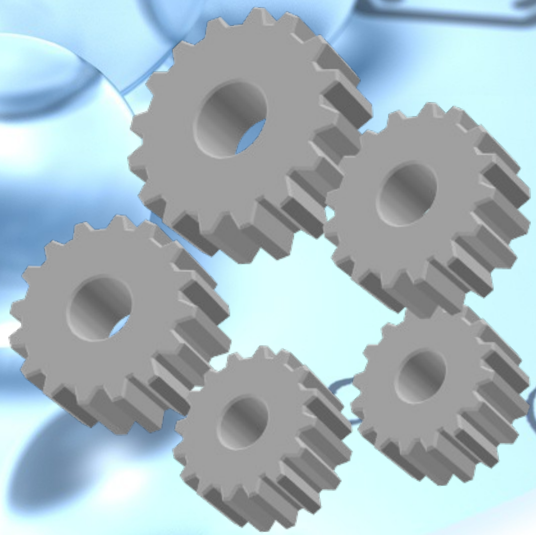
OPTOELECTRONICS GROUP
Harder Digital



HARDER. digital SOVA

PHOTON OPTRONICS

SOVA N VISION

Real electronics SERBIA

History of HD Opto Group

1975 – founded EI Sova , - vacuum technology as basic technology

1978 – 1992 Production of II Gen 1 , own R&D for production of II Gen 2

1992–2000 Sanctions , break of regular production, only repair of NVD

2000-2006 Critical period , looking for strategic partnership
1999- founded Harder Digital, Germany

2008 –Privatization of EI Sova, as HD Sova
Harder Digital Germany strategic partner

2009 – Founded Real Electronics
2010 – Founded Photon Optronics
2011 – Founded Sova Night Vision
2016 – Appeared as HD Opto Group

World trends in image intensifier technology

	Microchannel plate	Image intensifier	Power supply	Night vision devices
World trend	6- µm long life USA, Russia, France, Japan, China	3rd gen USA, Russia	Autogating PS USA, Russia, France	Riffles, goggles, monoculars – standard Fusion systems-R&D USA, Russia, Germany, Israel, France, China
HD Opto Group	Photon	HD Germany + HD Sova	Real Electronics	Sova NVision

Production portfolio of HD Opto Group

Night vision devices

based on

- Image intensifiers
- Thermal imaging
- Laser active range gating - R&D

CONCEPT "IN HOUSE TECH"

- *Research*
- *Development*
- *Production*
- *Maintance , service*

HD Opto Group

Facilities infrastructure

- Processing Rooms
- Clean Rooms Class 100 - 1,000
- Clean Rooms Class 10,000
- Dedicated Chemical Processing Rooms
- Air conditioning and Humidity control: 19 - 21ºC , 35 - 50% RH
- De-ionized water plant
- Pressurized dry oil-free Air supply
- Pressurized dry Nitrogen and Hydrogen supp
- Electrical and other supplies

	Space	Clean rooms
Harder Digital	1.200	500
Harder Digital Sova	4.500	300
Photon Optronics	1.300	450
Sova N Vision	170	-

Basic technologies

- Vacuum technology
- Material science
- Deep drawing of metal parts
- Techno chemical operations
- Sintering and pressing
- Glass mechanical work
- Glass –metal – ceramic joints
- Photocathode processing
- Luminescent screen production
- Optical fiber drawing
- Thin layer coating
- Plasma fisics

Support

- Nano Lab
- CNC machining
- Software developing

HD Opto Group

Strategical decisions in 2016

Diversification of production portfolio and developing of civil applications for specific nische market as
-Rail application (obstacle-detection on rail tracks with multiple sensors)
-Firefighting applications (visibility through smoke)
-Specialized optoelectronic cameras and multisensors platforms supported with customized softwares for image processing
-Smart helmets with augmented reality

Inovation Projekts - EU Fonds Horizon 2020 , Inovation Fond of Serbia

Model for faster financing of R&D Projects

Necessary preconditions
-Education of staf in the companies – all profiles
-Cooperation with Universities and Institutes

School of Electrical Engineering - Beograd ,
Faculty of Mechanical Engineering - Niš
Faculty of Mikroelektronics – Niš

Innovative Projects

Rail applications

Autonomous obstacle-detection on rail tracks with multiple sensors

Horozon 2020 - SMART Shift to rail

Current situation - short range obstacle detection, up to 100 m
- stereo vision, mono cameras, radar and laser

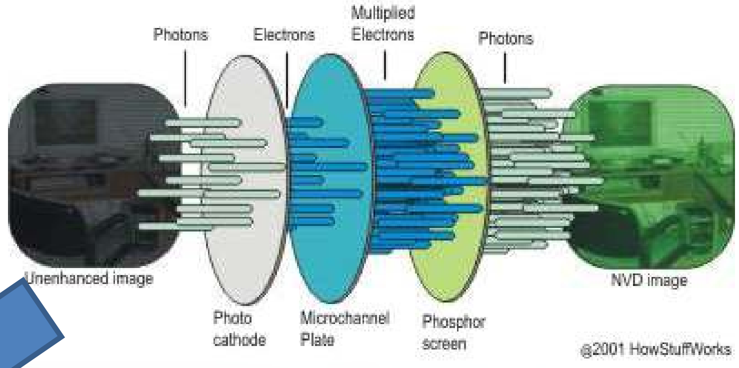
SMART project – integration of ICCD camera with a thermal camera, multi stereo-vision system and a laser scanner

Range - mid (up to 200 m) and long range (up to 1000 m)

Project - finalization to the end of 2019

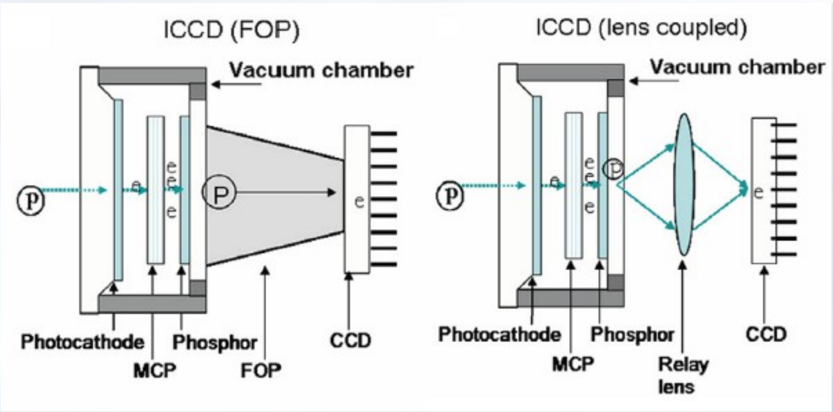
Specialized cameras

Intensified day/night camera with image enhancement
Innovation Fund Serbia 2018



Step 1. Operational and in-house developed image intensifier production line

Step 2. Develop CCD coupling to SOVA image intensifier tube.



