Instituto de Fusión Nuclear
Universidad Politécnica de Madrid, Madrid, Spain.

École Normale Supérieure
- Lyon – (FRANCE).
Laboratoire de Physique. ENS-Lyon & CNRS
Laboratoire transdisciplinaire Joliot-Curie.

Physical view of biomolecular interactions in nano-technological applications.

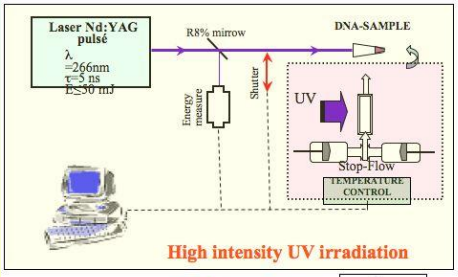
S. Cuesta-López

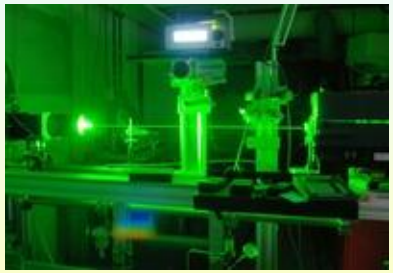
Dept. of Materials Science. Advanced Materials & Bio-nanotechology

In collaboration with:
M.Peyrard (ENS -Lyon), D. Angelov (ENS-Lyon) , A. Wildes (ILL-Grenoble),
A.Velazquez-Campoy (Unizar-ARAID) …

NANOSPAIN, 23-26th March 2010

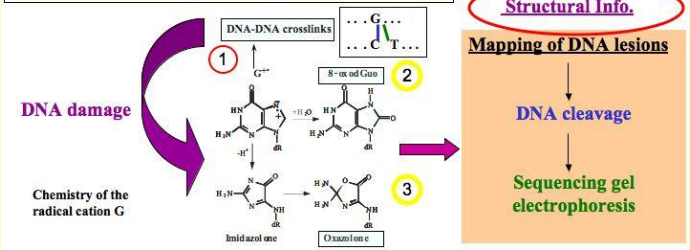
NANO-MOLECULAR PROBES CREATED BY HIGH INTENSITY UV LASER IRRADIATION

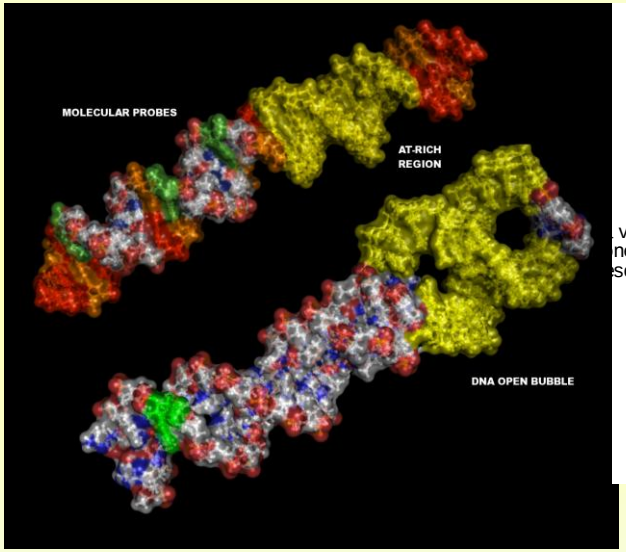




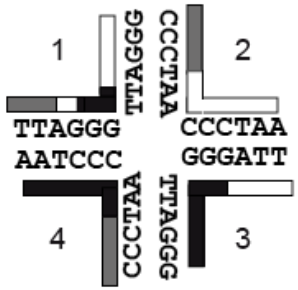
* Physics of DNA/RNA assembly. Characterizing structural assemblies in μRNA, Hairpins and loop structures.

