LMT Lichtmesstechnik GmbH Berlin

VELAS®

VEhicle Lighting Assessment System

On-Vehicle Headlamp Testing

Stephen Dahle
Dr. Thomas Reiners (Chair of GTB TF-VLLTP)

DrivingVisionNews.com
Automotive lighting and driver assistance technologies

Content

- Motivation
- System Components and Measurement principle
- Measurement performance
- Additional configurations
- Summary

Motivation

- Safety in Automotive Lighting requires reliable photometric data, traditionally generated on a component basis by means of a goniophotometer under laboratory conditions
- With IIHS, CR etc. we see the need for reliable on-vehicle headlamp performance data
- Ambient, local road conditions, and temporal vehicle parameters influence headlight data generated from outside night-drives
  - visibility is influenced by weather conditions and background luminance
  - temperature, humidity and environmental setup varies
  - Road surface reflection and driving parameters limit the reproducibility of test results
  - Headlamp alignment, vehicle suspension
  - Field photometric methods can be “weird and spooky”

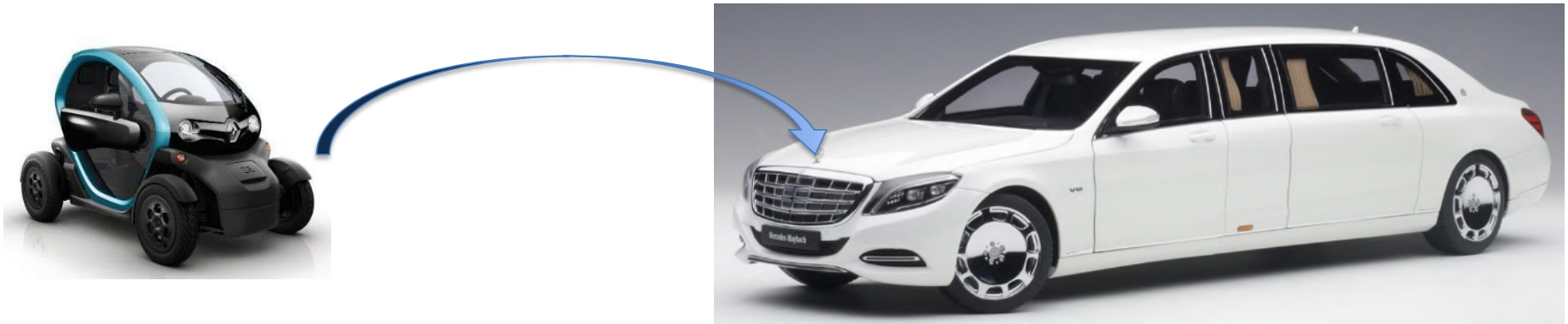
C-NCAP for Front Lighting

The C-NCAP Management Protocol requires Vehicle-Level Laboratory Testing Procedure (VLLTP)

C-NCAP

VELAS® is the test bench for C-NCAP

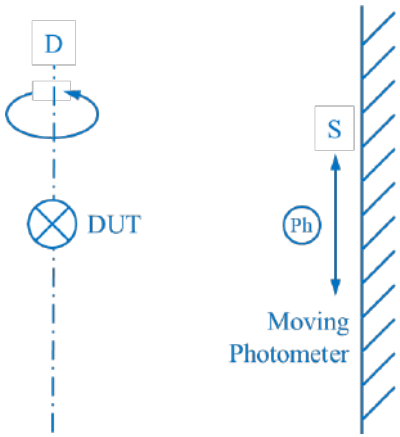
- 1st test stand worldwide for Measurement of headlamp lighting performance under laboratory conditions as installed on the vehicle
- Subsequent Evaluation of road illumination, for instance according to
  → C-NCAP or CIE S 021 (TC4-45)
  → GTB Headlamp Safety Performance Rating (HSPR)
  → Consumer Report Benchmark, IIHS assessment, …
- Devices under test are passenger cars (UNECE category M1)

