
SpectraWay
noninvasive blood parameters

Why

Patient

Prevent pain by eliminating needles

Doctor

Increase success rate by enabling a continuous monitoring

Hospital

Reduce variable costs to $0

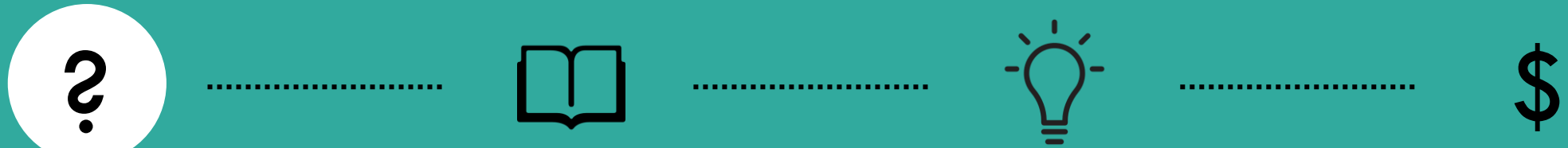
Who

People who need an ongoing control of blood parameters

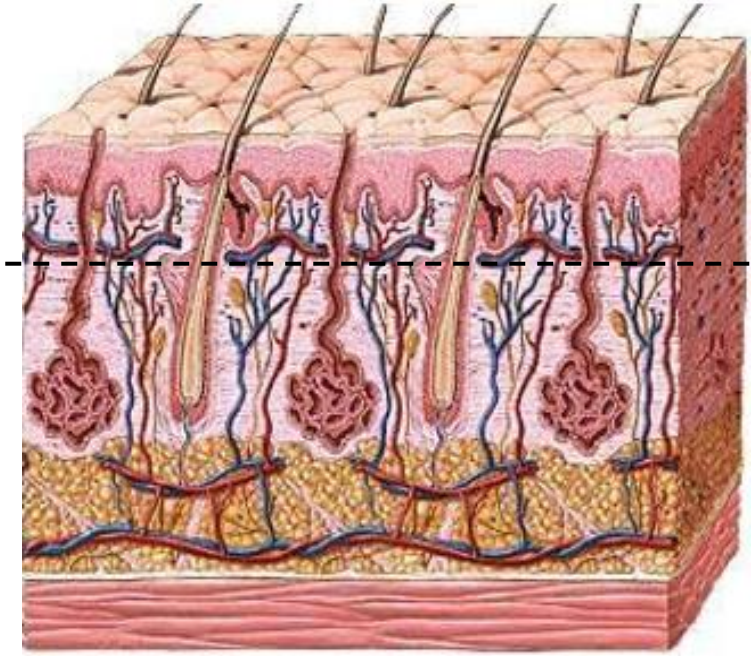
hemoglobin, bilirubin, saturation, water, beta-carotene, lipids, glucose, glycated hemoglobin

