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Conference & Exhibition

Single Particle Extinction and Scattering **(SPES)** enables the **characterization** and development of **micro and nano particles** in **complex fluids**

Claudia Cella,
Tiziano Sanvito, Federico Mariani, Paolo Milani, Marco AC Potenza

EOS
Effective Optical Systems

Micro and nanoparticles in commercial goods

PHARMA

COSMETICS

FOOD

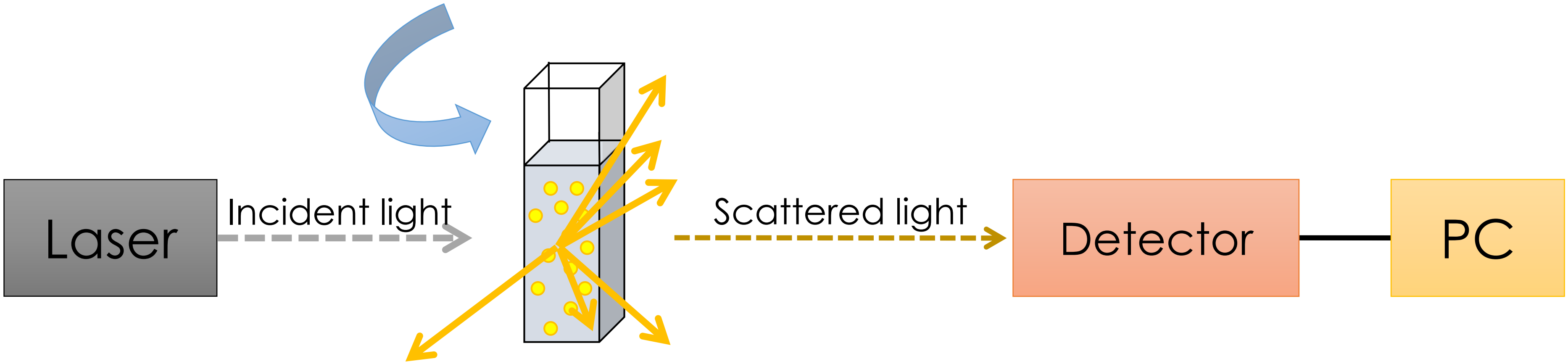
PIGMENTS

➡ Particle sizing and characterization are fundamental for

Micro and nanoparticles characterization

Traditional technologies for particle analysis are based on **light scattering**:

- Static Light Scattering (**SLS**)
- Dynamic Light Scattering (**DLS**)
- Single Particle Scattering (**SPS**)
- Nanoparticle Tracking Analysis (**NTA**)

