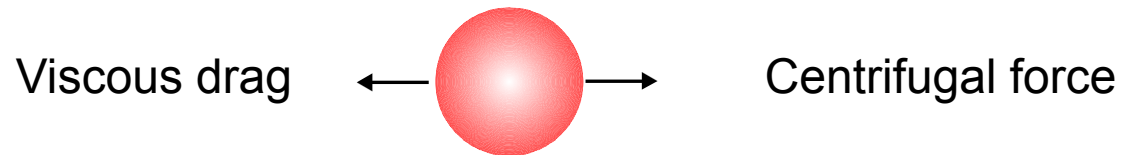


# Centrifugation sedimentation

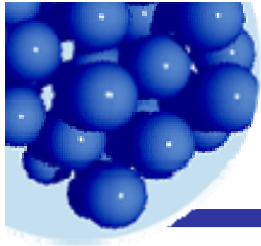


The centrifugal force on a particle is:  $F_{\text{centrifugal}} = \frac{4}{3} \pi R^3 \Delta \rho \omega^2$  5

The viscous drag is:  $F_{\text{drag}} = 6 \pi \eta R v$

The steady velocity is:  $v = \frac{2}{9} \frac{\Delta \rho R^2 \omega^2}{\eta}$  5

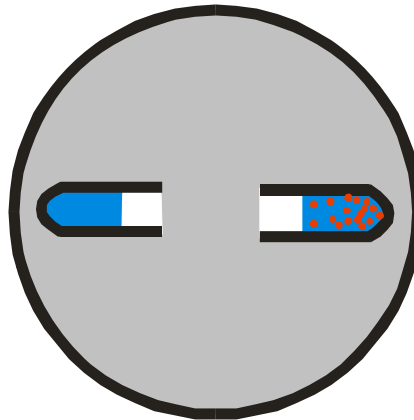
$R$  is the radius of the centrifuge  
 $\omega$  is the angular velocity (radian/sec)



# Centrifugation

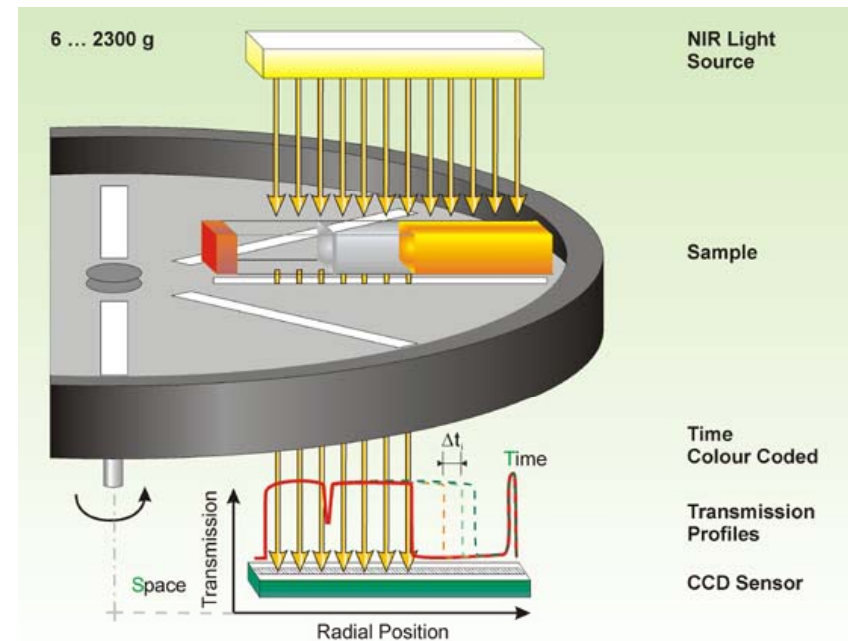
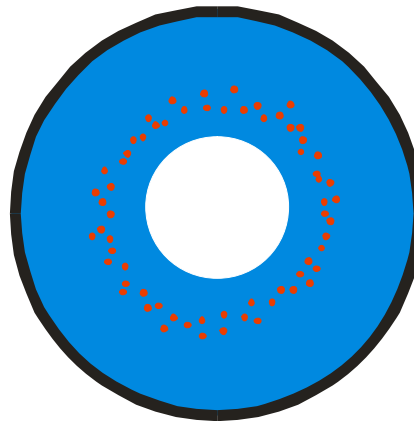
Homogeneous  
start

Gives cumulative  
distribution.

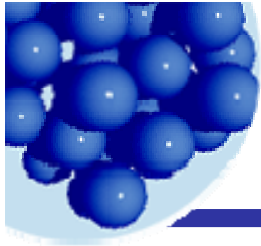


Line start

Gives size  
distribution.

