上海科技大学
ShanghaiTech University

REGAE GUN laser diagnostic upgrade

- Theory
- Experiment

Speaker: Nengyuan Zhang

Supervisor: Max Hachmann

立志成才报国裕民

Outline

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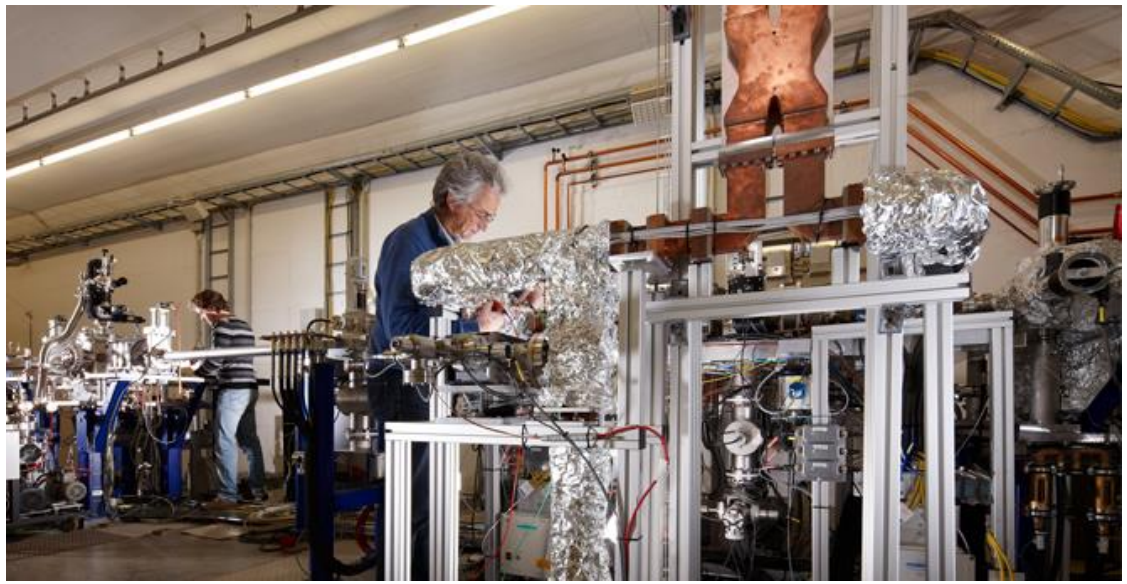
- **Theory**
  - Introduction of REGAE
  - Introduction of photocathode
  - Concept of virtual cathode
- **Experiment**
  - Virtual cathode of REGAE
  - How to setup new diagnostic system
  - Scan at virtual mirror
  - What could we do in the future

Introduction of REGAE

Relativistic **E**lectron **G**un for **A**tomic **E**xploration



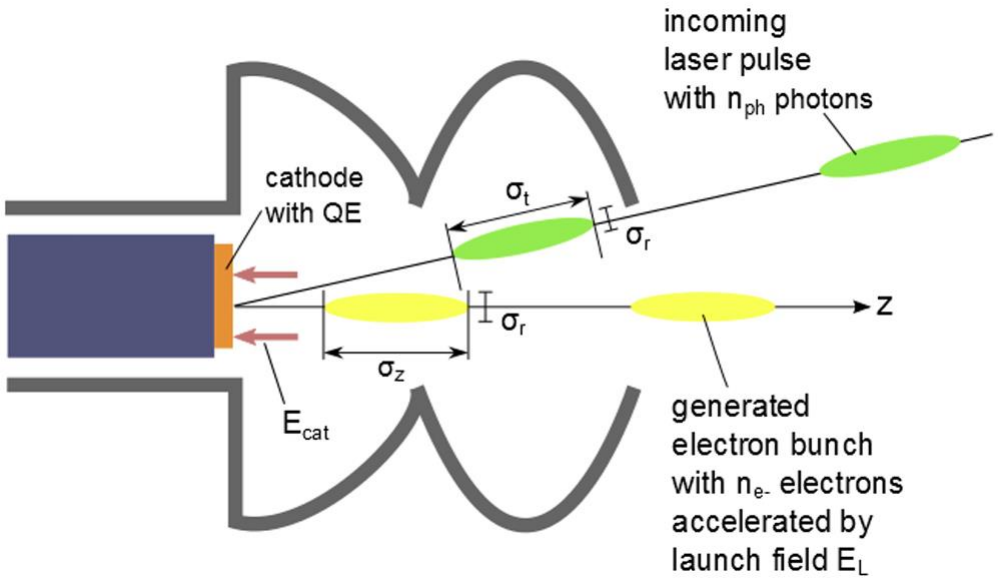
5 MeV injector for Ultrafast Electron Diffraction (UED)

- **Good diffraction quality need good electron bunch**
- Smaller emittance allows smaller beam diameters and a shorter pulse length
- High bunch charge for good signal-to-noise
- Higher bunch charge means higher space-charge forces on cathode -> worse emittance

REGAE - Deutsches Elektronen-Synchrotron DESY

Hirscht, J., Mazurenko, D. A., Zhang, D., Hada, M., Bayesteh, S., Delsim-Hashemi, H., ... & Miller, R. J. (2011). REGAE: New Source for Atomically Resolved Dynamics.

