Figures of Merit of NIR spectrometer for powder process monitoring: Quality by Design

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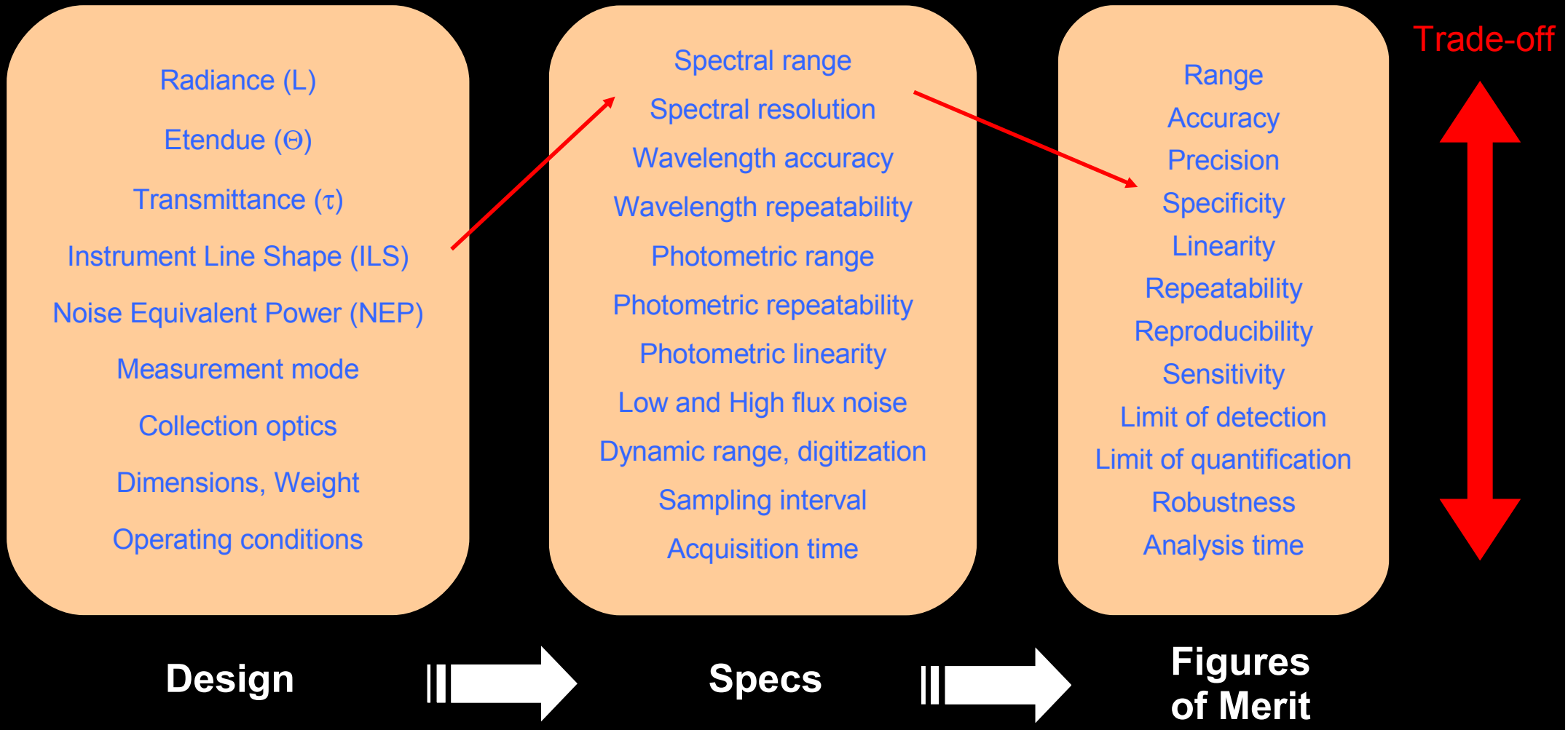
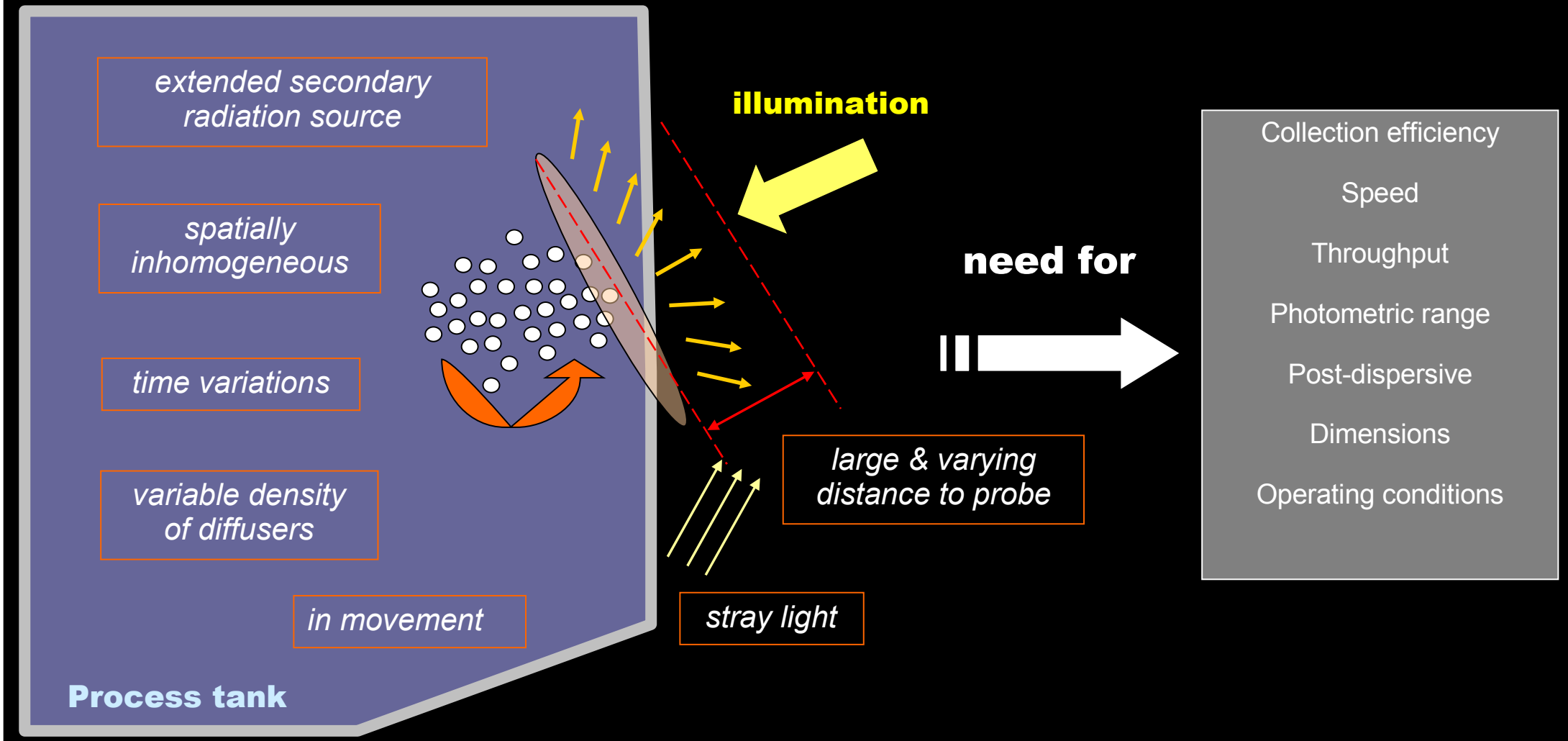
PHOTONLINES

