

ICARST 2017

1st International Conference on Applications
of Radiation Science and Technology

PROTEIN-BASED NANOPARTICLES PREPARED BY RADIATION-INDUCED CROSS-LINKING

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IMBICE - Universidad Nacional de Quilmes

ARGENTINA

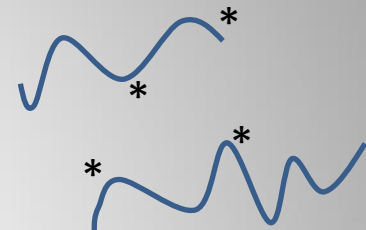
Vienna, Austria

(April 24-28, 2017)

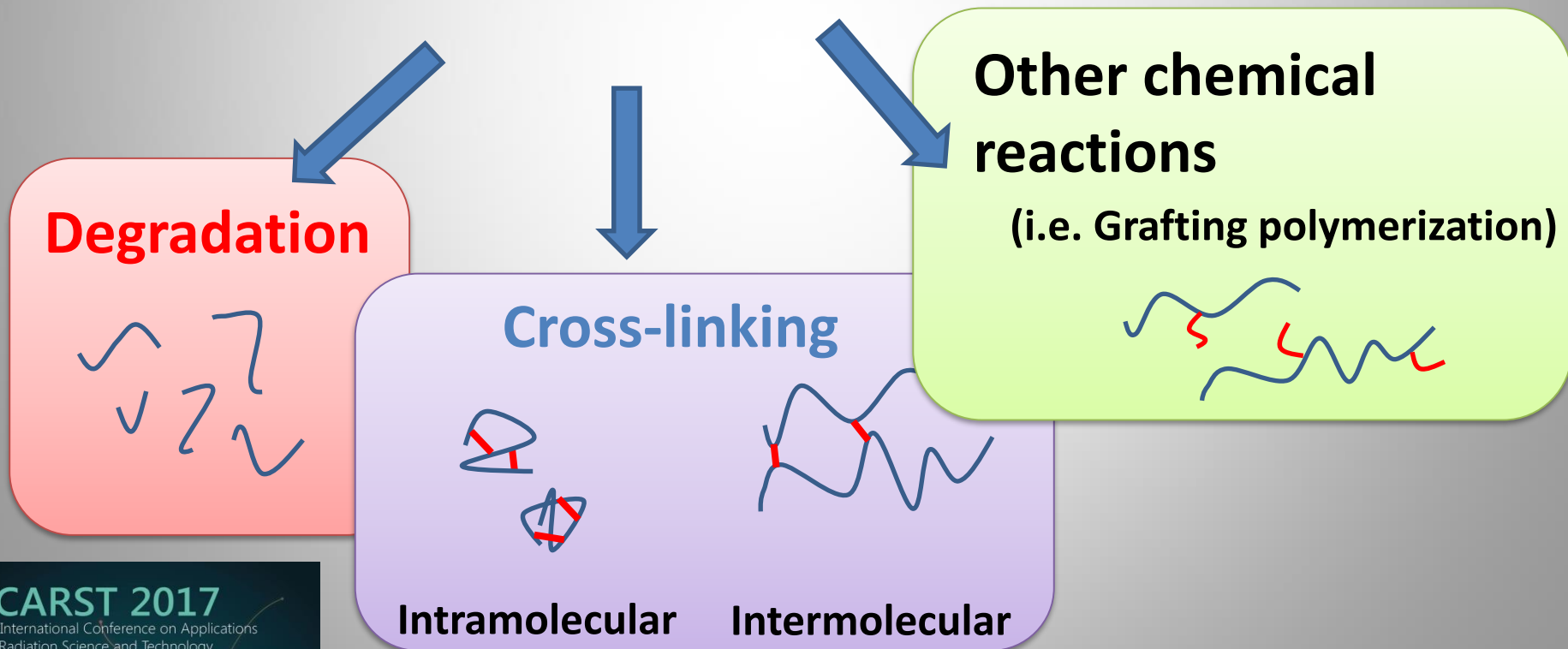


Interaction of ionizing radiation with macromolecules in solution

1st Physic events -> Ionization



2nd Chemical events



Irradiation of protein solutions...

Degradation

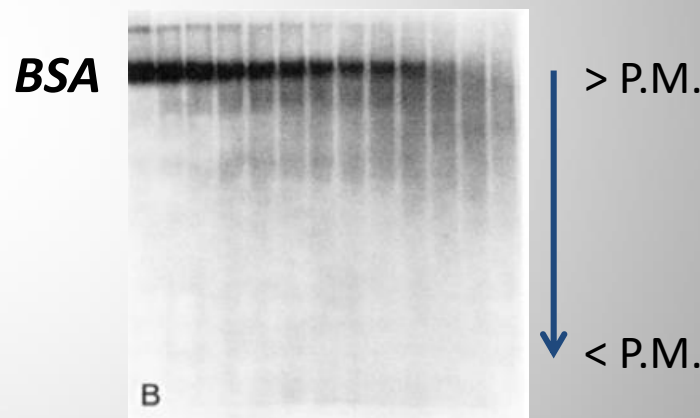


Main products...

