

# Capability of the light detection in the PITZ gun depending on the point of source.

**Task description**

**Simulation parameters**

**Results**

**Conclusions**

Igor Isaev, James David Good  
PPS  
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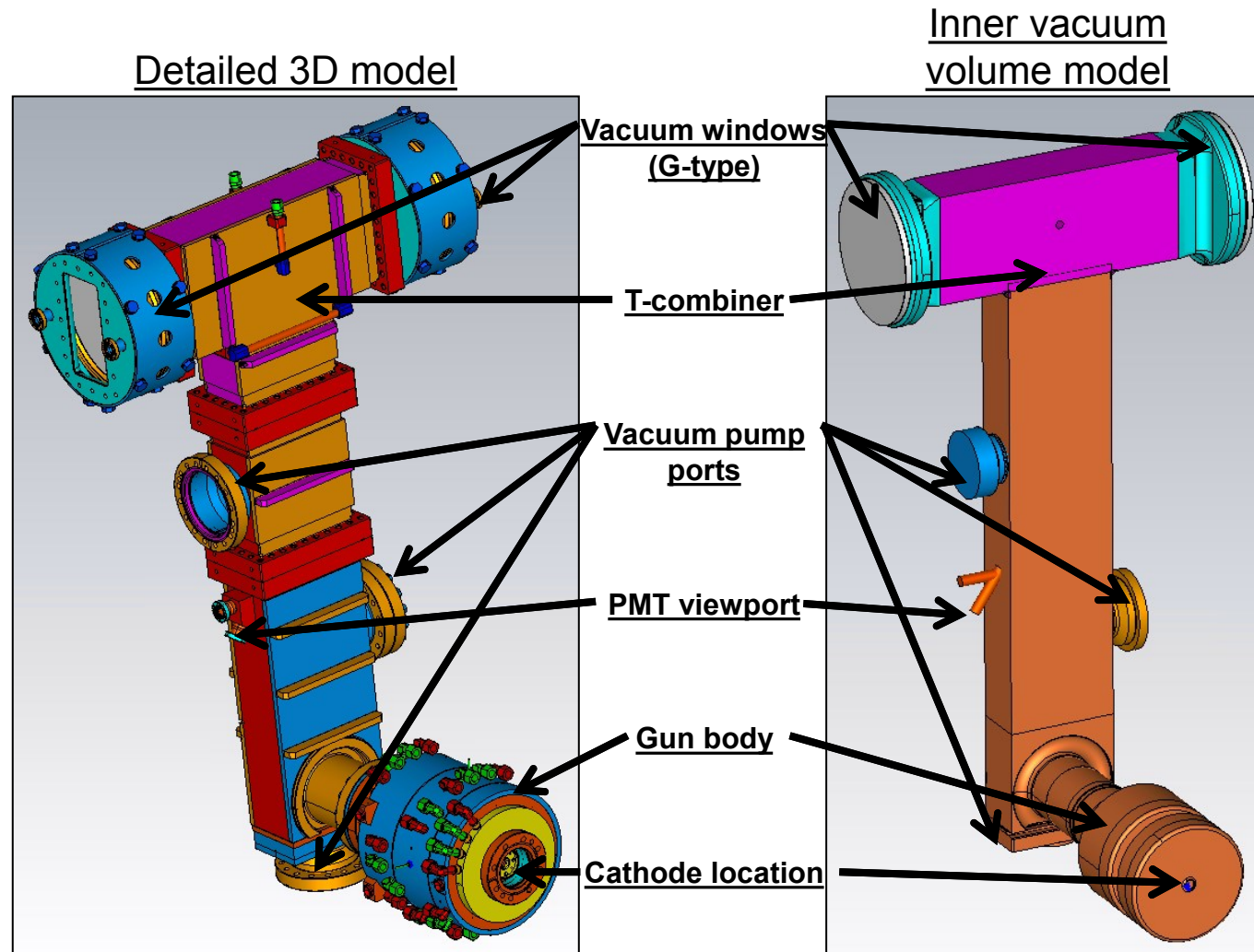
## > Gun setup features:

- Complicated vacuum volume part of a gun
- Few different combined vacuum volumes: gun body, coaxial coupler, rectangular waveguide, T-combiner
- Only one light detector (PMT)