Step 3. Image enhancement using advanced digital processing

Ministry of Education, Science and Technological Development

REPUBLIC OF SERBIA INNOVATION FUND

GOVERNMENT OF THE REPUBLIC OF SERBIA PUBLIC POLICY SECRETARIAT

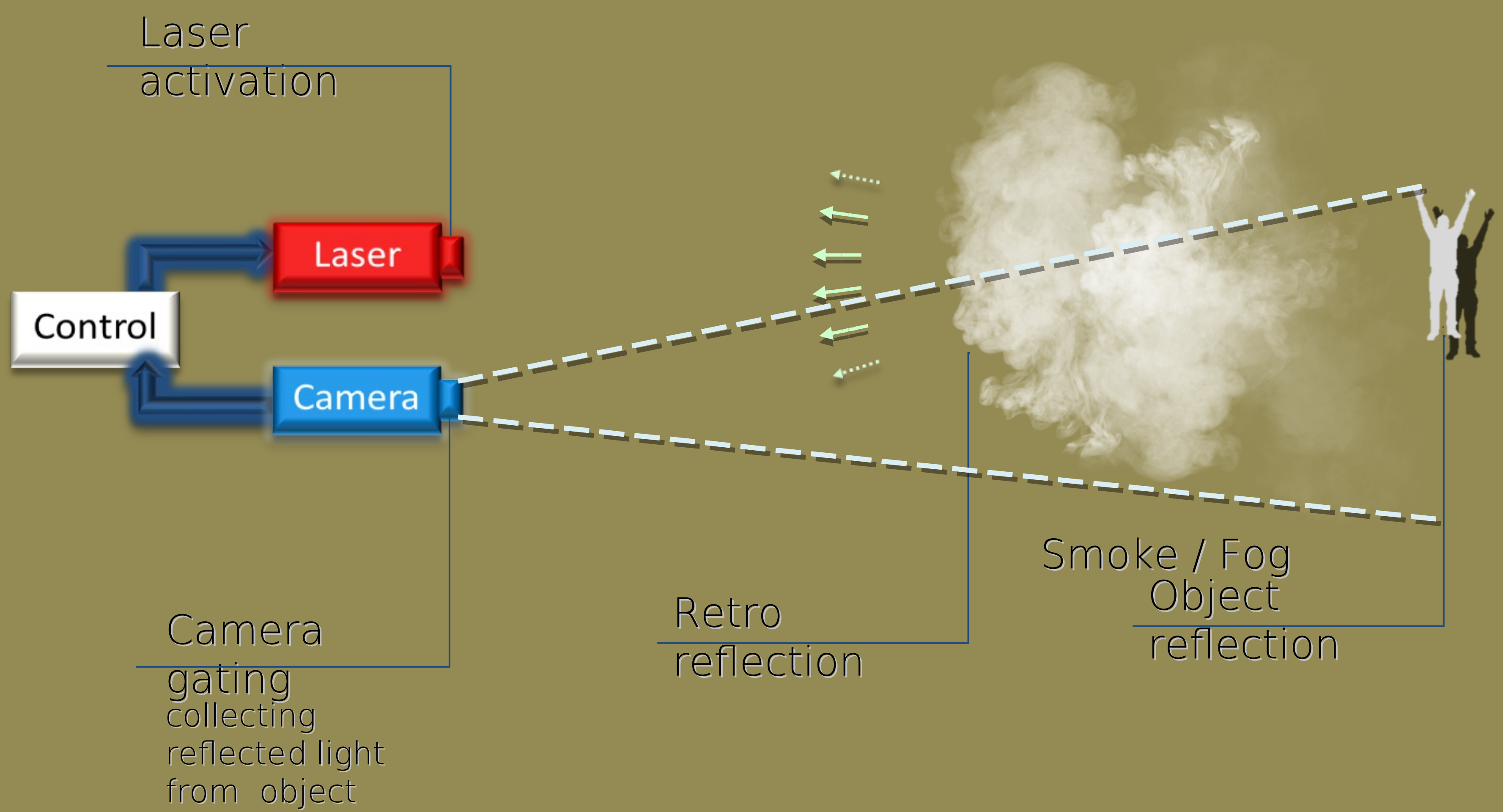
WORLD BANK GROUP

2.5D LADAR device

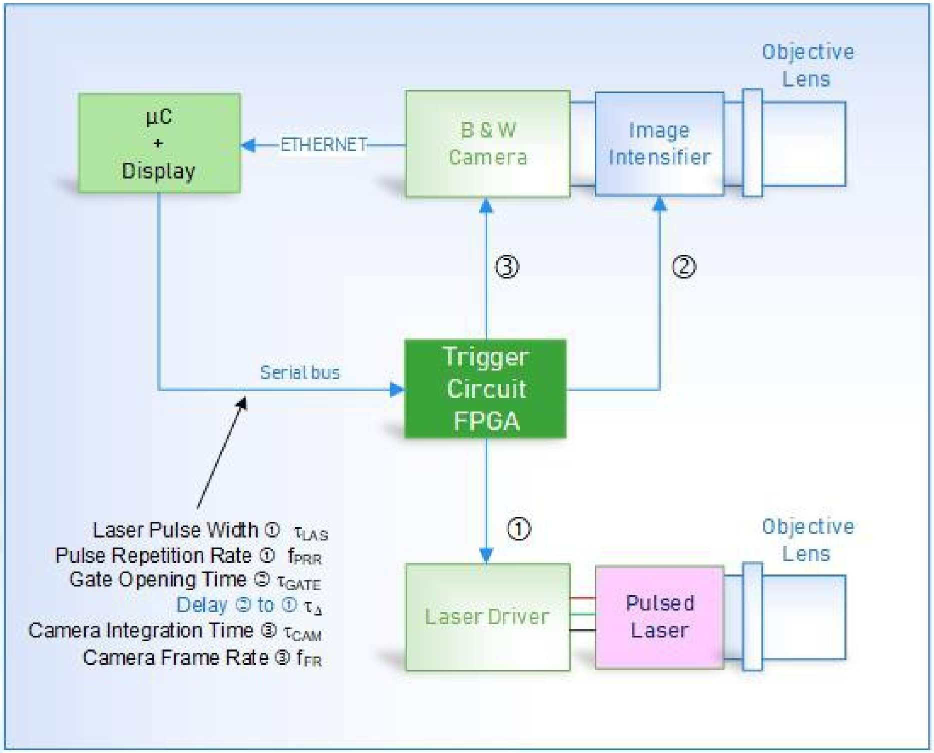
FIREFIGHTING APPLICATIONS
