OPTICAL TECHNOLOGIES
an IDEX Corporation platform

EPIC Meeting on Photonics for Space:
Opening New Horizons at Exail

IRIDIAN SPECTRAL TECHNOLOGIES thanks EPIC EUROPEAN PHOTONICS INDUSTRY CONSORTIUM and exail

"Earth Observation with Optical Filters"

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About Iridian

Canadian designer and manufacturer of custom optical filter solutions

- ~180 staff providing extensive expertise in optical filter manufacturing
- Canadian corporation, established in 1998; *now part of IDEX Optical Technologies*
- All manufacturing done in Ottawa, Ontario, Canada
  - Achieved ISO9001:2015 certification in May 2016
  - Registered in Canadian Controlled Goods Program
- *Officially opened 45,000 sq. ft. custom-built facility Nov 2012*

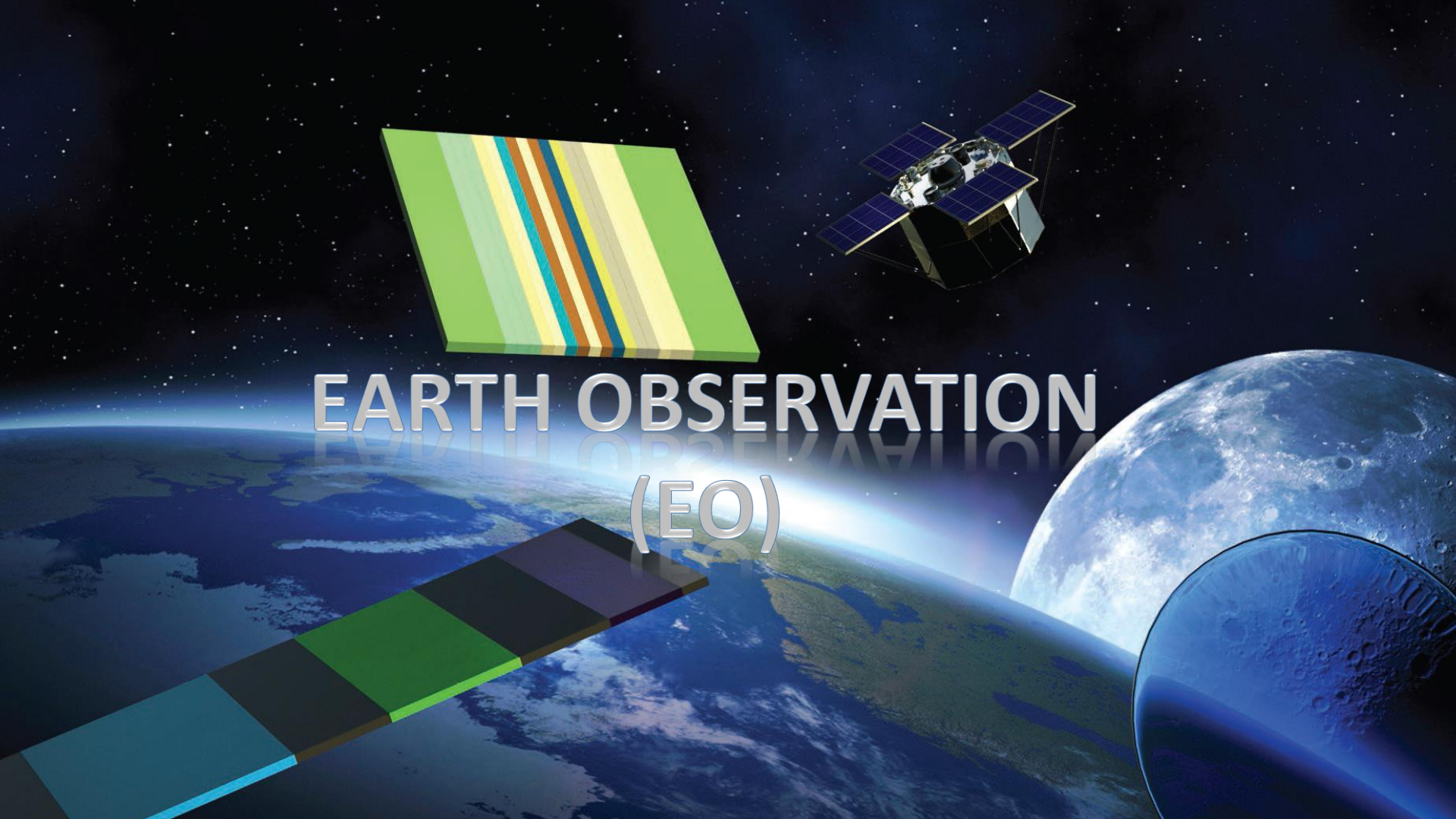
Iridian designs and manufactures thin-film dielectric optical filters and filter arrays