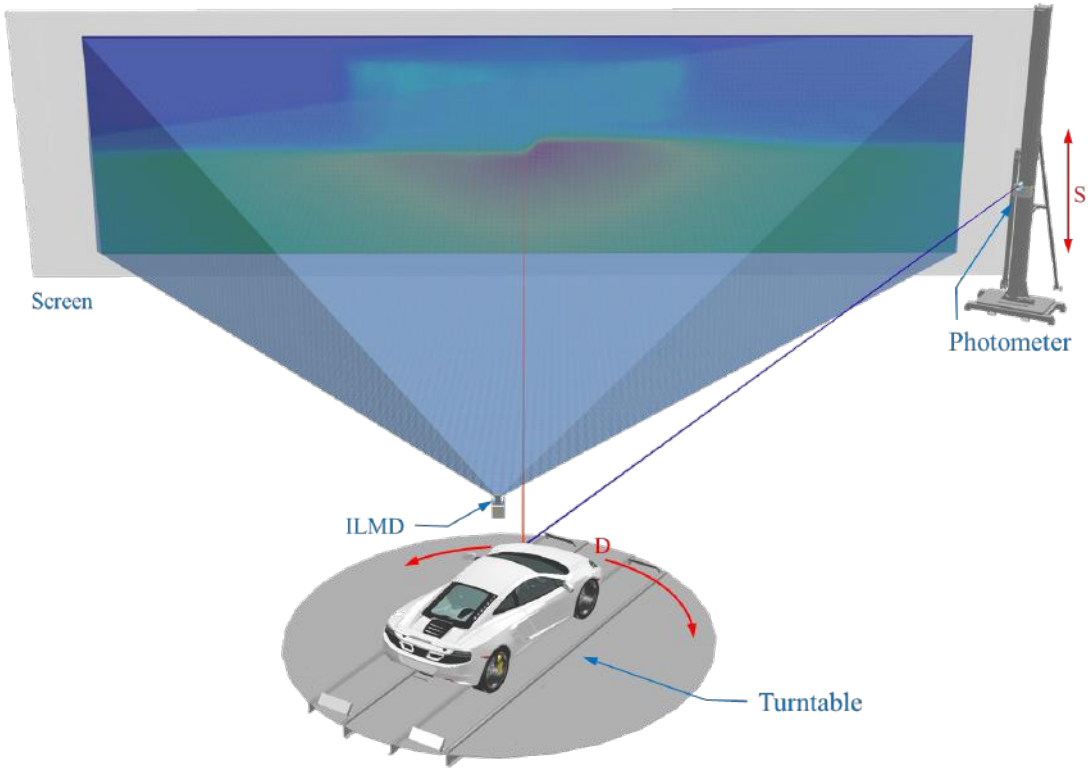


VELAS® GO-CL goniophotometer

Photometer position is fixed on a linear axis/ vehicle is rotated on a high precision goniometer

- Rotatable road (goniometer) and linear axis (photometer) constitute a goniophotometer with moving head (CIE TR-70, IES LM-75-19)



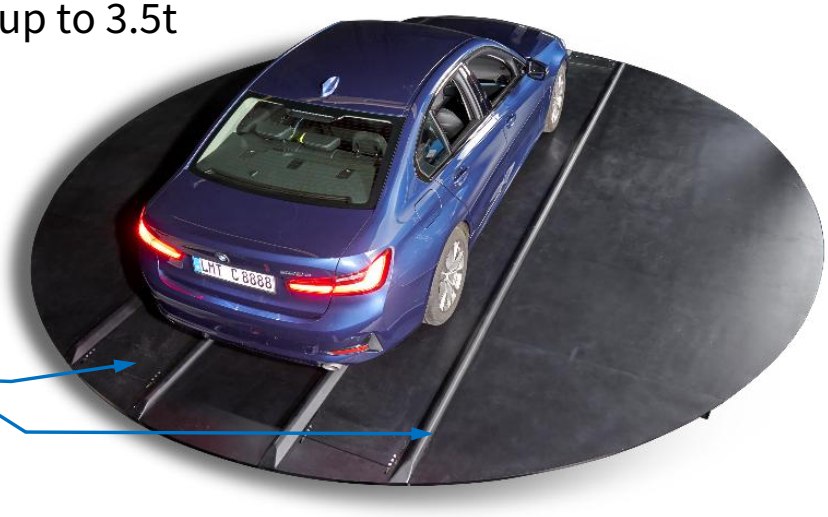


VeLAS® characteristics

All measurement results are geometrically referenced to the “Road”