1. From Design to Performances

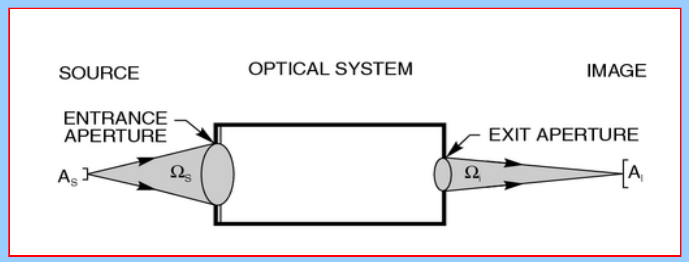


2. Powder process monitoring



3. Optical invariant & Throughput

Optical invariant, Lagrange principle



$$A_s \Omega_s = A_i \Omega_i$$

A : Area
Ω : Solid angle

G (geometrical extent or etendue) = A x Ω
G is an optical invariant of the optical system
It remains the same for any image plane

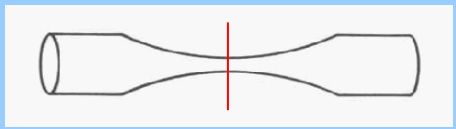
Maximum throughput

Whatever limits G, fixes the maximum throughput of the system.
No amount of clever optical design can improve that limit

