

# **Digital Amateur Astronomy**

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**EAS / TVS / WFS**

**7. Feb. 2004**



# Today's digital imaging devices for the amateur astronomer

- Webcam
- Digital Camera
- Digital SLR
- CCD
- Digital Video Camcorder



# Imaging Targets

Target	Pixel Resolution	Req'd Sensitivity
Wide angle, scenic shots (conjunctions, sunsets, evening colors)	High	Low to medium
Wide angle night time constellation shots, big comets, milkyway	High	High
Small angle faint object, deep sky objects, faint comets	Medium	Very high
Entire moon or sun	High	Low
Small feature on moon or sun, planet	Low	Low to medium



# Imaging Targets an Example

Do I need a 6MPixel camera to image Jupiter ?

Let's take a look:

Jupiter's apparent diameter	:	40 arcsec
Assume 8inch scope. Angular resolution	:	0.6 arcsec
Assume 3x over sampling yields	:	0.2 arcsec per pixel
How many pixel cover across Jupiter ?	:	200 pixel

**Solution : We don't need a megapixel camera! (for Jupiter)**

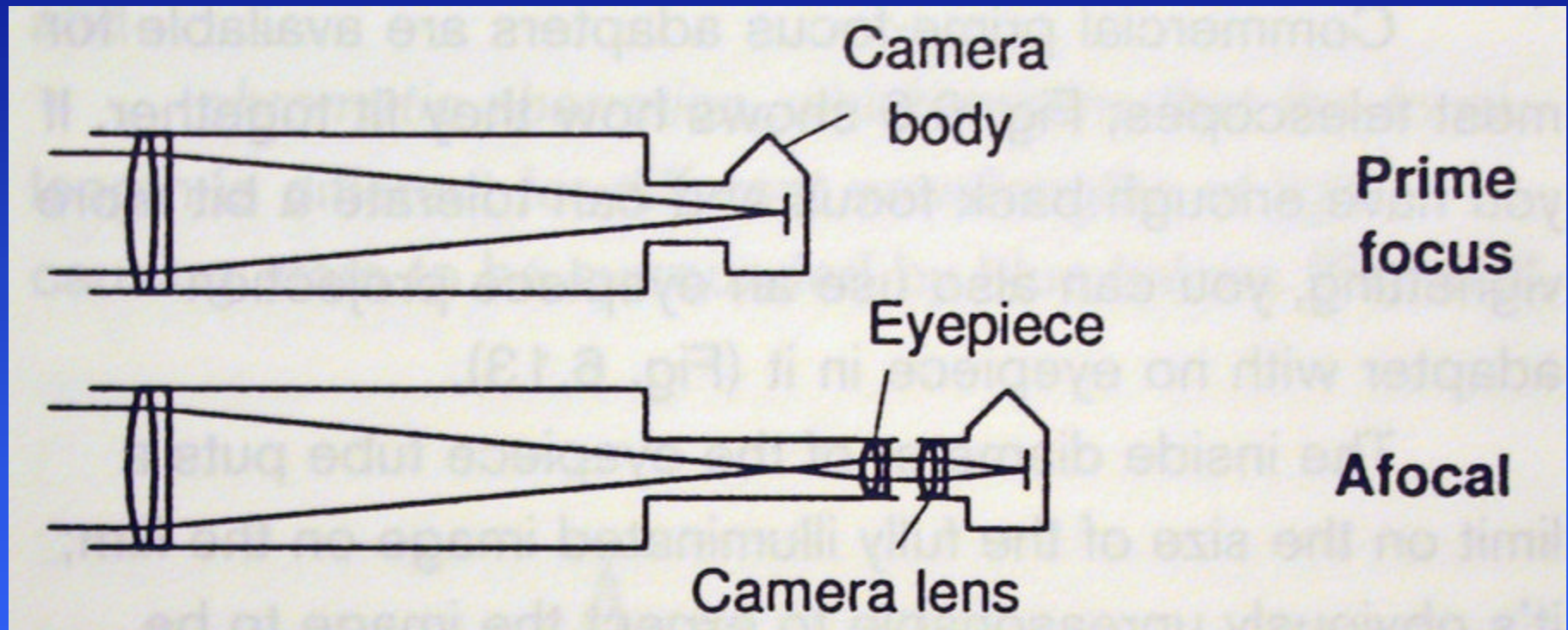


# How to get the image onto the chip ?

- **Lens that comes with the camera**
- **Prime focus adapter**
- **Afocal projection adapter**



# Digital cameras use afocal projection



**Now let's review the different  
imaging devices and see what  
we can do with them**



# Webcams

## Features:

- **Low price (<\$100)**
- **Good sensitivity**
- **Allows averaging lots of images**
- **No waste of film**
- **Digital image processing**
- **Color**





# Webcams

## Disadvantages :

- **Wiring at the telescope**
- **Power supply, PC, Camera**
- **Big files**
- **No long time exposures (cooling!)**
- **Medium resolution (640 x 480)**



# Webcams

## Camera / PC features :

- Webcam with CCD chip (vs. CMOS)
- Laptop with USB Port
- Removable camera lens
- IR block filter!
- Telescope adapter
- Free processing software



# Webcams

## Best Objects:

- Planets
- Sunspots (detail)
- Moon (crater detail)



