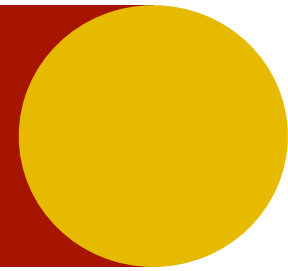


# The MultiScan MS 20

- Base unit MS 20
- IR and UV light sources
- Power supply & control electronics
- Touch display
- Status information
- Control of primary function
- Open/close of sample chamber lids
- Activate/deactivate barcode reader
- Barcode reader
- For fast & distinct sample registration
- Up to 6 scan towers ST-TEC
- Thermostatable measuring chamber
- Scanning plate for optical analysis...



# How it works ?



Studying the interaction of light (electromagnetic radiation) with a sample in order to deduce sample properties...

## Optical analysis

- signal measured at the detector is determined by
  - number (→ concentration),
  - size,
  - and type (→ the refractive index)of the particles (solid particles, droplets, gas bubbles) in the sample...

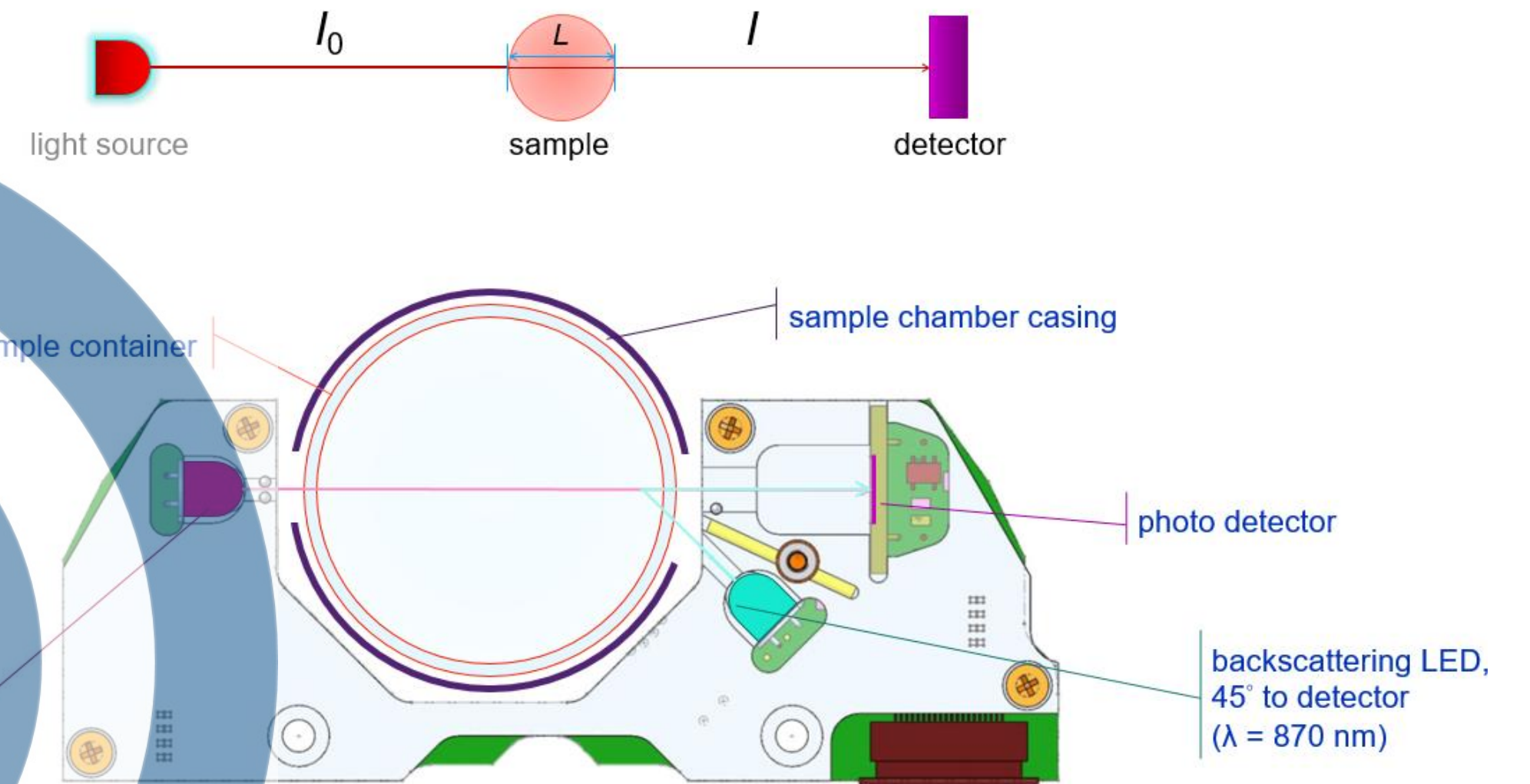
→ scattering theory (Mie) allows calculating the transmission and backscattering based on these parameters...

- transmission:  $T = \frac{I}{I_0} = e^{-L/l}$  (Lambert-Beer law)
- backscattering:  $BS \propto \sqrt{\frac{1}{l^*}}$

$l/l^*$ : mean free path / decorrelation length for scattering which are elaborate functions of:

- concentration (volume concentration  $\phi$ )
- particle size (diameter  $d$ )
- refractive indices of particles and dispersion medium ( $n_p, n_m$ )