Radiant flux through the system: $\phi = t\, G_{lim}\, L$

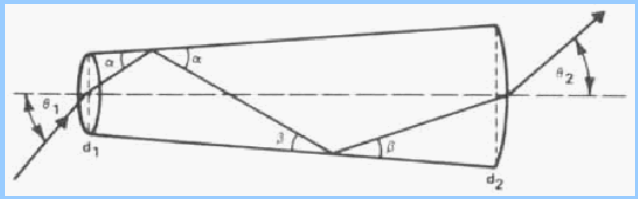
4. Fiber optics & Throughput

Mae-West fiber optic system



Smallest diameter fixes the acceptance angle of the system

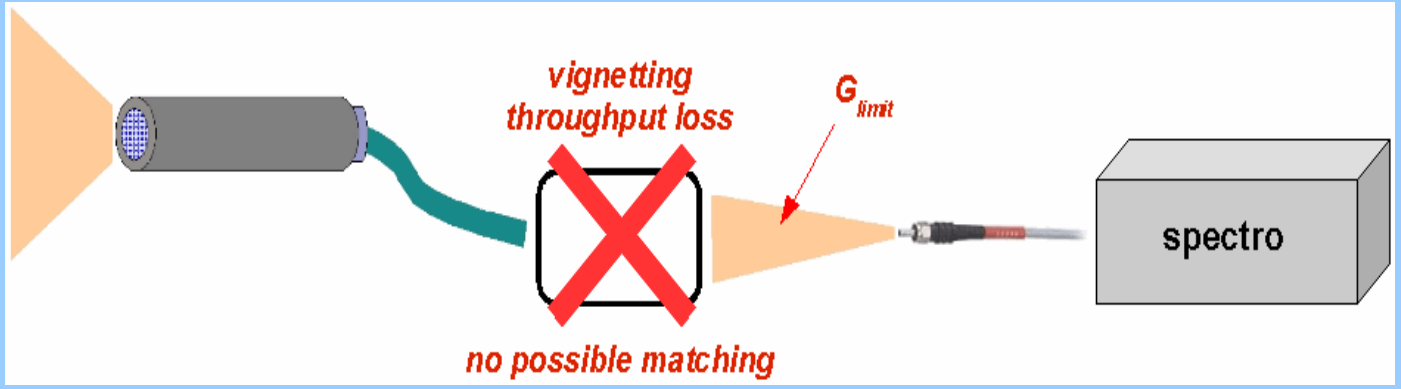
Tapered-fiber transmission



$$d1 \sin \theta 1 = d2 \sin \theta 2$$

It is impossible to condense a lambertian area of light !

