Innovative optical materials for the development of diffractive and holographic devices

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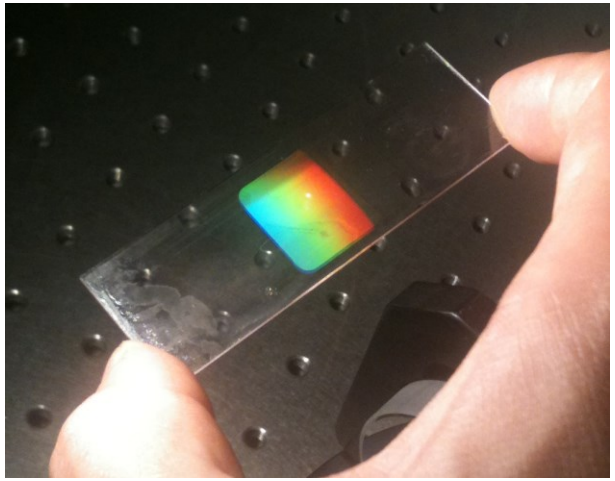
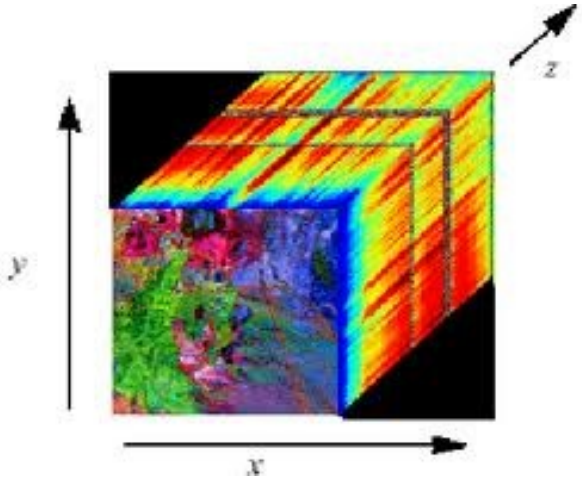
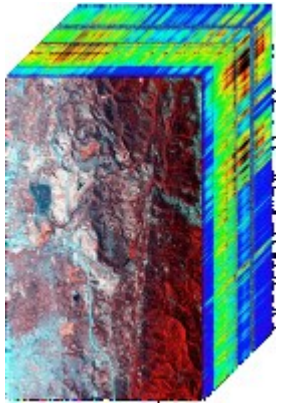
Volume holographic gratings