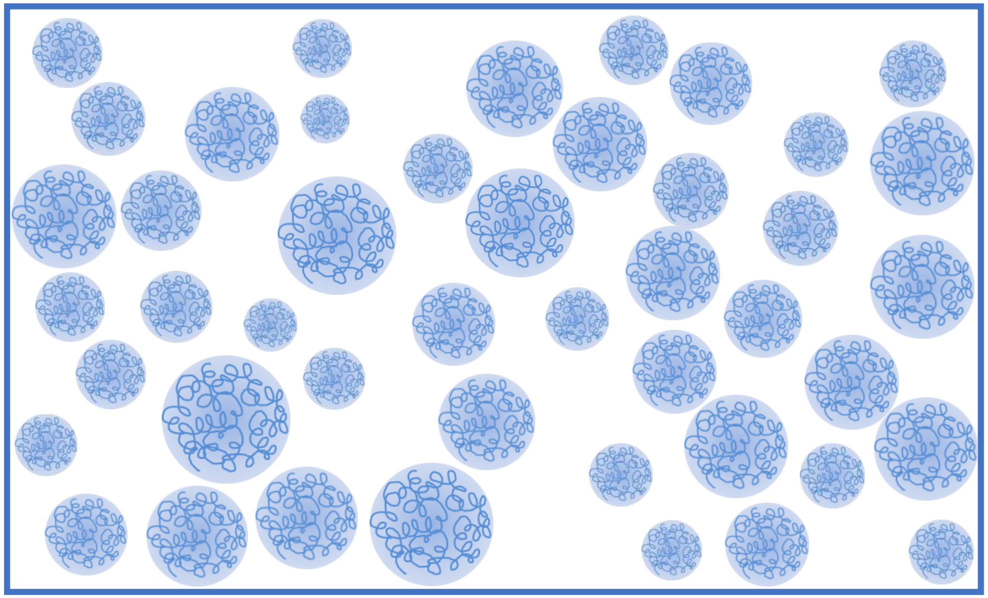


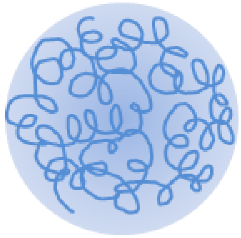
Advantages

- cost effective
- easy to use
- quantitative information

Traditional light scattering techniques limitations

They consider ALL particles as
perfect, uniform spheres of the same material

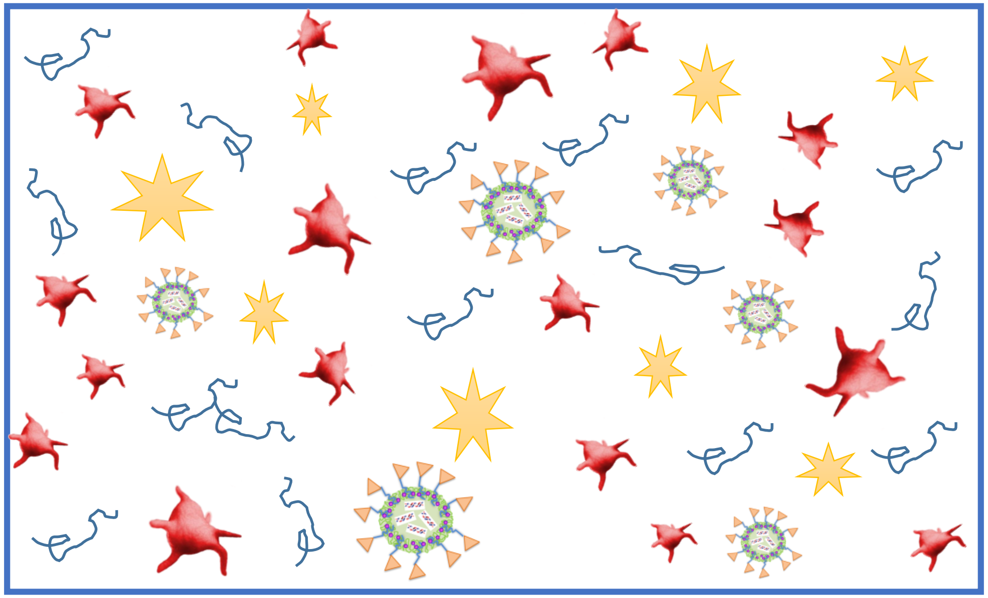


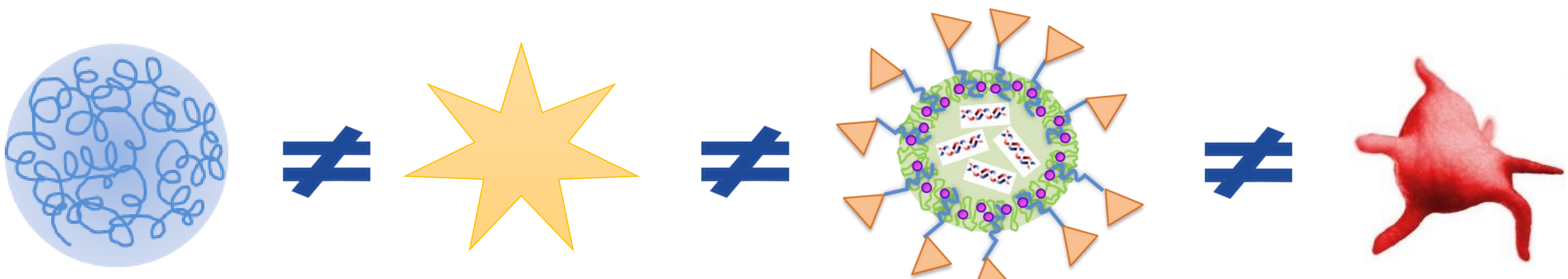


Polymeric

Traditional light scattering techniques limitations

But particles are **NOT** homogeneous, perfect, uniform spheres





Polymeric **Metallic** **Engineered** **Bio component**

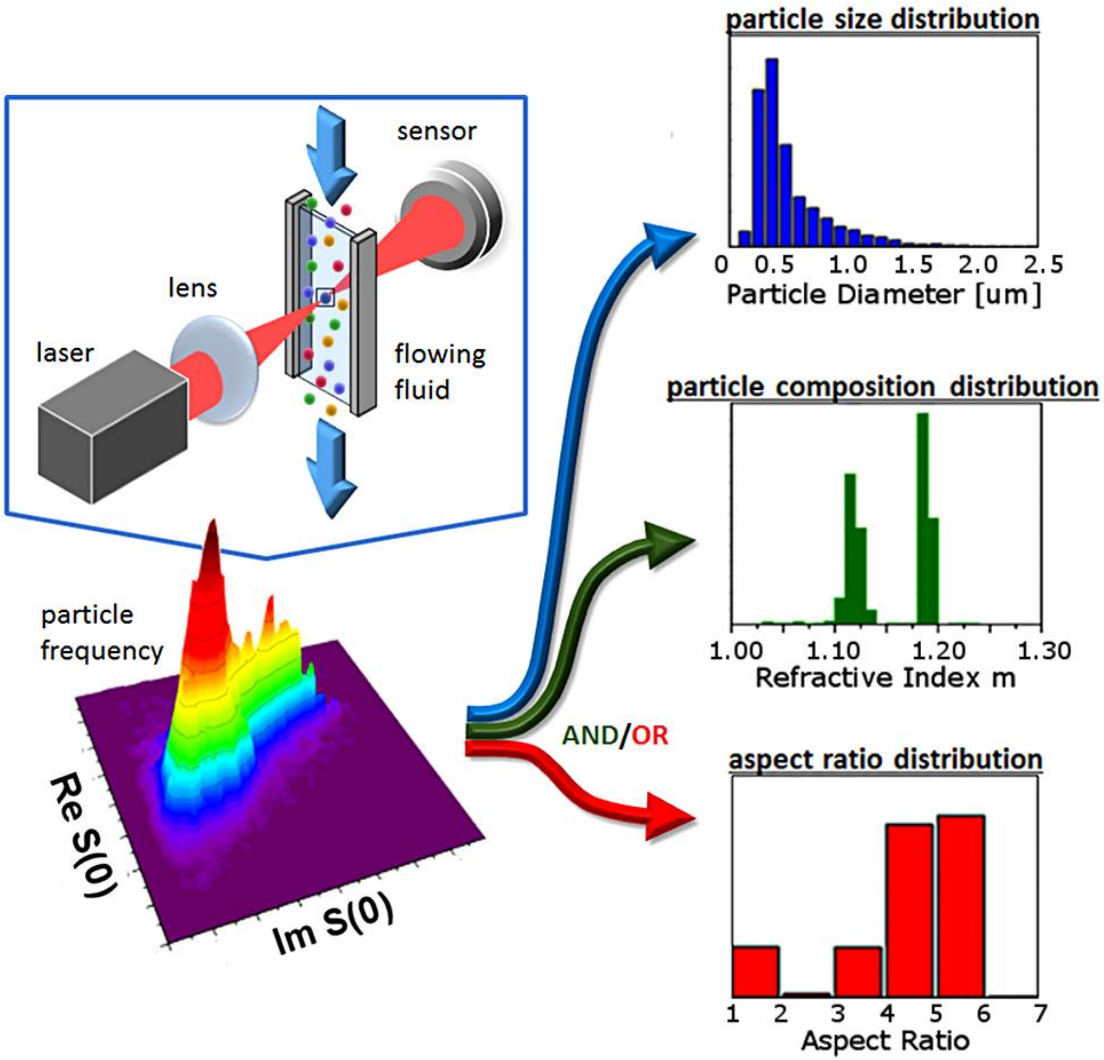
Traditional light scattering techniques limitations