- 7D–6U, 60L–60R with angular precision ≤ 0.01°
- “Road stability” on driving tracks is < 1mm for loads up to 3.5t

Ultra-stable driving tracks on vehicle goniometer “Road”



VeLAS® characteristics

Photometric Axis (Direct Photometery)

- Class L photometry (LMT) direct photometry (ISO Scanning with goniometer)
- Free standing tower with a heigh of 8m
- Linear positioning accuracy ≤1mm
- Test Distance 25m and thus comparable to component goniophotometry

VeLAS® characteristics

Indirect Photometry with ILMD and Calibrated Screen

- LMT has a partnership with Technoteam Bildverarbeitung GmbH
- LMK-5 with
  CCD (2/3"), 1380 (H) x 1030 (V) Pixel, 14 Bit conversion
- V(λ) adoption f1' < 3.5%
  → correction with class L
  photometer is performed

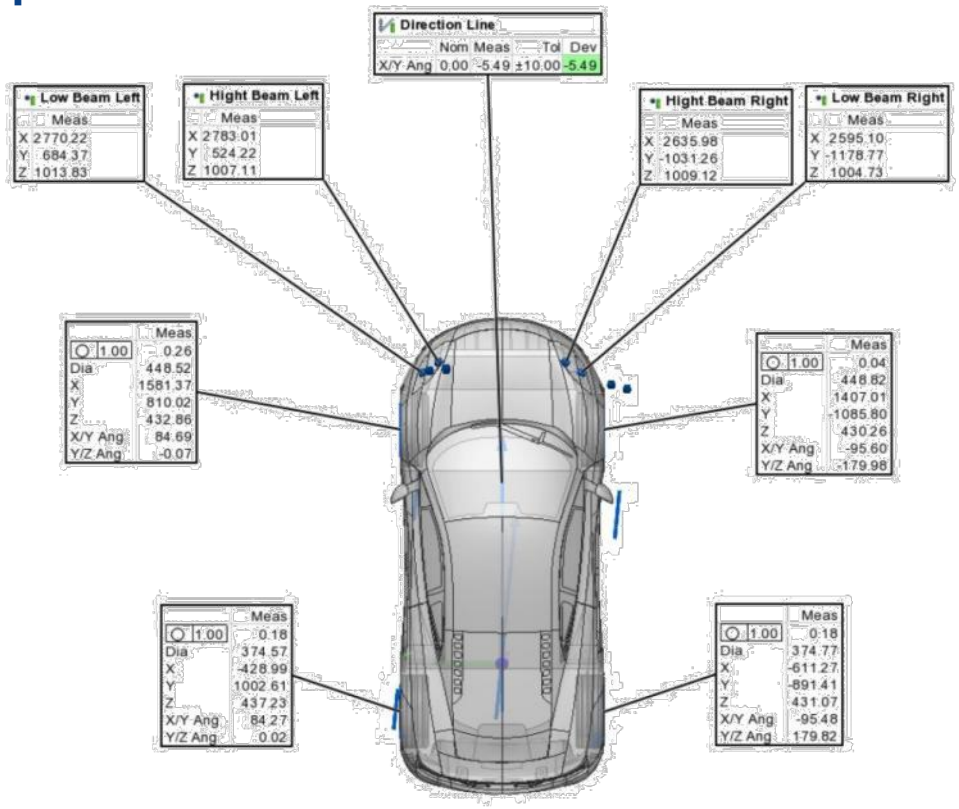
- Rapid generation of ISO-data

by stitching of multiple distribution images against a calibrated screen at 25m

Vehicle location on turn table

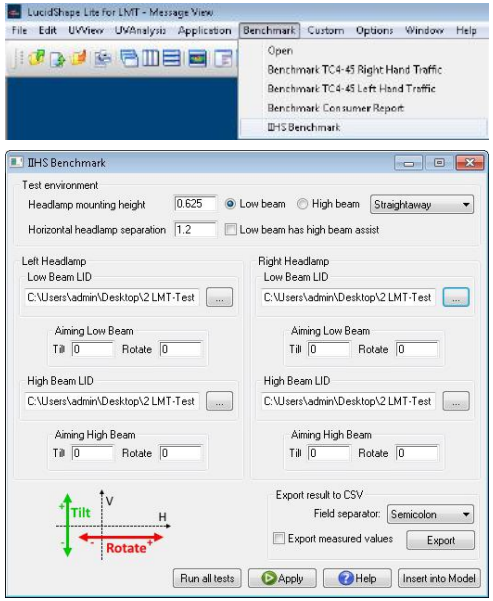
Key to measurement precision is determining vehicle location on turn table and applying an algorithm for off center position of the headlamps