Capabilities:

- WL range: 300nm to 15um
- Customized solutions
- Single/Multi-band; Multi-zone
- <1mm^2 to >150mm dia.

Technologies:

- Energetic sputtering (25 chambers) + 1 evaporator
- Custom design/control software
- In-house polishing, processing, photolithography


EARTH OBSERVATION
(EO)

“Measurement is the first step that leads to control and eventually to improvement.

If you can’t measure something, you can’t understand it.

If you can’t understand it, you can’t control it.

If you can’t control it, you can’t improve it.”

H. James Harrington

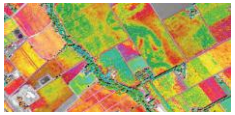
Why Earth Observation (EO)?

EO DATA

DISASTER RESPONSE

FORESTRY

AGRICULTURE

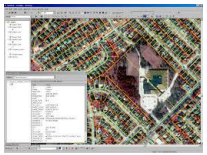


DEFENSE

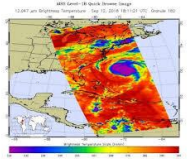
ENVIRONMENT

BUSINESS INTELLIGENCE

MAPPING/GIS



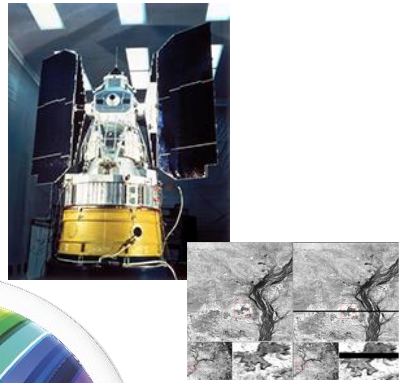
CLIMATE/WEATHER



EO Evolution

LANDSAT-1

1972 (*NASA*)
4 spectral bands
80 m resolution
1800 kg

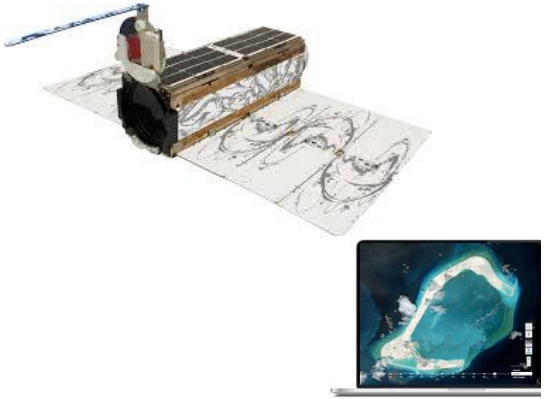


SENTINEL-2B

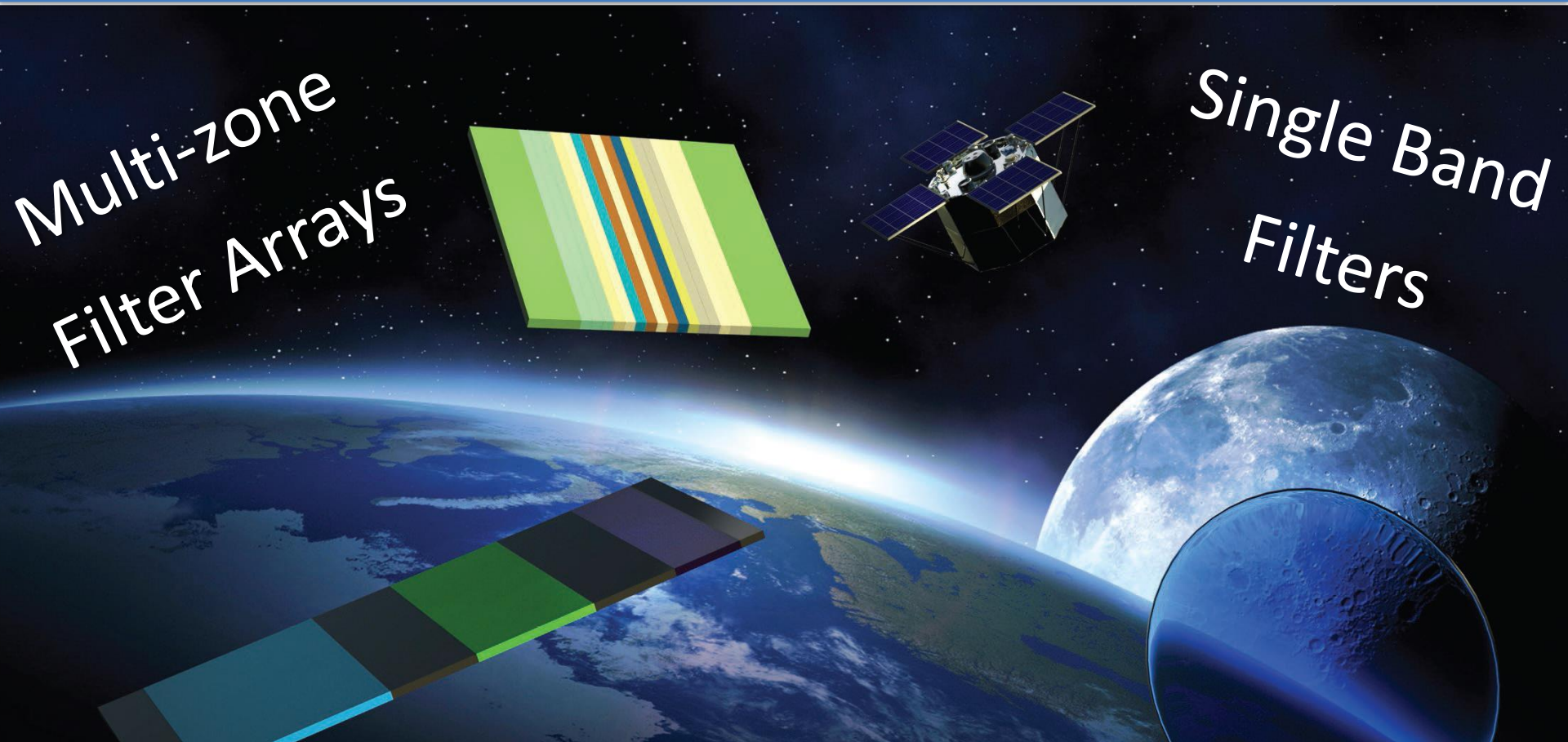
2017 (*ESA*)
13 spectral bands
10 m resolution
1140 kg

SUPERDOVE

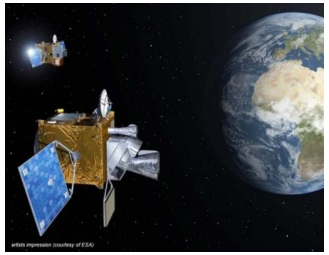
2019 (*Planet Labs*)
8 spectral bands
<1 m resolution
4 kg

