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Current status of photocathodes in Japan

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Network and Collaboration

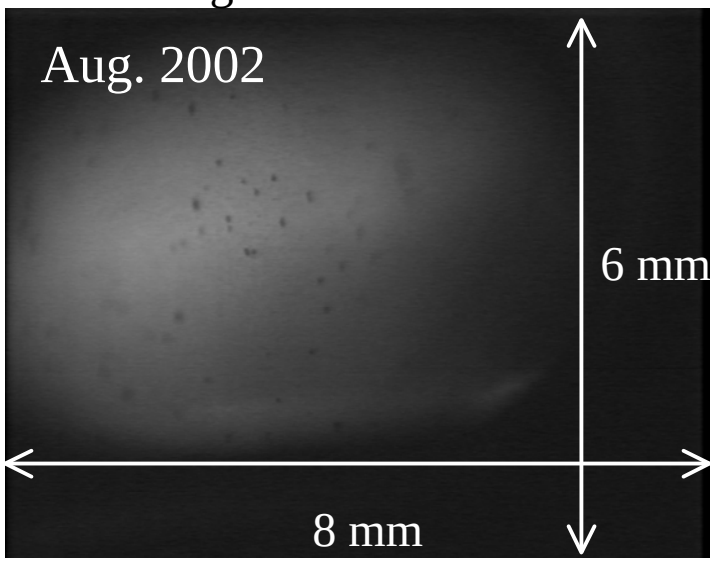
under National Project on Advanced Compact Accelerator for Medical Use

hosted by National Institute for Radiological Science

1. Mg (QE~10^{-3}) photoinjector :
   U.Tokyo/SPring8
2. Cs_2Te(QE~10^{-2}) load-lock-type photoinjector : KEK/Nagoya Univ..
3. Cs2Te/Diamond (QE~10^{-1}) cartridge-type photoinjector :
   SPring8/U.Tokyo/Hamamatsu Photonics

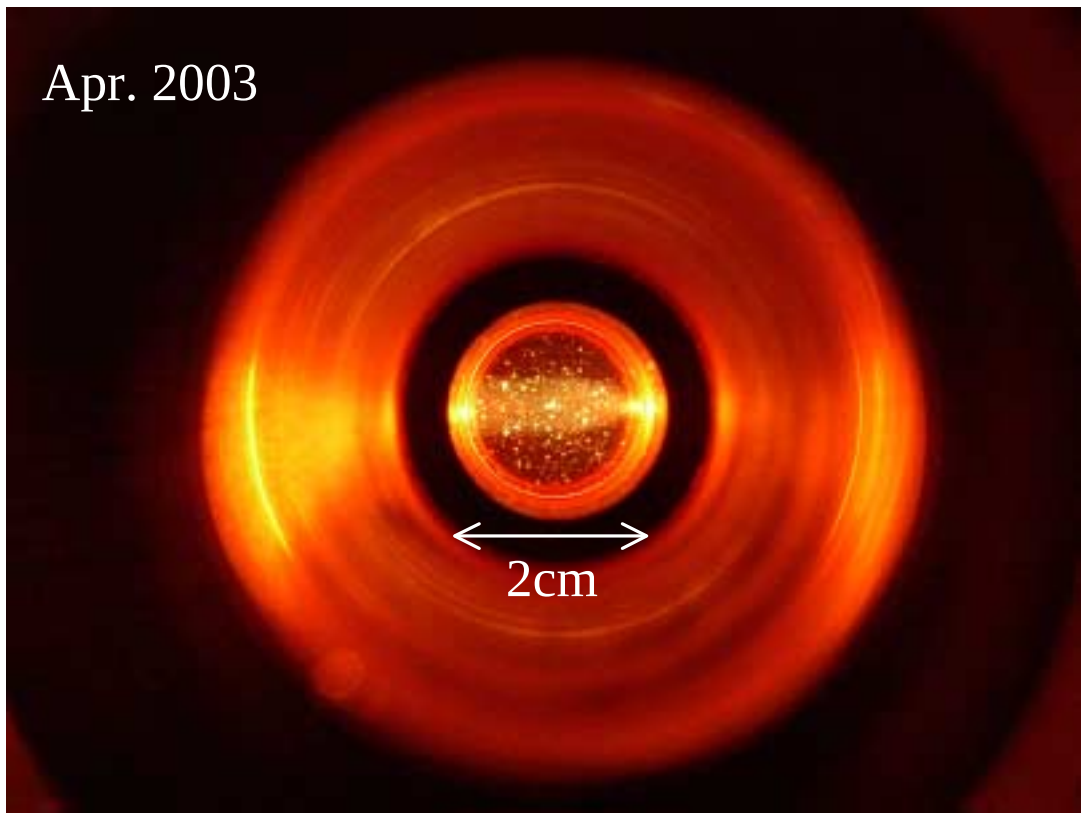
Cathode Surface

CCD Image of the cathode surface



Mg cathode (High QE, ~10^{-3})

