

The Sun

First Edition

An Astrophoto Album

by

David B. Viscio

September 2013

Introduction

In addition to being the center of our solar system, providing the gravitational glue holding the solar system together, and the energy source supporting most life on earth, the sun is the closest star. This closeness provides professional and amateur astronomers alike, with proper equipment, the unique opportunity to observe and photograph in detail the daily activity and cycles of a star. Years of detailed observations of the sun have led to our current knowledge of how stars function.

I began photographing the sun on film in the late 1990's (see album 'Solar System on Film') and transitioned to digital cameras in 2003. This album contains select photographs of the sun taken with a variety of digital cameras and optical systems during the decade from 2003 through 2013.

The Cameras

Nikon Coolpix 990 digital camera

The camera was attached to the telescopes using one of three eyepieces - William Optics DCL-28 (24 mm), ScopeTronix 18 mm or 14 mm wide-angles - which were specifically designed to screw into the 28 mm filter threading of the camera. Additional magnification was obtained by adding a ScopeTronix 1.6x MaxPower lens to the eyepieces. The camera was always set to maximum optic zoom.

Philips ToUCam 720K webcam

Image magnification was achieved using one of the following - ScopeTronix 1.6x MaxPower lens, TeleVue 1.8x barlow, Celestron Ultima 2x barlow or TeleVue 2.5x barlow. A Sirius NIR infra-red blocking filter was used for all imaging.

Nikon Coolpix 5700 with 1.5x telephoto lens

Canon EOS 20D

The Telescopes

Celestron C5+ Schmidt-Cassegrain

125 mm dia, 1250 mm FL, f/10 - on an equatorial wedge with a Tuthill Solar Screen.

Takahashi Sky 90 Refractor

90 mm dia, 500 mm FL, f/5.6 - on a Vixen GPDX equatorial mount with a Kendrick Baader Solar Filter or a Coronado SolarMax 90 Hydrogen-alpha filter with a BF-10 blocking filter.

Stellarvue SV115 Refractor

115 mm dia, 800 mm FL, f/7 - on a Vixen GPDX equatorial mount with a Tuthill Solar Screen.

The Procedures

For the three still cameras, exposure was adjusted by visually assessing test frames on the cameras' LCD screens and adjusting exposure until the image looked appropriate. Multiple images were then acquired. The individual frames were manually stacked in Adobe Photoshop (versions 4, CS and CS2) to reduce the noise in the final image. Levels and Curves adjustments were applied to the stacked raw image followed by a mild Unsharp Mask to yield the final image.

For the Philips webcam, the camera was operated using QFocus on a Dell Inspiron 8600 laptop computer with Windows XP. Gain and exposure time was adjusted by viewing the image on the computer screen. All captured video sequences were 5 frames per second for 5 minutes (1500 frames total). Using RegiStax 4 (Dell Inspiron 8600), the best 300 to 500 frames were selected and stacked. Wavelet processing was performed to enhance image detail. Levels and Curves adjustments were performed in Adobe Photoshop for additional image enhancement. Finally images were up-sampled from the native 640x480 pixels to 1280x960 pixels for more convenient viewing of the images.

The Images

Included with each image are the equipment, exposure, etc. details used to make the image. Unfortunately I was often remiss in recording the exact details and some details have been lost, so best guess estimations were sometimes included. In addition a small image from the website Spaceweather.com has been included to aid in identification of the sunspot groups photographed.

Cameras



Nikon Coolpix 990
with ScopeTronix eyepiece

Canon EOS 20D



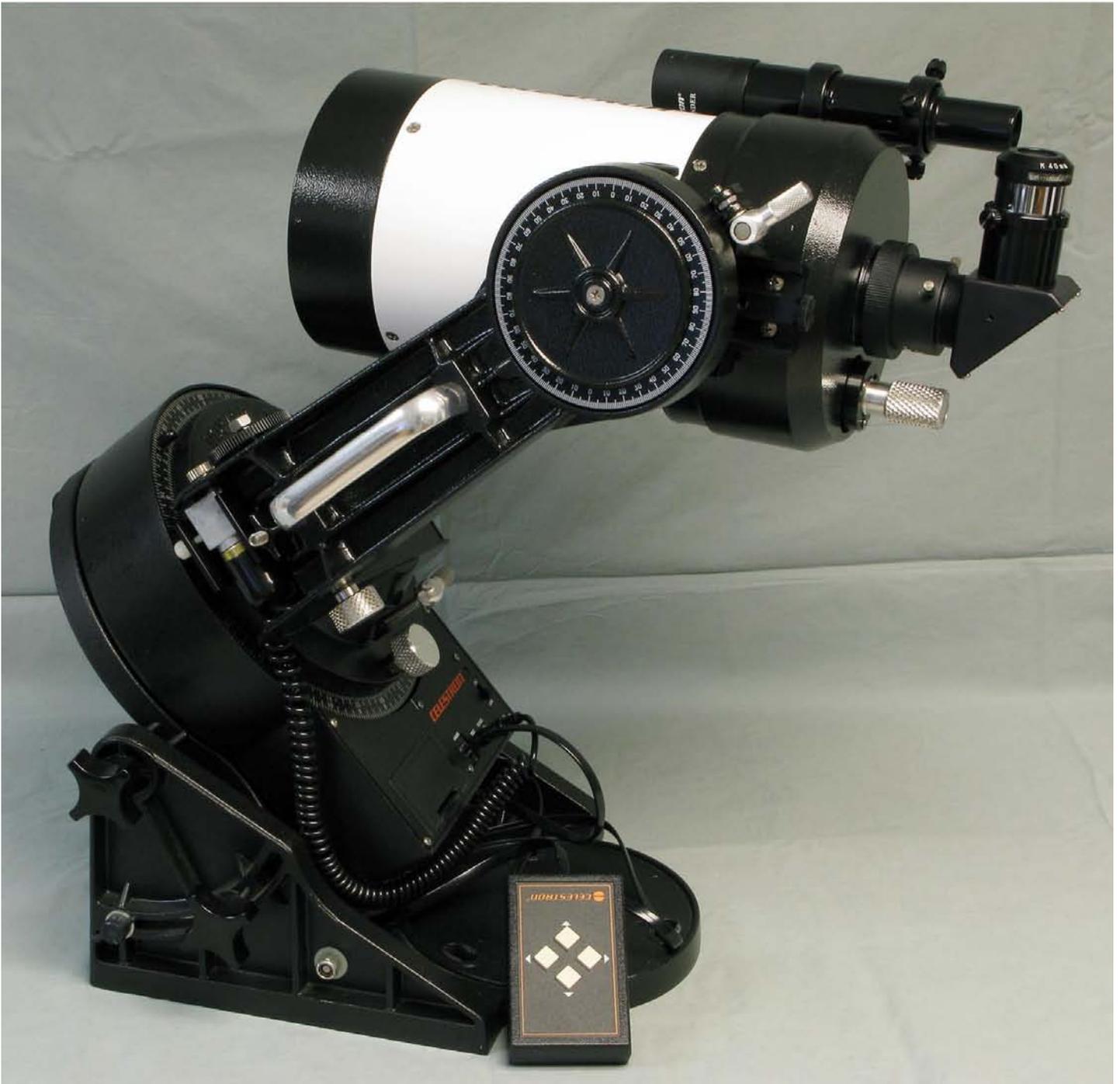
Nikon Coolpix 5700
with 1.5x Telephoto lens



Philips ToUCam 720K



Celestron C5+ Schmidt-Cassegrain



Takahashi Sky 90
500 mm FL, f/5.6



Coronado SolarMax 90 H- α Filter
with BF10 and Tmax Tuner

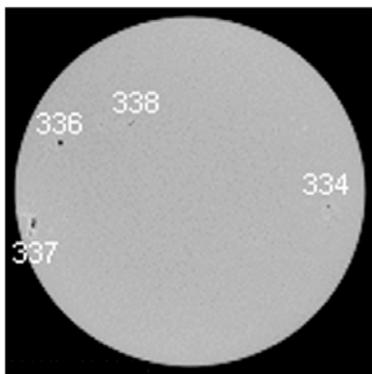
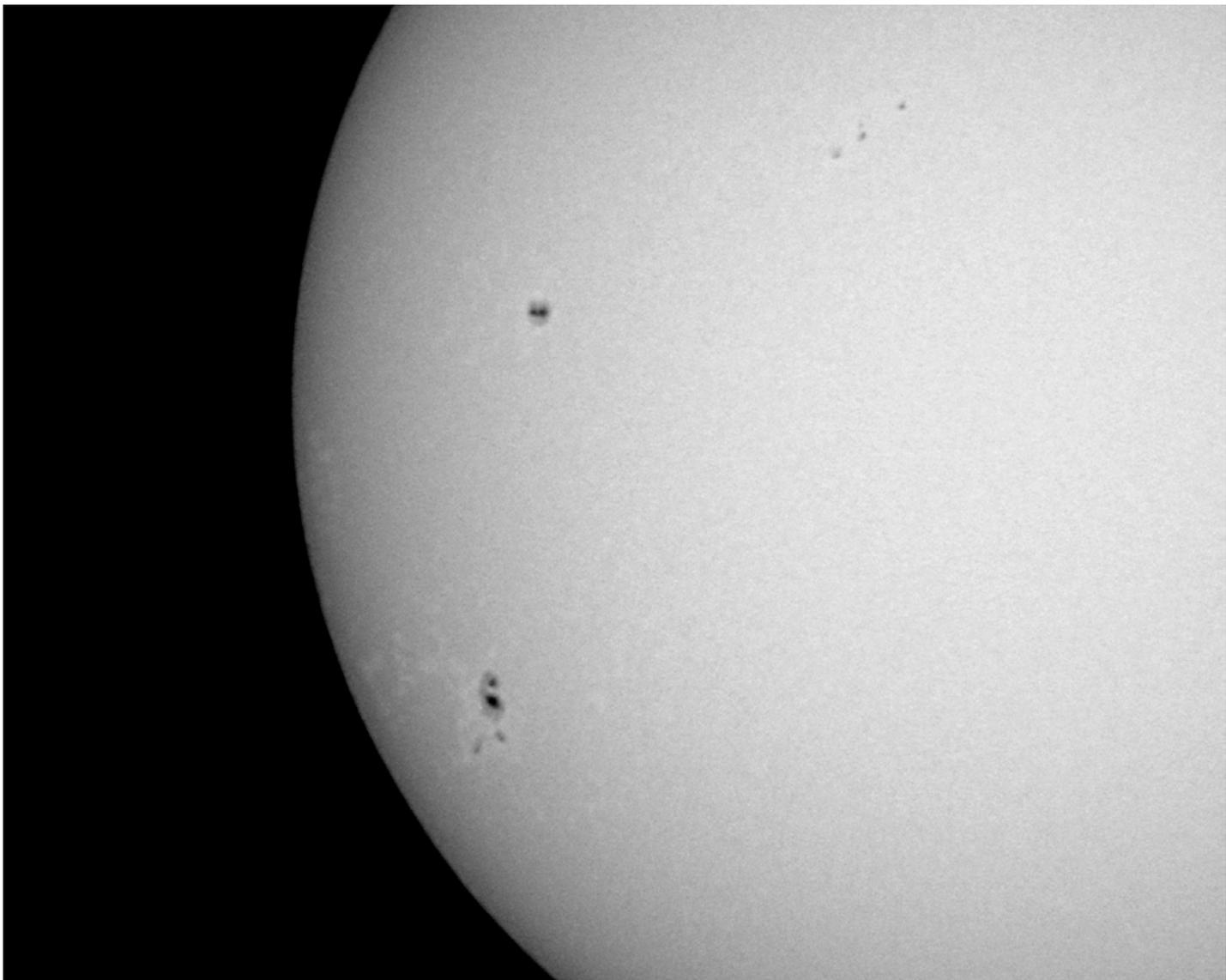


Stellarvue SV115 Refractor with Tuthill Solar Screen Philips ToUCam 720K



**Vixen GPDX Equatorial Mount
with SkySensor 2000
on JMI Wheeley Bar**

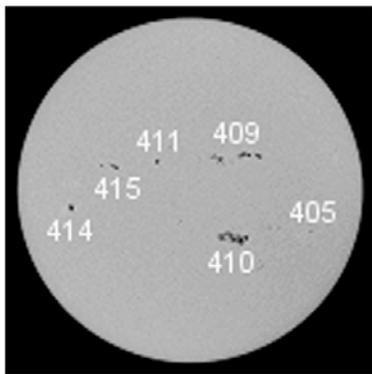
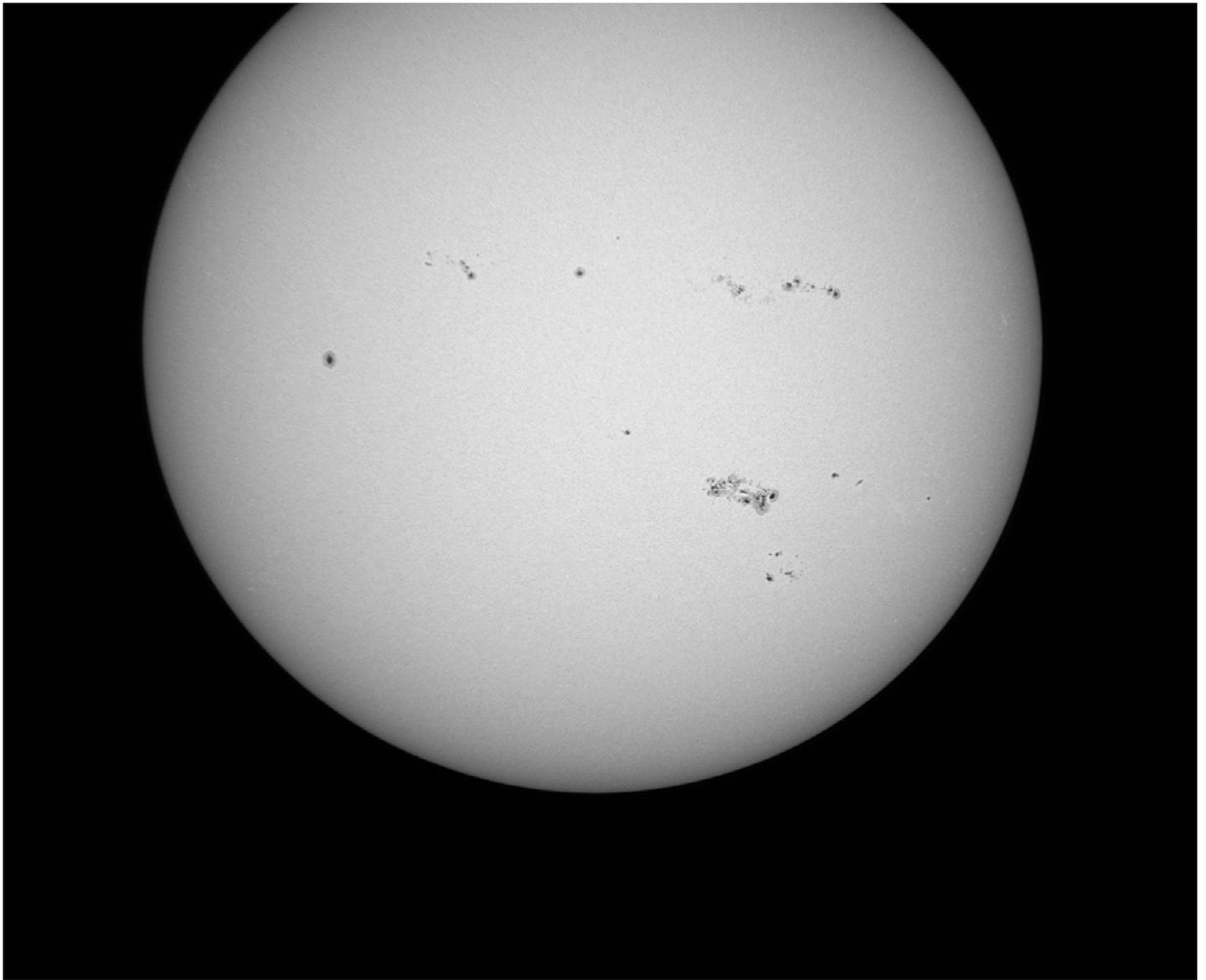