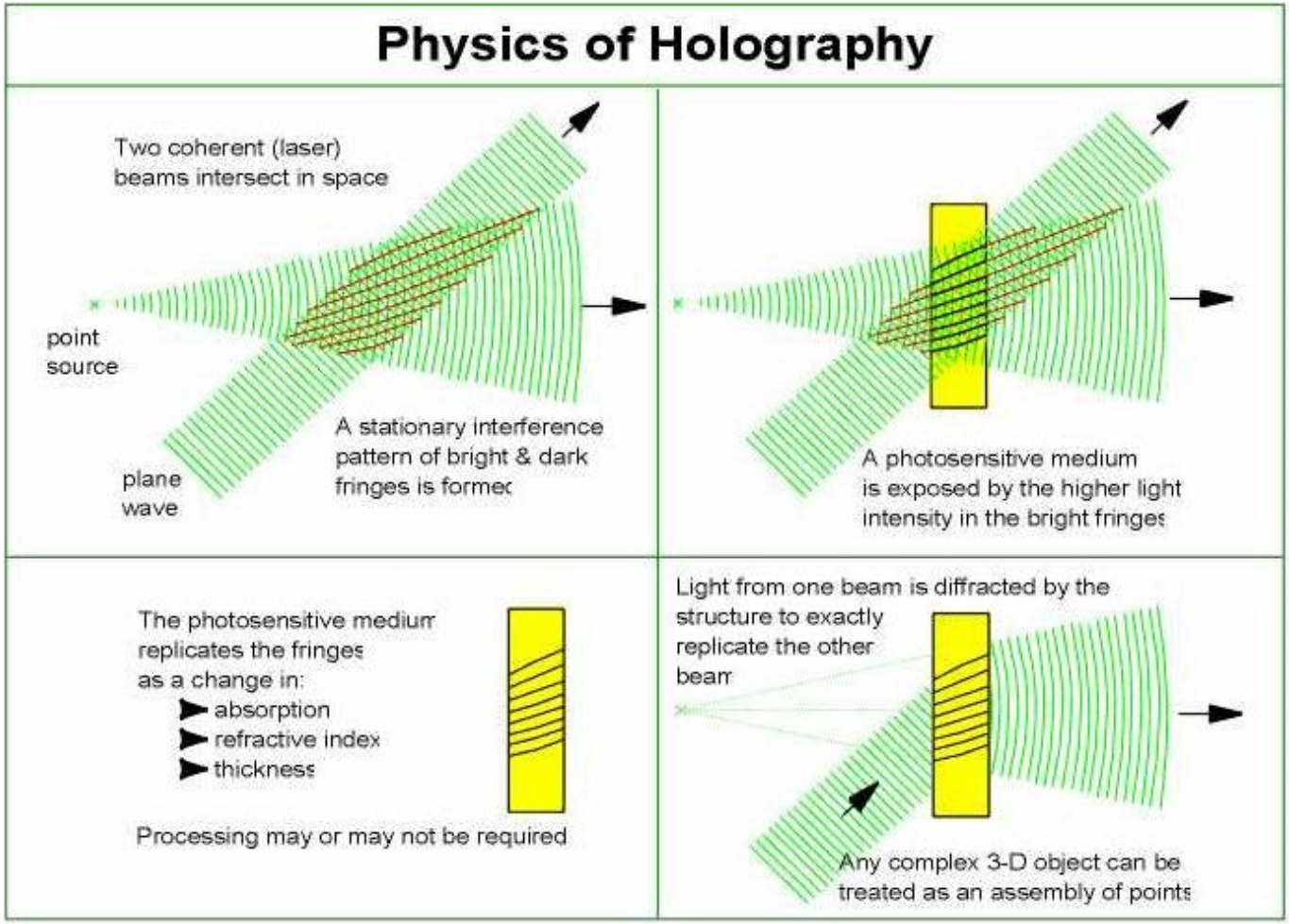


Diffractive optical elements, based on polymeric materials, have been developed for the realization of compact spectroscopic payloads, such as multispectral and hyperspectral cameras, for the analysis of chemical composition of planets atmosphere