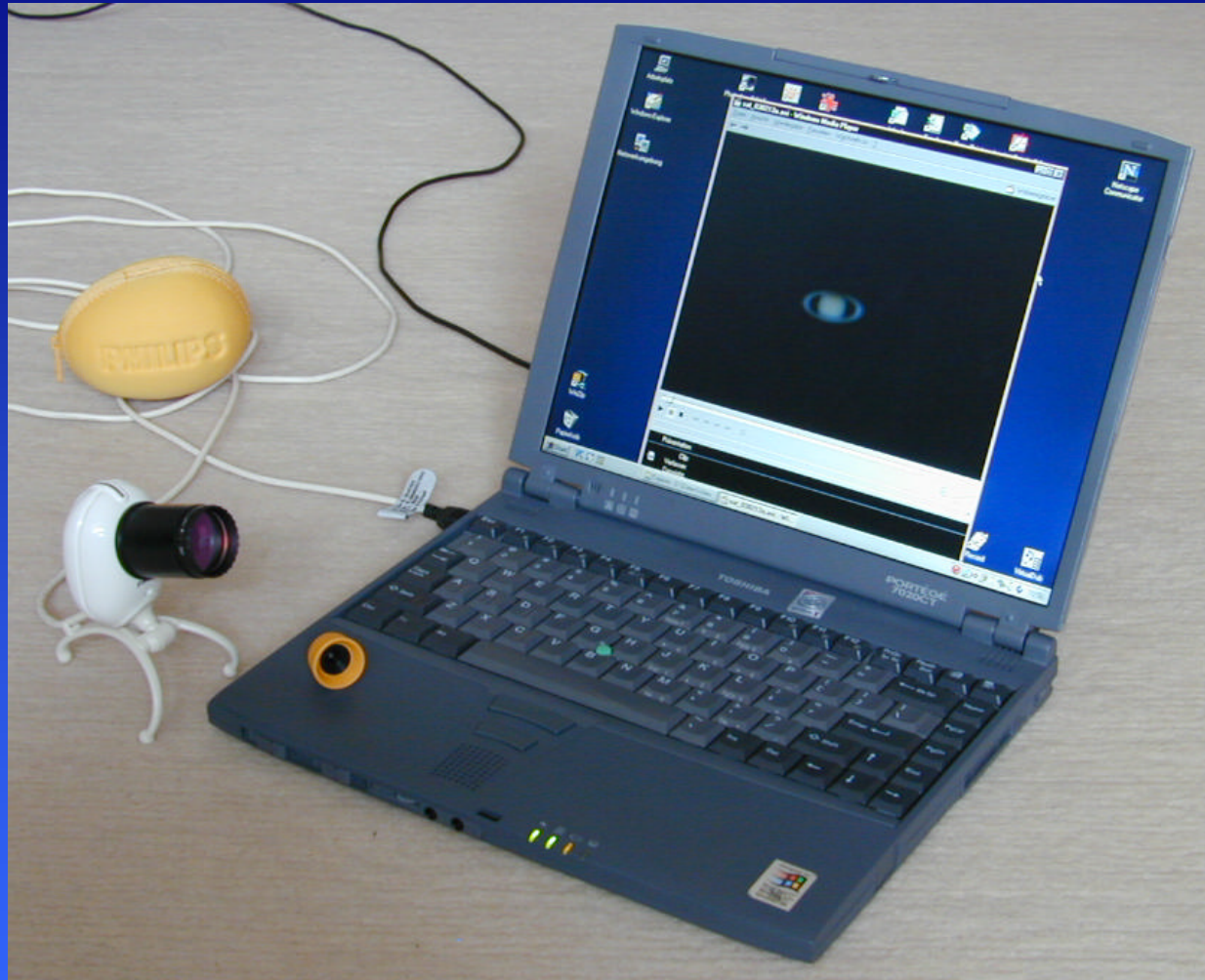
# Philips Webcam Selection Table

Manufacturer	Model No.	Name	Sensor Type	Sensitivity	Sensor Model	Sensor Spec.	Modified to SC Spec ?	Rating for Astro work	O/S
Philips	PCA 635 VC	?	CCD	10 lux	.	512 x 582 pixel	?		WIN95,98,NT4
..	PCA 645 VC	?	CCD	?	.	.	YES		WIN98, LINUX
..	PCA 646 VC	?	CCD	30 lux	.	.	YES		WIN98, LINUX
..	PCVC 655K	Vesta Fun	CMOS	15 lux	.	.			WIN98,Me
..	PCVC 675K	Vesta	1/4"CCD	<1 lux	<a href="#">Sony ICX098AK</a>	659 x 494 pixel 5.6x5.6um	YES	AAA	} ALL WIN + } MAC, LINUX - NOT MAC
..	PCVC 680K	Vesta Pro	CCD	<1 lux	Sony ICX098AK		YES	AAAA	
..	PCVC 690K	Vesta Scan	CCD	<1 lux	Sony ICX098AK		YES	AAAA	
..	PCVC 720K	Toucam XS	CMOS	10 lux	.	.			ALL WIN
..	PCVC 730K	Toucam Fun	CMOS	10 lux	.	.			} ALL WIN +
..	PCVC 740K	Toucam Pro	1/4"CCD	<1 lux	<a href="#">Sony ICX098BQ</a>	659 x 494 pixel 5.6x5.6um	YES	AAAAA	ALL WIN + MAC, LINUX
..	PCVC 750K	Toucam Pro 3D	CCD	<2 lux	?Sony ICX098BQ		same as 740 ?		ALL WIN- NOT MAC

<http://homepage.ntlworld.com/molyned/web-cameras.htm>



# Digital imaging equipment



**Best choice for planetary webcam imaging: Philips ToUCam 740k**



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Sibylle Fröhlich (WFS)

# Digital imaging equipment



# Image processing (Registax)



<http://aberrator.astronomy.net/registax/>



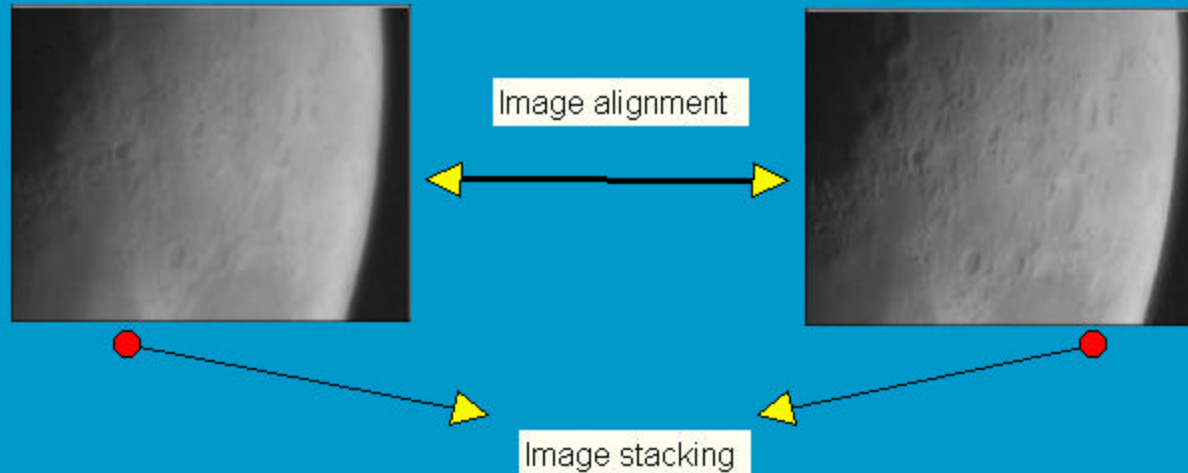
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Sibylle Fröhlich (WFS)

# Image processing (Registax)

## STEP 1: ALIGNMENT

During alignment accurate registration of the images is of the greatest importance. Next to alignment Registax also estimates the quality of the images.

See [alignment page](#)



## STEP 2: STACKING

During stacking all information of the images is used for final stacked image. The signal to noise ratio is increased.

See [Stacking](#)





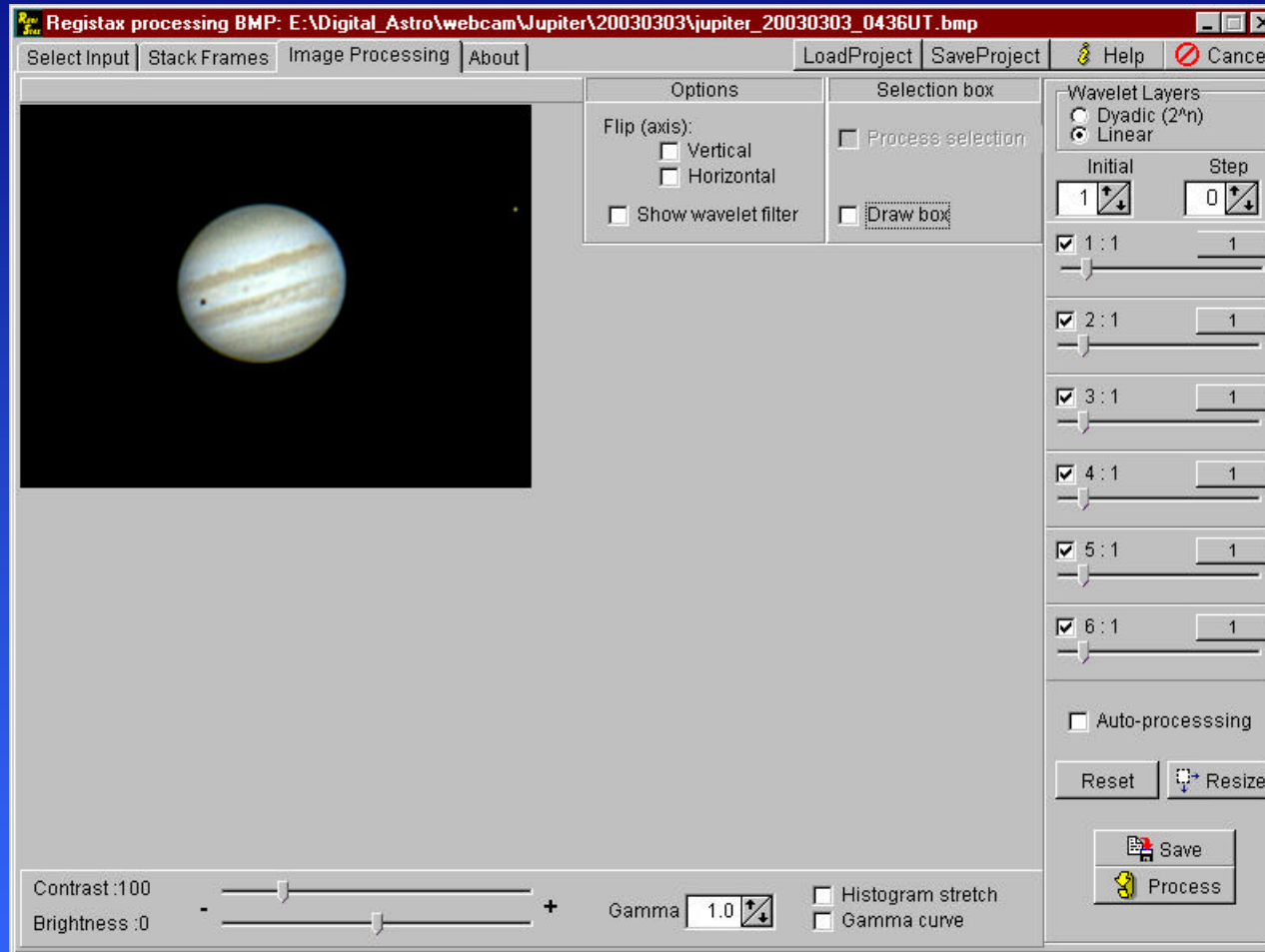
# Image processing (Registax)

