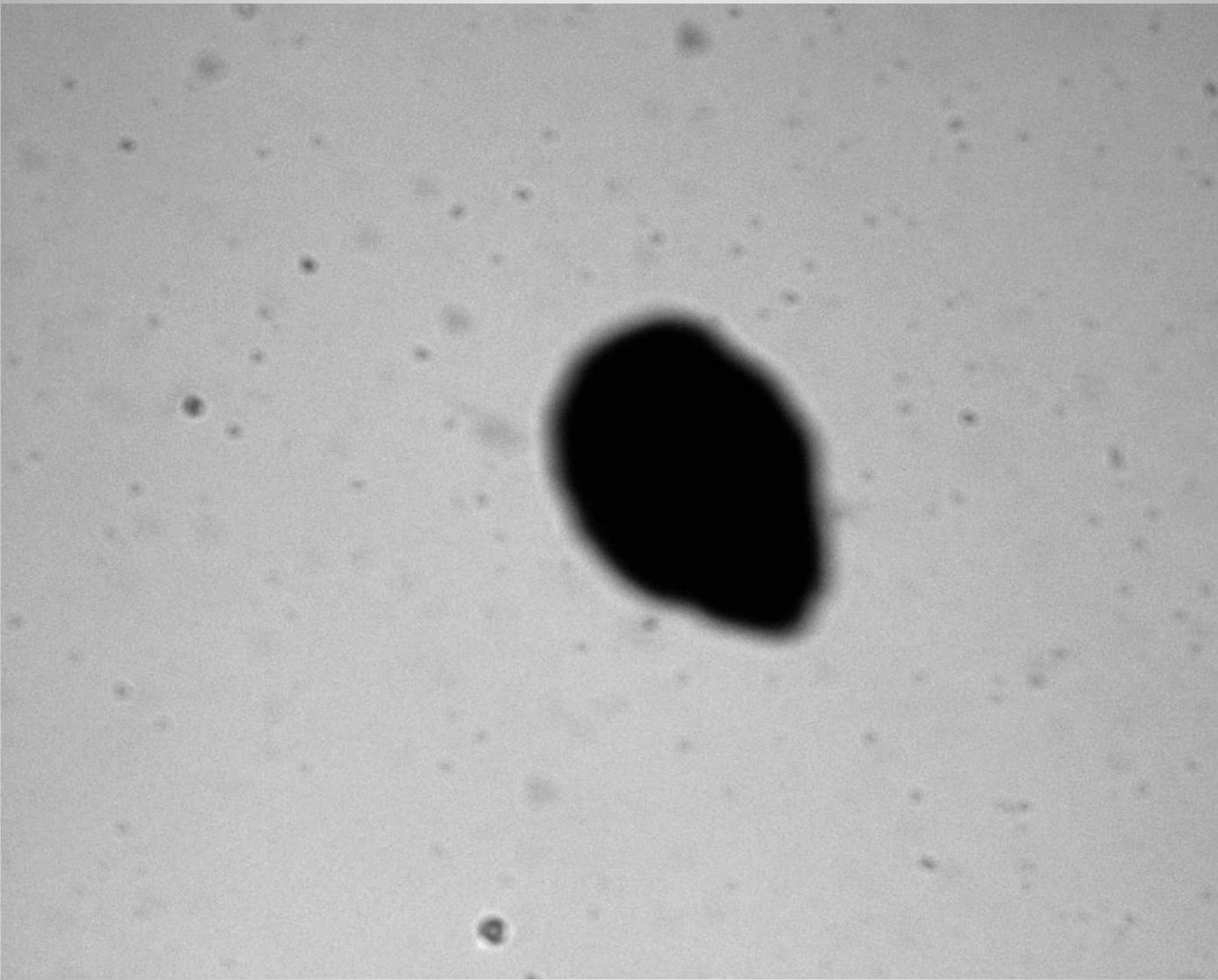
- Noise associated with signal
- Noise = Square root of signal
- Dominant source of noise in high signal areas
- Improved by high QE and large wells
- In astro imaging its not often a limiting factor.

