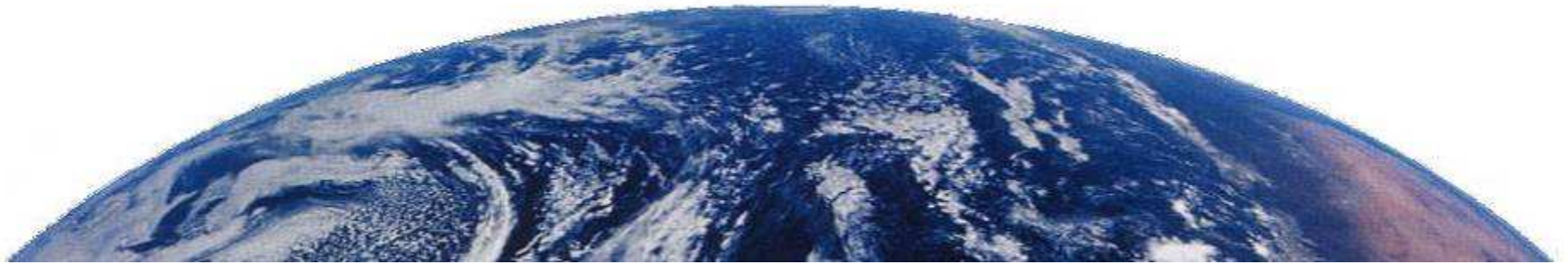


The logo for the ANTARES experiment. It features the word "ANTARES" in a bold, grey, sans-serif font. A blue, three-dimensional elliptical ring orbits around the text. Two red spheres of different sizes are positioned on the ring, one larger than the other, representing the neutrino detectors.

ANTARES



# Innovative optical materials for the development of diffractive and holographic devices

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*Author Affiliations:* <sup>1</sup> Antares S.c.a.r.l.; <sup>2</sup> CGS S.p.a; <sup>3</sup> INAF-OAB



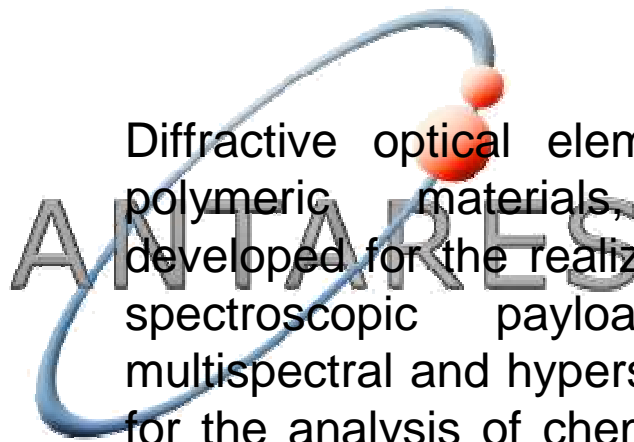
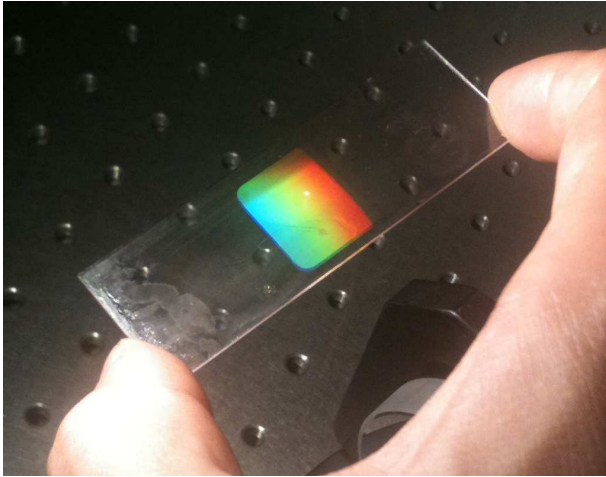
## OUTLINE

- **Space exploration technologies involved in the project**
- **The SPIN-OFF**
- **Civil applications**
  - Spectroscopic instruments
  - Holographic solar concentrators
- **Status of the activity**
- **Enhancements related to space exploration technologies**

