
Progress on UV laser design for the TPC prototype

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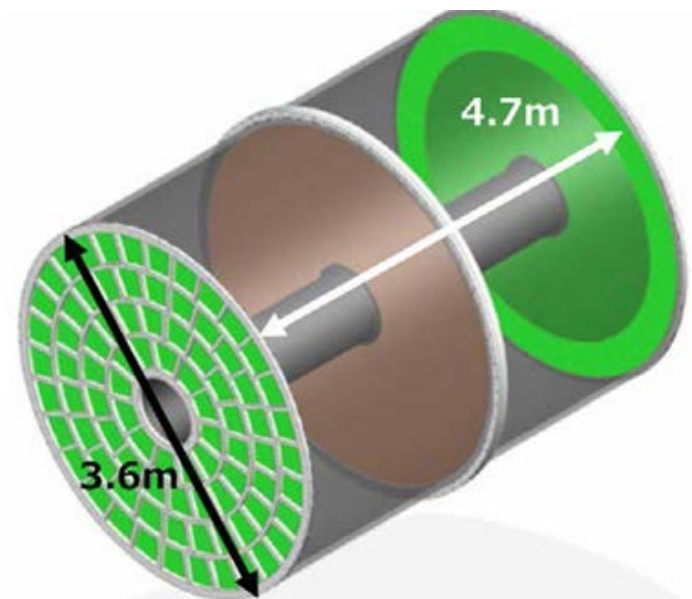
TPC could be as one tracker detector option for CEPC, 1M ZH events in 10yrs $E_{\text{cm}} \approx 250$ GeV, luminosity $\sim 2 \times 10^{34}$ cm⁻²s⁻¹, can also run at the Z-pole

The voxel occupancy takes its maximal value between 2×10^{-5} to 2×10^{-7} , which is safety for the Z pole operation. Of course, it is well for Higgs run too.

<https://doi.org/10.1088/1748-0221/12/07/P07005>

TPC detector concept:

- ❑ Motivated by the H tagging and Z
- ❑ Main tracker detector with TPC
- ❑ ~ 3 Tesla magnetic field
- ❑ ~ 100 μm position resolution in $r\phi$
- ❑ Systematics precision (< 20 μm internal)
- ❑ Large number of 3D points (~ 220)
- ❑ Distortion by IBF issues
- ❑ dE/dx resolution: $< 5\%$
- ❑ Tracker efficiency: $> 97\%$ for $p_T > 1\text{GeV}$



TPC detector concept

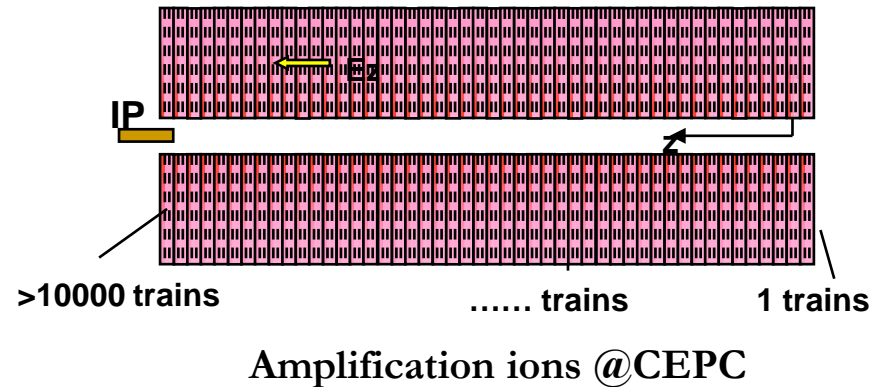
Technical challenges for TPC

Ion Back Flow and Distortion :

- ❑ $\sim 100 \mu\text{m}$ position resolution in $r\phi$
- ❑ Distortions by the primary ions at CEPC are negligible
- ❑ More than 10000 discs co-exist and distorted the path of the seed electrons
- ❑ The ions have to be cleared during the $\sim\mu\text{s}$ period continuously
- ❑ Continuous device for the ions
- ❑ Long working time

Calibration and alignment:

- ❑ Systematics precision ($<20 \mu\text{m}$ internal)
- ❑ Geometry and mechanic of chamber
- ❑ Modules and readout pads
- ❑ Track distortions due to space charge effects of positive ions



Possible technical solution Laser calibration system:

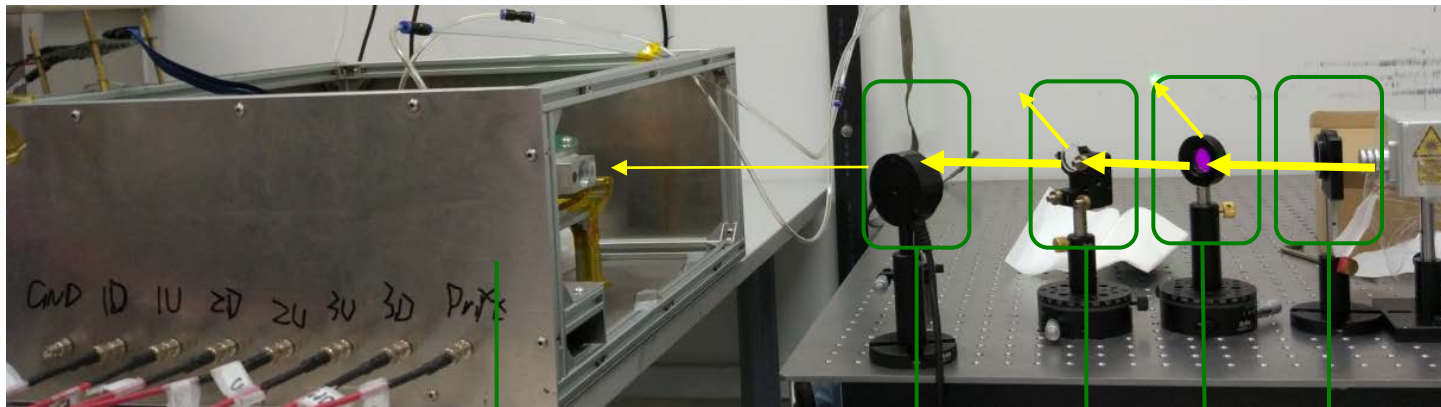
- ❑ Laser calibration system for Z-pole run
- ❑ Calibrated drift velocity, gain uniformity, ions back in chamber
- ❑ Calibration of the distortion
- ❑ Nd:YAG laser device@266nm