## STEP3: PROCESSING

Using wavelet processing techniques only the lower half of the stacked image was processed in Registax.  
See [Processing](#)



# Image processing (Registax)



Stacking of video images and wavelet processing of sum image



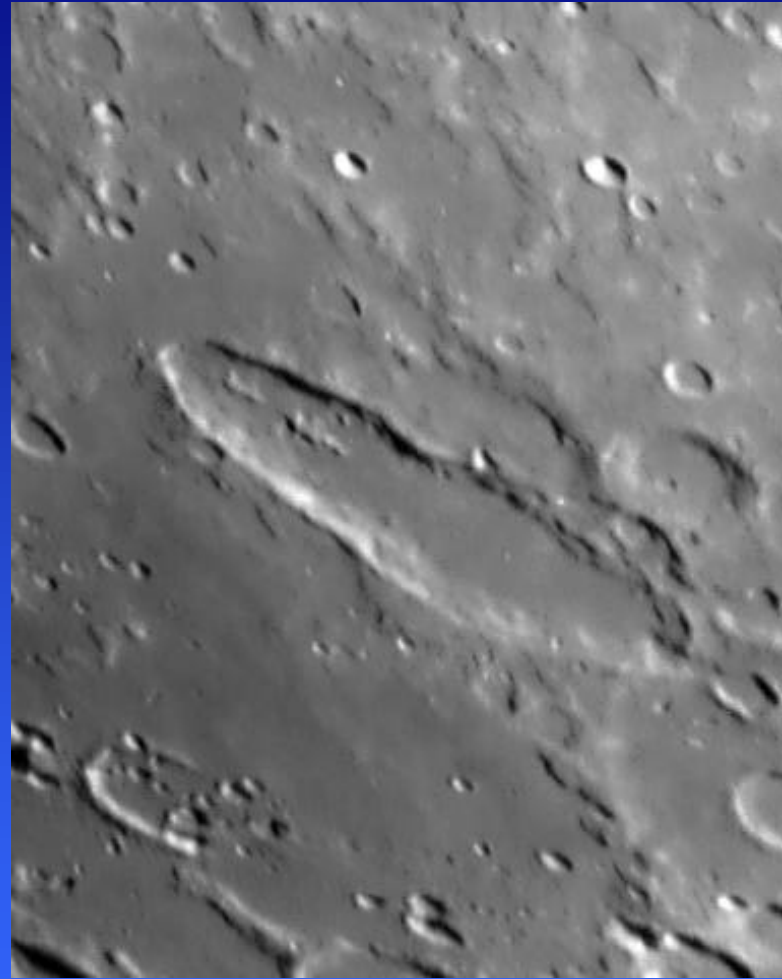
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# Copernicus



Feb. 11. 2003

# Schiller



Mar. 16. 2003

8" Newton f5, 3 x Barlow, ToUCam + IR, 1/100 sec

27 images averaged with Registax      6 images averaged with Registax

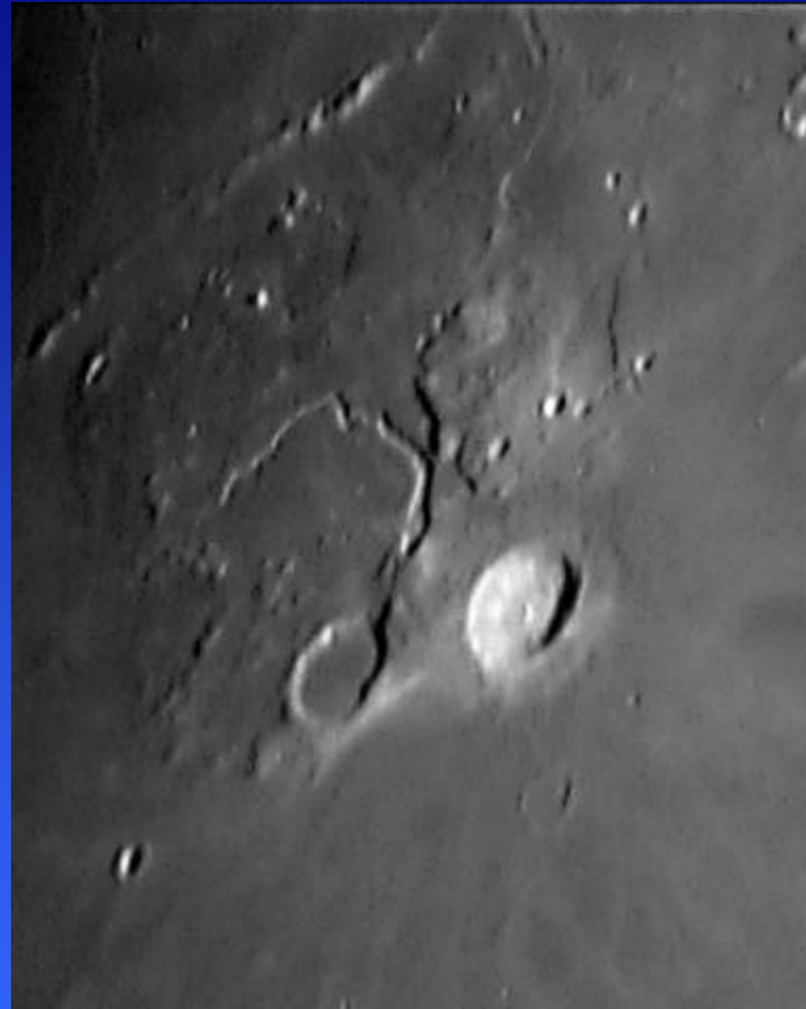


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## Gassendi



## Vallis Schröteri



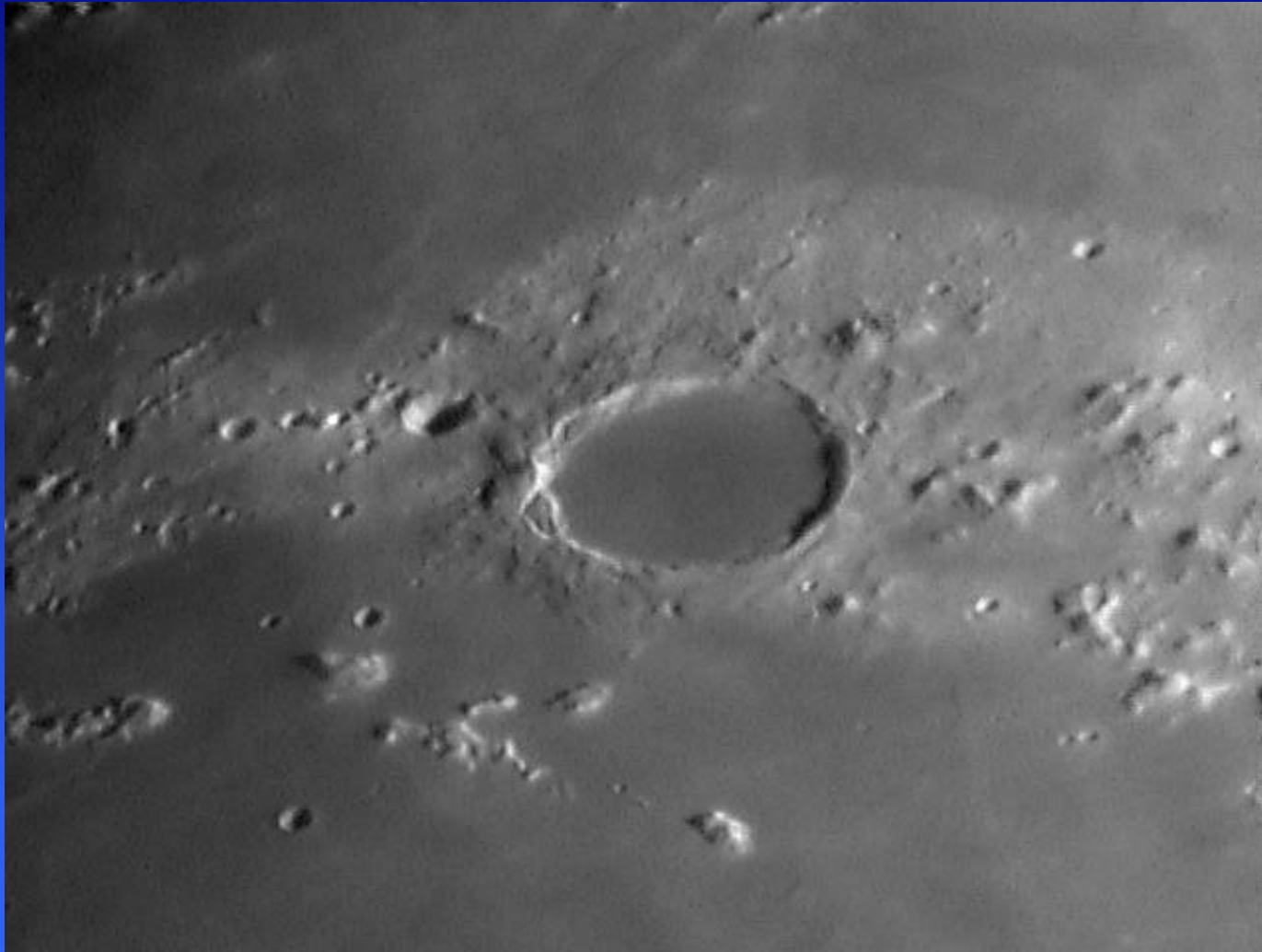
Mar. 15. 2003, 8" Newton f5, 3 x Barlow, ToUCam + IR, 1/100 sec  
5 images averaged with Registax

