# Effect of a two-dimensional velocity profile on the transfer function of a plate Differential Mobility Analyser (DMA)

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## Motivation and objective

**Plate Differential Mobility Analyser**: air + aerosol flow between parallel plates. Electric potential difference is applied to the plates => the particles are separated according to their weight and electrical mobility.

**Transfer function**: ratio of particles flux out/particles flux in, as a function of some operating parameter (e.g. electric potential).

**With velocity profile along height only** : easy to predict (trapeze shape)
But DMA width is finite => **velocity profile also in transverse direction**.
**How is the transfer function affected?**



Principle of plate DMA

Transfer function with 1D-velocity profile
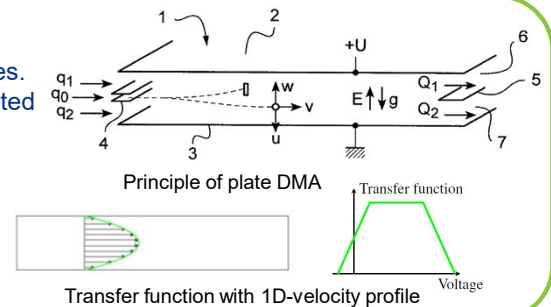
## Method

**2D-velocity profile**: formula from classical literature:
(could also be computed by CFD)

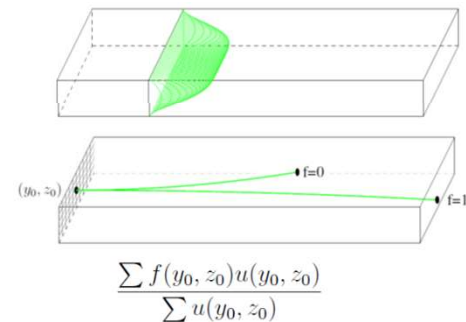$$u(y,z) = \frac{m+1}{m}\frac{n+1}{n}\left[1-\left(\frac{y}{l}\right)^m\right]\left[1-\left(\frac{z}{h}\right)^n\right]$$

**Emission** of particles from a grid
For each particle, computation of trajectory and indicator function:
f=1 if particle exists, f=0 if particle is stuck in DMA

**Indicator function is summed** over the grid, weighted by velocity

$$\frac{\sum f(y_0, z_0) u(y_0, z_0)}{\sum u(y_0, z_0)}$$

Shah RK, London AL. Laminar flow forced convection in ducts. Academic Press. New York; 1978.
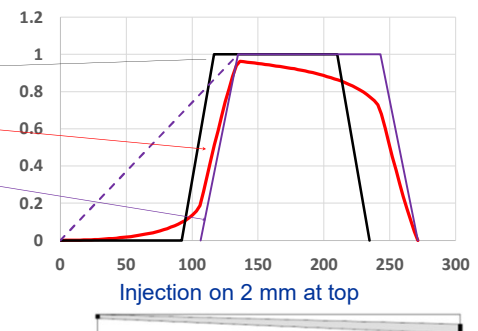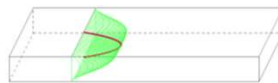
## Results

**An example:** DMA length 20 cm, width 5 cm, height 1 cm, flow rate 2 l.min$^{-1}$, latex particles Ø 800 nm, 100 positive charges – Collection in bottom half of DMA exit
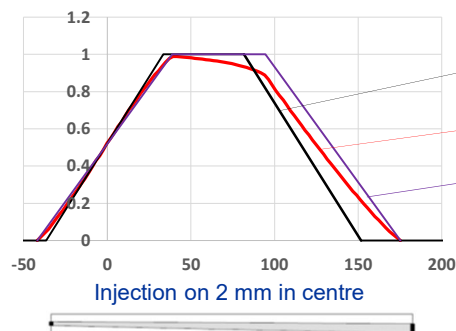


Original "1D" Transfer function

**"2D" transfer function**

"1D" transfer function at velocity maximum

Injection on 2 mm in centre

Injection on 2 mm at top

## Conclusions and perspectives

- **Effect of 2D-velocity profile is small**
- **Can be estimated** by considering the "1D" transfer function at maximum velocity
- **Perspective:** develop analytical calculation (and write a nice paper)

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