Target group examples

Expectant mother, newborn, people suffering from anemia



How



epidermis

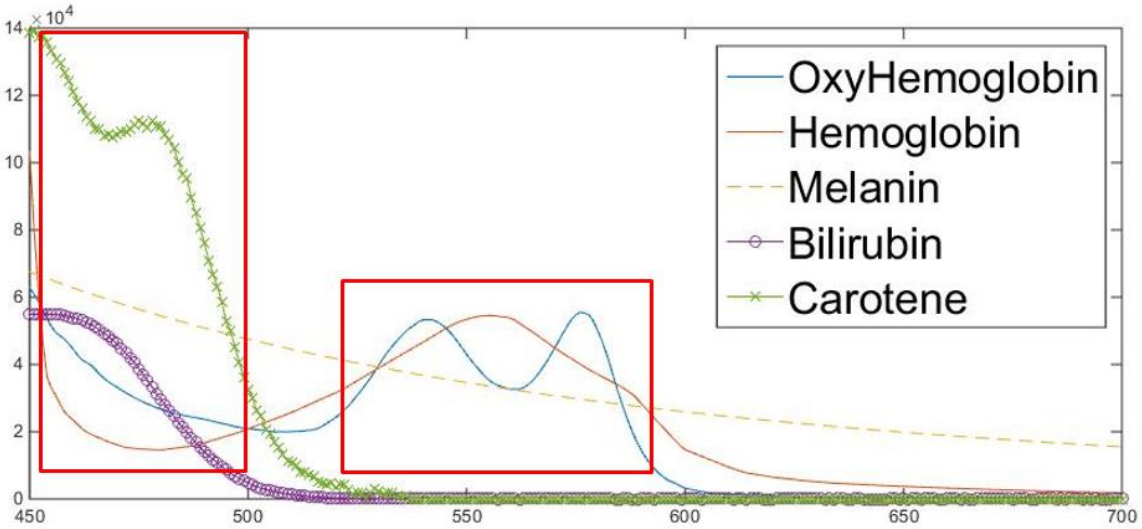
Melanin
Collagen

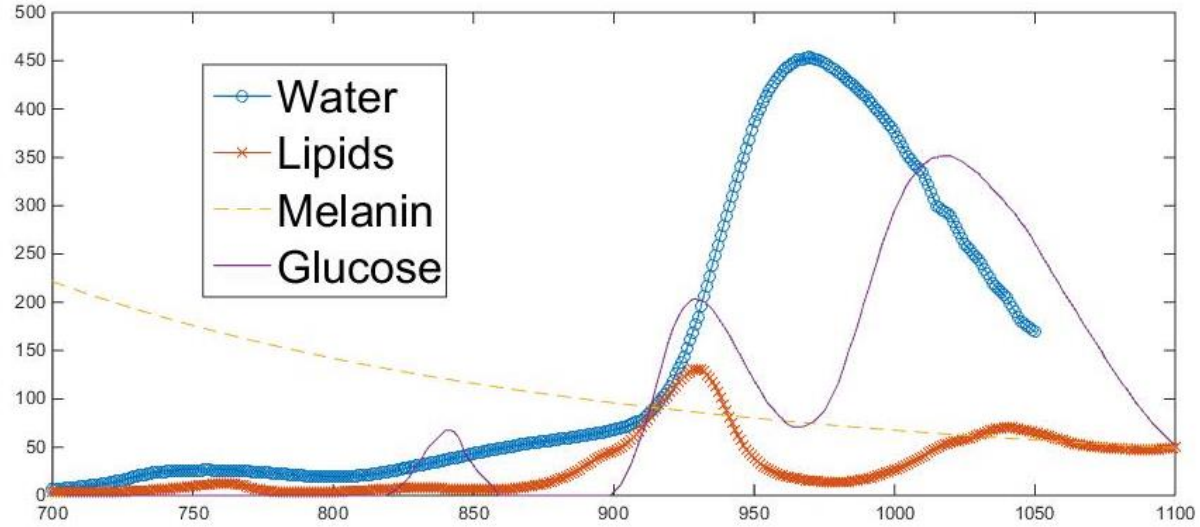
dermis

Water
Melanin
Hemoglobin
Oxyhemoglobin
Bilirubin
Carotene
Lipids
Glucose

How

Our skin has all the information we need





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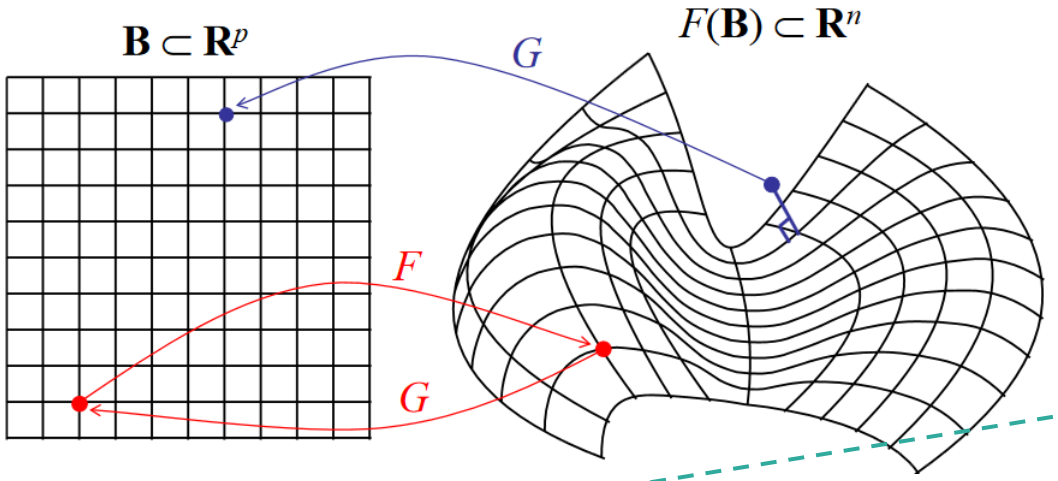
How



Inverse map $G(y) = F^{-1}(y), y \in F(\mathbf{B})$

$\mathbf{B}$ - *Parameters*
$F(\mathbf{B})$ - *Spectra*

Find parameter F^{-1} by using

Regression
+
Machine Learning
+
DiRect

Interpret different skins correctly

Age, color, gender

? ....