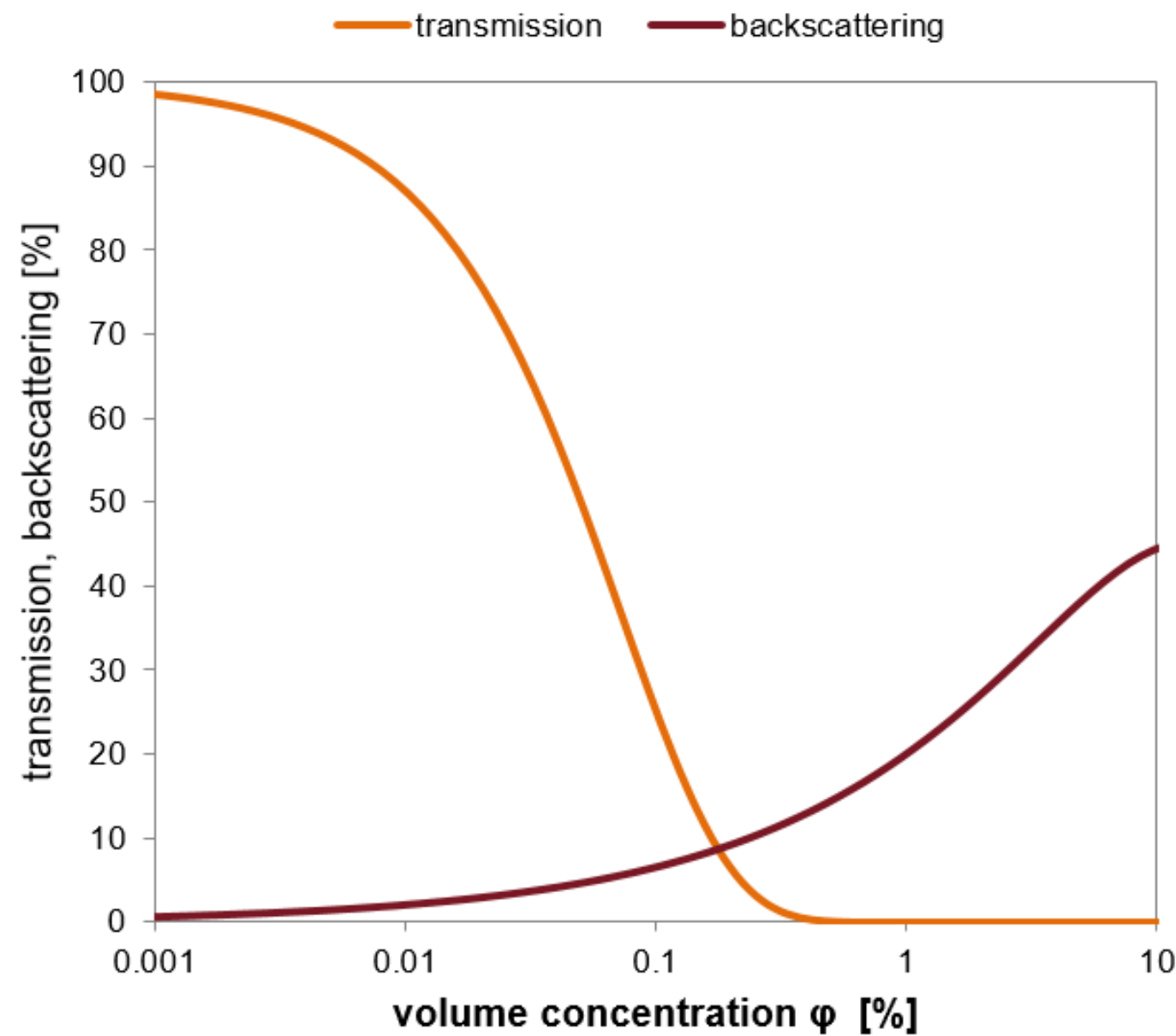
## set-up of the MS 20 scanning plate



# How it works ?

## Concentration dependence

silica particles ( $\varnothing$  0.3  $\mu\text{m}$ ) in water

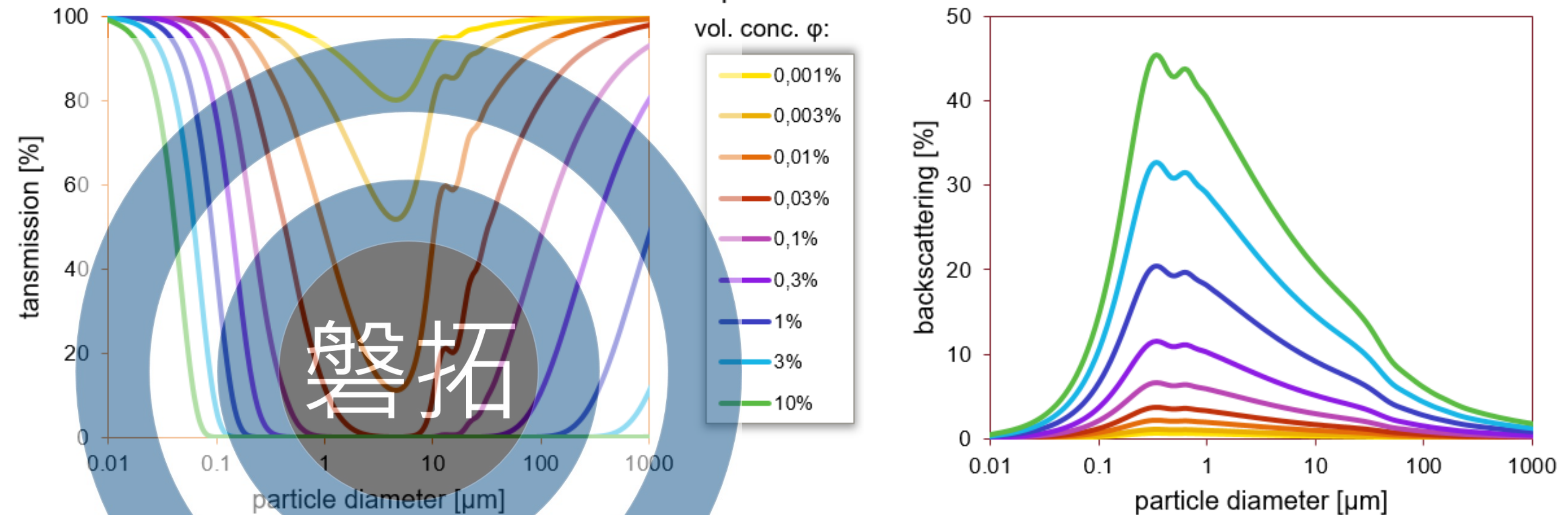


increasing volume concentration  $\varphi$ :

- transmission decreases
  - more and more particles obstruct light passage
- backscattering increases
  - more particles → higher backscattering potential

## Particle size dependence

silica particles in water



- at constant volume concentration  $\varphi$  the number of particles decreases with increasing particle diameter!
- first particles become big enough to be encountered by the incident light
  - decreasing transmission, increasing backscattering
- then there are big but merely few particles and light is likely to just pass by
  - increasing transmission, decreasing backscattering