- Traditional light scattering technologies are unsuitable for analysis in complex mixtures and real media
- Other complementary expensive and time-consuming analysis are needed
- Adequate sample preparation is necessary but results can be eventually altered

To overcome these limits, we propose a new approach based on **Single Particle Extinction and Scattering (SPES) technology**

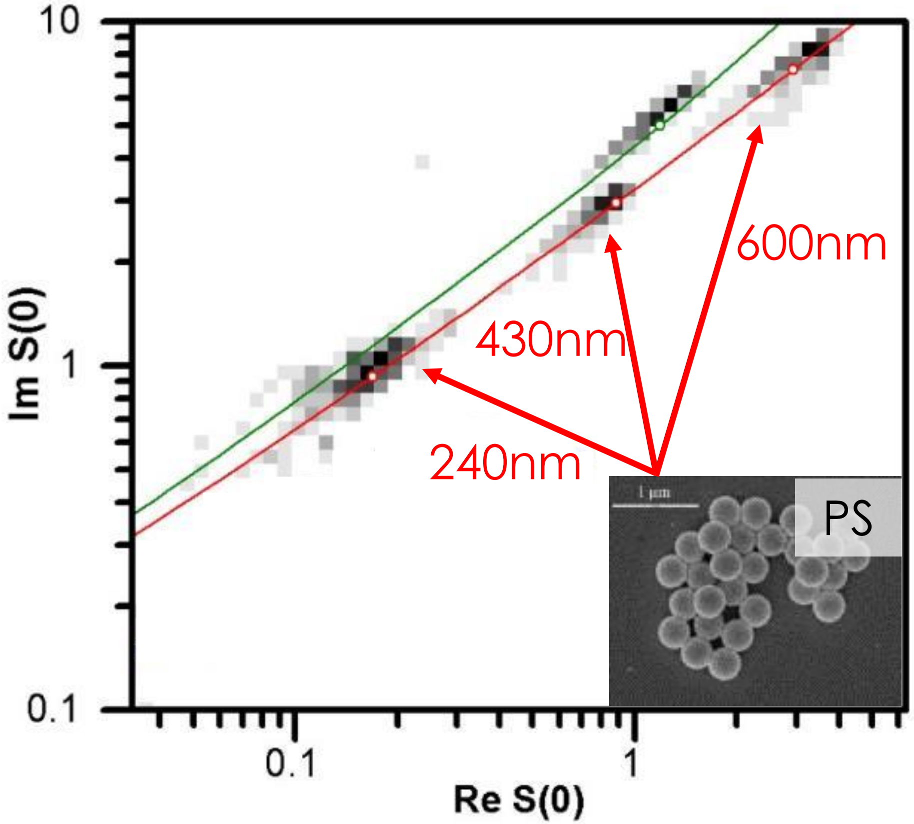
SPES graphical scheme

SPES is able to detect two different properties of each analyzed particle

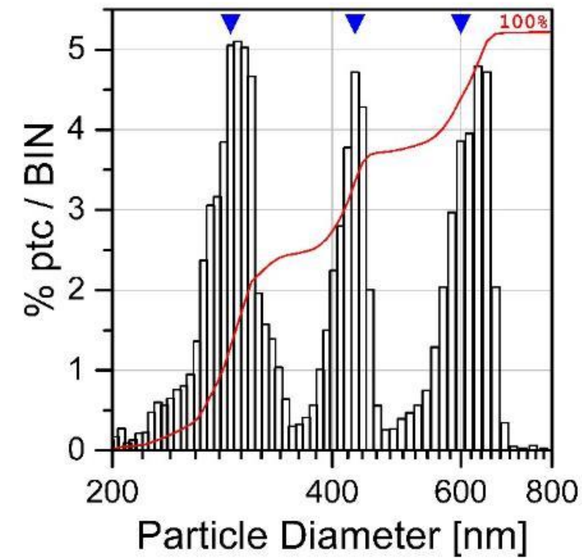


SPES distinguishes between size

SPES is able to discriminate particles with different size of the same material



same material, different size

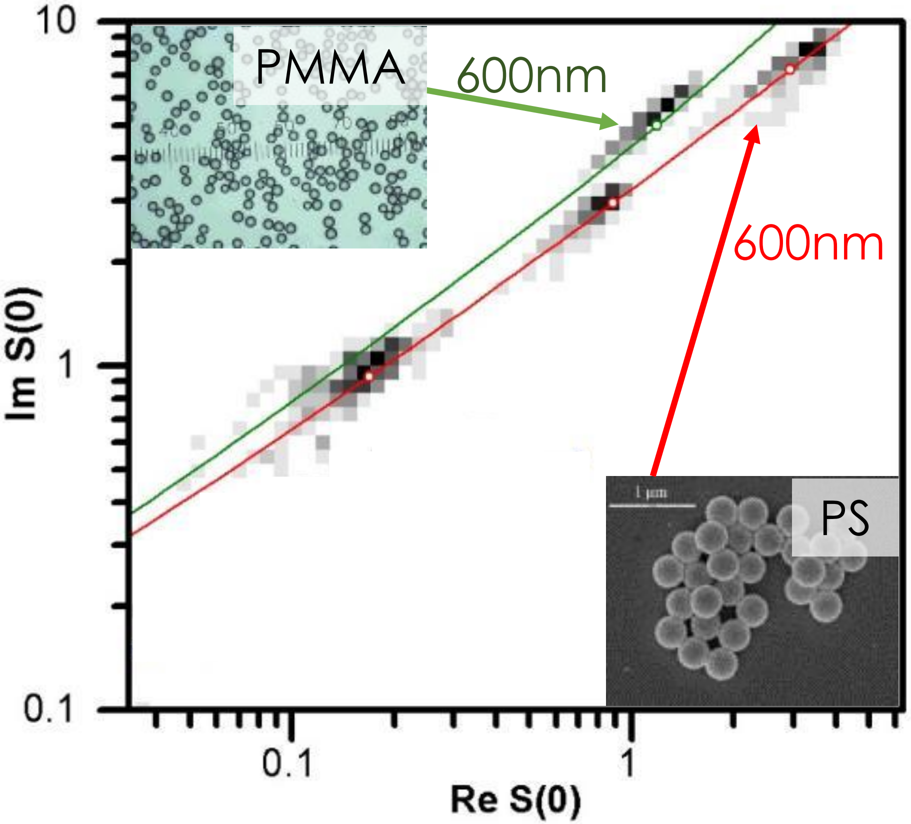


Polystyrene (PS) particles size distribution

