



IESALC | ILLUMINATING ENGINEERING SOCIETY of NORTH AMERICA
AVIATION LIGHTING COMMITTEE

Annual IES Aviation Lighting Committee Fall Conference
Las Vegas, NV | October 25-29, 2009

ACS *International LLC*

 **Argos** S.p.A.
ingegneria

**THE OPTOELECTRONIC
SOLUTION FOR PERFECT PAPI
ALIGNMENT**

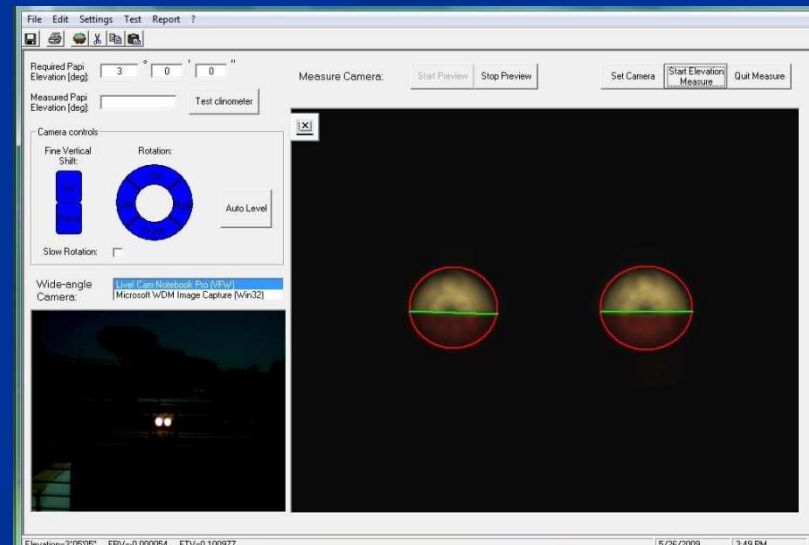
State of Art technology for PAPI performance testing.

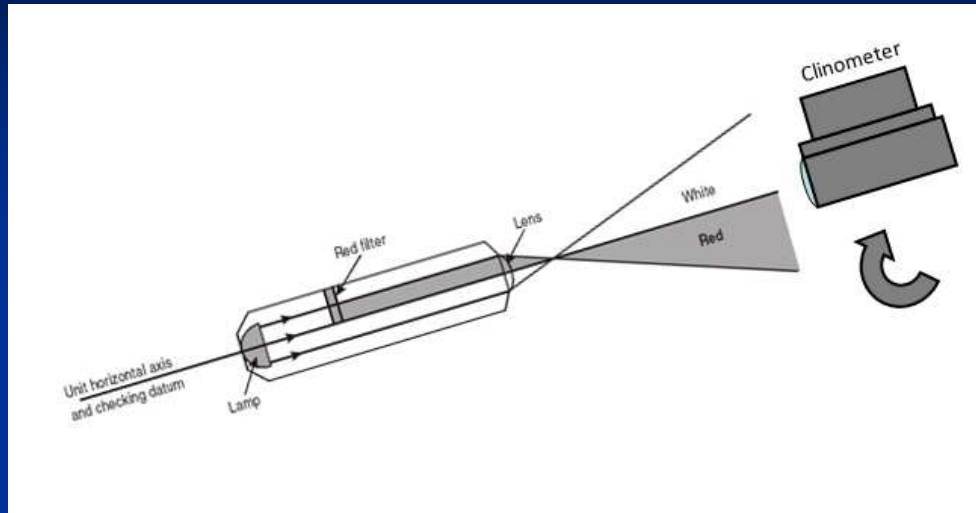
External observation of the PAPI beam just like the Pilot's eyes.



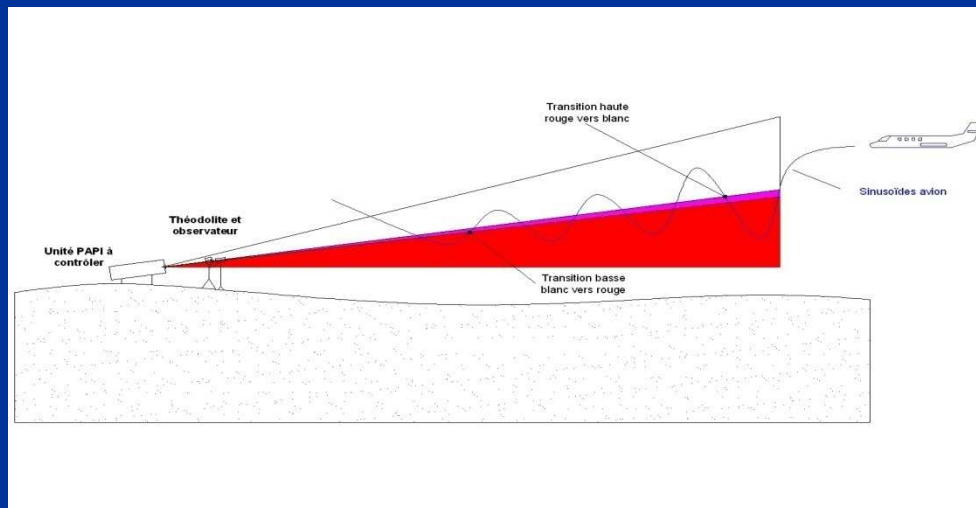


Sensor head mounted on a auto leveling moving mechanism and linked to a PC running an image analysis software.





