Review of RCOS 24RC Carbon Truss Ritchey-Chretien and Professional Series Equatorial Fork Mount

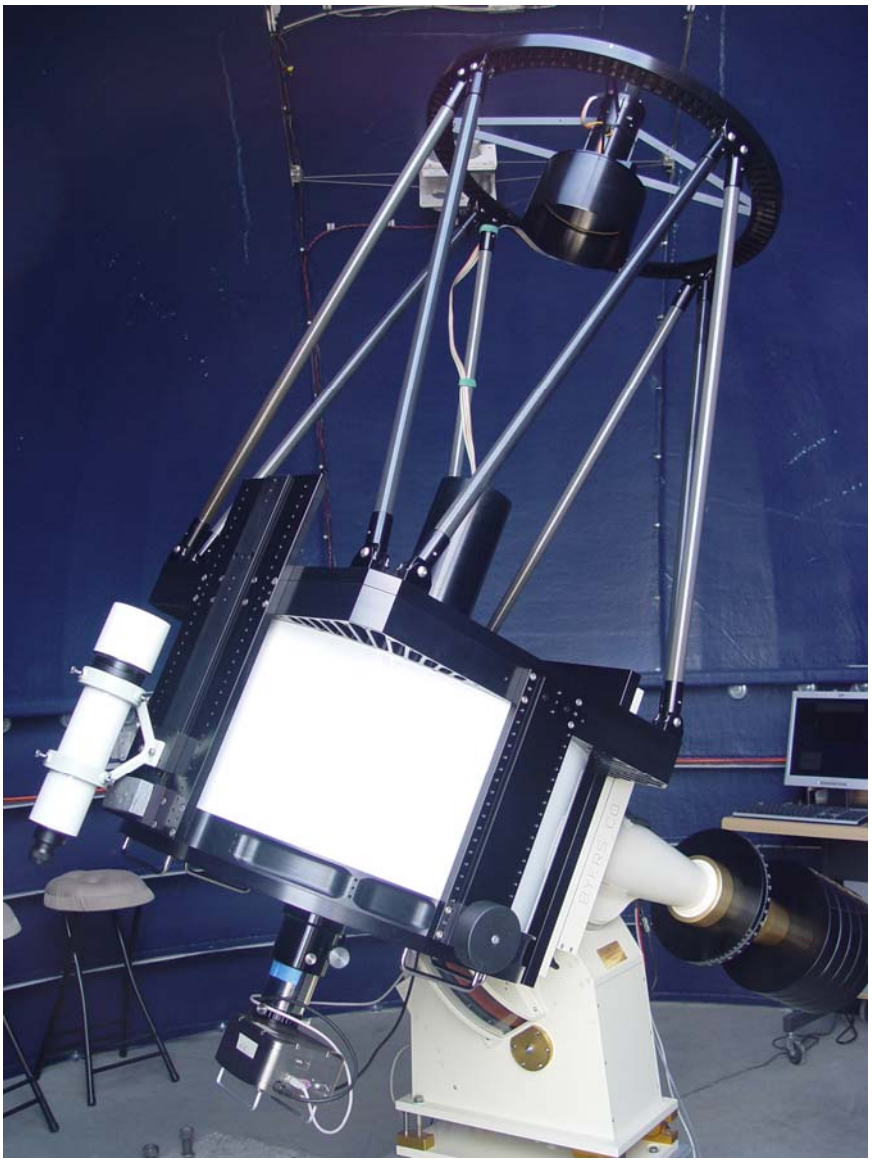
By Mike Rice at New Mexico Skies

January 28, 2007

Thank you Brad Ehrhorn for the opportunity to review the performance of your 24” and Professional Series mount here at New Mexico Skies.