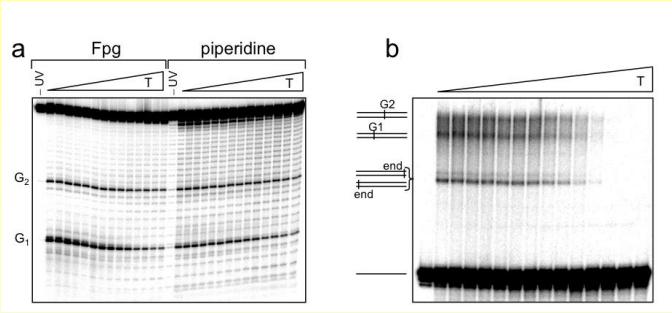
* Structural stability and integrity of DNA/RNA "puzzle pieces".

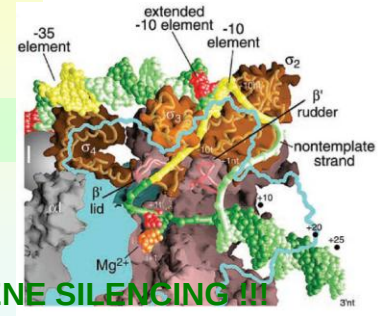




ver esta película, debe
ner de QuickTime™ y de
escompresor TIFF (LZW).







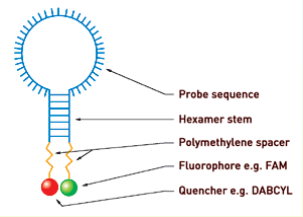
DNA FLUCTUATIONS PROPAGATE IN GENE PROMOTERS !!! FIRST EVIDENCE !!!

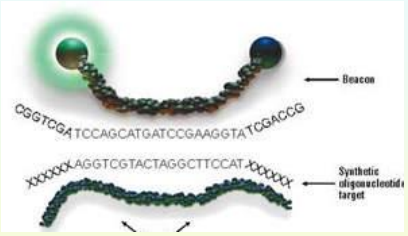
***** WE HAV DISCOVERED THIS EFFECT IN DIFFERENT GENES OF BACTERIA LIKE YERSINIA PESTIS, HELICOBACTER PYLORI AND MANY MORE !!!!**

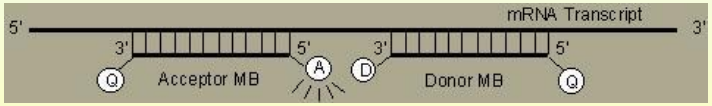
IMPORTANT BIOLOGICAL IMPLICATIONS AT THE LEVEL PROTEIN-DNA INT. AND GENE SILENCING !!!

S.Cuesta-Lopez et al. ***New Ang Chem Int.*** **(under review) (2010)**
S.Cuesta-Lopez et al. ***Eur. Phys. Letters*** **(2009)**

Learning from nature: DNA hairpins as molecular probes. Biophysics of *"Molecular Beacons"*. Biosensors.

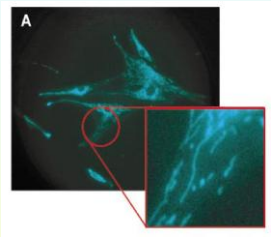


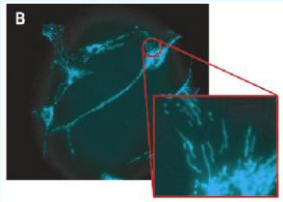


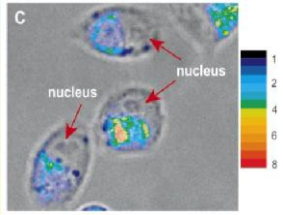


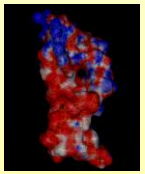
IN VIVO detection of gene expression

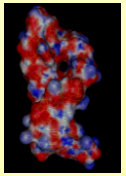
Molecular & cellular sensors. Early Cancer detection.

