

Discovery of Comet C/2013 R1 (rev 2)

In recent months I have been putting a considerable amount of effort into improving my automatic comet detection software. It's now at the point I am saving a considerable amount of time compared to the old method of blinking frames by eye. So it's really pleasing to have the software find a new comet, C/2013 R1.

On the morning of September 7 (UT) I did an imaging run consisting of 225 individual fields, with 3 separate exposures on each field. By taking 3 separate exposures of the same field, spaced by a time interval of, in this case 8.5 minutes, allows detection of minor planets and asteroids much easier. In practice objects moving as slowly as 0.2 degrees per day show a small but noticeable shift between the images.

Returning to September 7, all of the fields were processed through the detection software which identified a number of suspects. Although mostly false positives were found in the form of poorly registered stars, reflections and asteroids but one the suspects located in field number 76, centred on RA 6h 00m Dec -7d 9m, looked very much like a comet. At first I thought this would be one of the existing periodic comet's, but a quick check in guide showed nothing as well as a check using the online Comet NEO Checker tool on the Minor Planet Center website. A further check against the Digital Sky Survey showed nothing either (sometimes a row of faint stars can give the impression of a moving object if one or more of the stars is not visible in one of the image triplets). Below is the actual image triplet with the suspect in it.

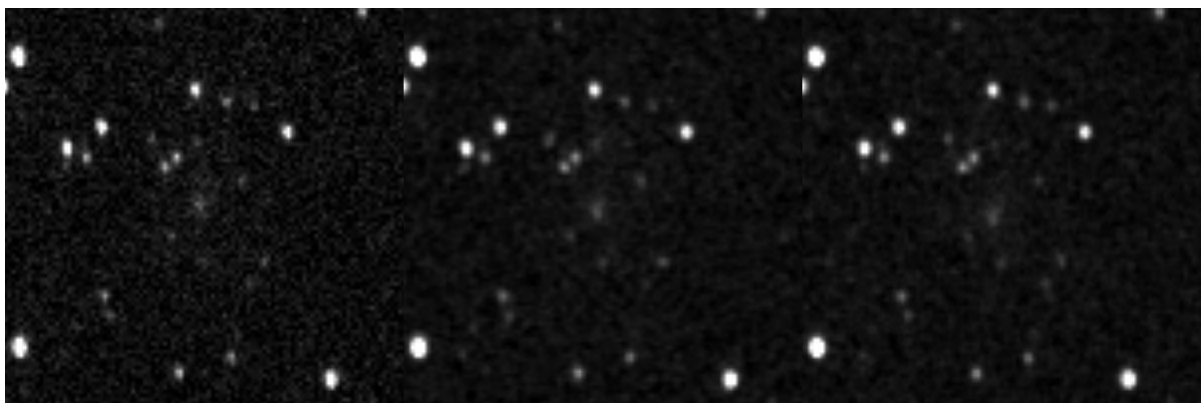


Figure 1 – The “suspect” as imaged at 2:30am, 2:38am and 2:47am local time. Each exposure is 14 seconds

Once it was established there was no existing object was there, it was necessary to rule out reflections from bright stars. I have been fooled by this a couple of times before, luckily never reporting it to CBAT until follow-up observations were performed. Furthermore it was surprising this could be a new comet, since the area was readily accessible to northern hemisphere surveys and amateur comet hunters.

So I extrapolated the position for the following morning at RA 05 59 40 and Dec -06 33 00 and waiting anxiously for that area of sky to get high enough to image. At 1:15 am I fired off a single 30 second exposure and as the image displayed I immediately saw a diffuse object very close to the predicted position. I felt positive I had a new comet, but to be sure I began a sequence of 30 second exposures, and as the images display slowly but surely I could see the object move against the star field. There was now no question about this being a comet, but to be certain it was time for other

people to confirm the sighting and an orbit to be determined prior to an official announcement. The orbit is important in determining whether the comet is new, or a lost periodic one being rediscovered. Furthermore CBAT have a strict process to prevent embarrassing mishaps (in the past a number of non-existent comets actually got designations).

After obtaining 3 additional astrometric positions from September 8, I submitted a report to CBAT and soon the NEO Confirmation page was updated to reflect the new object. Thanks to the prompt action of the following stations A79, H36, H47, I39, I47, Sato at I89 and Guido, Howes, Sato, Novichonok, Urbanik, Ligustri at Q62 the comet was quickly confirmed as C/2013 R1 in CBET 3649 issued on September 9.

The prospects for C/2013 R1 are quite favourable as it approaches the earth to 0.4 AU in late November when it will most likely be visible in binoculars from dark skies. Images seem to indicate a larger external coma and that the true brightness is around 2 magnitudes higher than current predictions, so it will be interesting to watch total magnitude estimates as it gets closer to the sun. Perihelion occurs on Christmas day when it will be between the orbit of earth and Venus, but it will have receded to 0.9 AU from the earth which should result in a net fading (but it should also be more condensed then). During this time it will pass close to Comet ISON and it may be possible to photograph both of them together with a short telephoto lens.