Our cathode… $QE = 1.3 \times 10^{-4}$ (at present)

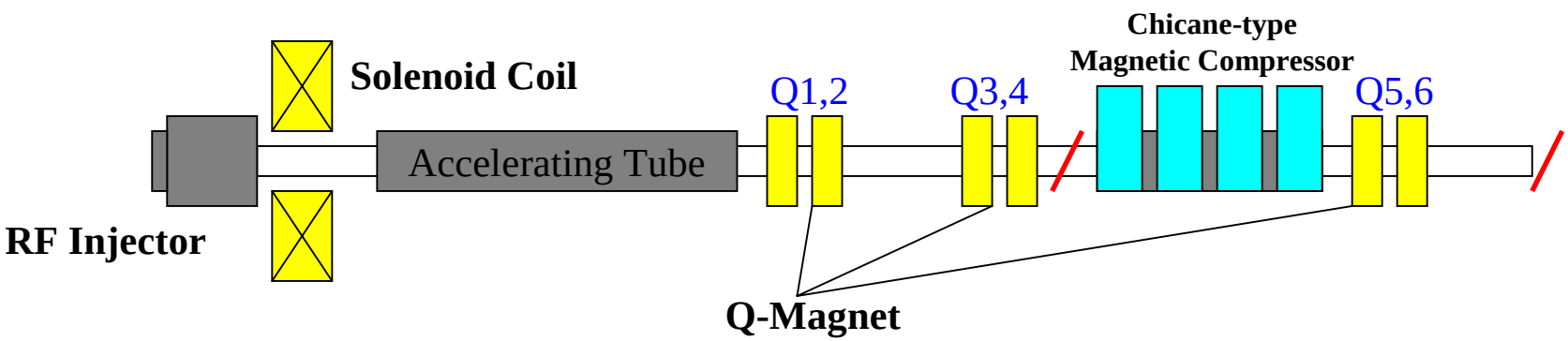


Craters due to
the RF discharge
on the cathode surface

Emittance Data

Date	Horizontal	Vertical	
'02.10	26 πmm.mrad	24 πmm.mrad	（Q3,4）
'03.9	21 πmm.mrad	29 πmm.mrad	（Q1,2 Velocity Bunching, E=10MeV）
'03.9	22 πmm.mrad	11 πmm.mrad	（Q1,2 Solenoid）
'03.9	29 πmm.mrad	34 πmm.mrad	（Q1,2）
'04.01	35 πmm.mrad	29 πmm.mrad	（Q5,6 OTR method）
'04.01	34 πmm.mrad	27 πmm.mrad	（Q5,6）

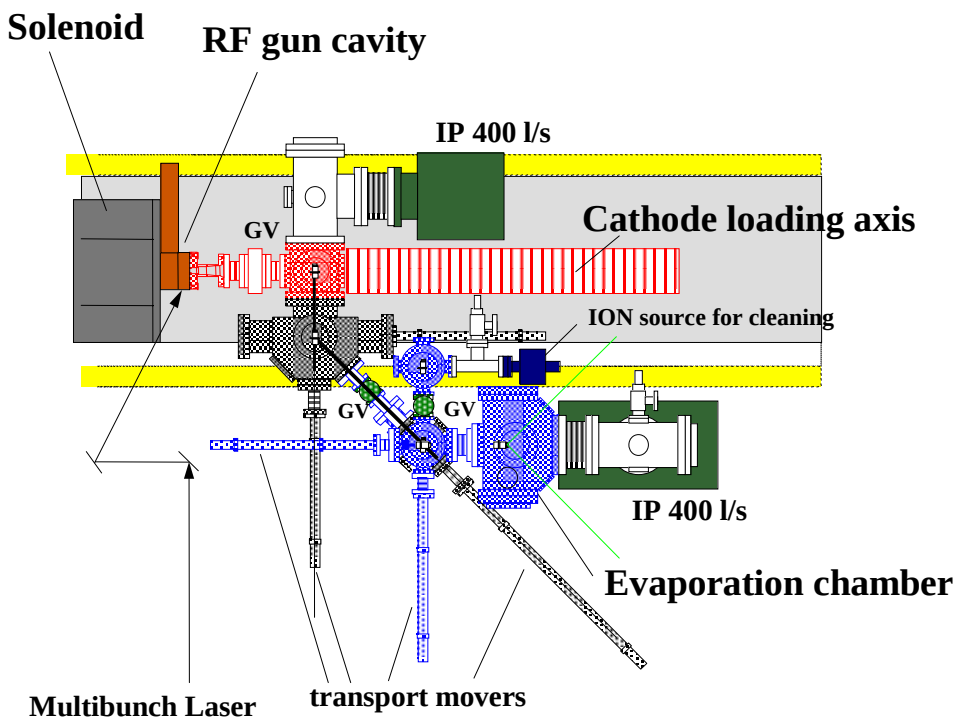
- Normalized, rms
- Energy 22MeV, Charge ∽1nC