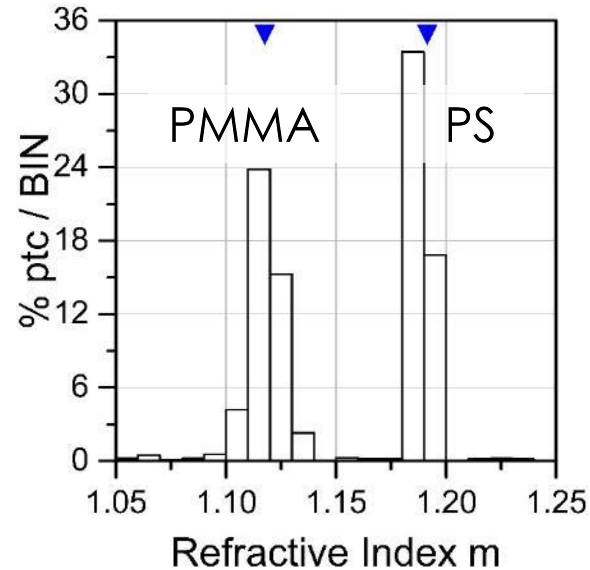
Potenza MAC, Sanvito T, Pullia A, "Measuring the complex field scattered by single submicron particles", AIP Advances 5 (2015)

SPES distinguishes between materials

SPES is able to discriminate particles with the same size of different material



same size, different material

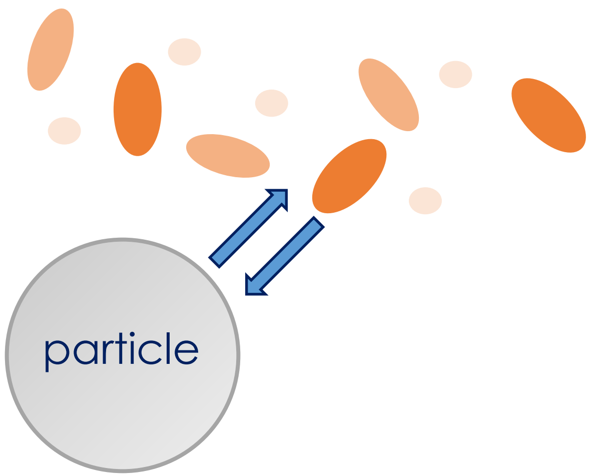


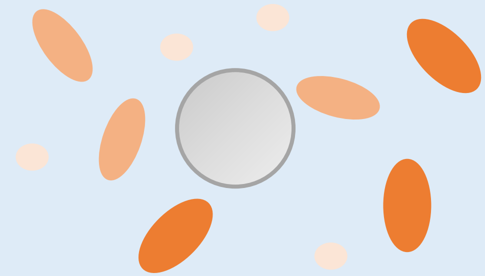
Polystyrene (PS) and Poly(methyl methacrylate) (PMMA) particles refractive index distribution

Potenza MAC, Sanvito T, Pullia A, "Measuring the complex field scattered by single submicron particles", AIP Advances 5 (2015)

Challenges: particles and complex fluids

Complex
medium
components





Understand particles fate and stability

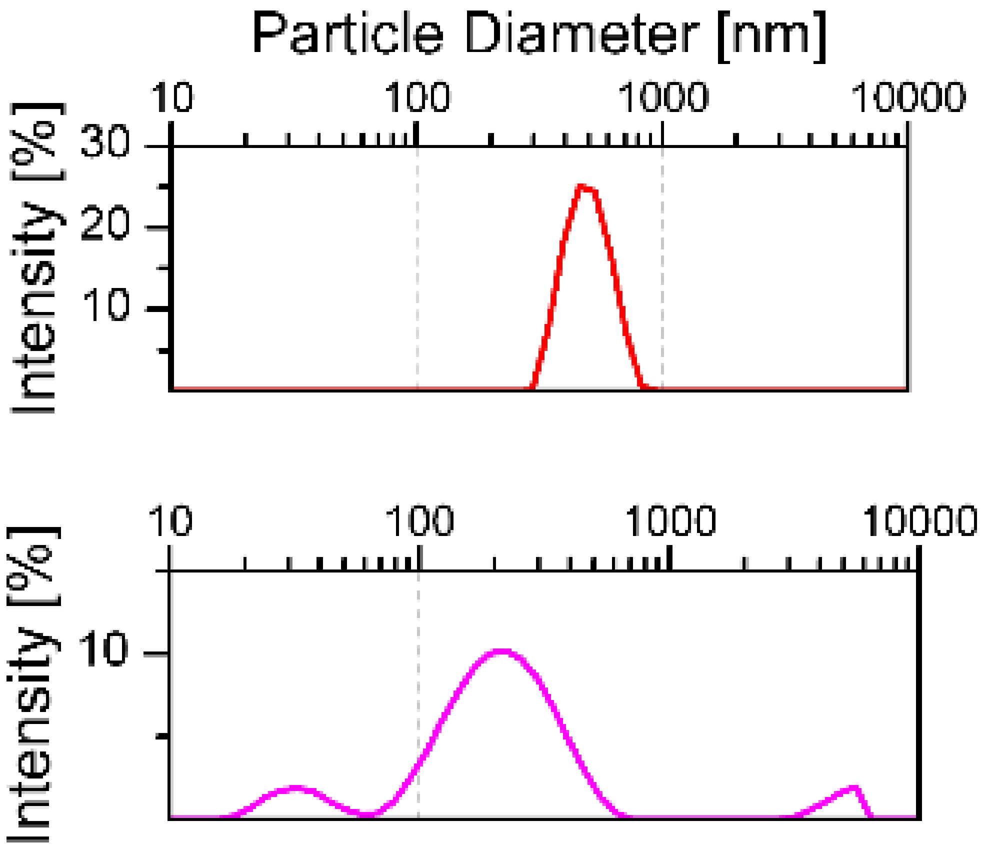
Discriminate particles from the medium components