*short peptides by
degradation process*

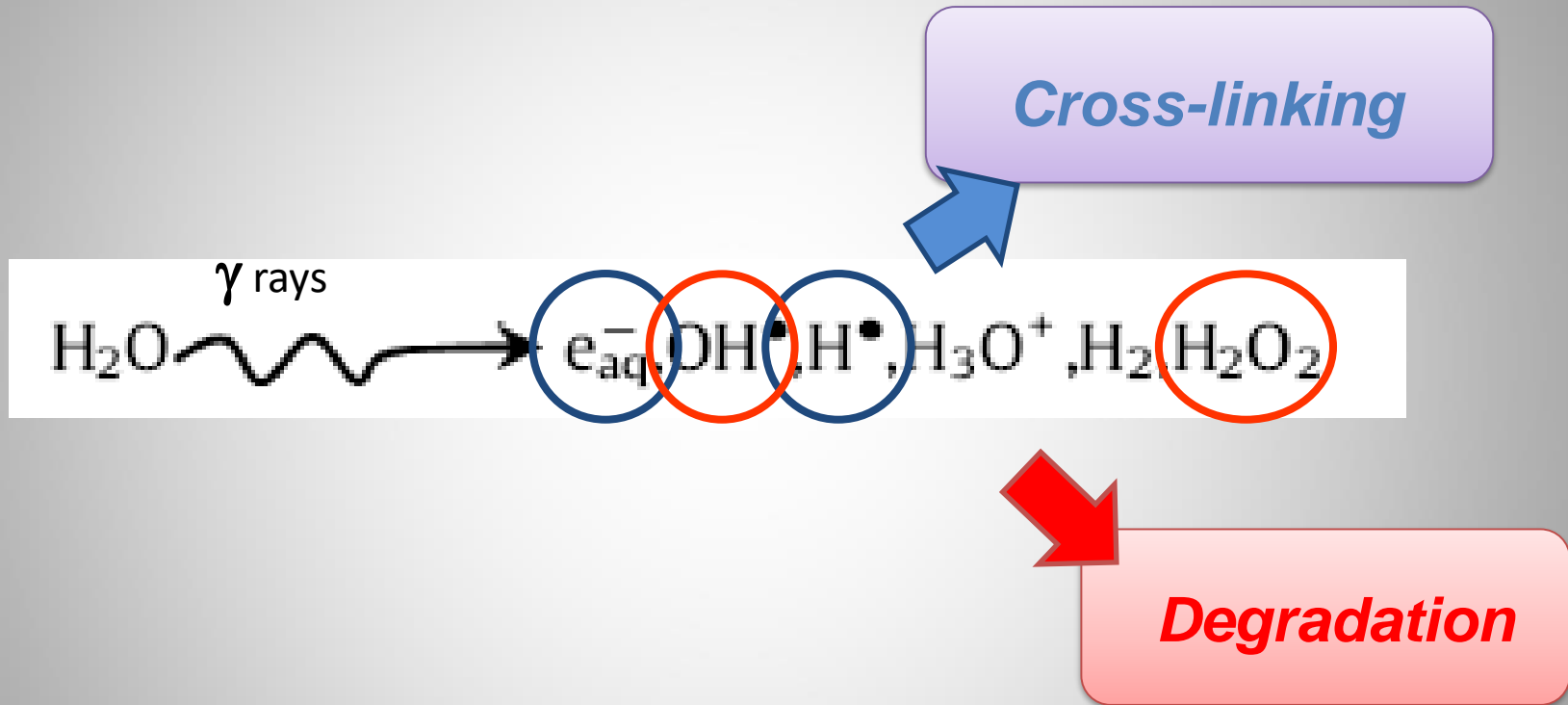
Protein electrophoresis analysis

SDS-PAGE



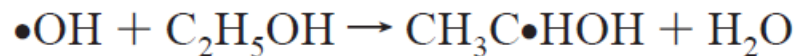
Amount of OH· radicals by
 γ irradiation