Introduction of photocathode



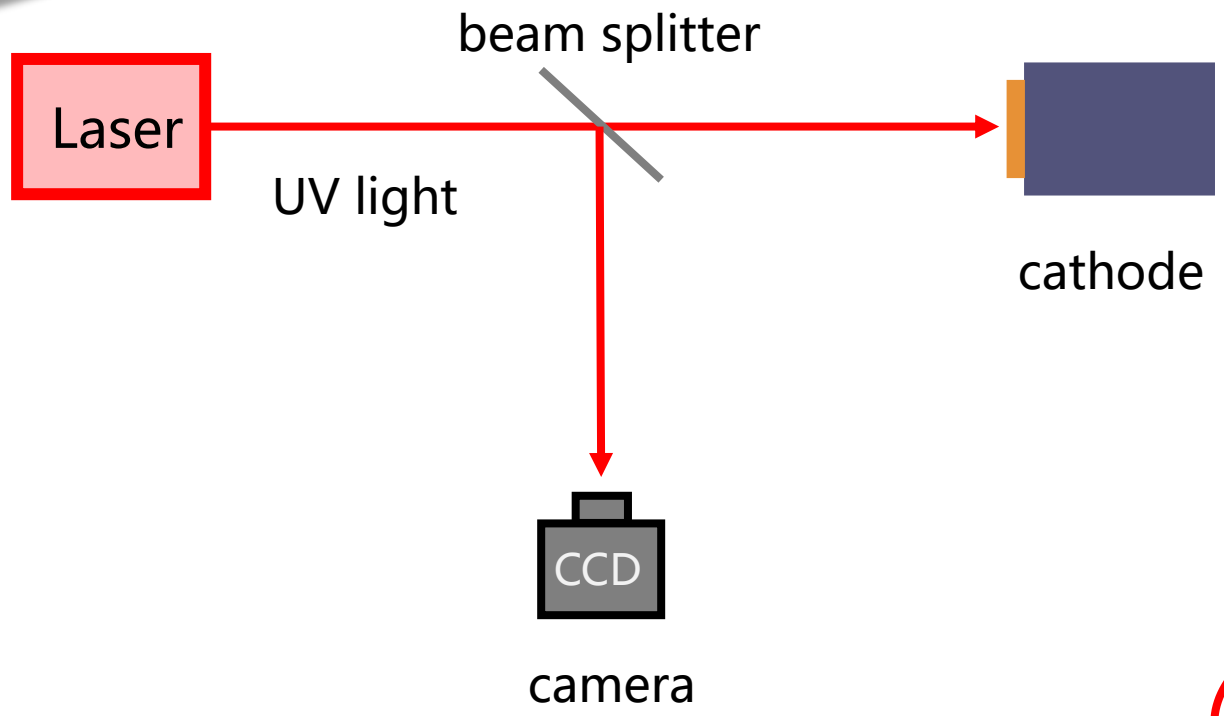
Laser spot size on the photocathode ⟺
- Transverse dimension
- Initial emittance
- Space charge phenomena

Laser pulse intensity ⟺
- Bunch charge

Laser pulse length ⟺
- Electron bunch length
- Peak current

Panofski, E., et al. "VIRTUAL CATHODE DIAGNOSTICS WITH A LARGE DYNAMIC RANGE FOR A CONTINUOUS WAVE SRF PHOTOINJECTOR."

Why we need virtual cathode



- Close relationship between laser and generated electron bunch requires continuous monitoring