Parameters of the TPC prototype

- Funding from the R&D of the TPC detector for CEPC CDR in IHEP
- To aim that the small TPC prototype for the estimation of the distortion due to the IBF, and the study of related physics parameters

- The TPC prototype
 - Drift length: 510mm
 - Readout active area: 200mm × 200mm
 - Integrated the laser and UV lamp device
 - Wavelength of laser: 266nm
 - GEMs/Micromegas as the readout
 - Materials: Non-magnetic material (Stainless steel, Aluminum)

Signal of the laser with $\Phi 1\text{mm}$



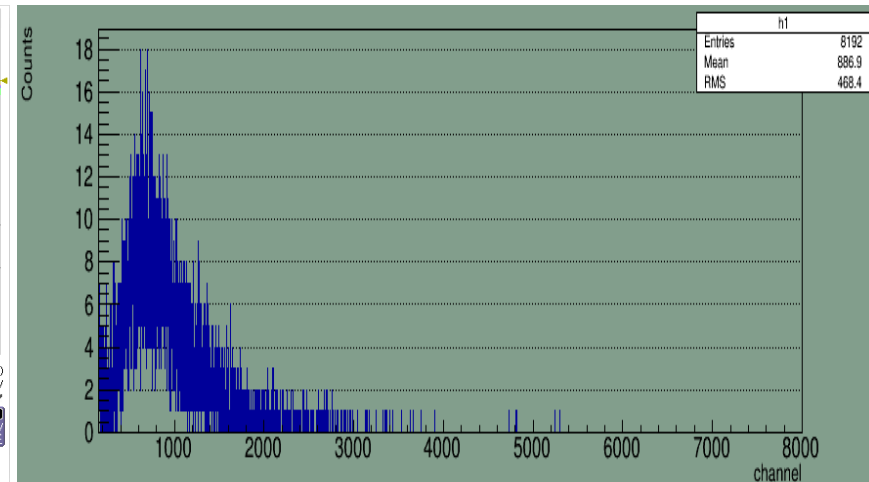
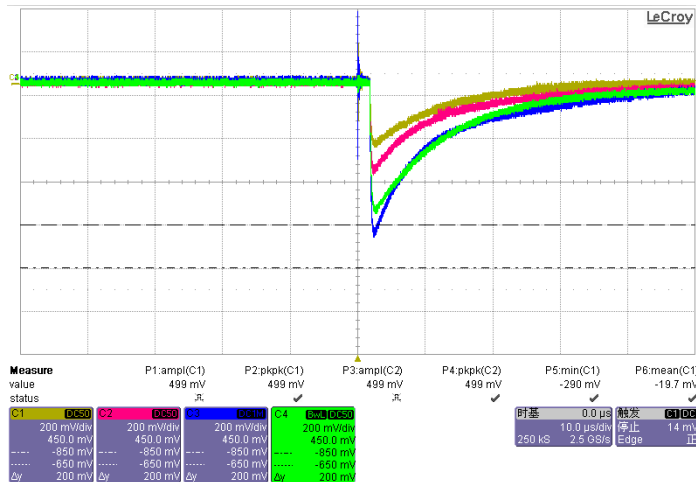
Triple GEMs
detector