April 20, 2003

Celestron C5+ w/Tuthill Solar Screen

Nikon Coolpix 990



July 20, 2003

Takahashi Sky 90

Kendrick Baader Solar Filter

Nikon Coolpix 990

1/500 sec, stack of 8

Aurora Observation October 31, 2003

During the months of October and November of 2003 the sun exhibited the most intense coronal mass ejection activity and strongest flares in history of solar observation. One outcome of this activity was my first observation of an aurora.

On the evening of October 31, 2003 at about 6:45 pm EST, I stepped out of the front door of our home in Monmouth Junction, NJ to start my car to take my son to an orthodontist appointment and observed a bright ruby-red glow in the NNE section of the sky. The glow stretched from the horizon to approximately the "W" of the constellation Cassiopeia and was about 30 to 40 degrees wide. Also, there were a couple of vertical 'zones' in the glow. The glow could be observed through the car windows for about 5 minutes, but by the time we reached the orthodontist 15 to 20 minutes later, the aurora had vanished.

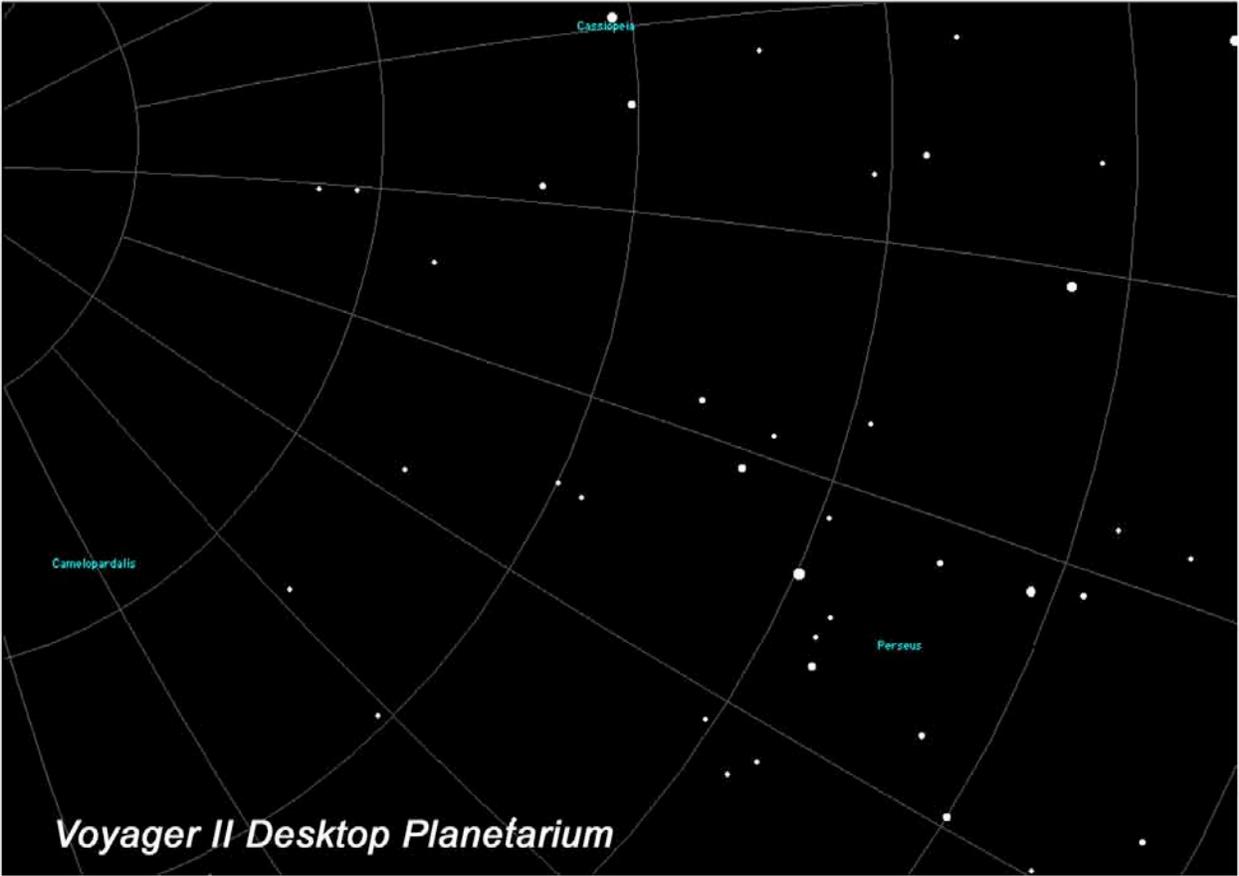
The next day, George Varros posted a photograph of the aurora from his location in Mount Airy, Maryland on the website Spaceweather.com (www.spaceweather.com) that showed essentially what I observed. Varros' photograph was an 8-second exposure obtained with a Nikon Coolpix 950 digital camera. There are several stars clearly visible in the photograph. Using Voyager II Desktop Planetarium on a Macintosh computer, I was able to approximate the star field centered at about RA 03h 20m and DEC +59° 40'. The field is about 51° wide with stars at magnitude 4.6.

The October 31, 2003 aurora were triggered by two of the most powerful recorded solar flares on October 28 and 29, 2003 from the sunspot group 486. The table below based on "Large Solar Flares Since 1976" compiled by IPS Radio & Space Services lists record-setting x-ray flares since 1976. On November 4, 2003 sunspot group 486 unleashed the most powerful flare ever recorded.

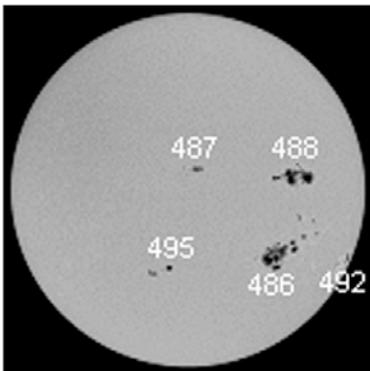
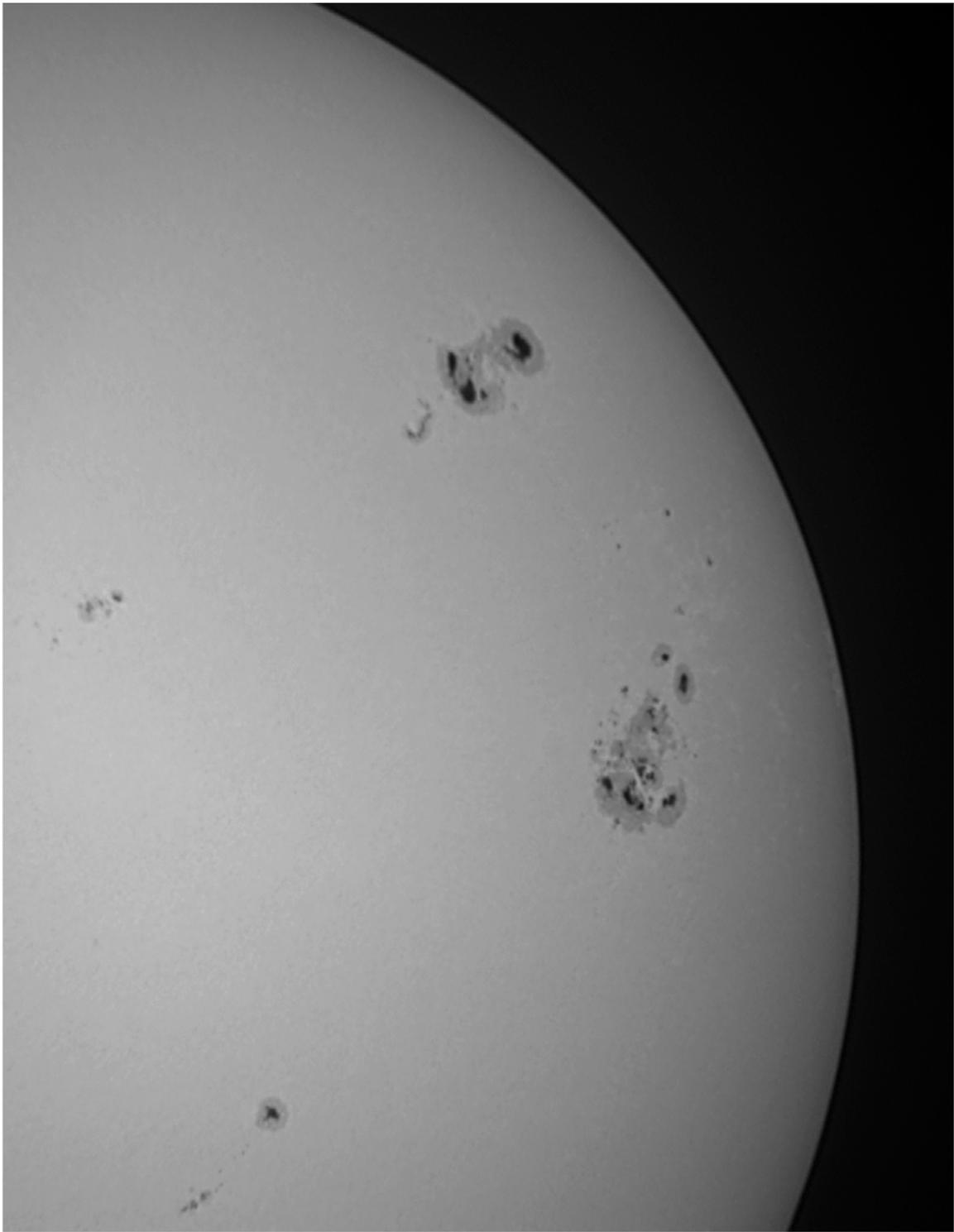
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2	02/04/01	X20.0	8	01/06/91	X12.0
2	16/08/89	X20.0	8	04/06/91	X12.0
3	28/10/03	X17.2	8	06/06/91	X12.0
4	06/03/89	X15.0	8	11/06/91	X12.0
4	11/07/78	X15.0	8	15/06/91	X12.0
5	15/04/01	X14.4	9	17/12/82	X10.1
6	24/04/84	X13.0	9	20/05/84	X10.1
6	19/10/89	X13.0	10	25/01/91	X10.0
7	15/12/82	X12.9	10	29/10/03	X10.0
			10	09/06/91	X10.0