# How it works ?

## Destabilisation mechanisms of fluid mixtures

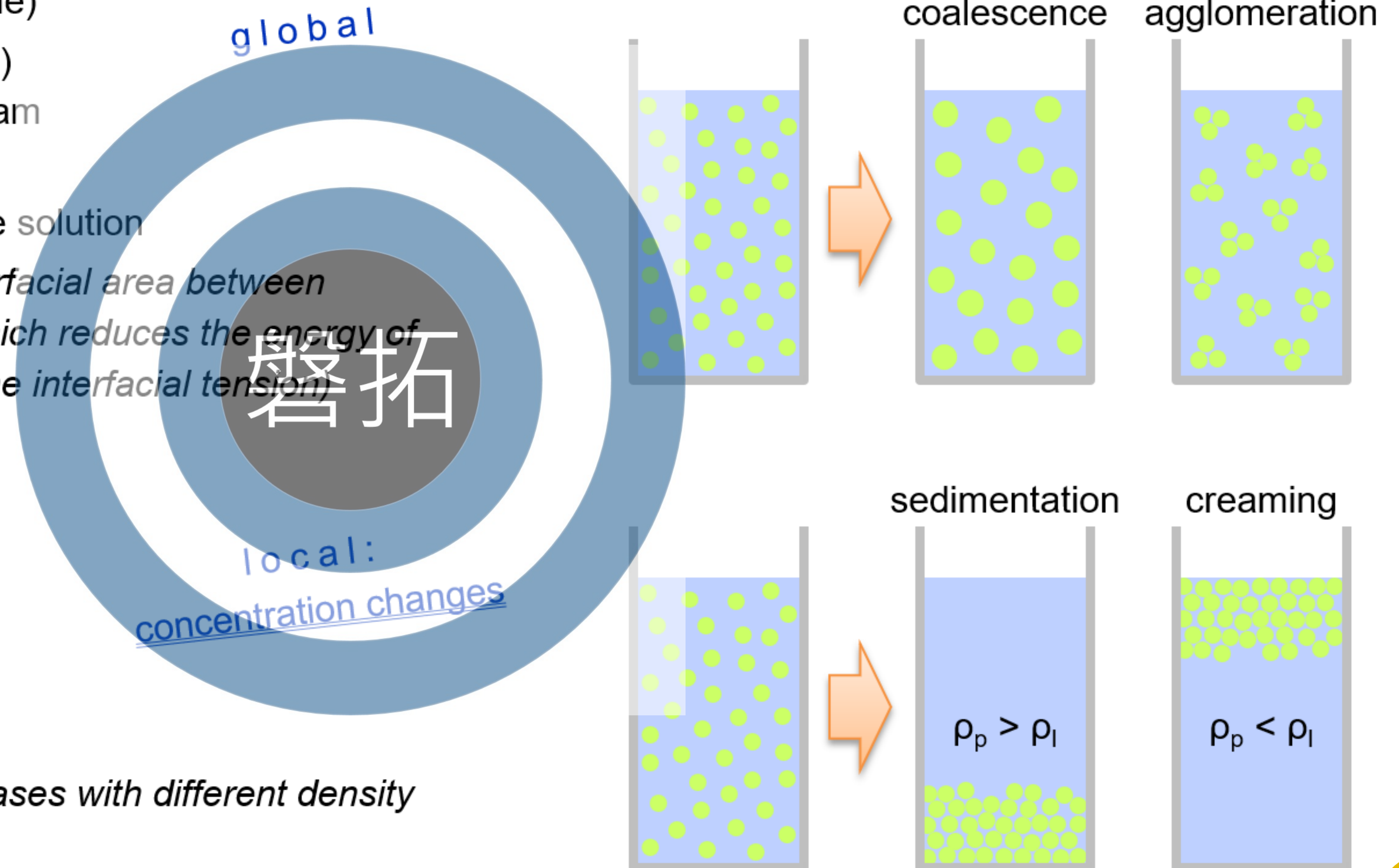
- particle size increase (often irreversible)
  - coalescence (merging of particles)  
e.g. breakup of an emulsion or foam
  - agglomeration, aggregation  
e.g. precipitation of salt from brine solution

*driving force: reduction the of interfacial area between different phases (which reduces the energy of the system due to the interfacial tension)*

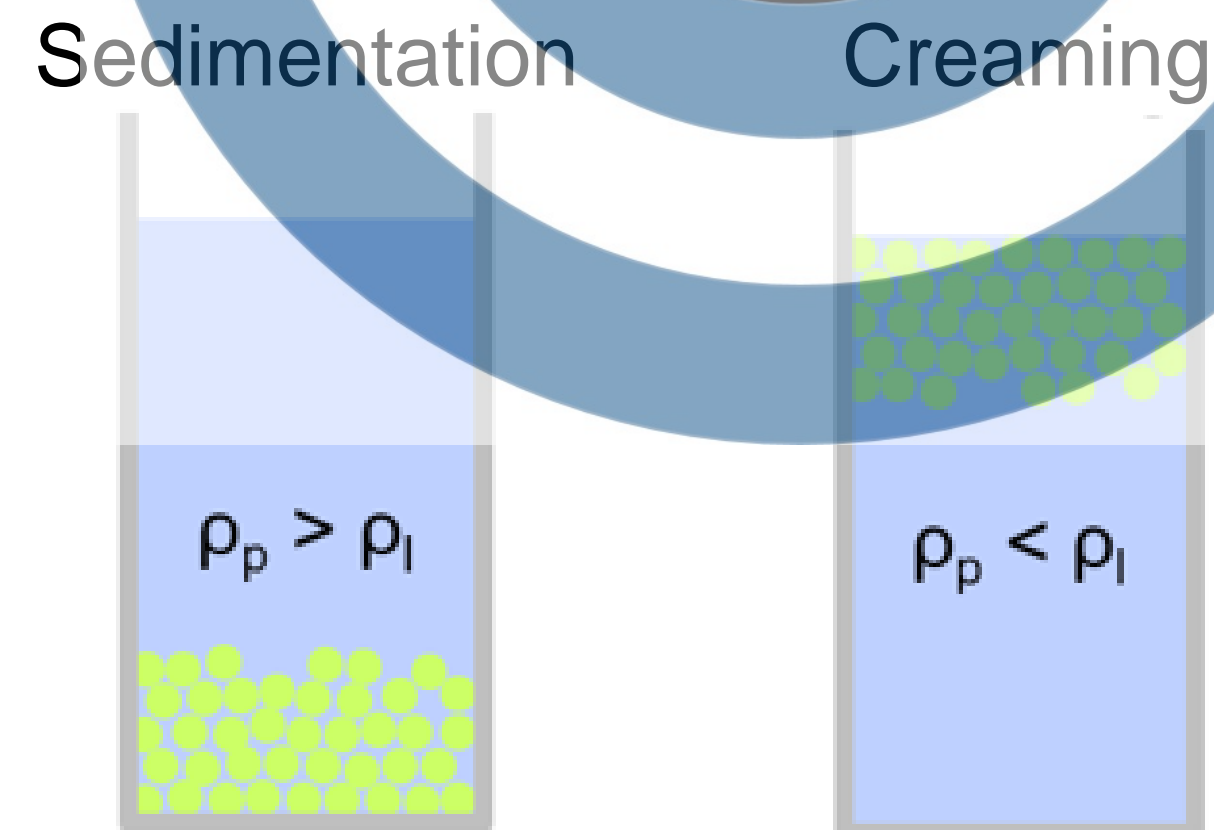
- particle migration (usually reversible)
  - sedimentation  
e.g. solid particles in slurry
  - creaming  
e.g. fat droplets in milk