How

Visualization

?

$

Status

Software MVP ✓

HW Prototype Phase 1 ✓

Status

Software MVP ✓

HW Prototype Phase 1 ✓

1 year

HW Prototype Phase 2

mechanical and non mechanical

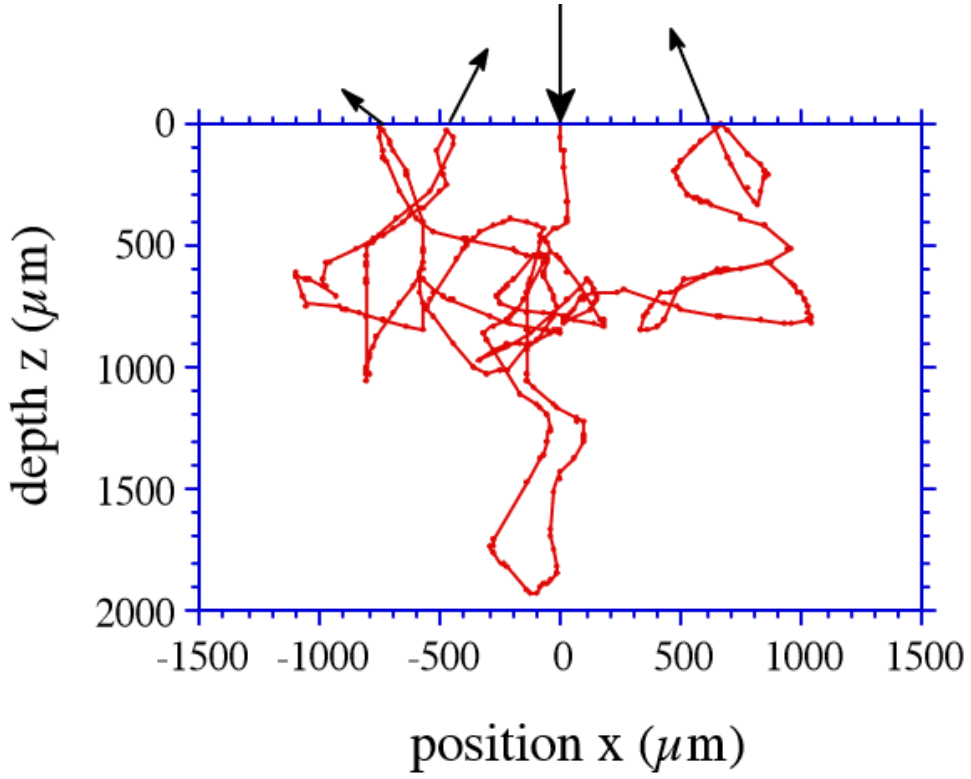
4 available measurable values

bilirubin, hemoglobin, saturation, water

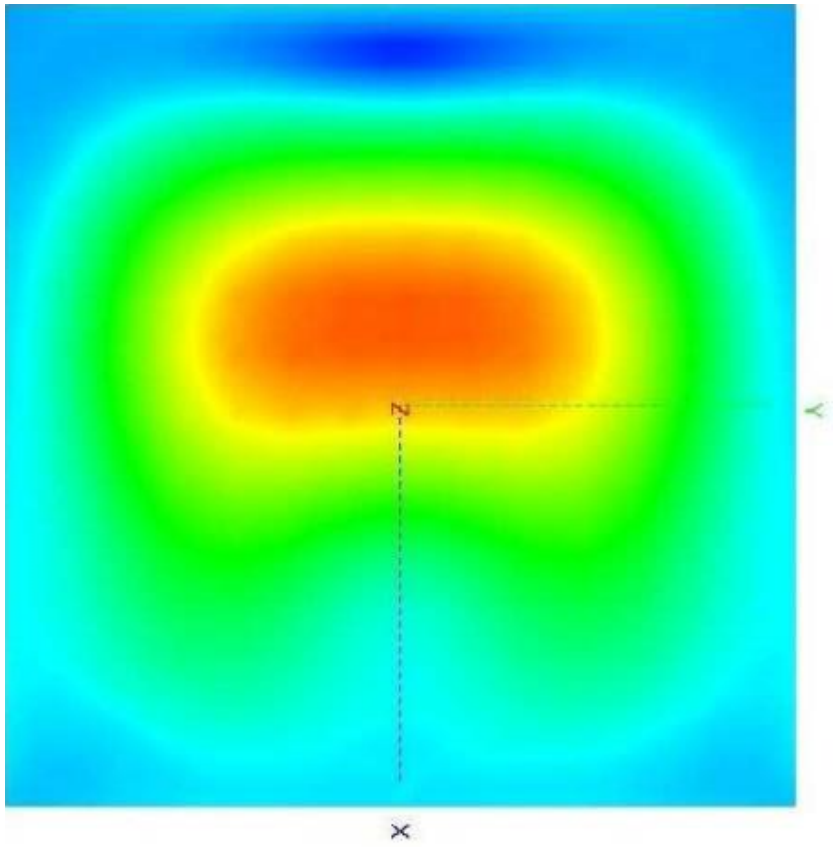
How light goes through skin

B2

Statistic solution (Monte-Carlo simulation)