6 images averaged with Registax



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# Plato



**Feb. 11. 2003 , 8" Newton f5, 3 x Barlow, ToUCam + IR, 1/100 sec  
6 images average with Registax**



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# Clavius

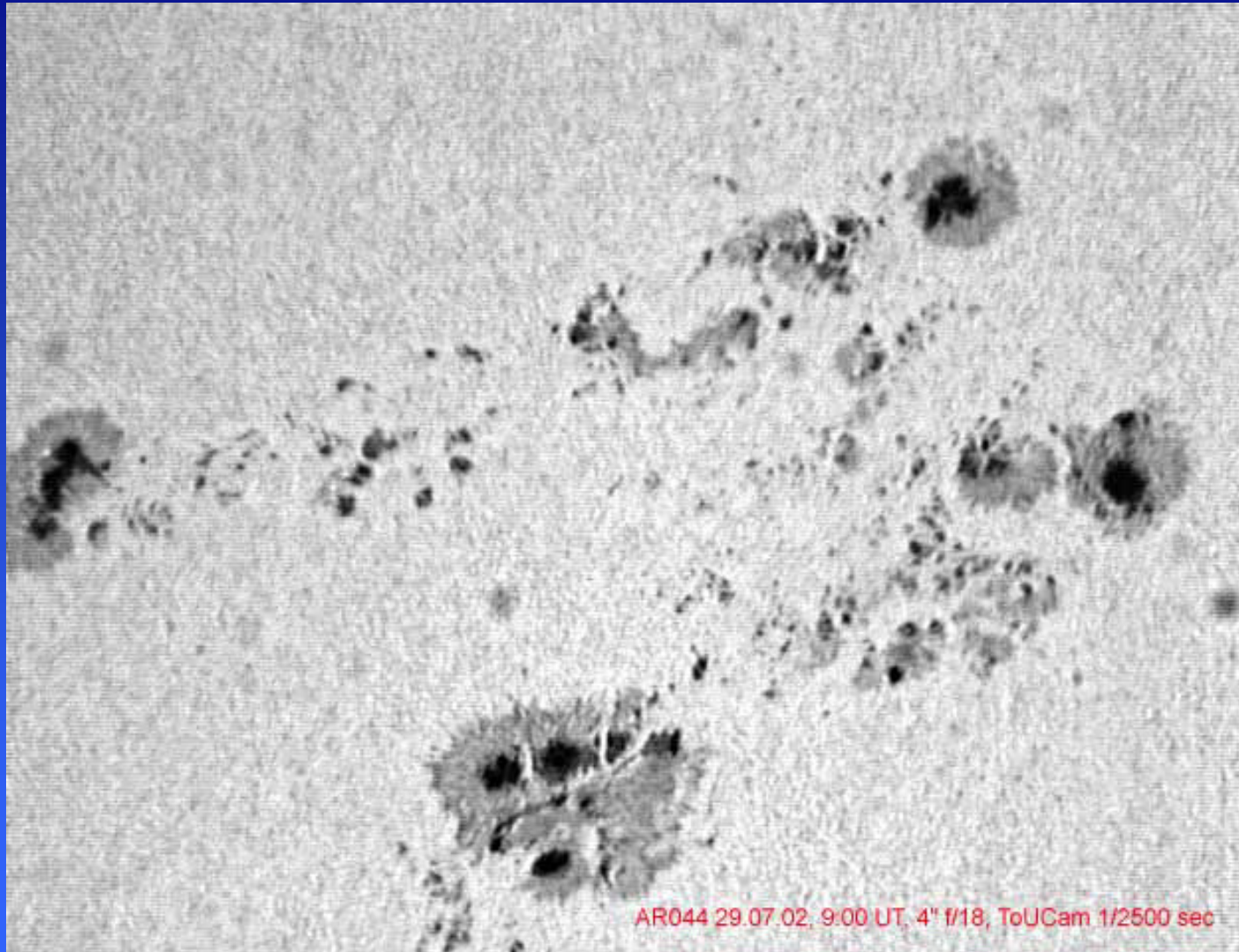


**Feb. 11. 2003 , 8" Newton f5, 3 x Barlow, ToUCam + IR, 1/100 sec  
6 images average with Registax**

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# Sunspot July 29. 2002 (by M.Kiehl, WFS)



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Sibylle Fröhlich (WFS)

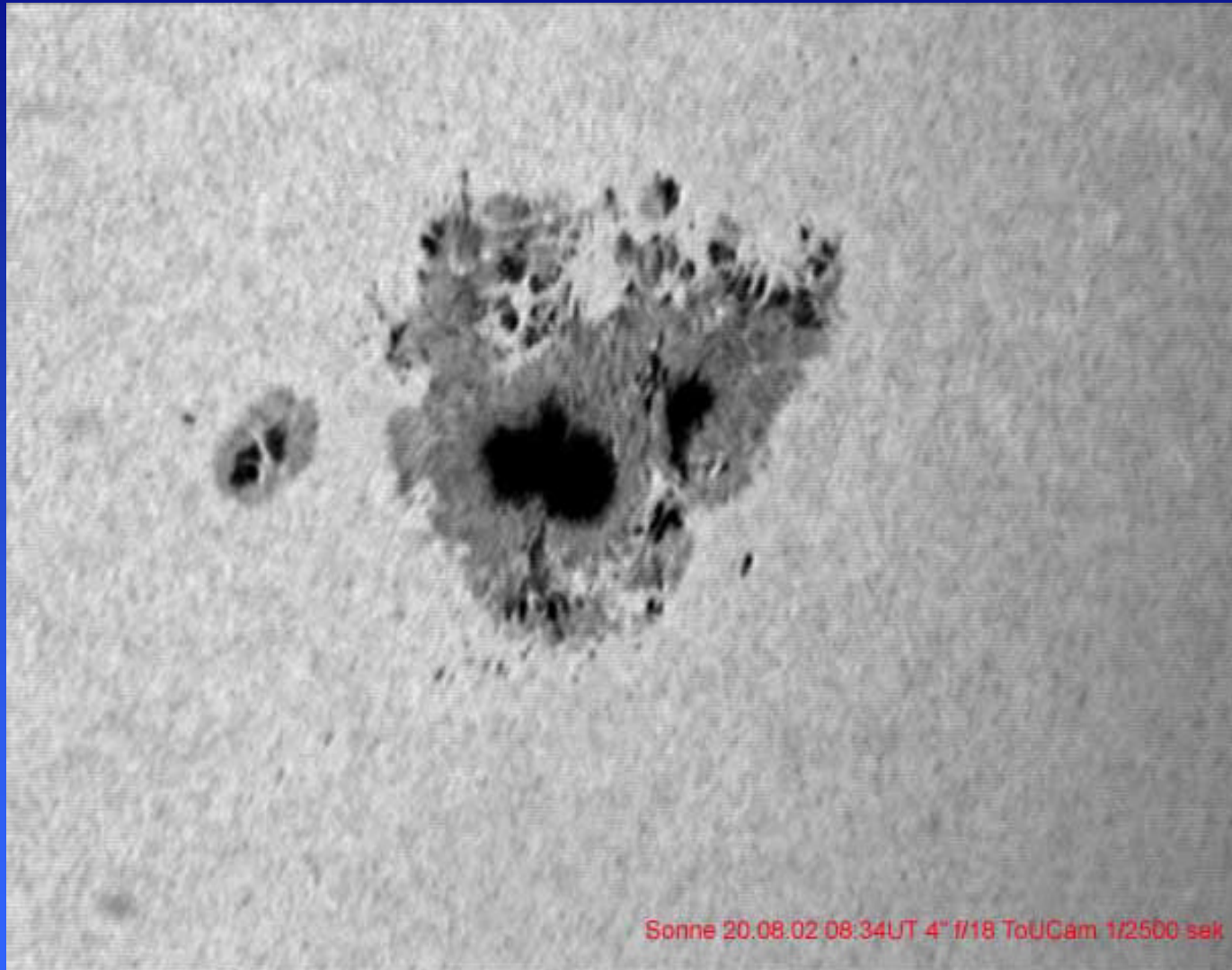
# Sunspot July 30. 2002 (by M.Kiehl, WFS)