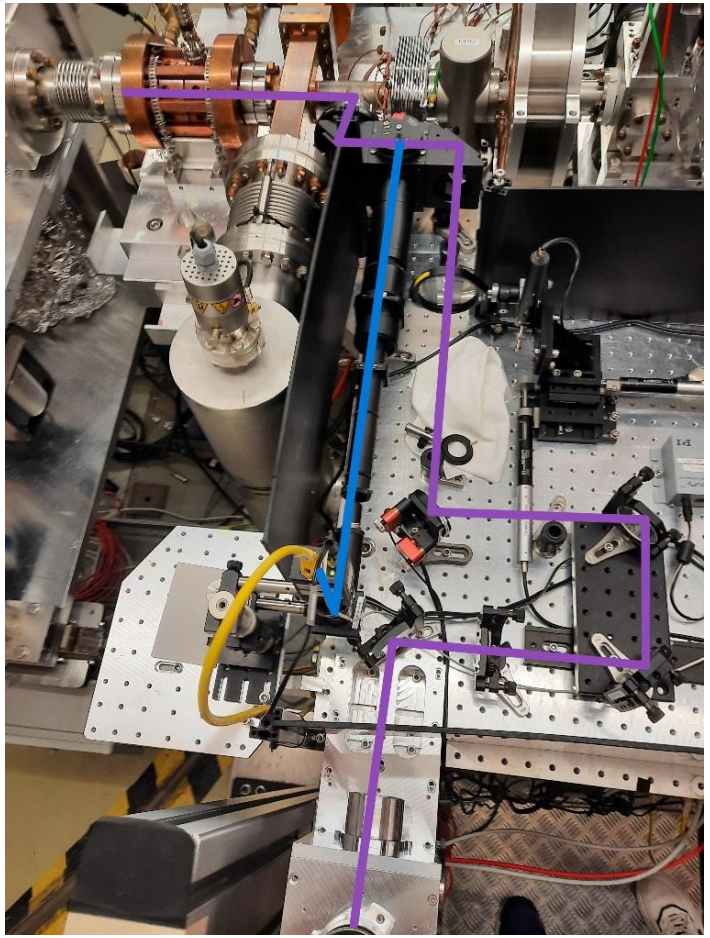
High diffraction quality

High quality electron beam

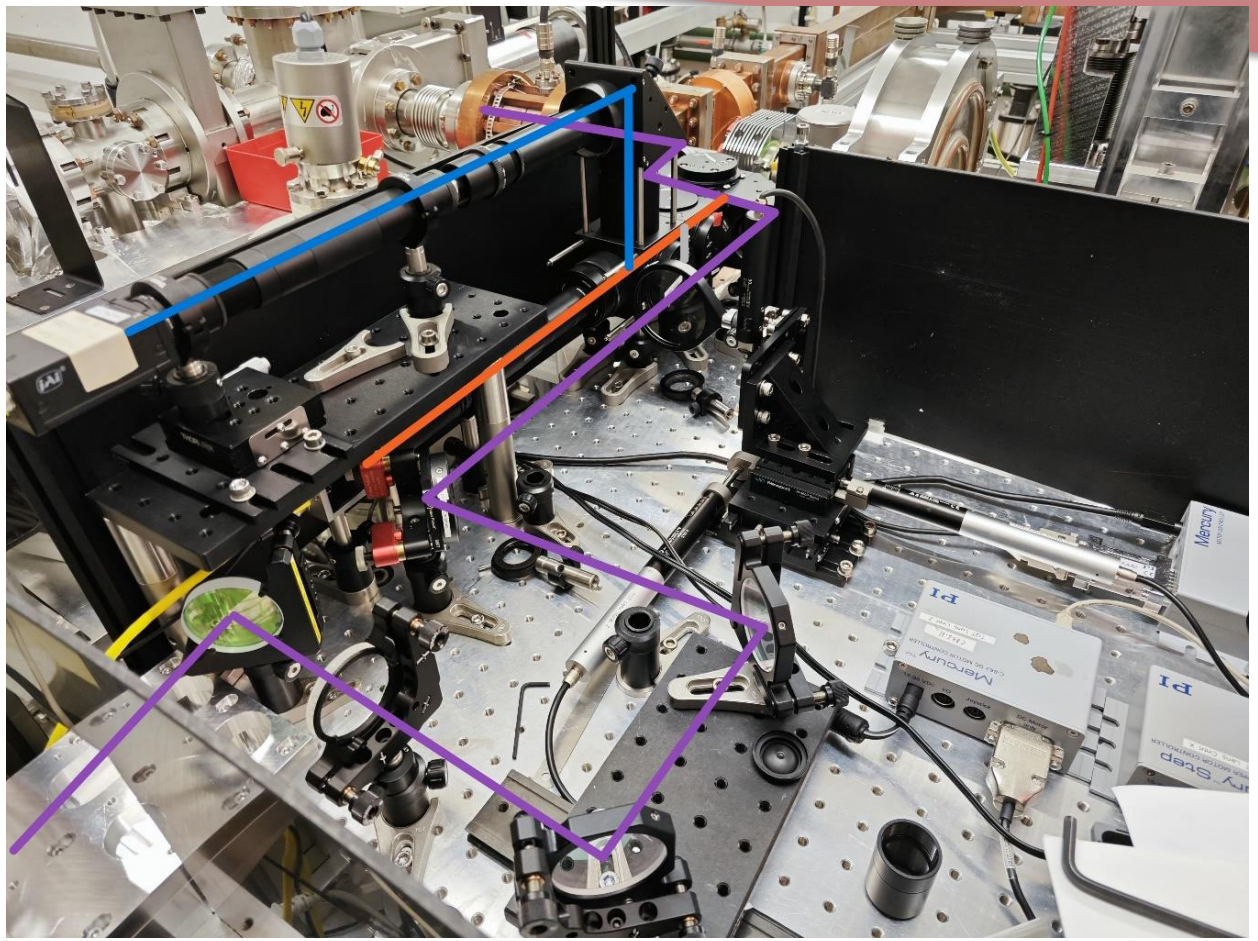
Determine & Control laser parameter

Panofski, E., et al. "VIRTUAL CATHODE DIAGNOSTICS WITH A LARGE DYNAMIC RANGE FOR A CONTINUOUS WAVE SRF PHOTOINJECTOR."