Water radiolysis



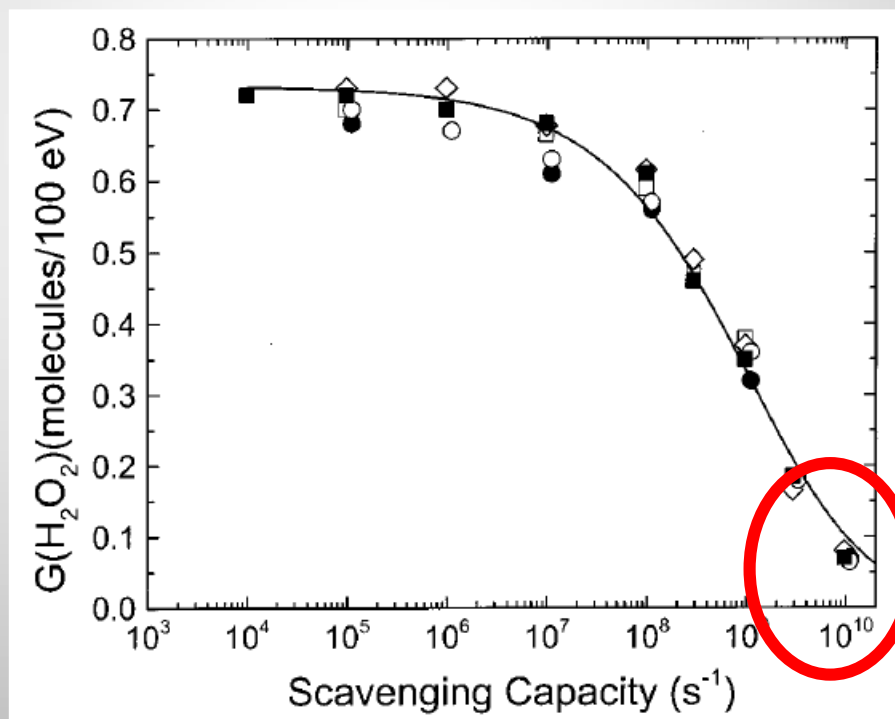
Scavengers

- Methanol
- Ethanol
- Bromide



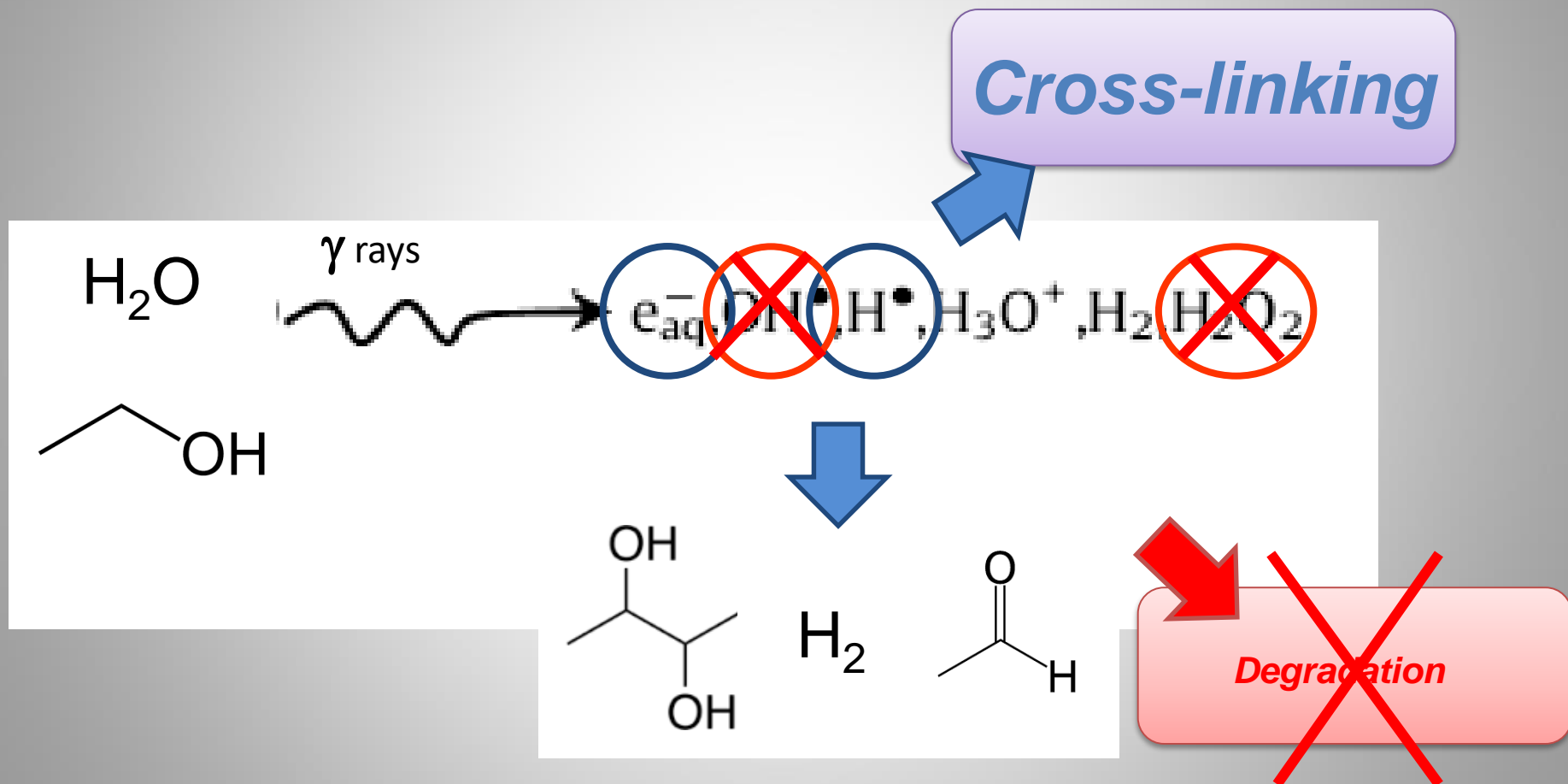
$$k_{3b} = 1.9 \times 10^9 \text{ M}^{-1} \text{ s}^{-1}$$

