APQ JENA

APQ Fluorite Polychromats

Concept

The focus of our development and manufacturing program is on completely new Fluorite Universal Polychromats and Fluorite Wide Field Polychromats, which are significantly superior to conventional apochromats

The production takes place in Jena Made in Germany. The small series character also allows for individual and special production as well as the consideration of individual customer wishes.

Innovation

The main feature of both optical designs is the polychromatic correction with a diffraction-limited imaging quality over a spectral range from 365nm (UV) to 1014nm (IR), which will benefit both visual observers and especially astrophotographers.

In the peripheral regions of the visual spectrum there is no decrease of the Strehl ratio near or below the diffraction limit as is the case with most apochromats.

APQ Fluorite Universal Polychromats

A Fluorite Quadruplet Polychromat from APQ JENA is the first astronomical objective to be able to use the full UBVRI spectral range (365nm – 1014nm) of modern electronic sensors (CCD, CMOS).

A Polychromat in the basic design is a four lens (quadruplet) objective, of which three lenses consist of special optical glasses and one lens of syntetically grown fluorite (CaF_2). We source the high-quality fluorite blanks with special parameters in selected quality from a certified manufacturer, which also supplies the global players of precision optical equipment with CaF_2 raw material for the production of stepper lenses for VUV photolithography.

Series from 100mm to 300mm aperture

In the aperture range from 100mm to 300mm we offer a series of Fluorite Quadruplet Polychromats with the respective special focal lens systems (Polychromatic Strehl ratio ≥ 0.95):

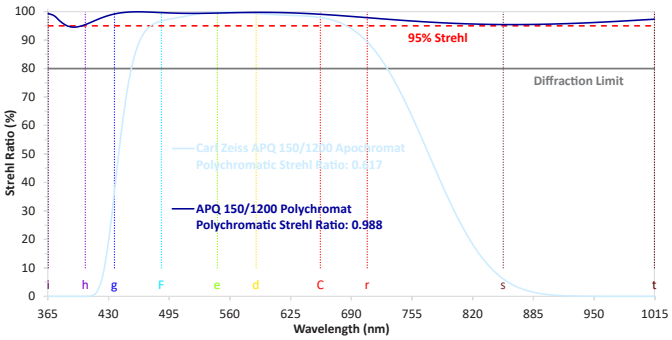
- 100/640 f/6.4 (f/5) [2]
- 130/1000 f/7.7 (f/5.4) [3]
- 150/1200 f/8 (f/5.6) [3]
- 180/1440 f/8 (f/5.6) [3]
- 200/1600 f/8 (f/5.6) [3]
- 250/2200 [1] f/8.8 (f/7) [4]
- 300/2700 [1] f/9 (f/7.2) [4]

[1] In preparation

[2] Focal ratio with 0.78x Reducer

[3] Focal ratio with 0.7x Reducer

[4] Focal ratio with 0.8x Reducer



APQ JENA vs. Carl Zeiss: Strehl Ratio vs. Wavelength (365nm – 1014nm) — Comparison between Polychromat and Apochromat

APQ 150/1200 Polychromat

In the wavelength range from 365nm to 1014nm, the completely oil spaced APQ 150/1200 Fluorite Quadruplet Polychromat has a polychromatic Strehl ratio of ≥ 0.95 and a maximum focal shift range of approx. ±0.003%.

Universal Planetary Refractor System

The APQ 150/1200 Polychromat is a universal planetary refractor, a system of the highest possible image quality, in which the basic system represents the polychromatic objective.

Depending on the task of observation, the Universal Polychromat is combined with a Flat Field Corrector (Flattener), Focal Reducer Corrector (Reducer) or Barlow System (Barlow Lens). The diffraction-limited correction is maintained in the spectral range from 365nm to 1014nm, so that the UBVRI spectral range of modern CCD and CMOS sensors can be fully utilized. All glass-to-air-surfaces receive the newly developed ultra broad band AR coating, characterized by an extremely low residual reflectivity RAVG of < 0.7% over the entire spectral range from 365nm (UV) to 1014nm (IR). With the newly developed Focal Reducer Corrector and Field Corrector with lenses made of CaF_2, vignette-free images are also possible in combination with current CMOS sensors.

APQ Fluorite Field Corrector

Together with the three lens flattener with a CaF_2 lens, the APQ 150/1200 Polychromat realizes a polychromatic system with diffraction-limited imaging, characterized by a very large image field diameter of approximately Ø73.6mm or 3,5° and a back focus of 100mm.

According to the optical design, the polychromatic RMS spot radius vs. field is ≤ 4.5µm (365nm – 1014nm) / Ø73.6mm (3.5°) and the maximum focal shift range is approx. ±0.003%. The focal ratio of the basic system remains unchanged at f/8, the focal length is 1200mm.