VISIBILITY THROUGH SMOKE

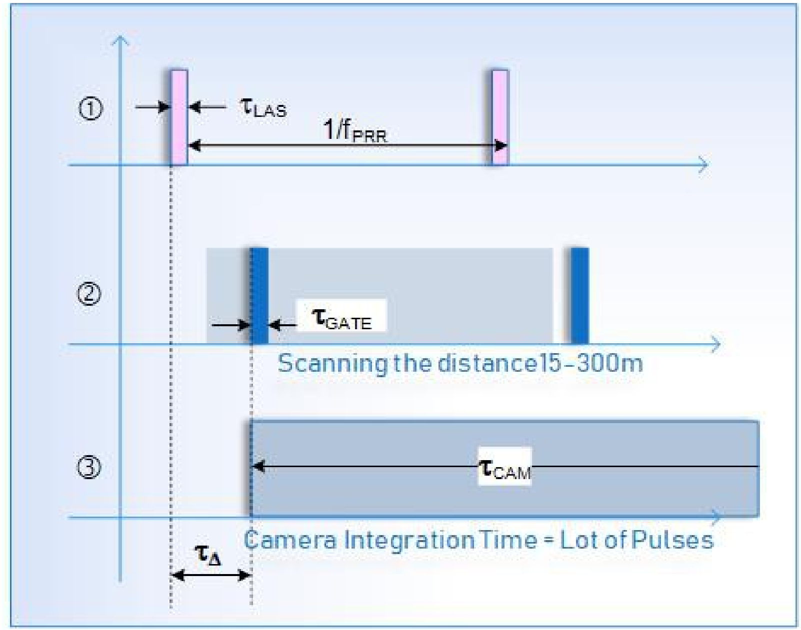
Project is supporting by Innovation Fund of Serbia
Start of Project – November 2018
End of Project – November 2021

□ RANGE-GATED ACTIVE IMAGING



DEVICE SCHEMATIC & TIMING DIAGRAM





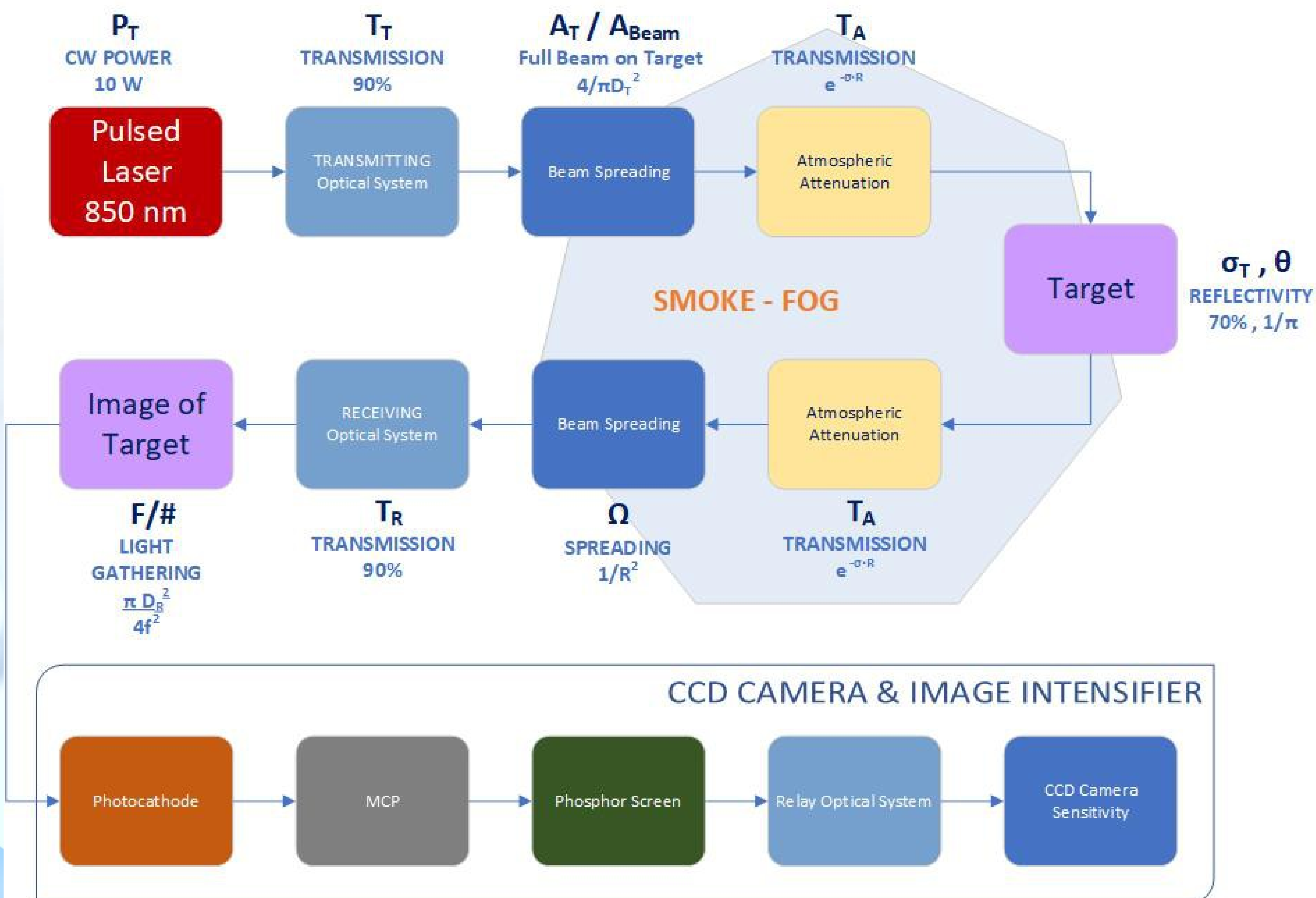
There is no changing of t_D during a camera integration time t_{CAM}