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Sibylle Fröhlich (WFS)



# Sunspot Aug. 20. 2002 (by M.Kiehl, WFS)



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# Sunspot Aug. 23. 2002 (by M.Kiehl, WFS)



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Sibylle Fröhlich (WFS)

# Mars

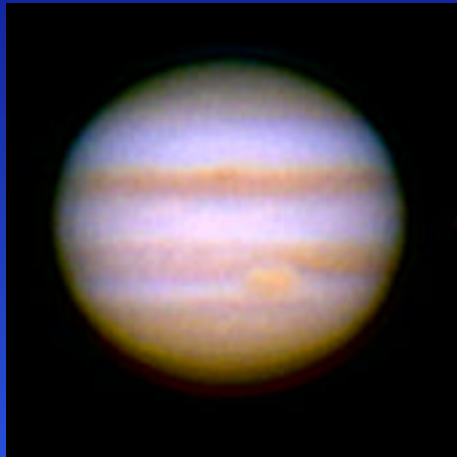


Single AVI video frame (left)

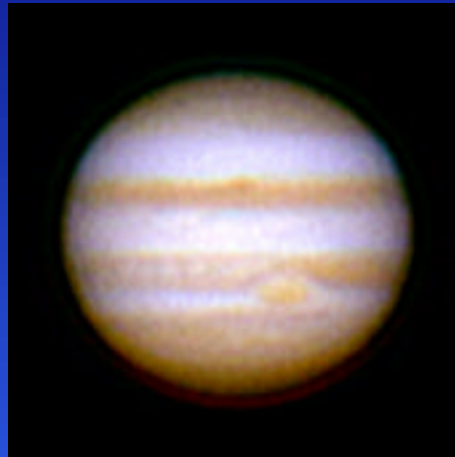
And processed images (below)



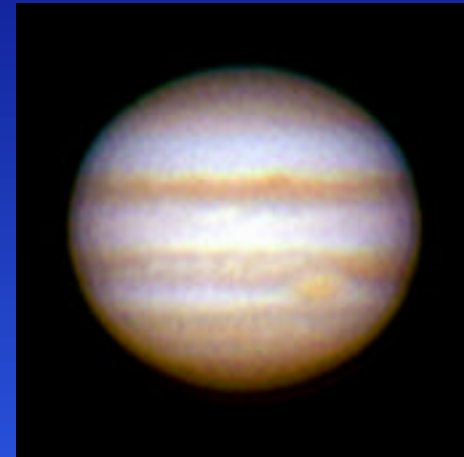
# Jupiter



01:07 UT



01:11 UT



01:26 UT

10. Februar 2003

8" Newton f5, 3 x Barlow, ToUCam + IR, 1/50 sec ,  
12 images averaged with Giotto



# Jupiter 12. Feb. 2003



Europa

Io

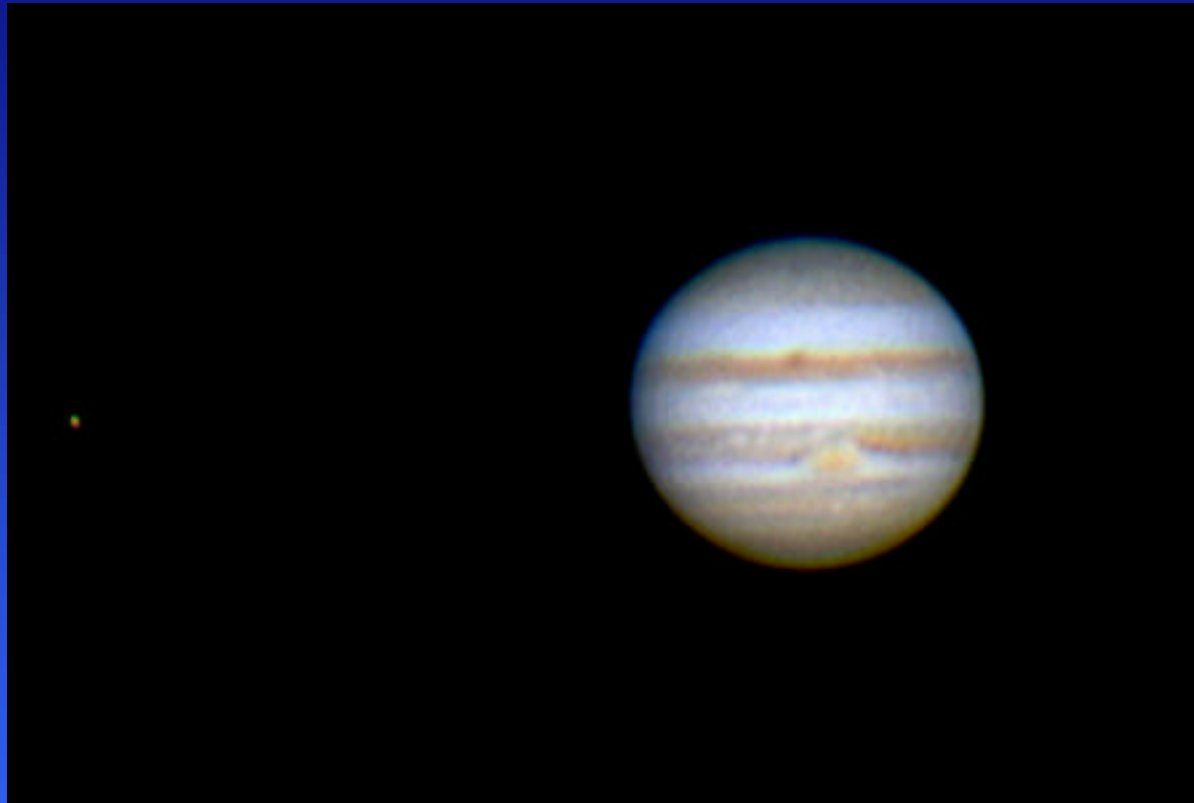
00:58 UT und 01:27 UT

8" Newton f5, 3 x Barlow, ToUCam + IR, 1/33 sec  
ca.25 images processed with Registax