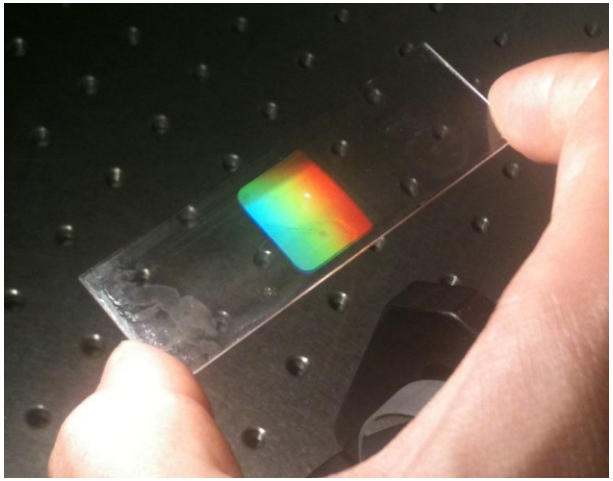


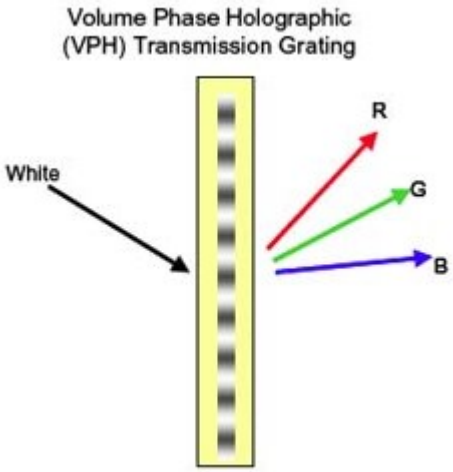
Volume holographic gratings



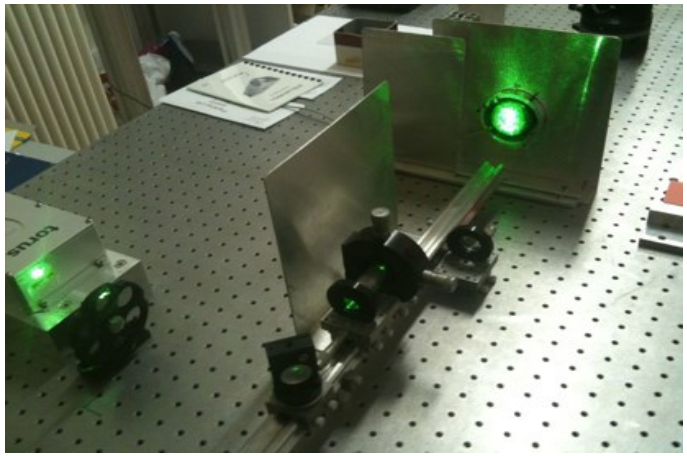
Volume holographic gratings

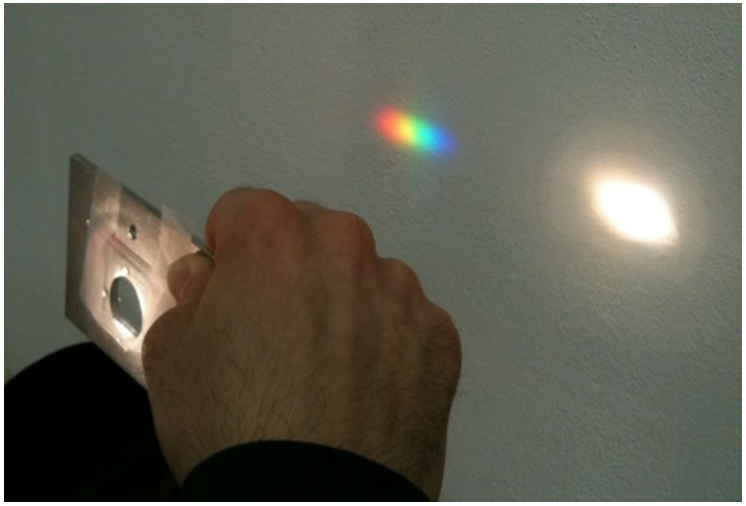
Volume holographic grating





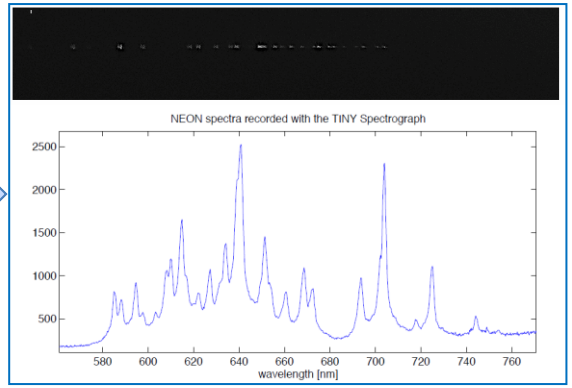
Holographic set-up





Volume holographic gratings

VHG compact size spectrometer

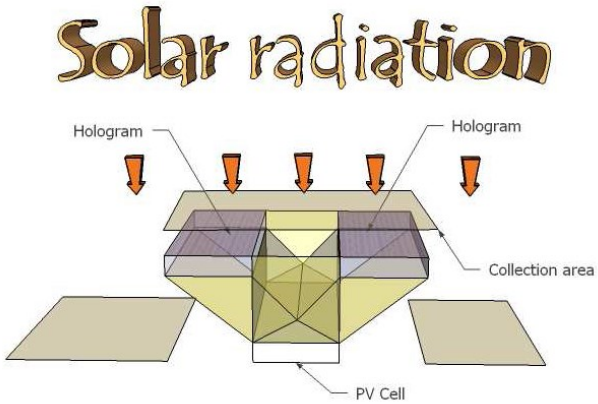


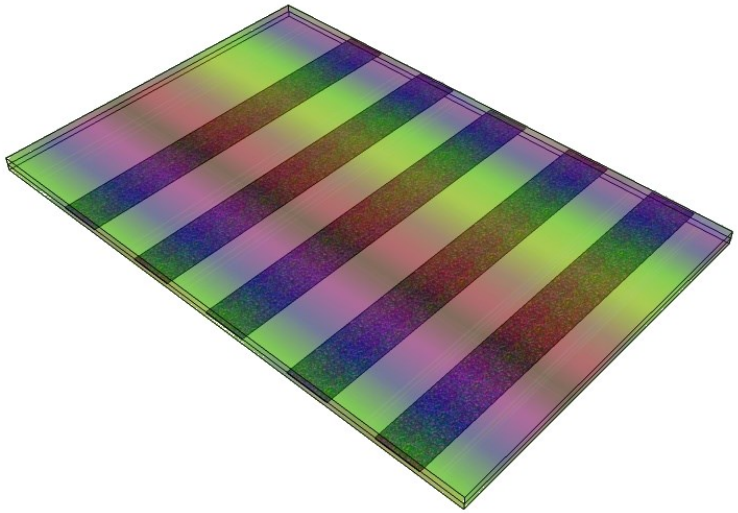
The holographic elements can be used as dispersive elements, for spectroscopic analysis of chemical composition of liquid or gaseous species. These performances allow to produce compact spectrometers that can be used for a wide range of applications.

Sample composition analysis
Environmental monitoring
Biological analysis