τ_{LAS} = 10 ns - 50 ns	Laser Pulse Width
$\tau_{GATE} = \tau_{LAS} + \tau_{ADD1}$	Gate Time Width
τ_Δ = 50 ns - 1000 ns	Delay of Gate Opening to Laser Pulse
$1/f_{PRR} = \tau_{LAS} + \tau_\Delta + \tau_{GATE} + \tau_{ADD2}$	Laser Pulse Repetition Rate
τ_{CAM} = 40 ms - 100 ms	Integration Time of Camera Frame
$1/f_{FR} = \tau_{CAM} + \tau_{ADD3}$	Camera Frame Rate

10 ns = spread along 3 m in space

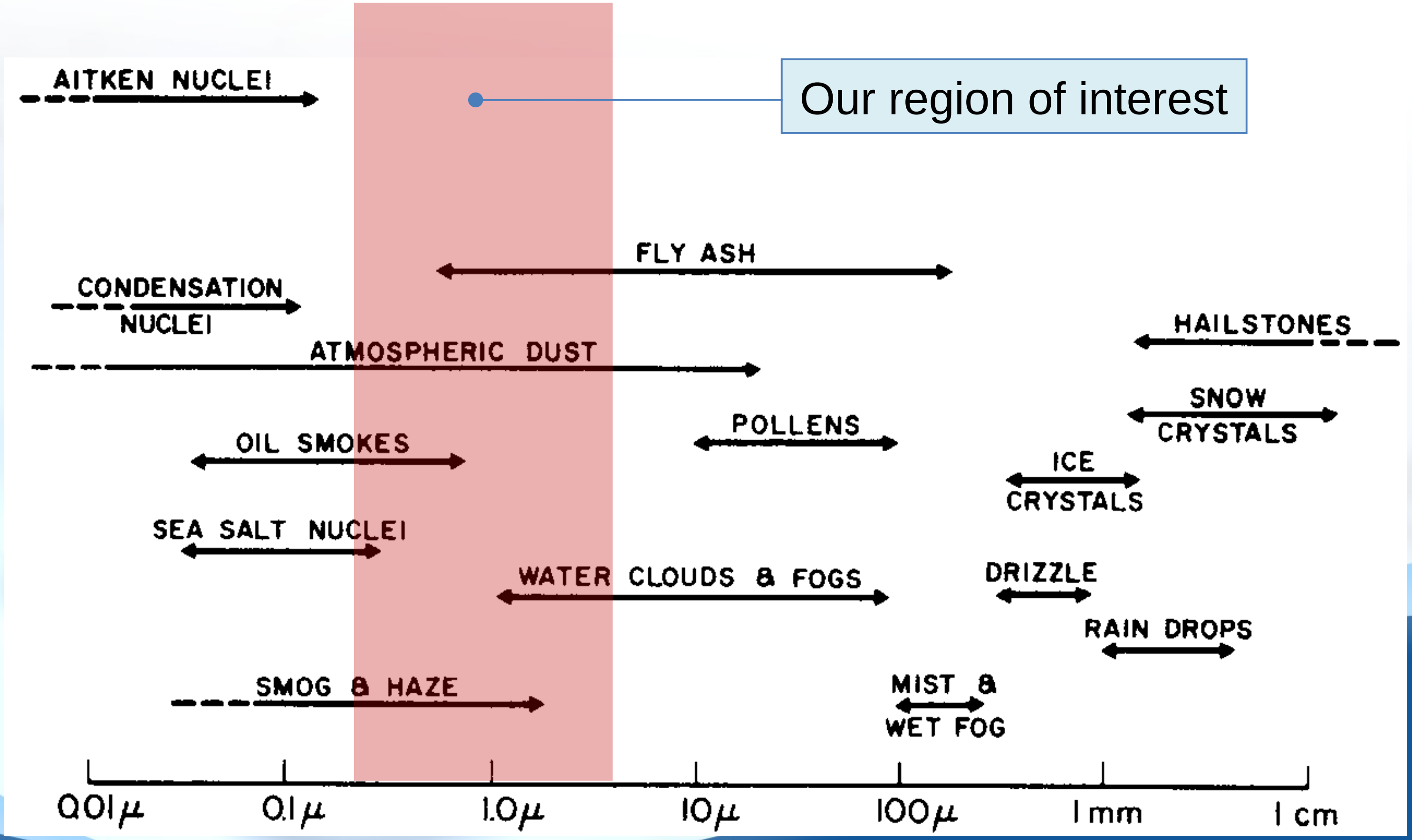
= 1.5 m of distance resolution

OPTICAL POWER BUDGET - CALCULATION



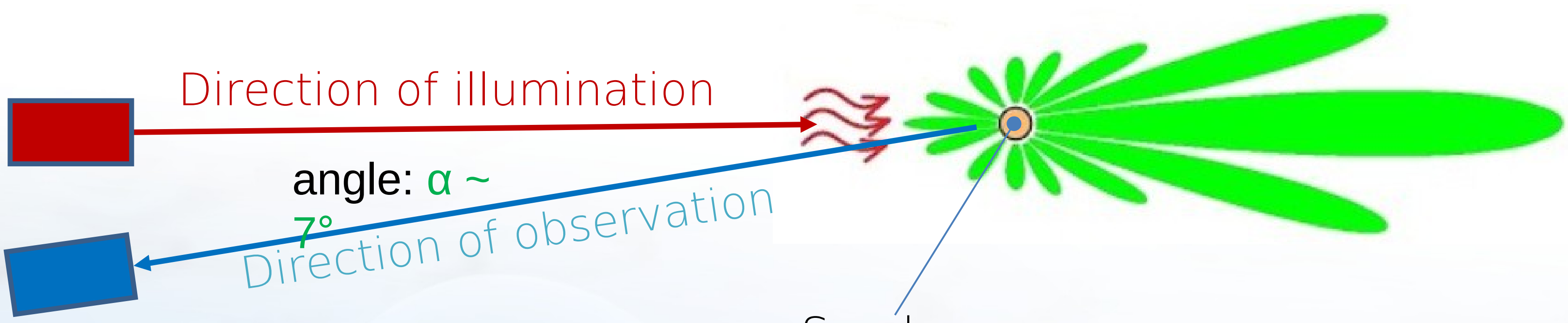
SCATTERING BY SMOKE

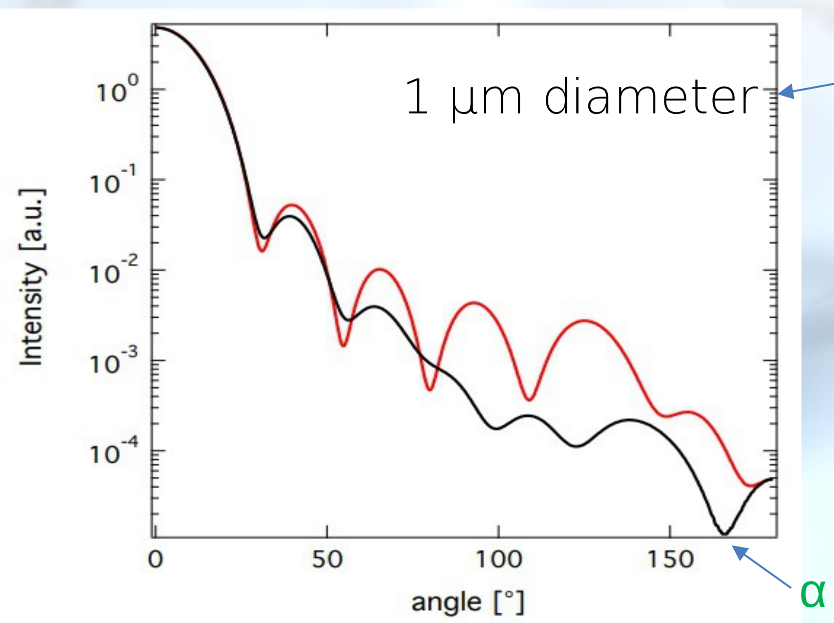
Light transmission through atmospheric obstacles is determined by scattering, which is dependent of **particle size** and **light wavelength**