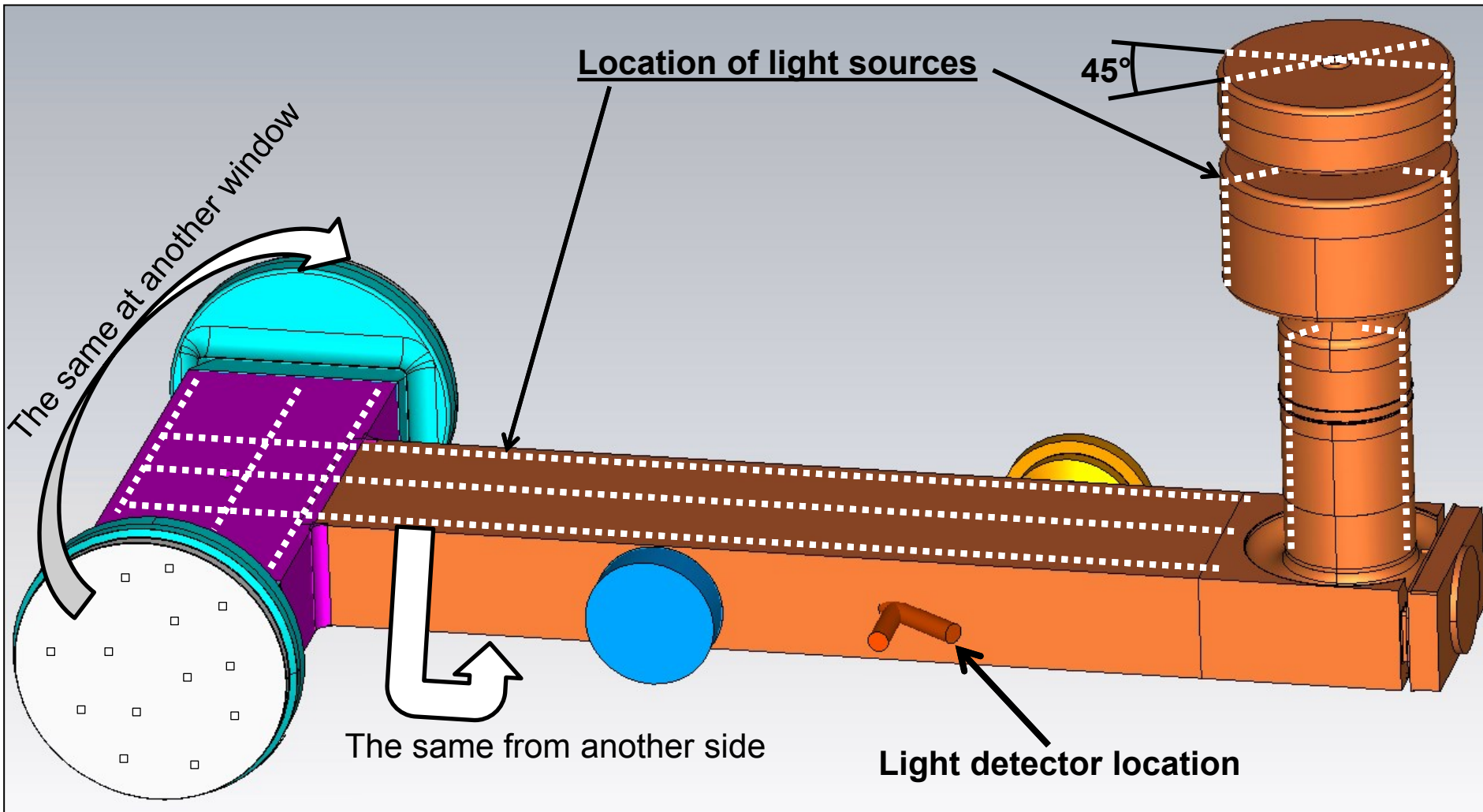
## > Assumptions that should be checked

- Is it possible to detect place of the light source inside the vacuum volume by light signal analysis?
- Is there any light sources in the gun which can not be observed?

- > Simplified inner vacuum model
- > Initial source power: 1 kW
- > Rays per source:  $10^5$
- > Angular spread of rays:  $360^\circ$
- > Homogeneous surface with reflectivity standard mirror (96%)
- > Pump ports are modeled as total absorbers: no reflection
- > Light detector is located at the place of PMT viewport