It was almost two years ago that Brad called me and asked if I would like to accept on loan a 24” F10 RCOS telescope and a Professional Series Equatorial Fork mount. Brad delivered the telescope in short order but the mount was still

under development. It was pure coincidence that we had been developing a conversion of the venerable Byers' Series III German Equatorial Mount to the Bisque MKS-4000 control system with the hope of handling larger telescopes than are practical with a Bisque Paramount. At the time we were planning on using the Series III under our 20" RCOS Truss Telescope which we felt was under mounted on a Bisque Paramount ME…not that it didn't work pretty well…we just wanted a mount that was a little more stout to use the 20" to full advantage. As it turned out the 24" arrived just as we were putting finishing touches on the Byers' conversion so we made the decision to mount the 24" on the Byers' while waiting for the new fork. The 24" Ritchey performed very well indeed on the Byers' mount and we were delighted to have the use of the telescope on the big GEM.



This review need not say anything about the performance of the 24” Truss Ritchey-Chretien accept to note that the performance of all RCOS scopes is the stuff of legends and the 24” has become its own legend. A slight note of caution should be noted here: A quarter ton, 6000 mm focal length instrument, such as this one, is a “bear” to take full advantage of. Tracking, pointing and guiding for any instrument of this class and weight is difficult under the best of circumstances.

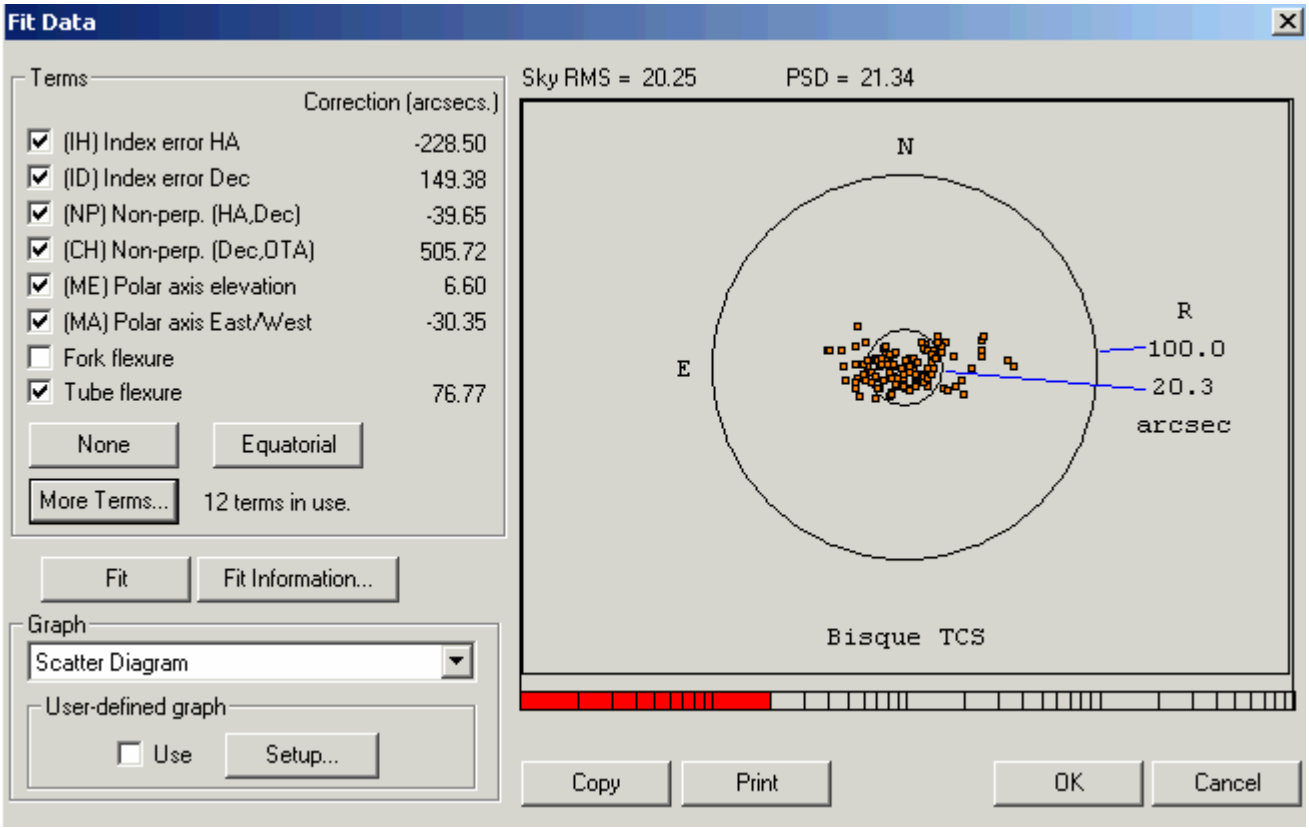
The Pro Series Fork arrived over a period of months and parts started accumulating in our shop. Every part was a jewel, finished to perfection in spite of the prototypal nature of this ‘first’ of the big Pro Series mounts from RCOS. The Polar base, weighing in at some 1400 lbs required us to borrow a bigger fork lift just to get it out of the truck. The fork itself weighs in at 400 lbs and required its own trip on a fork lift for delivery. Each trip we made to RCOS in Flagstaff found us with another load of parts. It all came together in the late fall of 2006. We had all the parts and there were no more reasons not to start building the mount. Brads instructions (and a few telephone conversations) were right on target as the mount went together very easily. Everything was beautifully machined and everything fit perfectly even thought the first parts were manufactured before the last parts were completely designed…..all through the wonders of CNC machining and CAD software that actually allows the product to be final designed at the drawing stage.