Virtual cathode of REGAE

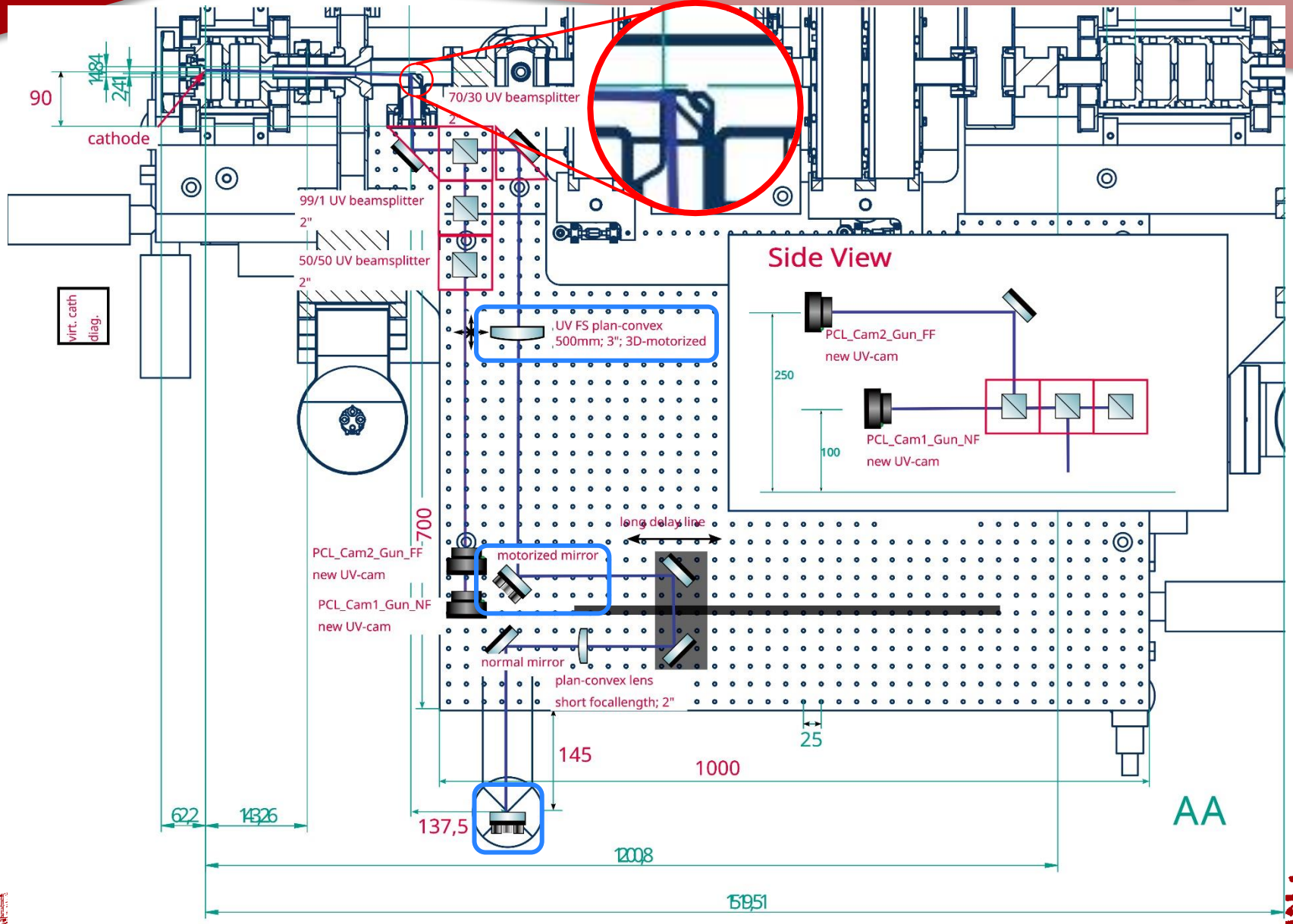


OLD



NEW

How to setup new diagnostic system