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# Jupiter am 27. Feb. 2003



**00:04 UT**

**8" Newton f5, 3 x Barlow, ToUCam + IR, 1/33 sec  
ca.25 images processed with Registax**



# Jupiter am 2. Mar. 2003



~20 images processed with Registax



# Jupiter 3. Mar. 2003

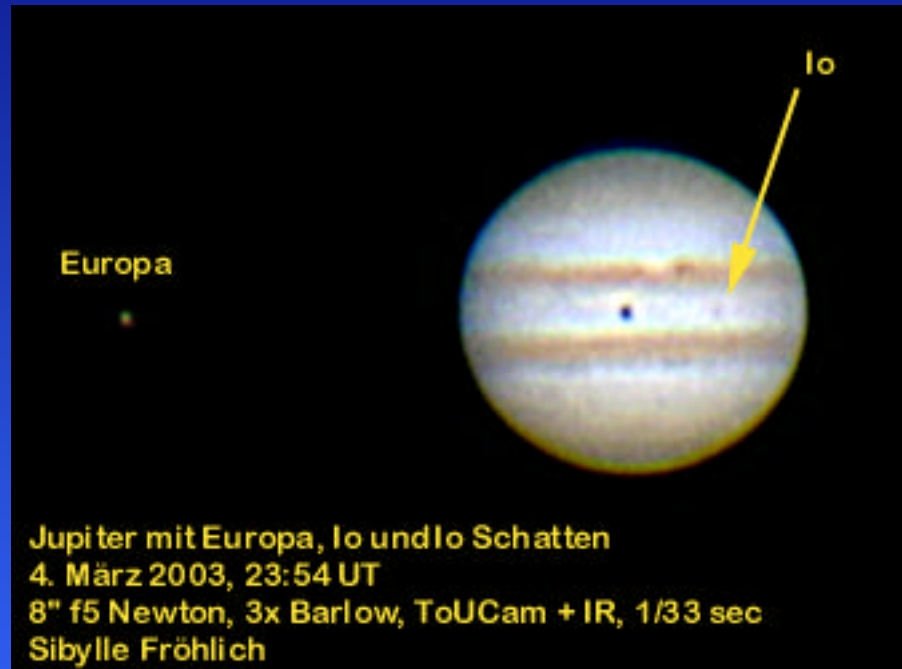


~20 images processed with Registax





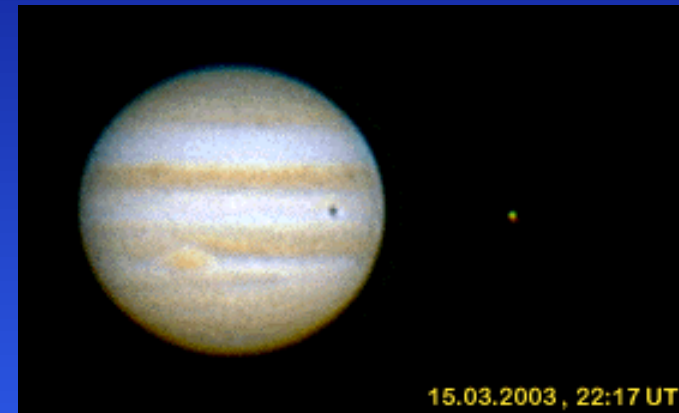
# Jupiter 4. Mar. 2003



31 images processed with Registax



# Jupiter 15. Mar. 2003



47 images processed with Registax



# Jupiter Mar. 22. 2003

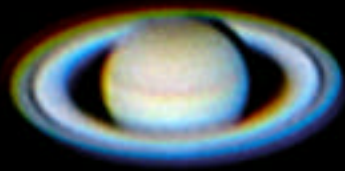


23, 87, 49 images averaged with Registax

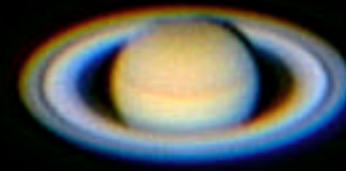


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Sibylle Fröhlich (WFS)

# Saturn



Saturn, 18.03.2003, 21:24 UT  
8" Newton f5, 3 x Barlow, ToUCam, 1/25 sec  
Sibylle Fröhlich



Saturn, 22. März 2003, 20:14 UT  
8" Newton f5, 3 x Barlow, ToUCam + IR  
1/25 sec, Sibylle Fröhlich

**ToUCam 1/25 sec**

**18. Feb. 2003, 21:24UT**

**27 images processed with Registax**

**22. Feb. 2003, 20:14UT**

**22 images processed with Registax**



# Registax Demo



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# Digital Cameras

## Features:

- **Good sensitivity**
- **High resolution (M-Pixel)**
- **Immediate feedback**
- **No waste of film**
- **Digital image processing**
- **Color**



# Digital Cameras

## Disadvantages:

- Price for advanced models with high resolution and manual features
- No long time exposures (less than 30sec.)

# Digital Cameras

## Preferred camera features :

- Manual function control (exposure, f-stop, focus, white balance)
- Remote shutter release (IR, cable)
- Matching eyepieces
- Threaded ring to connect adapters
- A variety of adapter rings





# Digital Cameras

## Best objects :

- Moon (+ eclipses)
- Sun, (+ eclipses)
- Planets / Moon conjunctions



# Nikon Coolpix 950

## Specifications:

- 1600 x 1200 pixel resolution
- 2,11 megapixel total
- 3 x optical zoom (1,25 x – 2,5 x) 7 – 21 mm
- f-stop 1:2,6 – 1:4
- Shutter 8 sec – 1/500sec (manual)
- Shutter or aperture manual, focus manual
- Manual flash disable



# Nikon Coolpix 950



# Nikon Coolpix 950



# Nikon Coolpix 950



# Canon Powershot G1

## Specifications :

- 2048 x 1536 pixel resolution
- 3.34 megapixel total
- 3 x optical zoom 7 – 21 mm (34 – 102 mm)
- f-stop 1:2 – 1:8
- Shutter 8 sec – 1/1000sec (manual)
- Shutter / aperture / focus manual control
- Manual flash disable



# Canon Powershot G1



# Canon Powershot G1





# Canon Powershot G1



# Canon Powershot G1



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Sibylle Fröhlich (WFS)

# The Winter Moon with Nikon Coolpix



**At  $-8^{\circ}\text{C}$  (!!)** =  **$17,6^{\circ}\text{F}$**   
**11. February 2003 , 22:07**  
**Nikon CoolPix**  
**1/125 sec , f 4,8**



# Nikon Coolpix 950 : Moon 17. May 2002



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Sibylle Fröhlich (WFS)

# Nikon Coolpix 950 : Moon 17. May 2002



# Canon Powershot G1 : Moon 24. Oct.01



Sibylle Frommer (WFS)

# Canon Powershot G1 : Moon 22. May 02



Moon, 2002 May 22, 2:25UT, 13" f4, 6mm LV, 3 x Barlow, Canon G1, Gert Gottschalk

Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)



# Canon Powershot G1 : Moon 22. May 02



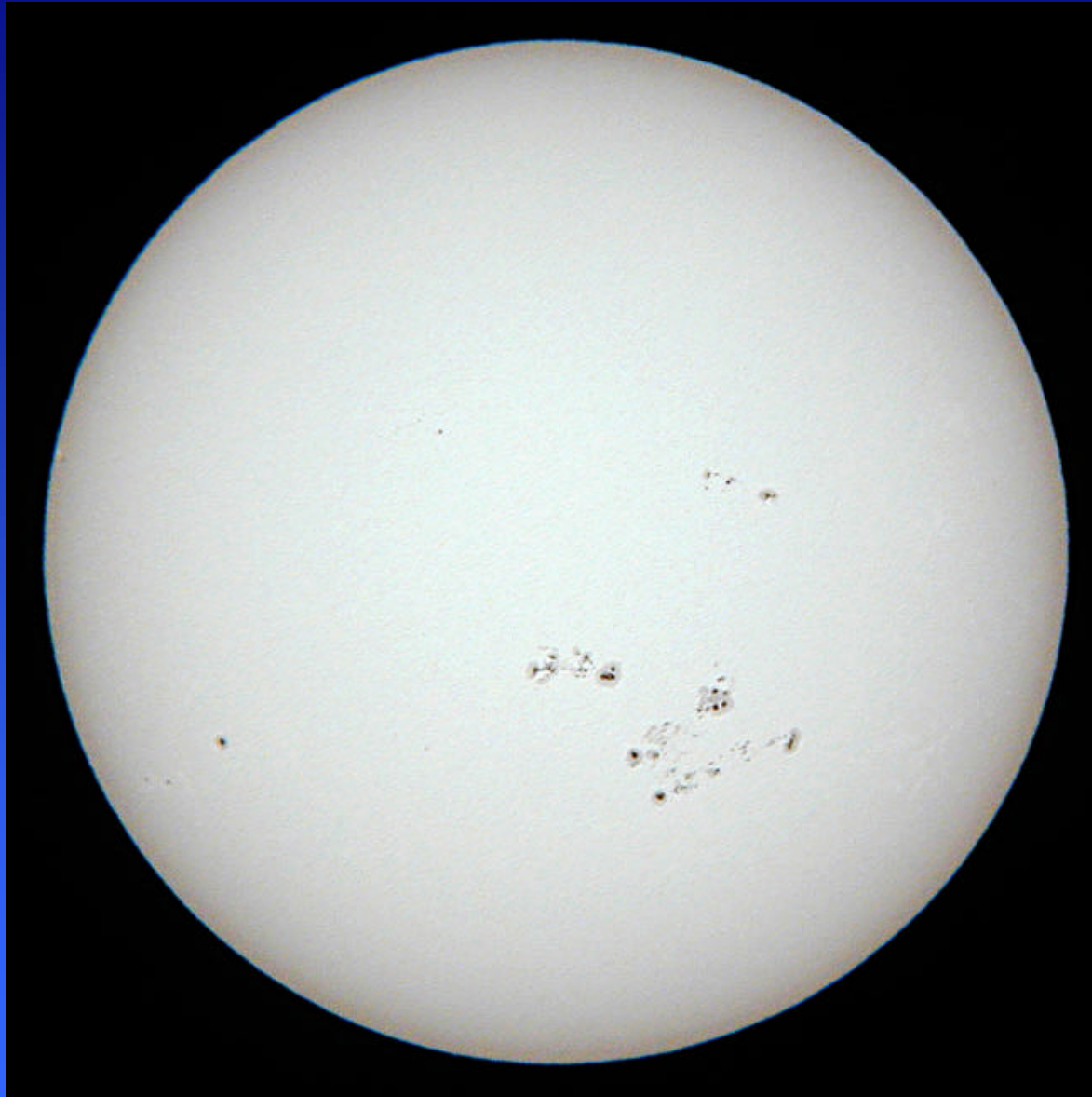
Moon, 2002 May 22, 2:25UT, 13" f4, 6mm LV, 3 x Barlow, Canon G1, Gert Gottschalk

Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)





# Nikon Coolpix 950 : Sun July 29. 2002



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# Nikon Coolpix 950 : Sun July 28. 2002

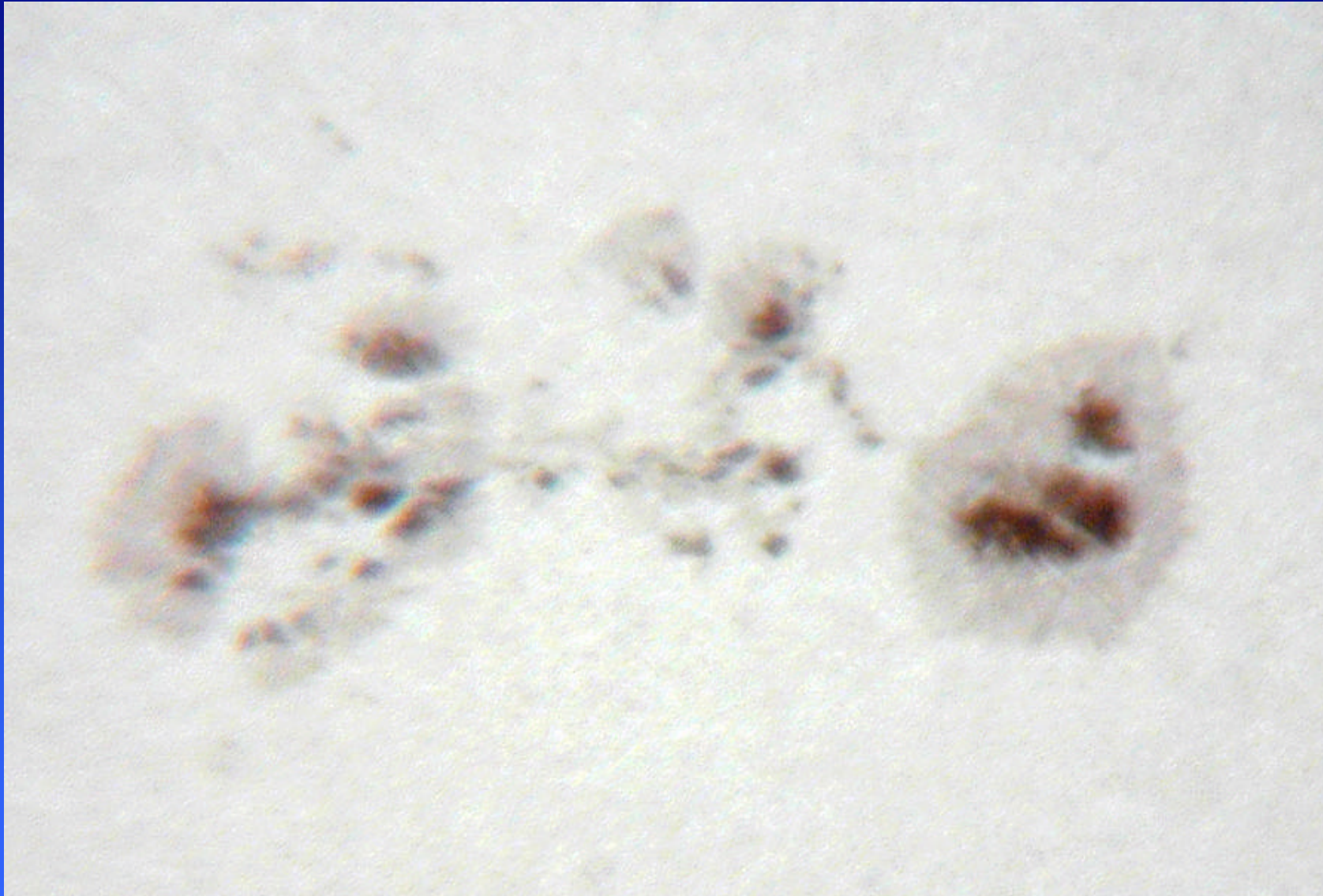


Sonne, 28.7.2002 15:49 UT



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# Nikon Coolpix 950 : Sun July 29. 2002



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

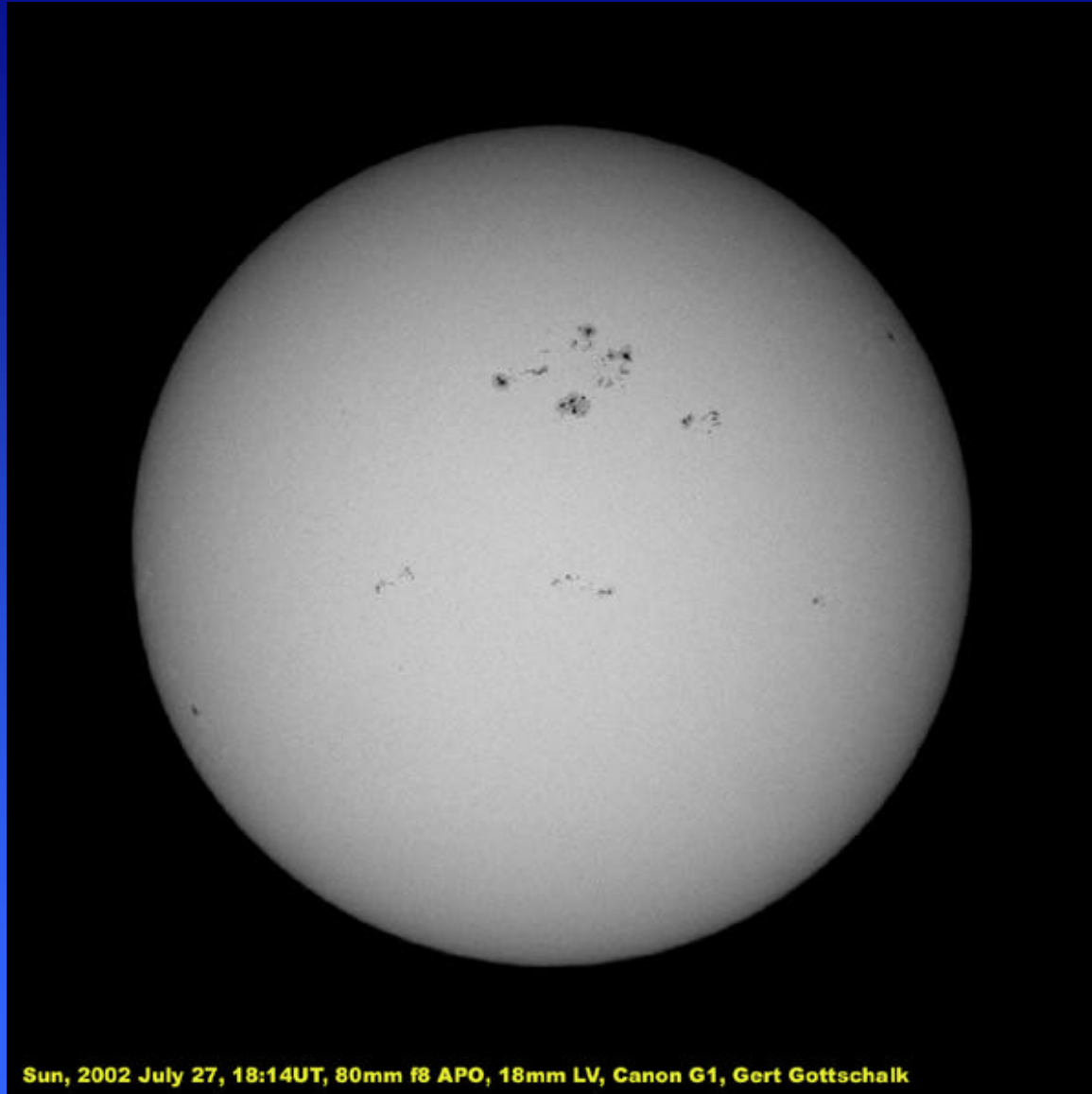
# Nikon Coolpix 950 : Sun Aug. 18. 2002



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)