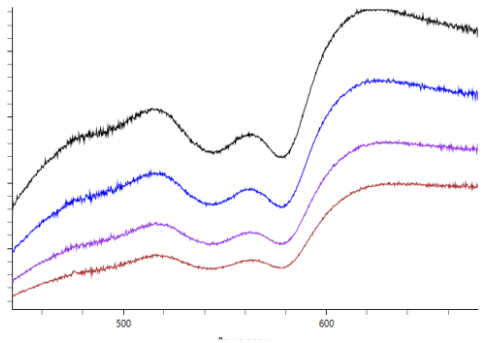


Exact solution (Maxwell equation solution)



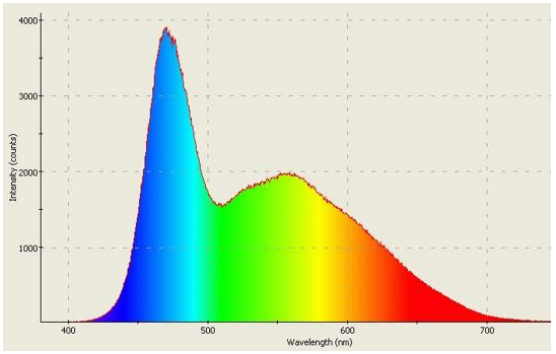
Optical request for skin (real case)