Moving day - November 28, 2006. The crane is on its way and the revised weather forecast calls for 50 mph winds. I'm going through this process in rather mercurial detail so the reader will know installing a mount and telescope of this size is not done without adequate help and without the right tools, e.g., a 25 ton crane in this case. We had planned to work all day but the crane operators really knew what they were doing and exactly two hours after the crane arrived the telescope was installed on the mount and the winds started howling. What good luck we are having with this beautiful mount.

The telescope installed and roughly polar aligned (within in about ten arc-minutes) and we are ready to start T Point mapping runs and polar alignment. Our first discovery, the mount slews very smoothly and rapidly (estimate about 7 degrees/second). It will go faster but all of us using it are a little afraid to press our luck. The entire mapping with T Point and final polar alignment was done in

one evening. The adjustments to azimuth and elevation were very easy. The azimuth adjustments are made with large hex screw adjusters on the front base of the mount with ultra-fine 80 tpi thread screws. The elevation adjustments are made by raising or lowering nuts on the pier base. The process could not have been easier.

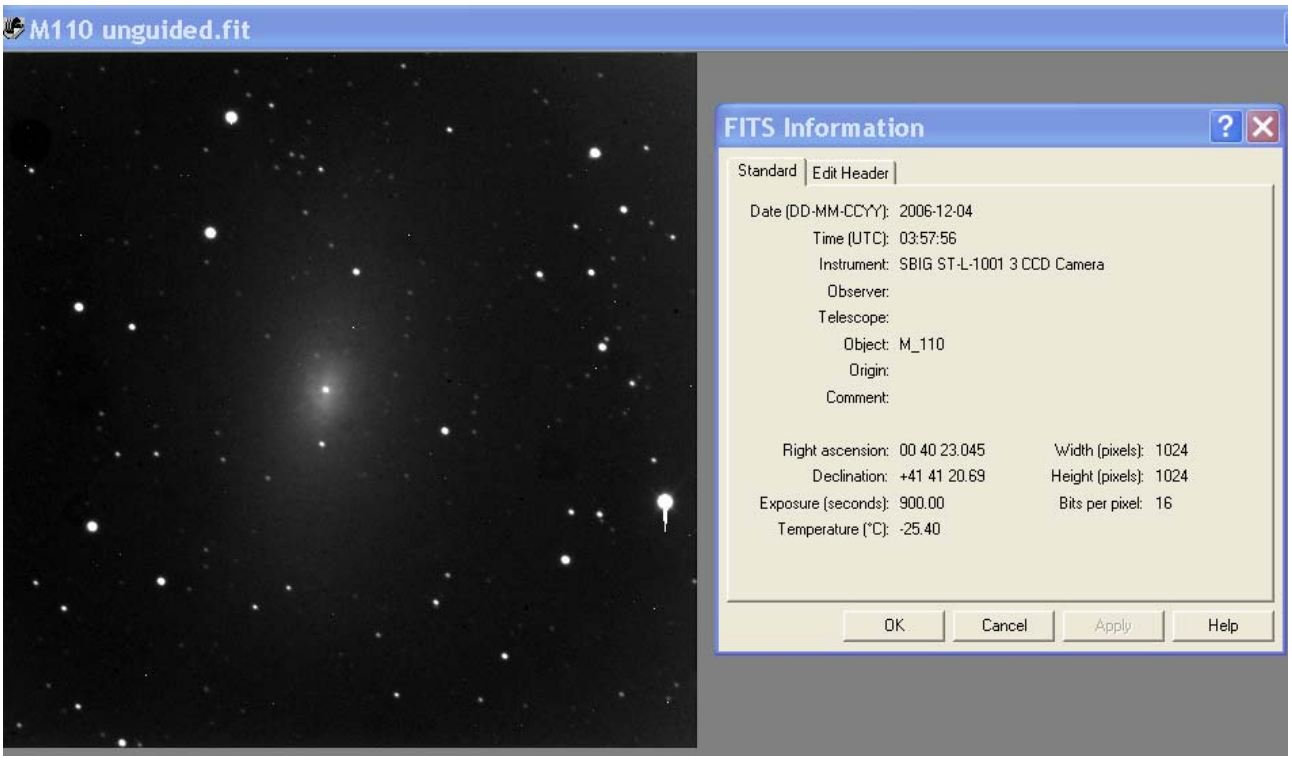
How does the mounts pointing compare with say a Paramount ME. Here is the final T Point model; you can judge for yourself.



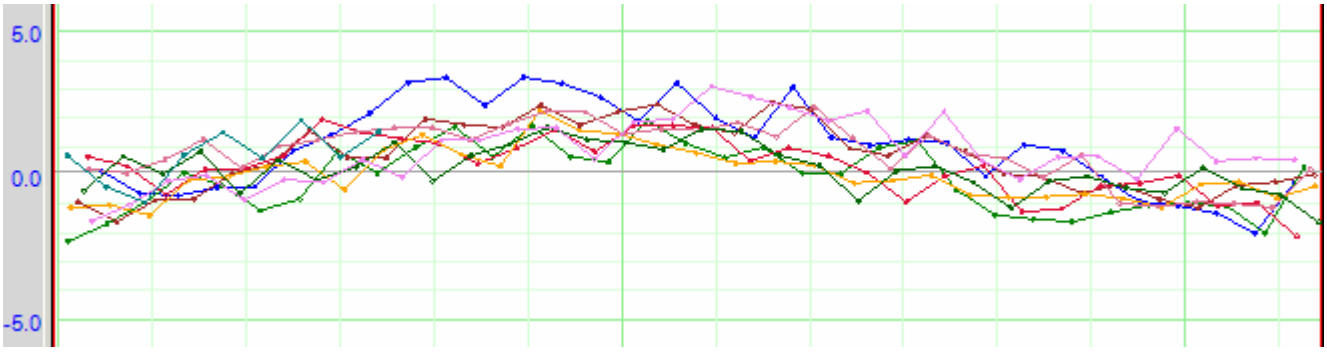
As you can see, 20 arc second pointing without any exotic harmonic terms, just the basic equatorial terms and four gear error terms. I'm sure with fine tuning we'll get this down to 15 arc seconds or so but for now very few mounts in the real world will yield this fine pointing, especially on the first night of use.