Study the particle shape influence

Distinguish particles with different shapes

DLS failed analysis in mouse serum

DLS is not able to distinguish between PS particles and serum components



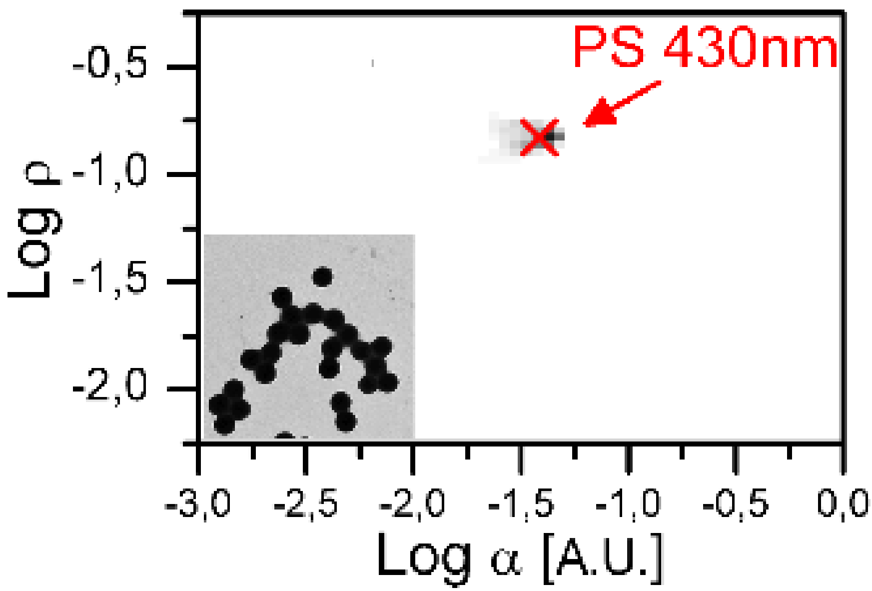
DLS analysis of PS particles (430nm) in water

DLS analysis of PS particles (430nm) in mouse serum

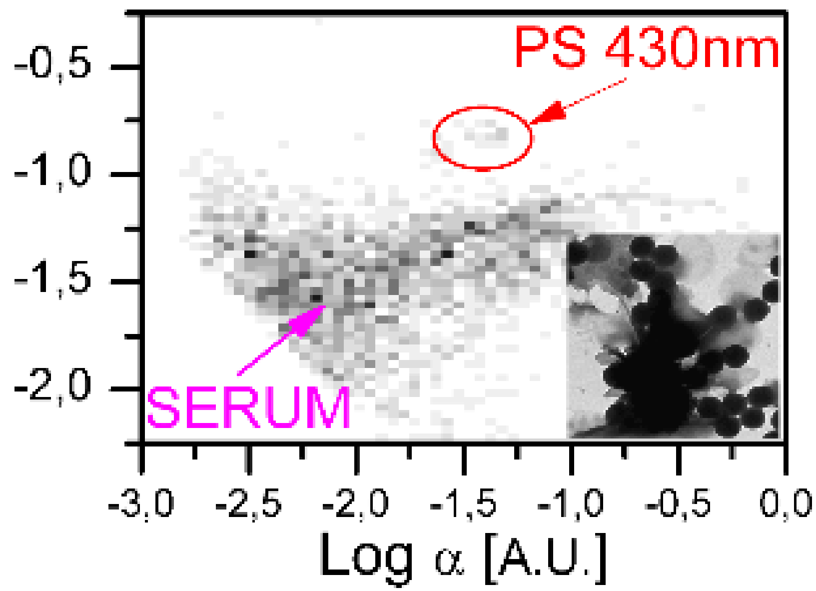
Sanvito T, Bigini P, Cavanna MV, Fiordaliso F, Violatto M, Talamini L, Salmona M, Milani P, Potenza MAC
Nanoscale (under submission)