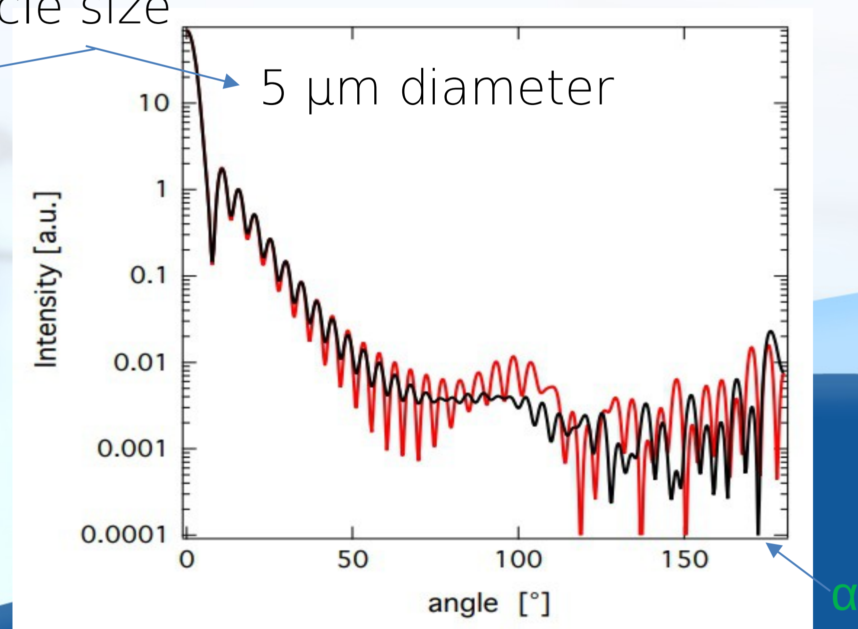


□ DIRECTION OF ILLUMINATION

How to avoid large retro-reflection from smoke particles?
Solution: separate the illumination device and the camera







WAVELENGTH CHOICE

Why we choose the wavelength of **850 nm?**

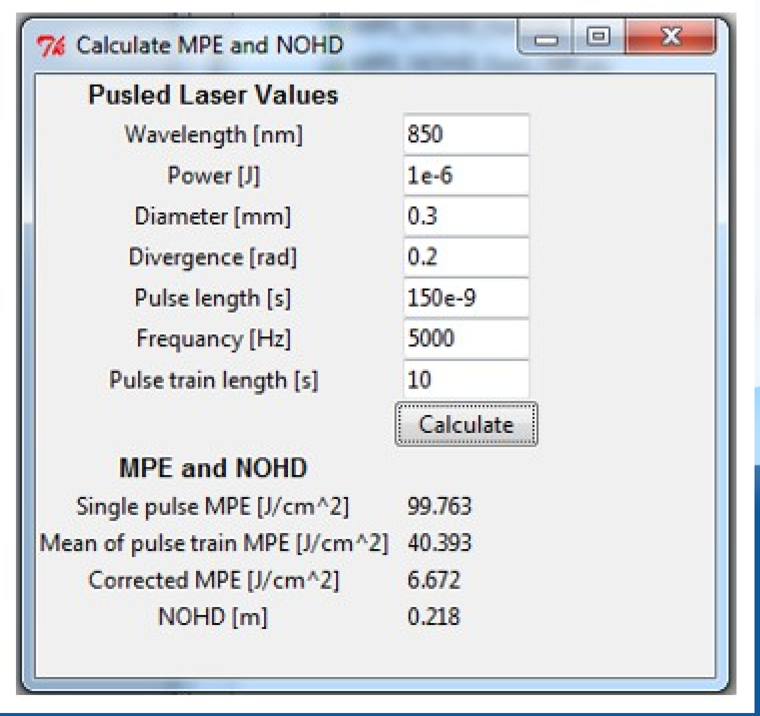
Available gated image intensifiers
(Gen. III, in-house production)
with high sensitivity at 850 nm

Available high-power
laser diode illuminators
at 850 nm

□ SAFETY CONSIDERATIONS

- Laser sources must be configured in a way that there will be <u>no danger to the observers and targets !</u>
- Field conditions imply necessary laser pulse power, duration and repetition rate to see through the smoke, but – this can be dangerous !