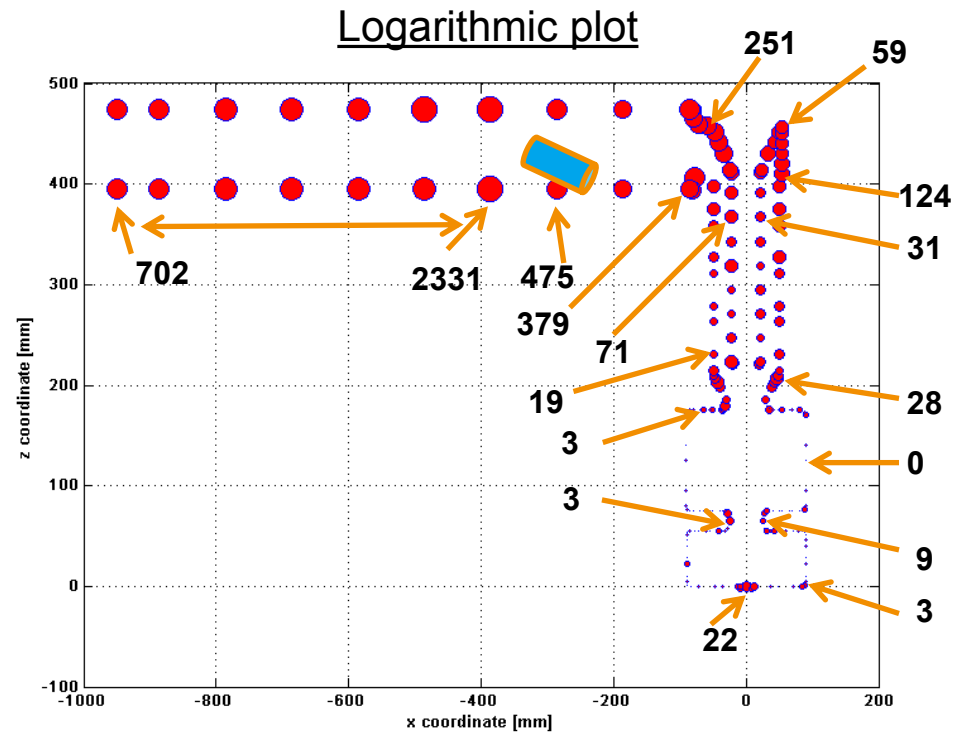
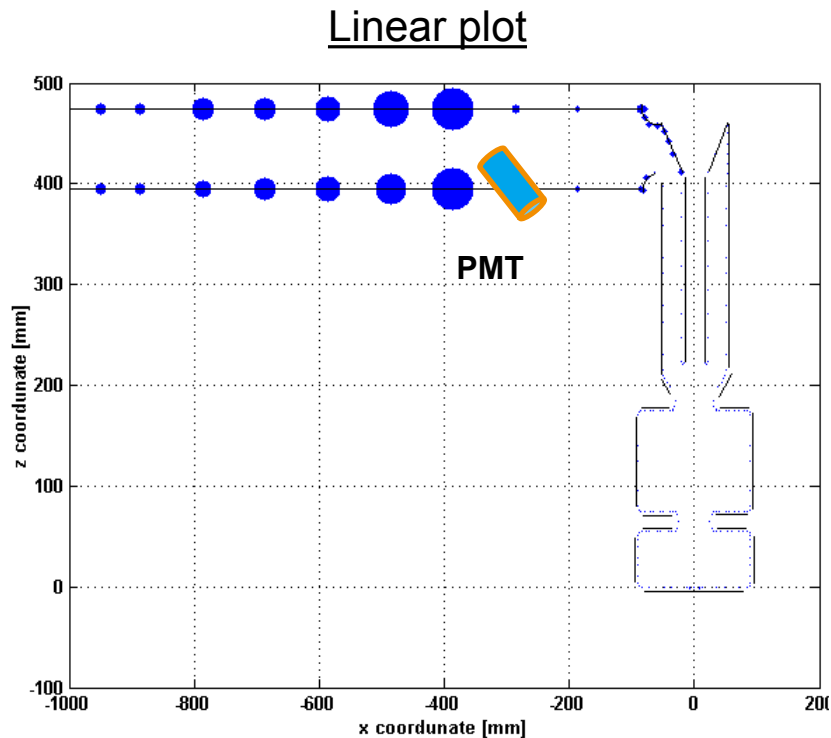