# Canon Powershot G1 : Sun



Sun, 2002 July 27, 18:14UT, 80mm f8 APO, 18mm LV, Canon G1, Gert Gottschalk



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# Nikon Coolpix 950 : Planets May 16. 2002



## Moon, Saturn, Jupiter

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Sibylle Fröhlich (WFS)



# Nikon Coolpix 950 : Planets June 4. 2002



## Jupiter, Saturn

Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)



# Nikon Coolpix 950 : Planets Dec. 2. 2002



## Moon, Venus, Mars

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Sibylle Fröhlich (WFS)





# Digital SLR Cameras

## Features:

- **Good to high sensitivity**
- **Very high resolution (M-Pixel)**
- **No fixed camera lens**
- **Many adv. features**
- **Color**

# Digital SLR Cameras

## Disadvantages:

- **Price for advanced models with high resolution and manual features**

# Digital SLR Cameras

## Preferred camera features :

- Manual function control (exposure, f-stop, focus, white balance)
- Noise reduction (dark field, digital processing in camera)
- Remote shutter release (IR, cable)
- A variety of adapter rings

# Digital SLR Cameras

## Best objects :

- Moon (+ eclipses)
- Sun, (+ eclipses)
- Planets / Moon conjunctions
- Deep Sky with some models



# Canon 10D



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# CCD Cameras

## Features:

- **Very high sensitivity**
- **Medium to high resolution**
- **No fixed camera lens**
- **Image like the Pros!**

# CCD Cameras

## Disadvantages:

- Price very high
- Can't be used for anything else

# CCD Cameras

## Best objects :

- Deep Sky faint objects
- Medium size objects for mid range priced cameras
- Large objects for Megapixel models





# Starlight MX716



NGC2237 (Rosetta Nebula), H-Alpha:32x4min., 13" f4, Starlight MX716, Jan. 2004, Gert Gottschalk

Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)



# Starlight MX716 (LRGB)



NGC 1976 (M42), L:30min., RGB:10min., 13" f4, Starlight MX716, Dec. 2003, Gert Gottschalk

Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)



# ST10MXE (Kitt Peak)



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Sibylle Fröhlich (WFS)

# Digital Video Camcorders

## Features:

- **It's a movie!**
- **Medium sensitivity**
- **Medium resolution**
- **fixed camera lens**
- **Many adv. features**
- **Color**



# Digital Video Camcorders

## Disadvantages:

- Price for advanced models with high resolution and manual features
- High demands on computer processing

# Digital Video Camcorders

## Preferred camera features :

- Manual function control (exposure, f-stop, focus, white balance)
- Noise reduction (dark field, digital processing in camera)
- Remote shutter release (IR, cable)
- A variety of adapter rings



# Digital Video Camcorders

## Best objects :

- Moon (+ eclipses)
- Sun, (+ eclipses)
- Anything that moves (occultations, transits)



# Panasonic NV-GS3EG





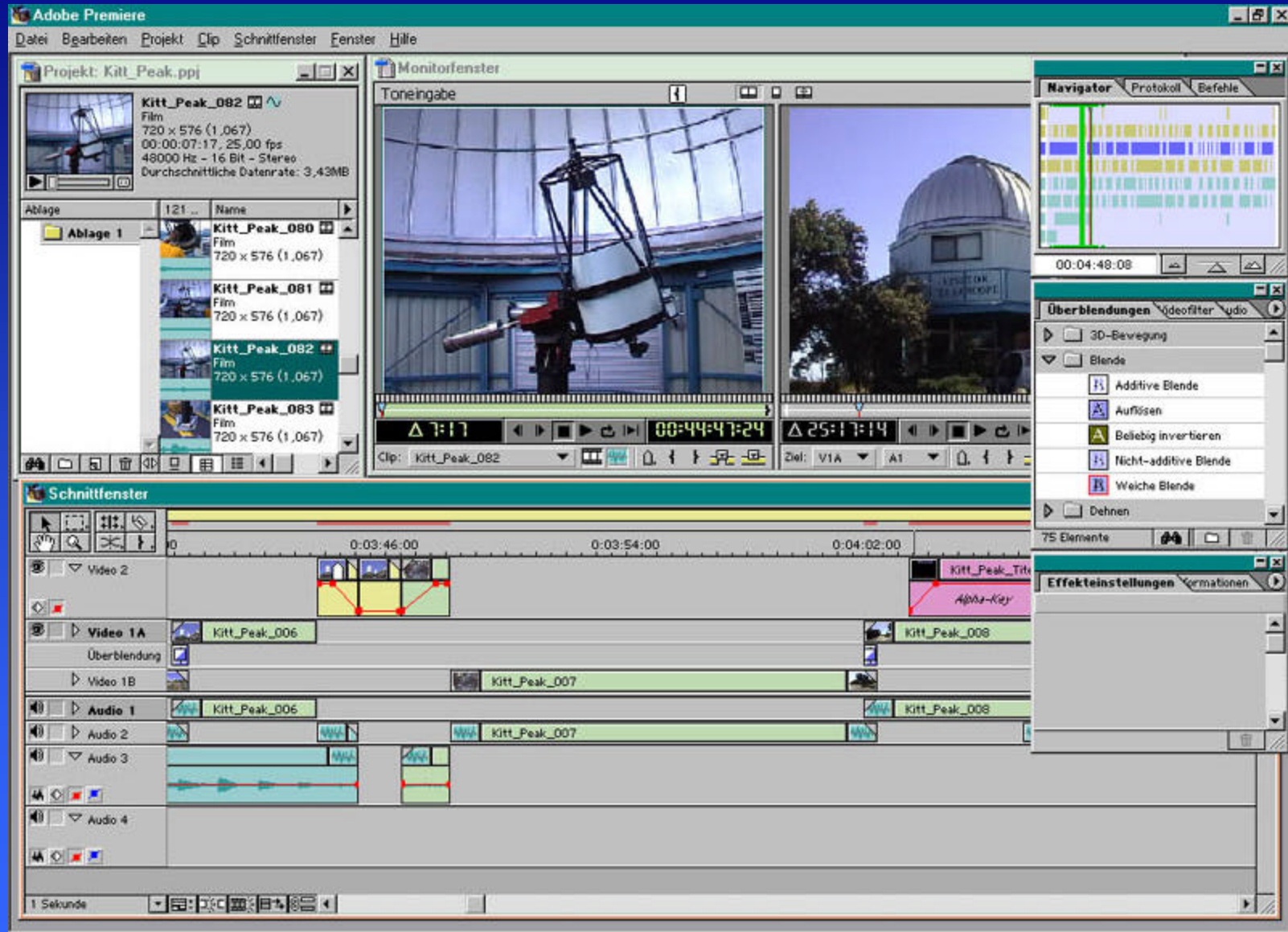
# Panasonic NV-GS3EG



# Panasonic NV-GS3EG



# Adobe Premiere Video Editing



# Video Demo



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

# Thank You!



Gert Gottschalk, Ron Bissinger,  
Sibylle Fröhlich (WFS)

## **AG Astrofotografie der Wilhelm Foerster Sternwarte e.V.**

**<http://www.be.schule.de/schulen/wfs/pages/AGAstrofoto/INDEX.HTM>**