Hole collimator
 $\Phi 1\text{mm}$

Trans/refl.
=1:99

Transmission
mirror

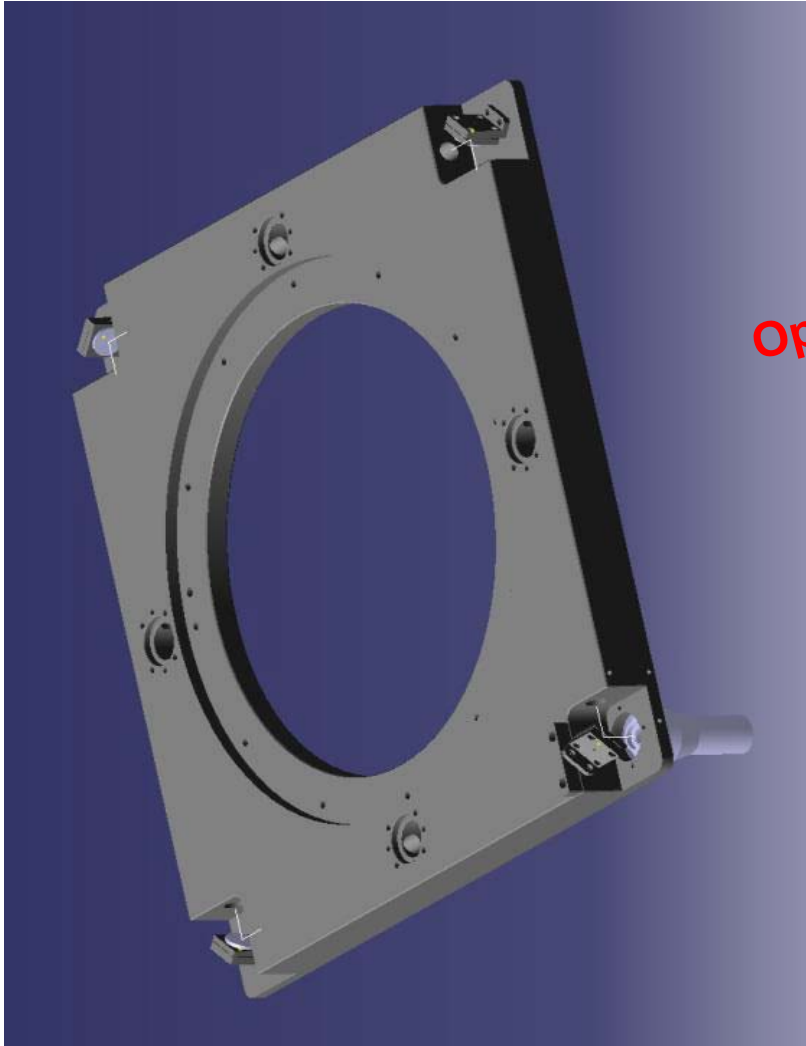
Transmission mirror



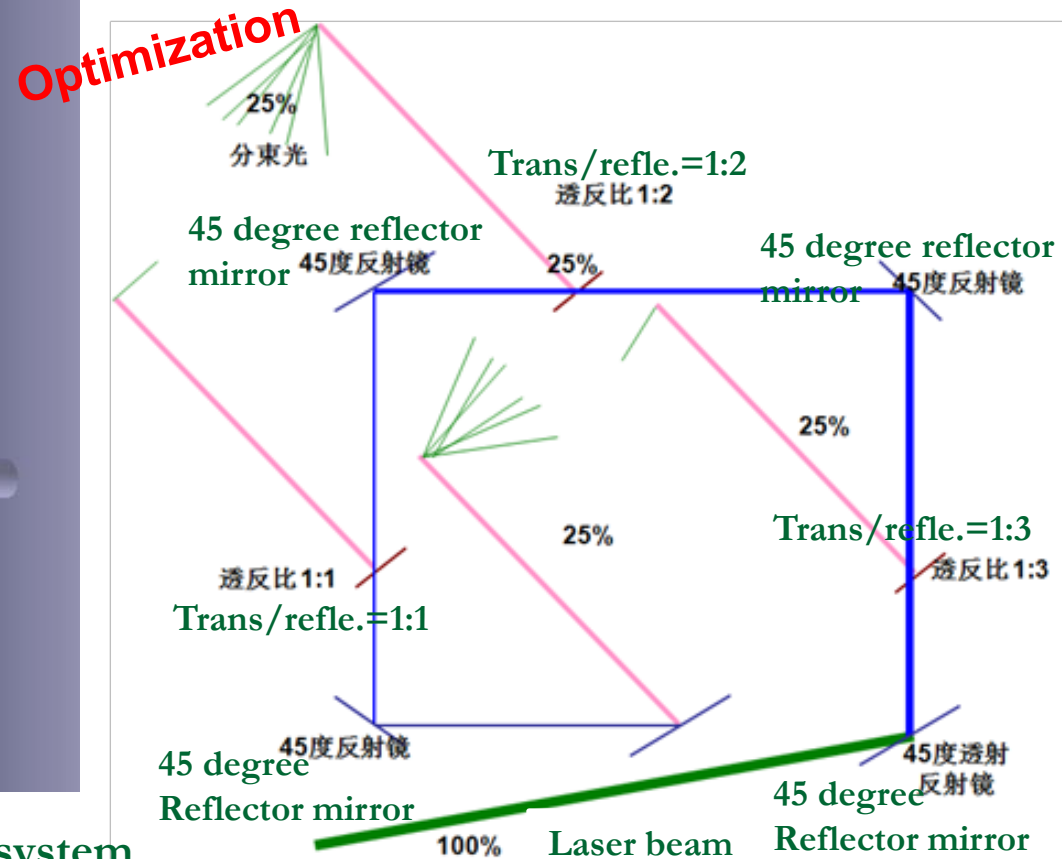
Signal of the laser with $\Phi 1\text{mm}$ @ Charge sensitive AMP/12mV/fC

Laser map in drift length

- ❑ Laser wave: 266nm
- ❑ Size: $\sim 1\text{mm} \times 1\text{mm}$
- ❑ Transmission and reflection mirrors
- ❑ Aluminum board integrated the laser device and supports