Finally here are some summary of statistics for this find:

Parameter	Value
Comet Discovery Location	Monoceros
Comet Discovery Site	E27
Comet Designation	C/2013 R1
Discover Date	Sep 9.7688, 2013
Comet Altitude at discovery	28
Comet Discovery Magnitude	14
Images taken since last Discovery	70,000
E27 Latitude	27.55 S
E27 Altitude	30m
E27 Clear nights (Jan) typical	3
E27 Clear nights (Aug) typical	10
E27 Annual Rainfall	1200mm
E27 Typical night humidity	60-95%
E27 Sky Brightness range	SQM 19.0-20.0 at Zenith
Scope Aperture	20.3 cm
F ratio	2.1
T ratio (calculated)	2.9
Camera CCD	Kodak 8300 KAF
Field of view	2.44 x 1.83 degrees
Image Scale	5.21 arc secs
Exposure range	10-40 seconds
Software	Maxim DL ASCOM Source Extractor / Pinpoint

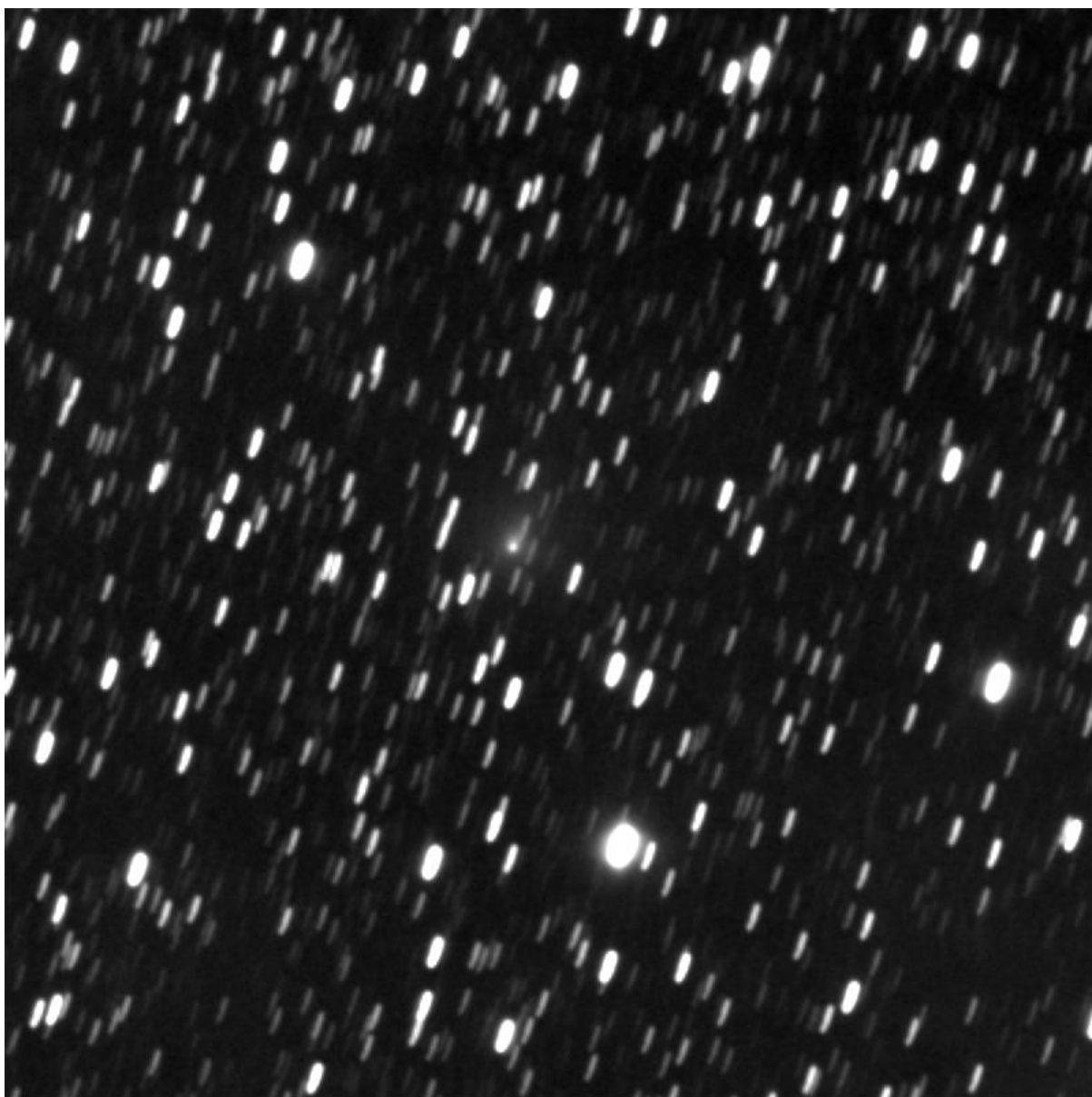


Figure 2- 2013 R1 : 80 x 30 second exposures, FOV is 33 x 33', North at left. Taken September 10.7, 2013 UT.

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