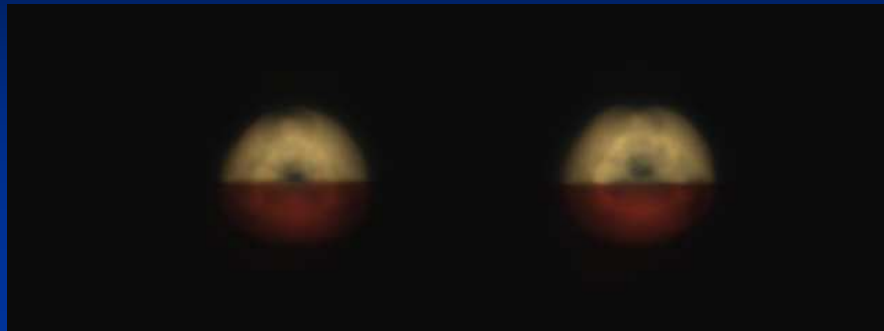
SMF/PAPI INSTRUMENT



FLIGHT INSPECTION



SMF/PAPI INSTRUMENT



What the instrument sees



FLIGHT INSPECTION



What the pilot sees



- Easy to use and to deploy in the field
- Angle measurement is available immediately including the instructions on how to correct the PAPI unit position if necessary.
- It measures the beam real angle with an accuracy better than 1'
- It reveals any problem in the PAPI projector including defocusing issues

- Flight check scheduling not easy and little or no time to re-align the PAPIs if required.
- Still necessary for obstacle assessment and PAPI/ILS coincidence check.

SMF/PAPI INSTRUMENT

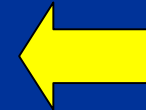


FLIGHT INSPECTION



PERSPECTIVES

- Accurate PAPIs alignment before the commissioning flight checks
- Effective maintenance of PAPI alignment and overall photometric performances between flight checks.
- Reduced flight check time = cost savings



SMF/PAPI INSTRUMENT





THE OPTOELECTRONIC SOLUTION FOR
PERFECT PAPI ALIGNMENT



SMF/PAPI IN USA

- **PURCHASED BY FAA LIGHTNING GROUP FOR THE LED PAPI EVALUATIONS TESTS.**
- **TRAINING OF THE FAA TEAM AND TESTS AT VERO BEACH MUNICIPAL AIRPORT (FL) AND ATLANTIC CITY FAA TECHNICAL CENTER.**
- **TESTS AT OFFUTT AFB ON NEW PAPIs BEFORE COMMISSIONING FLIGHT CHECK**



THE OPTOELECTRONIC SOLUTION FOR
PERFECT PAPI ALIGNMENT



FAA TRAINING AND TESTS OF SMF/PAPI AT VERO BEACH MUNICIPAL AIRPORT



FAA TRAINING AND TESTS OF SMF/PAPI AT VERO BEACH AIRPORT



ADB - 2 BEAMS

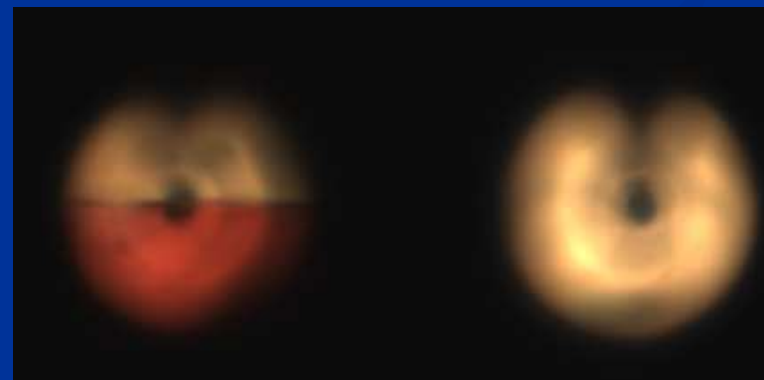
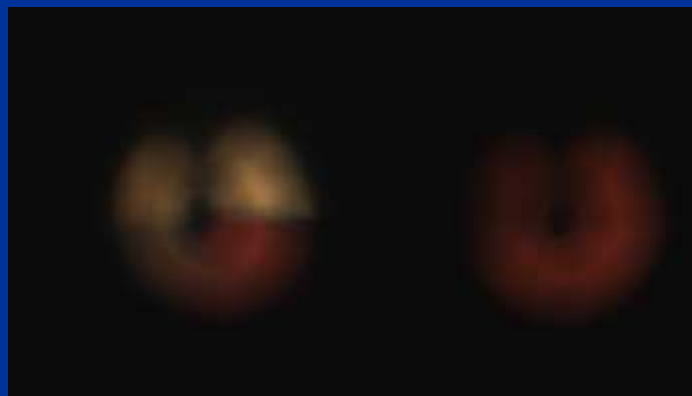
NEW PAPIs COMMISSIONING AT OFFUTT Air Force Base



