# Why excimer laser ablation profiles should be improved

## DGII 2017


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# Financial disclosures

- Directed research project University of Zurich &

  Schwind eye-tech solutions, Kleinostheim, Germany

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1. Background

# EXCIMER LASER PHOTOREFRACTIVE KERATECTOMY IN HIGH MYOPIA: A MULTICENTER STUDY*

BY *Richard L. Lindstrom*, MD, *Neal A. Sher*, MD (BY INVITATION), *Mark Barak*, MD (BY INVITATION), *Janet DeMarchi*, COT (BY INVITATION), *Angela Tucci*, BS (BY INVITATION), *Sheraz Daya*, MD (BY INVITATION), *David R. Hardten*, MD (BY INVITATION), *Jonathan M. Frantz*, MD (BY INVITATION), *Richard A. Eifermn*, MD (BY INVITATION), *Paula Parker*, COMT (BY INVITATION), *William B. Telfair III*, PhD (BY INVITATION), AND *Stephen S. Lane*, MD (BY INVITATION)

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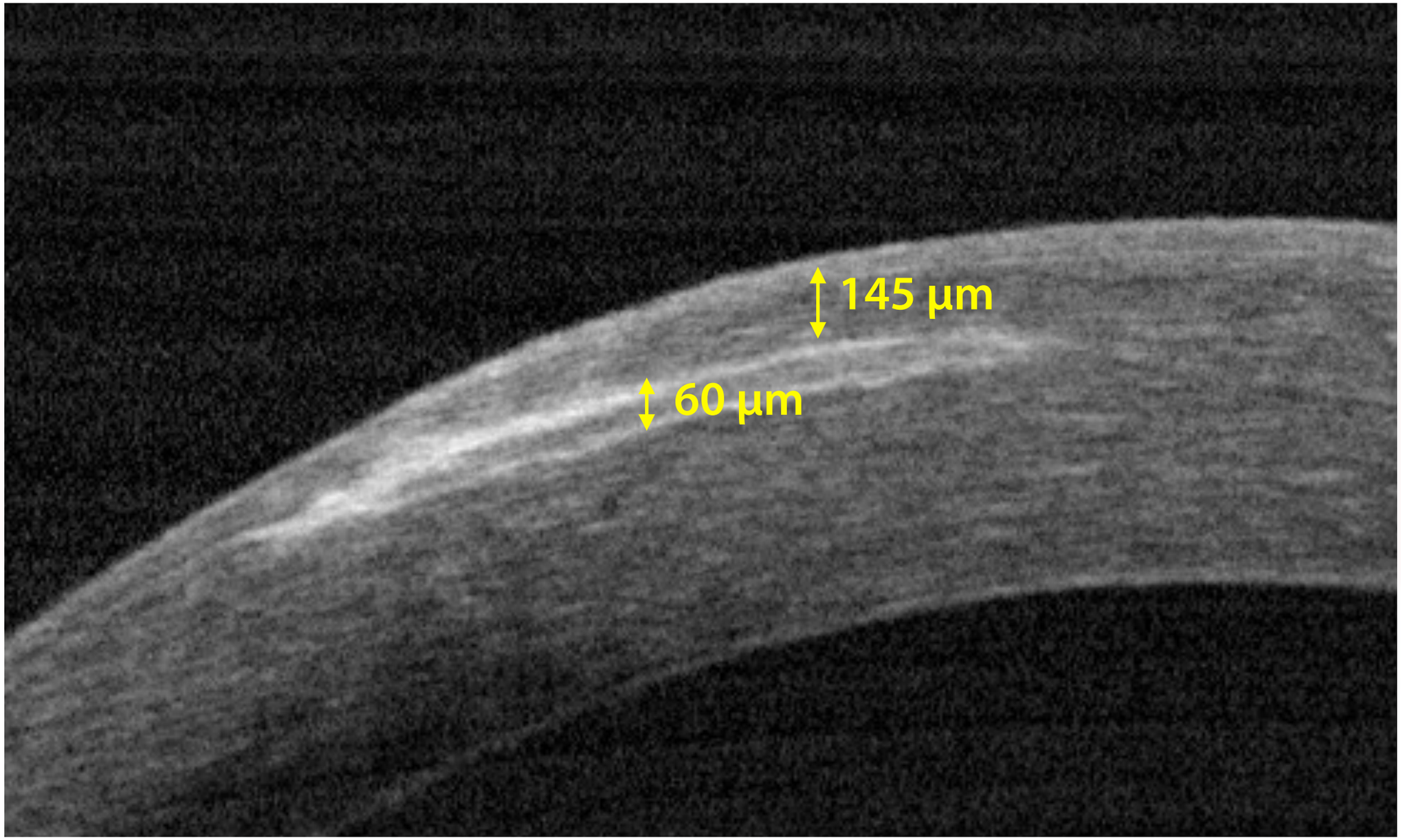
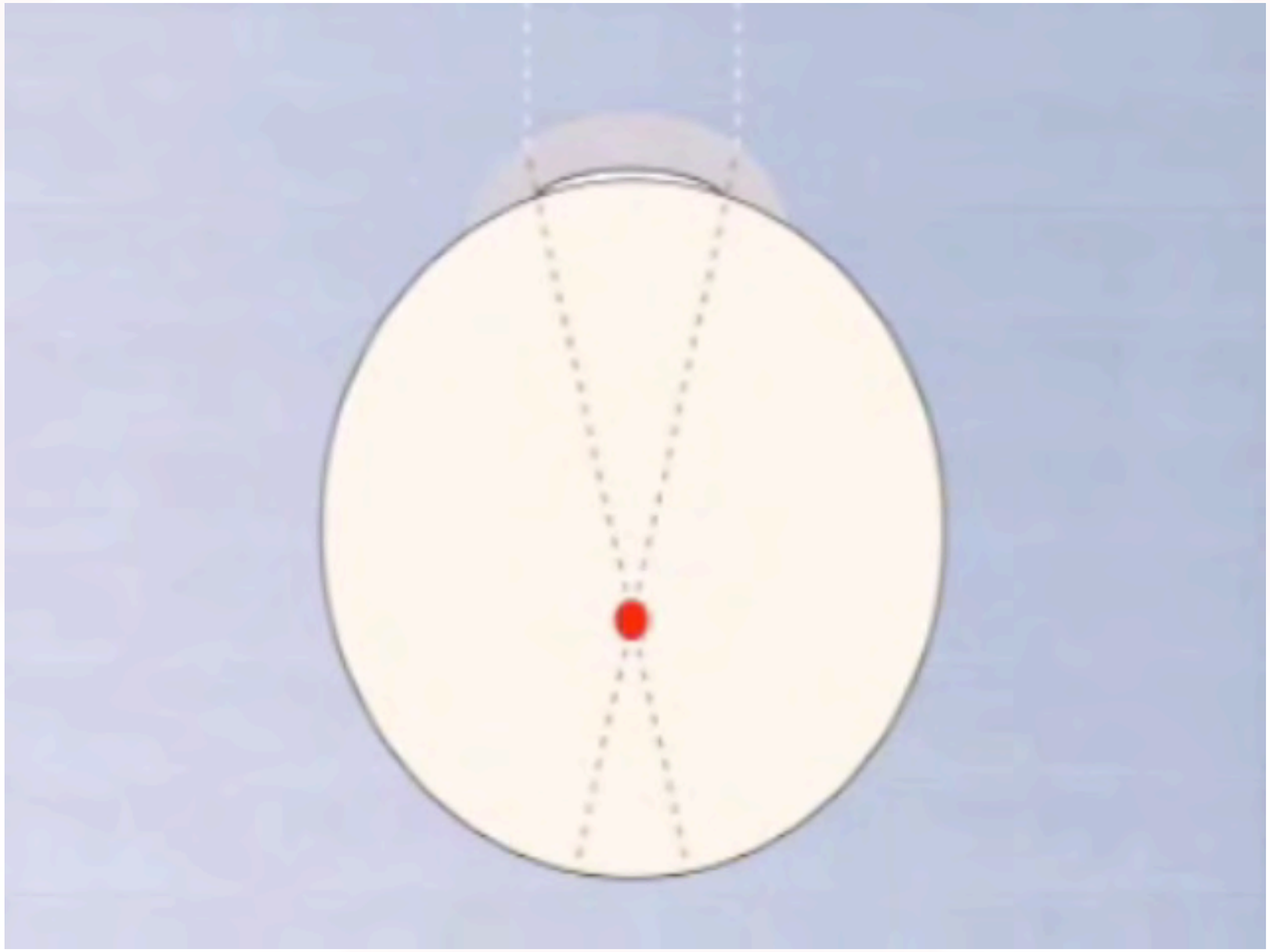
## 1. Background