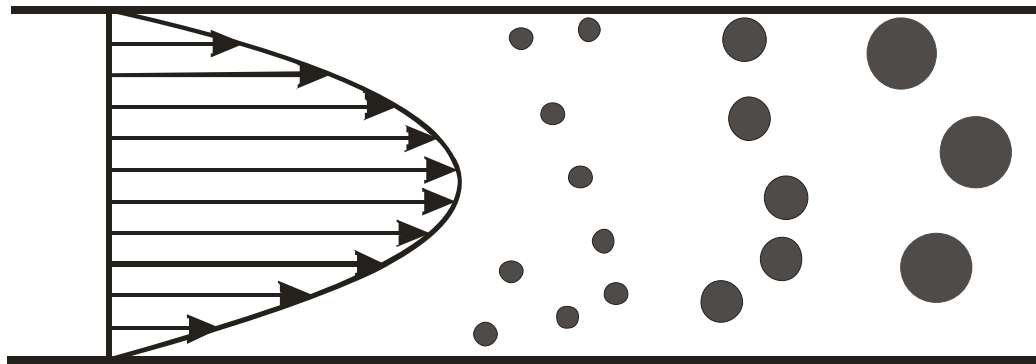


[www.lum-gmbh.com](http://www.lum-gmbh.com)



# Hydrodynamic chromatography

Separation of particles in a liquid flowing in a tube:

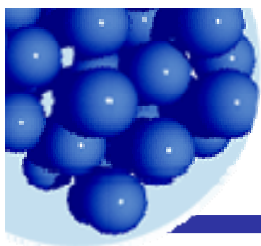


The liquid is moving slowest near the walls.

Next to the wall, the smaller the particle, the slower it moves.

Therefore, the smallest particles exit last.

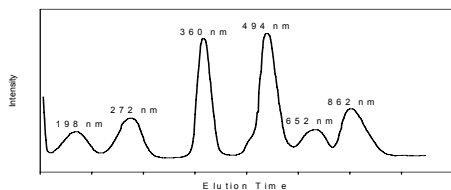
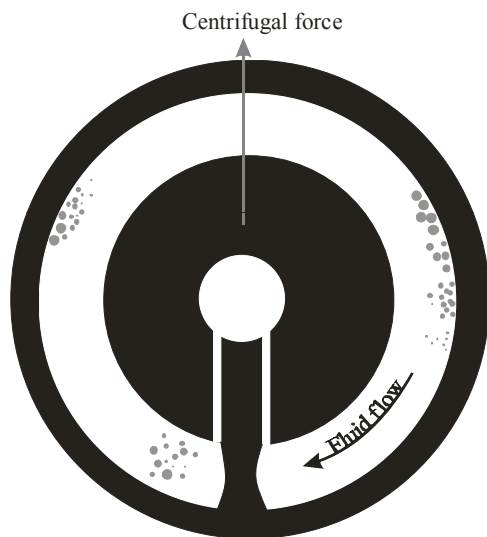
Real size distributions. (Size range claims from 10 *nm* to 3  $\mu m$ .)



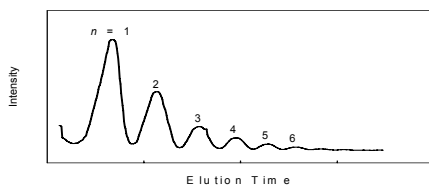
# Field flow fractionation – with thermal, flow, electrical\*

## Sedimentation field flow fractionation

Larger particles are pushed to the outside where the fluid flow is the least.

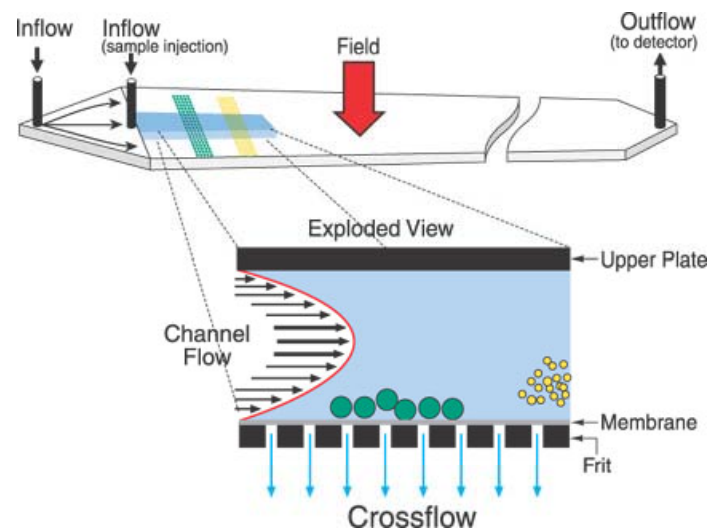


Polystyrene particles



PMMA particles

## Asymmetric field flow fractionation (Wyatt Technologies)



[www.wyatt.com](http://www.wyatt.com)

\*[www.postnova.com](http://www.postnova.com)