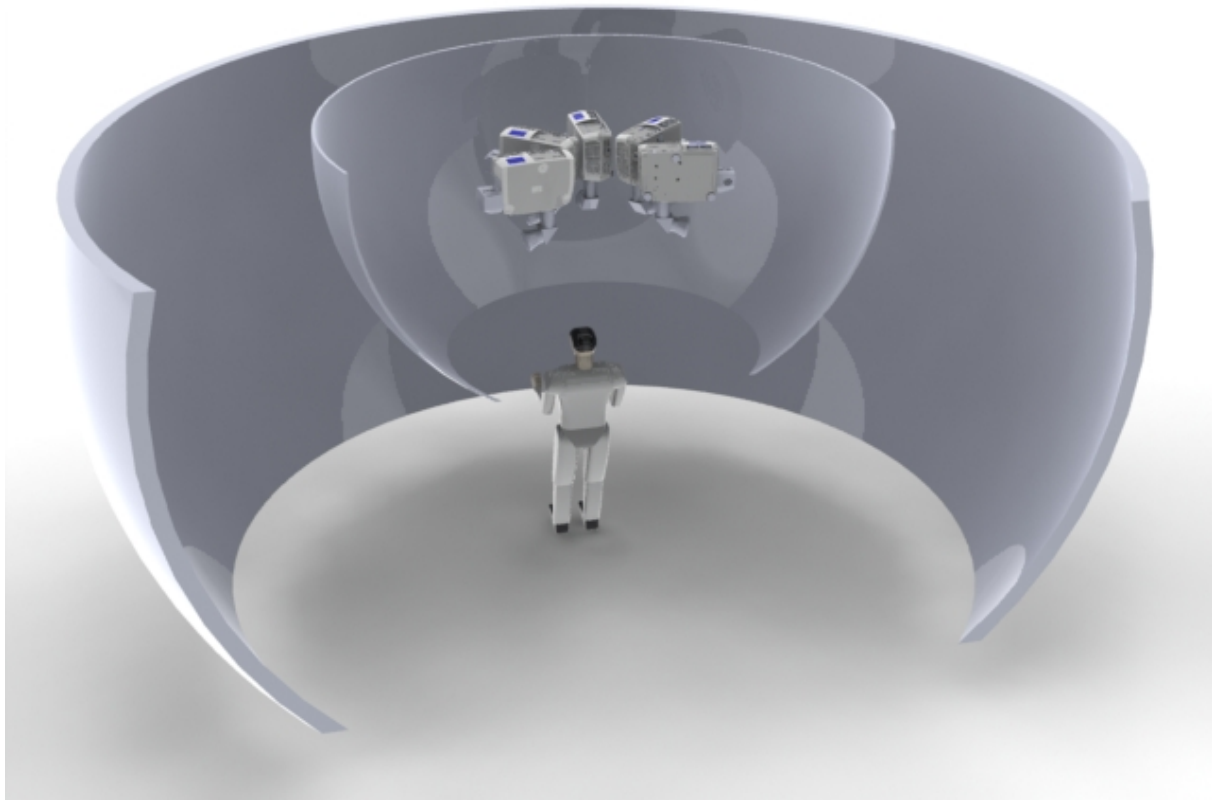


# CRT Replacement System For Collimated Displays

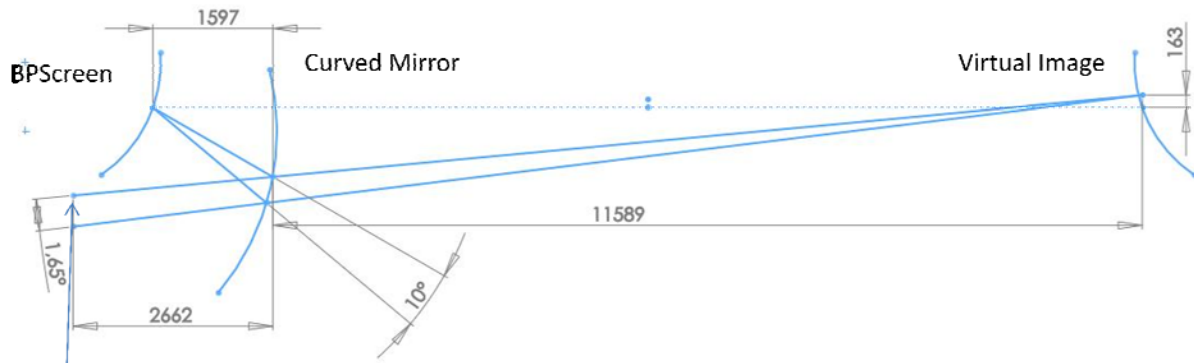


## Summary

MOD offers a **Visual System for Collimated Displays**. Our commitment is the complete **replacement of existing CRT based systems** with matrix projector. The **package** contains the **projectors**, special **projection lenses** and image manipulation engines for **warping** and **blending** as well as adjustments and installation of hardware. Various Displays consisting of different projectors and multiple channels can be installed to meet different performing requirements. The system can be understood as a complete unit that takes care of the visual part within the simulator which needs to be connected to a capable IG to start training. Of course our system offers MOD's specialty the capability for **night vision stimulated** trainings.

## Collimated Display

A Collimated Display is a simulator using a compound of two projection planes a curved Back Projection Screen and a curved Mirror. The projectors throw a scene onto the BPS which becomes the image source that is reflected by the curved mirror into