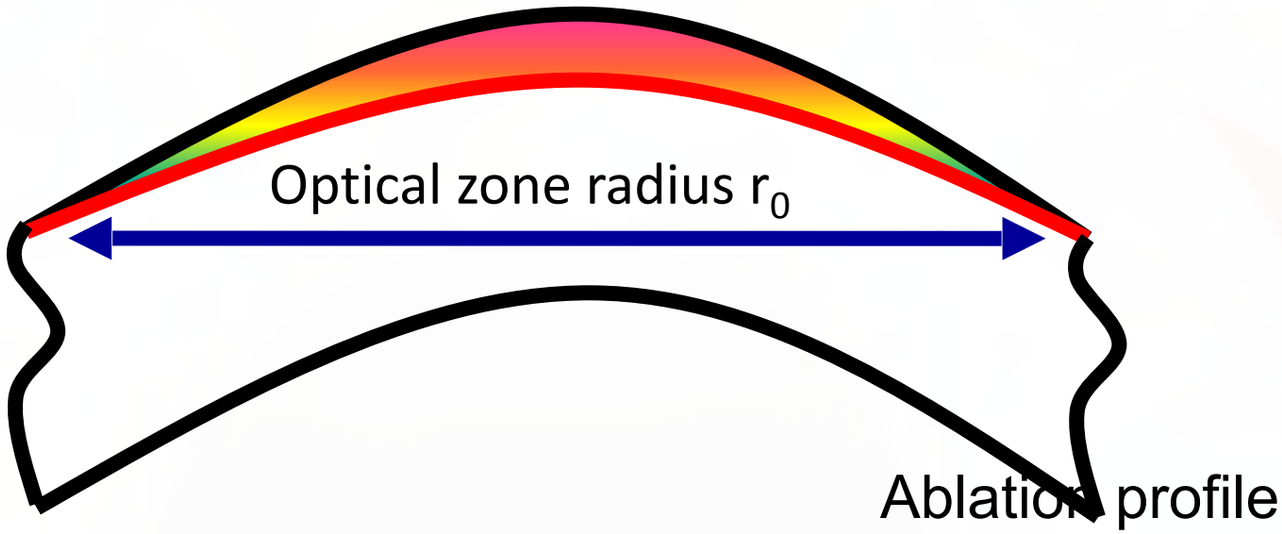


# Ablation profiles

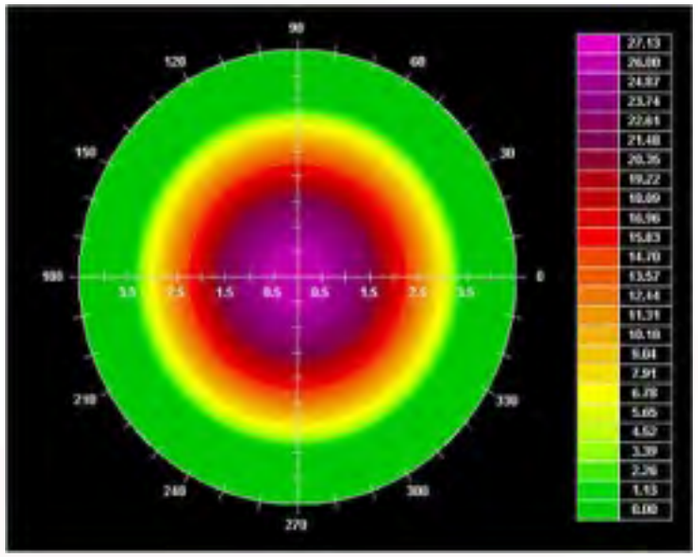
- Remodelling of the cornea



# Munnerlyn's Formula

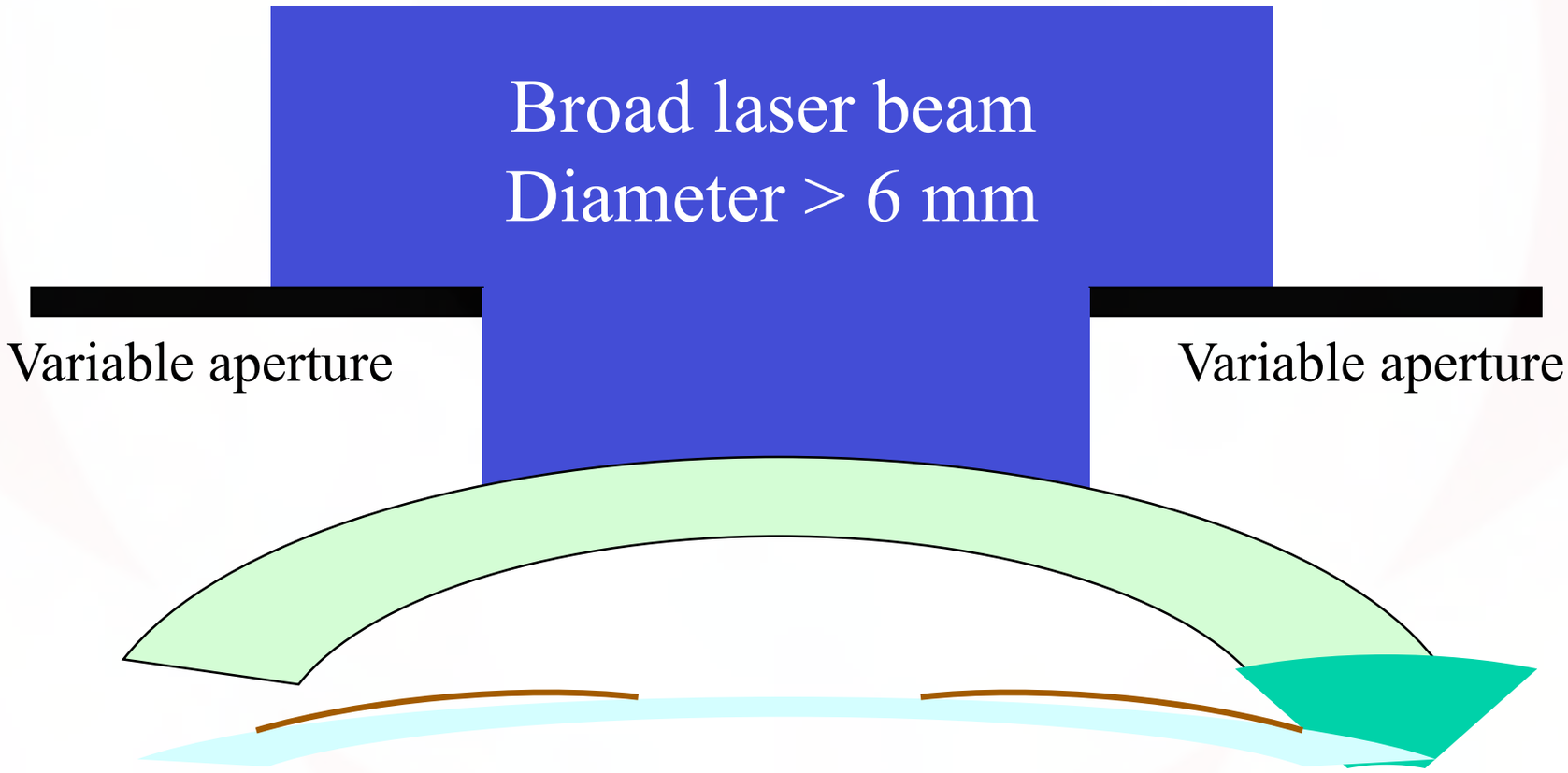



$$a(r) = y_1(r) - y_2(r)$$



# Ablation concepts

- Scanning slit



