TECHNISCHE HOCHSCHULE NÜRNBERG
GEORG SIMON OHM

From chips to large-area lighting

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Introduction: Area lighting

Data

	LED chip	Area luminaire
Size	1 mm	600 mm
Luminous flux	100 lm	3000-4000 lm
Intensity distribution	Lambertian	Cut Lambertian, bat wing
Flux / area	100 lm/mm^2	0.011 lm/mm^2

Thus: Area lighting is a perfect application for inorganic LEDs

- Few emitters
- Big area

Easy thermal management

Introduction: Area lighting

Competition

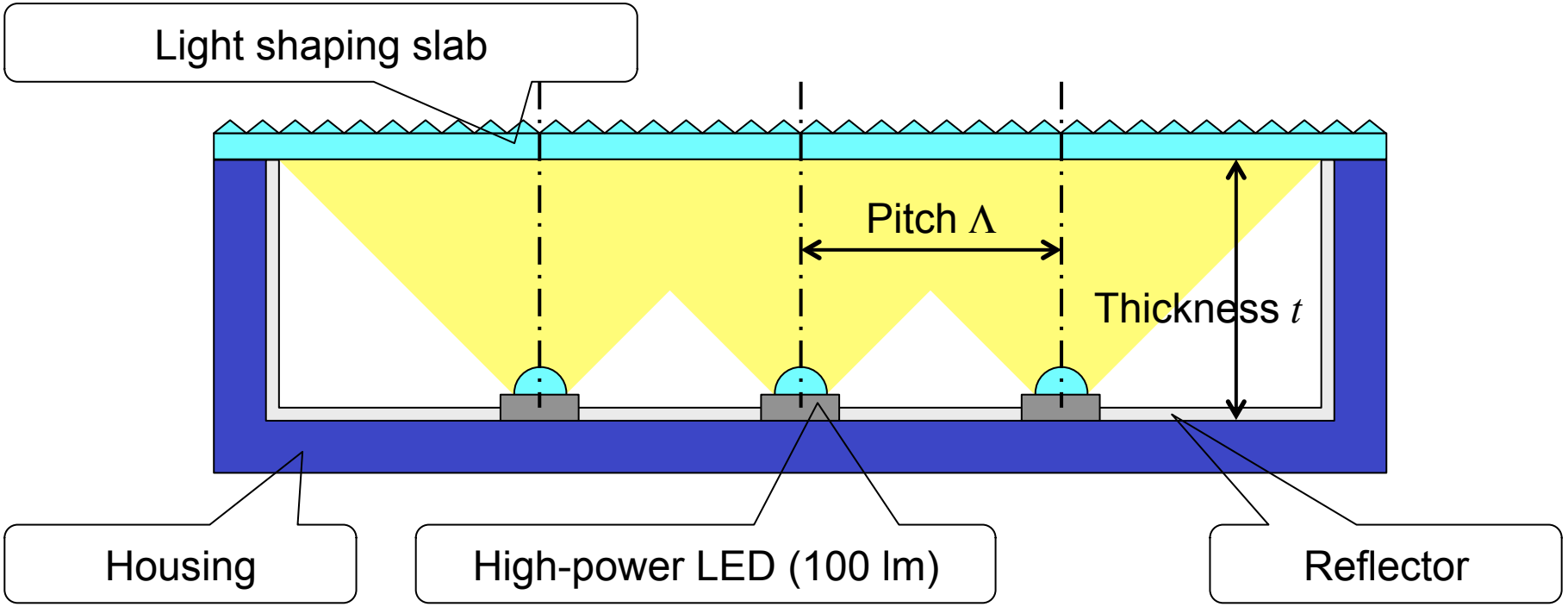
- Aluminum grid luminaire with 3 fluorescent tubes:
- LPW > 70 lm/W in system
- Extremely cheap: 20-50 EUR
- Norm-conformal lighting