→ these parameters will be used for real time calculation of allowed values which must satisfy maximum permissible exposure (MPE) and adjusted accordingly The NOHD is the distance along the laser beam to the point at which the beam does not exceed the laser's maximum permissible exposure (MPE).



Future work

Research and development will be focused on shifting the laser illumination towards longer wavelength where:

•the scattering is less problematic, and

•illumination is eye-safe

Future work I

Receiver: Gated Image Intensifier with GaAs £
photocathode sensitive till 1100 nm

Illuminator: Pulsed Nd:YAG Laser @1064 nm or
High Power Pulsed Laser Diode @980 nm

- Reduced scattering from atmospheric obstacles due to a larger wavelength
- More laser power from commercially available laser sources

Future work

Receiver: Gated SWIR camera §

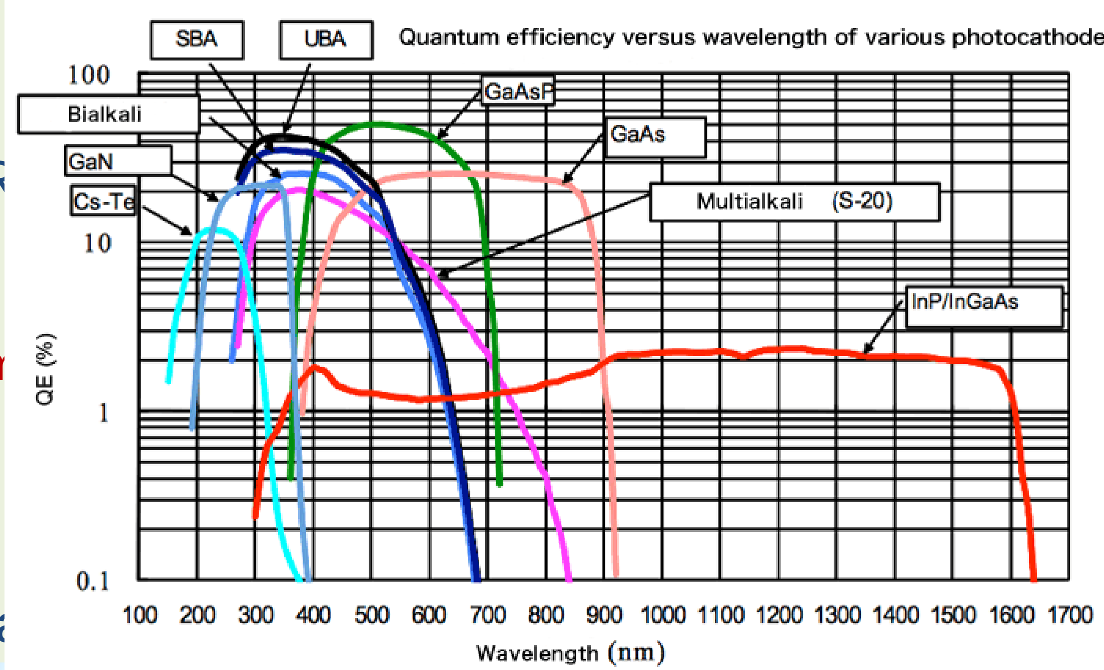
Illuminator: High Power Pulsed LD @1550 nm

- Reduced scattering from atmospheric obstacles
- Sensitive in NIR and SWIR
- Eye safe wavelength