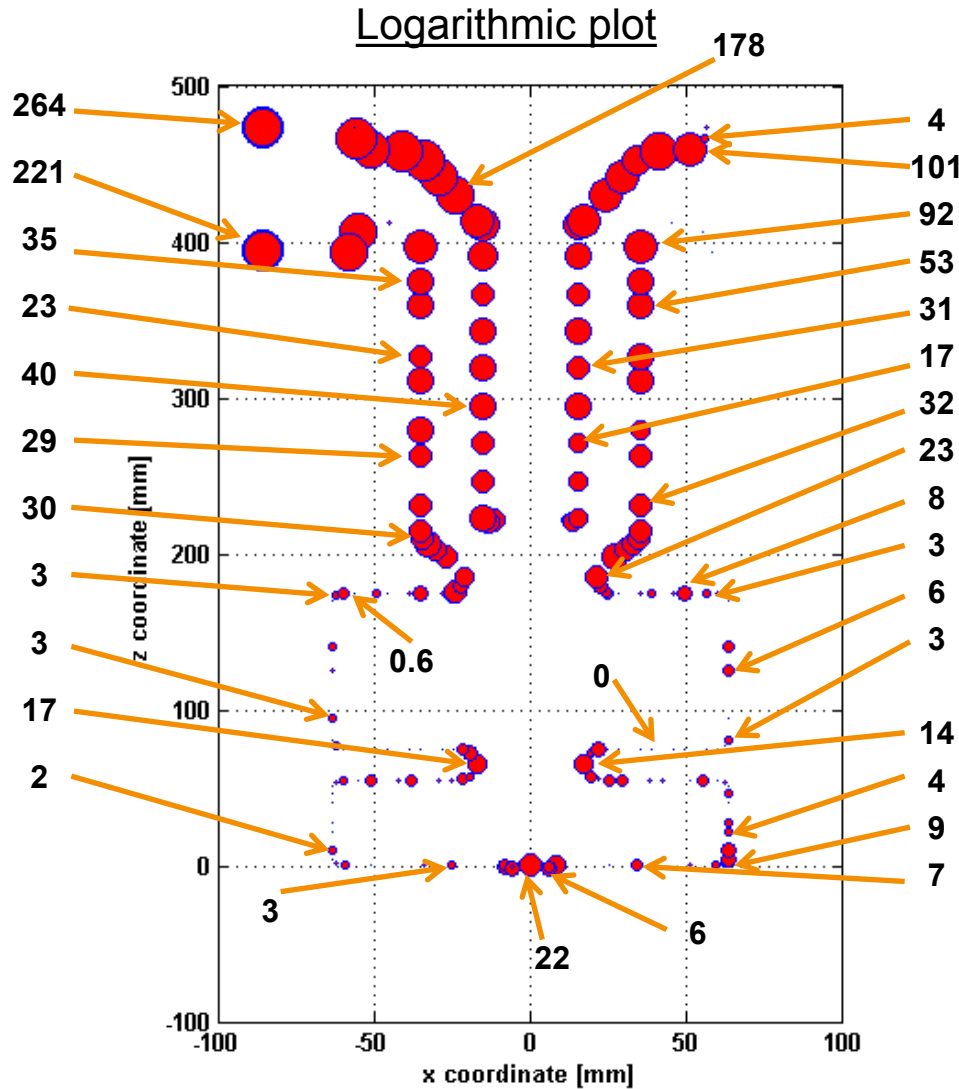
# Light source locations



# Simulation results: y=0 cut

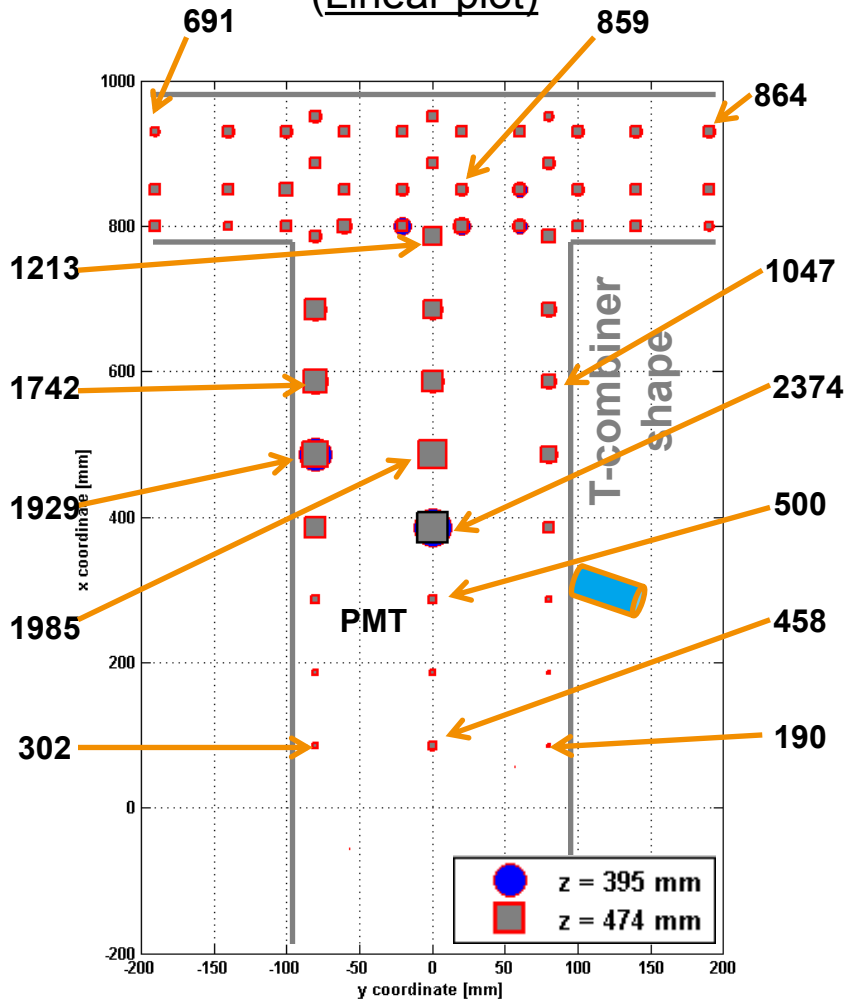
- The plots show position of the light sources
- Size of the stop corresponds to the light intensity at the position of PMT
- Numbers show the ratio of the initial power (1000 W) and detected power at PMT position multiplied by  $10^6$  (detected power  $n \cdot 10^{-9}$ )