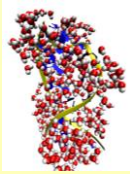


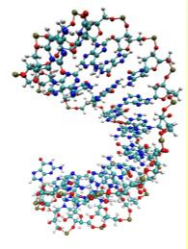






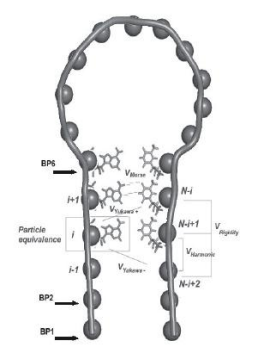






1TFN
(RNA intermediate structure)

THEORETICAL & COMPUTATIONAL MODELLING OF DNA/RNA HAIRPINS:

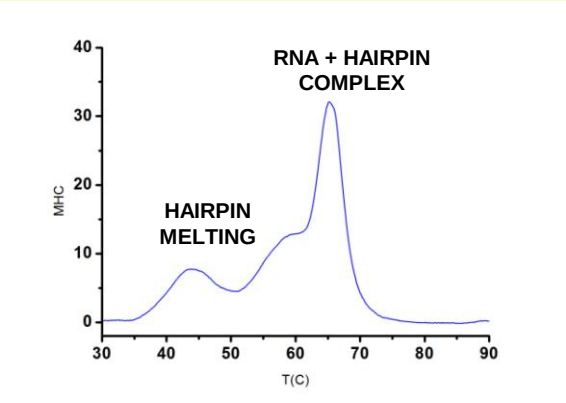


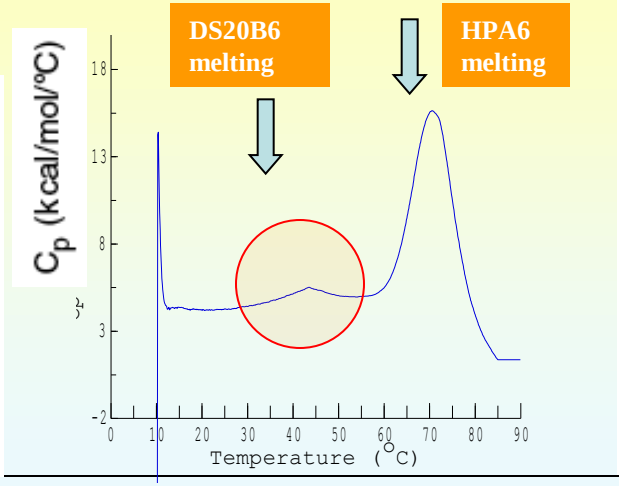
Nano-Calorimetry & Biomolecular interactions

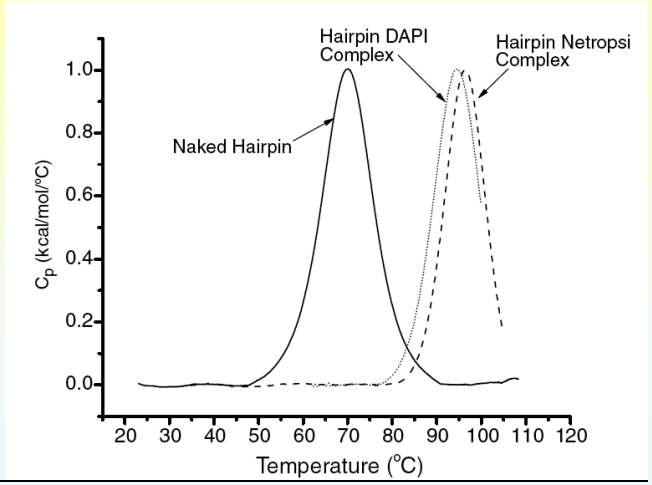
Detecting structural assemblies in mRNA, Hairpins and loop structures

Detecting DRUG-binding to DNA hairpins:

THERMODYNAMICS OF DNA HAIRPINS: SENSOR + TARGET BINDING DYNAMICS

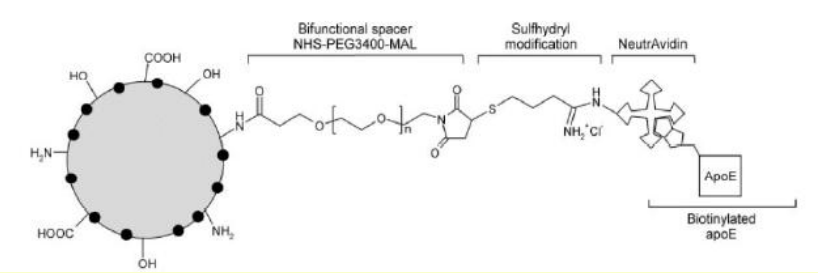






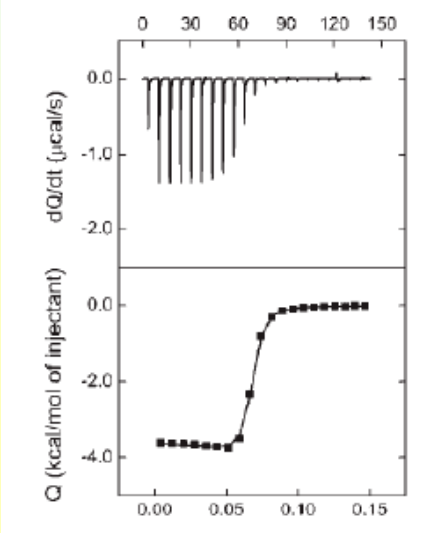
Biophysical basis of nanoparticles for medical applications. Improving designs and multi-functionality

IMPROVING FUNCTIONALIZATION:

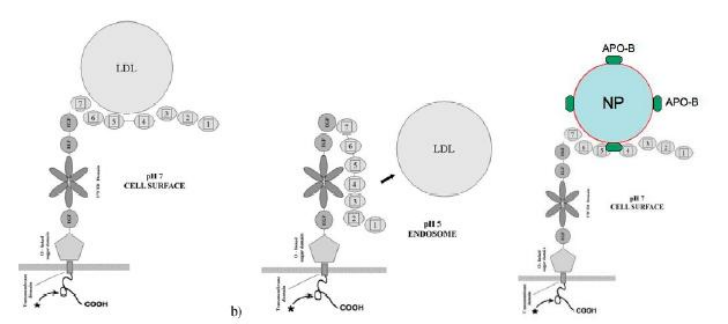


ITC studies on the LDL receptor mechanism:

* ITC analysis of LA4 vs APO-E/B-100
* ITC analysis of LA5 vs APO-E/B-100
* ITC analysis of LA6 vs APO-E/B-100
* ITC analysis of LA4to6 vs APO-E/B-100



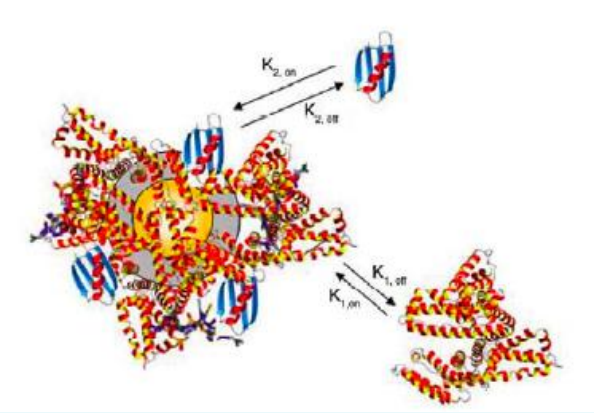
♦ **Using the LDL-r and EGF-r as routing/functionalization strategies**



ITC studies of ligand binding to sEGFr:

I) EGF binding to sEGF-r
II) HB-EGF binding to sEGF-r
III) TGF-a binding to sEGF-r
IV) mAb806 binding to sEGF-r
V) anti-ErbB2 binding to sEGF-r
VI) ScFvEGFR

BIOPHYSICAL BASIS OF NP BIOCOMPATIBILITY:



** Interaction of a functionalized Nanoparticle, in physiological conditions, with common plasma proteins.

♦ Combining both ITC and size exclusion chromatography techniques: Screen an ensemble of plasma proteins against a set of two different NPs coronas:

- HSA-NP and IO-NP.
-Albumin, Apolipoproteins (AI,E), immunoglobulins and fibrinogen.