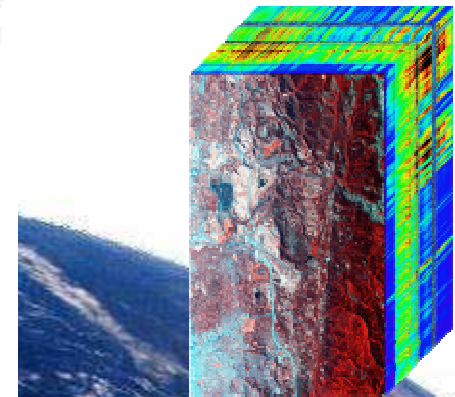
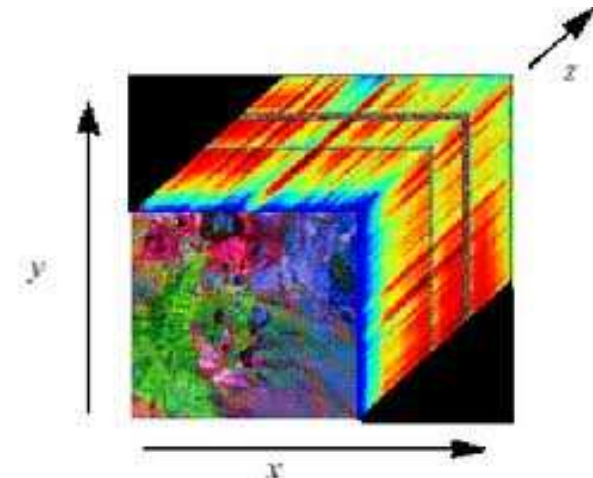
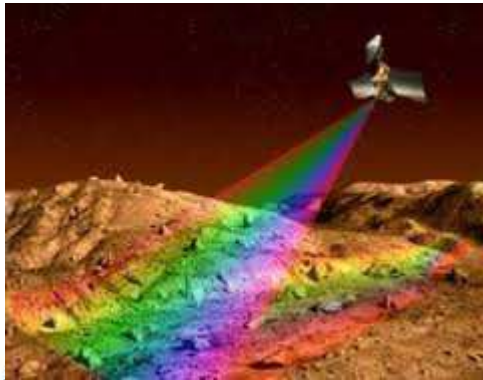
ANTARES



# Space exploration technologies involved in the project



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



# The SPIN-OFF

From Space...



Know-How Transfer

Space technology applied for diffractive-holographic elements, used in the development of scientific payloads for space exploration, be also used to realize innovative optical devices for civil applications

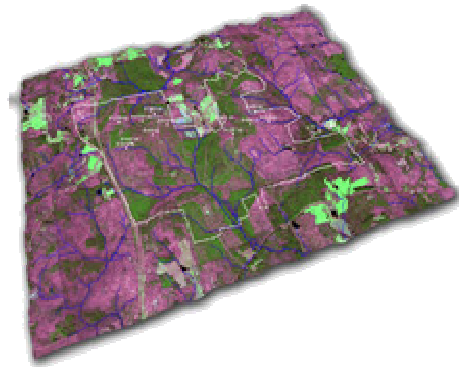


...to Civil applications



# Civil applications: Spectroscopic Instruments

The holographic elements can be used as dispersive optics 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 civil applications, such as:

- Food and beverage quality analysis
- Environmental monitoring
- Homeland security
- Drugs detection (law enforcement)
- Anti-adulteration



# Civil applications: Holographic solar concentrators - I

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



Holographic solar concentrator cell Concept design

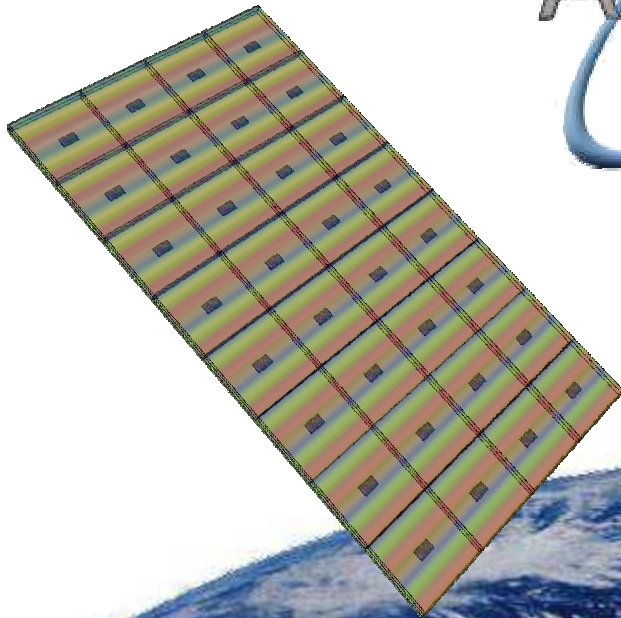
The use of polymer based diffractive elements allows to realize planar optical concentrators with high performance, comparable to standard ones.