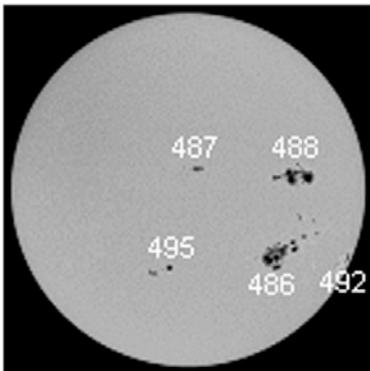
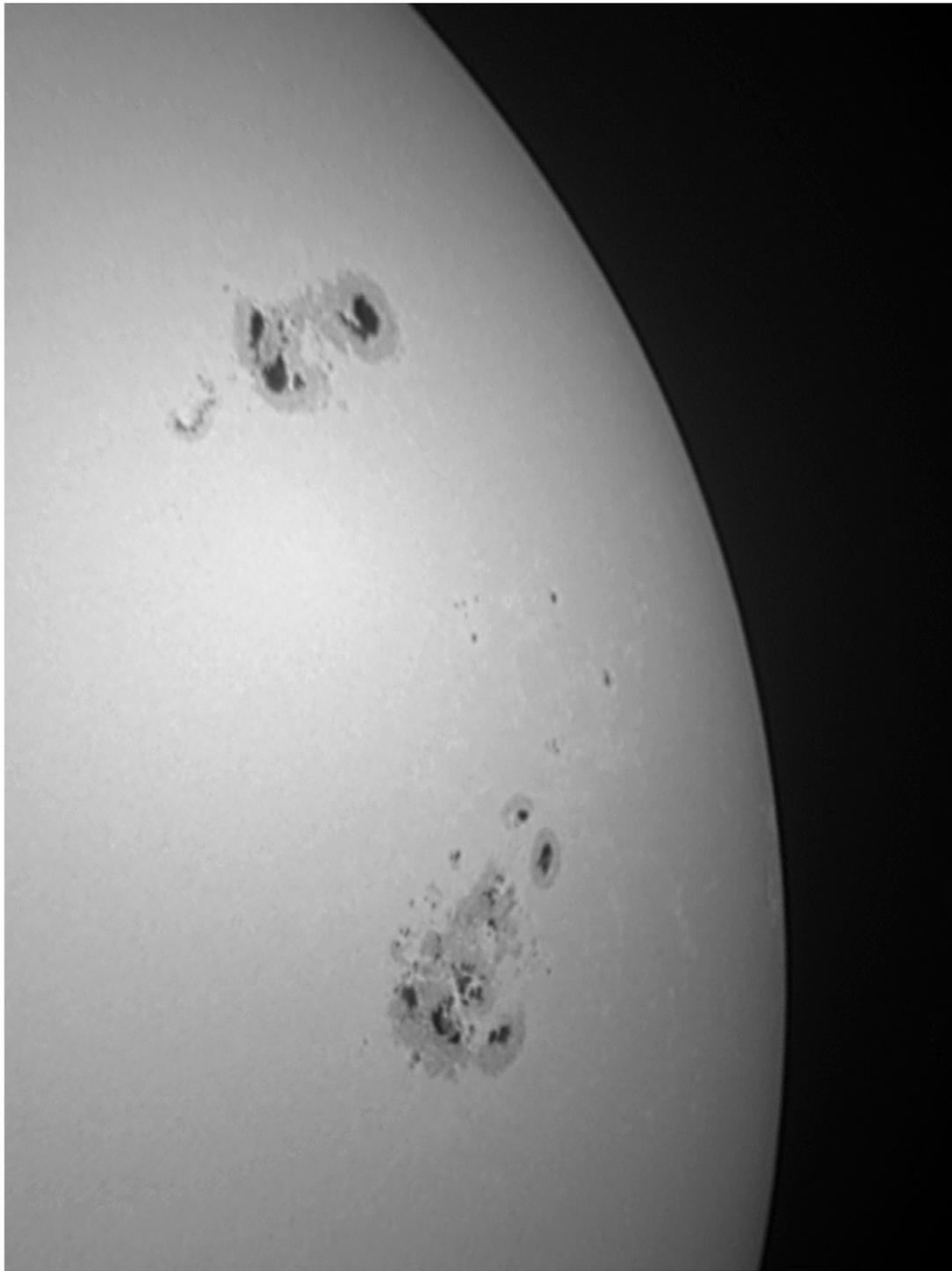
George Varros - Mt. Airy, Maryland



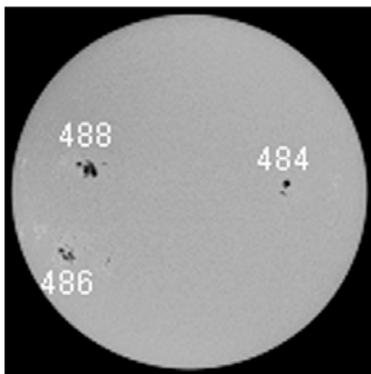
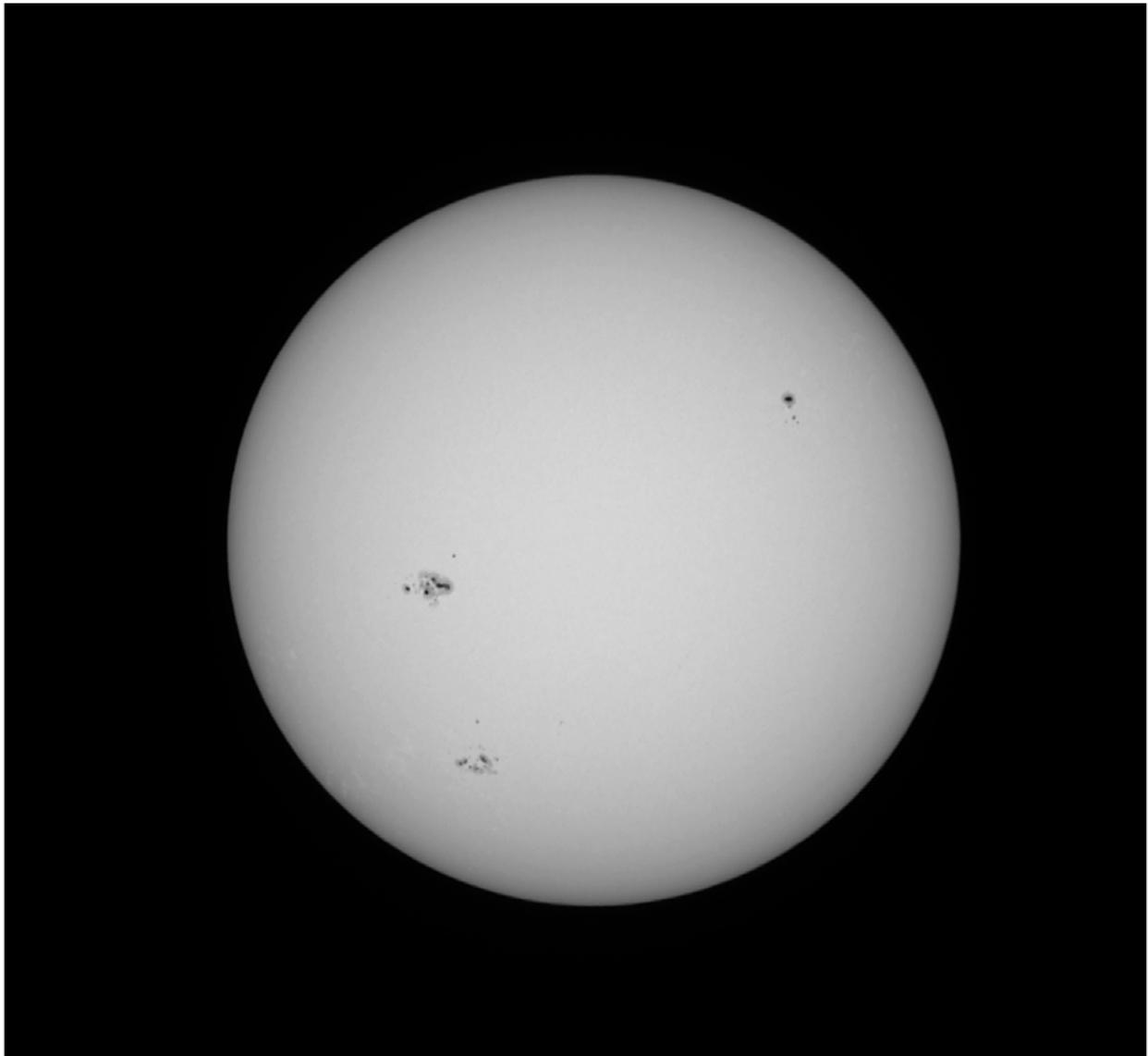
Voyager II Desktop Planetarium



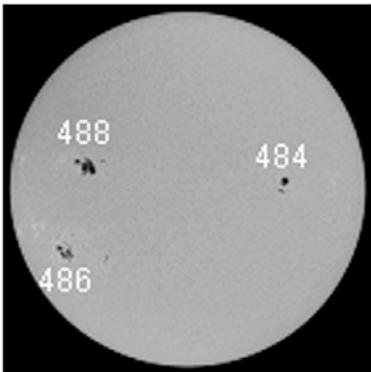
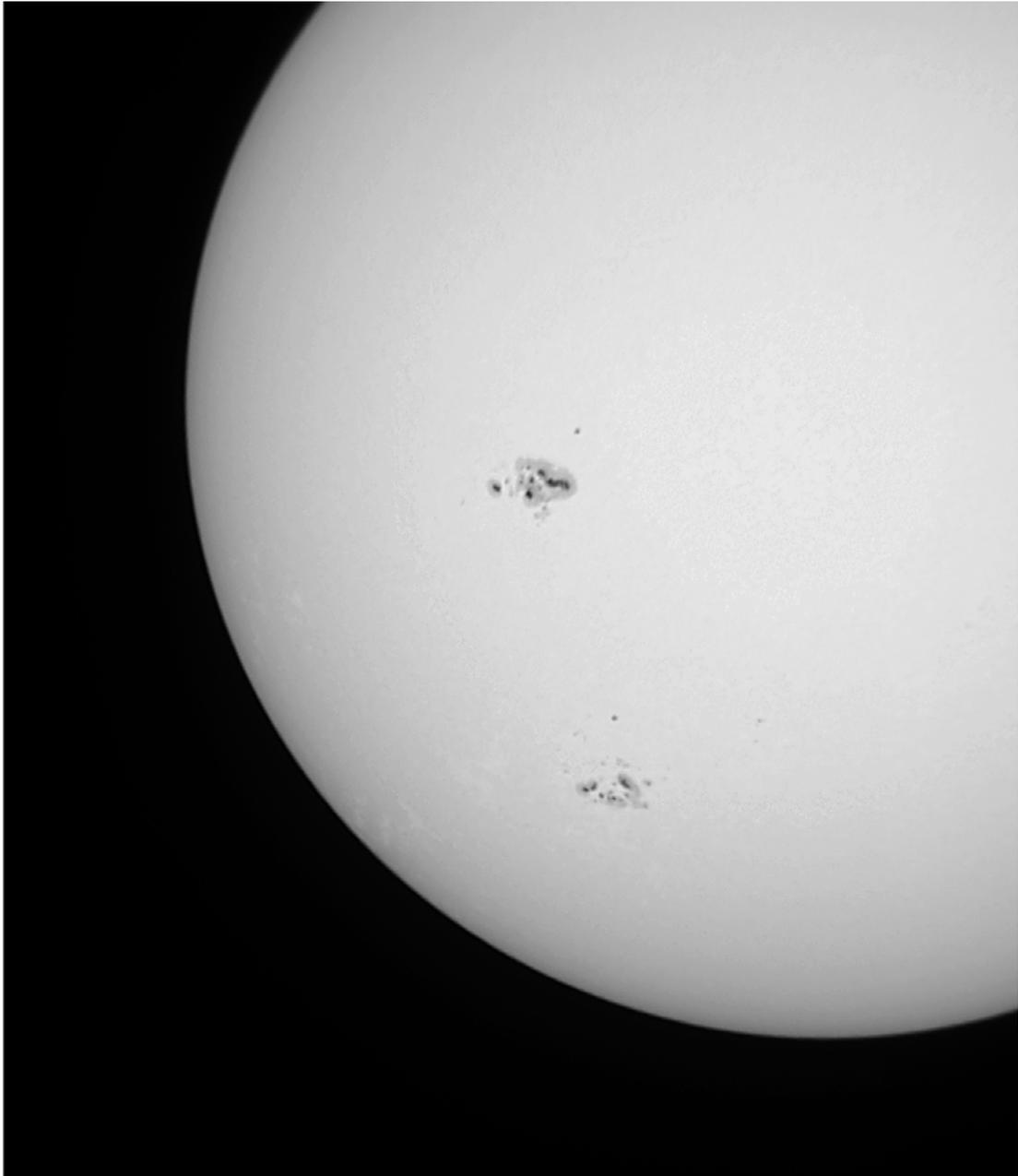
*November 1, 2003
Celestron C5+ w/Tuthill Solar Screen
Nikon Coolpix 990
William Optics DCL-28
stack of 8*



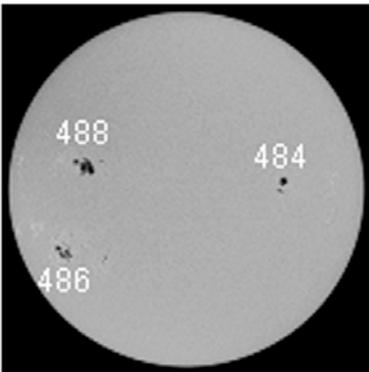
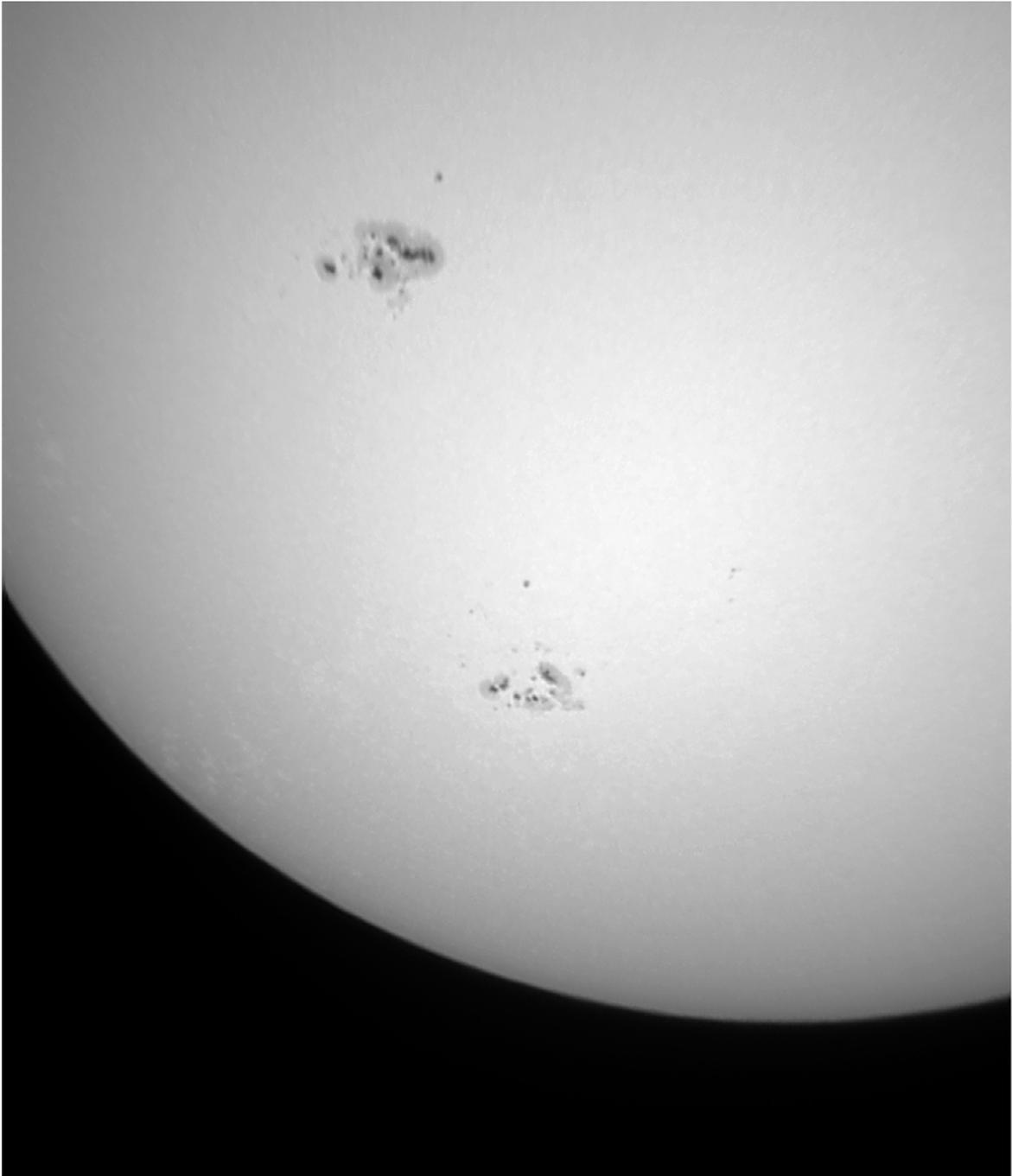
*November 1, 2003
Celestron C5+ w/Tuthill Solar Screen
Nikon Coolpix 990
ScopeTronix 18 mm
stack of 8*