# Ablation concepts

- Scanning spot

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1. Background

2. Physical side effects

# Scanning spot lasers

**Fluence**

Amount of energy applied to the ablative zone

**Ablation rate**

= pulse energy

= amount of tissue ablated with each pulse

**Spot size**

The finer the better

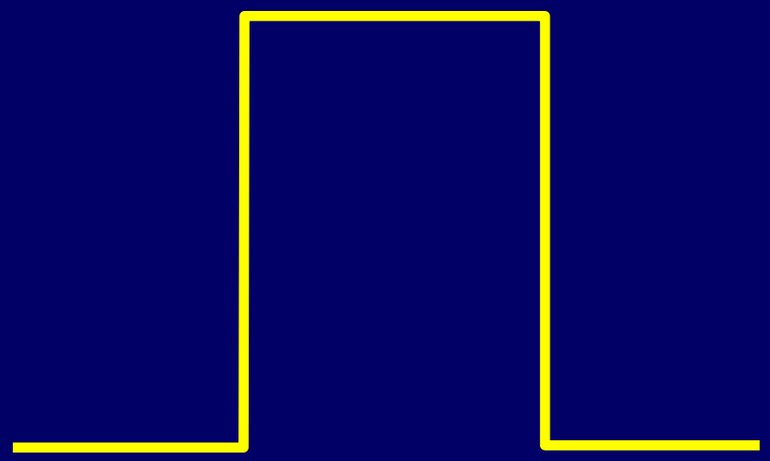
**Spot distribution**

= Pulse Sorting

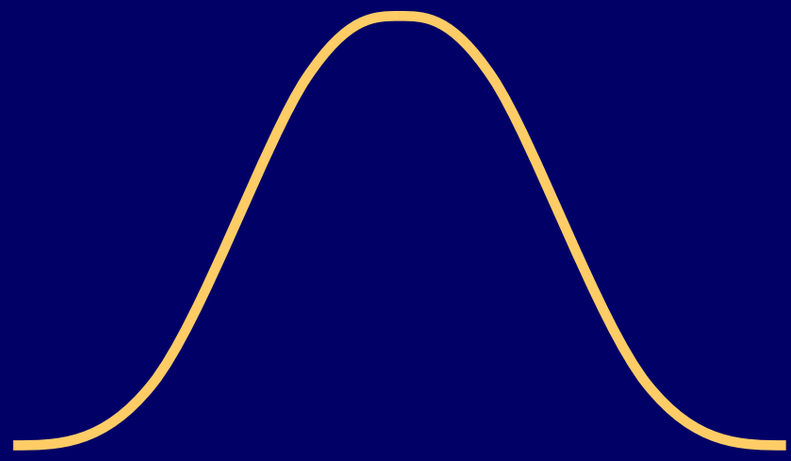
Thermal issues

# Spot Profile

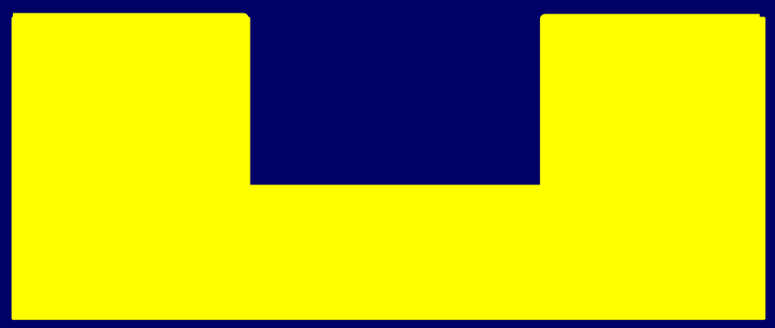
- Overlap of spots cannot be avoided
- Top hat or Gauss profile?