I can't resist taking a few images. We're not ready yet for sure. We'll need to train the PEC and fine tune the guiding. The first image is M110 in Andromeda. No special reason; the sky is partly cloudy and Andromeda is in the clear. The camera is an SBIG STL-1001E with 24 micron pixels in an array 1024 x 1024. I know from experience using little bitty 9 micron pixels at 6000 mm focal length is ridiculous. Plate scale is 0.82 arc seconds per pixel; well matched to the average seeing at New Mexico Skies. Our first exposure is unguided (we haven't even calibrated the guider at this point) for 2 minutes and it yields perfect stars. Can we get decent stars at 5 minutes? Yes! Can we get decent stars at 10 minutes?

Yes!! (This is getting boring…there are no problems to report) My assistant asks 'should we try 15 minutes?' Yes and the stars are pretty good, all unguided with nearly 300 lbs of telescopes mounted: I expect the slight "ovaling" is due either to the untrained PEC or to a bit of drift. We are not using either PEC or Pro Track at this point.

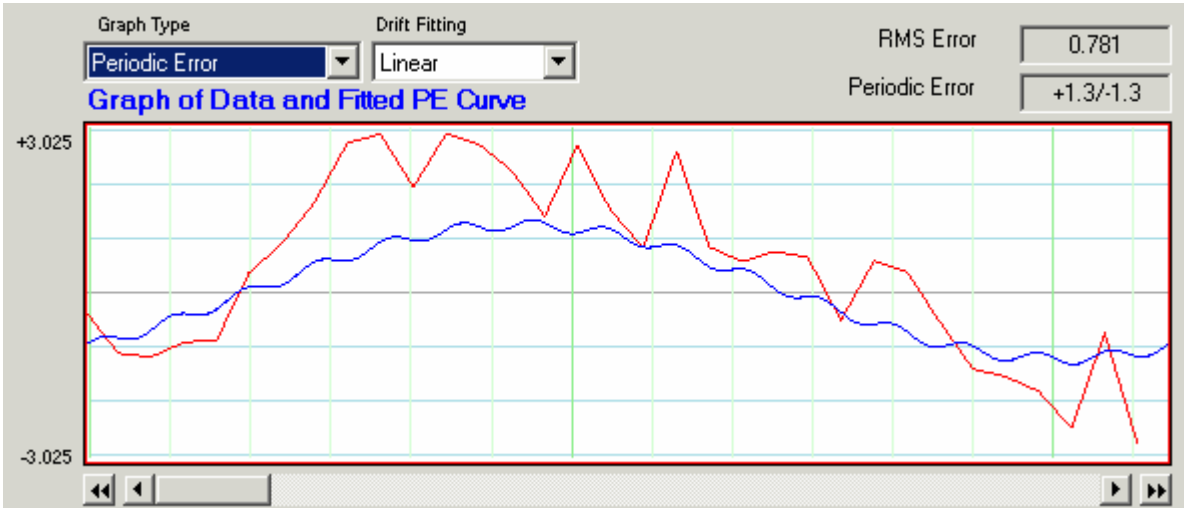


Training the PEC: We've elected to use Ray Gralak's Pempro software (www.ccdware.com) to train the PEC. At this point there does not appear to be much PE but for a complete install we need to check it out. Here are the graphs of the first 12 complete turns of the worm (1608 seconds of data).



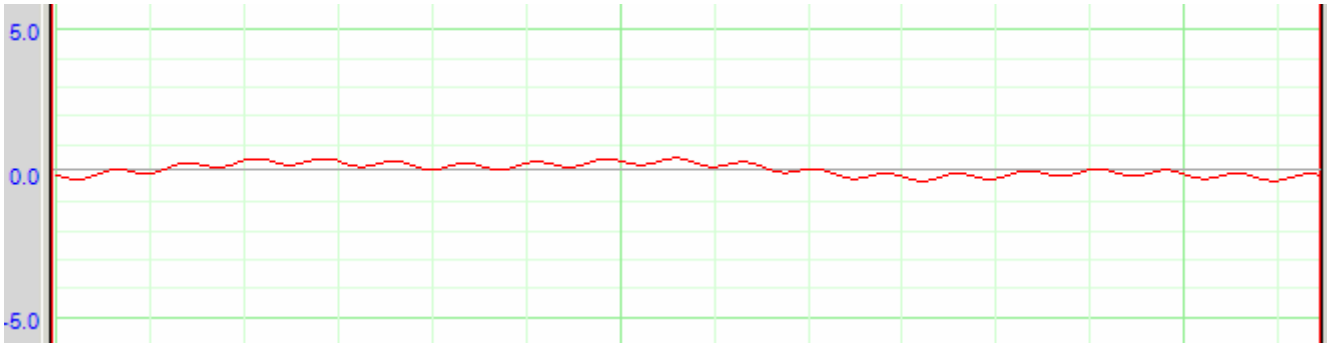
The data are in arc-seconds. This all looks mostly like noise to me, very little PE. We know that all worm gear systems have to have periodic error so using