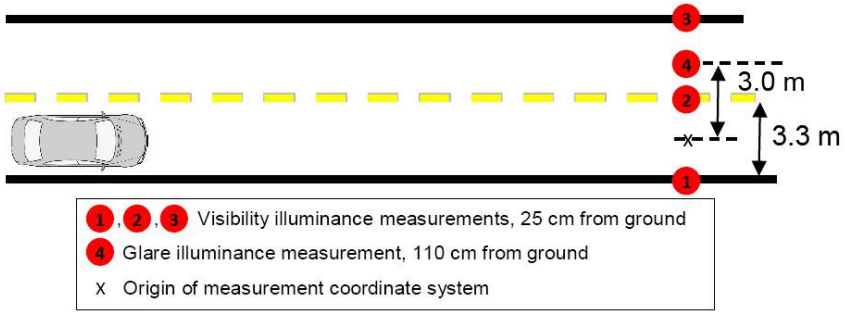
- Once the vehicle is placed on the goniometer, wheels and headlamp positions are measured by a tactile system accurately within 10 minutes
- Vehicle geometry data constitute a subset of each individual light distribution data
- They are necessary for angle and distance calibration as well as for evaluation of road illumination



On top of standard evaluation in LMT software
LucidShape Lite for LMT offers additional benchmark tools

Example:
IIHS benchmark report





Test results

TEST TYPE		VISIBILITY [m]		GLARE	GLARE	DEMERITS		DEMERITS (HBA)	
Beam	Curve	Left	Right	test?	demerits	Left	Right	Left	Right
High	150m L	37.6	48			1.62			
High	250m L	48.1	56.9			1.59			
High	150m R	45.2	33.2				1.84		
High	250m R	58.2	42.9				1.86		
High	straight	15	89			13.5			
Low	150m L	37.9	42.2	OK		3.31			
Low	250m L	41.2	44.6	OK		4.32			
Low	150m R	64	56.8	OK			0.479		
Low	250m R	80.2	72	OK			0		
Low	straight	40.9	69.7	OK		8.6	9.09		