SPES analyzes particles in mouse serum

SPES easily discriminates between PS particles and serum components



SPES analysis of PS particles (430nm) in water

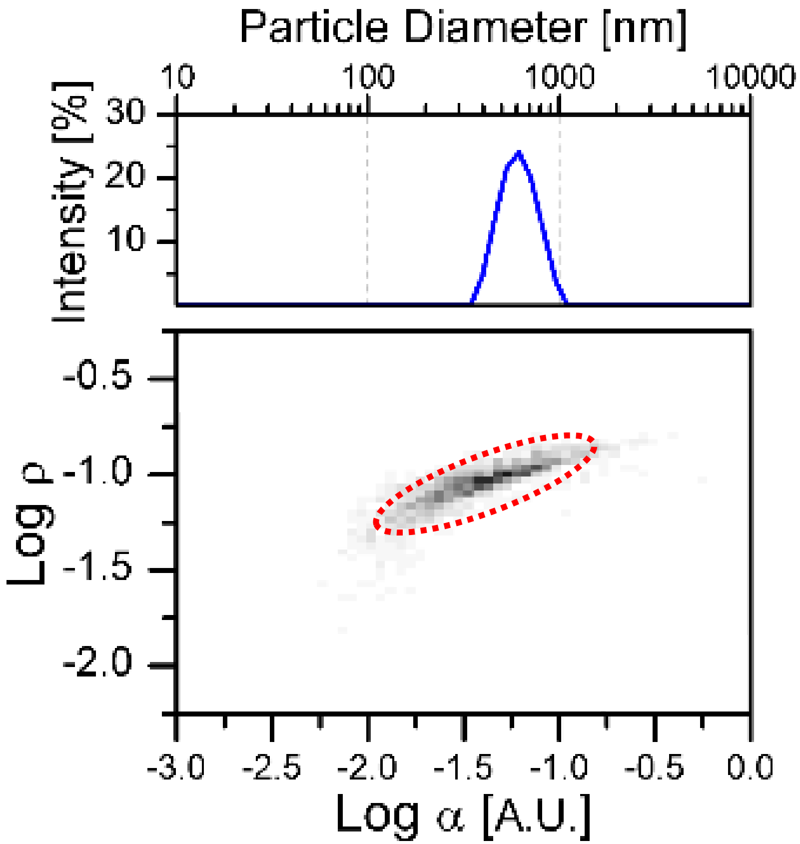


SPES analysis of PS particles (430nm) in mouse serum

Sanvito T, Bigini P, Cavanna MV, Fiordaliso F, Violatto M, Talamini L, Salmona M, Milani P, Potenza MAC
Nanoscale (under submission)

SPES recognizes PLGA particles

SPES discriminates between polydisperse poly(lactic-co-glycolic)acid PLGA particles and serum components



DLS analysis

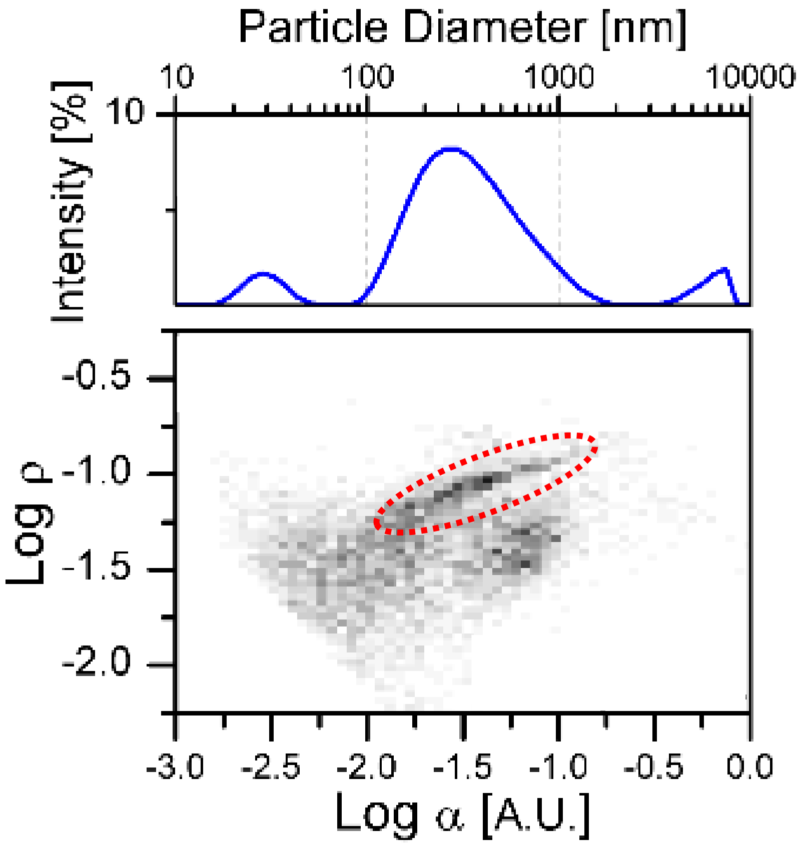
SPES analysis

- **Mouse serum**
- **PLGA 4.1E6 ptc/mL**

Sanvito T, Bigini P, Cavanna MV, Fiordaliso F, Violatto M, Talamini L, Salmona M, Milani P, Potenza MAC
Nanoscale (under submission)

SPES works at low concentration

SPES discriminate PLGA particles and serum components, even at very low concentration, where DLS fails