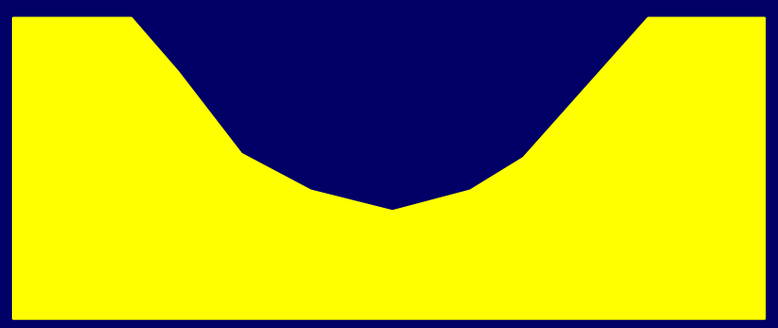


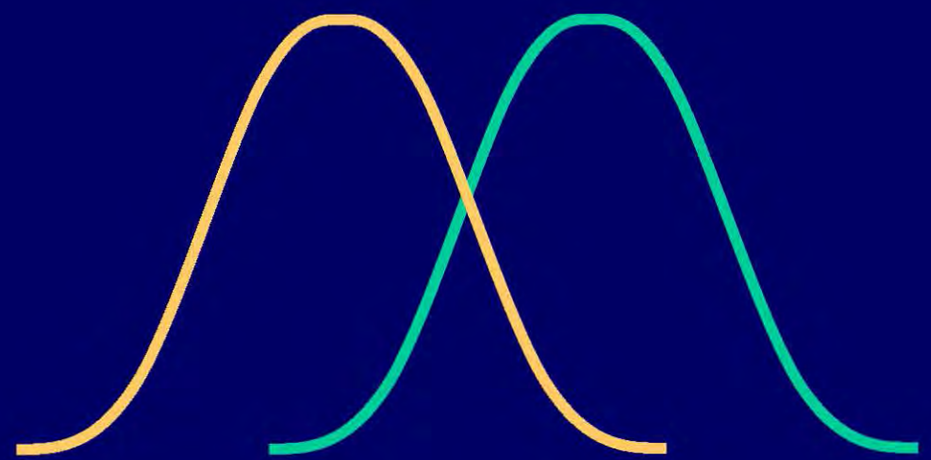
Top Hat

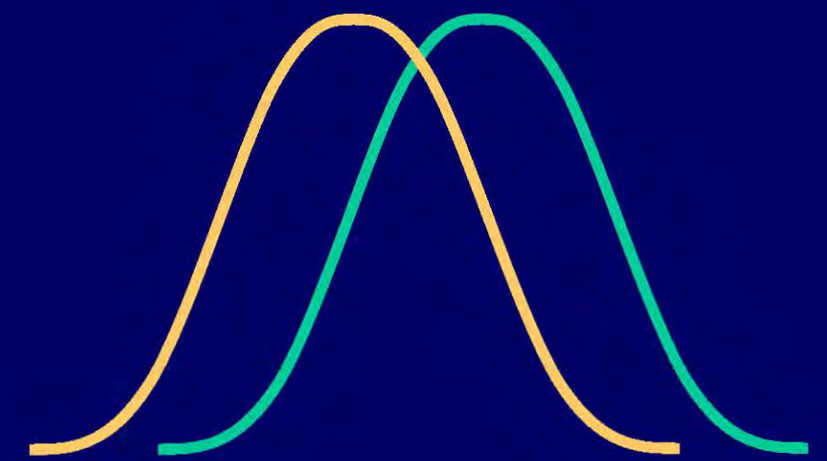


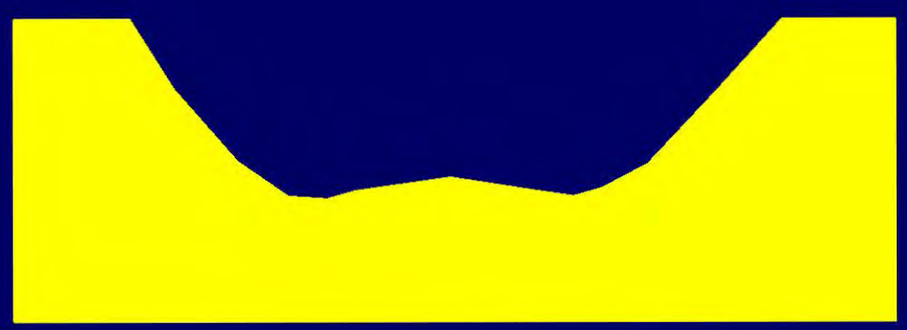
Gauss

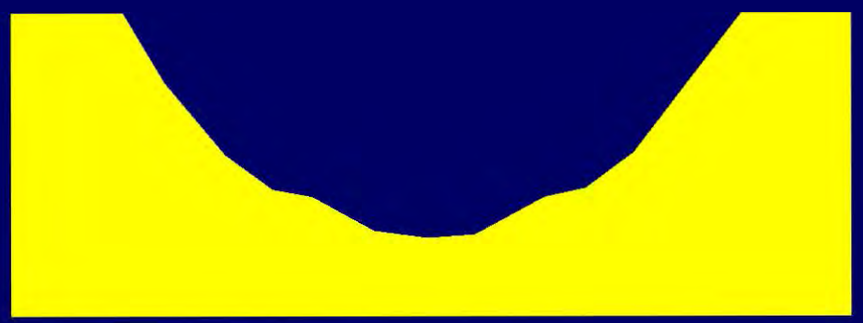






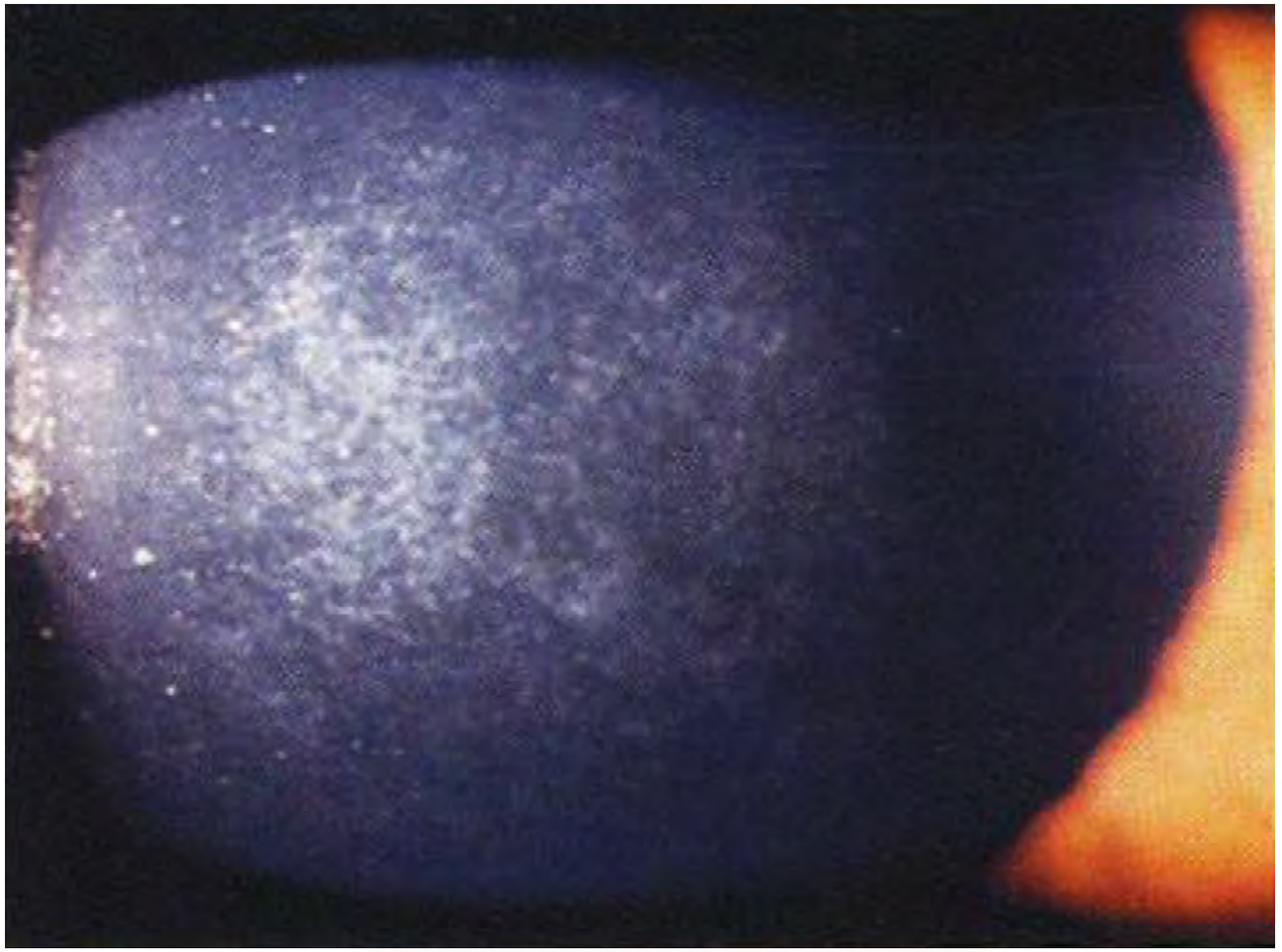






# Biological side effect: thermal damage

- Correlates with haze formation
- Pulse sorting/ repetition rate
- Total dose = Ablation depth



# Physics and Biology

**PRK**

**Physical / Mathematical approach**

**“Biological” approach**

**Cornea**

**(Living tissue)**

# Physics and biology

**PRK**

**Physical / Mathematical approach**

**+**

**“Biological” approach**

**“Biological” approach**

**Living tissue**

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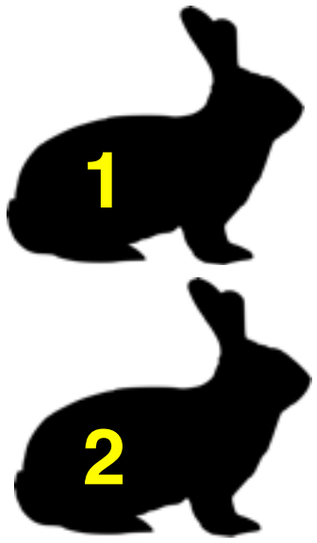
1. Background

2. Biological side effect

3. Physics and biology

Can we optimize the ablation profile using biological parameters (inflammatory regulators) ?