*driving force: gravity acting on phases with different density*

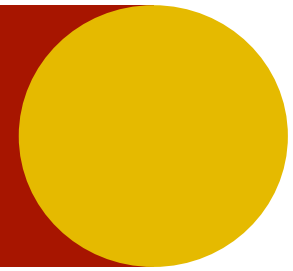
- both mechanisms are recognized by optical analysis!



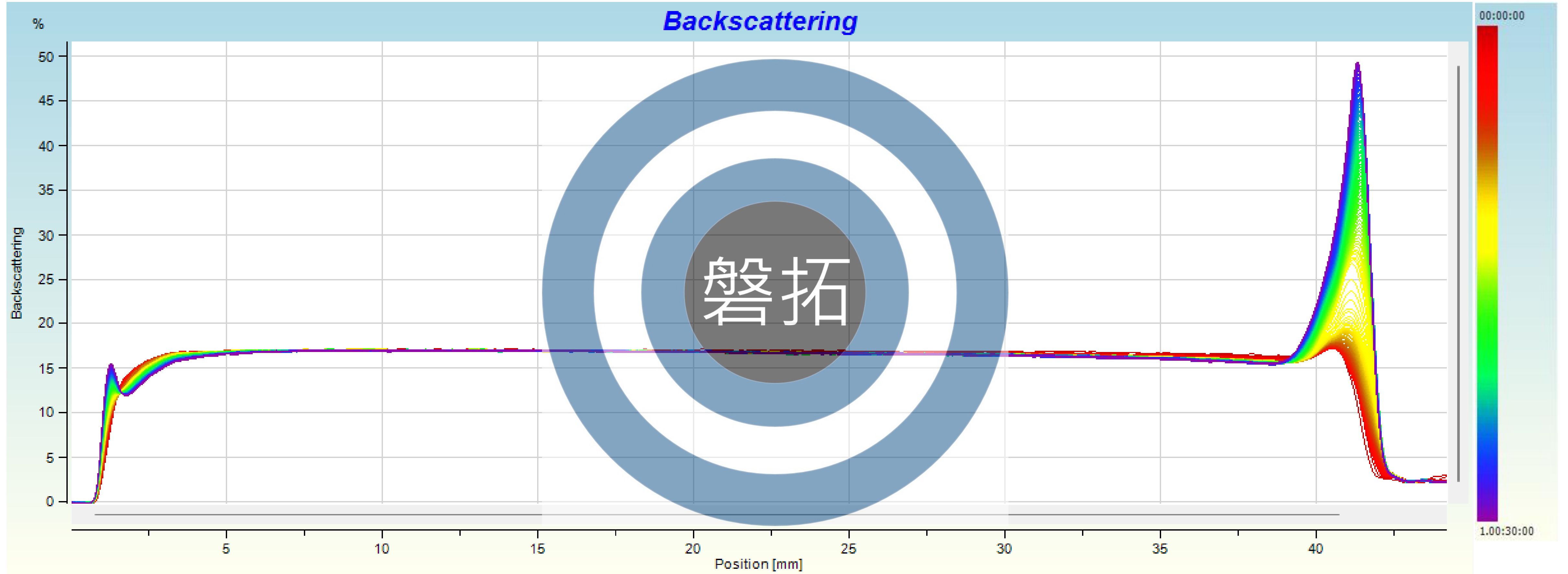
- I. Backscattering data : 背向光原始數據
- II. Delta Backscattering data : 分析結果和第一次掃描的相對變化量
- III. Stability Index: 比較樣品變化量以判定分散優劣
- IV. Backscattering Mean value 背向光平均值比較
- V. Sedimentation Peak Area 底部沉積層峰域面積比較



# Result



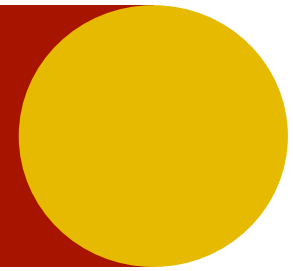
## I. Backscattering data : 背向光數據 Sample\_0411