High concentration
30 %v/v
(> 5 M)

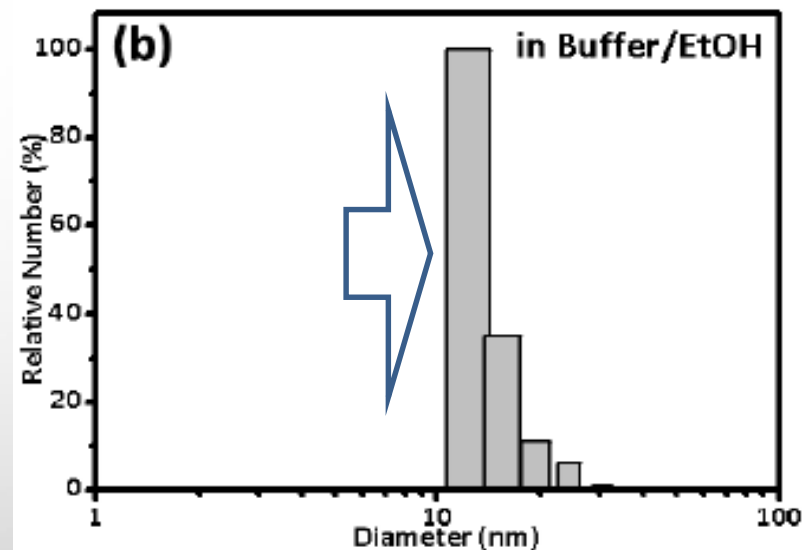
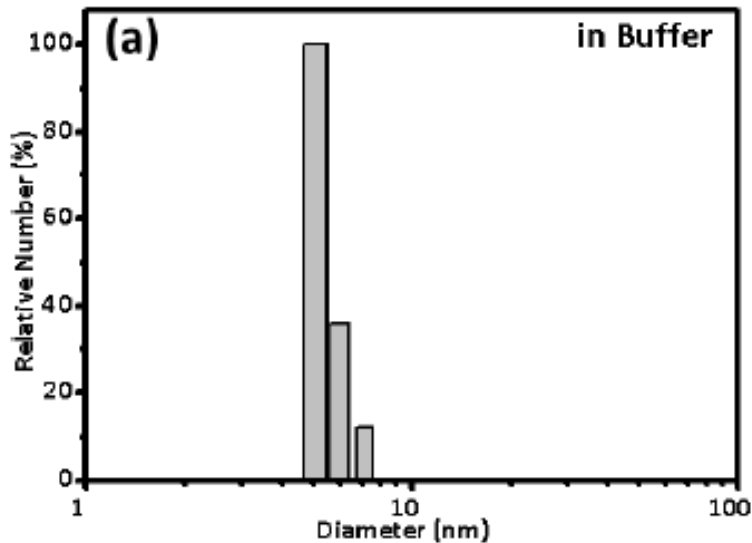
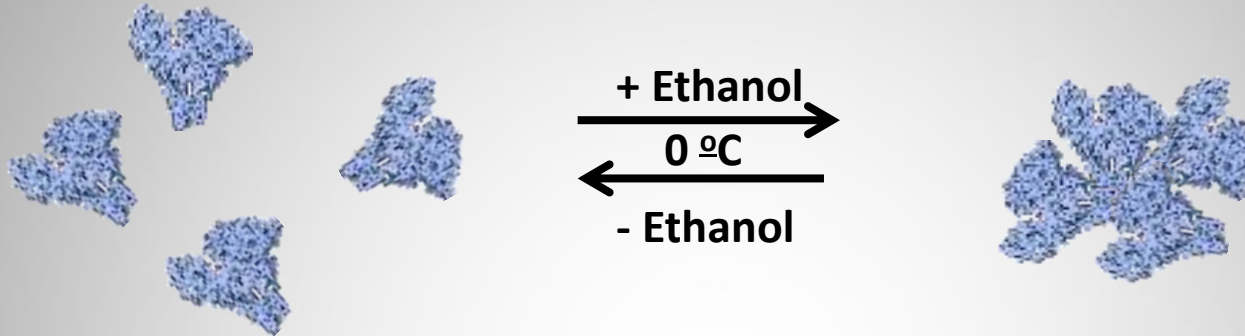