Cs_2Te cathode at KEK-ATF

Kuriki M. and Terunuma N. for ATF collaboration

- CsTe cathode is formed by evaporation on Mo plug.
- QE was measured by illuminating UV light from Xe lump.
- The cathode is transported to the gun cavity in the load-lock chamber.



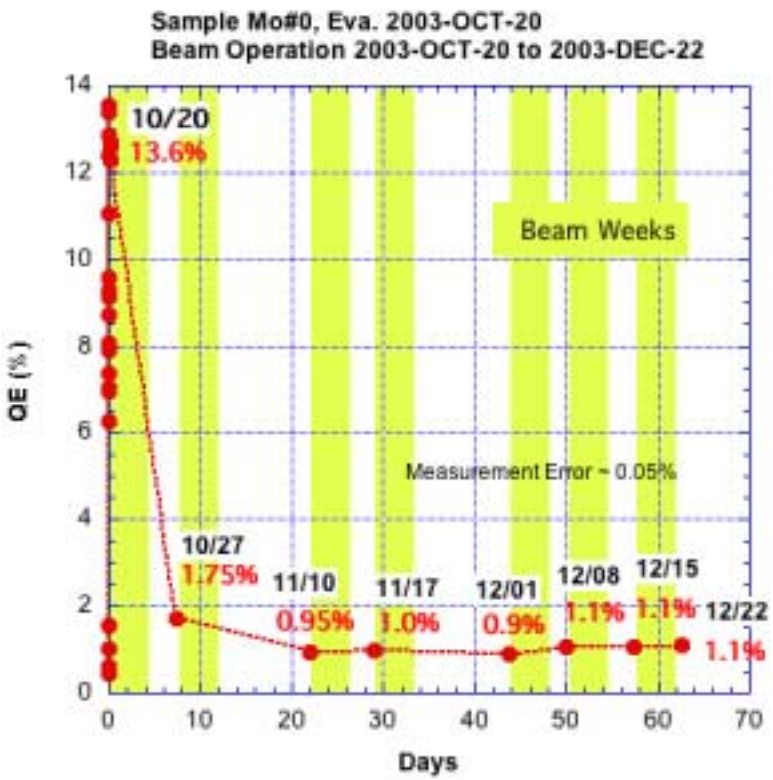
Evaporation System

15mm

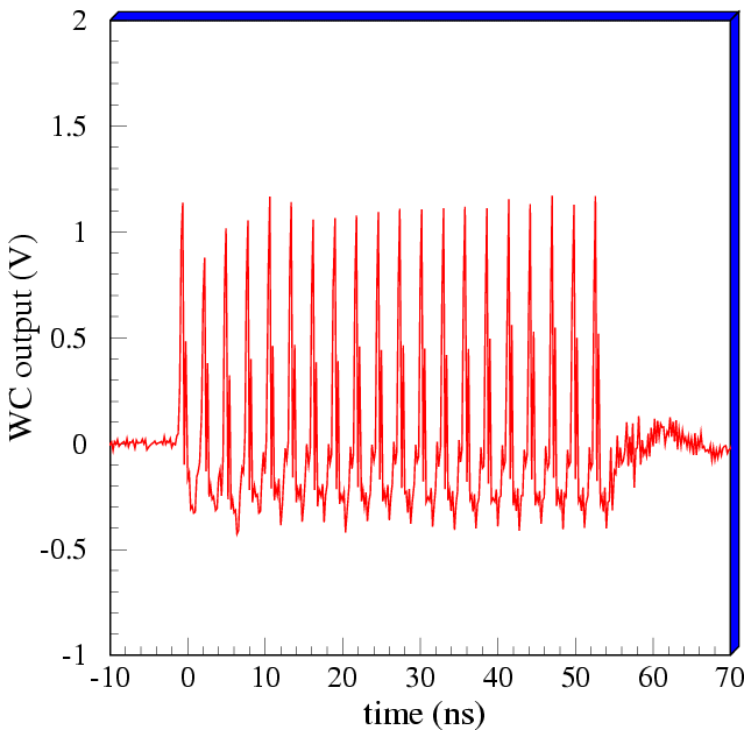
Cathode Plug (Cu)