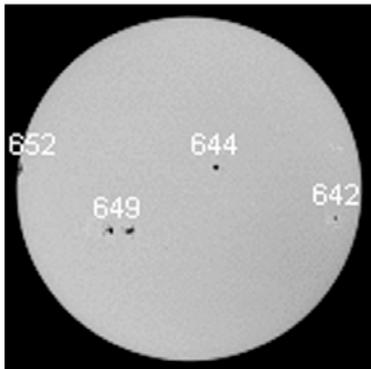
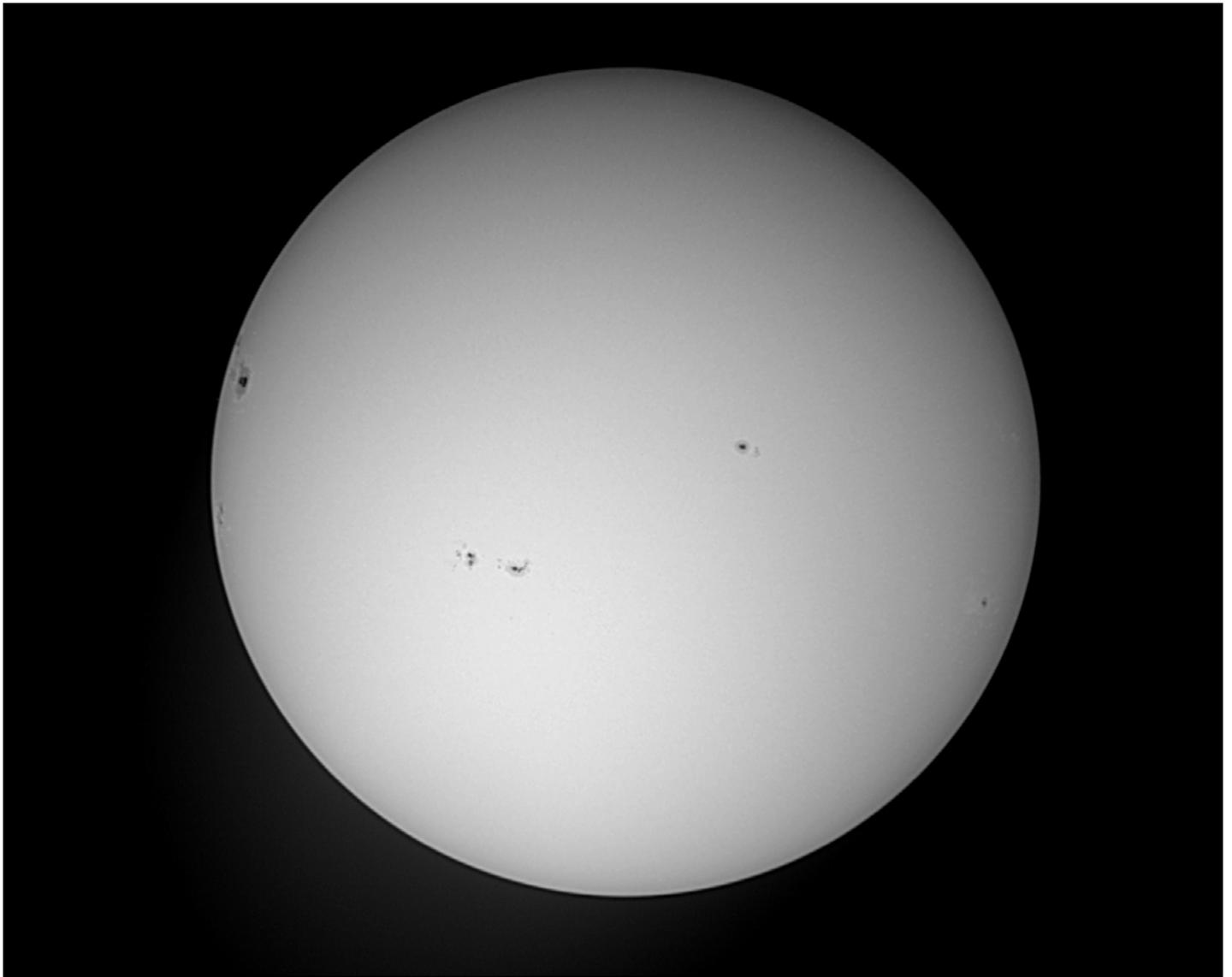
*November 22, 2003
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
William Optics DCL-28
stack of 24*



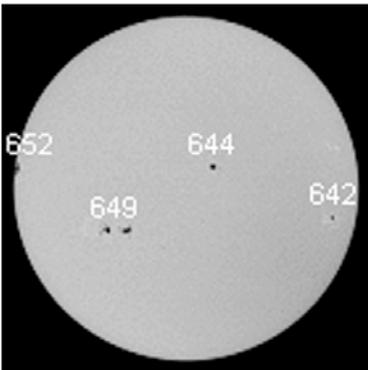
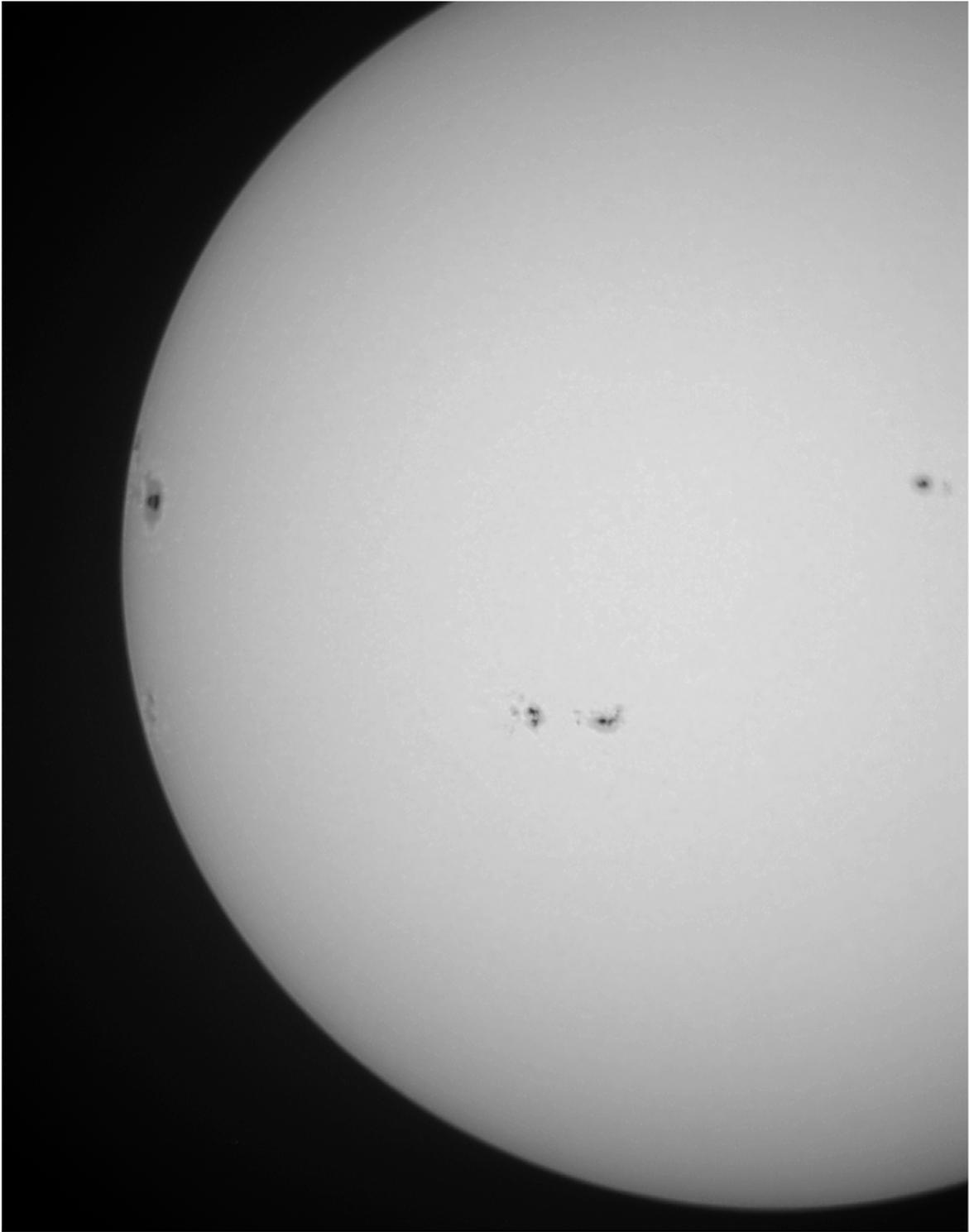
*November 22, 2003
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
Scope Tronix 14 mm
stack of 32*



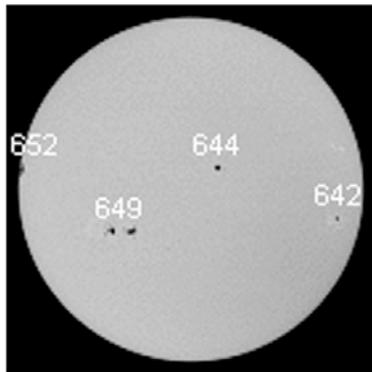
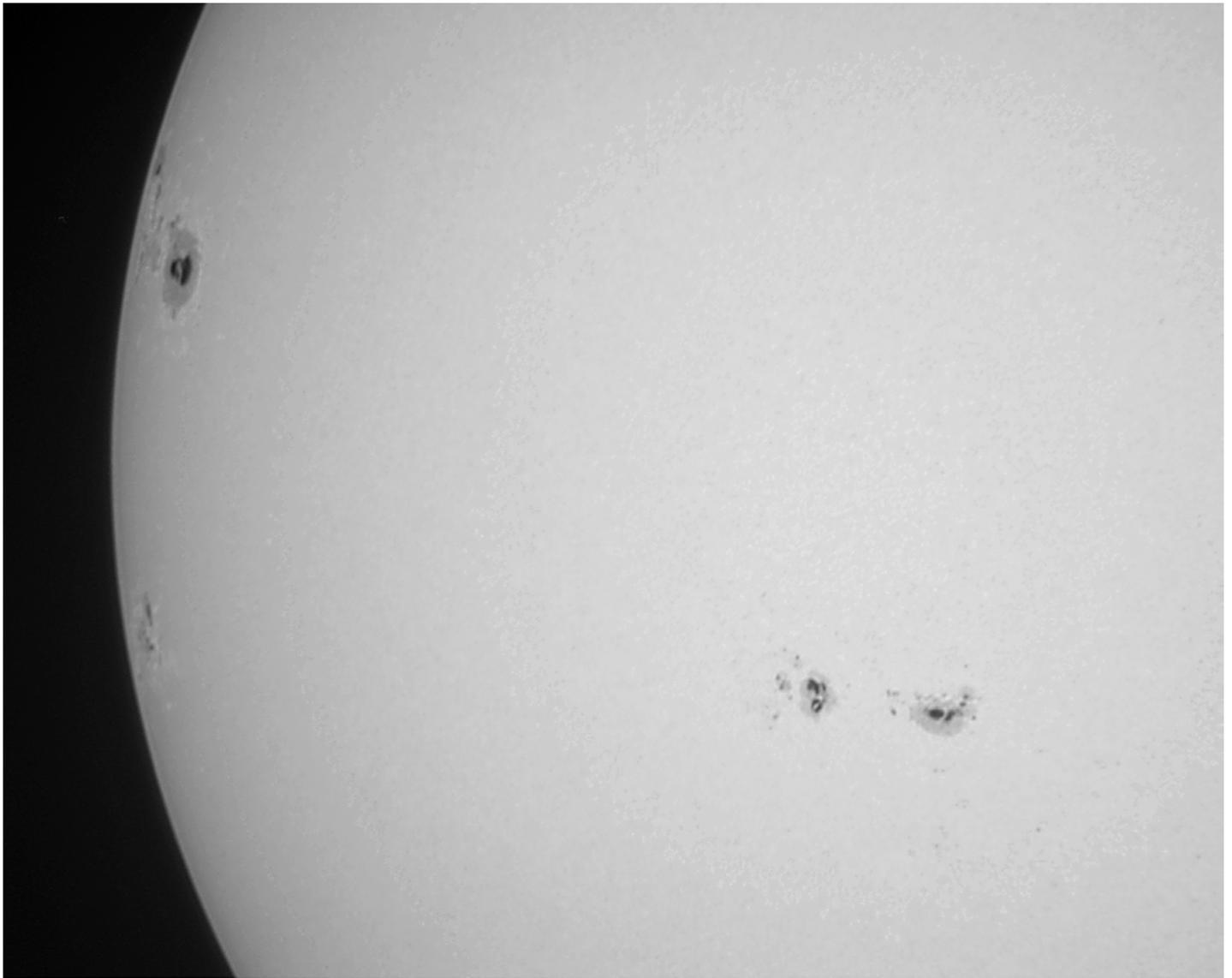
*November 22, 2003
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
ScopeTronix 14 mm
ScopeTronix 1.6x MaxPower
stack of 24*