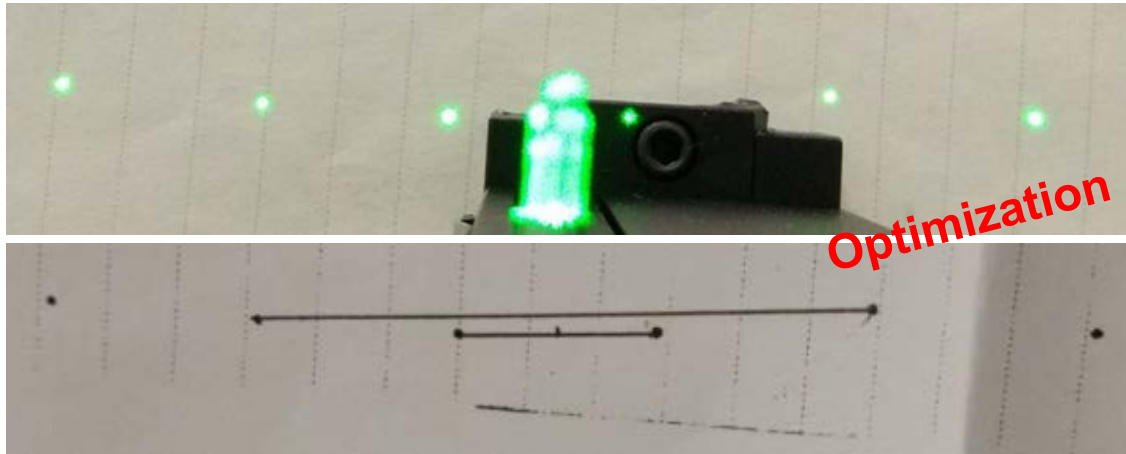


Aluminum board integrated the laser system

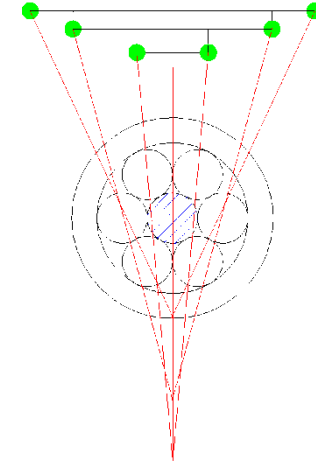


Mirrors test with 532nm

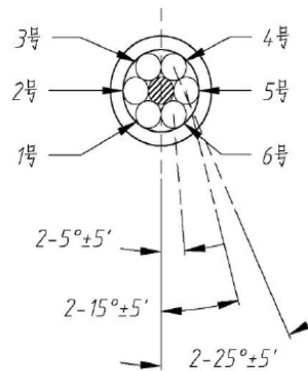
Test:



Shape of the six points:



Report of the mirrors:



夹角公差

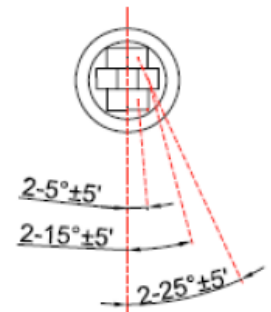
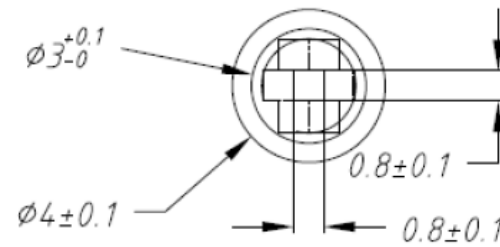
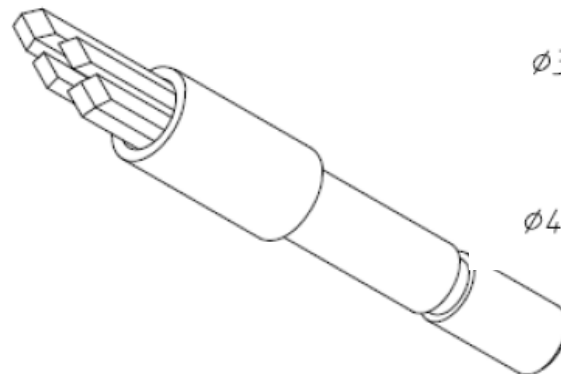
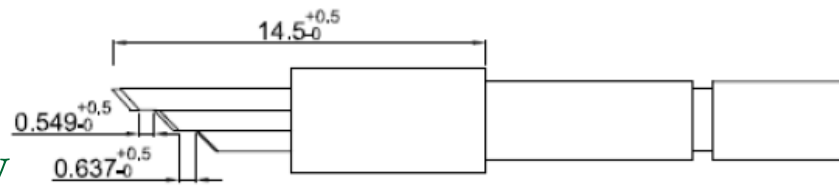
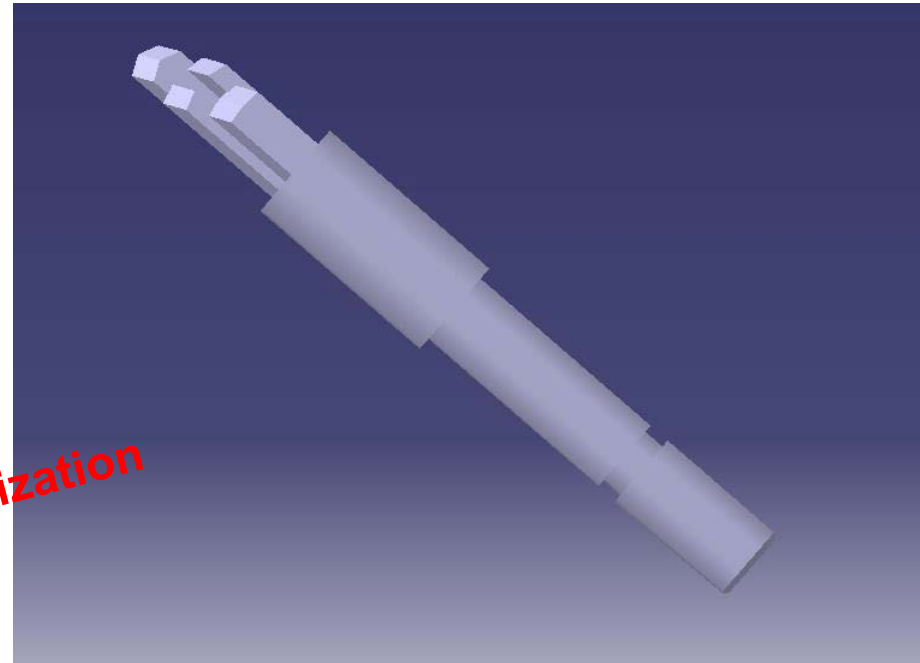
5°角	<5'	合格
15°角	<5'	合格
25°角	<5'	合格