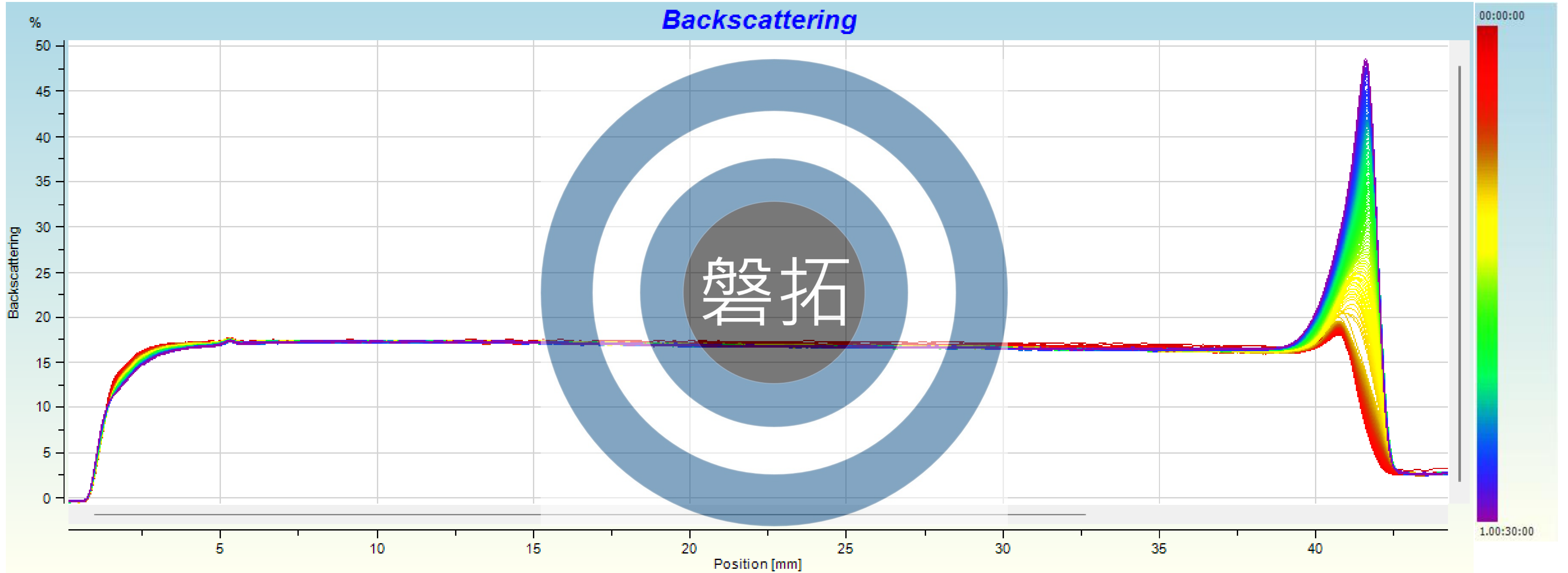
Bottom

Top

# Result



## I. Backscattering data : 背向光數據 Sample\_0603



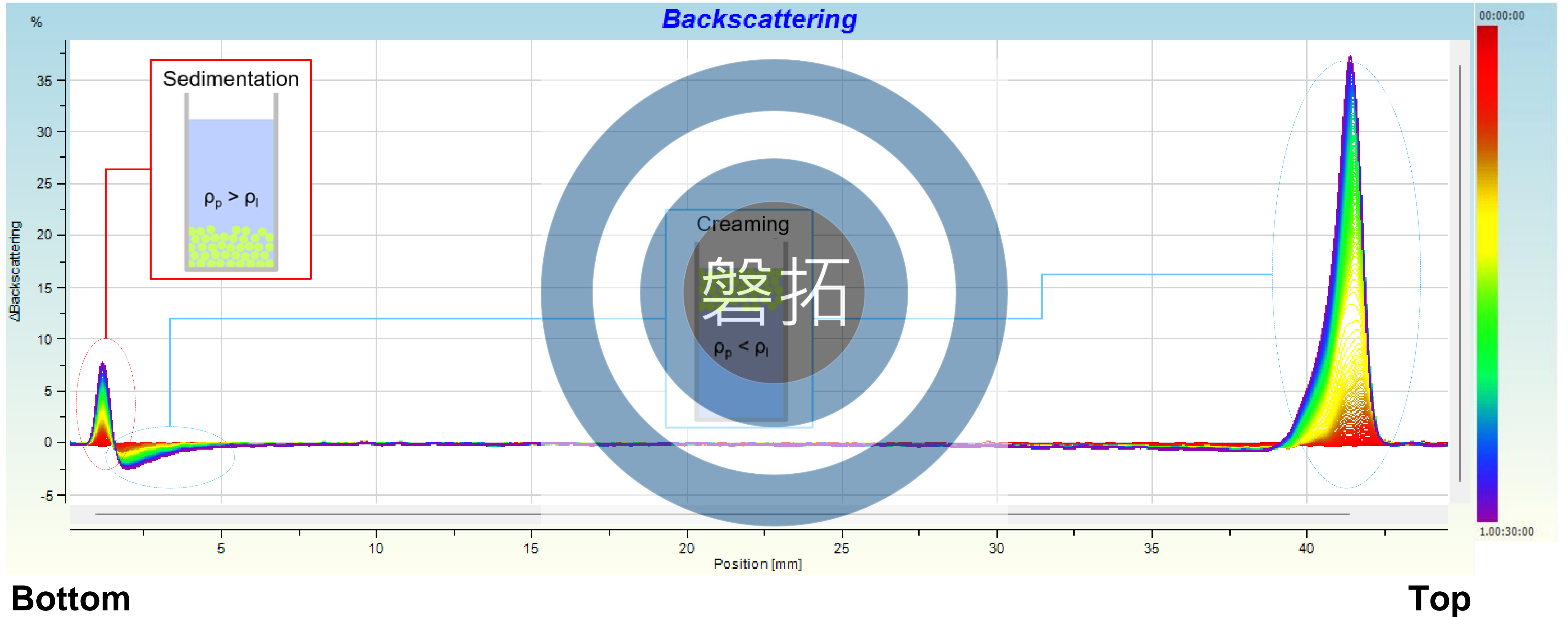
Bottom

Top

# Result

## II. $\Delta$ Backscattering : 分析結果和第一次掃描的相對變化量

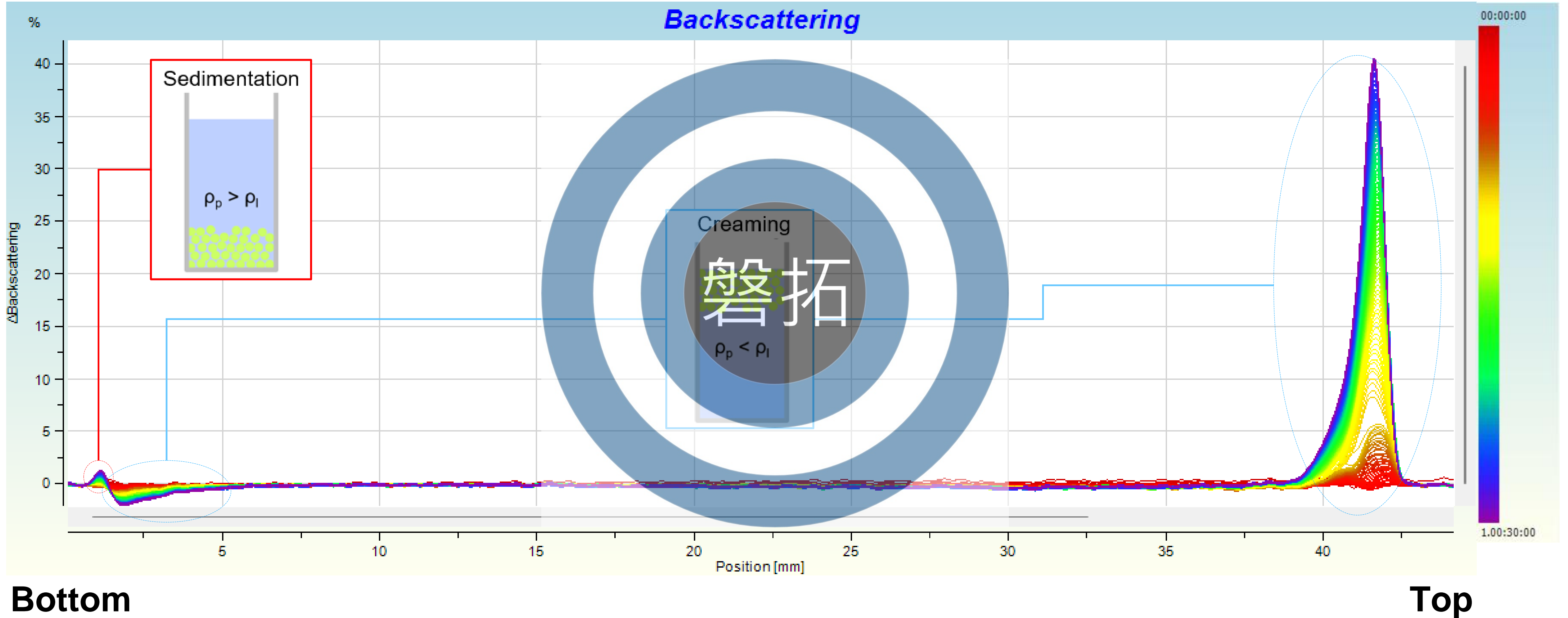