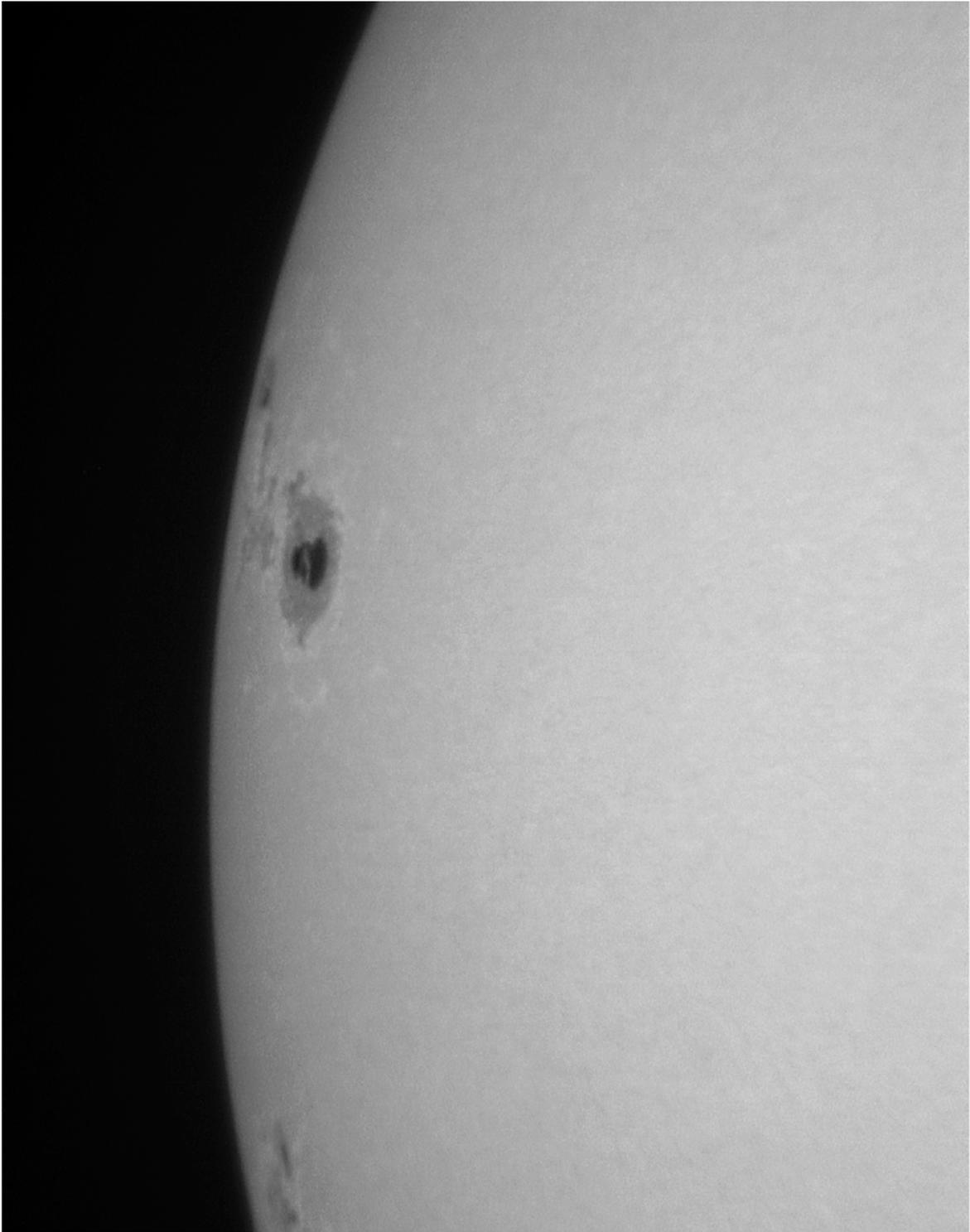
July 17, 2004
Celestron C5+ w/Tuthill Solar Screen
Nikon Coolpix 990
ScopeTronix 40 mm
1/125 sec
stack of 16



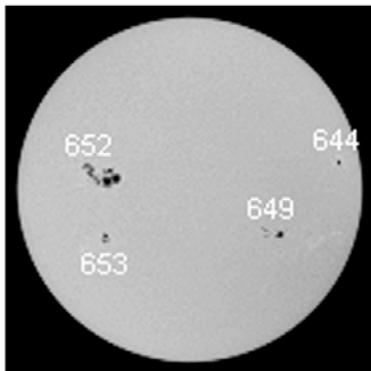
July 17, 2004
Celestron C5+ w/ Tuthill Solar Screen
Nikon Coolpix 990
William Optics DCL-28
1/125 sec, stack of 16



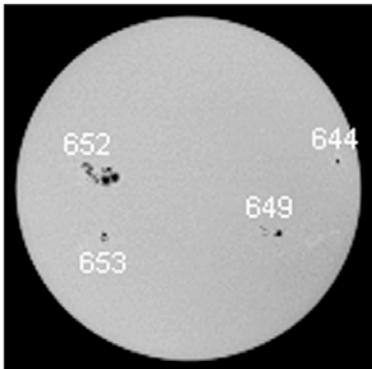
July 17, 2004
Celestron C5+ w/ Tuthill Solar Screen
Nikon Coolpix 990
William Optics DCL-28
1/30 sec
stack of 16



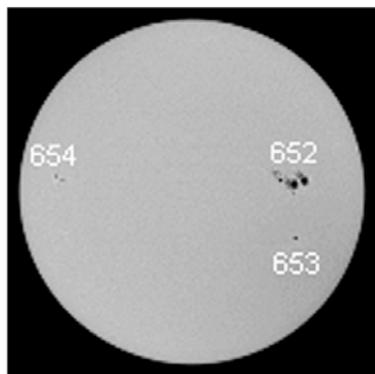
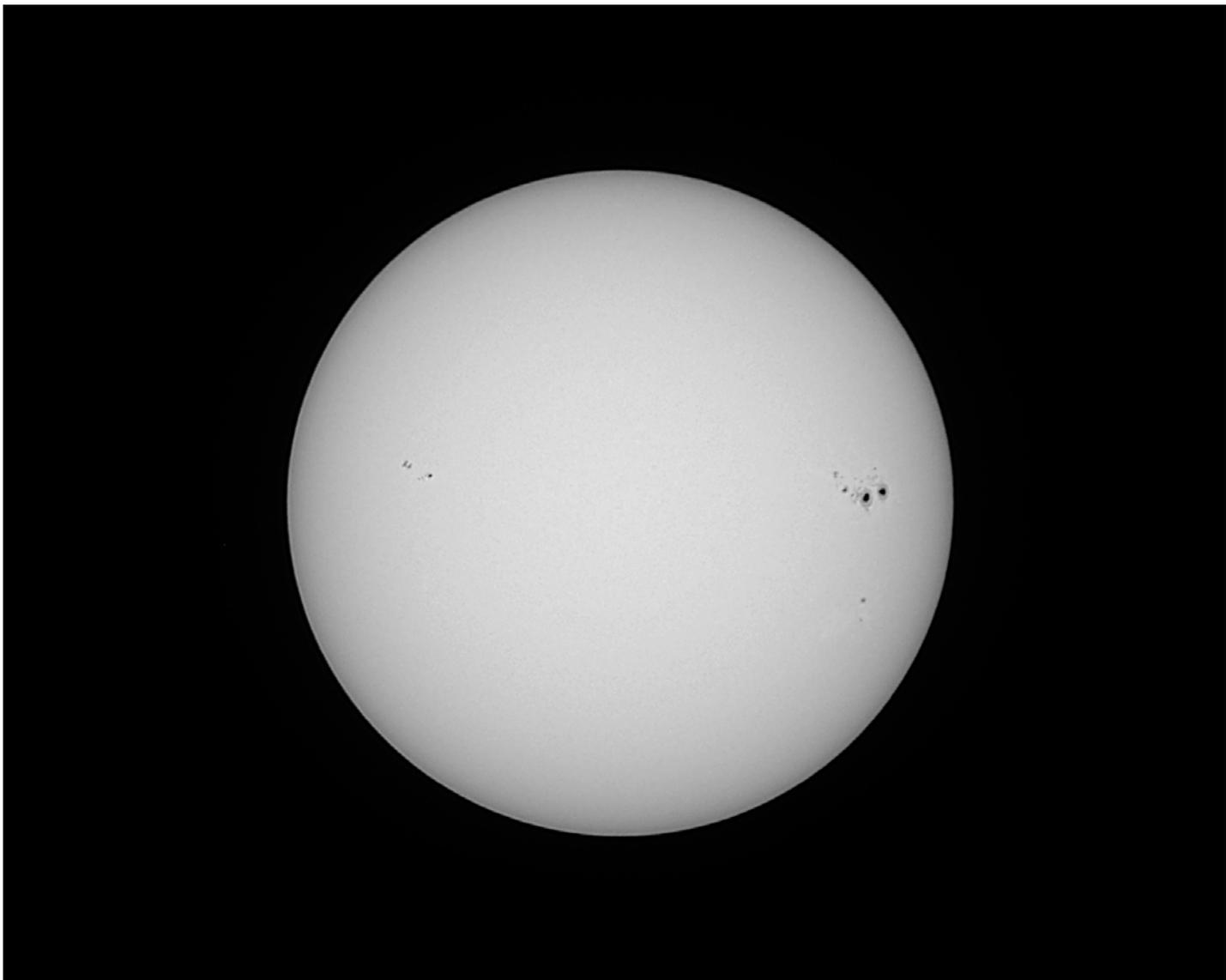
*July 17, 2004
Celestron C5+ w/Tuthill Solar Screen
Nikon Coolpix 990
ScopeTronix 14 mm
1/30 sec, stack of 8
Sunspot #652*



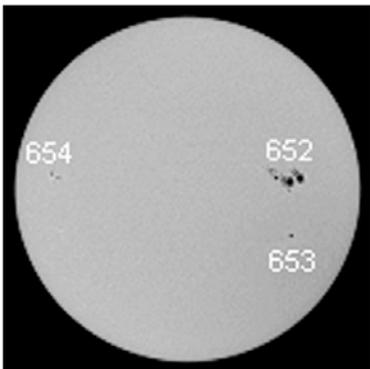
Nikon Coolpix 5700
1.5x Telephoto Lens
22.4x zoom
Kendrick Baader Solar Filter
1/125 sec
stack of 16



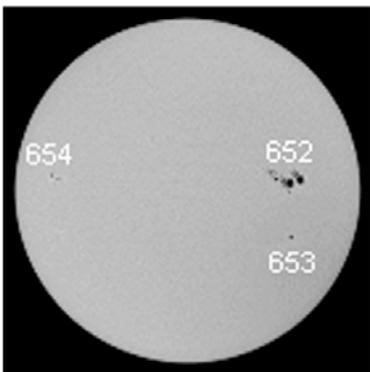
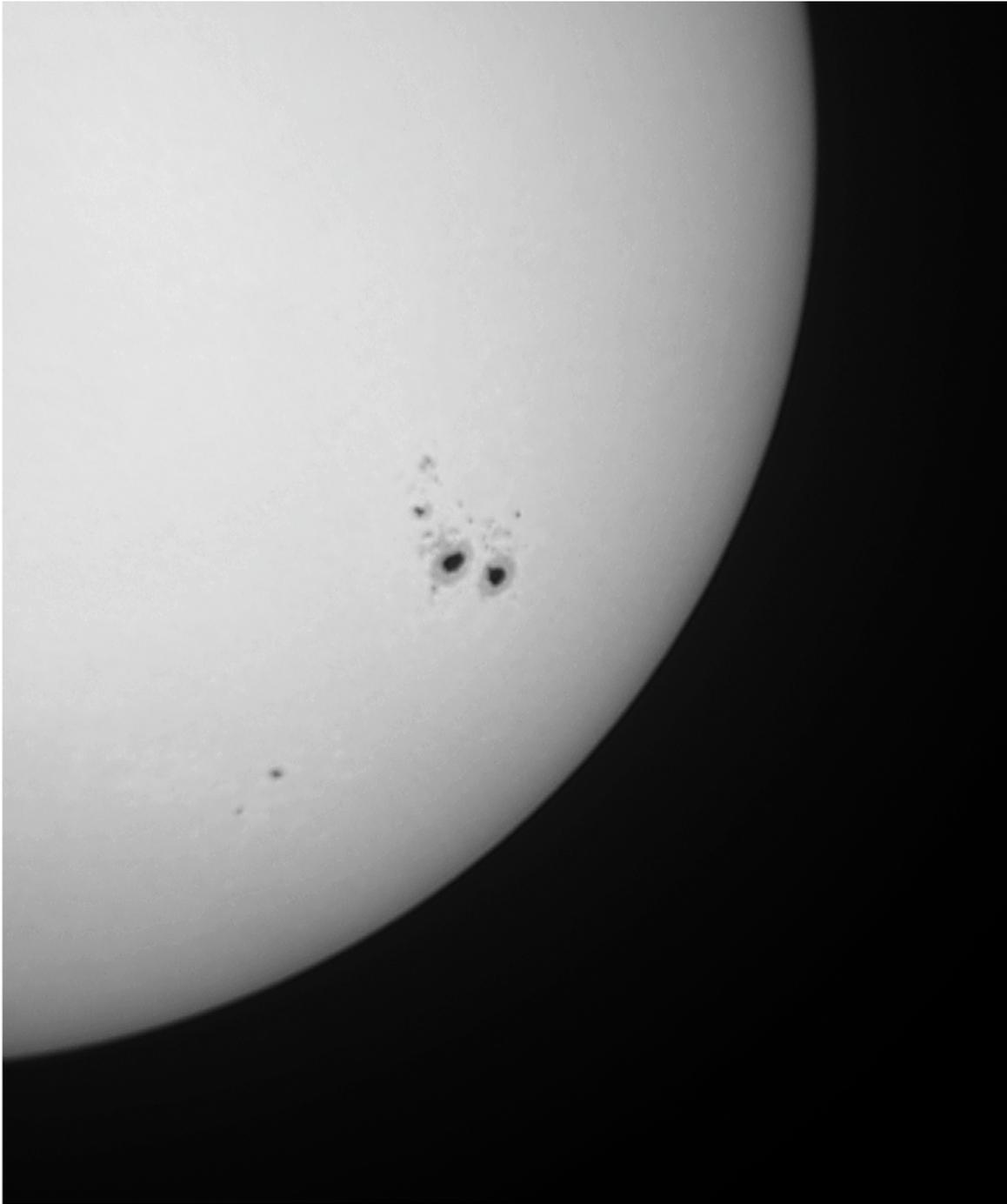
Nikon Coolpix 5700
1.5x Telephoto Lens
32x Zoom
Kendrick Baader Solar Filter
1/125 sec
stack of 24