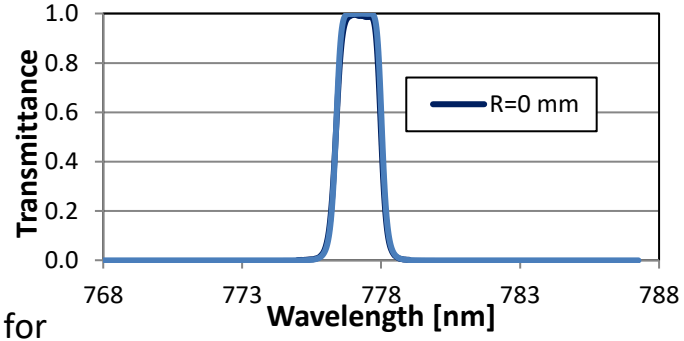


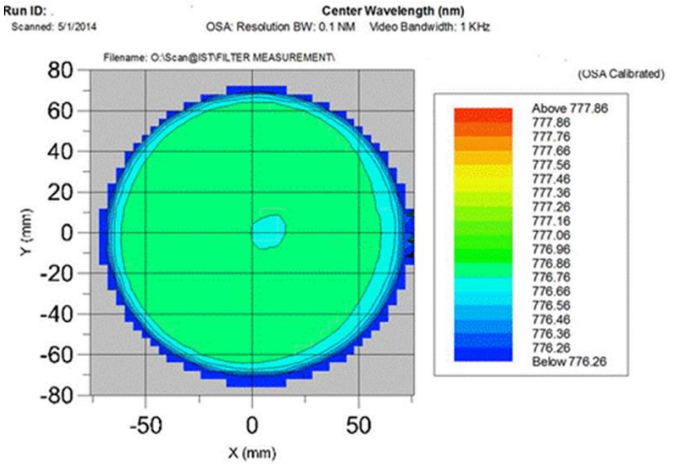
EO Optical Filters



EO Example: Lightning Imager

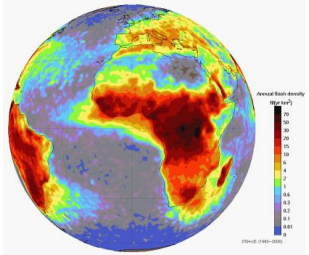






777.4 nm oxygen triplet line for lightning detection from space

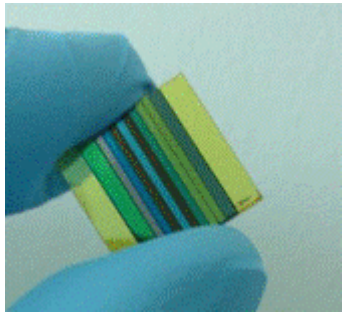
- Requires narrow BPF (~1.72 nm FWHM)
- Large clear aperture (125mm)

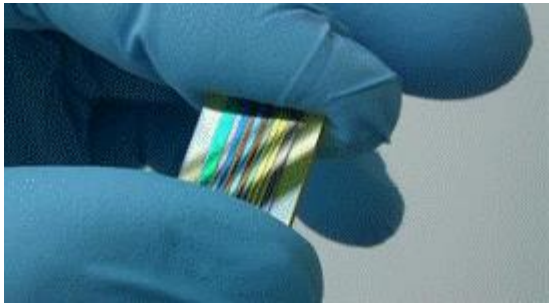


Change in CWL (uniformity)	0.094nm	Δ ≤ 0.013%
Change in Bandwidth (FWHM)	1.705nm – 1.735nm	Δ ≤ 1.8%
CWL targeting	±10 pm	Δ ≤ 0.003%
Change in peak Transmittance	98.70% – 99.52%	Δ ≤ 0.82%

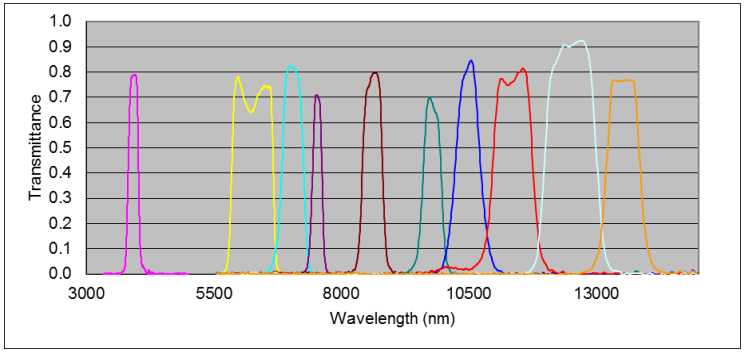
The above mentioned NBPF has been developed under a contract with Leonardo S.p.a for the Lightning Imager Instrument, in the frame of the ESA program Meteosat Third Generation (MTG), with Thales Alenia Space France as prime contractor.

Example: EO MultiSpectral Imaging





These images show a MZF with ten band pass filters between 3 µm and 13 µm developed under a subcontract from ABB Canada for the Space Technology Development Program of the Canadian Space Agency.