### Sample\_0411



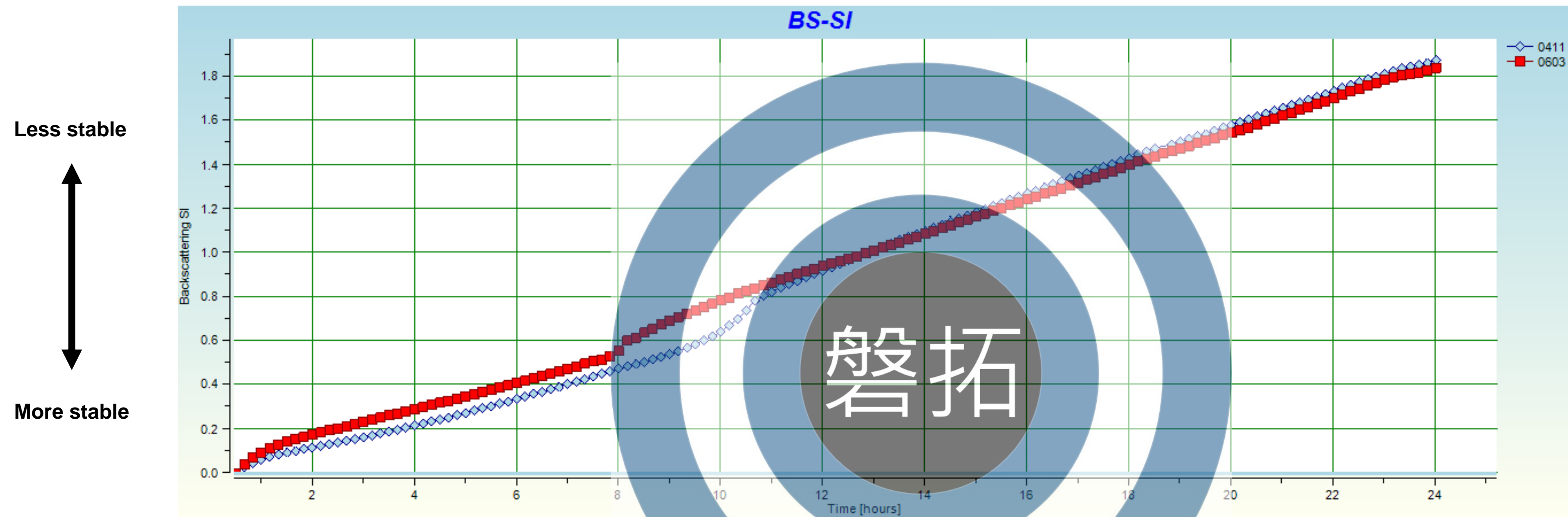
# Result

## II. $\Delta$ Backscattering : 分析結果和第一次掃描的相對變化量

### Sample\_0603



## III. Stability Index (比較樣品變化量以判定分散優劣)



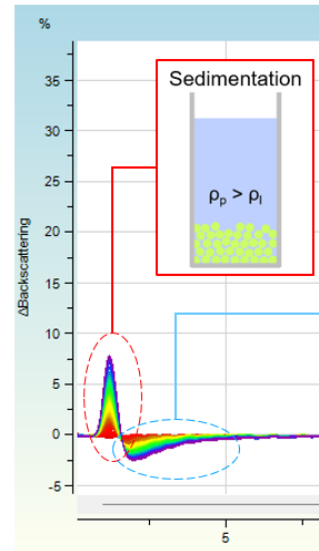
Stability Index	6hrs	12hrs	18hrs	24hrs
0411	0.34	0.92	1.42	1.87
0603	0.40	0.93	1.39	1.84