# Civil applications: Holographic solar concentrators - II

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.

# ANTARES

Spherical mirror solar concentrator



Holographic solar concentrator

**Vs.**



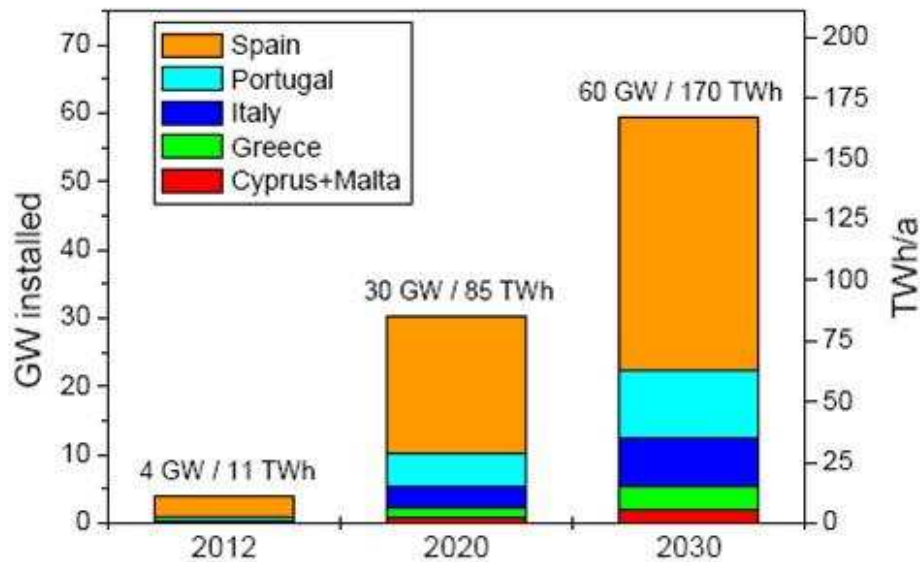
Fresnel solar concentrator





# Potential of Concentrating Solar Power systems

The devices performances will quickly allow the diffusion of medium and low scale solar power plants on the EU area, with more benefits for the European citizens.



RES

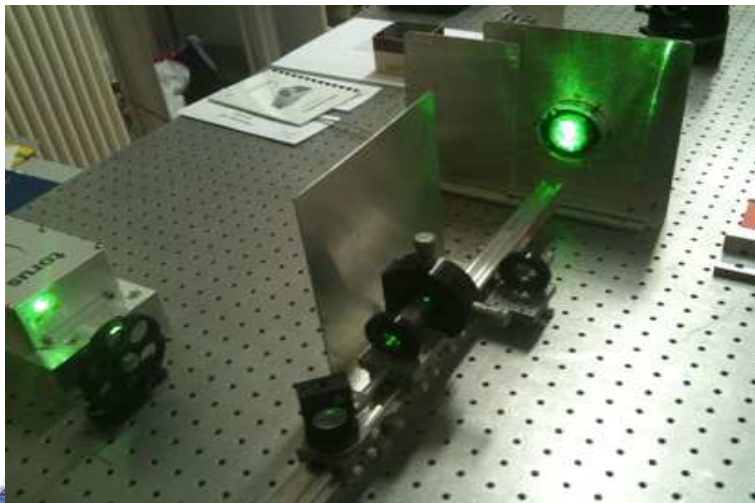
Potential of CSP in Europe (Source: ESTELA - European Solar Thermal Electricity Association)

The Concentrating Solar Power (CSP) systems will provide 7% of the world's generating capacity by 2030. By 2050 investment could reach €92.5bn, creating almost 2M jobs by 2050 and saving 2.1bn tonnes of CO<sub>2</sub> every year.

## Status of the activity

To date, the activity is in the Research phase.

The optical and thermal properties of the materials have been analyzed.