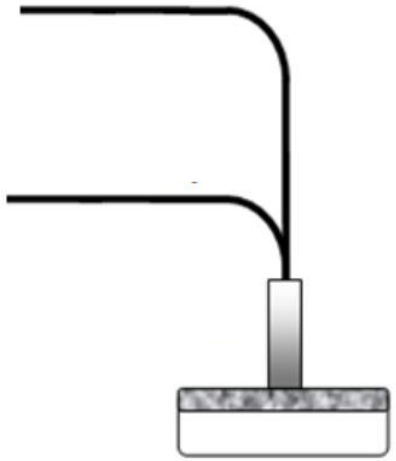
B3

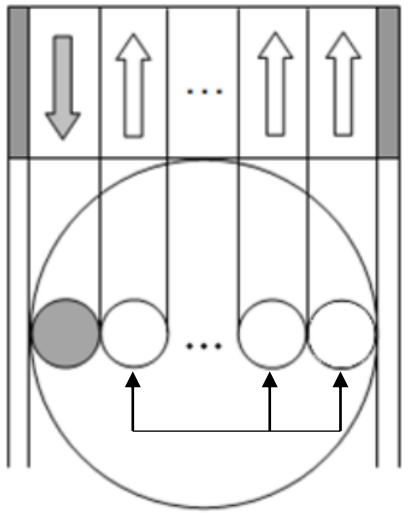


spectrometer

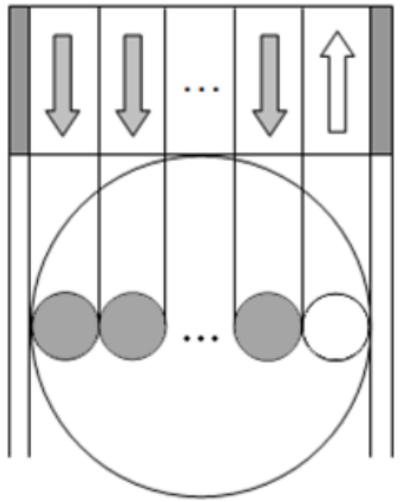
[widespectral] diode







a) mechanical movement of collected fiber

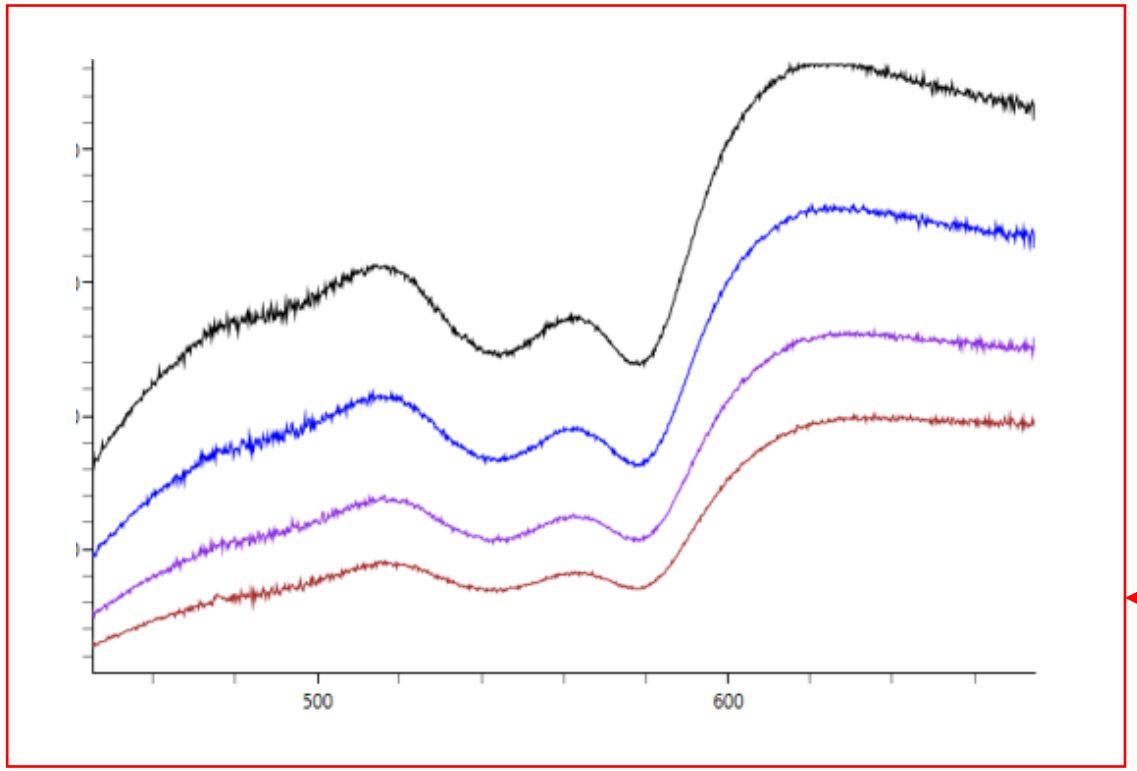


b) many wide spectral diodes turn on successively

Optical request for skin (ideal case)

B4

Spectral request from skin



Problem:

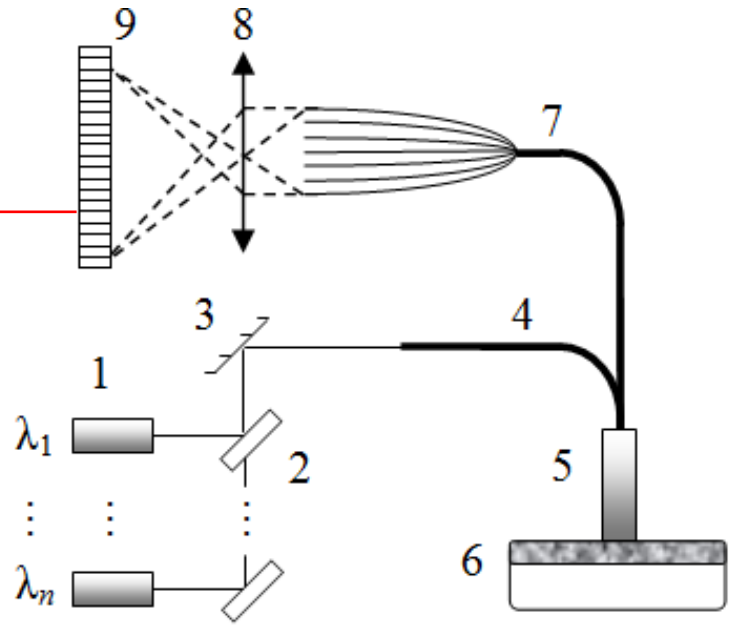
Diode lasers – unstable

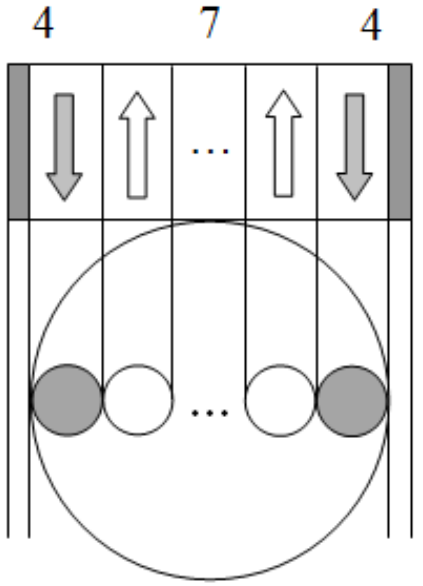
Other lasers – irregular cover spectral range