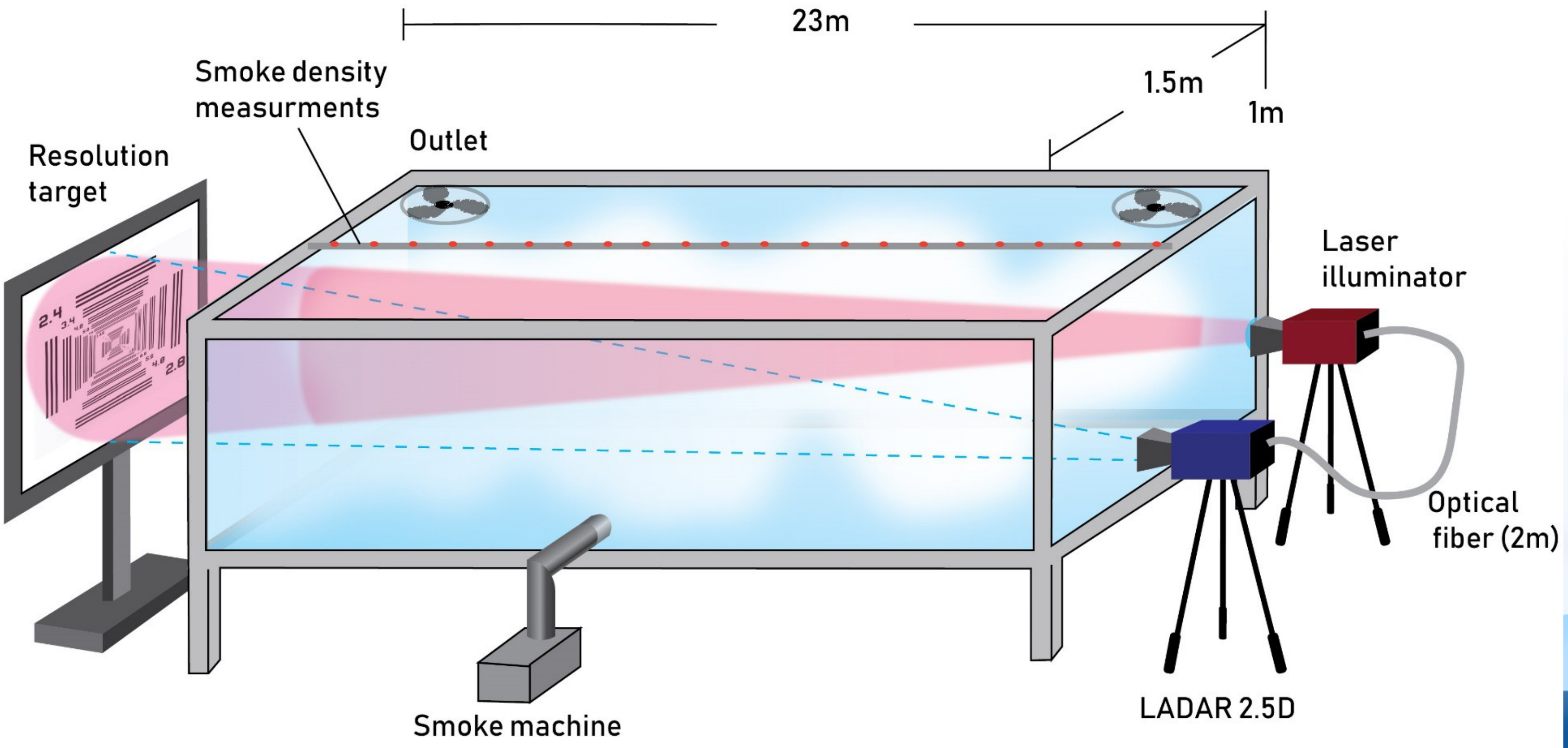
Eye safe zone around 1500 nm

Limitation

- High price of SWIR camera

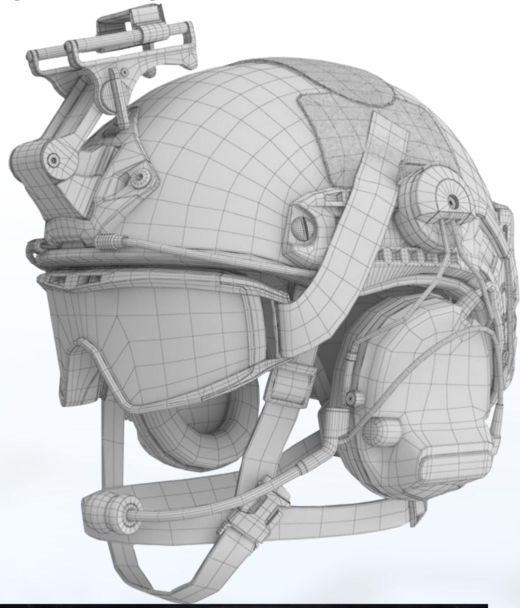


Experimental arrangement



Smart Helmet
with augmented reality

Applications – military , police , firefighting , medicine, gaming .....
Shape – helmet mounted systems (HMD) , head-up display (HUD)



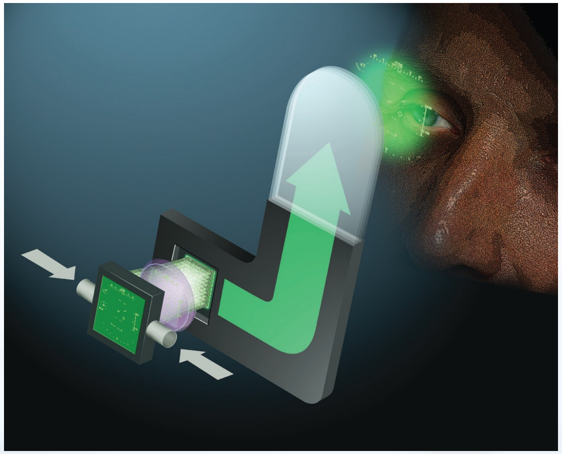
- Smart helmets allow user to communicate and visualize digital content directly on transparent visor in front of eyes, without using additional devices
- Main benefit of such system is focus on current activity
- Integrated earphone, microphone and visualization screen
- Interaction with helmet is executed by using voice commands or hardware buttons.

- Current developed model - Image is projected on the visor by using prism and HD micro-display

Smart Helmet

Typical Functions

- Voice and data communications with the rest of squad members, squad leader, HQ
- Positioning and navigation integrated with GIS
- Situational awareness
- Information from field - Common Relevant Operational dron...)
- Georeferenced sketches, drawings and pictures
- Health monitoring system
- Mission planning tool
- Data logger for After Action Review tool



-Possible to customize according to requirements

- Firefighting applications and functions
  to be defined
- Also offer support for communication equipment

Smart Helmet

About Augmented reality (AR)

- **Augmented reality** (**AR**) is an interactive experience of a real-world environment
  where the objects that reside in the real-world are enhanced by computer-generated
  perceptual information.
- **Virtual Reality (VR) -** the users' perception of reality is completely based on virtual
  information.
- Both worlds harmoniously exist, providing users a new improved natural world

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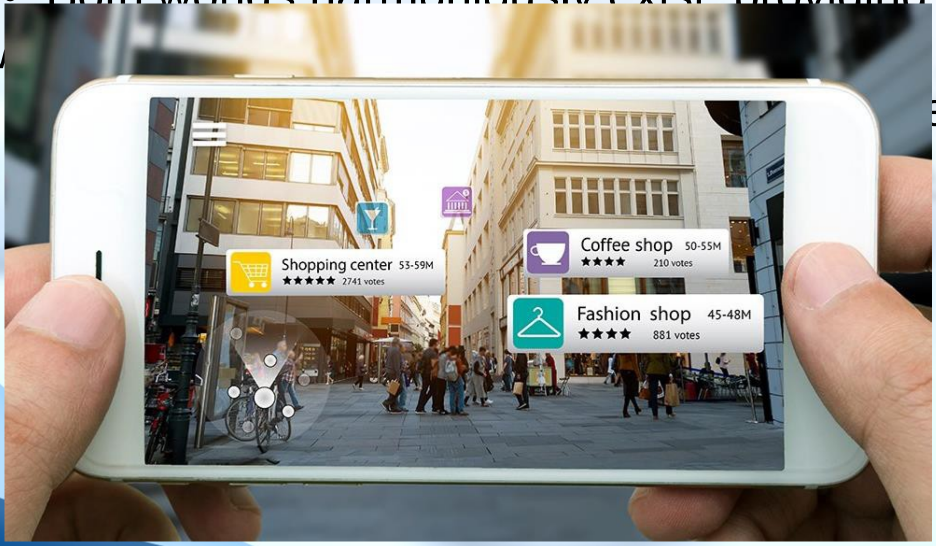
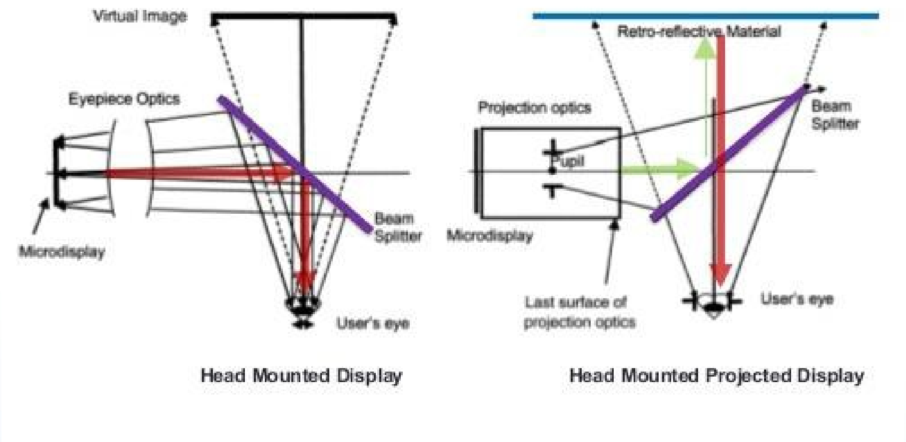