Pempro here is the bottom line on raw periodic error for the RCOS Pro Series Fork Mount:



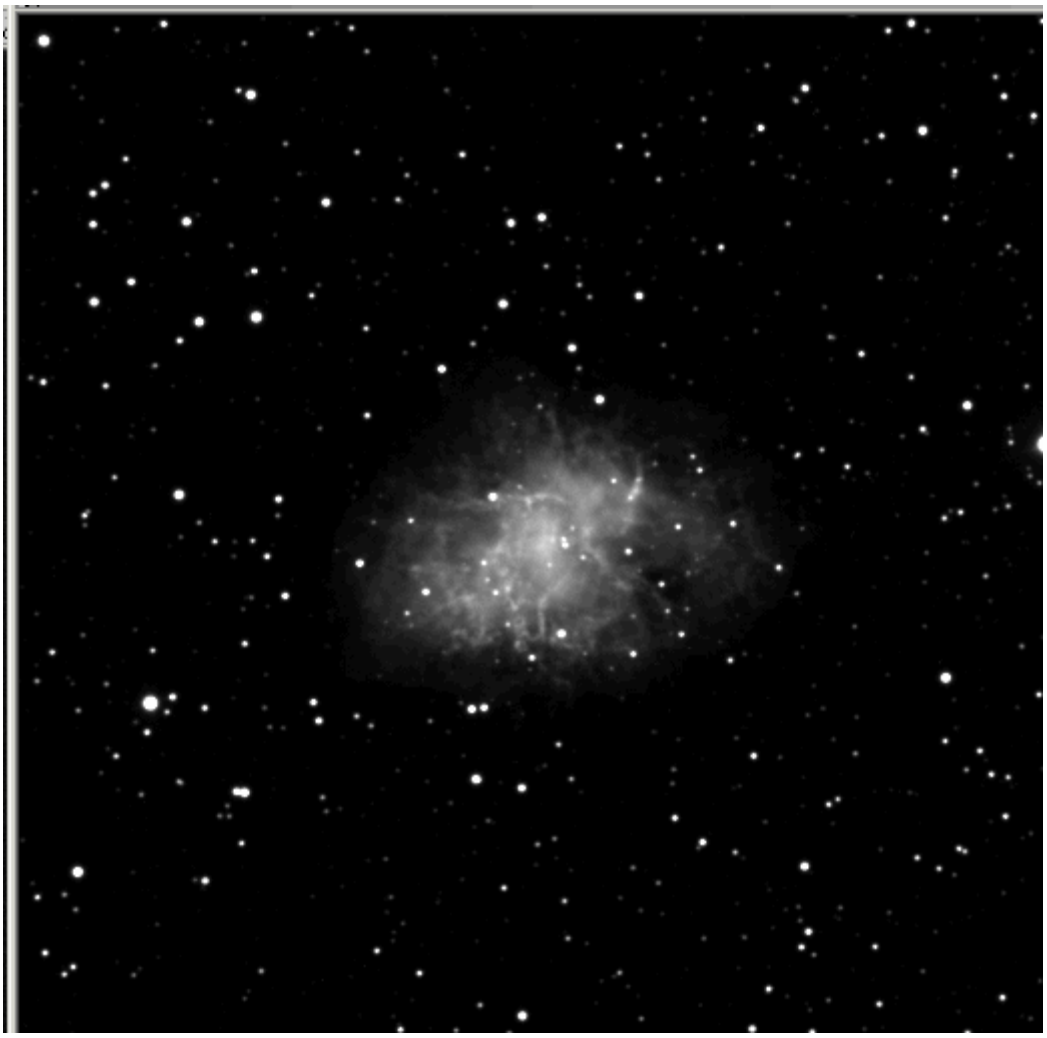
The blue line tells the story: Peak to peak PE of 2.6 arc-seconds or RMS 0.781 arc-seconds. This is the kind of raw PE we would expect on a very much larger telescope….like the Keck !!