the human eye. The collimation effect generated by the curvature of the Mylar coated mirror displays the discernible virtual image about 32 feet away from the eye point, the observer's position.



### Eye Point

The figure shows the effect of the curved mirror. The reduction of the beam angle of the image observed at the eye point simulates a virtual image at a greater distance than the BPS.

## Display System

### Projector

The projectors are equipped with a single chip DLP resolution WUXGA 1920x1200. Both LED or Lamp light source are available. The advanced 120Hz technology yield an optimized stimulation of night vision goggles with near infrared light. Special adjustments to the projector guarantees motion compatibility for 3g or up to 10g accelerations.



projector U12DN01

projector U12LH01



### Lens

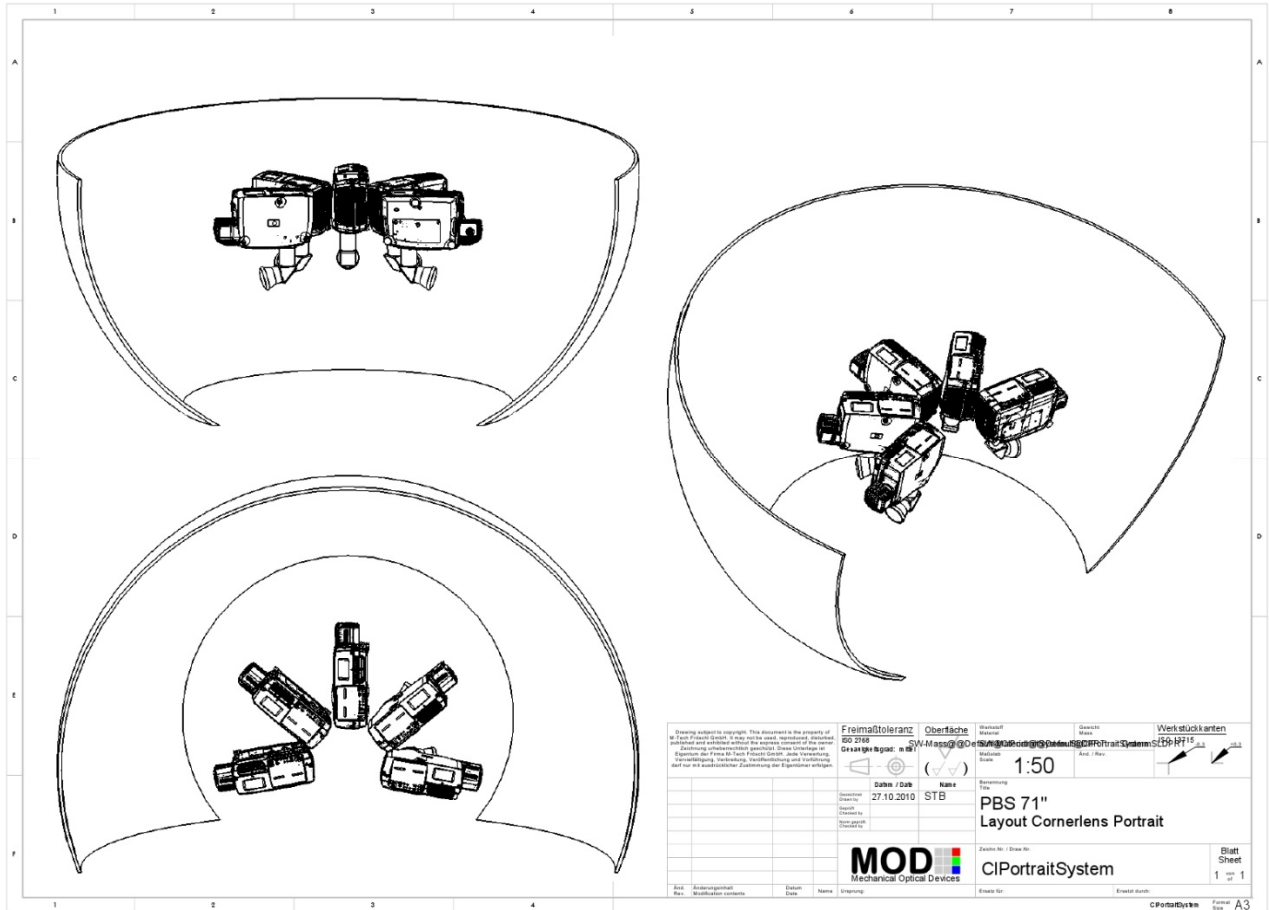
A special lens was designed. Its major property is its beam folding mechanism to achieve an optimised position of the projectors within the BPS. Further features are an ultra wide projection angle, a throw ratio of  $\sim 0.3:1$  and an intermediate image plane to manage an almost perfect hardware blending.