Very low
production of
H₂O₂

Water radiolysis in aqueous ethanol mixture

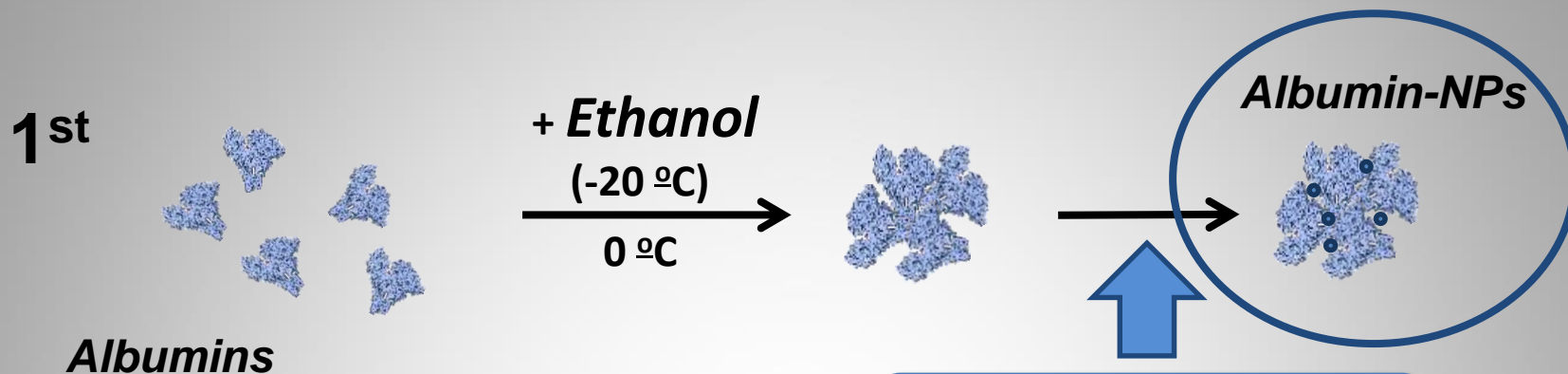


In addition, ethanol induces protein aggregation ...



It is a dynamic process!!!

Overall effect....