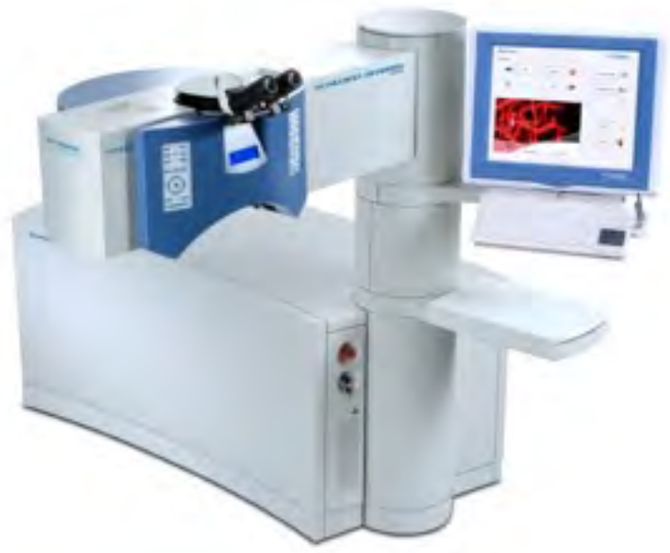



1

**2 days after PRK**

# PRK

- Group 1: Standard irradiance
- Group 2: Low irradiance
- Group 3: untreated (control)
- OZ 6 mm, 112 $\mu$m

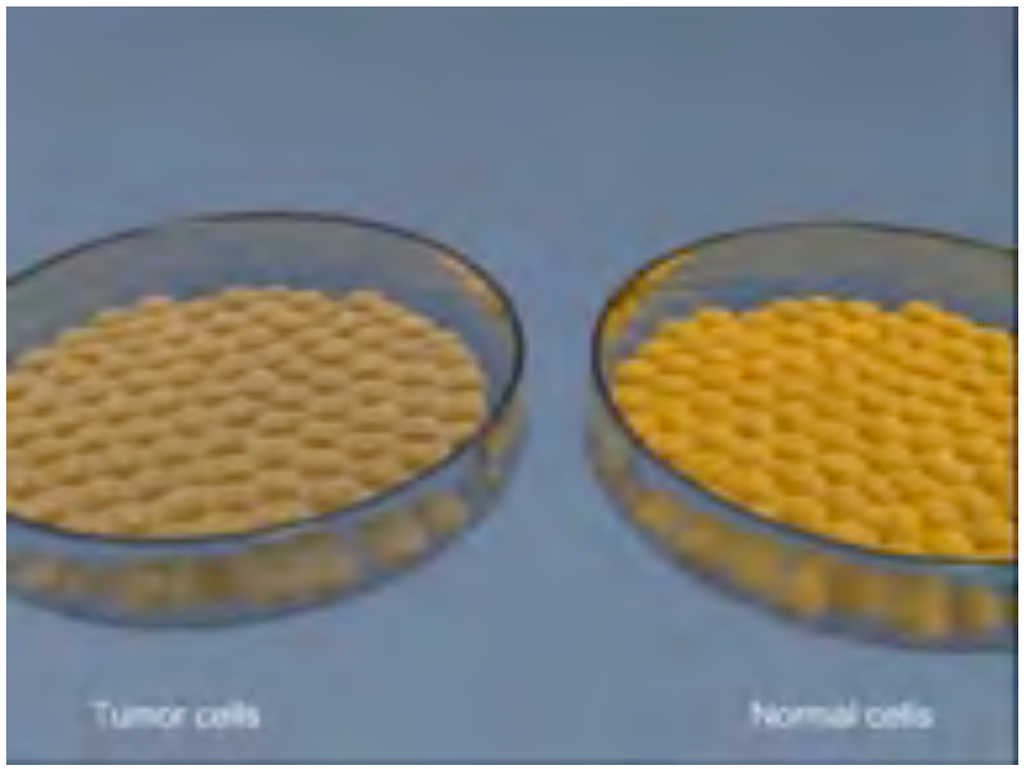


2

## Affymetrix microarray

3

**Identify activated inflammatory genes**

# ARVO 2016

**Results**

The analysis revealed significant differences for 885 transcripts (13 related to inflammation) between low fluence treatments and controls, 1080 transcripts (21 related to inflammation) between normal fluence and controls and 62 transcripts (8 related to inflammation) between low fluence and normal fluence.

- **Platform**
  Schwind AMARIS 1050S

# Benefits

- **Immediate**
  Establish new ablation profiles optimized for the inflammatory response. Less inflammation after ablation.

- **Mid-term**
  Deeper ablation without excessive haze?
  Validate via trials