Concepts for inorganic LEDs

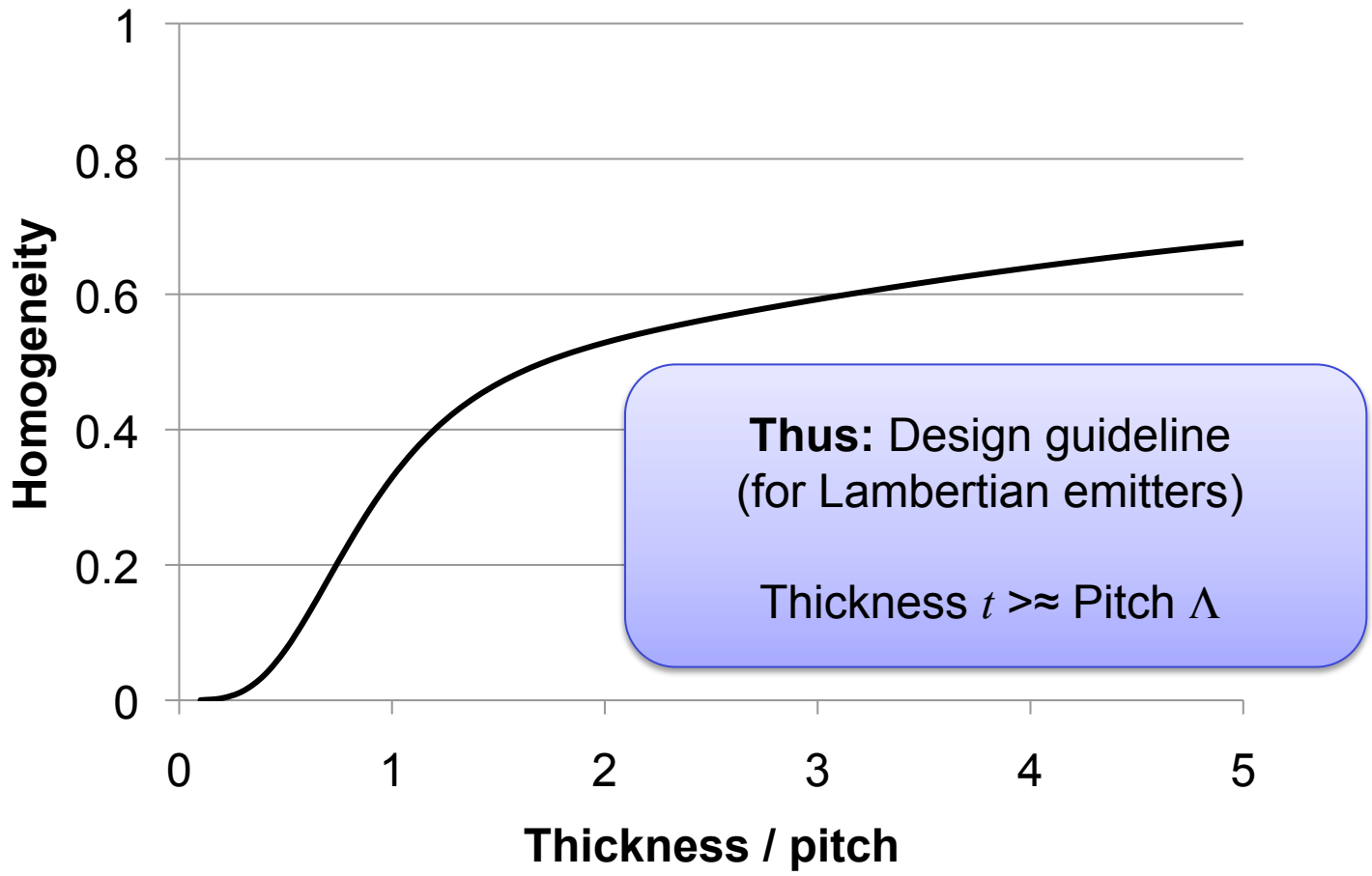
- Direct backlighting
- Edge coupling

Both allow light shaping

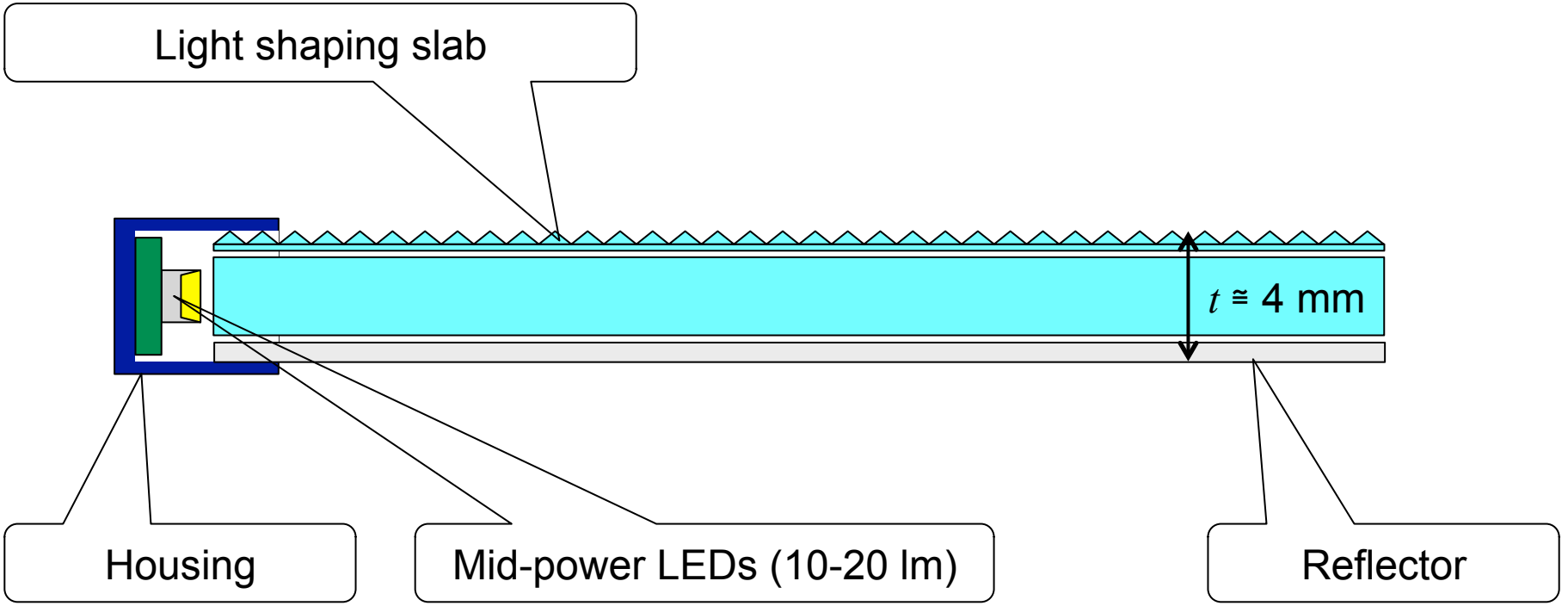
Direct backlighting / light box



Homogeneity