Diodes – wide spectrum (*solvable*)

Filter – very expensive (source + filter system)

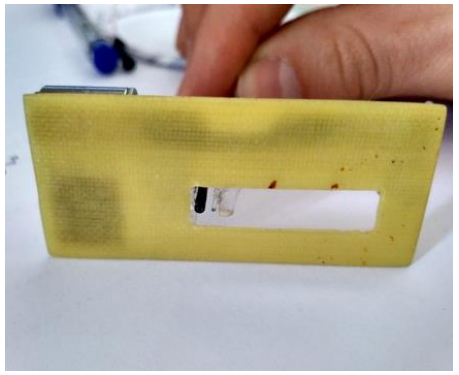
Fiber-optic probe **5** for measuring parameters of the biological tissues contains two transmitting fibers **4** between collected fibers **7**. Radiation from laser diodes **1** goes to beam-splitting plates **2** and successively into excitation channels **4**. The radiation scattered by the tissue **6** enters to the receiving fibers **7**, through which it enters the photodetectors or is focused by the micro-object **8** onto the CCD line **9**

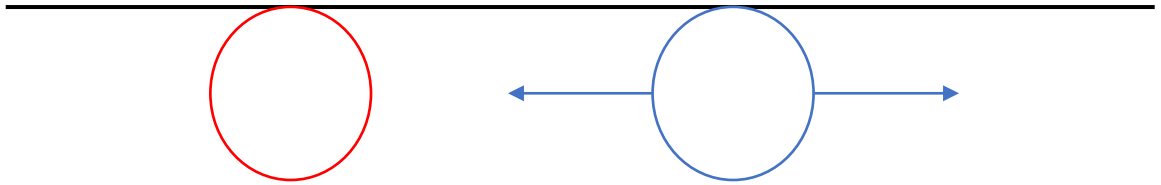


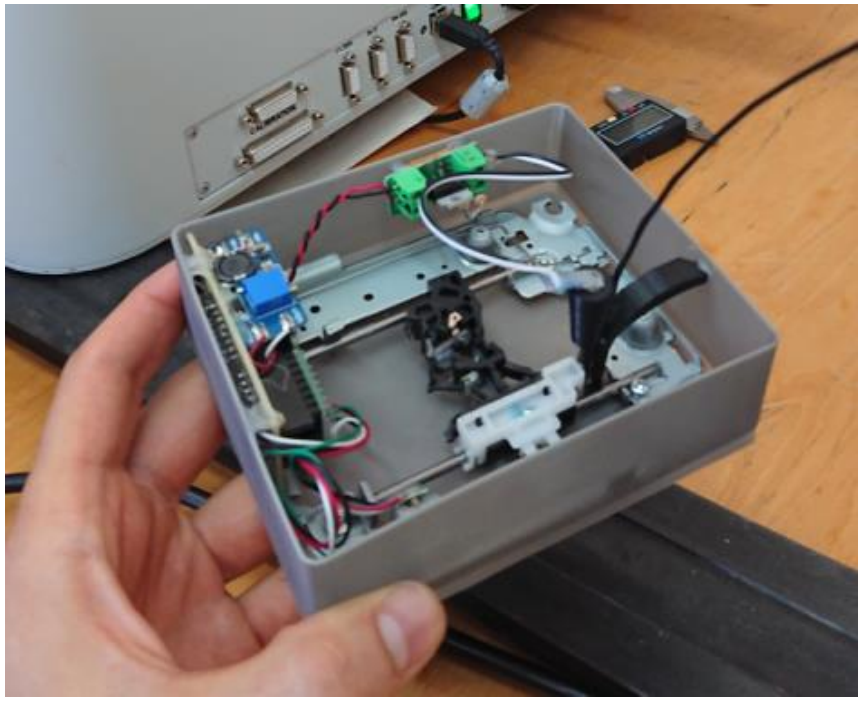


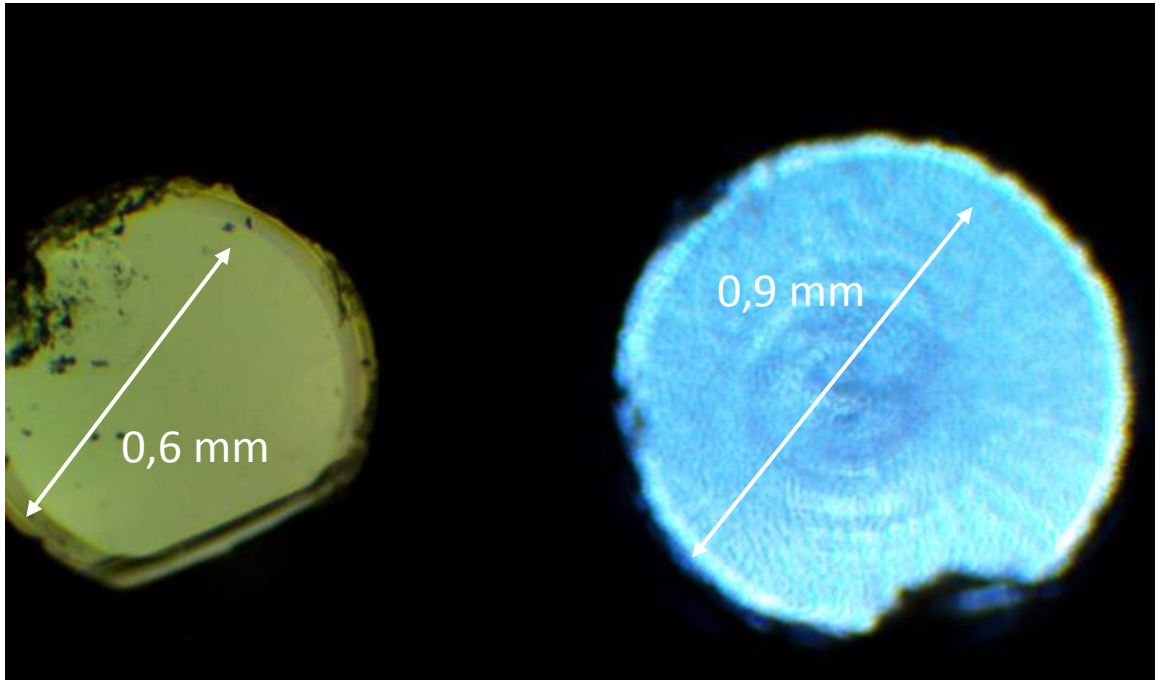
Prototypes - mechanical movement