The PAPIs alignment with SMF was successfully confirmed by the
FAA flight check

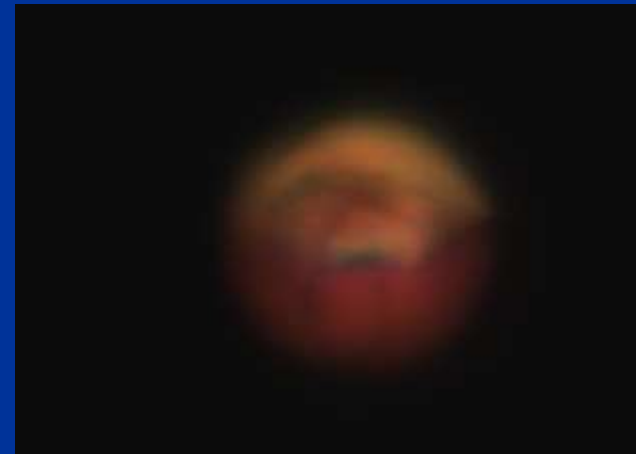
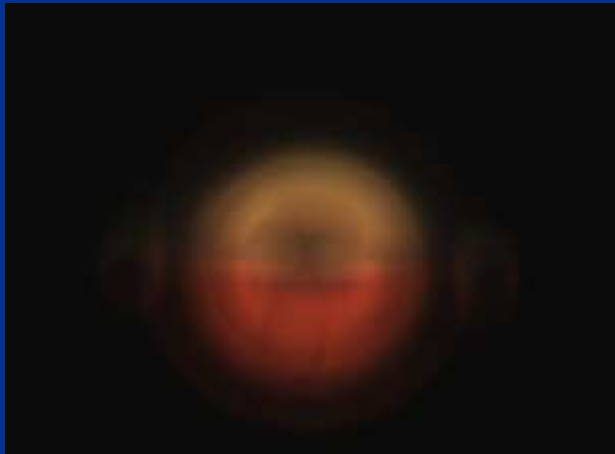
PROBLEMS ENCOUNTERED