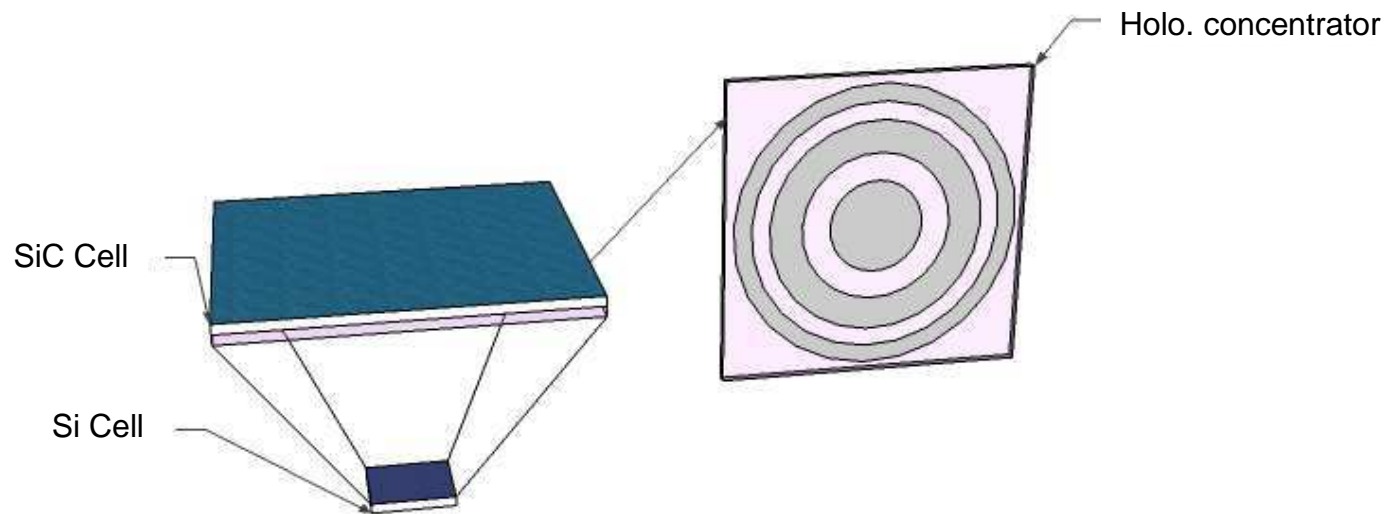


The numerical modeling of polymer based holographic optical elements is being studied and the manufacturing process for holographic optical elements is under development.

Volume holograms have been recorded in polymeric substrates.


## Future developments

Technological upgrade of materials and optical devices can be referred principally to the holographic solar concentrators.




To date, a promising approach is represented by hybrid photovoltaic cells composed by Si/SiC cell equipped with polymer based volume holograms concentrators

# Enhancements related to space exploration technologies



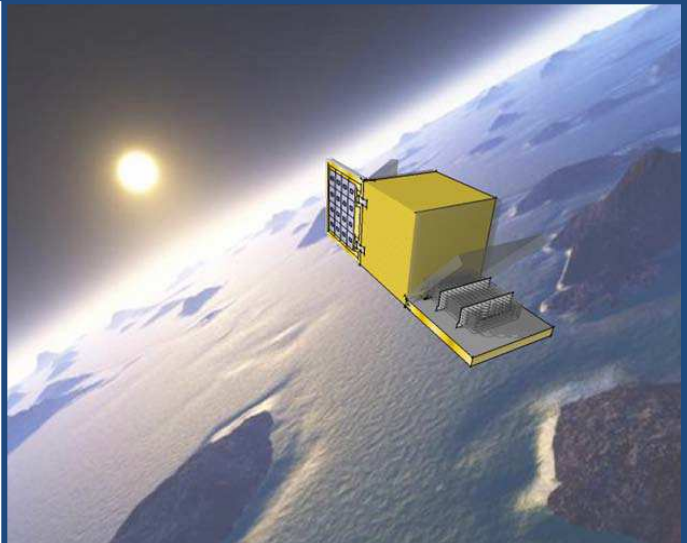
V-through solar concentrator

Stretched Fresnel Lens array



State of the art

Satellite equipped with the Holographic solar concentrator



**FUTURE DEVELOPMENTS:** 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.

The holographic solar concentrators could be the best candidates for this purpose