DLS analysis

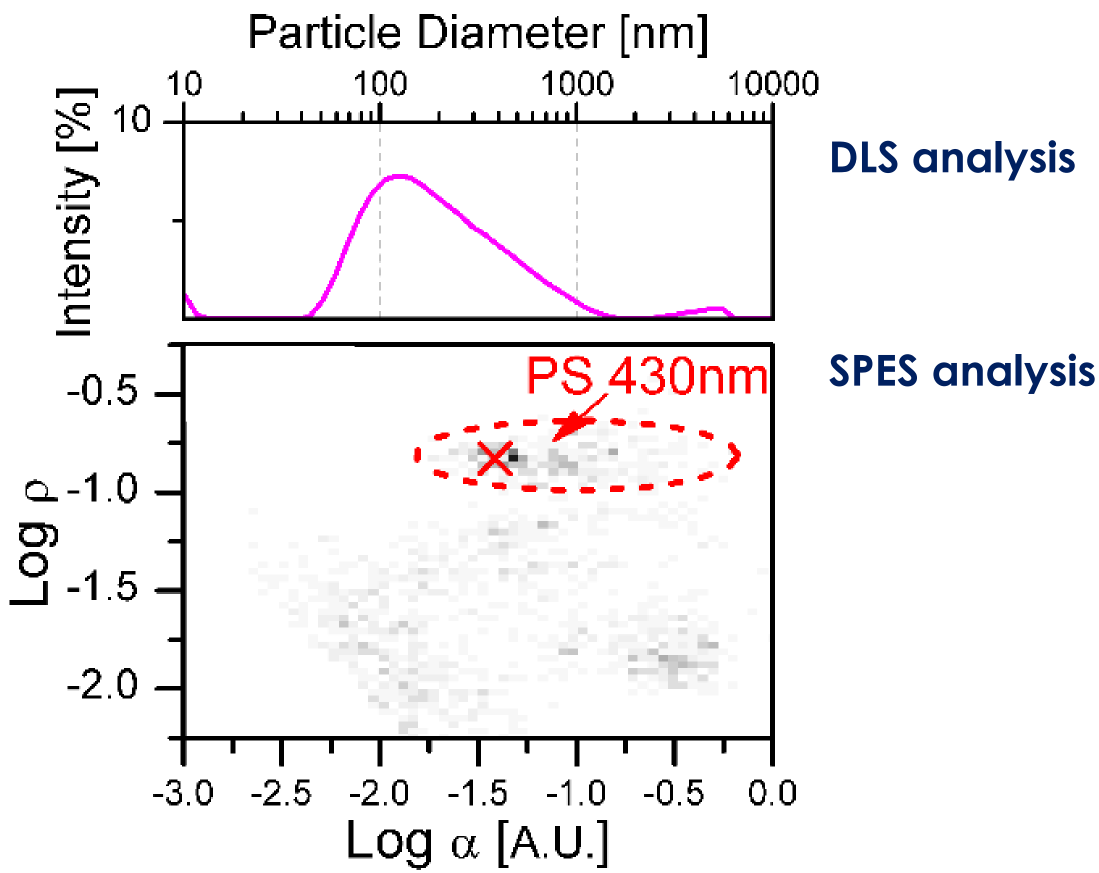
SPES analysis

- **Mouse serum**
- **PLGA 1.1E5 ptc/mL**

Sanvito T, Bigini P, Cavanna MV, Fiordaliso F, Violatto M, Talamini L, Salmona M, Milani P, Potenza MAC
Nanoscale (under submission)

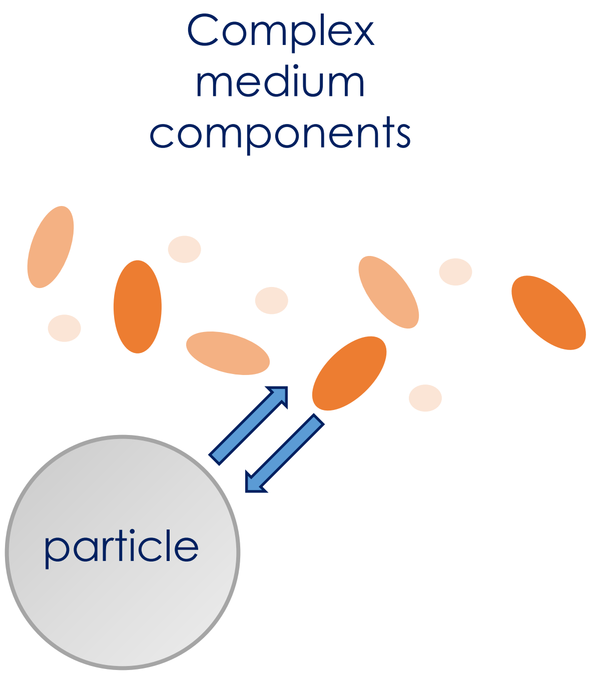
SPES analyzes particles in whole blood

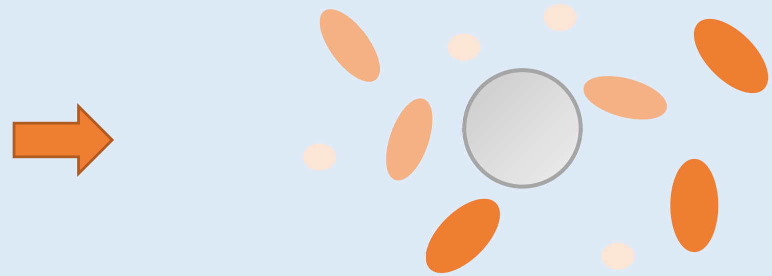
SPES ability to detect PS particles in medium as complex as whole blood opens opportunity for understanding interaction between particles and biocomponent



Sanvito T, Bigini P, Cavanna MV, Fiordaliso F, Violatto M, Talamini L, Salmona M, Milani P, Potenza MAC
Nanoscale (under submission)

Challenges: particles and complex fluids





Understand particles fate and stability

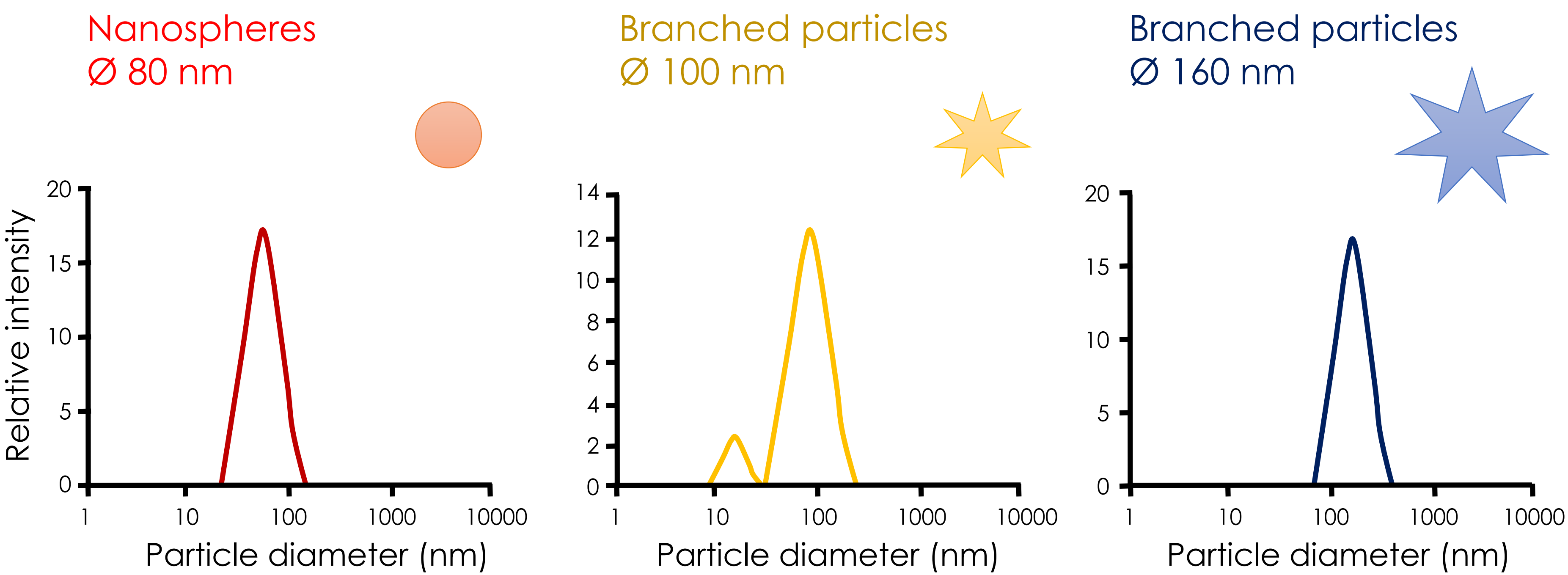
**Discriminate particles
from the medium components**

