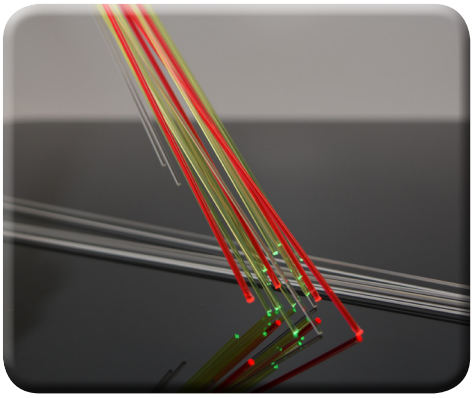
Plastic Scintillating Fibers

Saint-Gobain Crystals manufactures a variety of plastic scintillating, wavelength-shifting and light-transmitting fibers used for research and industry.

Scintillating fibers are well-suited for such applications as:



- Neutron imaging
- Particle discrimination
- Calorimeters
- Cosmic ray telescopes
- Real-time imaging systems
- Flow cells
- Tracking detectors

We produce a variety of plastic scintillating, wavelength-shifting and light-transmitting fibers. They are available in bulk quantities wound on spools (smaller cross-sections) and as canes (pre-cut straight lengths), or assembled into stacked arrays, bundles, ribbons and complete detectors.

Current sizes range from 0.25 mm to 5 mm square or round cross-sections.

The flexibility of fibers allows them to conform to surface shapes, yielding geometries superior to those of other types of detectors. Examples are detectors for monitoring pipes or barrels.

Below are the properties of our standard fiber formulations.

Specific Properties of Standard Formulations

Fiber	Emission Color	Emission Peak, nm	Decay Time, ns	# of Photons per MeV**	Characteristics / Applications
BCF-10	blue	432	2.7	~8000	General purpose; optimized for diameters >250µm
BCF-12	blue	435	3.2	~8000	Improved transmission for use in long lengths
BCF-20	green	492	2.7	~8000	Fast green scintillator
BCF-60	green	530	7	~7100	3HF formulation for increased hardness
BCF-91A	green	494	12	n/a	Shifts blue to green
BCF-92	green	492	2.7	n/a	Fast blue to green shifter
BCF-98	n/a	n/a	n/a	n/a	Clear waveguide

** For Minimum Ionizing Particle (MIP), corrected for PMT sensitivity

Standard Fibers, Single-clad –

Our standard fibers consist of a polystyrene-based core and a PMMA cladding. External EMA (optional) is often used to eliminate optical crosstalk.

The scintillating core contains a combination of fluorescent dopants selected to produce the desired scintillation, optical and radiation-resistance characteristics. Often, one property is enhanced while another is mildly compromised. In small fibers (≤ 0.5mm), the fluor concentration is increased, usually at the expense of light attenuation length.

Scintillation efficiency is generally kept near maximum, which for BCF-10, BCF-12 and BCF-20 is 2.4% (nominal). This means that these fibers yield about 8,000 photons per MeV from a minimum ionizing particle. The trapping efficiency, however, permits the collection of less than 4% of the photons for passage down the fiber.

Multi-clad Fibers –

This special class of fibers has a second layer of cladding that has an even lower refractive index and, thus, permits total internal reflection at a second boundary. The additional photons guided by multi-clad fibers increase the output signal up to 60% over conventional single-clad fibers. All of Saint-Gobain Crystals' fibers can be supplied in either single-clad or multi-clad variations.

Optical Cladding –

PMMA (polymethylmethacrylate, $C_5H_8O_2$) is the standard cladding material for Saint-Gobain Crystals' fibers. It has a density of 1.2 g/cc and a refractive index of 1.49.

The refractive indexes of the core and cladding and the cross section of the fiber determine the trapping efficiency.

