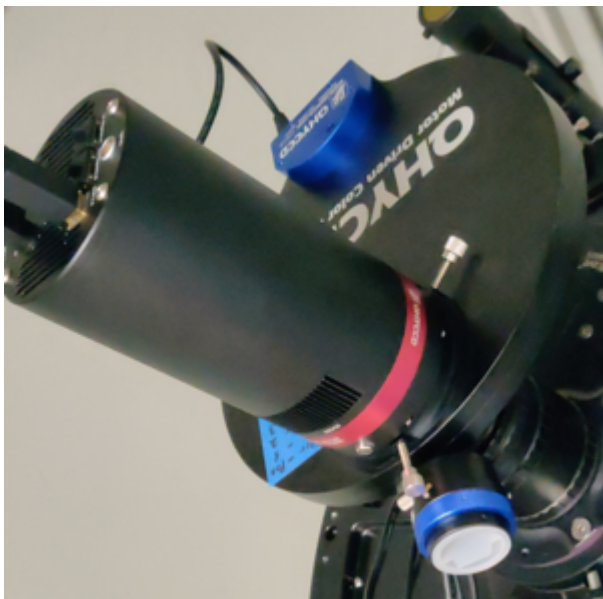


# Specialized astro cameras



Our QHY 600M with the filter wheel

## CMOS cameras

Our main cameras are CMOS cameras designed specifically for astrophotography. For deep sky imaging we use two QHY 600M, which offer a full frame sensor, very high quantum efficiency, very low readout noise and very low dark current. For these cameras, we also have an off-axis guide, a 9-position filter wheel, and a 7-position filter wheel.

As main camera for our two [spectrographs](#) serves a QHY 268M. Furthermore we have a QHY 485C and a ZWO ASI174.

## CCD Cameras

Furthermore, four older CCD cameras (ST-7, ST-8, STF-8300M, ST-i) from SBIG (*Santa Barbara Instrument Group*) and one CCD camera (Skyris 445C) from *Celestron* are available.

The ST-7, ST-8, and STF-8300M are deep-sky cameras, but due to their relatively small field of view they are rarely used currently.

The ST-i, the QHY 485C, and the Skyris 445C are „planetary cameras“ which allow very short exposure times. They are mainly used for solar observations or as guiding cameras (see e.g. [here](#) or [here](#)) in connection with the QHY 600M and the spectrographs.

All cameras can be controlled via [Maxim DL](#). For the SBIG cameras [CCDOPS](#) is also available as control software. We have dedicated a separate article to the [assembly](#) of some cameras.

## Basic data

### Main cameras



Our QHY 268

	QHY 600M (2x)	QHY 268M
<b>Model number</b>	QHY 600M PRO-L & QHY 600M PH	QHY 268M-PH
<b>pixel size</b>	3.76 $\mu\text{m}$ x 3.76 $\mu\text{m}$	3.76 $\mu\text{m}$ x 3.76 $\mu\text{m}$
<b>Number of pixels</b>	9576 x 6388	6280 x 4210
<b>Total size of the chip</b>	36 mm x 24 mm	23.45 mm x 15.7 mm
<b>Field of view with the CDK20</b>	35.8' x 23.4'	23.3' x 15.6'
<b>Sampling</b>	4.5 Pixel per arcsec	4.5 Pixel per arcsec

### Planetary/Guiding cameras

	Skyris 445	QHY 485C	SBIG ST-i	ZWO ASI174	ZWO ASI220	ZWO ASI678
<b>Model number</b>	Skyris 445C	QHY-5-III-485C	ST-i monochrome	ZWO ASI174MM Mini Mono	ZWO ASI220MM Mini Mono	ZWO ASI678MM
<b>Number of pixels</b>	1280 x 960	3864 x 2180	648 x 486	1936 x 1216	1920 x 1080	3840 x 2160
<b>Pixel size</b> [ $\mu\text{m}$ ]	3.75 x 3.75	2.9 x 2.9	7.4 x 7.4	5.86 x 5.86	4 x 4	2 x 2
<b>Total size of the chip</b> [mm]	6.26 x 5.01	11.2 x 6.3	4.8 x 3.6	11.3 x 7.1	7,68 x 4,32	7,7 x 4,3
<b>CDK20 field of view</b> [']	6.2 x 5.0	11.2 x 6.3	4.8 x 3.6	11.2 x 7.1		
<b>CDK20 sampling</b> [Pixel per arcsec]	3.4	5.8	2.3	2.9		

### Cameras that are no longer in daily use



Our SBIG ST-8

	<b>ST-7</b>	<b>ST-8</b>	<b>STF-8300</b>
<b>Model number</b>	ST-7XME-D	ST-8XME	STF-8300M
<b>pixel size</b>	9 $\mu\text{m}$ x 9 $\mu\text{m}$	9 $\mu\text{m}$ x 9 $\mu\text{m}$	5.4 $\mu\text{m}$ x 5.4 $\mu\text{m}$
<b>Number of pixels</b>	765 x 510	1530 x 1020	3326 x 2504
<b>Total size of the chip</b>	6.9 mm x 4.6 mm	13.8 mm x 9.2 mm	17.96 mm x 13.52 mm
<b>Field of view with the CDK20</b>	6.9' x 4.6'	13.7' x 9.2'	17.9' x 13.5'
<b>Sampling</b>	1.9 Pixel per arcsec	1.9 Pixel per arcsec	3.1 Pixel per arcsec

## Filter wheels

### QHY 600M

We have two filter wheels for the QHY 600Ms. The first is a QHY CFW3-XL with the following Bessel filters:

Filter position	1	2	3	4	5	6	7	8	9
<b>Filter</b>	H_alpha	OIII	SII	U	B	V	R	I	Clear
<b>Comment</b>	Narrowband	Narrowband	Narrowband	Broadband	Broadband	Broadband	Broadband	Broadband	

The transmission curves of the UBVRI filters can be found on the website of *Baader Planetarium*: [Filter Transmission](#). The filter curves of the bandpass filters are similar to those of the STF-8300.