Study the particle shape influence

**Distinguish particles
with different shapes**

DLS is not able to distinguish particle shape

DLS gives information on the particles size and size distribution of gold particles but is unable to distinguish between particles shape

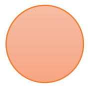


DLS analysis

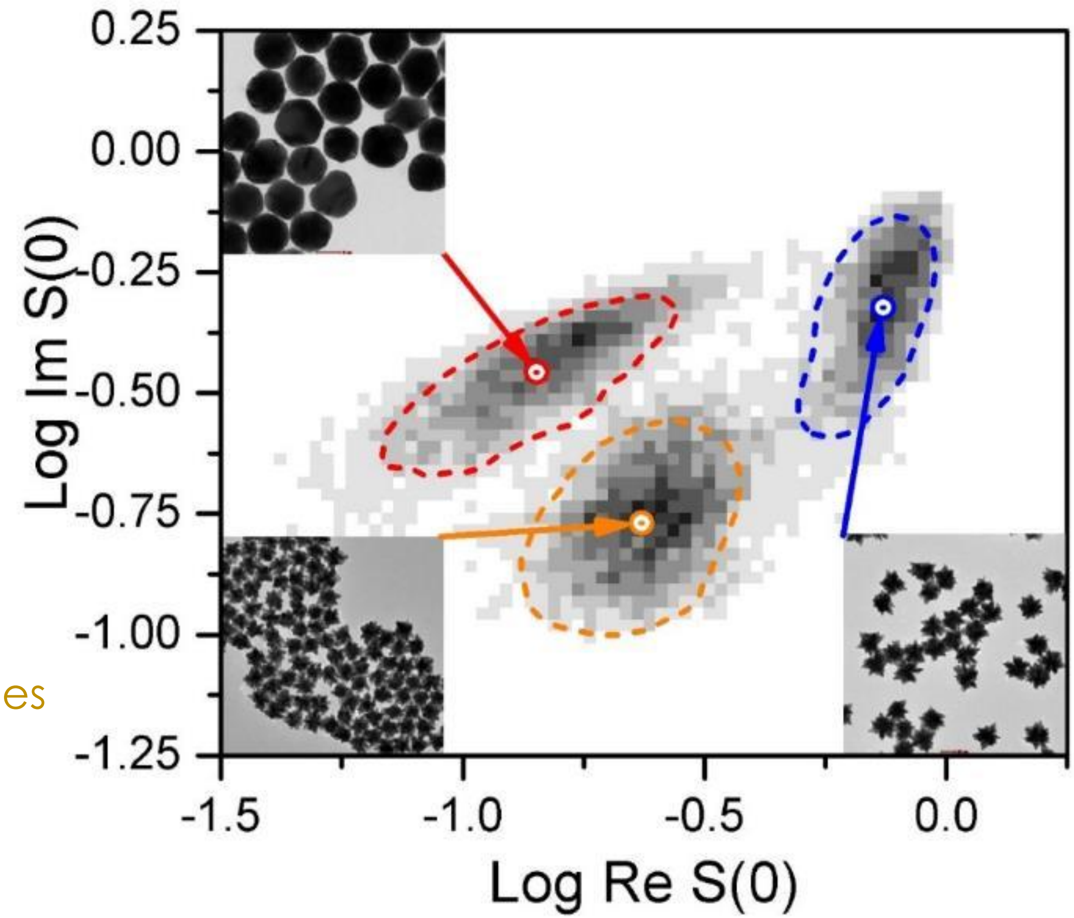
Potenza MAC, Krpetic Z, Sanvito T, Cai Q, Monopoli M, de Araújo J, Cella C, Boselli L, Castagnola V, Milani P, Dawson K
Nanoscale (submitted)

SPES discriminates particles with different shape

Differences of the surface plasmon resonance are detected by SPES that is able to distinguish different shape of gold particles



Nanospheres
Ø 80 nm



Branched particles
Ø 100 nm

Branched particles
Ø 160 nm

SPES analysis

Potenza MAC, Krpetic Z, Sanvito T, Cai Q, Monopoli M, de Araújo J, Cella C, Boselli L, Castagnola V, Milani P, Dawson K
Nanoscale (submitted)

Conclusions

- SPES is able to discriminate polymeric particles from the components of complex medium, even at very low particles concentration

➡ Understand particles fate and stability in real systems

- SPES is able to distinguish gold particles with different size and shapes

➡ Study the particle shape influence

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viale Ortles 22/4, 20139 Milano (Mi) – Italy
E-Mail: claudia.cella@eosinstruments.com

Thank you all for your attention