俯仰角度，也可理解为 45°角

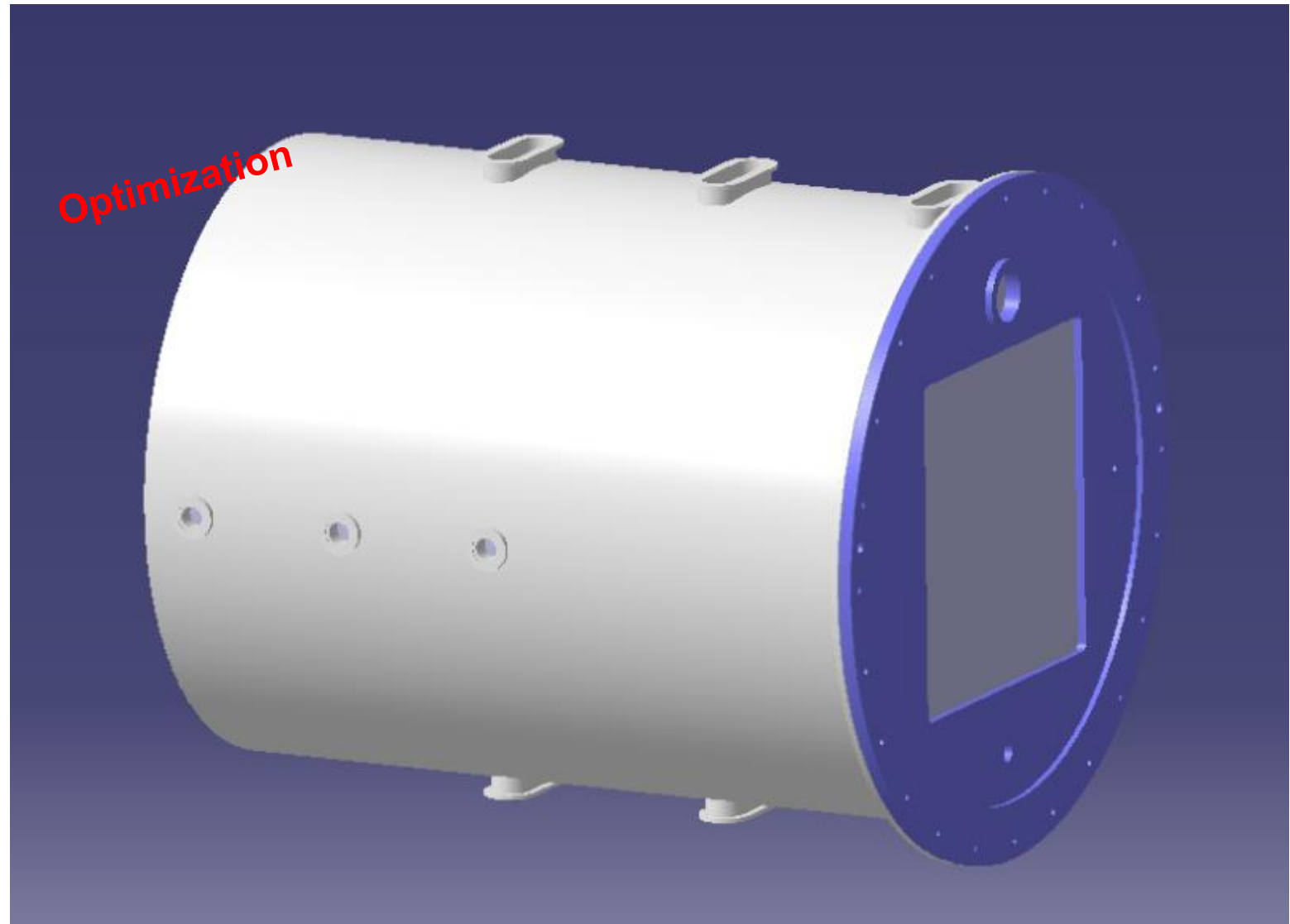
1号	<5'	合格
2号	<5'	合格
3号	<1°	需优化
4号	<10'	需优化
5号	<5'	合格
6号	<5'	合格

Divide and reflection mirrors

- ❑ Laser wave for the divide and reflection mirrors: 266nm
- ❑ Size: $\sim 0.8\text{mm} \times 0.8\text{mm}$
- ❑ Number of the divide trackers: 6 **Optimization**
- ❑ Stainless steel support integrated the laser mirrors
- ❑ Reflection efficiency: $>99\% @ 266\text{nm}$
- ❑ Reflection position accuracy $1/30$ degree