ELEVATION DIFFERENCES BETWEEN THE MECHANICAL
REFERENCE AXIS AND THE OPTICAL AXIS



LAMPS NOT ALIGNED

PROBLEMS ENCOUNTERED



POOR FOCUS



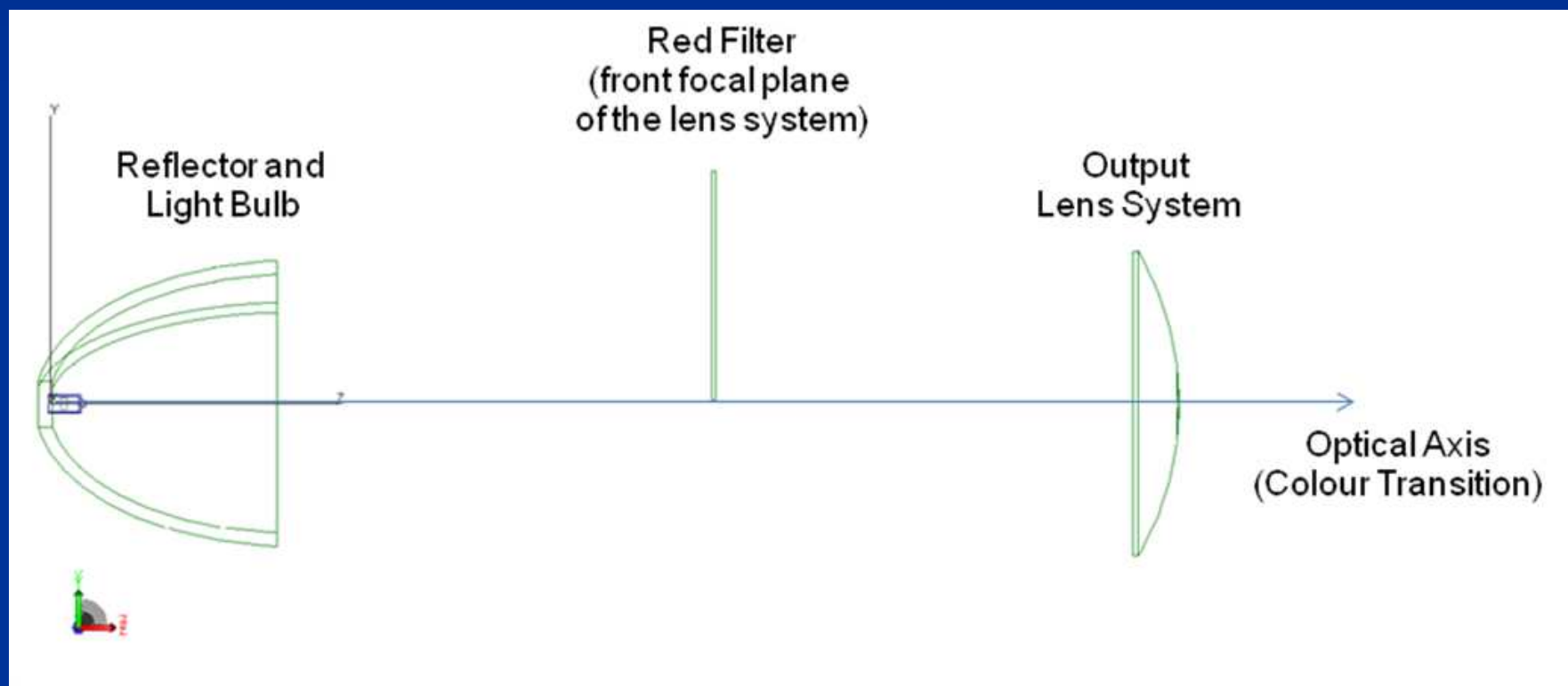
**THE OPTOELECTRONIC SOLUTION FOR
PERFECT PAPI ALIGNMENT**



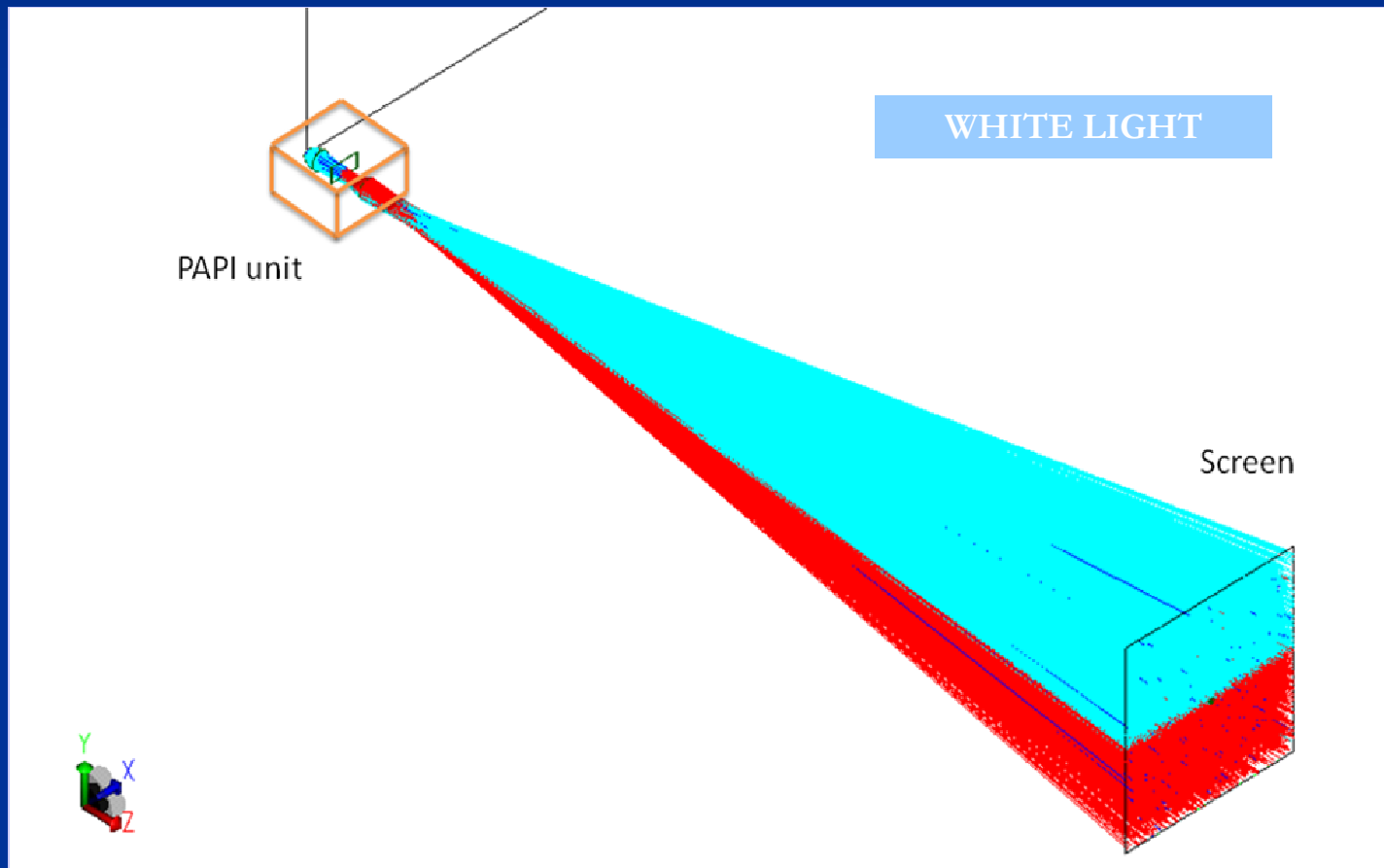
APPLICATION OF SMF/PAPI