On-line NIR system in diffuse reflectance

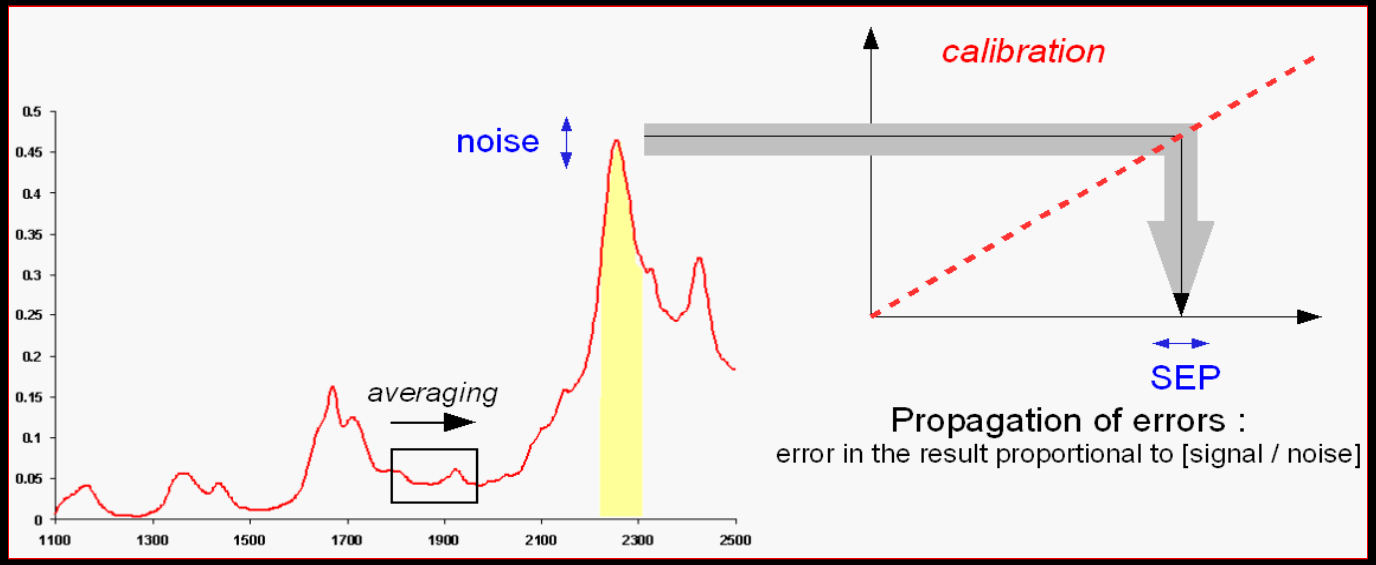


5. Signal/Noise & Speed

in the lab

Signal/Noise vs Resolution

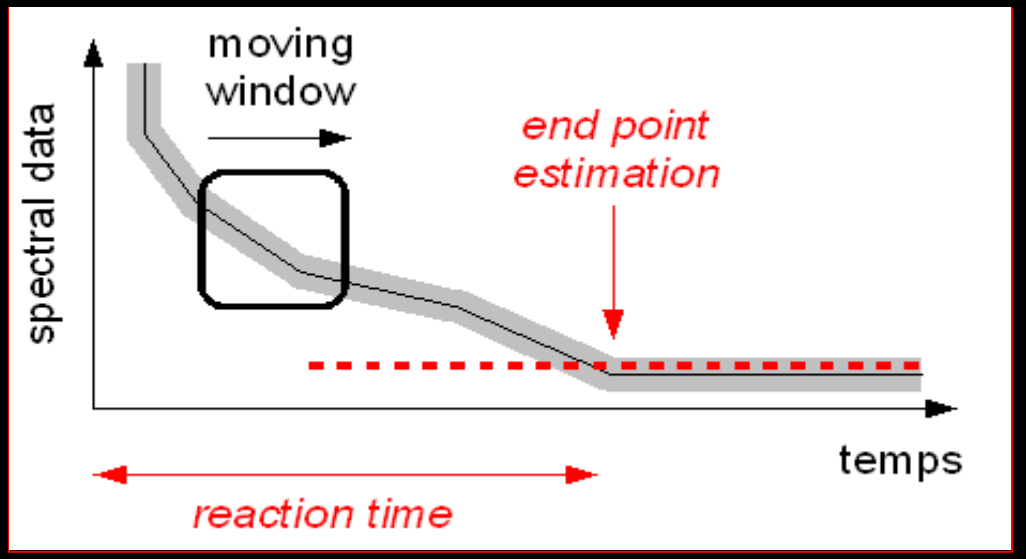