In-flight Water and Air Quality Monitoring

Holographic solar concentrators

The ability of light manipulation, shown by these diffractive devices, has been exploited, even in the development of holographic solar concentrators for high efficiency and low cost photovoltaic modules.





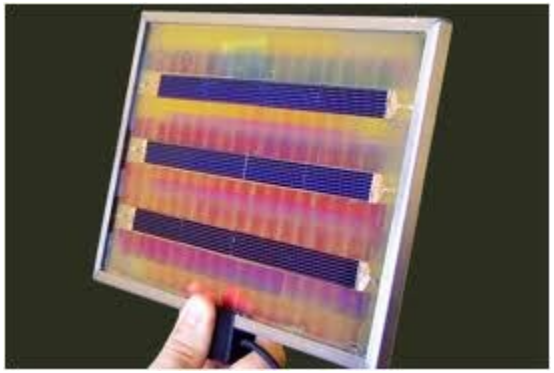
Holographic solar concentrator cell Concept design

The use of polymer based diffractive elements allows to realize planar optical concentrators with high performance, comparable to standard ones.

Holographic solar concentrators

The technological processes and the materials involved results in compact and less-expensive devices compared to the standard approaches, such as micro-machined Fresnel lens or spherical mirror.

Spherical mirror solar concentrator



Vs.