**A CASE OF STUDY: THE EFFECTS OF THE RED
FILTER VERTICAL AND LONGITUDINAL SHIFT
(DEFOCUSING)**

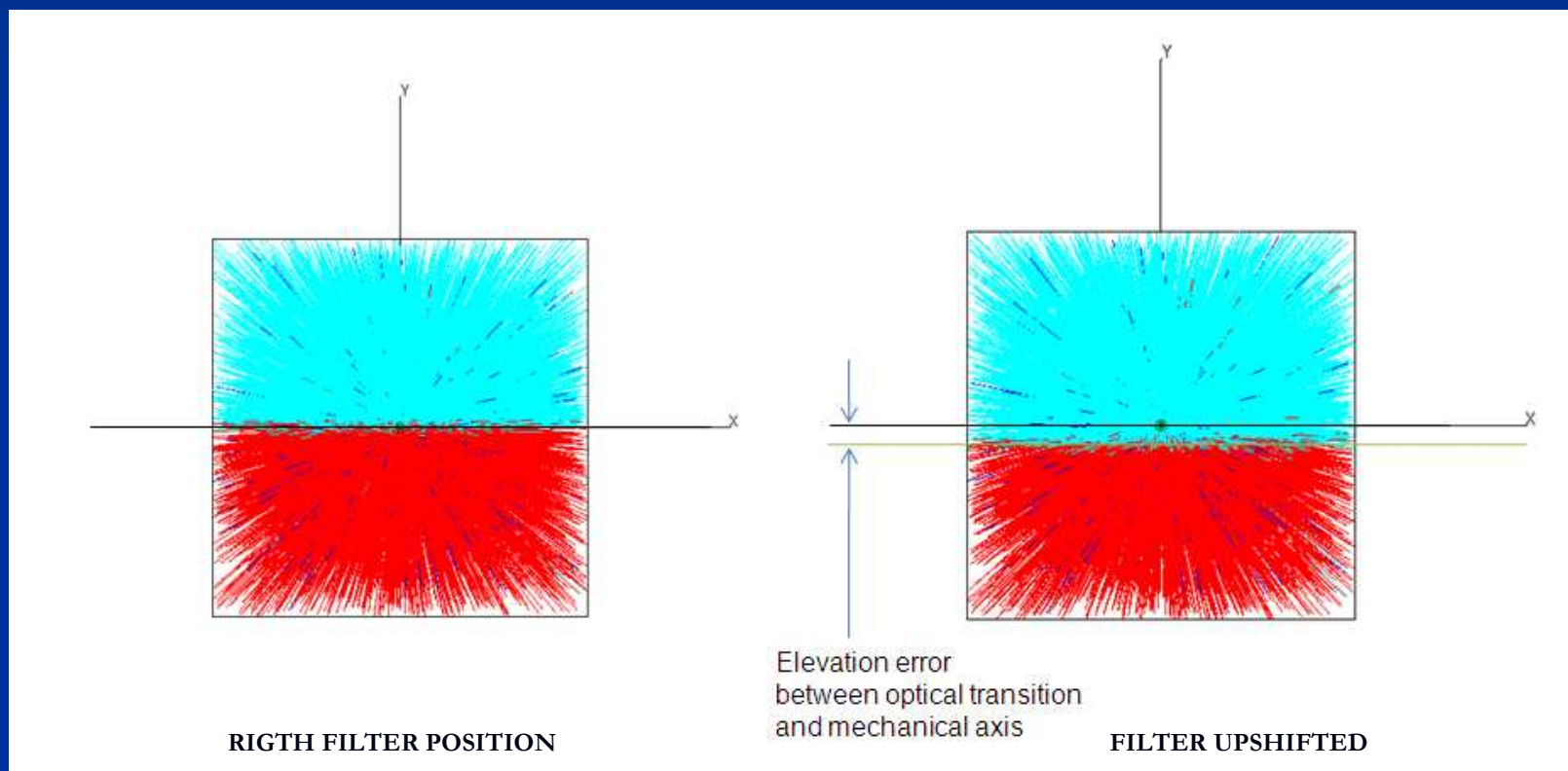
GENERAL SCHEME OF A PAPI CHANNEL



RAY TRACING SIMULATION OF A GOOD PAPI BEAM



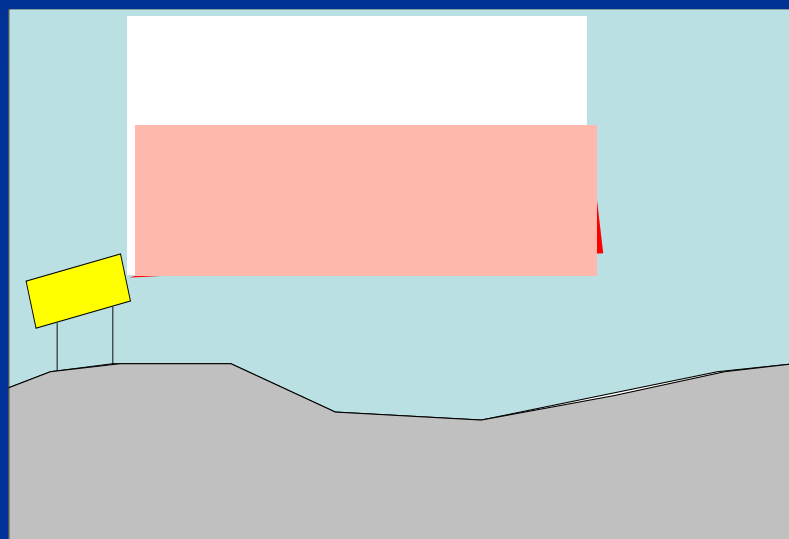
WHAT HAPPENS IN CASE OF VERTICAL SHIFT (UP)