Need precision



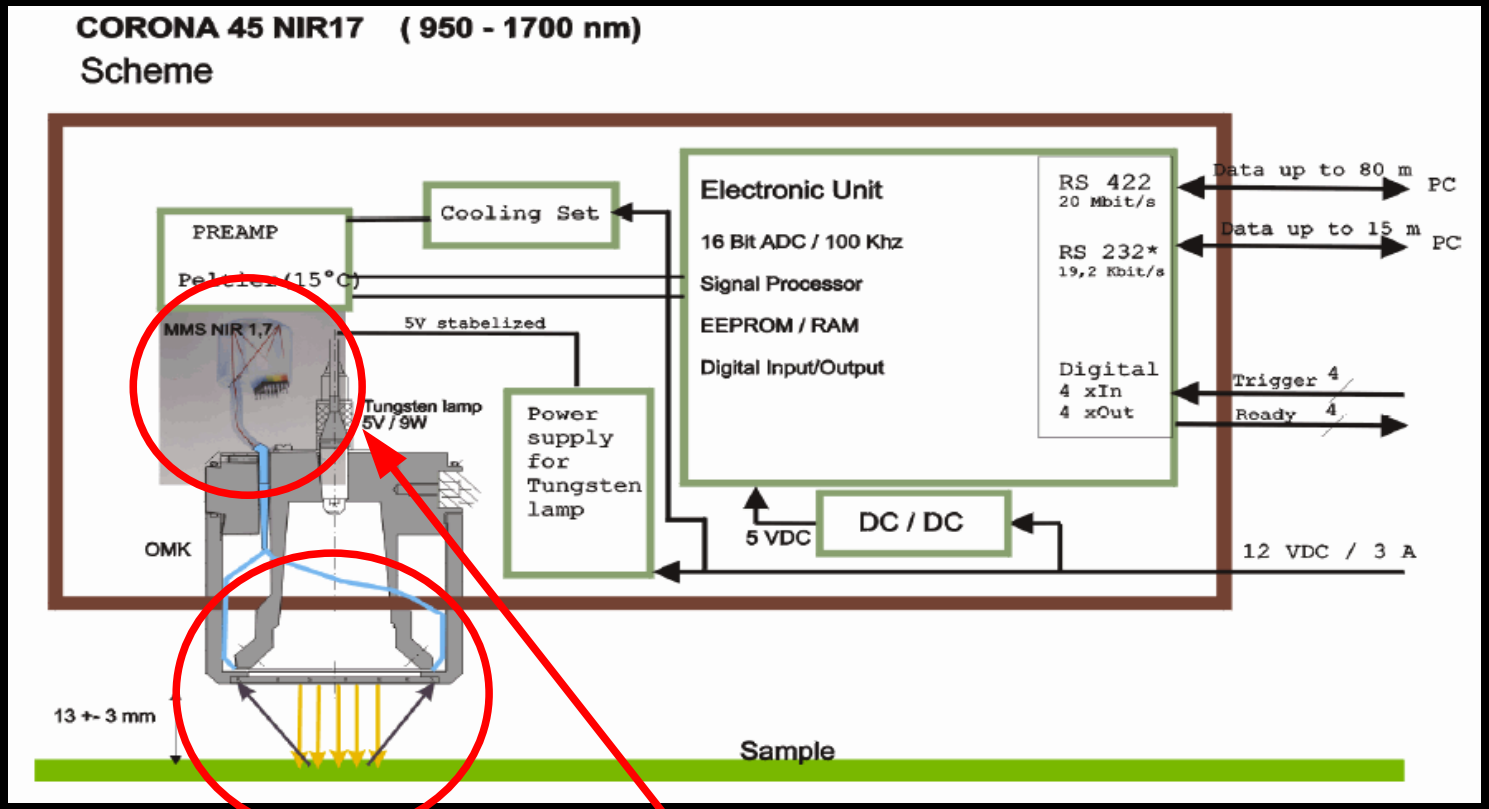
in process

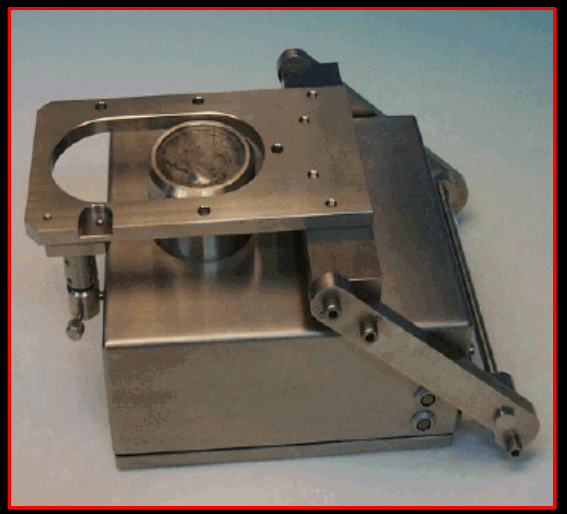
High acquisition speed required

High Dynamics



6. The CORONA NIR family