Cross-linking

2nd

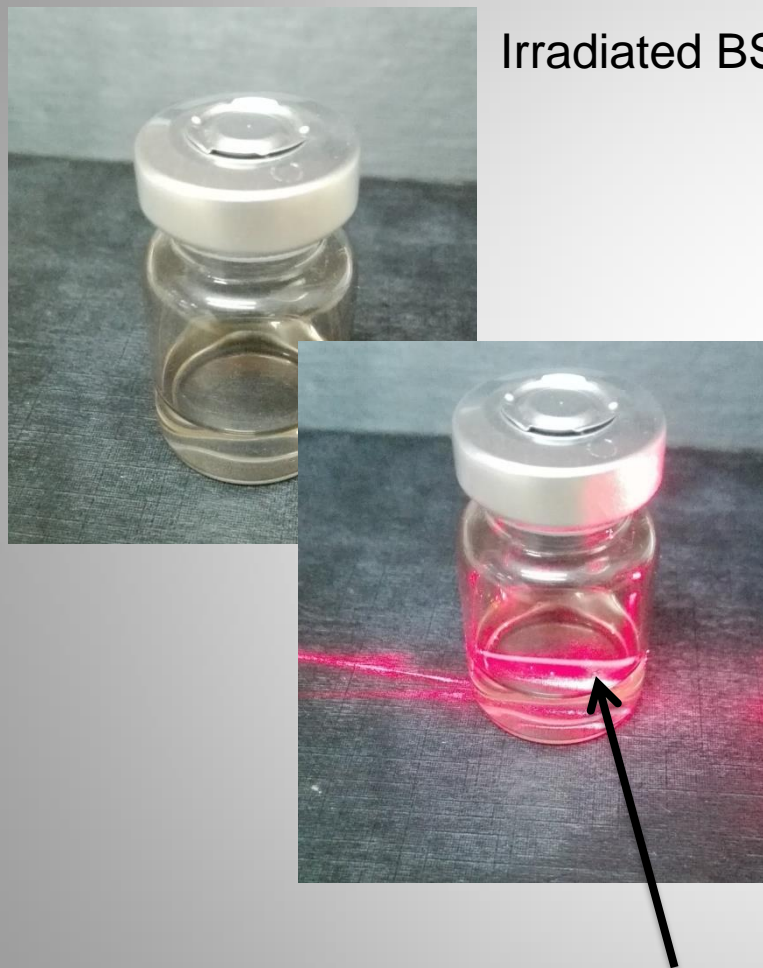


+ **Ethanol**



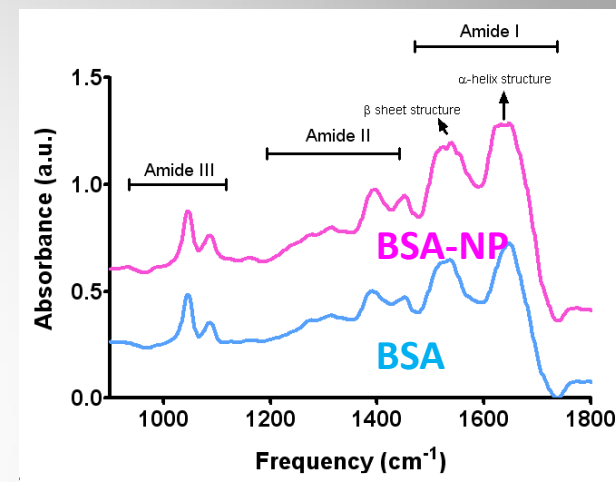
Albumin Nanoparticles

Irradiated BSA solution

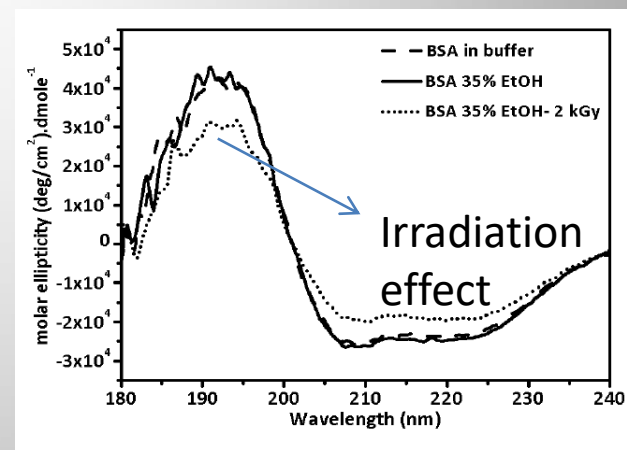


Tyndall effect

FT-IR



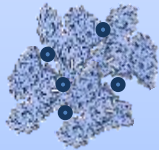
Circular dichroism



Preparation of protein shell...

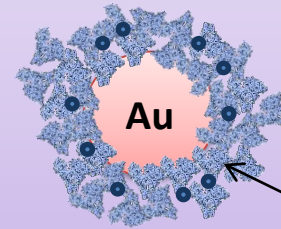
Preparation of protein-NPs

Albumin-NPs



Preparation of hybrid-NPs

Au/Albumin-NPs

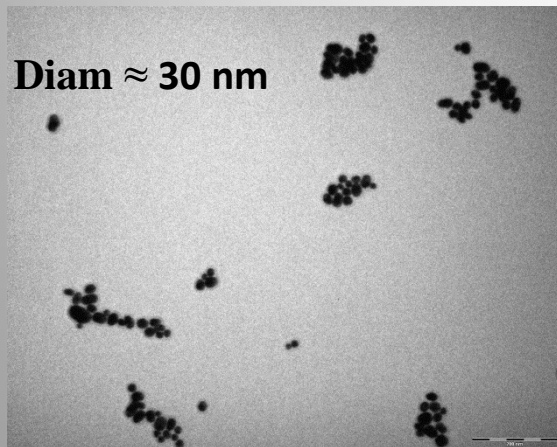
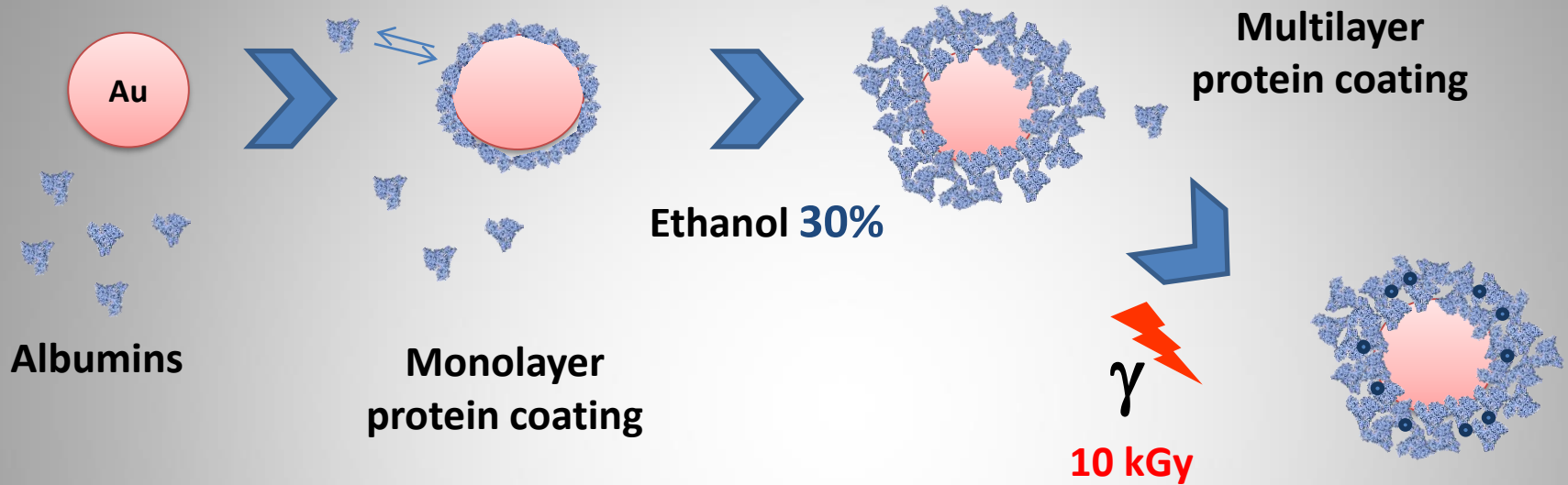