❖ 整體變化量相當接近

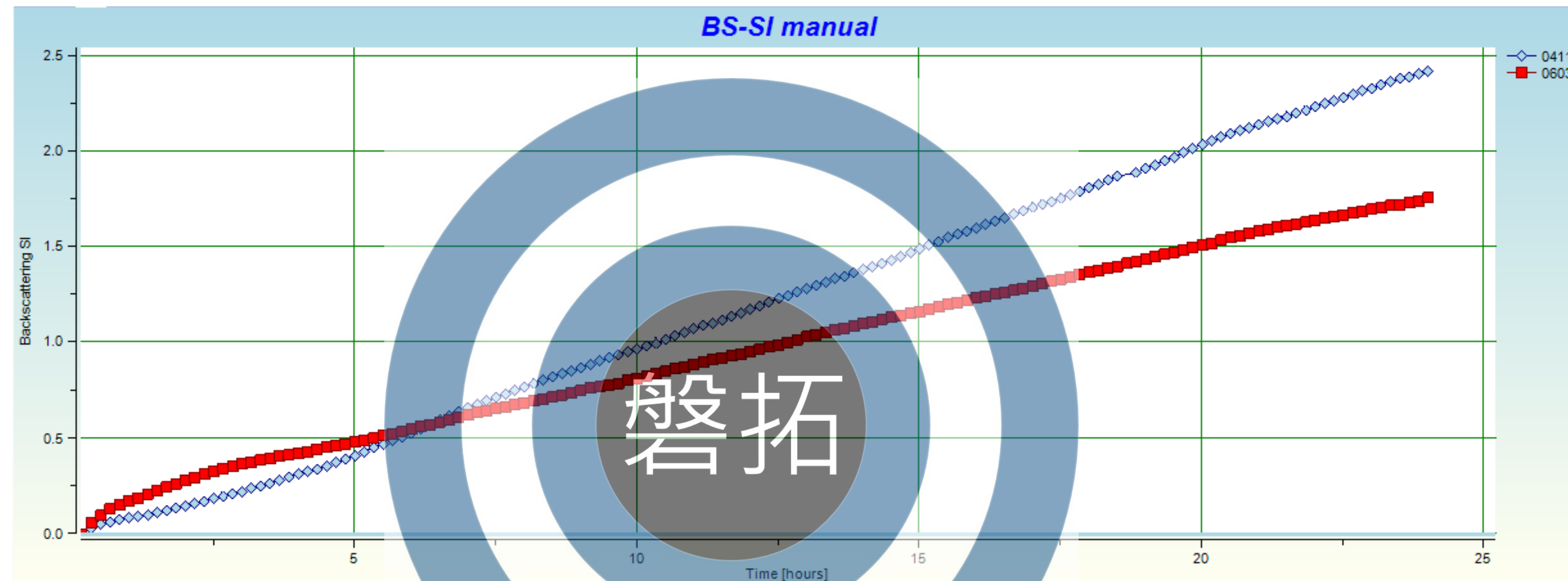
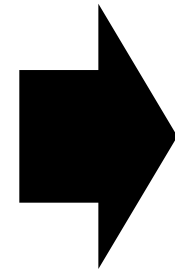
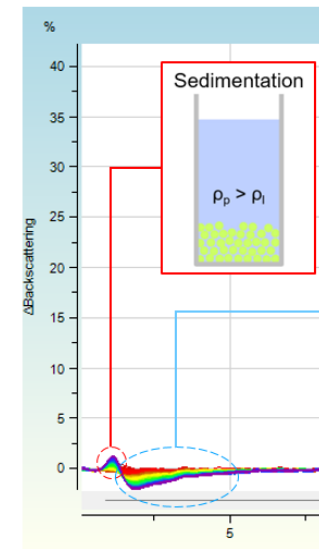
# Result

## III. Stability Index (Bottom Sedimentation) 底部沉積層變化

0411



0603

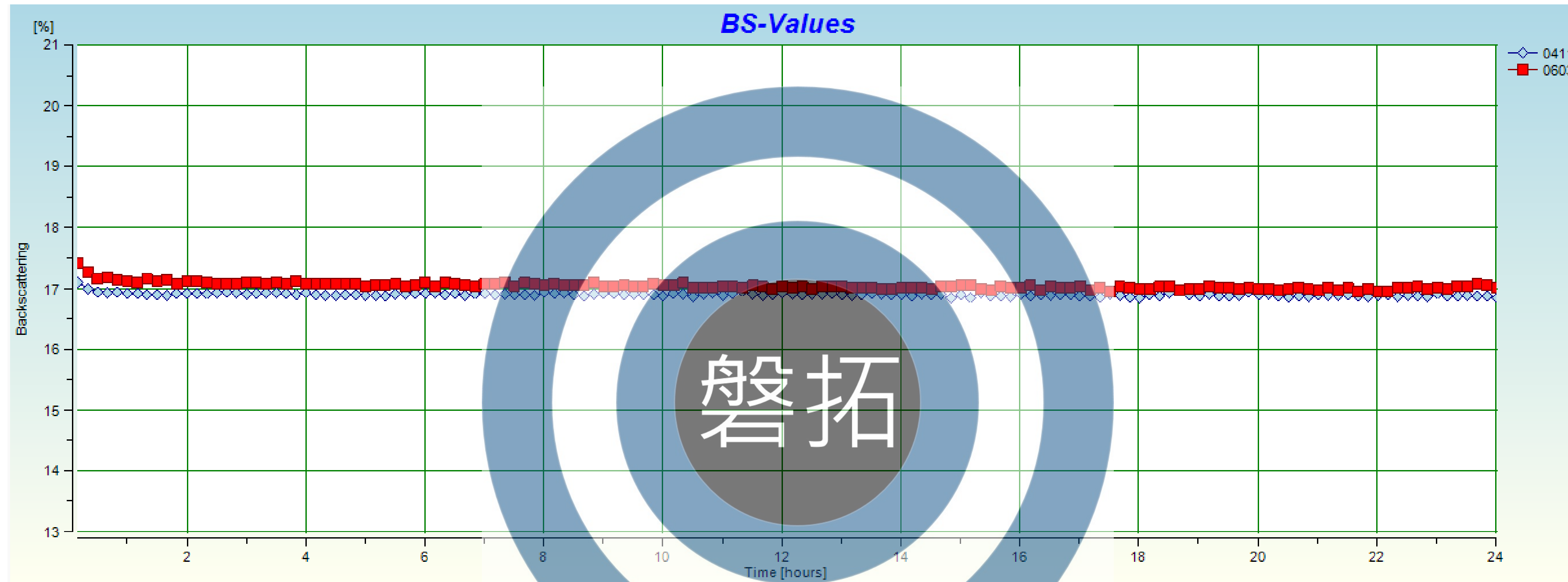


Stability Index	6hrs	12hrs	18hrs	24hrs
0411	0.53	1.17	1.81	2.41
0603	0.54	0.95	1.37	1.75