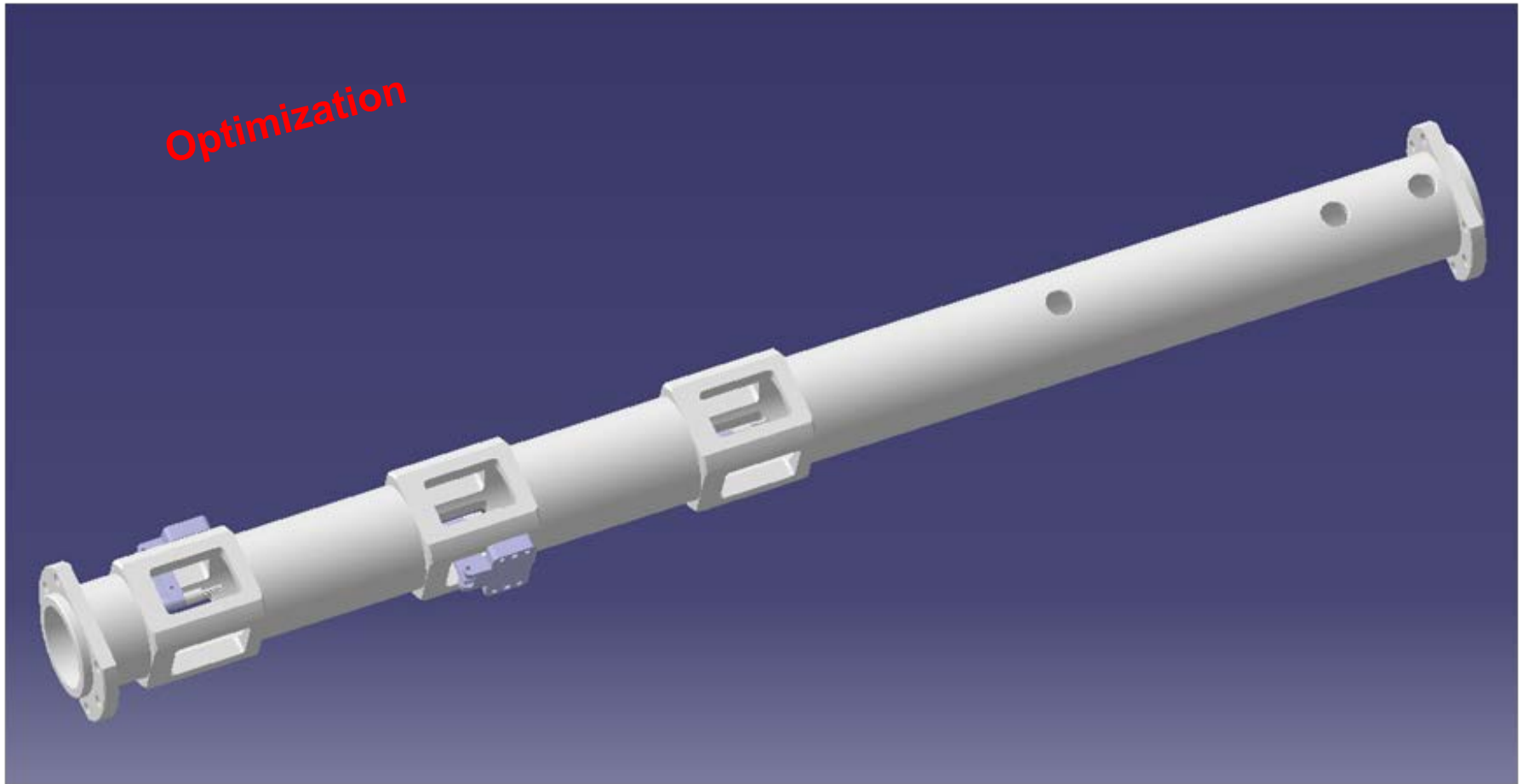


TPC barrel

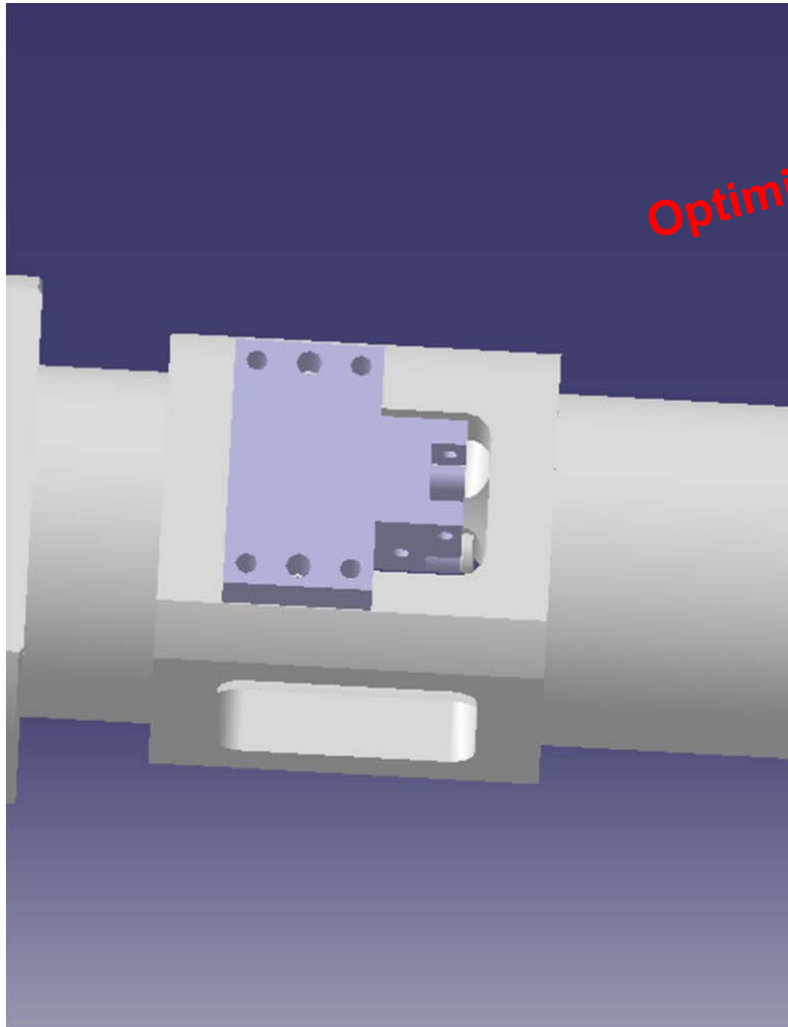


The TPC barrel with the 266nm laser windows

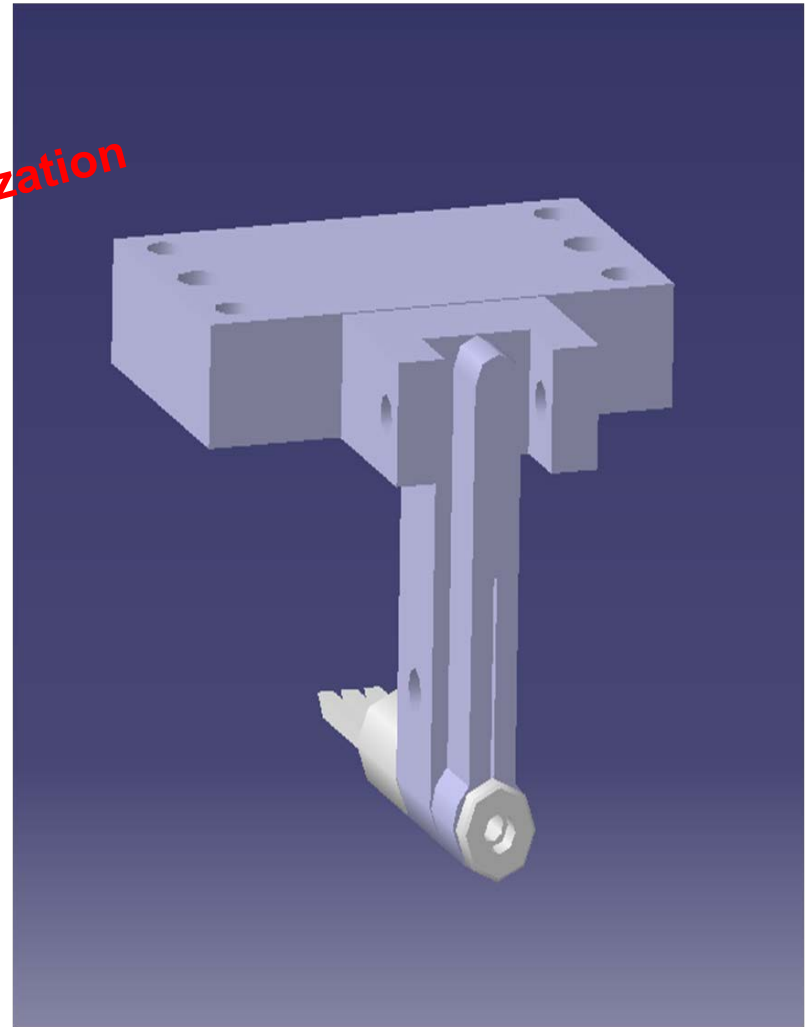
Rod for the mirrors



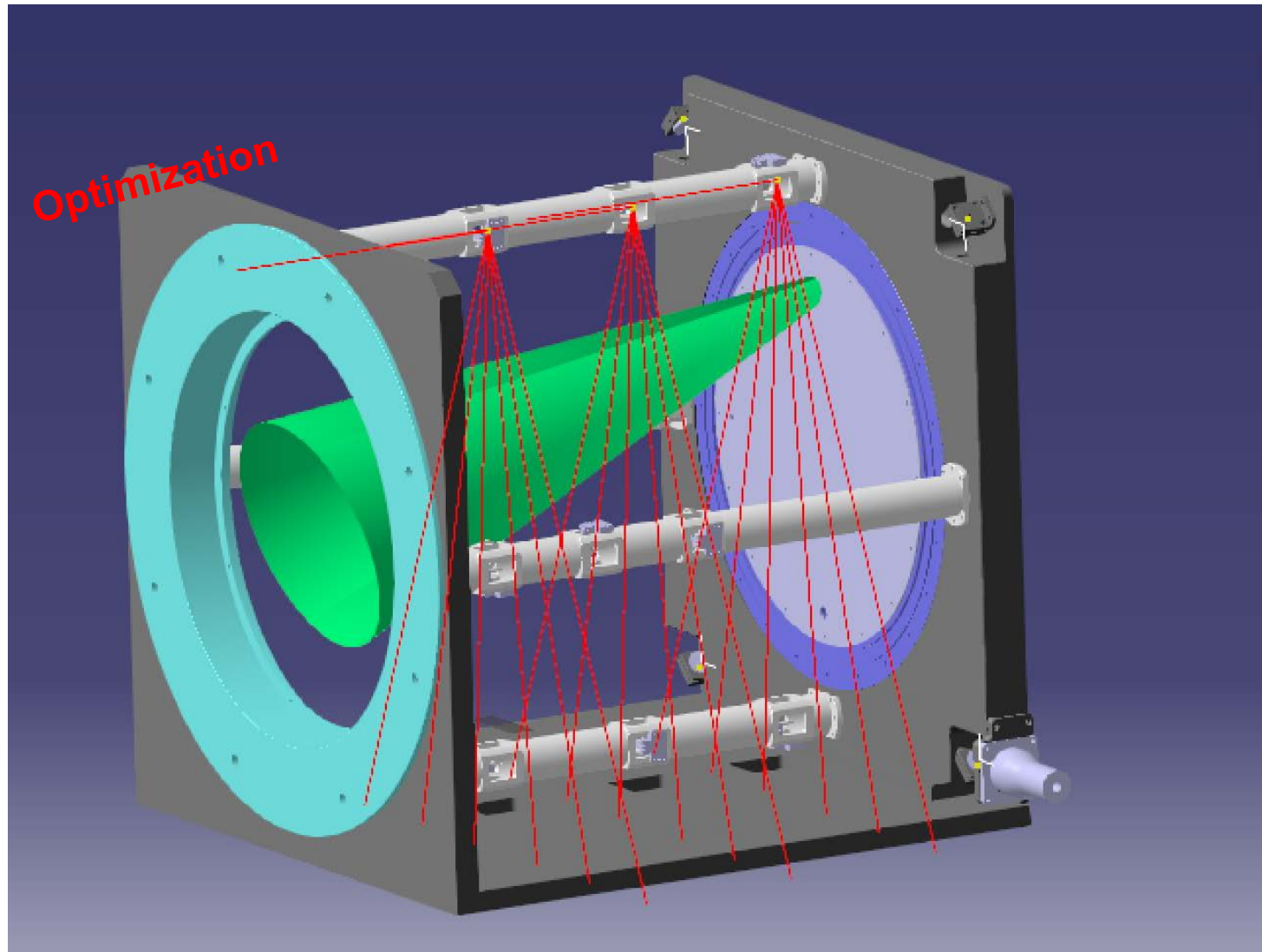