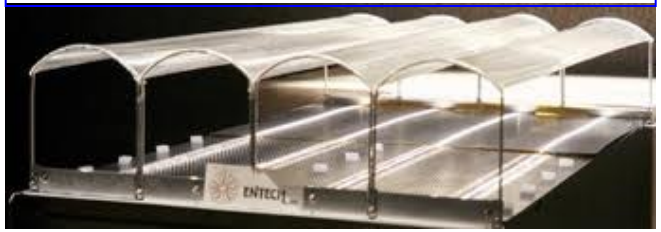
Holographic solar concentrator

Fresnel solar concentrator

Holographic solar concentrators

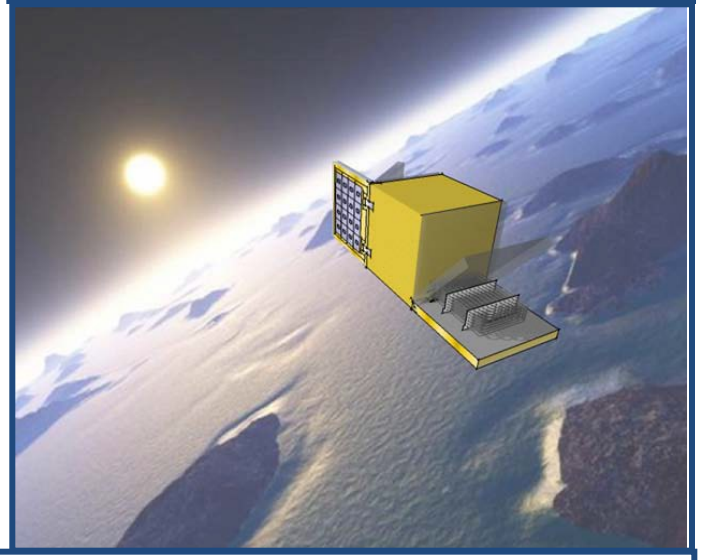
V-through solar concentrator

Stretched Fresnel Lens array



State of the art

Satellite equipped with the Holographic solar concentrator



High efficiency photovoltaic modules can reduce the complexity of the power system design, the volume and development costs, with high benefit in terms of mission cost and life cycle.

<u>The holographic solar concentrators could be the best candidates for this purpose</u>

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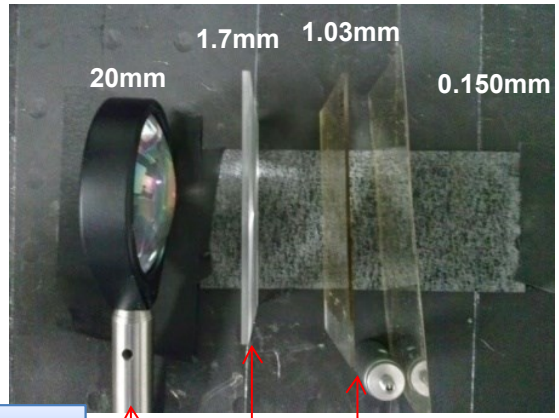
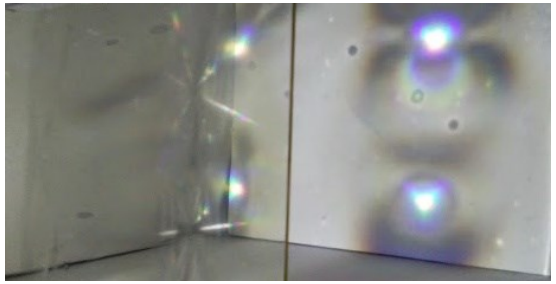
Holographic solar concentrators

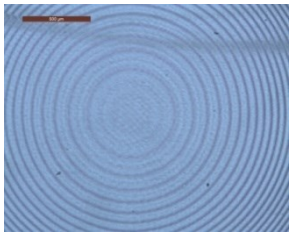
From grating…

…to lens



The hologram of a lens is a lens itself !!





75mm focal length

Refractive lens
Fresnel lens
Holographic lens on glass substrate
Holographic lens on flexible substrate

Holographic lens array has been recorded in a specially developed photopolymer. A wide range of substrates can be coated by the photosensitive polymer, allowing even freeform lens and gratings