July 26, 2004
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
William Optics DCL-28
1/1000 sec
stack of 8



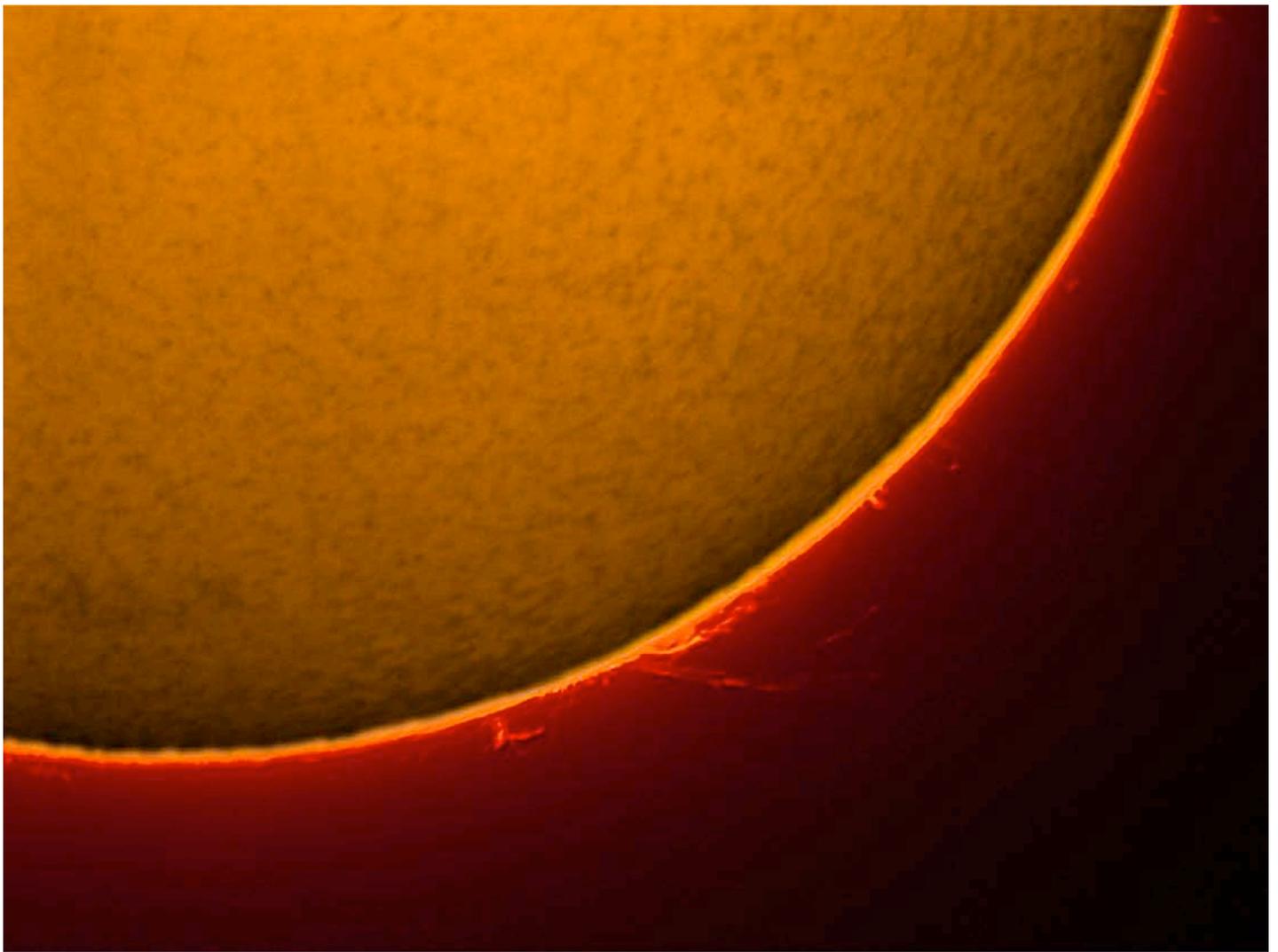
*July 26, 2004
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
ScopeTronic 14 mm
1/500 sec, stack of 8*



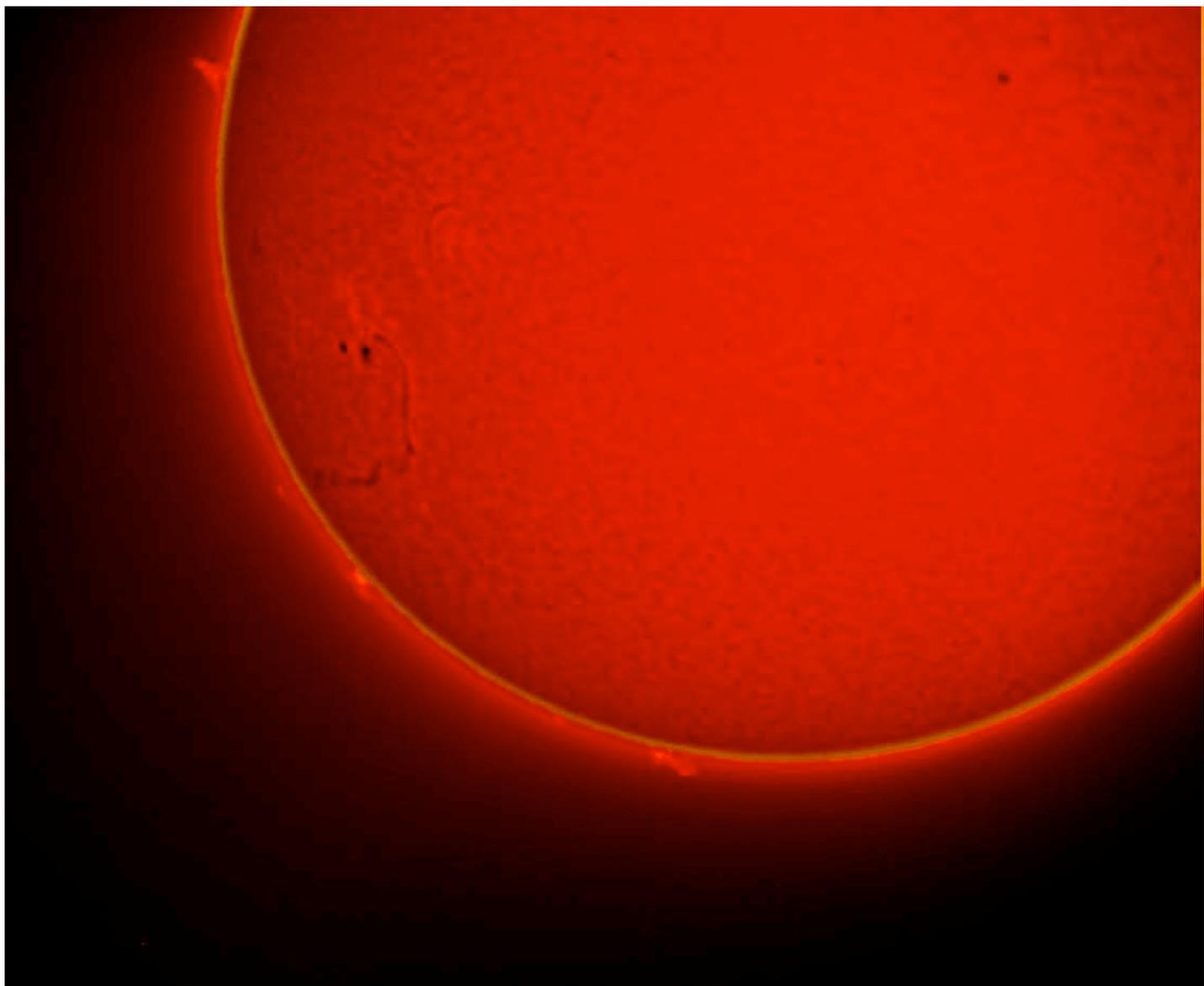
*July 26, 2004
Takahashi Sky 90
Kendrick Baader Solar Filter
ScopeTronix 14 mm
ScopeTronix 1.6x MaxPower
1/250 sec, stack of 8*



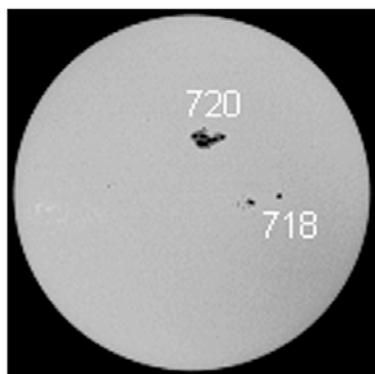
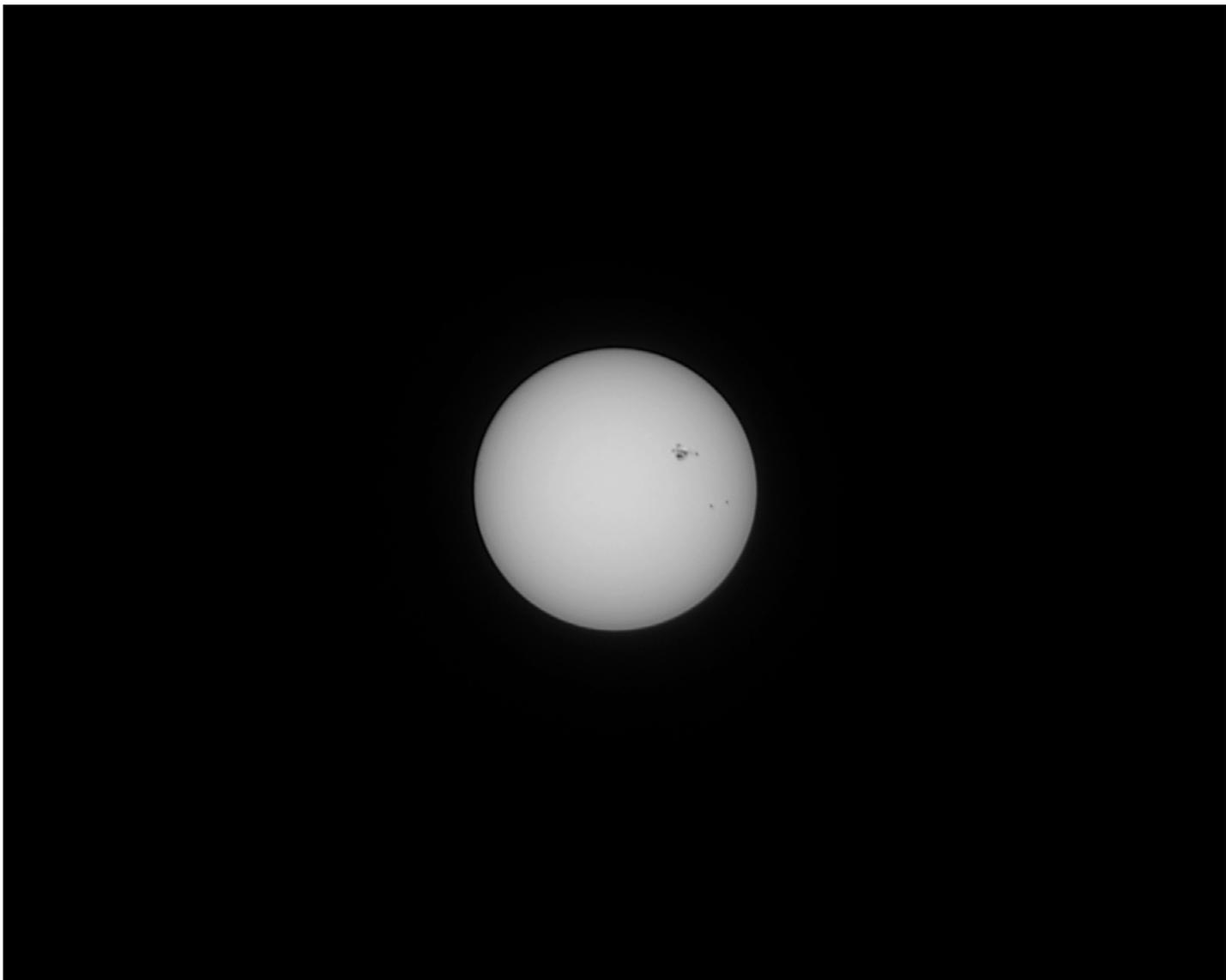
*July 29, 2004
Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Nikon Coolpix 990
ScopeTronix 14 mm
Composite*