FINAL DEMERITS: 52.2974 for performance classification

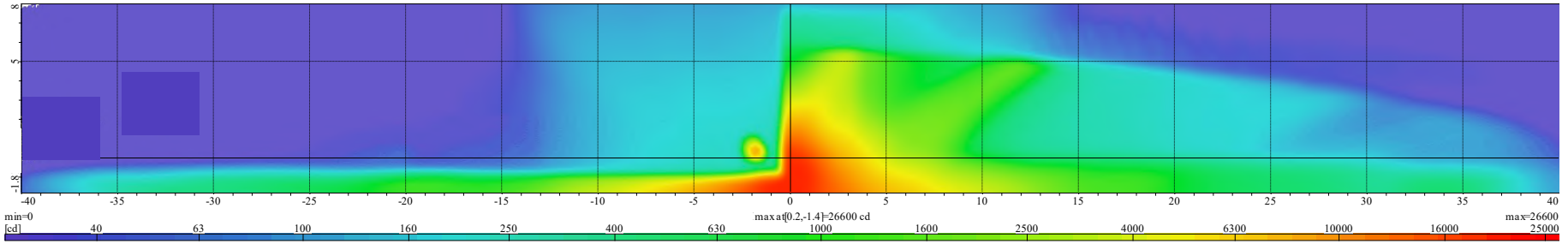
00:00:00:00

Content

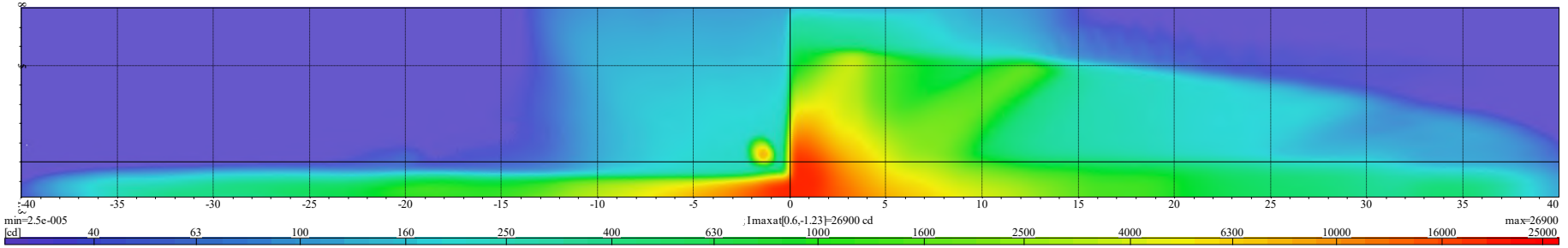
Photometer measurements

Perfect match of on-vehicle data and conventionally gained measurement data

- GO-H – conventional A-type goniophotometer

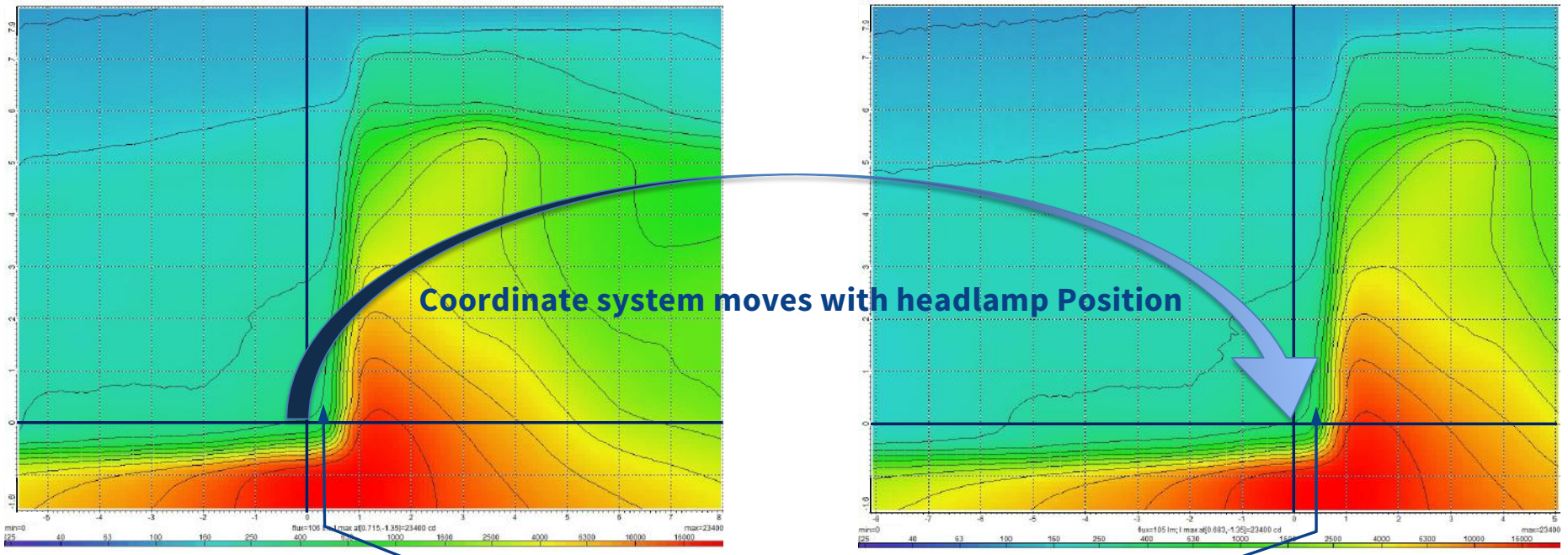


- GO-CL – on-vehicle measurement with VELAS® goniophotometer



Screen photometer

Captured headlamp distributions are independent of their mounting position on vehicle