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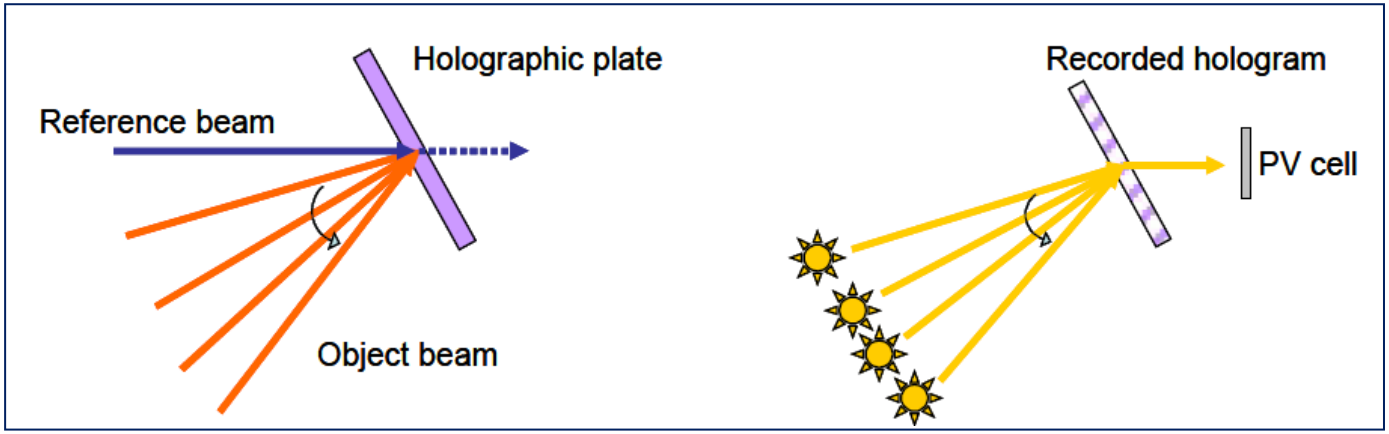
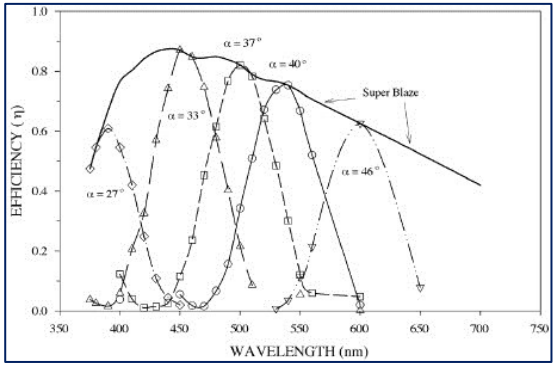
Holographic solar concentrators

Passive Solar Tracking…

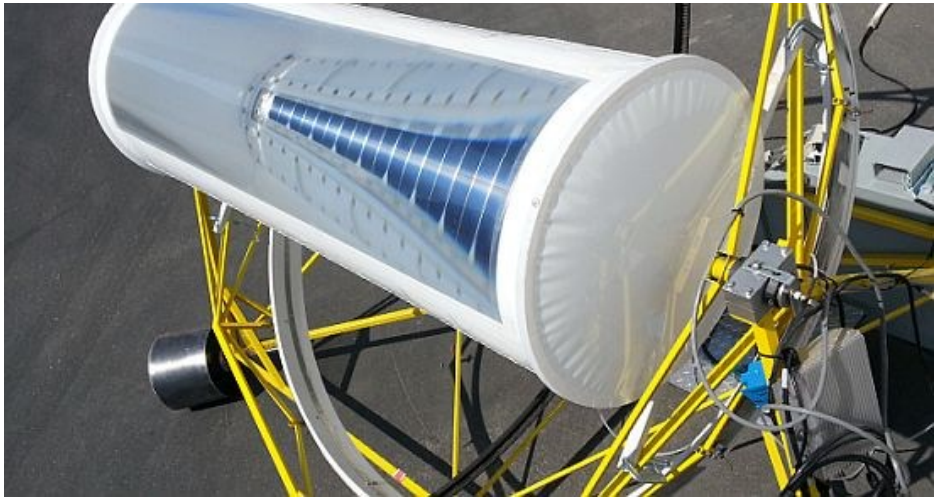


… by VHG Multiplexing Capabilities



Holographic solar concentrators

Inflatable solar concentrator modules for space exploration



Light management for deployable greenhouse for planetary exploration

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“The future cannot be predicted, but futures can be invented. It was man's ability to invent which has made human society what it is”

Dennis Gabor - “Inventing the Future” (1963)