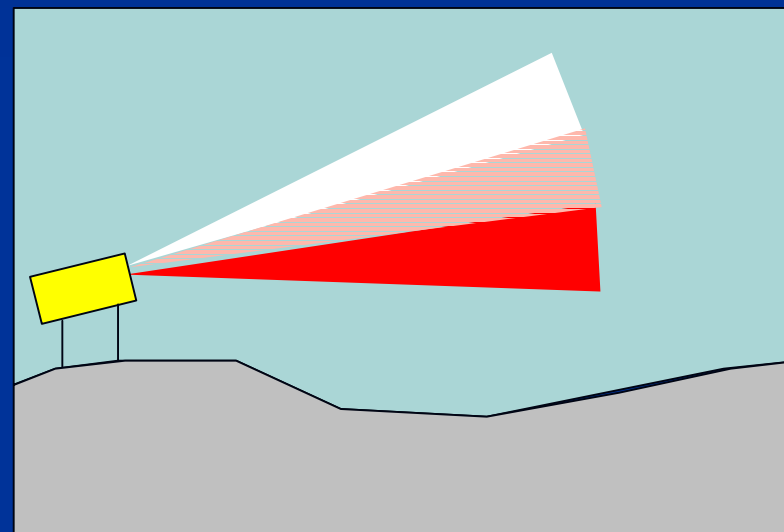
In a typical PAPI unit model, the elevation error between the mechanical axis and the color transition may reach values of **14'** for 1 mm of filter vertical misalignment.

A significant difference may arise between the value given by the clinometer and the flight check values.

WHAT HAPPENS IN CASE OF LONGITUDINAL SHIFT (DEFOCUSING)