Content

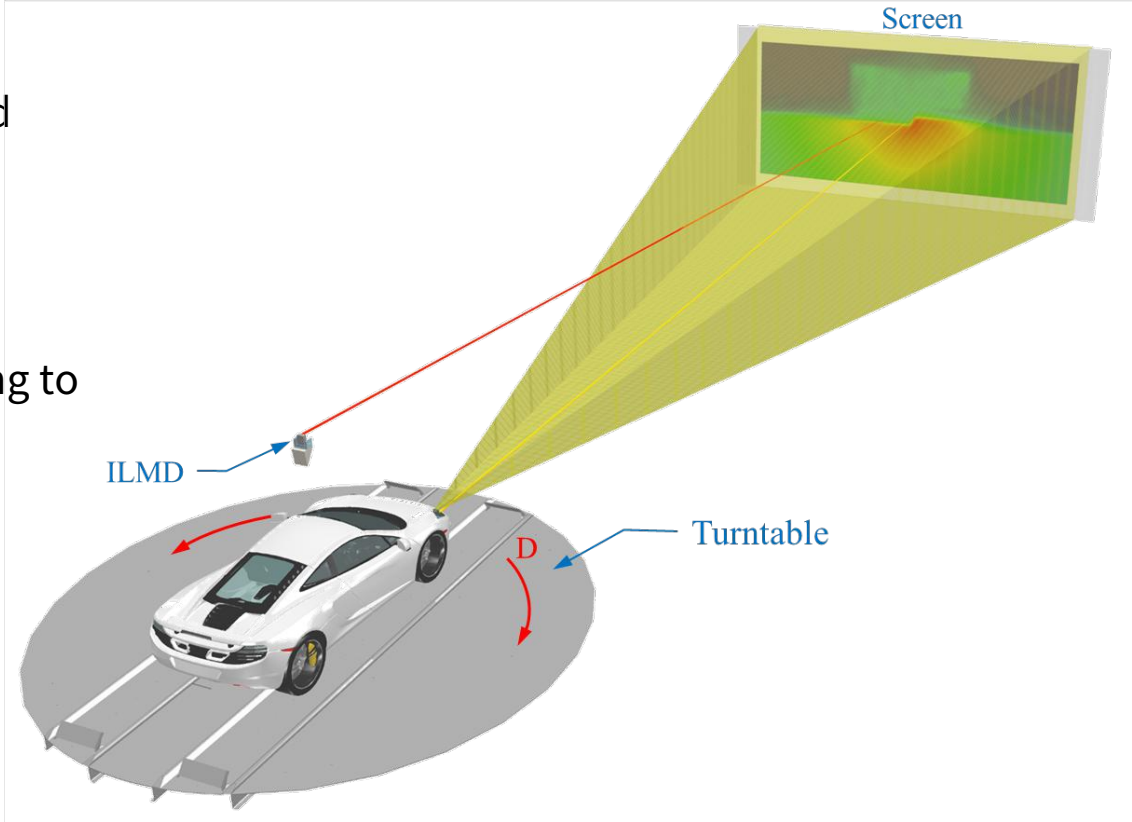
Additional Configurations

- The VELAS ® goniophotometer system can be modularly configured
  a) **2-axis** configuration with direct (photometer based ISO-Scanning) and indirect (camera-based ISO-Stitching) measurement of luminous intensity distributions e.g. C-NCAP
  b) **1-axis** configuration with camera-based goniophotometry ISO-Stitching
  c) **0-axis** configuration with camera for immediate assessment of headlamp aim and centre beam characteristics for benchmarking, vehicle preparation, etc.

VELAS® GO-C goniophotometer

1-Axis configuration with camera-based goniophotometry for standard test purposes