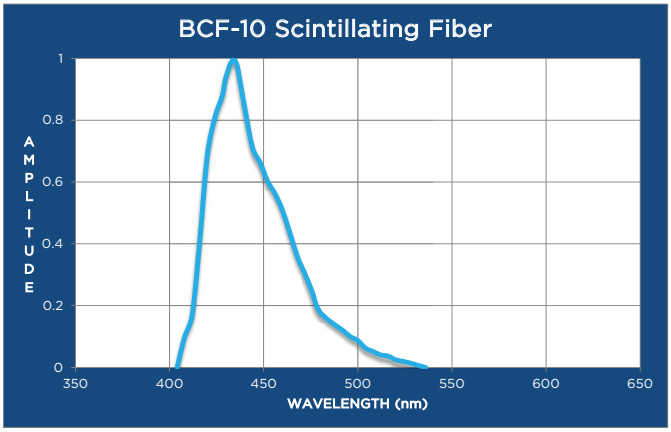
In round fibers, the trapping efficiency also depends on the distance between the fiber axis and the scintillation event. The trapping efficiency of Saint-Gobain Crystals' round fibers ranges from 3.4% for events occurring at the fiber axis to ~7% for events near the core-cladding interface. For square fibers, the trapping efficiency is 4% and is independent of the scintillation event's location in the fiber.

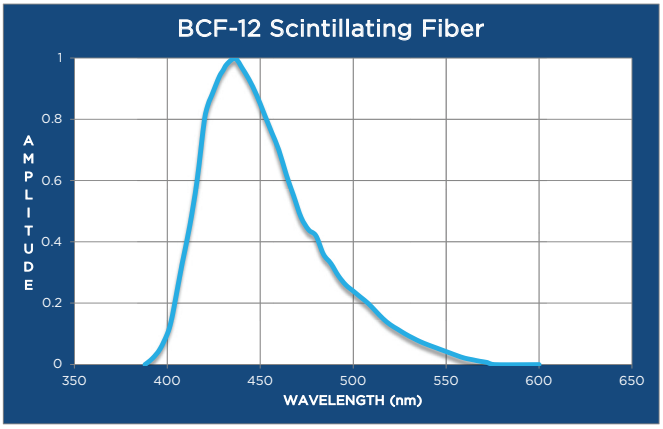
EMA (Extra Mural Absorber) –

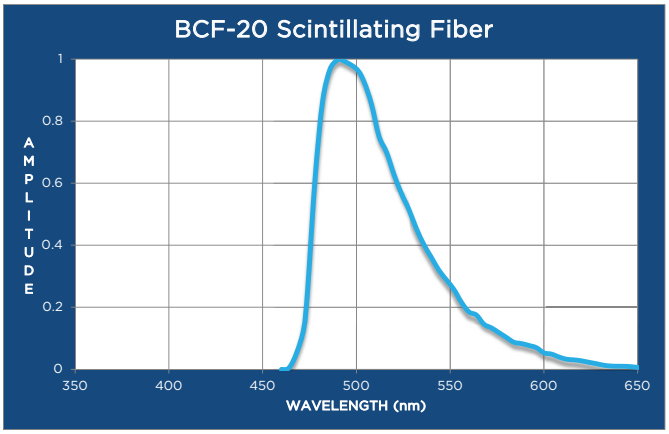
White or black coatings may be applied to the outer fiber surface primarily to eliminate crosstalk among closely packed fibers. Our coatings are typically 10 to 15 microns thick.
An EMA coating decreases the overall signal intensity obtained from a fiber, irrespective of its length. This effect is greatest with black EMA, as well as with short fibers. The coating can interfere with useful light-piping in the cladding. Black EMA applied at the near end of fibers can be used to flatten out position dependent response. White EMA is used in the construction of short fiber imaging bundles.

