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Editorial

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Optical systems for space applications face challenges that are very different from those known for terrestrial conditions, which we are all too familiar with. First of all, there is the launch, which shakes delicate systems to a degree that our common optics would jump out of their mechanical mounts or break apart. Next, the space environment imposes thermal conditions that are extremely demanding. We are faced with an extremely cold background on the side that is looking away from the sun, while at the same time other areas of the space craft suffer from a very high thermal load. To make things worse, the situation typically is not stable in time, due to orbital or operational variations. The varying temperature gradients would certainly create nightmares for designers of earth-bound optical systems. And then there is the vacuum environment, which has a huge impact on thermal management, but also creates huge challenges related to the propagation of (outgassing) contaminants, which are likely to deposit on exactly those places you do not want to have them: on the optics, causing stray light, or on the detectors, deteriorating the efficiency and possibly creating artificial spectral features. Finally, after the launch you cannot repair your highly expensive equipment; a Hubble repair mission, aside from the enormous cost, is simply not always possible.

The issues mentioned above should be kept in mind when one reads the articles in this Space Optics issue of *Advanced Optical Technologies* (*AOT*). If you think about this, you really start to appreciate the near-impossible task one has to fulfil when designing and building an extremely accurate instrument like the James Webb Space Telescope (JWST) with its four state of the art instruments. This issue of *AOT* contains a detailed description of two of JWST's optical instruments, the near infrared spectrograph and the mid-infrared instrument. These somewhat boring names do no justice to the fabulous technology behind them. Thinking about the ground-breaking scientific discoveries to be made with JWST makes every astronomer's heart beat faster, and not only theirs.

Next to space telescopes like the JWST a different class of space missions is being developed in our quest to understand the universe and its fundamental laws a lot better. Gravitational waves have only recently been observed in incredibly sensitive experiments on Earth. In order to understand their full dynamics, there is a need of a space-based observatory, which will complement the earth-bound experiments. First, concepts of an instrument design for this very important science mission are discussed in the article on the telescope of the Laser Interferometer Space Antenna (LISA).

The JWST is, as we all know, a highly complex and extremely expensive instrument. On the other side of the complexity/price spectrum we have space systems that are meant to be far easier to be built and a lot cheaper. It all depends on what you have to do with it. For instance, a constellation of many cheap and small satellites with limited field of view allows Earth observations with a high spatial and temporal resolution. Also there, we might want to gather as much light as possible and increase the optical resolution. If space instruments can be designed such that they unfold to their full size and capability only after being launched into space, the size of the satellite could become smaller and the cost of launching such a volume would be a lot cheaper. A deployable space telescope, as is described in this issue, allows doing just that.

When talking about Earth observation special attention should be paid to the Earth's atmosphere. In view of global warming, detailed knowledge of atmospheric chemistry and radiative properties is crucial. While a lot is known already, thanks to several Earth orbiting instruments like TROPOMI making detailed maps of our Earth atmosphere, more knowledge is required on the impact of aerosols. This is a topic of worldwide interest, as shown by the contribution from China about their Aerosol Sensor to be launched on the GaoFen-5B satellite.

Many earth observation instruments are spectroscopic instruments. An essential part of these units are the dispersive elements – most of the time – the gratings. Therefore, it is of great importance to understand the performance of the grating and especially all the artefacts

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which might be associated with this crucial part. Therefore, it is very much worthwhile reading the article on stray light and ghosts in catadioptric spectrometers, and how to use grating scatter measurements for the optical system design.

In closing this editorial, we would like to thank the authors, the reviewers, and the *AOT* team for their contribution to this issue of *Advanced Optical Technologies*, for showing a glimpse of the exciting world of space optics. We hope the reader will enjoy it as much as we did when reading the articles.

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