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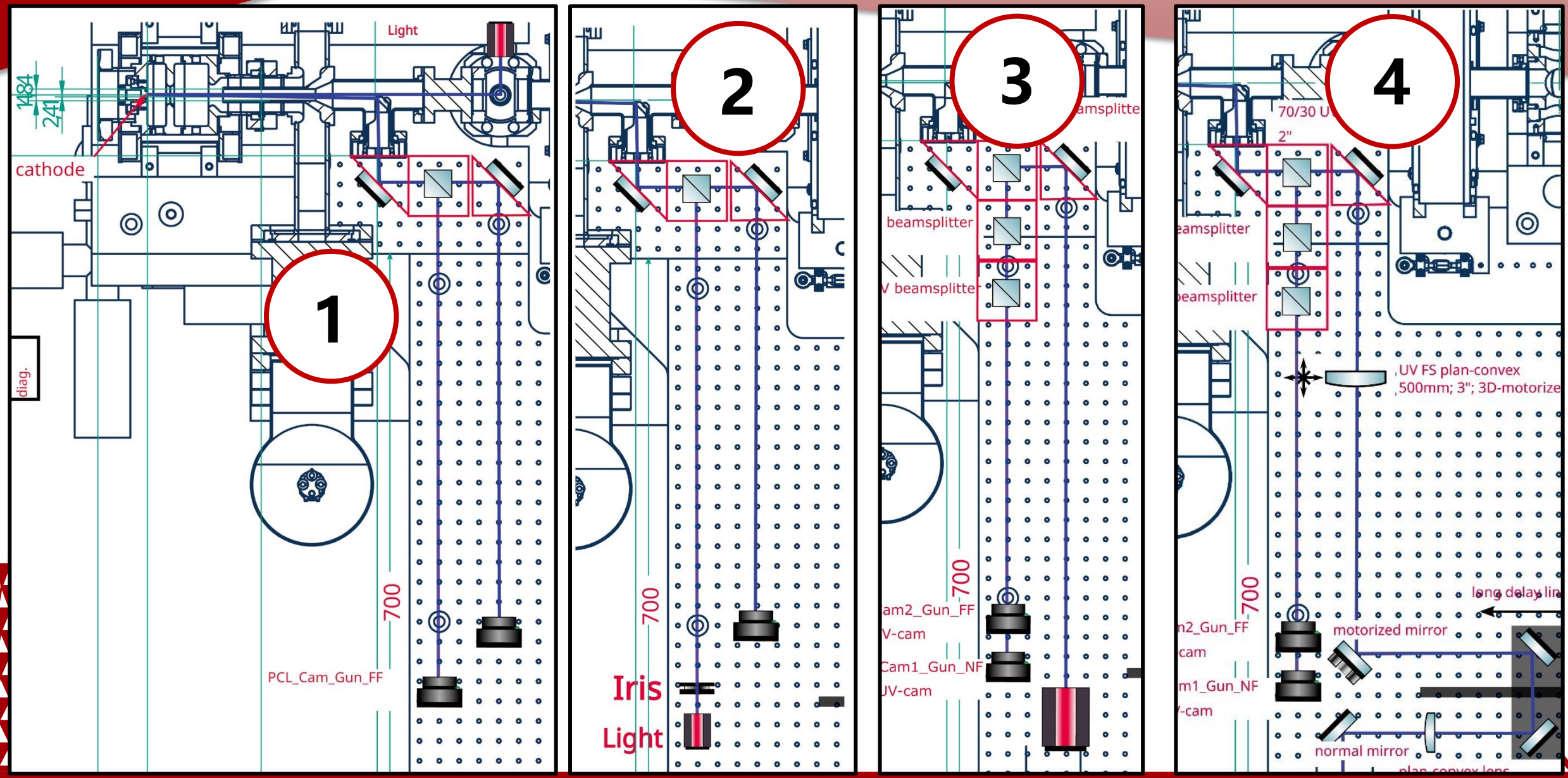