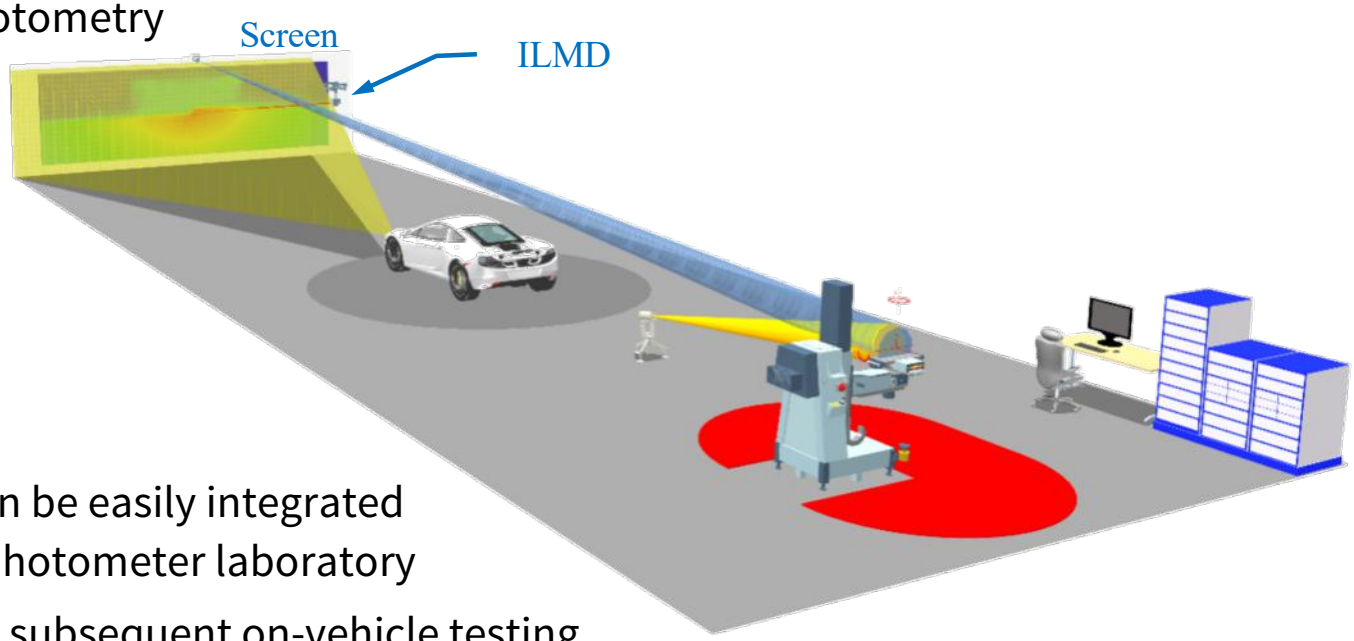
- Rapid LID generation via turntable in combination with indirect screen and camera
- Multiple images are stitched into the required solid angle
- Screen width can be chosen according to building restrictions
- Screen height determines the accessible vertical angle



VELAS® GO-C goniophotometer

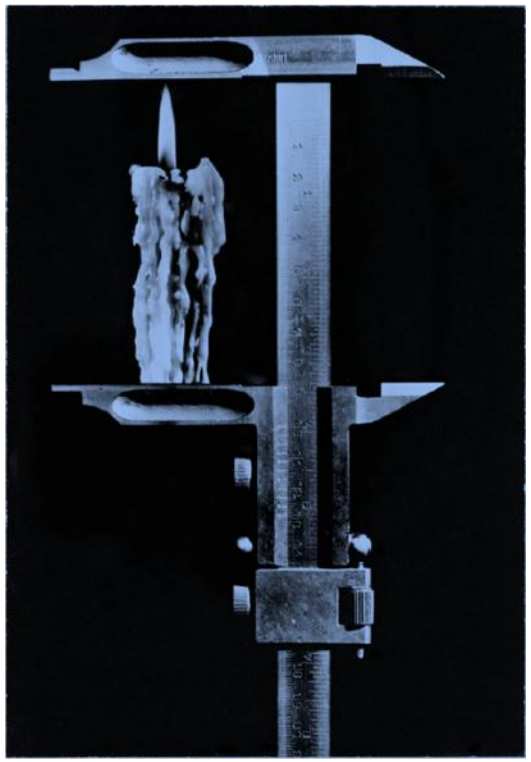
0-Axis configuration for quick assessment of headlamp aim and centre beam characteristics

- Vehicle position is determined on a “virtual” turntable
- Accessible LID is captured on the screen via camera-based goniophotometry
- Headlamp mounting height determines the accessible vertical angle



- The measurement setup can be easily integrated into an existing LMT goniophotometer laboratory combining component and subsequent on-vehicle testing

Contact



Contact

stephen.dahle@lmt.de

Thank you