Ease of use / Enjoyable to use



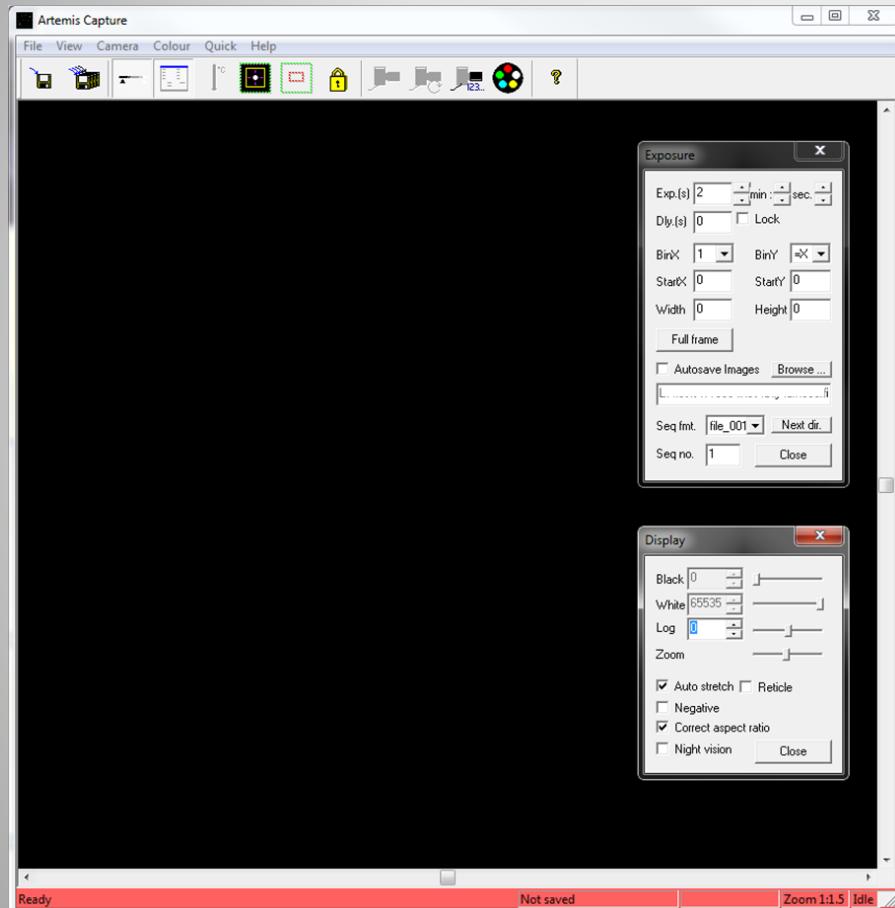






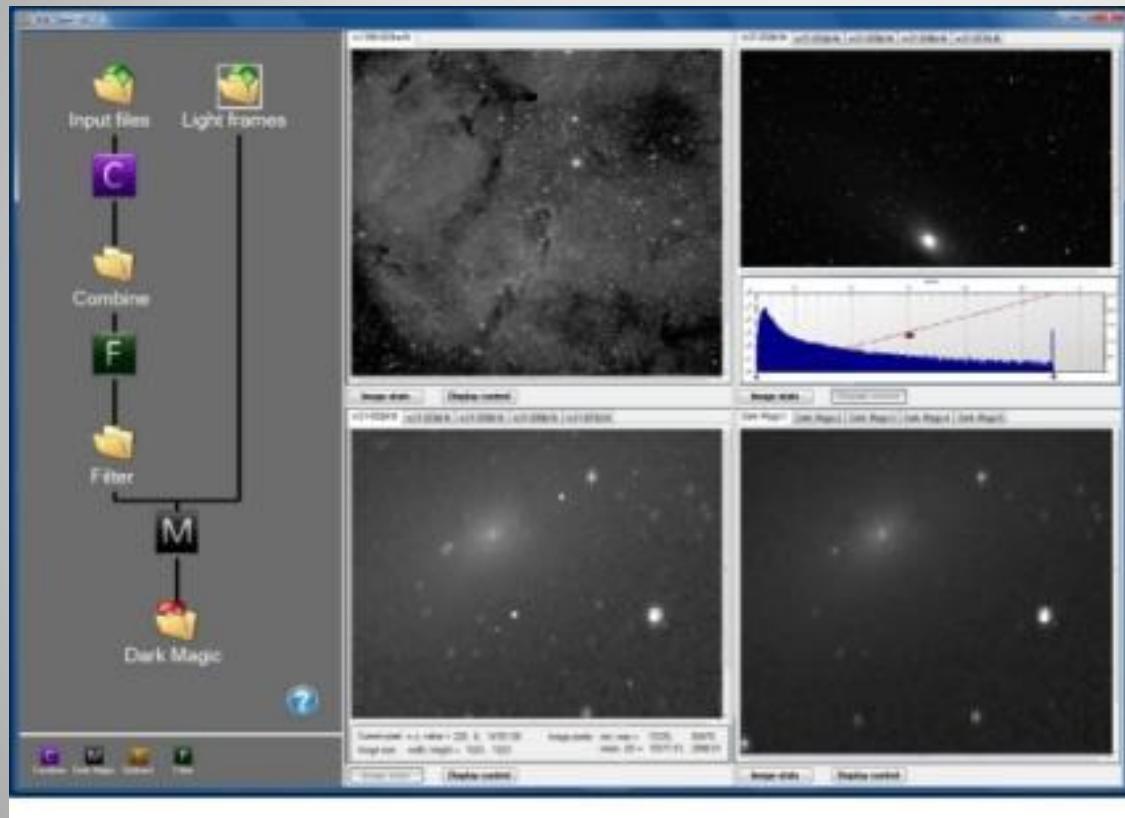
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Software