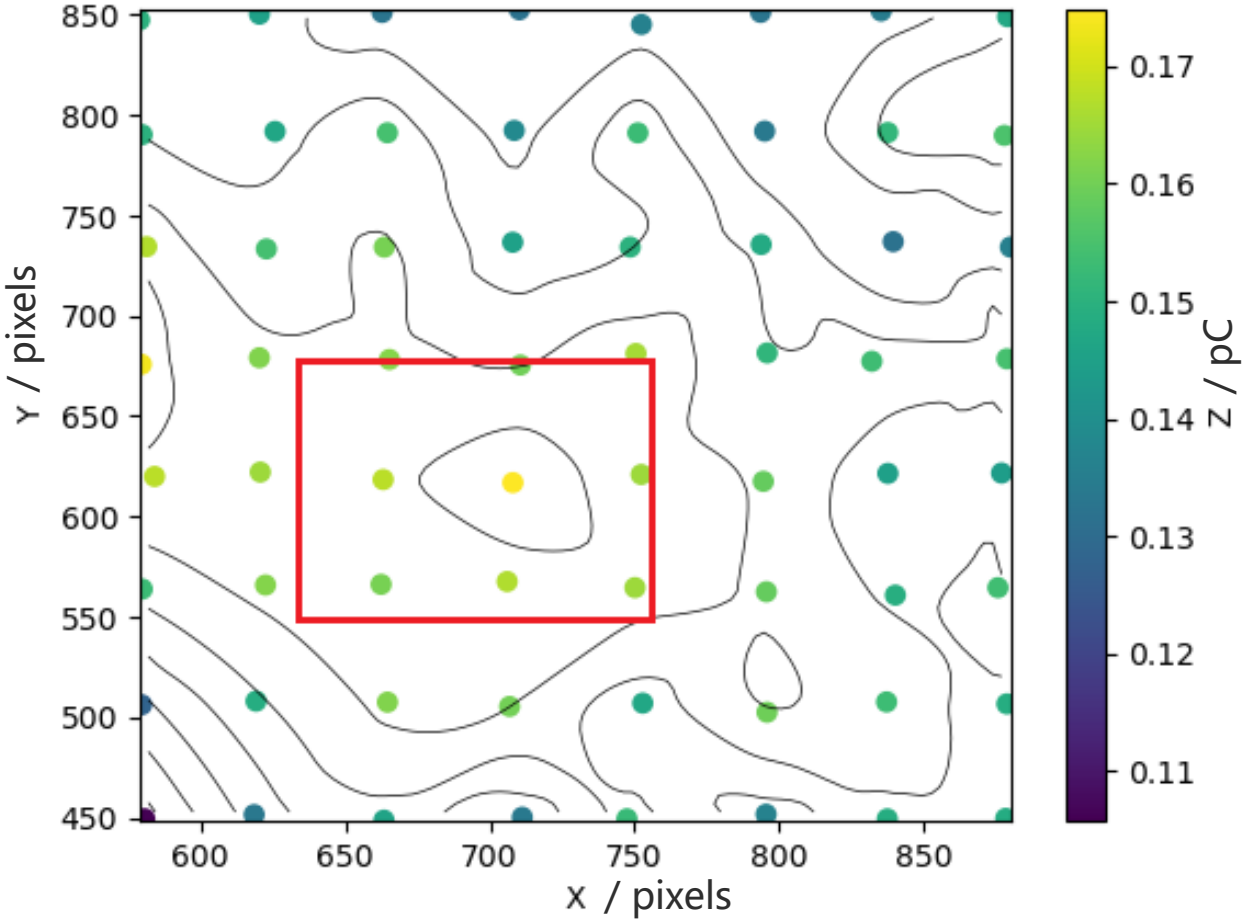
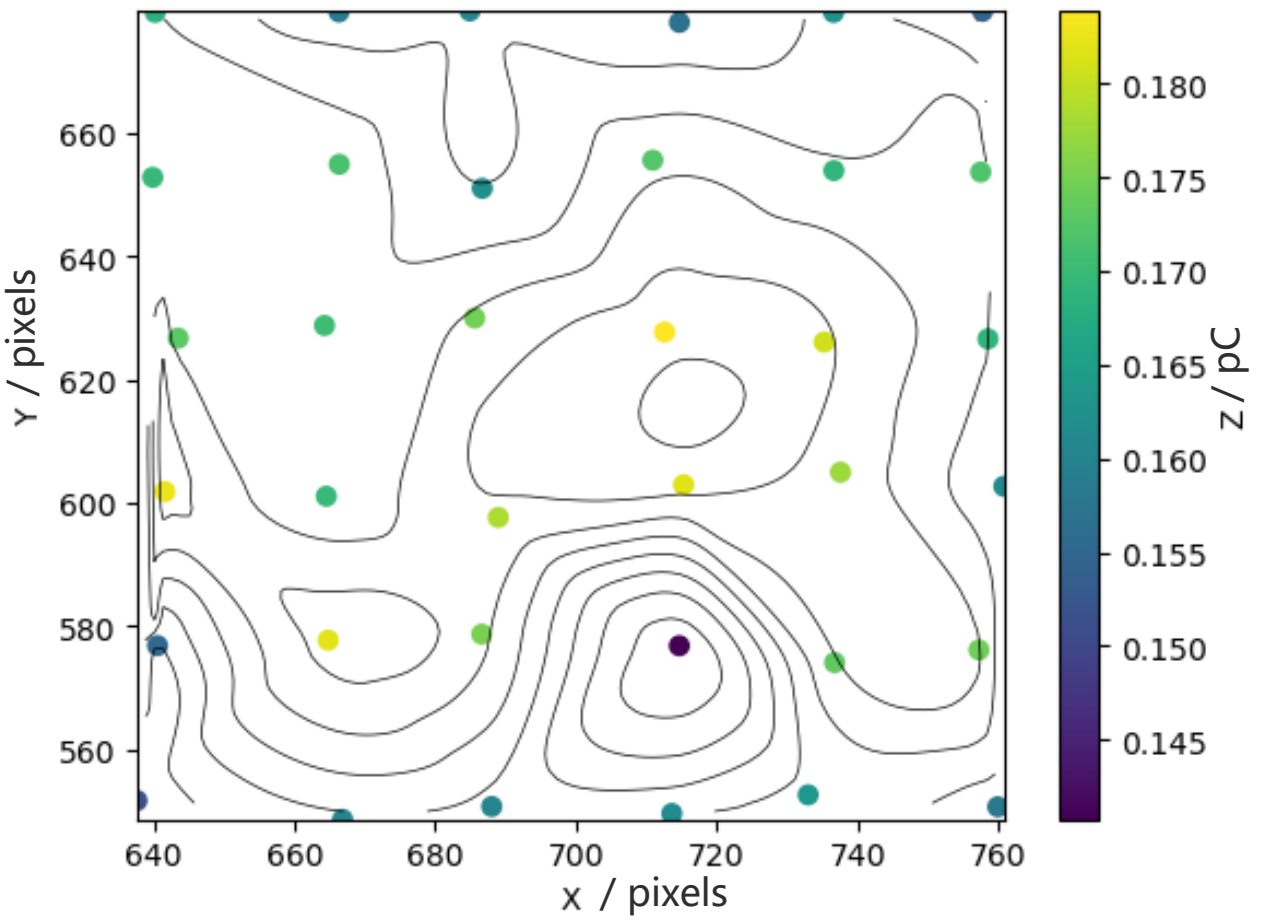
How to setup new diagnostic system



