FUSION FOR ENERGY

TECHNOLOGY OFFER



High-performance spectrometer-based diagnostic systems: design & integration

Through its collaboration with Fusion for Energy (F4E), Bertin Technologies has established specialized expertise in the design of high-performance, highly customizable spectrometer systems for active spectroscopy in extreme environments. Bertin Technologies' capability covers from optical concept to fully integrated multi-band detection systems, tailoring the balance between spectral resolution, throughput, field of view, frame rate and system footprint to deliver optimised solutions for each application.

The technology

Bertin Technologies designed spectrometers splitting the input light from a single dioptric collimator assembly into three simultaneous spectral bands (blue, green, red) using VPH gratings, acquired by large-format Teledyne COSMOS10 cameras. The design achieves a spectral dispersion of 0.02 nm/pixel and a frame rate of ≥ 50 Hz, on a compact optical table of ~1.8 × 1.2 m.

More broadly, Bertin also designs the complete light collection and transport chain upstream of the spectrometers: long focal telescope, fiber bundle coupling optics, and in-vessel front-end mirrors. This end-to-end mastery enables system-level throughput optimisation from source to detector, with a total chain throughput validated by Zemax modelling across all subsystems.

Advantages and Potential Applications

- Simultaneous multi-band acquisition from a single collimator assembly (compact optical footprint), with trade-off analysis across custom configurations to meet framerate and high throughput.
- High spectral performance: 0.02 nm/pixel dispersion, 15 Å/mm resolution and frame rate ≥ 50 Hz.
- Optical alignment expertise for complex multi-subsystem chains, with tolerancing validated under both ambient and operational temperature conditions.

Target applications span high-performance multi-spectral spectrometers for plasma diagnostics in fusion, astrophysics, and accelerator physics, as well as custom spectroscopic systems engineered for constrained scientific and industrial environments. The technology is particularly well-suited for active spectroscopy requiring fully integrated light collection, transport, and detection chains, as well as nuclear or radiation-hard optical systems demanding first-mirror protection and RF cleaning technologies. Additionally, it enables high-precision spectroscopic monitoring of demanding industrial processes, including combustion, plasma treatment, and thin-film material deposition.

Collaboration opportunities

Bertin Technologies is open to partnerships, technology transfer and direct supply agreements with organisations requiring high-performance spectrometer systems adapted to their specific application. Bertin can contribute at any stage: from feasibility study and optical design, through spectrometer manufacturing and system integration, to calibration and spectral analysis software development.

Fusion for Energy Technology Transfer Programme

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