- Camera control
- Filterwheel
- Sequencing
- Guiding
- Dithering

Software



- Aligning
- Stacking
- Darks
- Flats
- Colour combine

Atik Astro Imagers

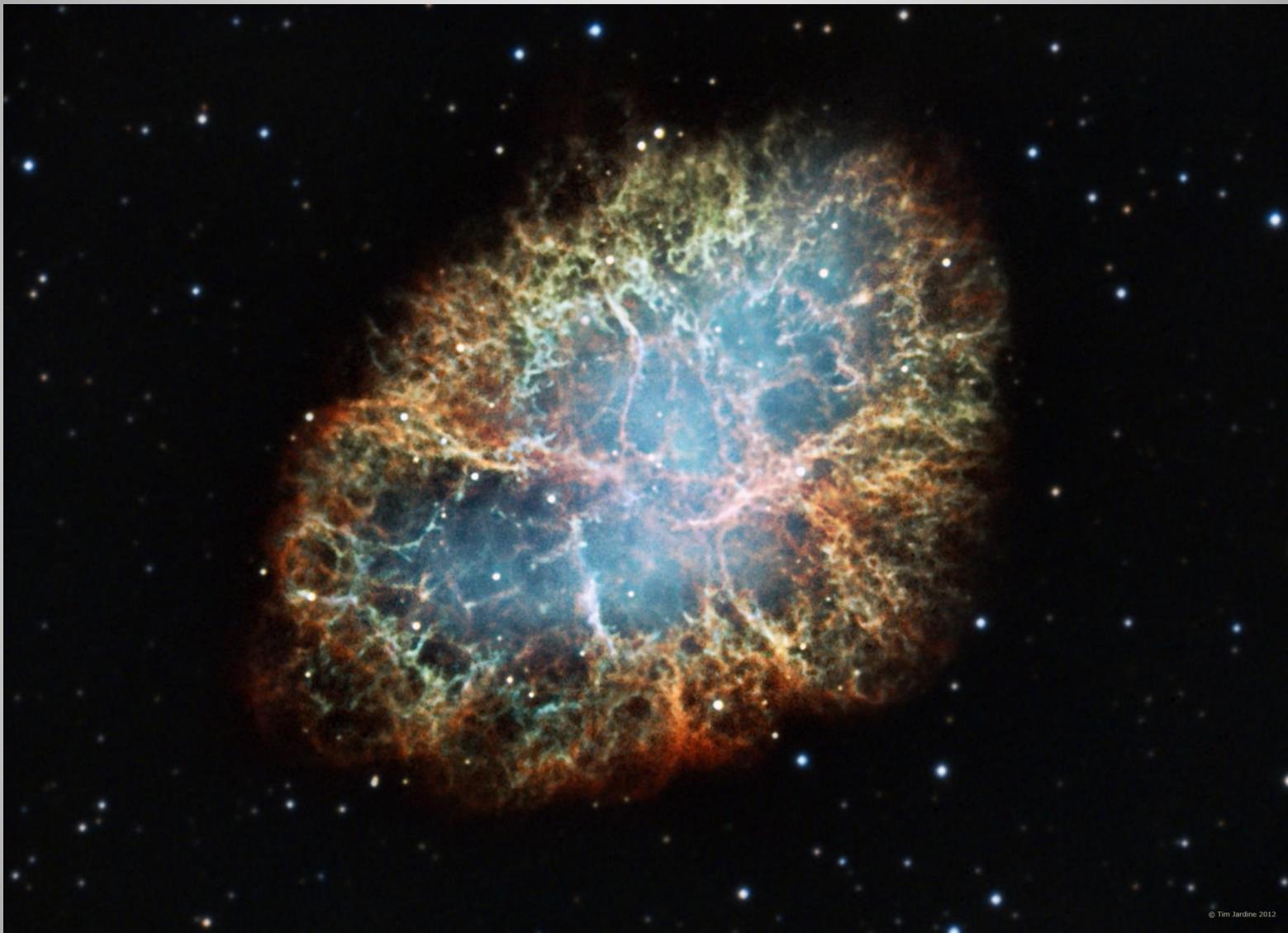


Rui Tripa – Production manager
Pedro Mota – Production
Vince Bygrave – Support
Steve Chambers – Design





NGC672 S Chambers C11 Atik 460ex CEDIC'15



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Tim Jardine 428ex C11 EdgeHD @ 2800mm CEDIC'15



Angelos Kechagias 428ex

CEDIC'15

Thank You

www.Atik-Cameras.com