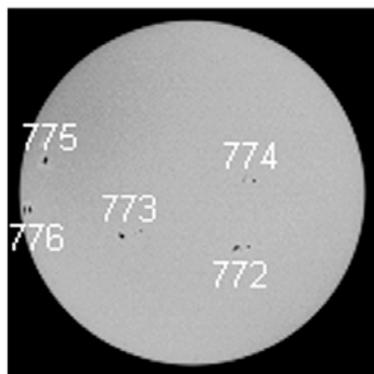
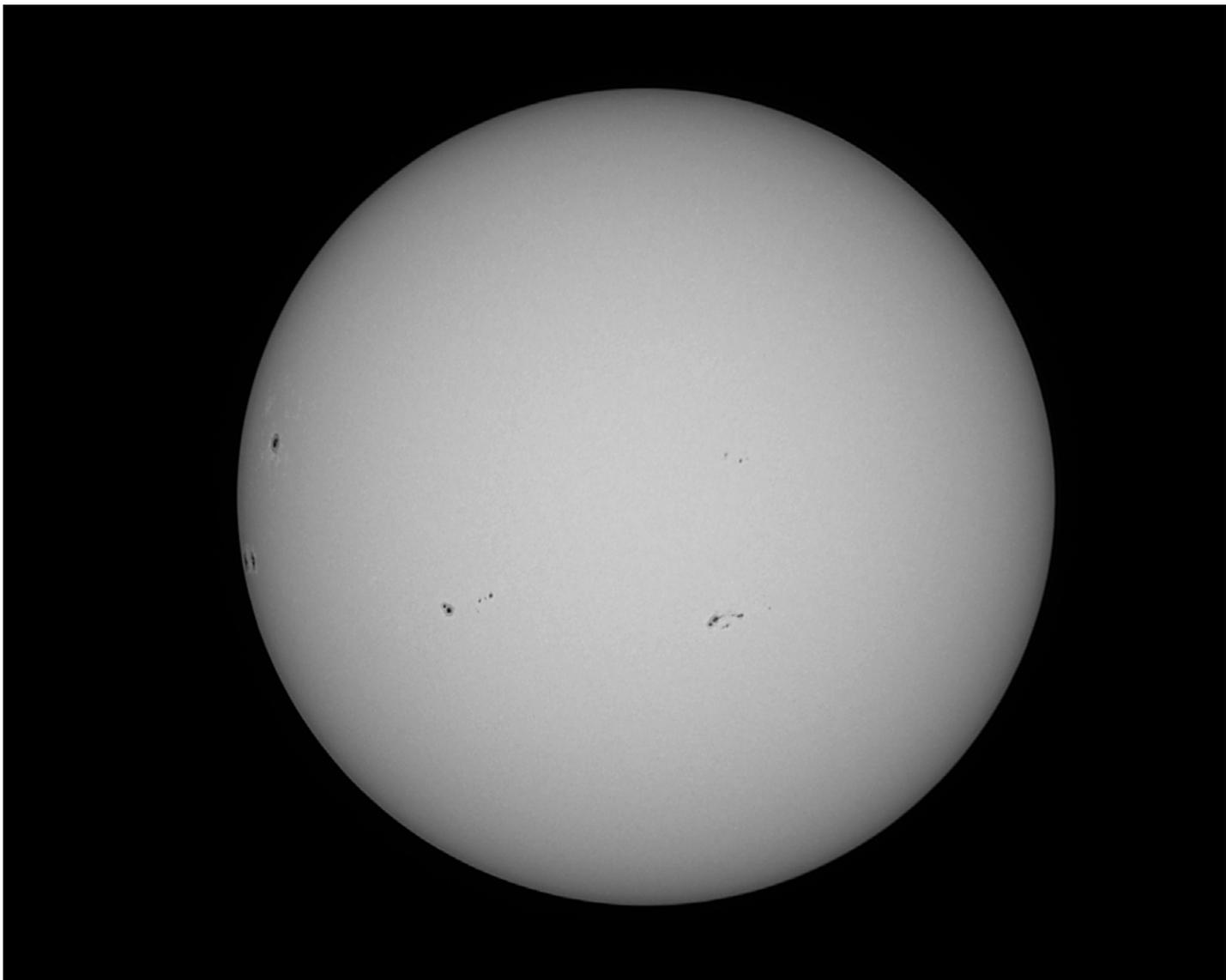
*July 29, 2004
Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Nikon Coolpix 990
ScopeTronix 14 mm
ScopeTronix 1.6x MaxPower
Composite*



*August 23, 2004
Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Nikon Coolpix 990
ScopeTronix 18 mm
Composite*



January 17, 2005
Canon 20D
Canon EF 75-300mm f/4-5.6
at 300mm f/5.6
Kendrick Baader Solar Filter
Stationary tripod
1/1600 sec
stack of 8



June 5, 2005
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
William Optics DCL-28
1/1000 sec
stack of 8



*June 5, 2005
Takahashi Sky 90
Kendrick Baader Solar
Filter
Nikon Coolpix 990
ScopeTronix 14 mm
1/250 sec
stack of 8*

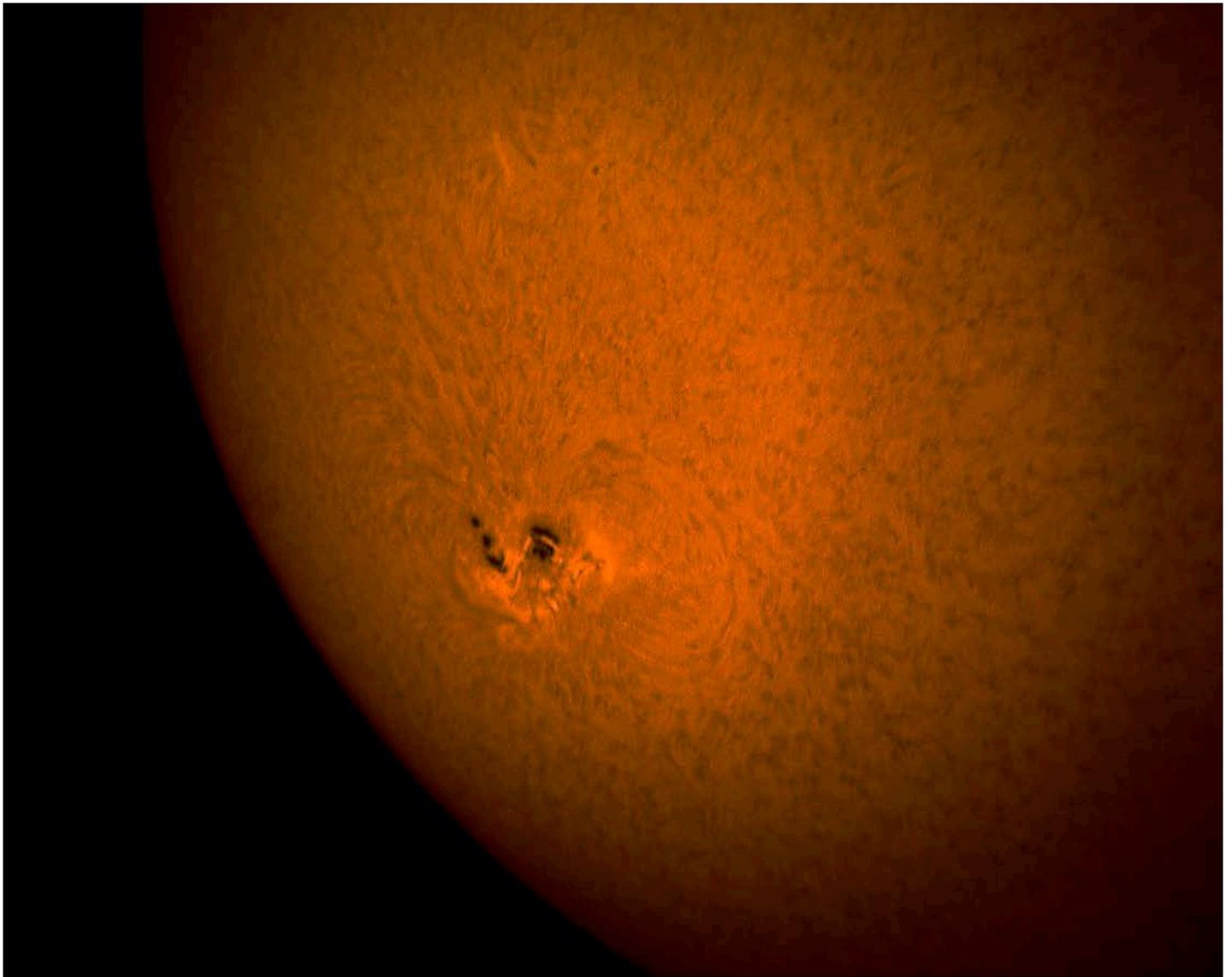


June 5, 2005

Takahashi Sky 90, Coronado SolarMax 90 H- α Filter

Nikon Coolpix 990, ScopeTronix 14 mm

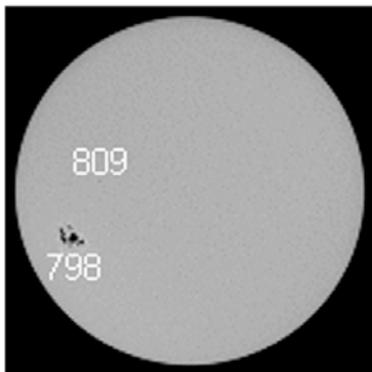
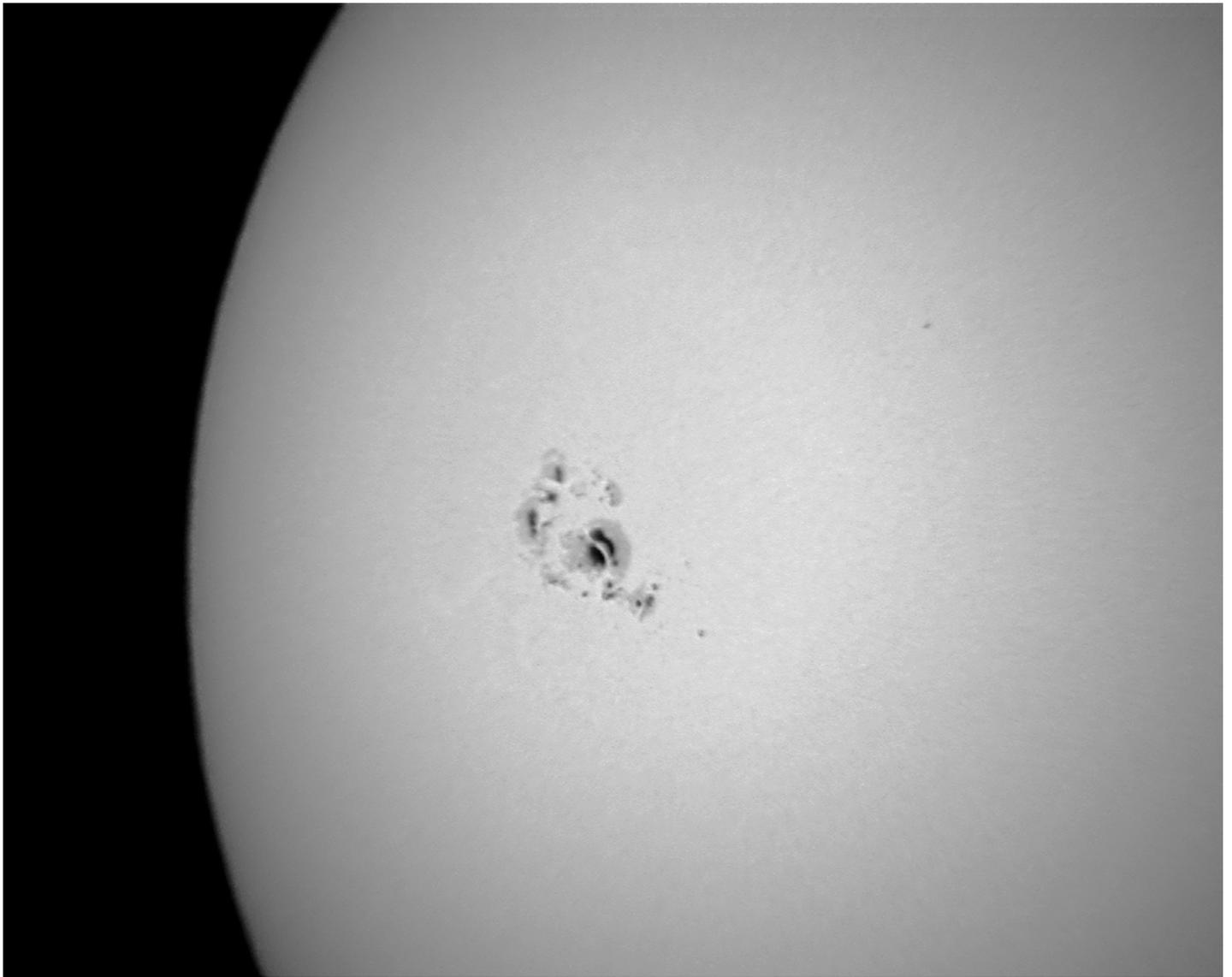
1/30 sec, stack of 8



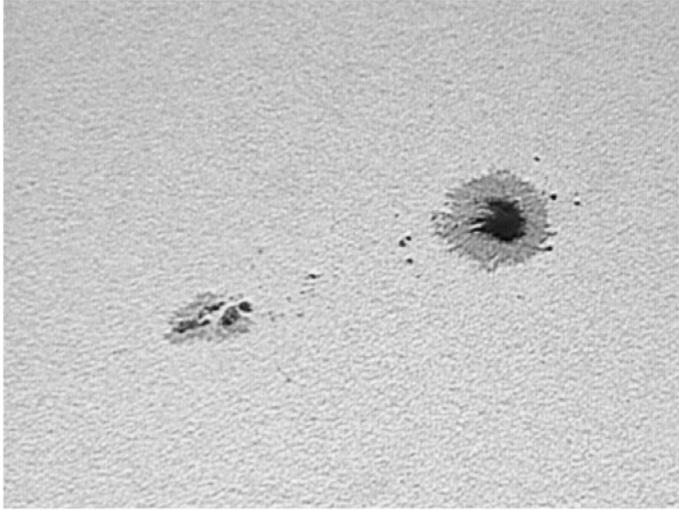
*September 10, 2005
Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Nikon Coolpix 990
ScopeTronix 14 mm
1/125 sec
stack of 8*



