

<https://doi.org/10.69646/1csst24>

PHOTONIC SOLUTIONS FOR NEXT GENERATION GROUND BASED ASTRONOMICAL INSTRUMENTATION

SAŠA TOPIĆ¹

¹ *Serbia Photonics, sasatopic@serbiaphotonics.com.*

ABSTRACT

In this work we will present multiple photonic enabling technologies that serve as the force multiplier for small and medium telescopes as to get them on par with 10 m scale installations

First is a suite of solutions for overcoming atmospheric turbulence in the form of low order Zernike Deformable Mirror (DM) Adaptive Optics (AO) modules and new developments in the form of passive AO in the form of interferometric modal decomposition masks/recombinators both of which we codevelop with our foreign partners.

We will present various fiber optic photonic feeds such are Photonic Crystal Large Mode Area Endlessly Single Mode (LMA ESM PCF) optical fibers, Mode Field Adapters (MFA) that ensure high light collection even in single mode usage as well as fiber bundles and photonic lanterns that we have experience with developing and fielding.

As a centerpiece a fiber coupled diffraction limited echelle spectrograph of small format capable of reaching resolutions of $R > 50\,000$ will be presented. High demands for pupil illumination uniformity, PSF profile centroid stability and low modal noise is met by use of aforementioned speciality fibers that couple spectrograph to the telescope which guide only fundamental TEM₀₀ mode that results in a Gaussian beam profile, low modal noise and small sized input aperture presented to the instrument - thus resolution is larger, optics an order of magnitude smaller and less complex and instrument is inherently easier to temperature and pressure stabilize.

Spectrographic unit uses several new technologies such as holographic dispersive elements and a proprietary freeform aberration control optical surfaces and phase plates that cancel out any intrinsic optical aberrations

hence enabling high resolution that is sufficient to resolve astrocomb features with 10 GHz line separation.

Following are suite of photonic calibrators meant for reaching absolute frequency reference in likes of astrocombs and compact photonic devices that deliver a set of equidistant and homogeneous spectral features in the form of Fiber Mach-Zehnder Interferometers (FMZI) and Fiber Fabry Perot Interferometers (FFPI) which are absolutely referenced to atomic line transition of alkalis.

At the very end a case study for versatile Low/medium resolution (holographic) imaging, spectroscopic/polarimetric instrument capable for use directly mounted on the telescope or equipped with ancillary Integral Field Unit (IFU)/slitlet mask will be presented as a trump card for advocating the need for Astrophotonic devices.