The lens considers near infrared light as well to ensure optimised night vision stimulation.

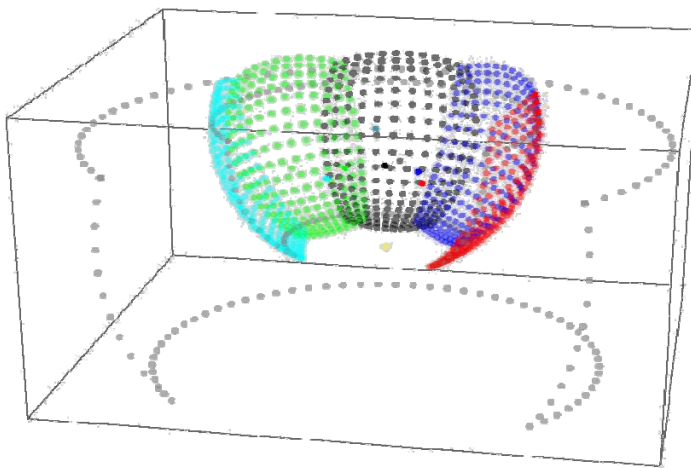
### Warp Engine/Software Blending

Different Engines can be used to modify the image and compensate distortions due to screen shapes or eye positions. Theoretical calculations as well as measurements in the actual system guarantee correct warping. Additional to hard edge blending the image content can be modified to render continuous blending between the channels.