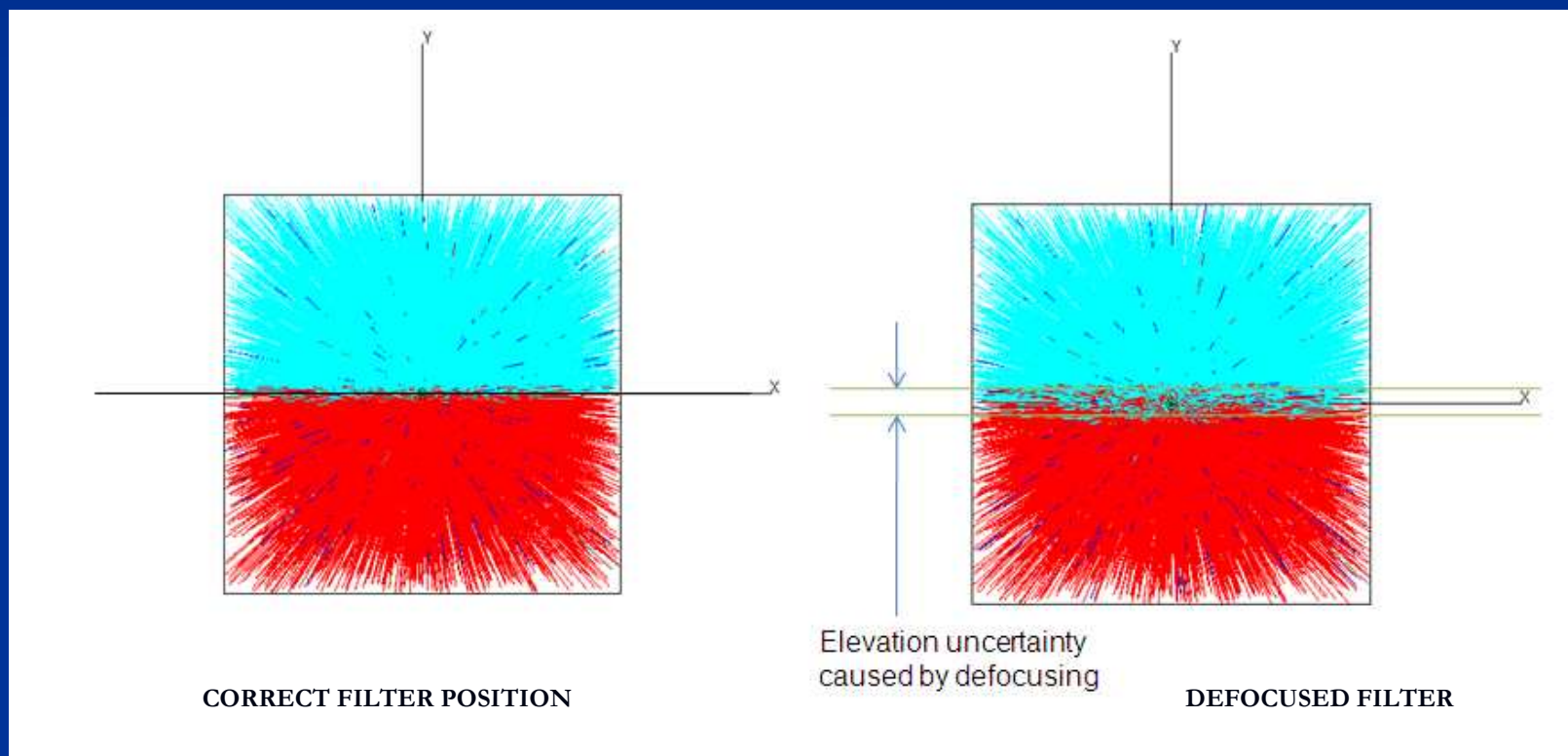


Schematic representation of a
normal transition



Schematic representation of an
abnormal transition due to
defocusing

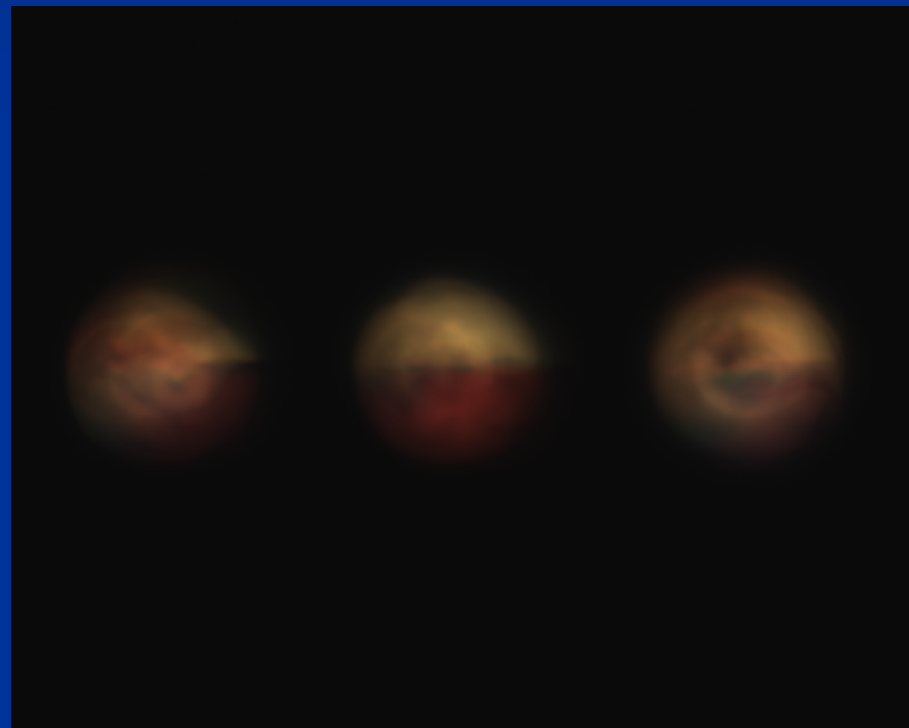
WHAT HAPPENS IN CASE OF LONGITUDINAL SHIFT (DEFOCUSING)



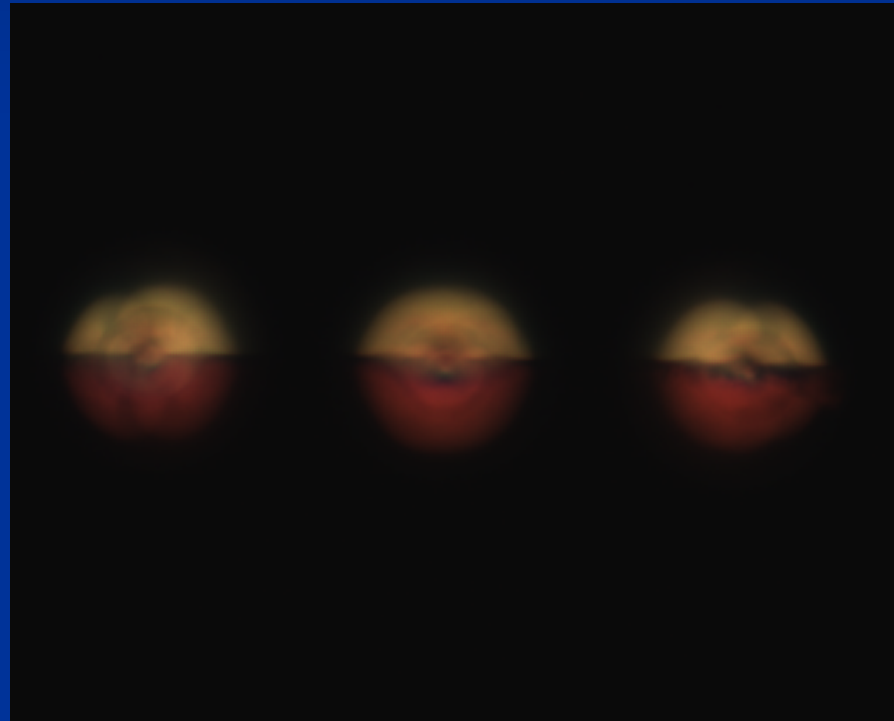
Defocusing produces a rose region between the white and the red colors. When PAPI units under flight check show defocusing problems, flight check results may be affected by the uncertainty in measuring the white-to-rose or rose-to-red transition.