❖ 底部沉積層變化量，0411明顯較0603大

## IV. Backscattering Mean value (Refer to page 3)

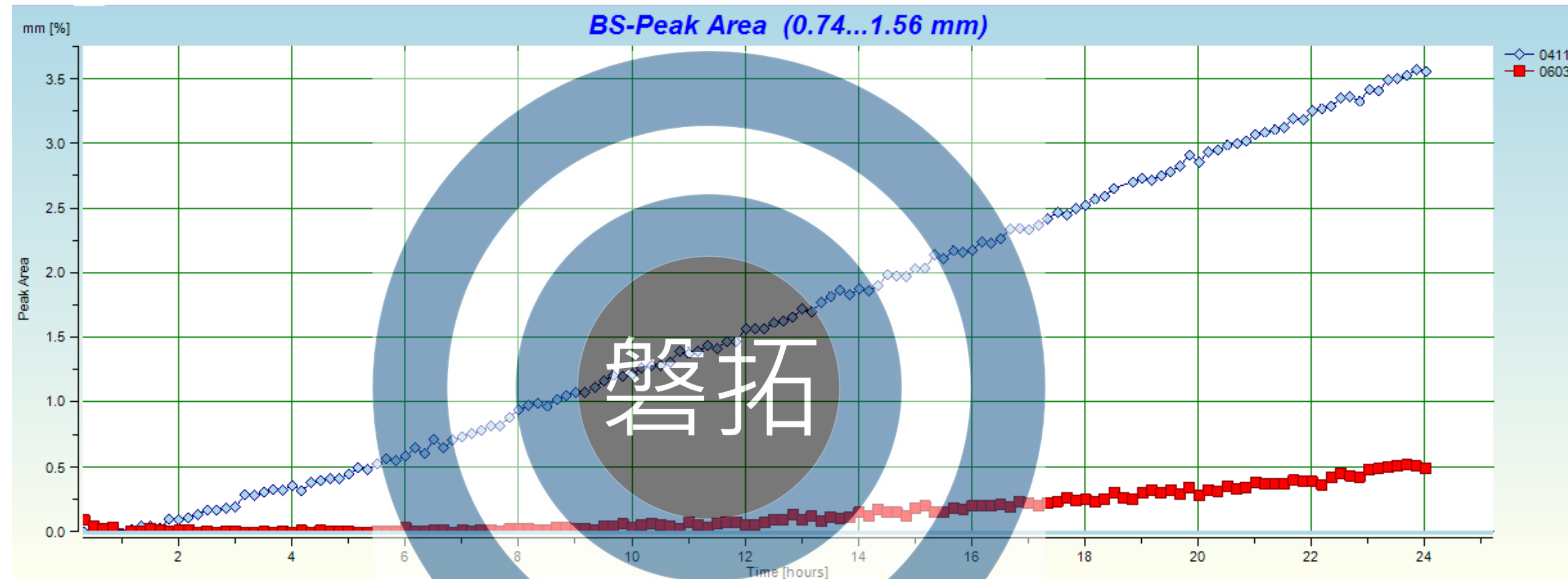
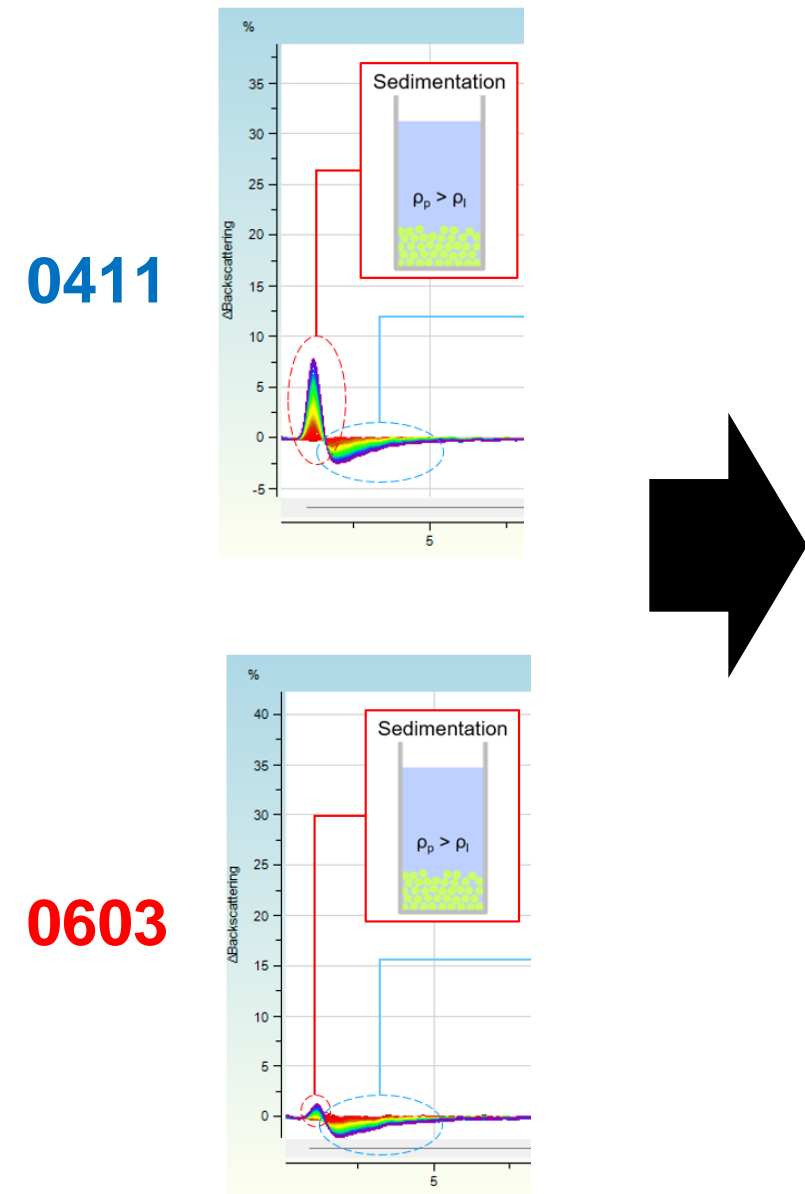
背向光平均值 = 樣品身分證 (對應樣品特性、添加物、濃度、粒徑)



BS-Value (Sample A)	0hr	6hrs	12hrs	18hrs	24hrs
<b>Tower 1</b>	17.11 %	16.92 %	16.93 %	16.85 %	16.86 %
<b>Tower 2</b>	17.43 %	17.10 %	17.04 %	17.00 %	17.06 %

# Result

## V. Sedimentation Peak Area 底部沉積層峰域面積比較



Sedimentation Peak Area	6hrs	12hrs	18hrs	24hrs
0411	0.59 mm [%]	1.57 mm [%]	2.53 mm [%]	3.55 mm [%]
0603	0.04 mm [%]	0.06 mm [%]	0.25 mm [%]	0.51 mm [%]

❖ 底部沉積層峰域面積，0411明顯較0603大

# Summary

- The Stability Index method revealed strong differences between the tested samples.
- Based on the Mie theory and Stokes law, the mean particle can be studied easily
- The results of the studies using IR towers are consistent
- MS 20 proved to be a convenient solution for measuring the stability differences of the tested samples.