Adjustable optical mount



Optimization

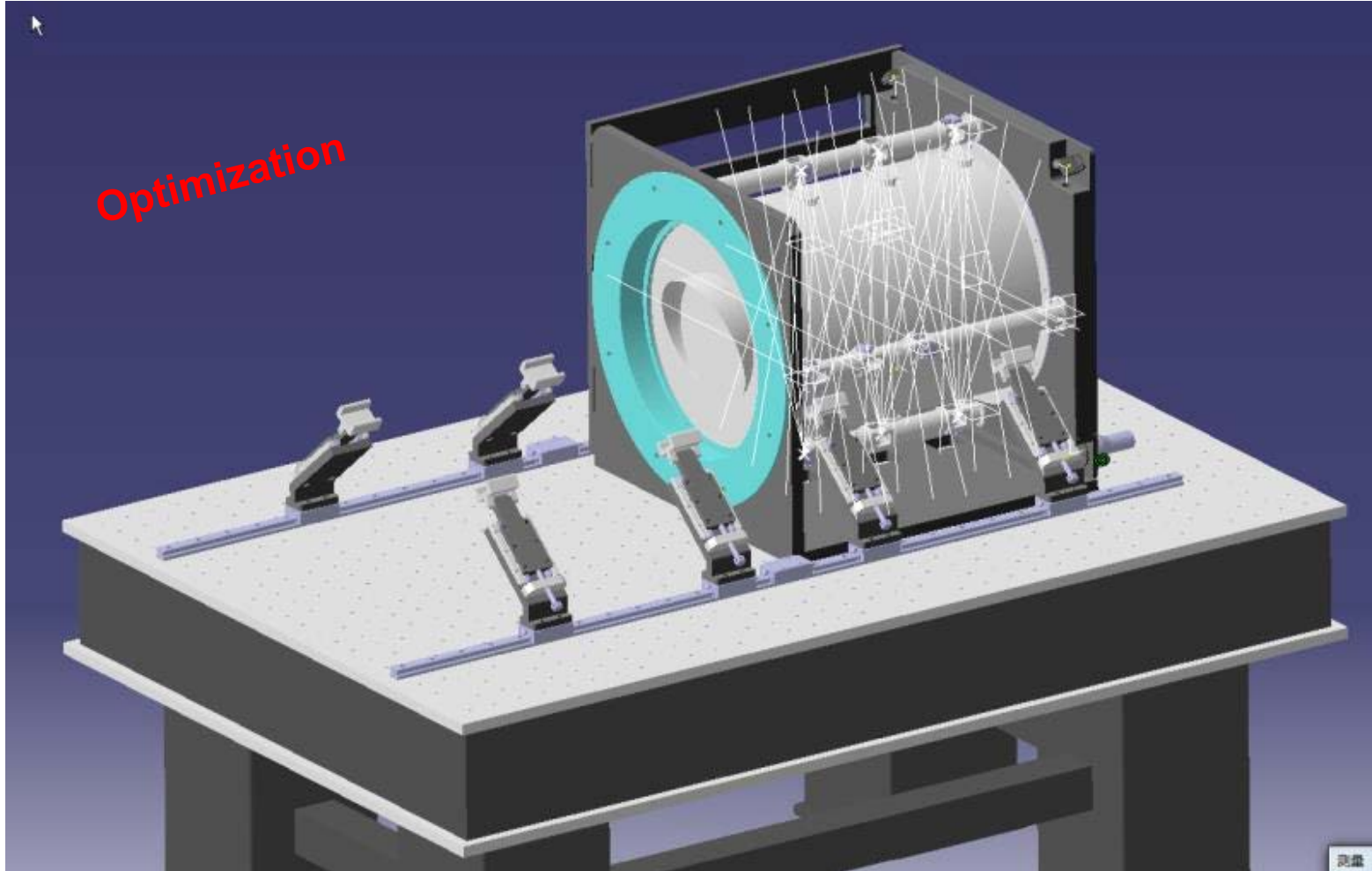


Design of the prototype with laser and UV



The laser and UV lamp structure without the TPC barrel

Design of the prototype with laser (Final version)



- ❑ Support platform: 1200mm×1500mm (all size as the actual geometry)
- ❑ TPC barrel mount and re-mount with the Auxiliary brackets
- ❑ Design is done and hardware would be finished about 6~8 weeks

Thanks.