# Advanced methods for conversion of concentrated solar radiation

A prototype of parabolic trough concentrator is installed at the Lab of Solar Energy Conversion, on the roof of the DII building in Via Venezia 1, Padova. This concentrator (Fig. 1) has an aperture area of almost seven square metres and is asymmetrical. The reflecting optical surface is made of four back silvered glass facets arranged in two rows. The concentrator is equipped with a two-axes solar tracking system and is used to study new types of solar receivers operating under concentrated solar flux. For this purpose, a solar flux mapping system has been set-up. Fig. 2 shows the solar flux distribution measured on the receiver plane in a clear sky day. Two projects are presently going on in this apparatus.

*1* The first project addresses the use of nanofluids to absorb solar radiation in solar collectors. Some nanofluids present peculiar optical properties that allow their use as absorbing and heat transfer media in direct absorption solar collectors (DASC). The solar radiation is directly and volumetrically absorbed by the fluid instead of limiting the absorption to a surface and thus high efficiency receivers can be developed. Fig. 3 shows the test section designed and fabricated by our Lab to flow a nanofluid under concentrated solar flux. So far, using a thickness of 18 mm of an aqueous suspension of single wall carbon nanohorns (SWCNHs) with 0,02 g/L concentration, it was possible to absorb 85% of the solar flux. To the best of our knowledge, this is the first experiment of this kind ever done.

*Fig.1 Asymmetrical parabolic trough*

*2* The second project regards the generation of steam of an organic fluid to be used in an expander of a Rankine cycle. The basic concept is the use of the solar flux as energy input in a power generation cycle. The working fluid is a low global-warming-potential fluid classified as R1233zd(E).
The receiver is an internally designed prototype, made in aluminum and manufactured using the bar-and-plate technology. This geometry allows optimal distribution of the two phase mixture and thus efficient generation of vapor directly from the sun.

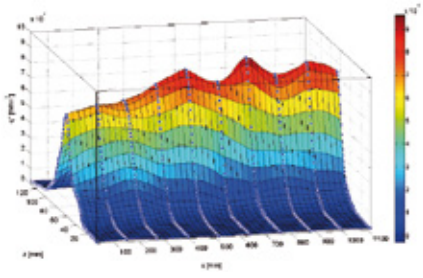

*Fig.2 Measurement of 3D concentrated solar flux distribution for a clear sky day in Padova*

*Fig.3 Test section with flowing nanofluid under concentrated solar flux*

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*Energy*

**DII research group**
**STET – Sustainable Thermal Energy Technologies**

Davide Del Col
davide.delcol@unipd.it
+39 049 8276891

Assisted by
Dr. Matteo Bortolato (post-doc)
Dr. Stefano Bortolin (post-doc)
Simone Dugaria (PhD student)

www.dii.unipd.it/en/sustainable-thermal-energy-technologies

The research activity regarding the use of aqueous suspension of single wall carbon nanohorns is performed in collaboration with CNR (Istituto per le Tecnologie della Costruzione and Istituto di Chimica della Materia condensata e di Tecnologie per l'Energia in Padova; Istituto Nazionale di Ottica in Florence) and is co-funded by Interdepartmental Centre Giorgio Levi Cases.

The research activity addressing the evaporation of an organic fluid from solar flux for a Rankine cycle is carried out in collaboration with ENEA, in the framework of PAR 2016.