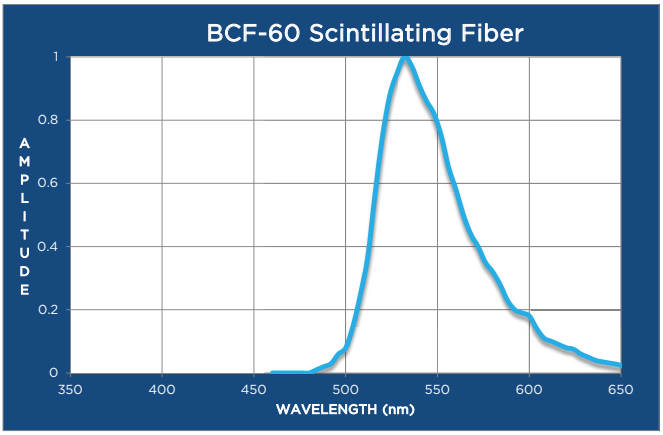
Common Properties of Single-clad Fibers –	
Core material	Polystyrene
Core refractive index	1.60
Density	1.05
Cladding material	Acrylic
Cladding refractive index	1.49
Trapping efficiency, round fibers	3.44% minimum
Trapping efficiency, square fibers	4.4%
No. of H atoms per cc (core)	4.82×10^{22}
No. of C atoms per cc (core)	4.85×10^{22}
No. of electrons per cc (core)	3.4×10^{23}
Operating temperature	-20°C to +50°C
Vacuum compatible	Yes
Common Properties of Multi-clad Fibers –	
Second cladding material	Fluor-acrylic
Refractive index	1.42
Numerical aperture	0.74
Trapping efficiency, round fibers	5.6% minimum
Trapping efficiency, square fibers	7.3%