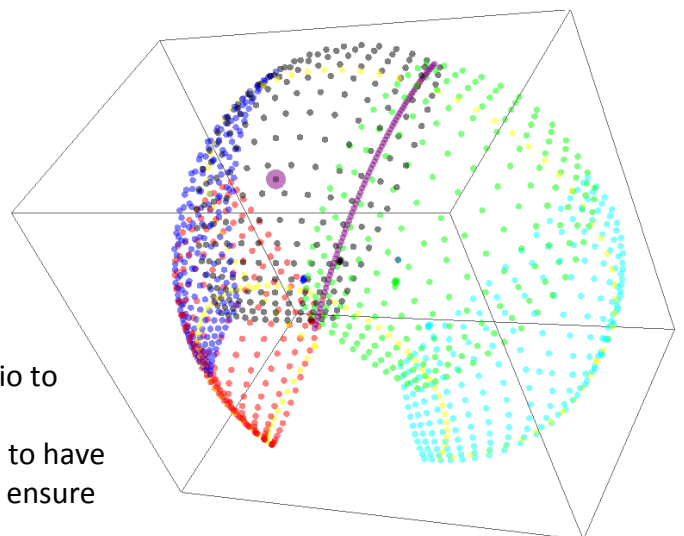
## 5 projector System, portrait mode



## Illumination of a 71 inch BPS using five projectors in portrait mode



The graphics show extracts of the simulation done to evaluate the Display Systems performance on screen.



Calculated are the projection range, blend zones, blend edges, light losses due to misfits of aspect ratio to screen dimensions and the effective resolution and brightness with respect to the eye point. The goal is to have a realistic prediction of the displays performance to ensure compliance with requirements.

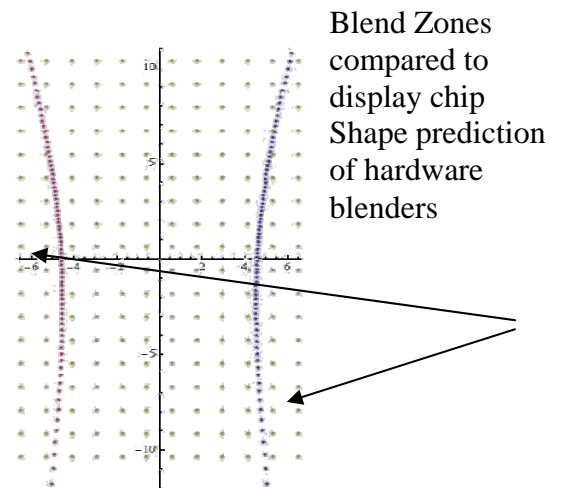
## Calculations for software and hardware blending

Both software and hardware blending can be implemented to achieve improvements in the blending process and better contrast.

Software blending generates a regime of continuous brightness reduction smoothing images together. Various functions can be applied for brightness gradients to fit screen shapes and take projector positions into account. Hardware blending additional to software blending shuts remaining overlap regions of black level to increase contrast and uniformity.



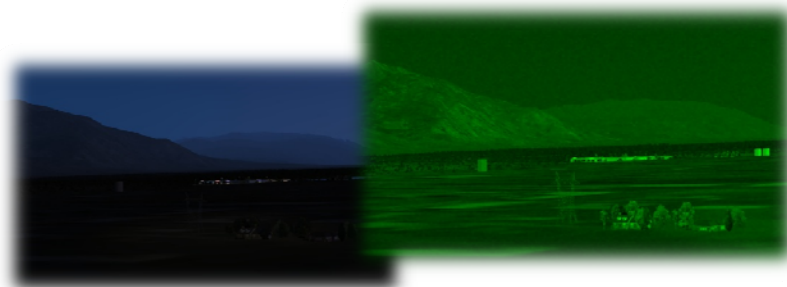
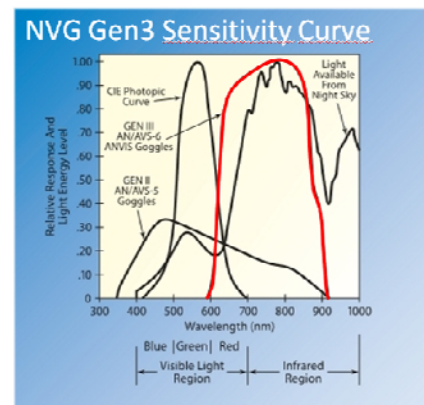
Continuous software blending



## Night Vision Stimulation

An additional near infrared LED or a modified Lamp module respectively in combination with a 120Hz video electronic renders the projectors to be versatile in any Night and Day Vision trainings.

Dimmable light output in both channels visible and near infrared lead to realistic simulations of night levels in brightness, contrast and colour



## Image Generator

Requirements on the IG concerning resolution and Night Vision Training are

- Two channel output, Visible and NVG modules implemented
- Resolutions of 1920x1200 pixel at 60 Hz for both channels