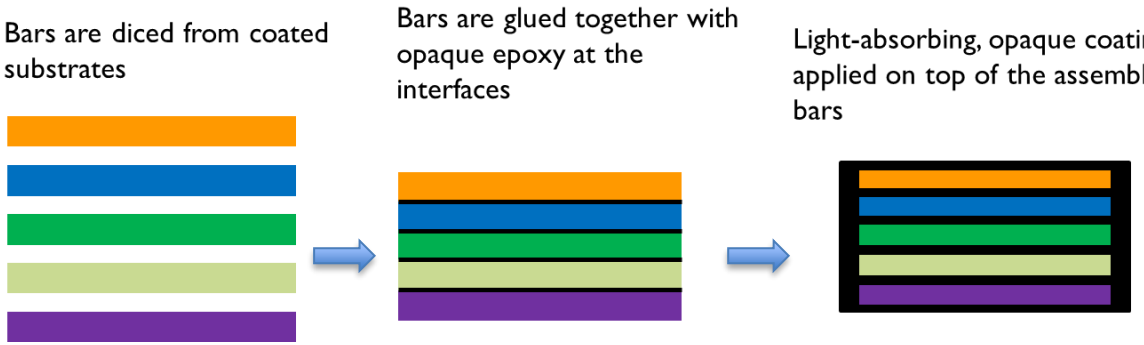


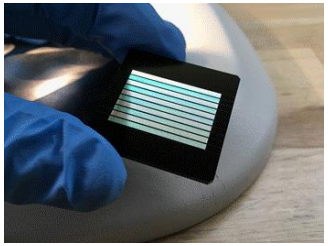
Filter Array Manufacturing Approaches

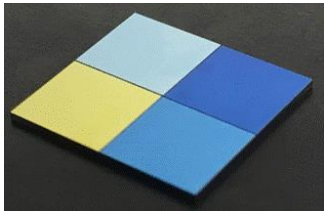
- Demonstrated capabilities for **butcher block style build of multi-zone filter assemblies** for use in space
- Demonstrated capabilities for **photo-lithographically patterned monolithic multi-zone arrays** for use in space
- Demonstrated capabilities for **hybrid builds** using monolithic elements assembled together as a butcher block

Multi-Zone Filters: Assembled Arrays

- Addresses needs in multi-spectral imaging applications requiring:
  - many bands
  - complex filter coatings/constraints on cost



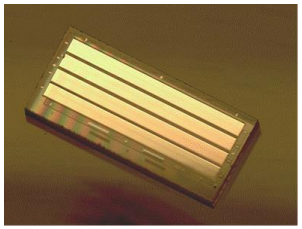


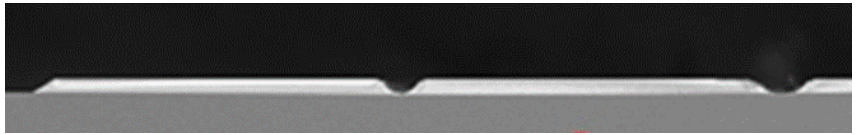


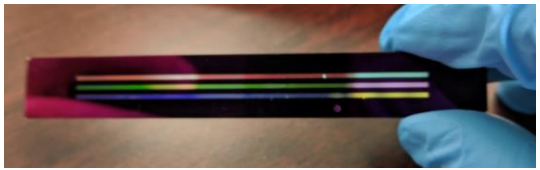
- Achieve zone-to-zone transitions of < 250 µm
- As many as ten (or more) different spectral bands
  - turn single detectors into multi-spectral imaging devices!

Multi-Zone Filters: Patterned Arrays

- For applications requiring a small transition zone , patterns not possible to achieve by assembly, or arrays requiring excellent coplanarity
- ISO 6 class clean room capable of patterning up to 150 mm diameter wafers
  - Patterning capable of up to five different zones
  - Zone-to-zone transitions 5-100 µm (dependent on complexity)
- Patterned MZF's can include black coating transitions zones
  - isolate the separate spectral bands
  - reduces potential for cross-talk at the detector







Patterned vs Assembled

	Patterned Array	Butcher Block Assembly
Max # of filters/zones	5	10+
Coating Yields	compounding	individual
1D vs 2D pattern	1D or 2D	2D much more complex
Complexity of filter	thickness limited	unlimited
Zone transition width	10s of um	250um
Zone edge light leakage	none	application dependent
Co-planarity	monolithic	controlled by process
Off angle cross-talk	design dependent	minimized by epoxy seam

Why Iridian?

OPTICAL TECHNOLOGIES
an IDEX Corporation platform

- Reliable Partner
- Valuable Expertise
- Custom solutions

Products of:

- High Quality & Reliability
- Competitive pricing

CCGP certified
ISO9001:2015 certified

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