Emission Spectra –

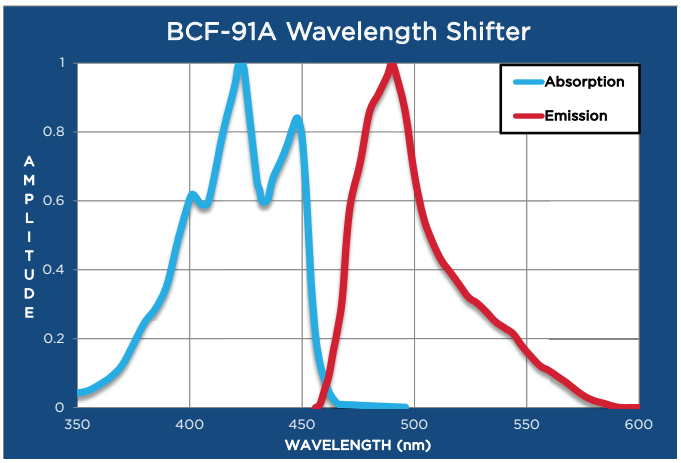


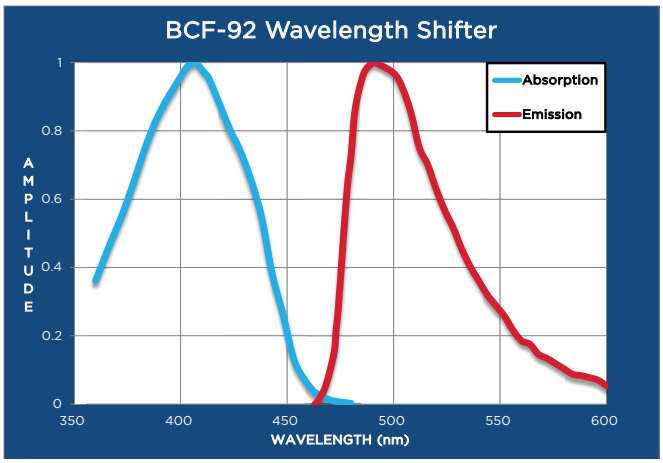




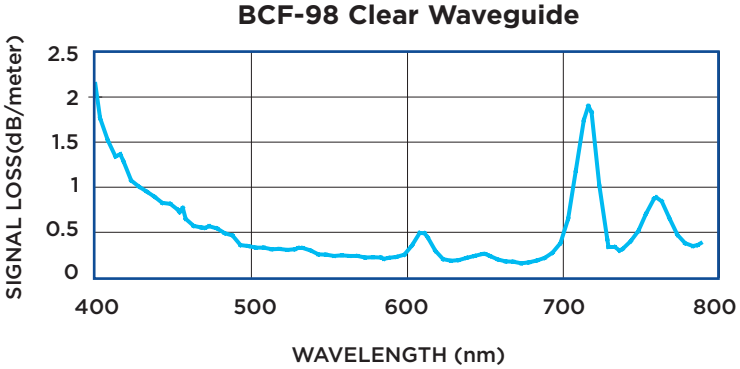


Optical Spectra –



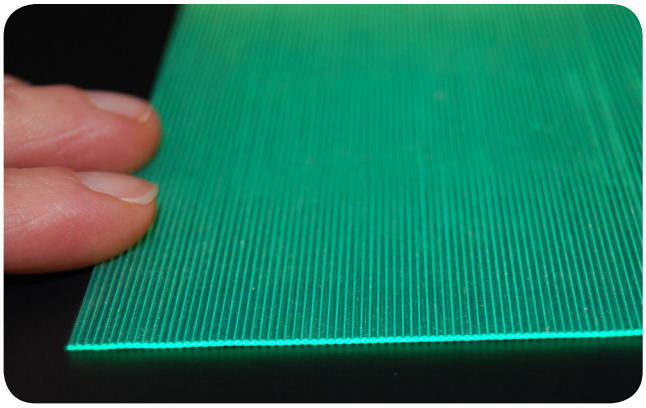


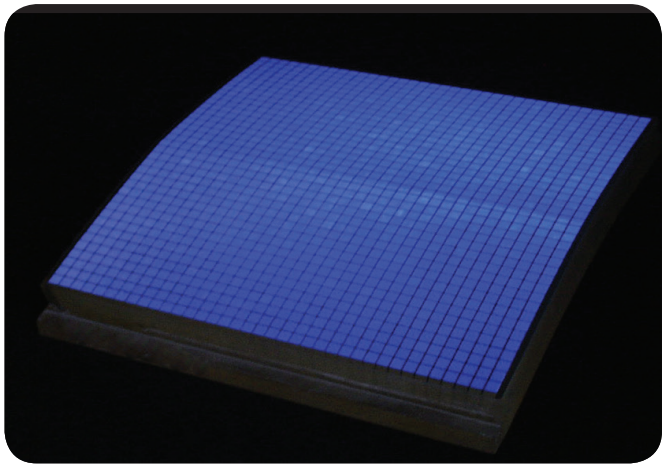
Attenuation vs. Wavelength –



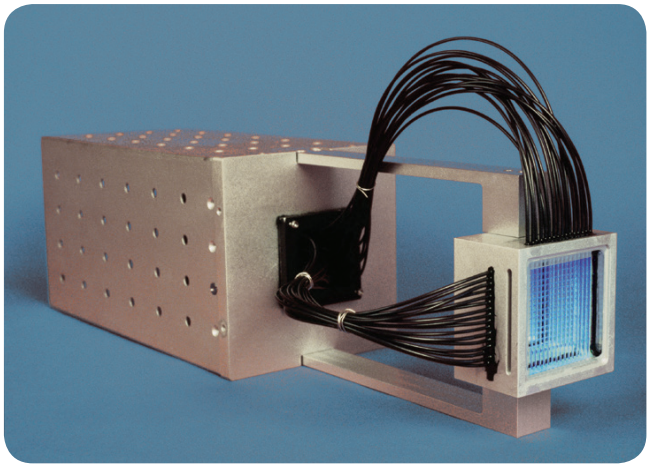
Types of Fiber Assemblies Available –

- Single ribbons as wide as 300mm and as long as 3200mm
- Multilayered ribbons up to 4 layers thick
- Coherent imagers of round or square fiber
- Ribbons with precision alignment to MA-PMT's
- Crossed fiber arrays
- Flow cells
- Detectors with long, flexible sheathed bundles





Focused fiber array



Beam profile monitor with orthogonal fiber ribbons

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Contact Us

(07-18)