Scan at virtual mirror





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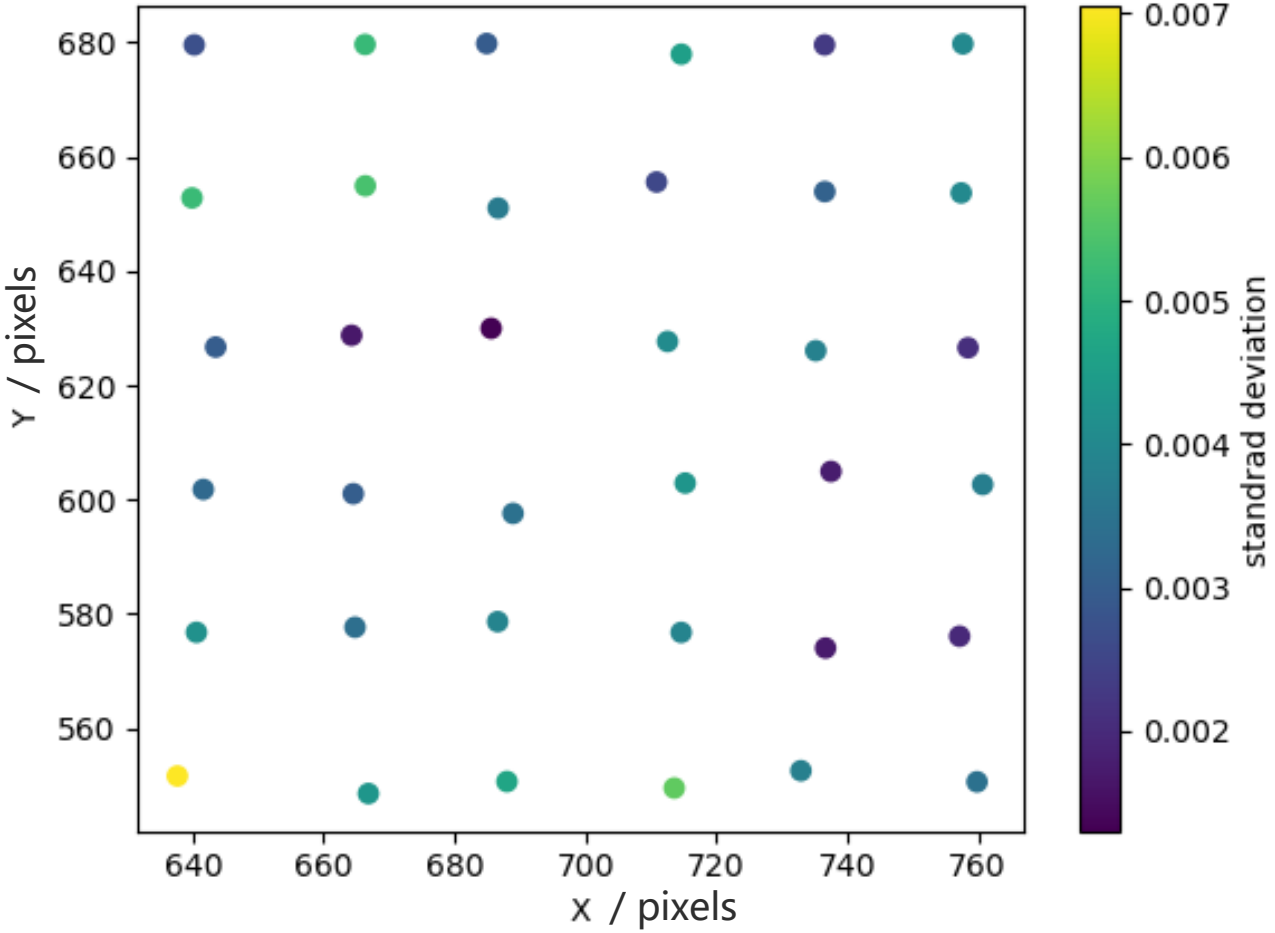
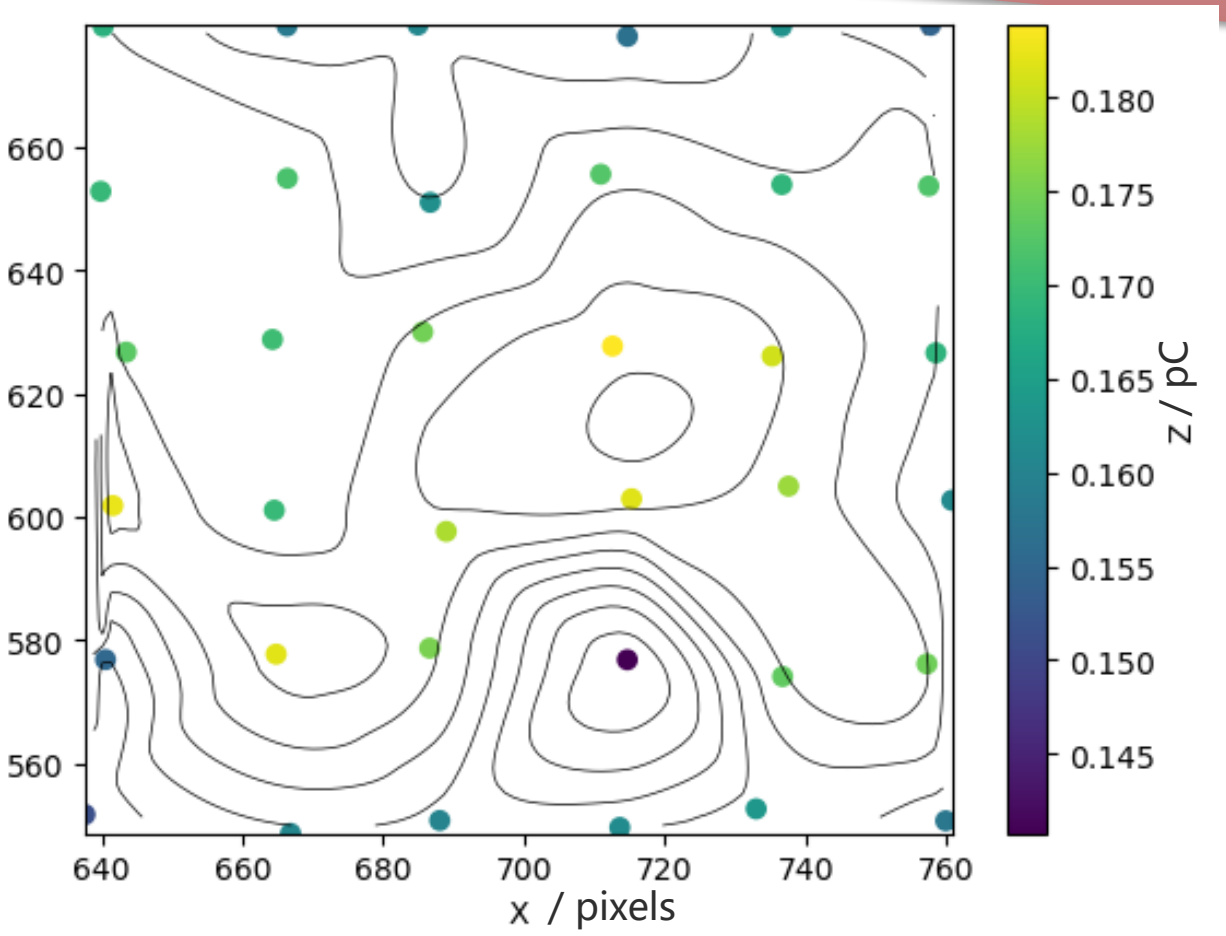
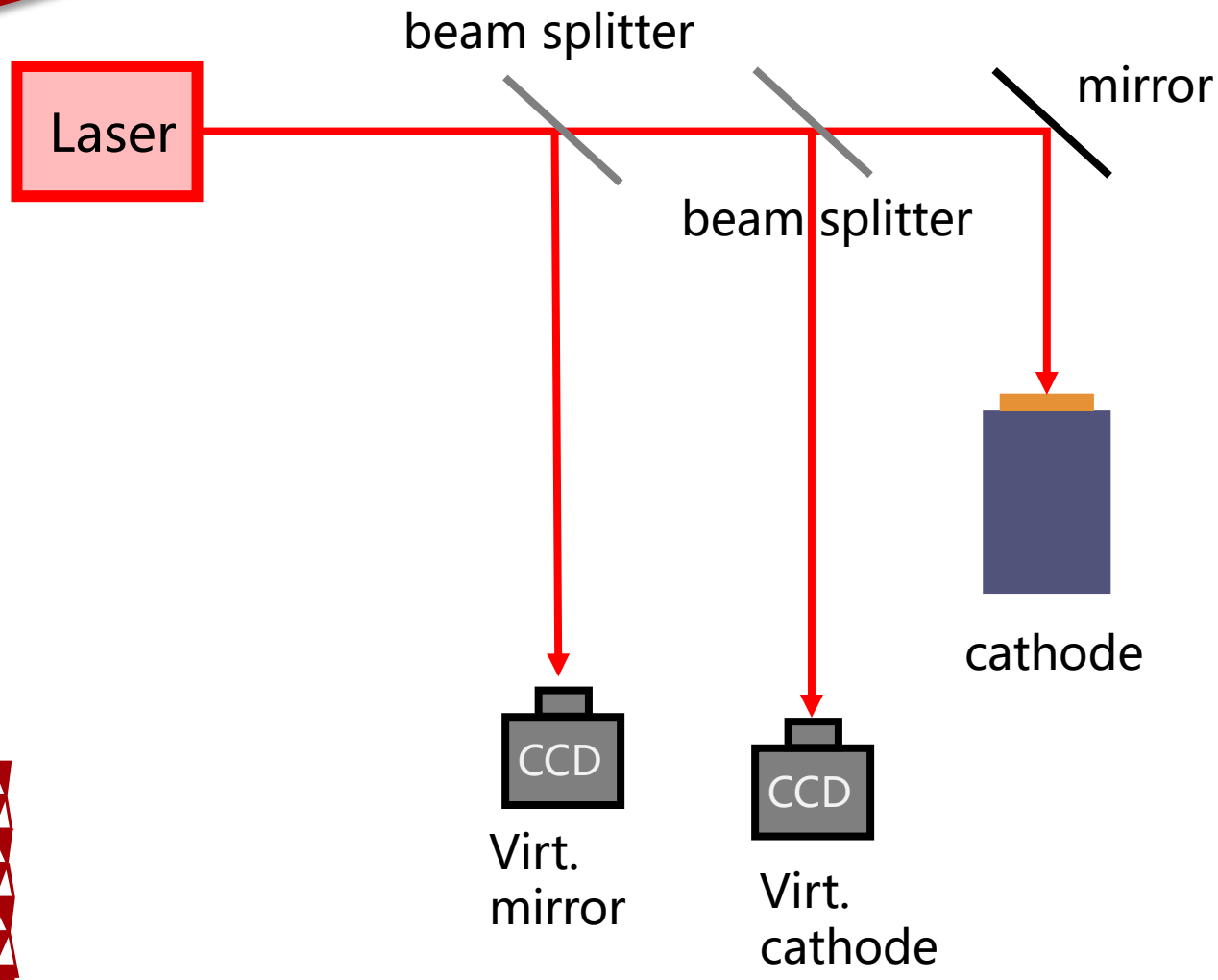




What could we do in the future



In future plans, the position of the beam on the mirror can be fixed, and the position focused on the photocathode can be varied to measure the quantum efficiency at different incidence points, thereby creating a quantum efficiency topographical map of the photocathode.


Thank you for your attention