

Small steps for a giant leap - Unique Custom Optics for Plasma Diagnostics and ITER

G. SZABÓ, István¹, PÁPAI, Lőrinc¹, POLNAUER, Cecília¹, KATONA, Ferenc¹, NAGY, Domonkos Ferenc², SÜTŐ, Martin Dániel³, HAVRILÓ, Balázs³
OMI OPTIKA Engineering Ltd, 1121 Budapest, Konkoly-Thege M. út 29-33.¹
Centre for Energy Research/ELKH, 1121 Budapest, Konkoly-Thege M. út 29-33.²
Budapest University of Technology and Economics (BME), student, 1111 Budapest, Műegyetem rkp. 3.³

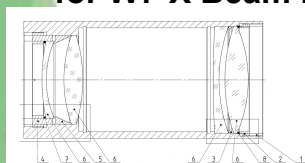
Based on participation and experience in previous plasma diagnostic projects -TEXTOR(DE), W7-X(DE), EAST(CN), JT60SA(JP)- OMI OPTIKA Engineering Ltd has been involved to similar works led by the Centre for Energy Research-ELKH in 2019-22 years. A new challenge was the production of some unique 'small step' custom optical tools required for the task now directly related to the development of the 'giant leap', the ITER:

- wide spectral range (340-930nm) objective system for Wendelstein W7-X Beam Emission Spectroscopy and coupled 132 channel, 8m long coherent fiberoptics bundle (2020-21);
- Coherent /ordered fiberoptics including 128 channels and extra high power LED illuminators for ultrafast imaging used in the Shattered Pellet Injector test laboratory (EK-CER) for ultra fast observation of frozen H2 pellets flying with a speed of Mach2 (2021-22). High power LED reflectors were built for the ELI infrastructure, too for in-chamber illumination tasks.

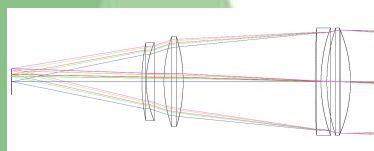
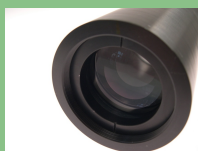
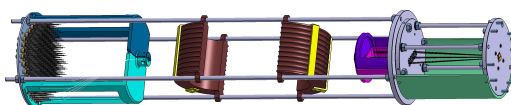
UV-VIS-NIR corrected objective and coupled 132 channel coherent/ordered fiberoptics bundle for W7-X Beam Emission Spectroscopy



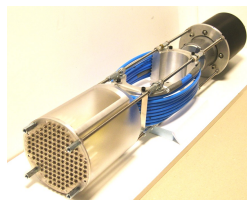
- 0.063x magn.
- WD 2800mm
- T>80%/400-750nm
- T>50%/340-930nm
- SPOT(RMS): <16µm/400-930nm, <23µm/340-400nm
- CaF2 cx-cx lenses
- Petzval-system, Ø70mm entrance pupil, f168mm



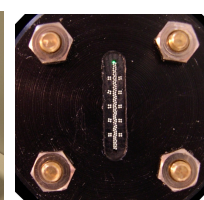
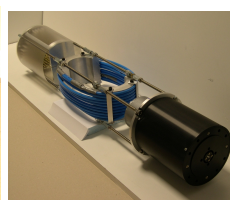
- 160µm fiber core diameter
- 132 pcs of quartz fibers
- 10x0.4mm entrance slit (input)
- 132pcs SMA connectors (output)
- 8000mm fiber length



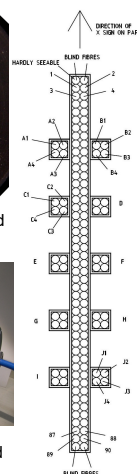
Wide range objective used to project plasma image onto a coherent/ordered fiberoptics entrance slit with 10mm length in Wendelstein 7-X facility. Fiber core diameter is 160µm.



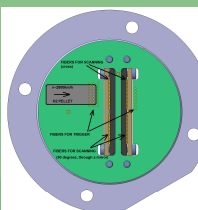
Finished fiber bundle with frame and reel ready for transport



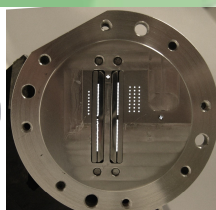
Each slit-fiber is assigned to one SMA connector



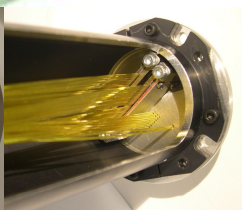
Coherent/ordered 128 channel fiberoptics for ITER Optical Pellet Diagnostic (OPD) used in Shattered Pellet Injection technology for ITER Disruption Mitigation System (DMS) (EK-CER test laboratory)



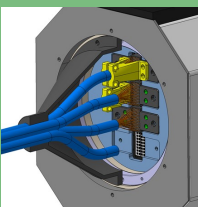
Scanning and trigger fiber's setup at Pellet-side



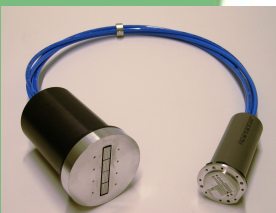
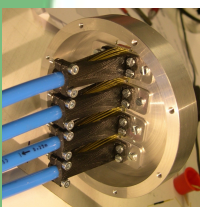
Fiber organizer, Pellet-side



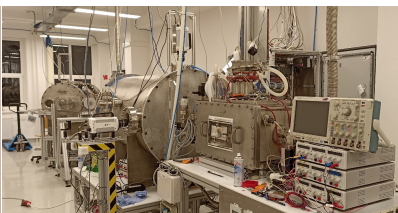
Fiber plate for 128 channels APDCAM-10G with 400µm fibre core diameter



Fiber organizer for 128 channels APDCAM-10G ultrafast high sensitivity camera with sample rate of 2MHz



128 channel Back-end fiber bundle with total length of 1000mm

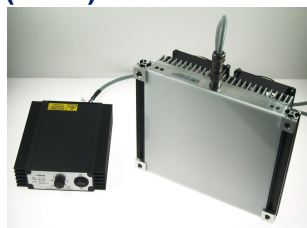


EK-CER Shattered Pellet Injector test laboratory with OPD to observe frozen H2 pellets flying with 800m/s

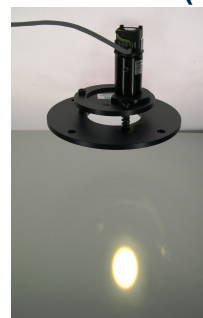


Exploded-view design of laser coupled illuminator and finished fiber ends

High power LED illuminators for ultrafast imaging (OPD) and in-chamber illumination (ELI)



260W/24000lm backlight and 51W/6100lm SPOT illuminator for OPD imaging used for up to 90,000fps



High power LED illuminators used at ELI vacuum chambers up to 4200lm and WD 6000mm