Multilayer protein
coating



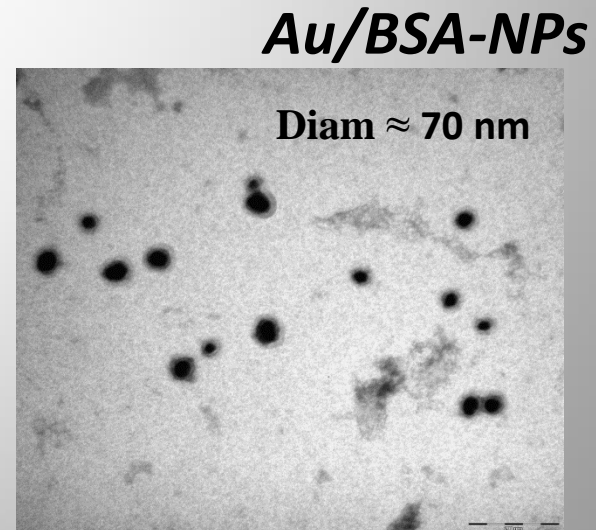
NEW IDEA

Au/Albumin (core/shell) NPs



Au-NPs

TEM pictures



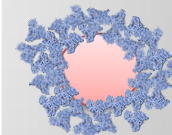
Au/BSA-NPs

Au/Albumin NPs



Au/Albumin NP. Zeta potential

<i>Samples</i>	Zeta potential (mV)
Au NPs	-40 to -50*
Au/HSA mono NPs	-21
Au/HSA NPs	-12.1
HSA NPs	-11.4
HSA	-15.4**