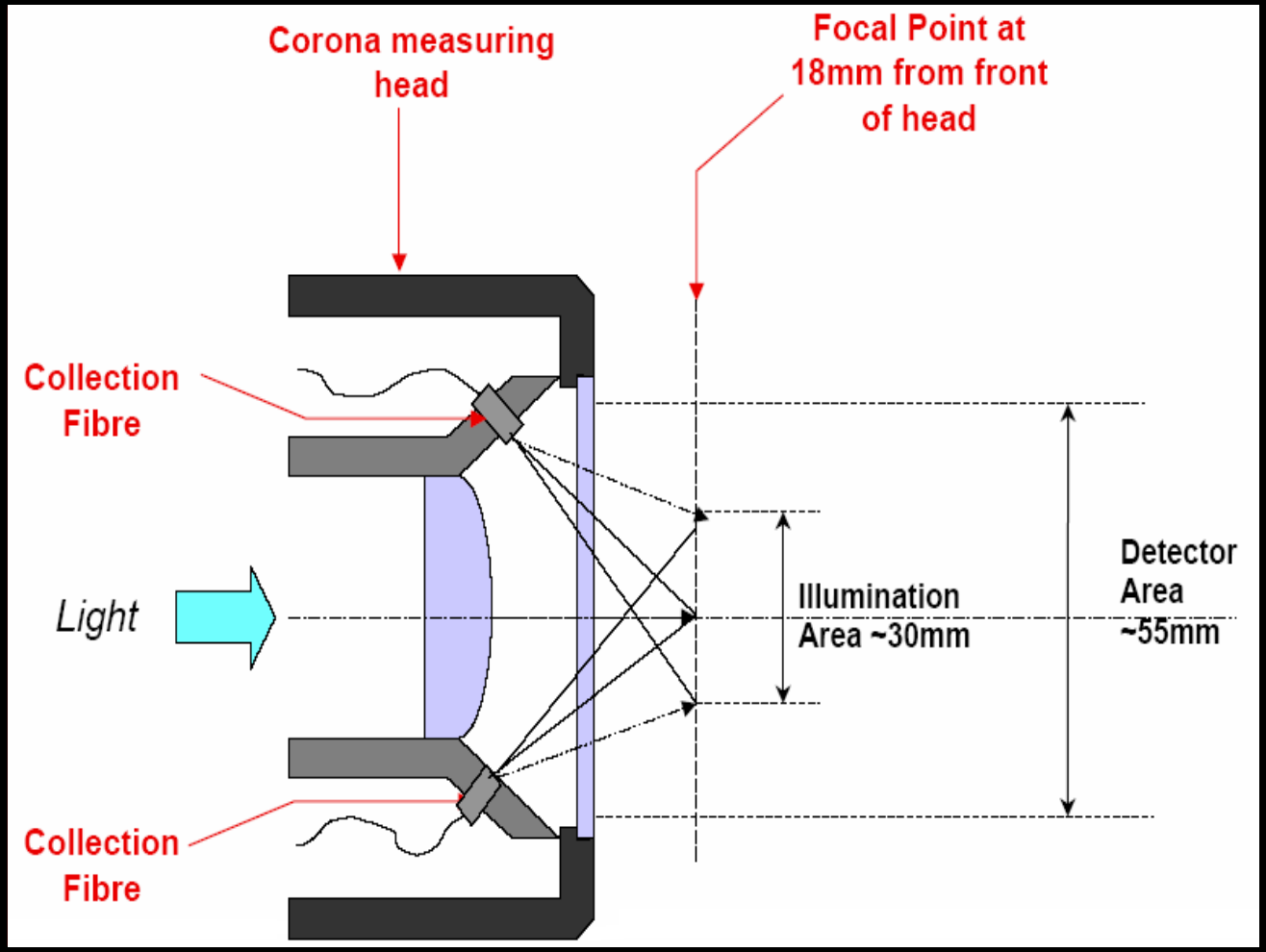


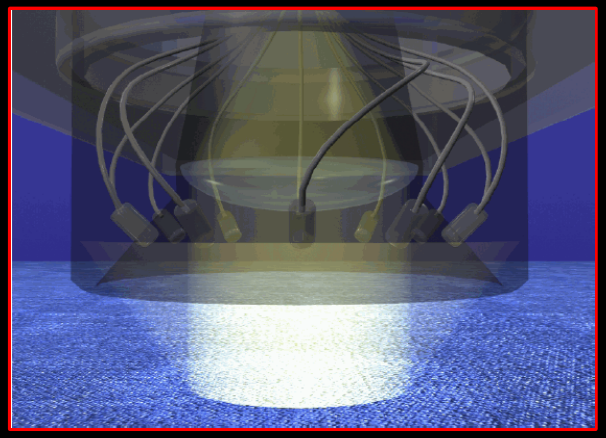


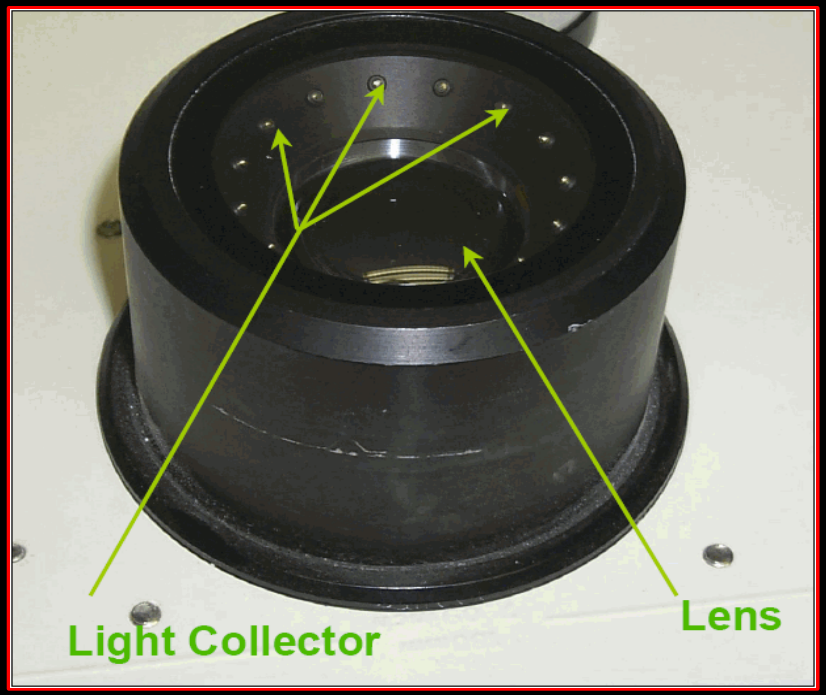
Monochromator

OMK head

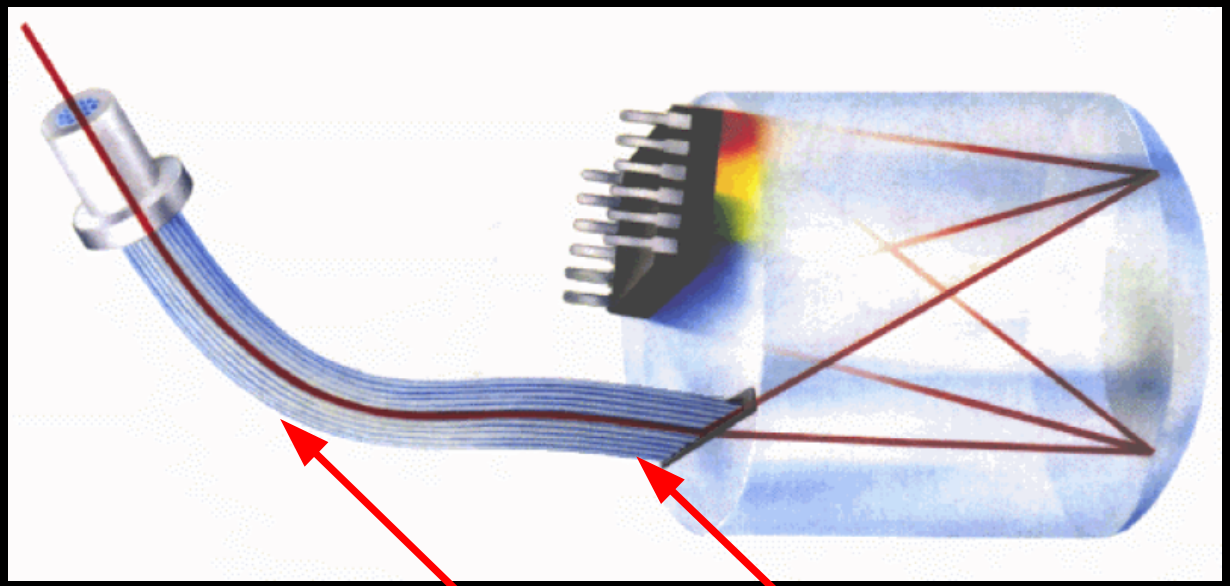
7. The OMK Head : Collection efficiency





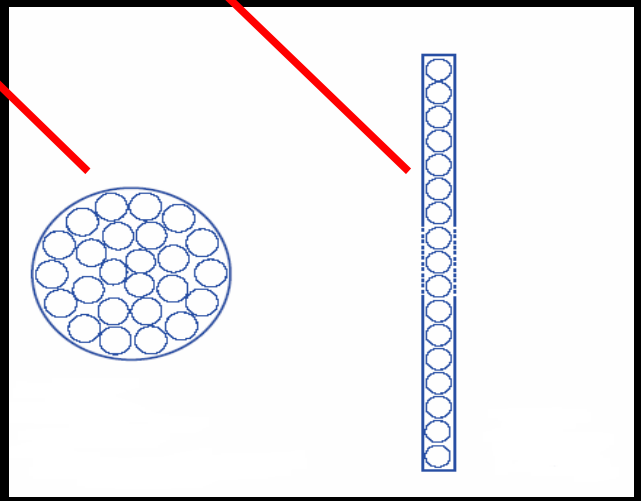


8. The Monochromator: robustness & throughput



Monolithic diode-array monochromator:

no slits (entrance, exit)
ruggedness
permanent alignment
high speed



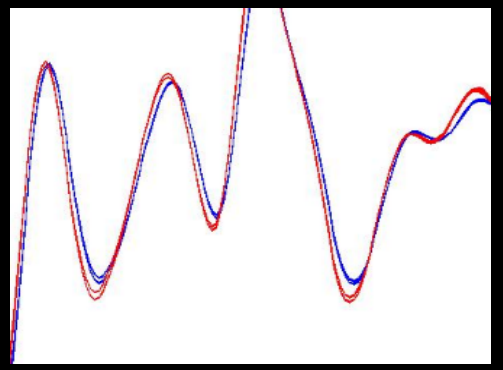
Fiber bundle cross section converter

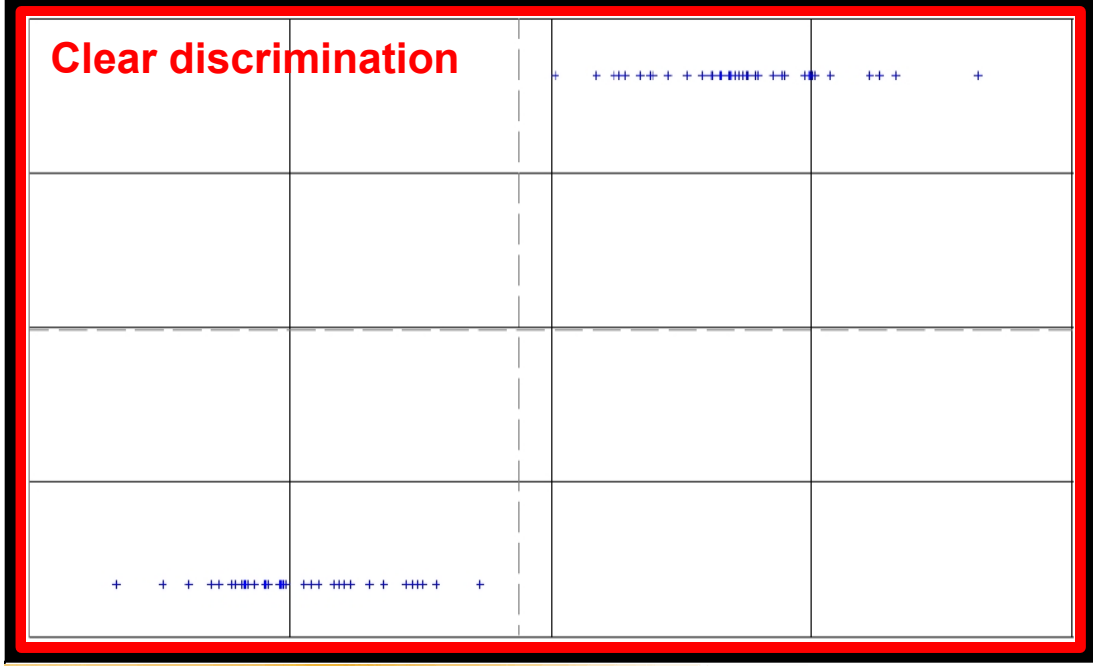
9. Throughput advantage for critical applications

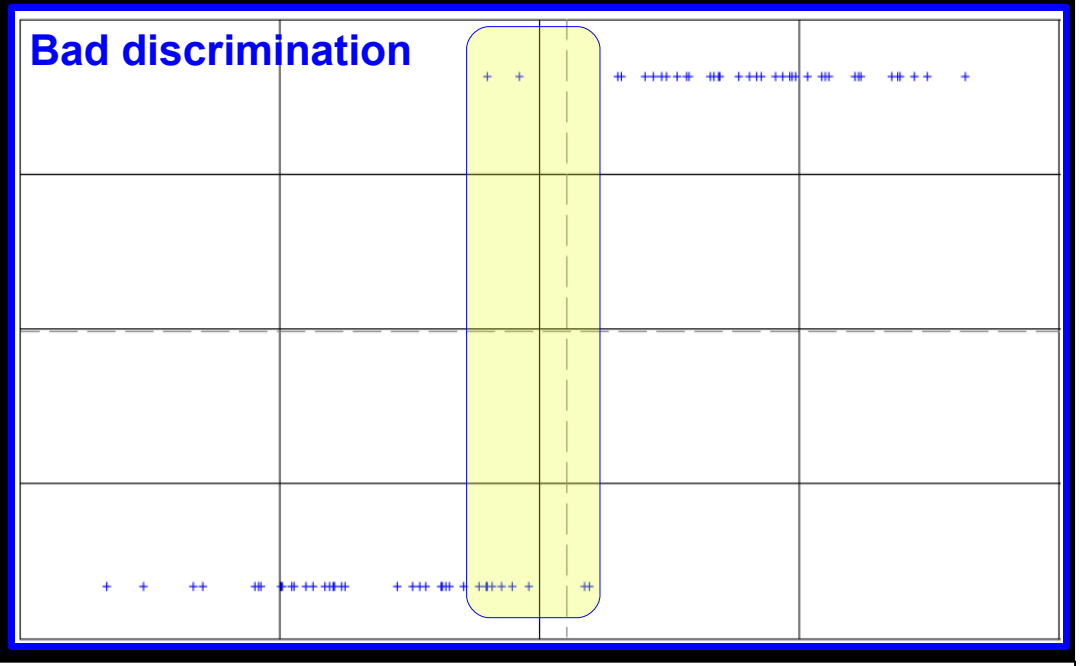
Low Active vs Excipient discrimination with 2 Corona configurations : integrated and remote OMK head (SMA connector)

without SMA :

Integration time reduced by 25% (62,5 ms vs 80,0 ms)
Higher Signal/Noise 20% (RMS noise 118 vs 153)
Better sensitivity







10. Process Powder applications

Glatt Multicell Fluid bed Dryer