The second is a QHY CFW3-L with the following SLOAN/SDSS filters:

Filter position	1	2	3	4	5	6	7
<b>Filter</b>	u'	g'	r'	i'	z-s'	y'	Clear
<b>Comment</b>	Wideband	Wideband	Wideband	Wideband	Wideband	Wideband	

The transmission curves of the ugriz' filters can be found on the website of *Baader Planetarium*: [Filter Transmission](#).

We also have a [UFC-filter-changing-system](#) for our RASA 11 V2, which can be equipped with

50mmx50mm square filters. Currently we have a complete set of SLOAN/SDSS filters (see above) and H-alpha, O-III, S-II [ultra highspeed filter](#).

## ST-7 & ST-8

A filter wheel with the following filters can be attached to the ST-7 and ST-8:

Filter position	1	2	3	4	5	6	7	8	9	10
Filter	U	B	V	R	I	H_beta	H_alpha	SII	OIII	EMPTY
Comment	broad band	broad band	broad band	broad band	broad band	narrow band	narrow band	narrow band	narrow band	

The transmission curves of the UBVRI filters can be found at the web page of *Baader Planetarium*: [Filter transmission](#). The transmission curves of the narrow band filter are similar to those of the STF8300.

## STF-8300

For the STF-8300 a filter wheel with the following filters is available:

Filter position	1	2	3	4	5	6	7	8
Filter	Block-UV/IR (L)	Blue	Green	Red	H_alpha	OIII	V	B
Comment	luminance	broad band	broad band	broad band	narrow band	narrow band	broad band	broad band

The transmission curves of the new filters can be found at the web page of *Baader Planetarium*: [Filter transmission](#).

The transmission curves of the V and B filters are identical with the V and B filters used in the ST-7.

## Features

- For the ST-7 and ST-8 we have an adaptive optics module, the AO-7, which can be used for guiding and to optimize the exposure quality (see e.g. [here](#)).
- The ST-7 and ST-8 contain an additional guiding chip in addition to the normal CCD chip, which can be used to automatically track an object (see e.g. [here](#)), while the main CCD can be used to take the actual image.
- The Off Axis Guides of the STF-8300 and the QHY 600M have the advantage that they are placed in front of the respective filter wheel and therefore the guiding is independent of the brightness of the guide star in the respective filter. For this reason, these cameras can make use of fainter guide stars/objects in comparison to the ST-7 and ST-8.

## Maintenance


Every 12 months (or before) the desiccant cartouches of the cameras need to be regenerated (baked), otherwise there's the possibility that the cooled CCD sensors can suffer from icing due to moisture in the cameras. The desiccant cartouches of the ST-7 and ST-8 can be found at the bottom of the camera and can easily be released from the camera case with a screw driver. This procedure is even easier for the STF-8300, where the desiccant cartouche (located at one side of the camera) can be unscrew with two fingers. Attention! The connection between the camera cases and desiccant cartouches are secured by sealing rings that can easily fall off the cartouches and vanish inside the camera cases. To prevent water (vapor) from getting into the camera during the regeneration of its desiccant cartouche, remove the desiccant cartouche in a dry environment and replace it with one of the dummies, which can be found in the room 2.009. It takes about four hours at 170°C in a common oven (without the sealing ring!) to regenerate the desiccant in the cartouche, so that the camera can work for another year without icing.

## DSLR

For short time exposures and lucky imaging there is also a digital (single) reflex camera (DSLR): Canon EOS 700D. It has been optimized for amateur astronomers by *Baader Planetarium* by changing the used filters. The transmission properties of the original Canon filters in comparison to the optimized ones can be found at the Baader web page [click to view the image](#).

### Basic data



 Our DSLR (Canon EOS 700D)

	<b>EOS 700D</b>
<b>Image sensor</b>	CMOS sensor
<b>Size of the pixels</b>	4.3 $\mu\text{m}$ x 4.3 $\mu\text{m}$
<b>Number of pixels</b>	5,184 x 3,456
<b>Total size of the chip</b>	APS-C 22.3 $\text{mm}$ x 14.9 $\text{mm}$
<b>Format factor and Axe ratio</b>	1.6 and 3:2

<b>Field of view with the Celestron C14</b>	19.6' x 13.1'
<b>Field of view with the Celestron C11</b>	27.4' x 18.3'
<b>Field of view with the Celestron C11 + F/6.3 focal reducer</b>	43.5' x 29.0'
<b>Field of view with the Celestron C8</b>	37.7' x 25.2'
<b>Field of view with the Celestron C8 + F/6.3 focal reducer</b>	59.9' x 40.0'
<b>Exposure times</b>	30-1/4,000 $\text{s}$ (halves or thirds of steps)
<b>ISO-Sensitivity</b>	100-12,800 (can be expanded up to 25,600)

Furthermore, one can take full-HD videos with an ISO sensitivity of max. 6,400 (can be expanded up to 12,800). The camera can be controlled by a rotatable and slewable 7,7 cm LCD touchscreen or by a computer interface. Exposure series can be taken at a maximum speed of approx. 5 images per second, which can be maintained for about 22 exposures (JPEG format) or 6 exposures (RAW format).

It is also possible to remotely control the camera [by a computer](#).

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