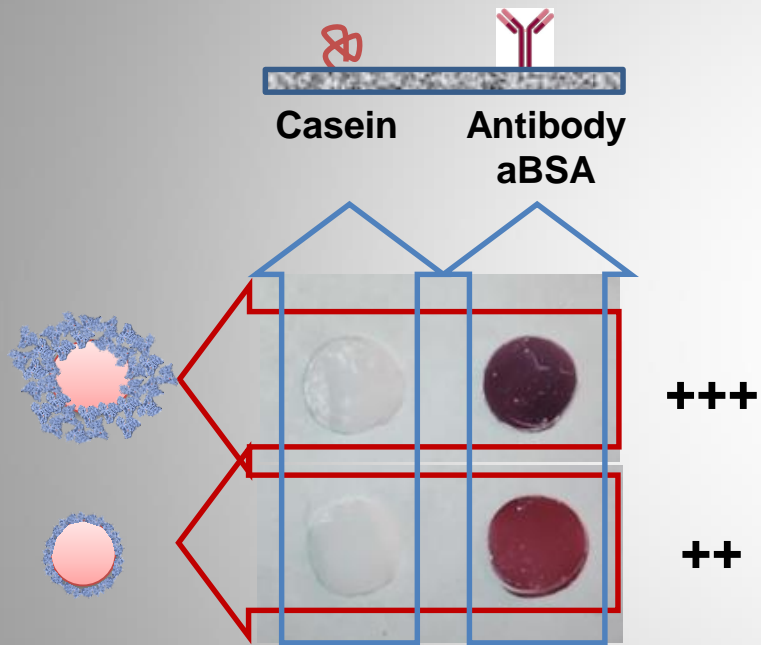


*Brewer *et al*, *Langmuir* **21** (2005) 9303-9307

Hosainzadeh *et al*, *J. Biomolec. Struct. Dynam.* **29 (2012) 1013-1050

Au/Albumin NP. Bio-recognition

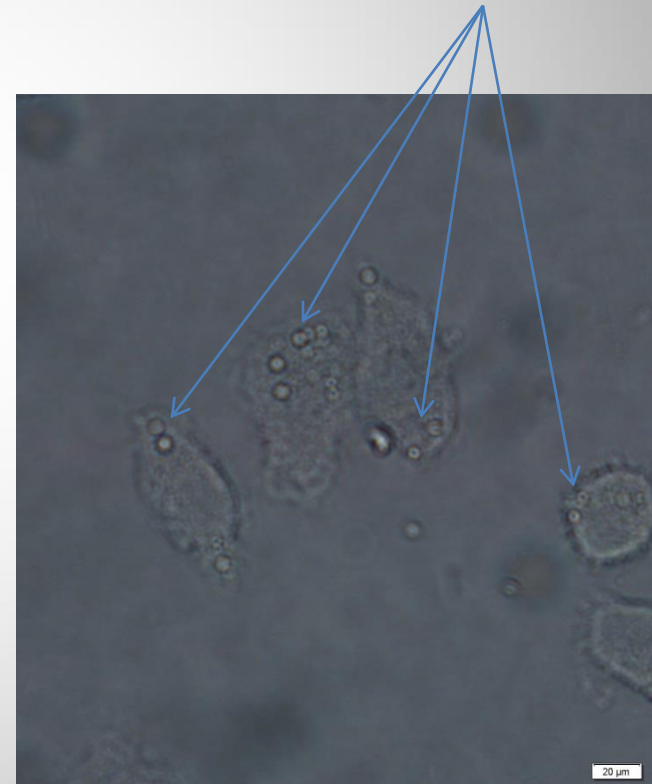
Protein recognition



Dot-blot analysis

Cell recognition

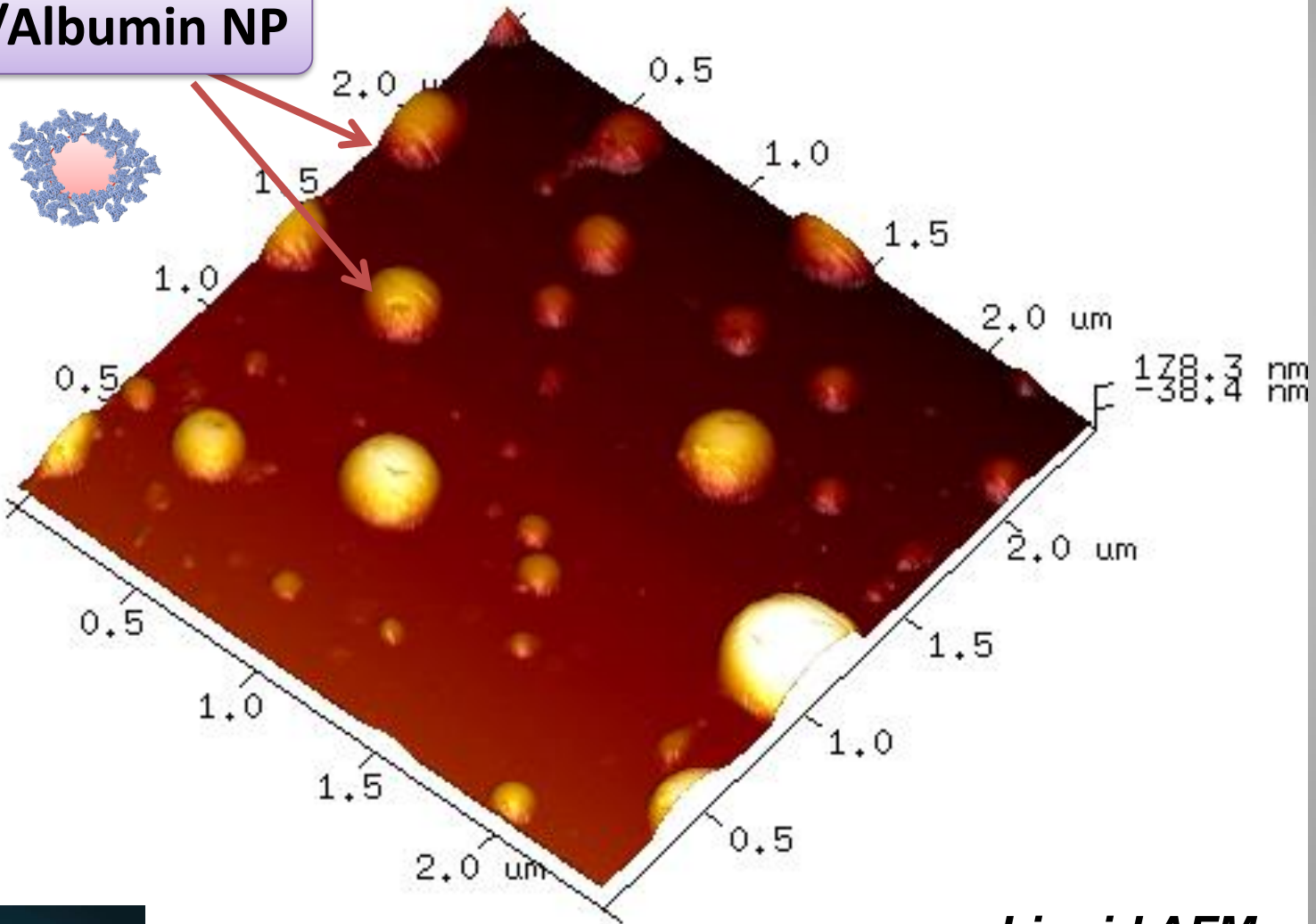
Peptide- Au/HSA NPs



Cell culture

Au/Albumin NP. AFM analysis

Au/Albumin NP



Liquid AFM

Conclusions

- ✓ Ionizing radiation can be used to prepare hybrid protein/inorganic nanoparticles

Future perspectives....

*Radiation-based preparation of
theranostic NPs based on proteins*

Long life to the Nanoparticles !!!

Thanks for your attention...



**LaMaBio's team
Quilmes, Argentina**

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