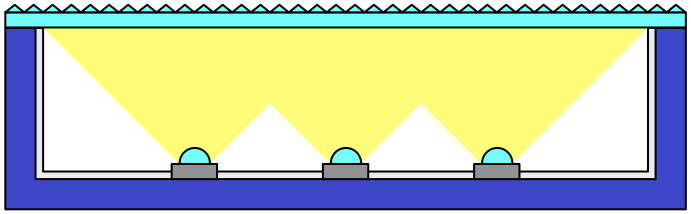


Edge coupling



Comparison

Direct backlighting / light box



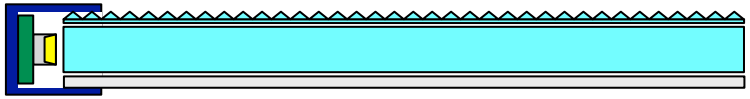
Pro

- High optical efficiency: ≈ 95%
- Simple construction

Con

- Thick: 4-10 cm

Edge coupling



Pro

- Slim setup, attractive designs

Con

- Optical efficiency: ≈ 75%
- Heat concentrated at edges
- Light guide expensive

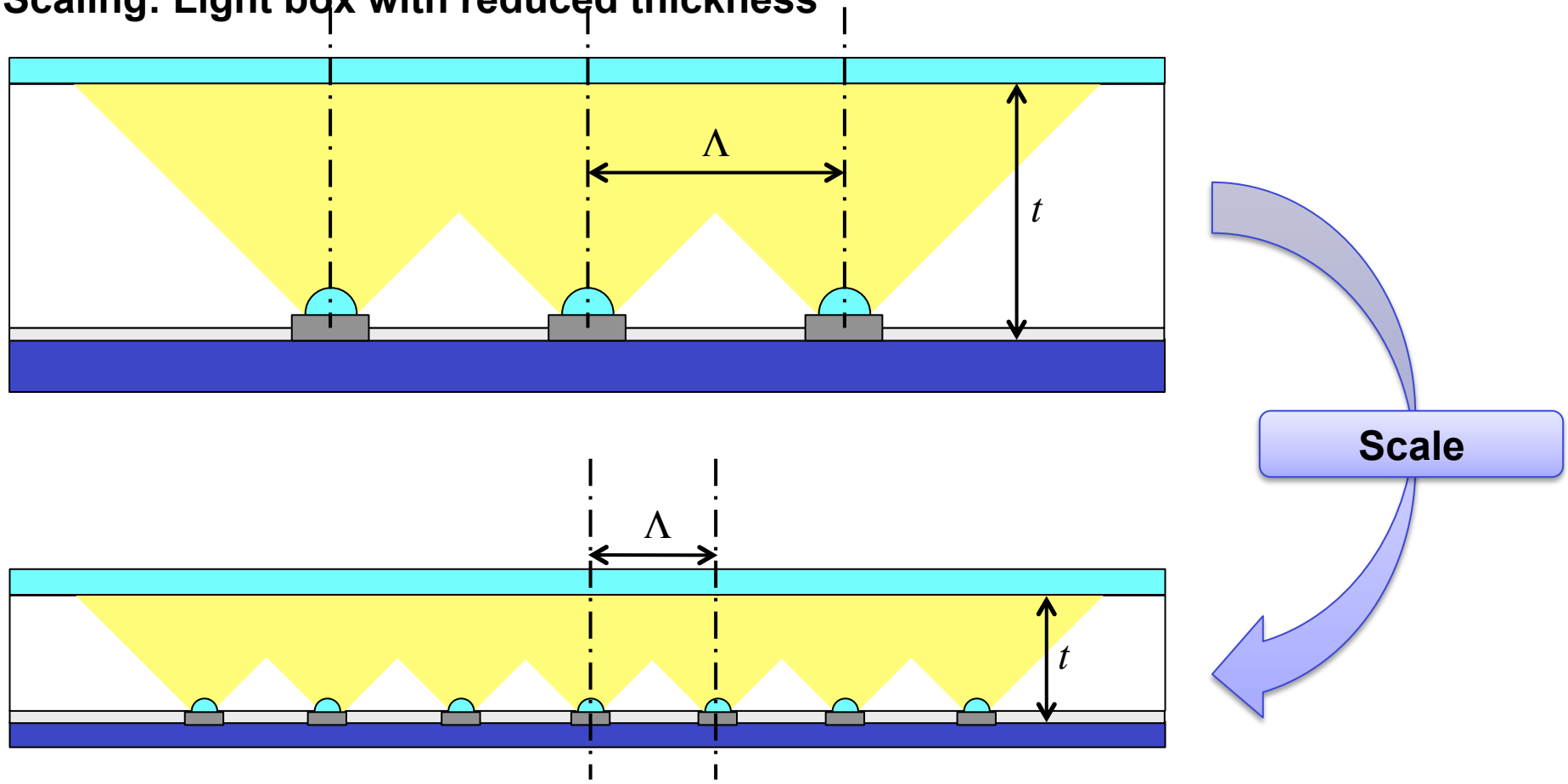
Problem statement

Efficient, thin system concepts

for area lighting with inorganic LEDs?