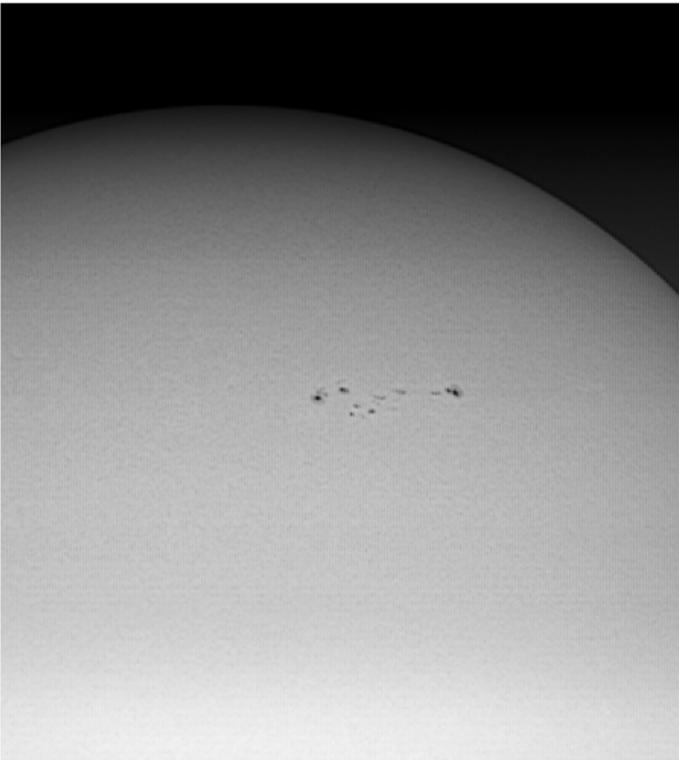
*September 10, 2005
Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Nikon Coolpix 990
ScopeTronix 14 mm
1/15 sec
stack of 8*



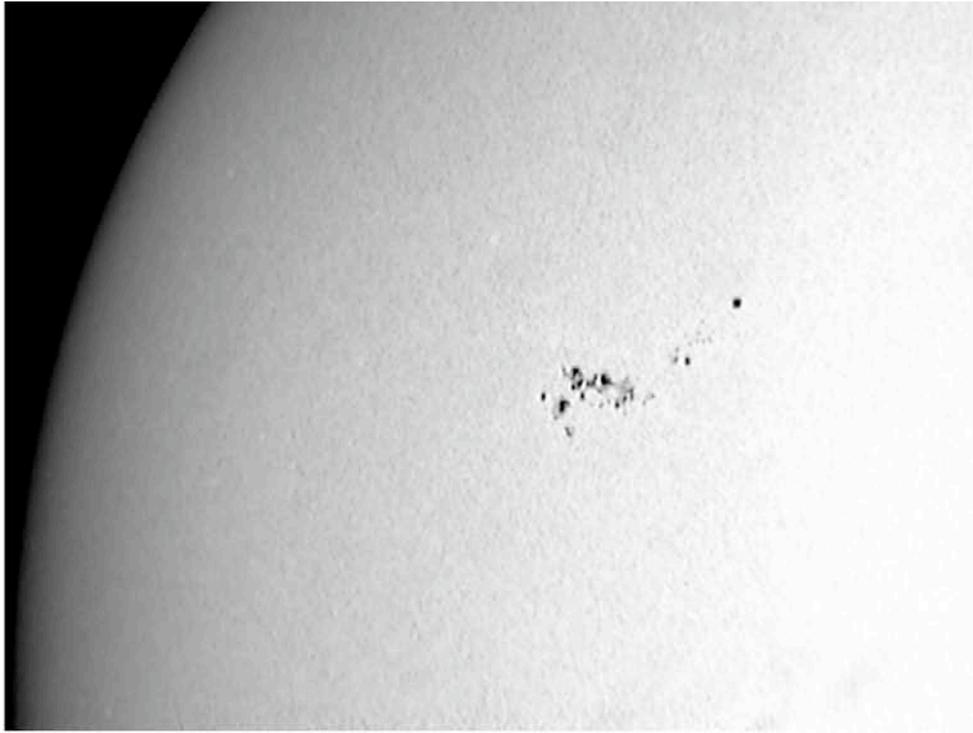
***September 11, 2005
Takahashi Sky 90
Kendrick Baader Solar Filter
Nikon Coolpix 990
ScopeTronix 14 mm
1/125 sec
stack of 4***



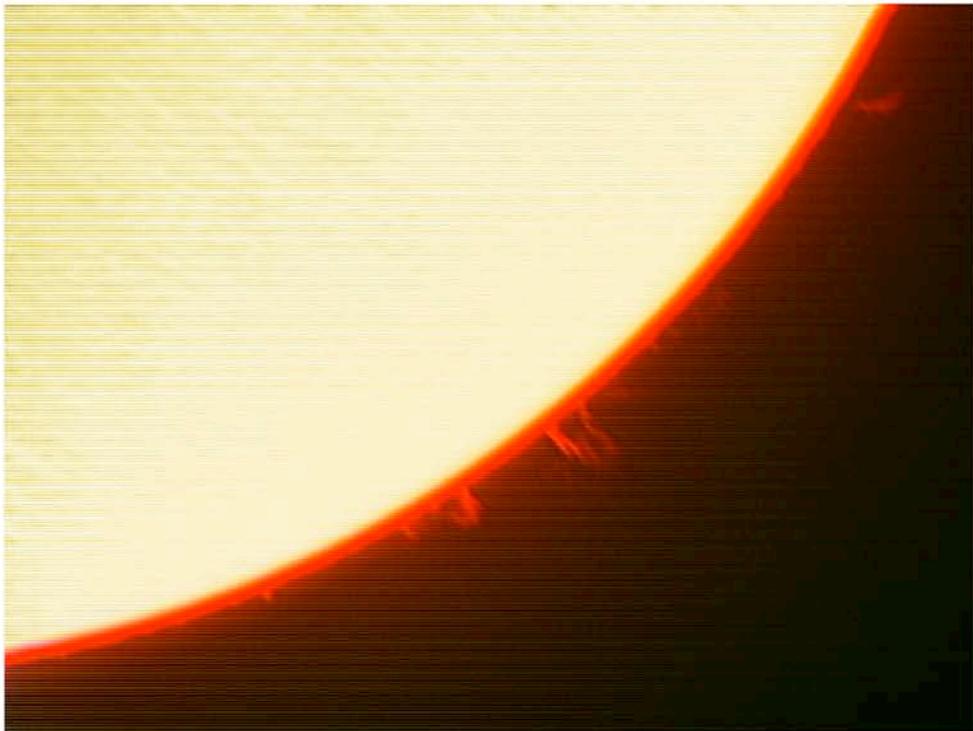
*August 16, 2006
Sunspot #904
Stellarvue SV115
Tuthill Solar Screen
Philips ToUCam 720K
2x Celestron Ultima Barlow*



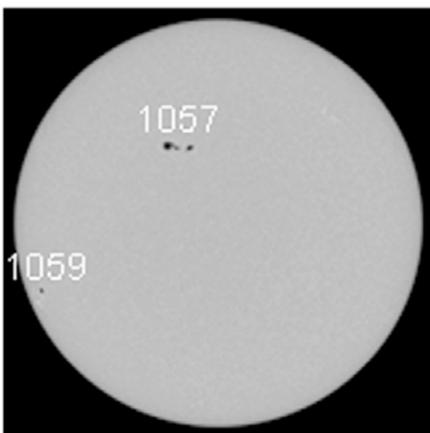
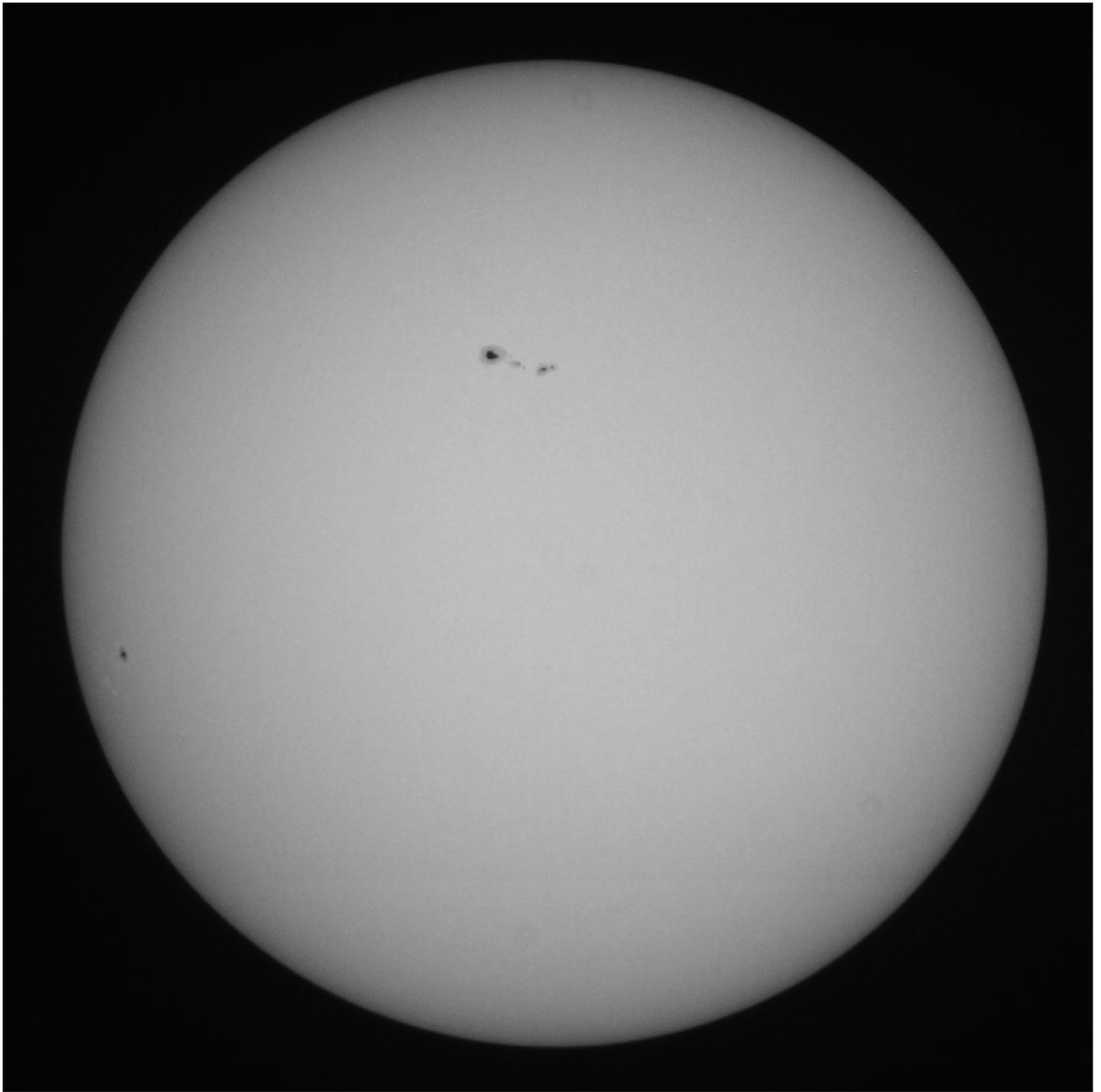
*February 9, 2010
Sunspot #1045
Takahashi Sky 90
Kendrick Baader
Solar Filter
Philips ToUCam 720K*



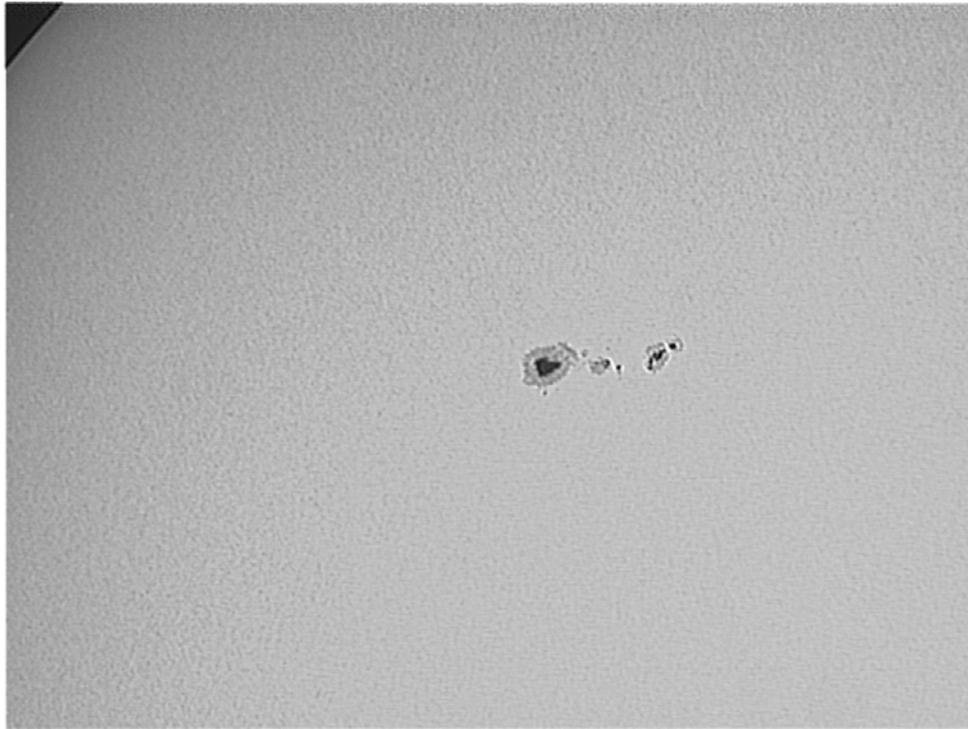
*February 11, 2010 - Sunspot #1046
Takahashi Sky 90 - Kendrick Baader Solar Filter
Philips ToUCam 720K - ScopeTronix 1.6x MaxPower*



*February 11, 2010 - Takahashi Sky 90
Coronado SolarMax 90 H- α Filter
Philips ToUCam 720K - ScopeTronix 1.6x MaxPower*



*March 28, 2010
Celestron C5+ w/Tuthill Solar Screen
Canon 20D
1/3200 sec
stack of 10*



*March 28, 2010 - Sunspot #1057
Stellarvue SV115 - Tuthill Solar Screen
Philips ToUCam 720K*



*March 28, 2010 - Sunspot #1057
Stellarvue SV115 - Tuthill Solar Screen
Philips ToUCam 720K - TeleVue 2.5x Barlow*



*Solar Eclipse; May 20, 2012; 6:50 PM PDT; Lat. 33.994785, Long. -177.890301
Tree Leaf Pinhole Projection*



David B. Vucic

September 1, 2013