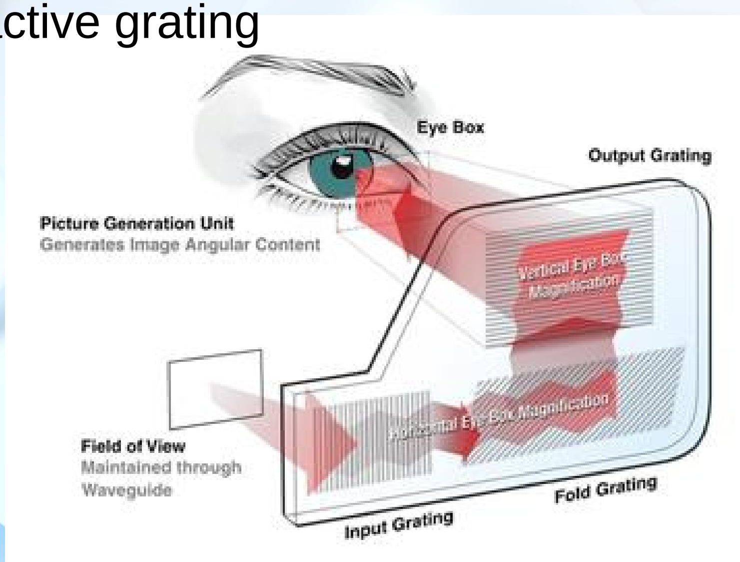
Smart Helmet

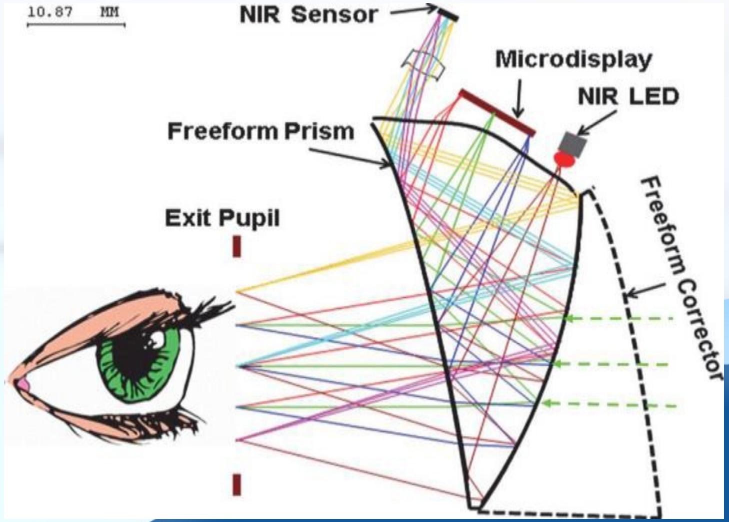
Principle of work

Types of existing systems include :

-Freeform optical prism projection system
-Retina scanning
-Reflective system or hybrid refl./refr. System
-Optical planar waveguides with diffractive grating



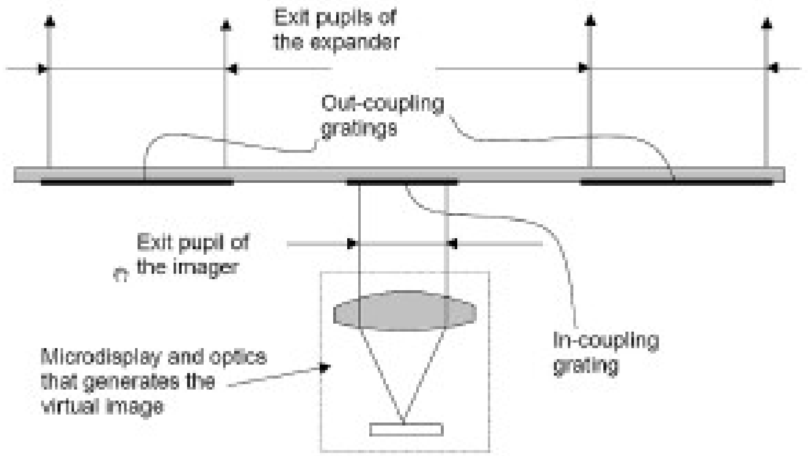


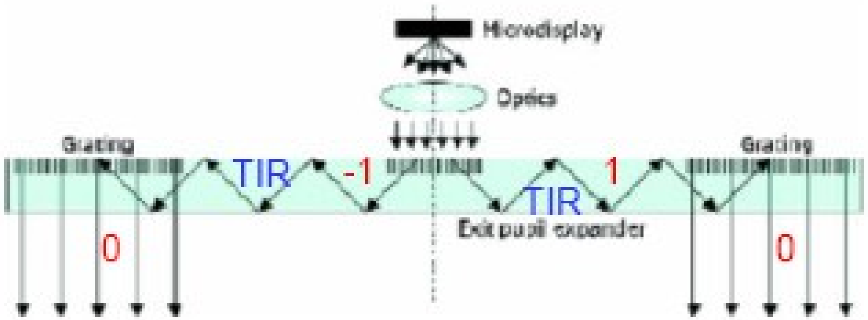


Smart Helmet Systems

Basic schematic of Optical waveguide

- Function of Diffractive gratings
  - couple light into waveguide plate and couple light out of plate into eyes
  - Wavelength selection
  - Wavefront shaping
  - Grating must be designed properly so that optical system produces good images





Current Models on market

Microsoft
HOLOLENS

Lingxhi AR Technology
AW60

Thank you !

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