Center: APQ 150/1200 Fluorite Quadruplet Polychromat (with special equipment)

Objective APQ 150/1200 Fluorite Quadruplet Polychromat (Compensation cell)

APQ 0.7x Fluorite Focal Reducer Corrector

The APQ 0.7x Reducer is the most sophisticated focal lens system in current portfolio. The Reducer consists of three oil spaced lens groups with a total of six lenses, two of which are made of CaF_2.

The Focal Reducer Corrector increases the focal ratio of the APQ 150/1200 Polychromat by a factor of 0.7, so that the effective focal length is 840 mm and the focal ratio f/5.6. The image field diameter of the polychromatic system with diffraction-limited imaging is approximately Ø52.3mm or 3,5°, the back focus is 100mm.

According to the optical design, the polychromatic RMS spot radius vs. field is ≤ 3.2µm (365nm – 1014nm) / Ø52.3mm (3.5°) and the maximum focal shift range is approx. ±0.004%.

Benefits for the users

With visual observations and CCD or CMOS imaging, an almost error-free image is guaranteed. Compared to conventional doublet and triplet apochromats, the APQ Fluorite Quadruplet Polychromats have the following advantages:

- the images are bright, almost free of chromatic aberrations, astigmatism, coma, aperture and Gaussian errors,
- the theoretical resolution is almost reached,
- particularly in demanding planetary observation, highest magnifications are possible due to the brilliant, detailed and high-contrast image quality,
- the usable wavelength range is 365nm to 1014nm and thus up to three times wider compared to the limited visual spectral range of classic apochromatic doublet and triplet lenses (usually from 436nm to 656nm or from 480nm to 707nm),
- by making previously unobservable structures visible in the UV and IR, we open up completely new areas of research and activity for our customers.

To ensure that the lens cell is thermally invariant, free of play, and has high centering accuracy, we have developed a thermally compensated optical lens cell (compensation cell) for our Fluorite Quadruplet Polychromats.

The operating temperature range of the new compensation cell extends from -20°C to 40°C (working temperature interval ≥ 60K) and the storage and transport temperature range from -40°C to 60°C.

The new compensation cell offers the following advantages over classic cells:

- the lenses are each received on six or more surfaces and held by compensation parts in temperature fluctuations in a stable position,
- thermal stresses due to a working temperature interval of at least 60K (operating temperature range from -20°C to 40C) or changing gravitational forces on the lenses must not have any functionally changing influences, in particular no effects on the optical quality of the overall system,
- there is no rattling of lenses in the cell, costly readjustments are not incurred,

The assembly technology used by means of a fluid, optically transparent medium (oil) between the lenses offers several advantages over the classical technology of the individual lenses with air gaps:

- thermal stresses between the lenses are excluded by the oil in between,
- the oil film prevents surface tilting, as is possible with an air gap,
- there are fewer glass-to-air surfaces and thus virtually no stray light, the transparency of the optical system increases,
- the adaptation to the ambient temperature is faster, i.e. the optical system has a better thermal behavior.

Technology

Due to the small-batch character of the production with the possibility of single and special production, both conventional and modern CNC production technologies are used.

However, these advanced CNC technologies can not replace the knowledge and expertise of a precision optics master with decades of experience in his field.

The precision machining of spherical and aspherical optics as well as mechanical parts takes place in close cooperation with our regional manufacturing partners.

With the existing technologies, precision lenses made of optical glasses and CaF_2 up to a diameter of 300mm can be machined, completely assembled objectives can be manufactured, and they can be tested with the most modern measuring and testing technologies.

APQ Fluorite Wide Field Polychromats

The APQ 110/550 Polychromat is ultimately suitable for astronomical and nature photography with modern CMOS cameras due to its fast focal ratio, its brilliant image quality and its huge image field.

Visual observers benefit from the high polychromatic Strehl ratio and its compact, travel-ready dimensions.

Due to its polychromatic correction, the ten lens CaF_2 optical system of the APQ 110/550 is able to achieve the maximum possible resolution up to the edge of the non-vignetted image field of Ø67.4mm (IMX411: image diagonal 66.7mm) and thereby utilize the full UBVRI spectral range (365nm – 1014nm) of modern electronic sensors (CCD, CMOS).

The first APQ Wide Field Polychromat starts with the following specification:

- 110mm aperture
- 550mm focal length
- f/5 focal ratio
- Ten lens aspherical design
- 3 lenses from CaF_2
- Integrated special focal reducer corrector
- Rectractable and lockable dew cap
- Feather Touch Focuser FTF3545
- Ø67.4mm non-vignetted image field
- UBVRI Fluorite Wide Field Polychromat
- Polychromatic RMS spot radius vs. field ≤ 1.0µm in the spectral range from 365nm to 1014nm over the entire field diameter of Ø67.4mm (7°)
- Polychromatic Strehl ratio ≥ 0.95 (365nm – 1014nm)
- Compact travel-ready dimensions (427mm transport length)
- Stunning imaging performance for astronomy and nature observation that shows where to go

APQ 110/550 Fluorit Weitfeld Polychromat (with special equipment)

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