After training of the PEC in the Bisque TCS-4000 controller, the PE truly is in the noise:

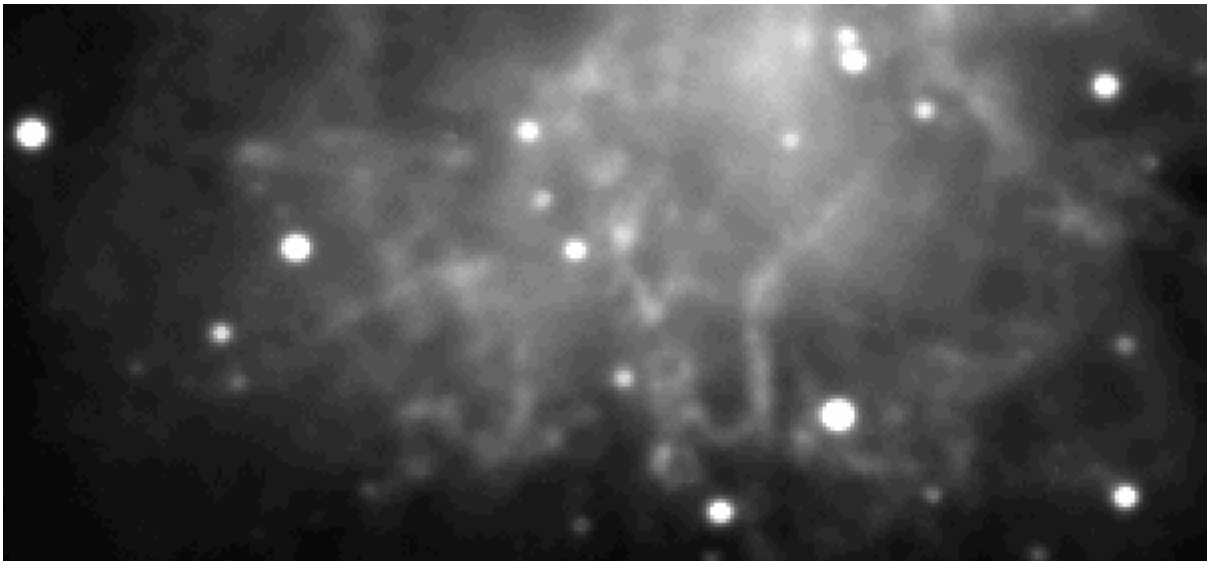


I have never seen a mount so free of periodic error. The figures from Pempro analysis are peak to peak PE of 0.79 arc-seconds, RMS 0.22 arc-seconds of PE.

The proof is in the imaging. Here is an unguided (PEC trained and Pro Track engaged) 900 second image that has been dark subtracted but with no other processing: The image has been reduced by 50 % to show scale:



Here is a portion of the same image at 200%: Are your unguided stars this good? At 6000 mm focal length?



Because of unusually bad weather in the Sacramento Mountains this January 2007, we have not yet had the opportunity to give this wonderful RCOS instrument a full work-out. Nevertheless our initial results are so impressive we wanted to share them with Brad, who has labored long and hard to develop the telescope and especially the mount. We also asked Brad to publish this review on the RCOS web site; a piece of equipment this excellent needs to have the raw data available to all who are curious.

Mike Rice
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