Again a difference between the value given by the clinometer and the flight check values may occur.

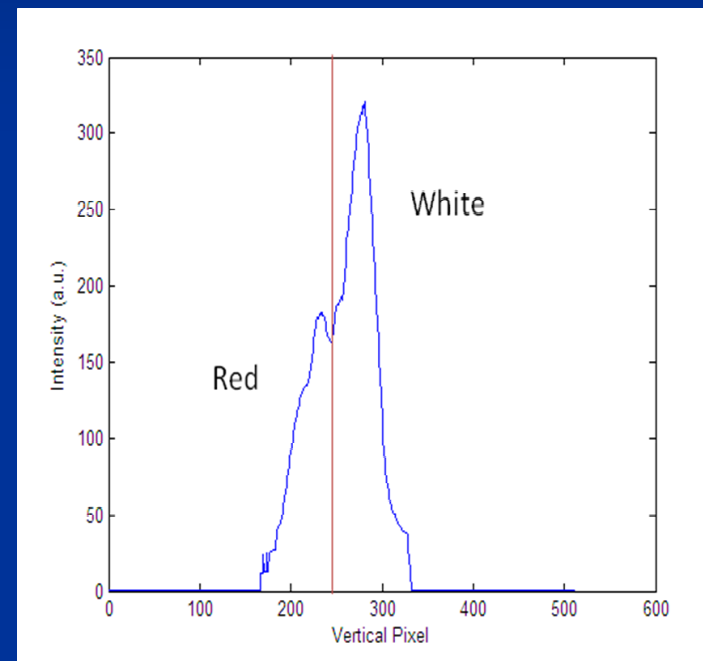
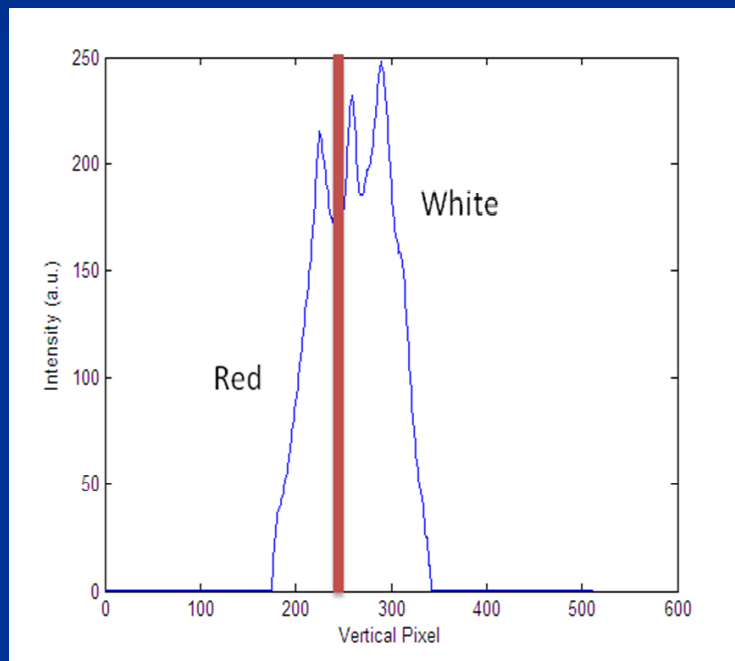
A 3-beam defocused PAPI unit



The same PAPI unit after re-focusing and re-alignment



Vertical light intensity profile of a measured beam



left: non-focused - right: focused

CONCLUSIONS (1)

Field proven experience indicates that the PAPI optical axis is not always perfectly aligned with the mechanical axis. The optoelectronics test instruments are therefore the perfect tools to assess the PAPIs performances.

All PAPIs checked and aligned with the SMF/PAPIs have passed flight check.

With the SMF/PAPI the PAPIs performances are maintained between the flight checks increasing the level of safe operations.

CONCLUSIONS (2)

ENAC, the Italian Civil Aviation Authority ENAC has released a specifications document ; APS-01 Technical Standard, for PAPIIS optoelectronics test instrument.

AENA – Spanish Civil Aviation Authority has adopted the same Technical Standard document.

The ICAO AERODROME PANEL – Visual Aid Working Group (VAWG) approved during the 7th meeting held in Kansai (October, 2009) the amendment of the Aerodrome Design Manual, Part. 4, “Electronic checking equipment” par. 8.3.18.1-2 , introducing the recommendation to use optoelectronic instruments for a more precise check of PAPI units .



ANY QUESTION?