Slim direct backlighting systems

Scaling: Light box with reduced thickness



Slim direct backlighting systems

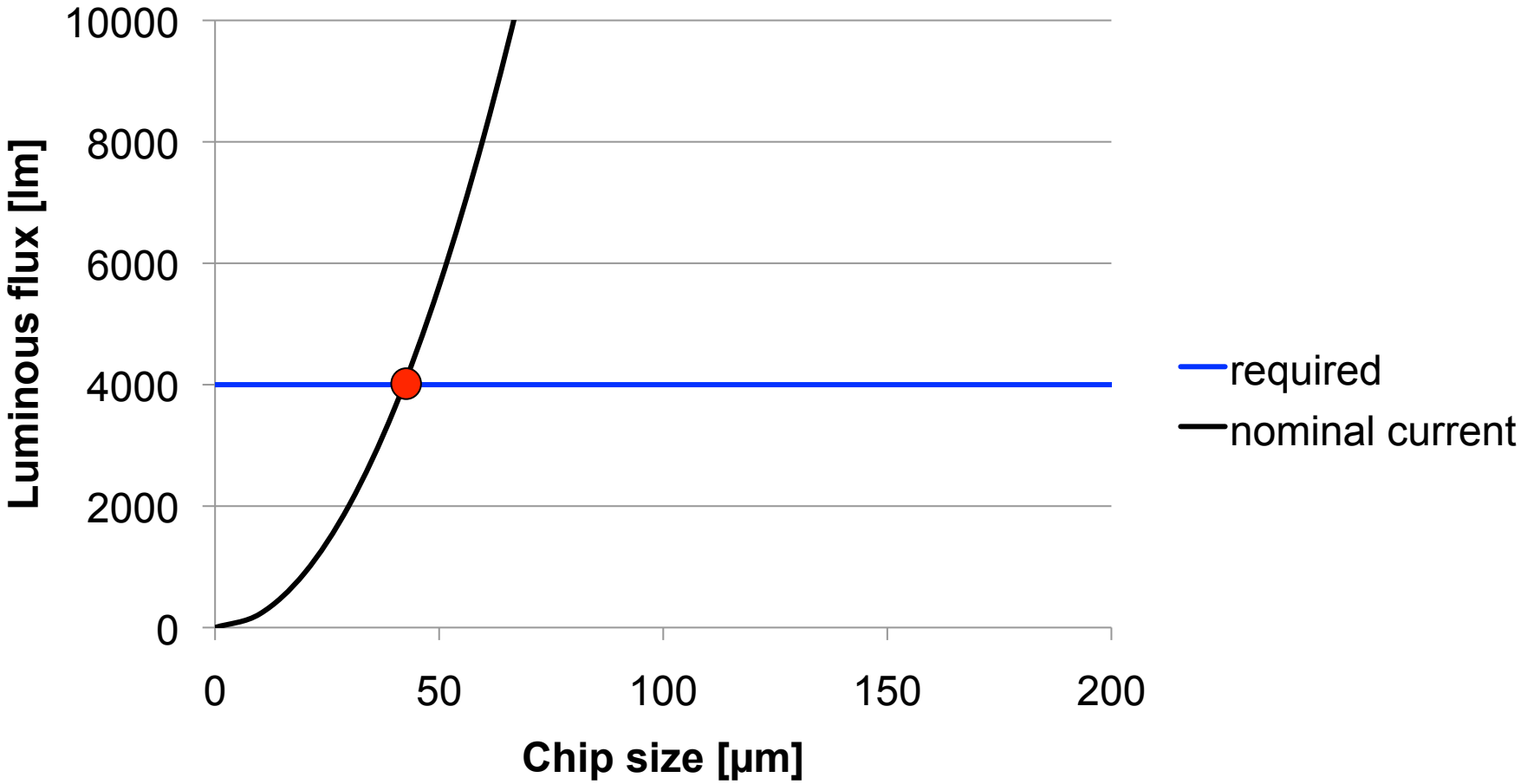
Use typical system data

- Size 600 mm x 600 mm
- Luminous flux 4000 lm
- Thickness 4 mm

Thus

- Emitter count: 22,500
- Emitter size?
  Calculate from required flux!

Slim direct backlighting systems



Slim direct backlighting systems

Result: Required chip size

- ≈ 40 µm LEDs driven at nominal current

Issues

- Circuitry and wiring?
- Economic assembly of 22,500 chips?

Possible ways out

- Unconventional chip architectures and assembly concepts
- Specialized optical elements for emission to high angles

Examples

Unconventional chip architectures and assembly concepts

- Link: http://www.nthdegreetech.com/
- Key idea: Small chips in suspension, printing processes

Specialized optical elements for emission to high angles

- Link: http://www.photonik.de/pl/11/9/0/1122/effiziente-flaechenbeleuchtung-und-qualitativ-hochwertiges-licht-mit-leds.html
- Key idea: Light box with “proprietary primary optics over chips for light mixing and broad emission”

Summary and conclusions

- Two established concepts for LED area lighting
- Fluorescent tube troffers with aluminum grid reflectors still severe competitor
- Research and development on novel area lighting concepts with inorganic LEDs in progress
- Currently no “game changer”

Thank you