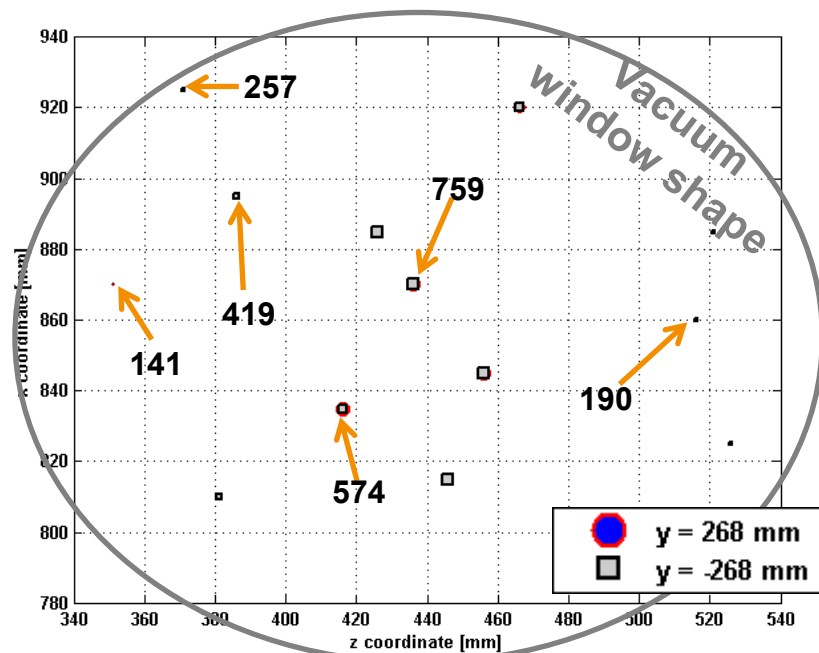


# Simulation results. Light source location at T-combiner and RF windows

Z-cut of the T-combiner  
(Linear plot)



Y-cuts of the windows  
(Linear plot)



- The intensity detected by PMT from the light sources located upstream the PMT viewport (in direction of forward RF wave) is ~5 times higher than for the case of light sources downstream the PMT viewport
- The biggest part of light sources located in the gun body give us very low intensity of light reached PMT position
- The sources located at: gun iris, cathode surface and transition between full cell and coaxial coupler give one order higher intensity than the sources located at the rest positions of the gun body
- There are some positions in the gun body of a light source which can not be detected by PMT (it could be very low intensity which was not detected during simulations)
- The simulations give us only estimation of **visible** light amount which could be detected by PMT in the waveguide
- There is another process which takes place during IL event:  $\gamma$ -ray production by electrons from discharge. Such  $\gamma$ -rays can not be stopped by the gun wall and could be detected by PMT: via direct influence on the PMT scintillator or by production of the Cherenkov light in the waveguide.



## > Further simulations

- It is possible to run simulations with the model where few PMT detectors will be present : current setup with 2 THALES windows. It should be possible to determine place of a light source by ratio of light intensity detected by PMTs.

## > Experiment:

- It should be possible to get reliable data from PMT about amount of light traveled from source to the PMT via vacuum system if we would install a blind PD directly on the PMT. The PD will be detecting only  $\gamma$ -rays. Subtraction of PMT and PD signals suppose to give us estimation of light amount from IL event.