B5



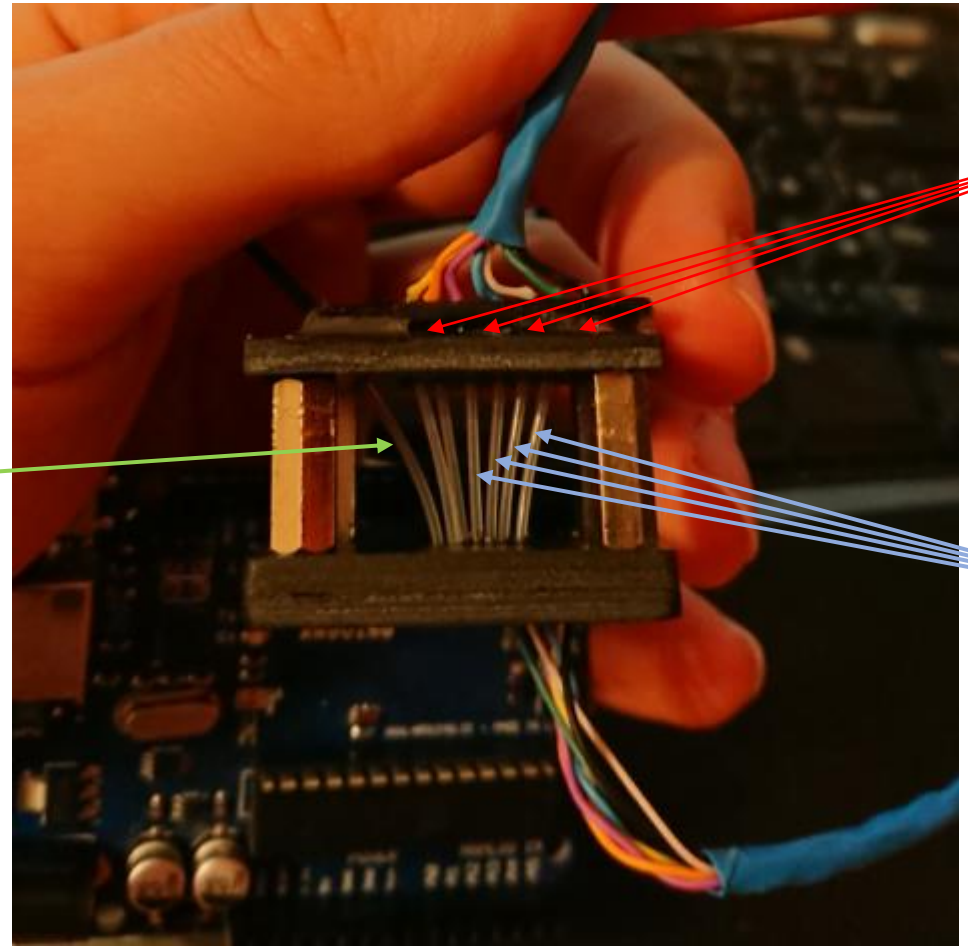






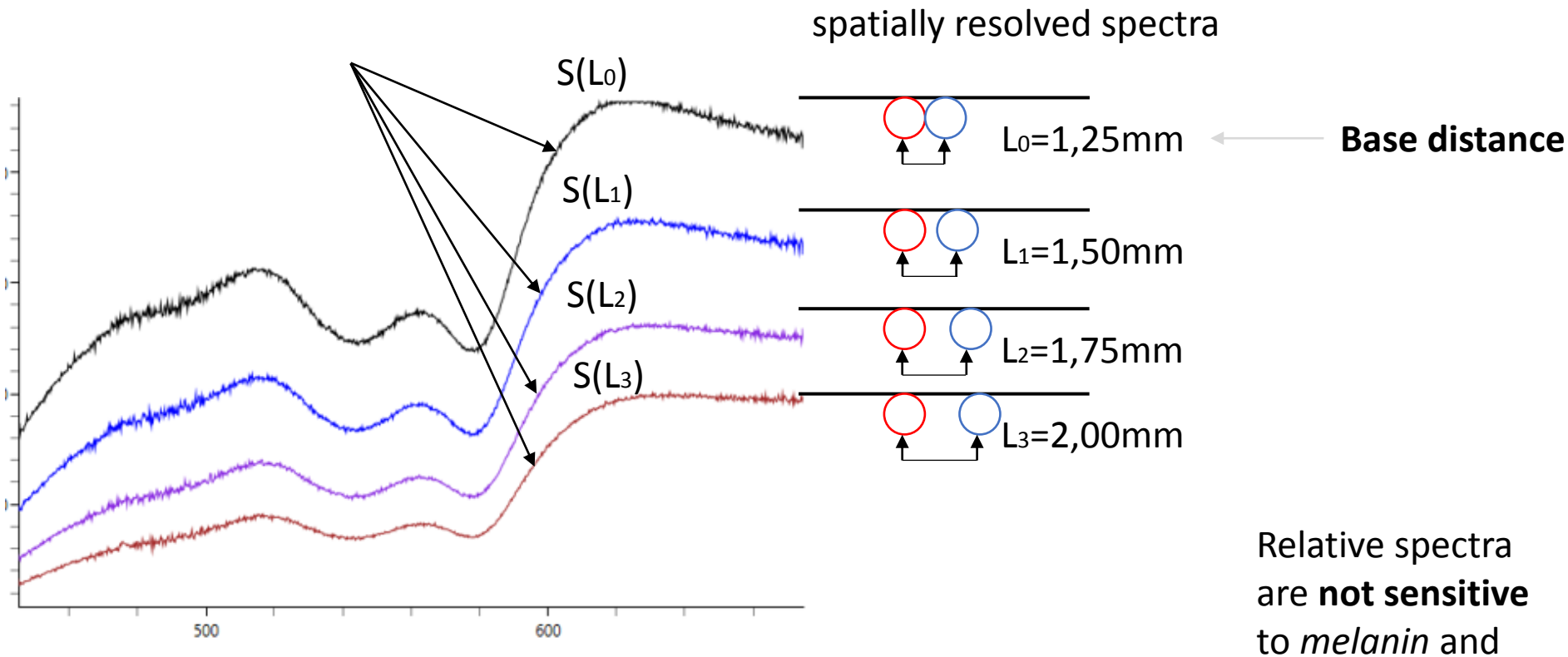
Multiple wide spectral diodes

B6



Spectral information retrieved from skin

B7



Relative spectra are **not sensitive** to *melanin* and apparatus constants

$$S_{10} = \frac{S(L_1)}{S(L_0)}$$

$$S_{20} = \frac{S(L_2)}{S(L_0)}$$

$$S_{30} = \frac{S(L_3)}{S(L_0)}$$