Performance

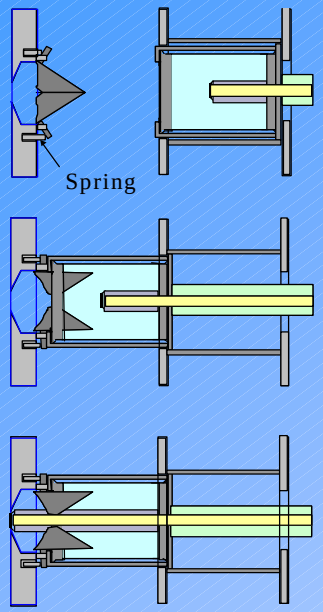
- QE that was initially more than 10% was decreased rapidly down to around 1%.
- Even though, QE was kept around 1%.
- The operation did not affect the cathode performance. The life time might be forever (at least more than two months).

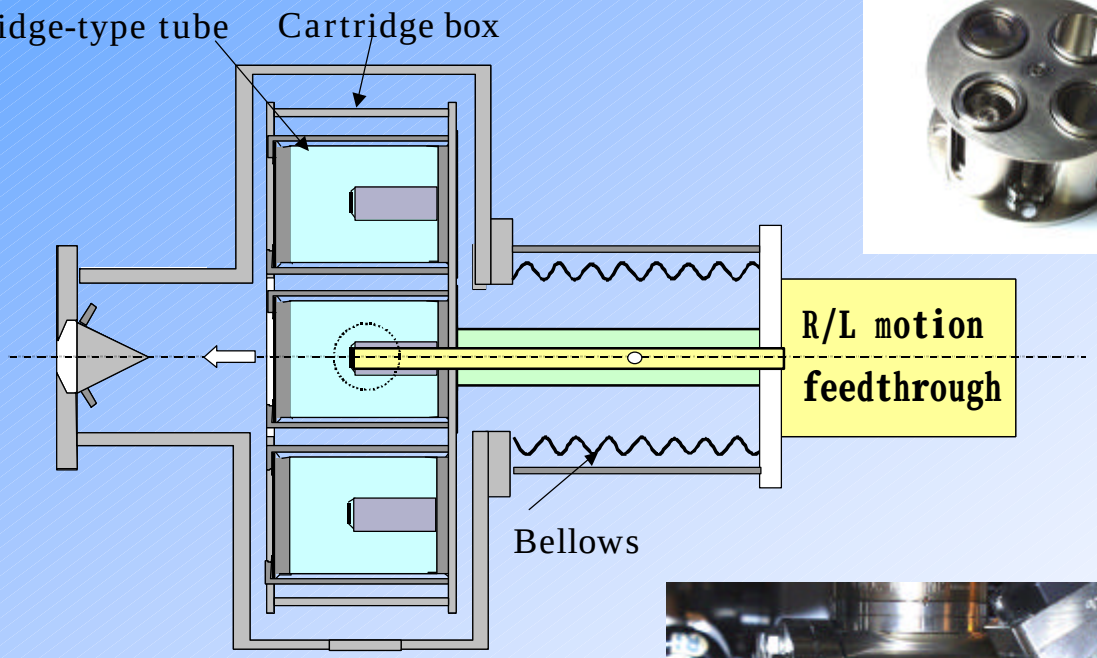


Generated multi-bunch beam
Measured by WC monitor

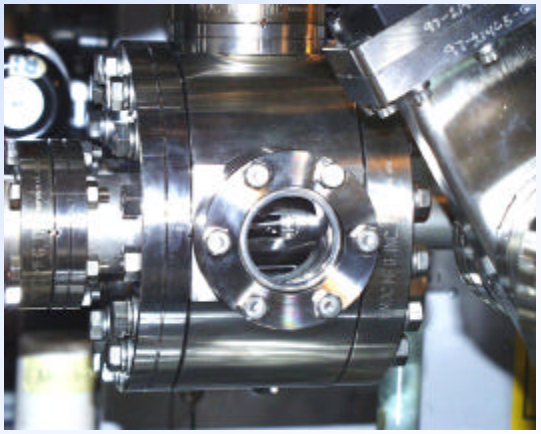


Electron Gun including cartridge-type photocathode tubes





Reflection-type
Cs_2Te tube



Transparent-type Cs_2Te and NEA Diamond tubes with high quantum efficiency are now under developing.

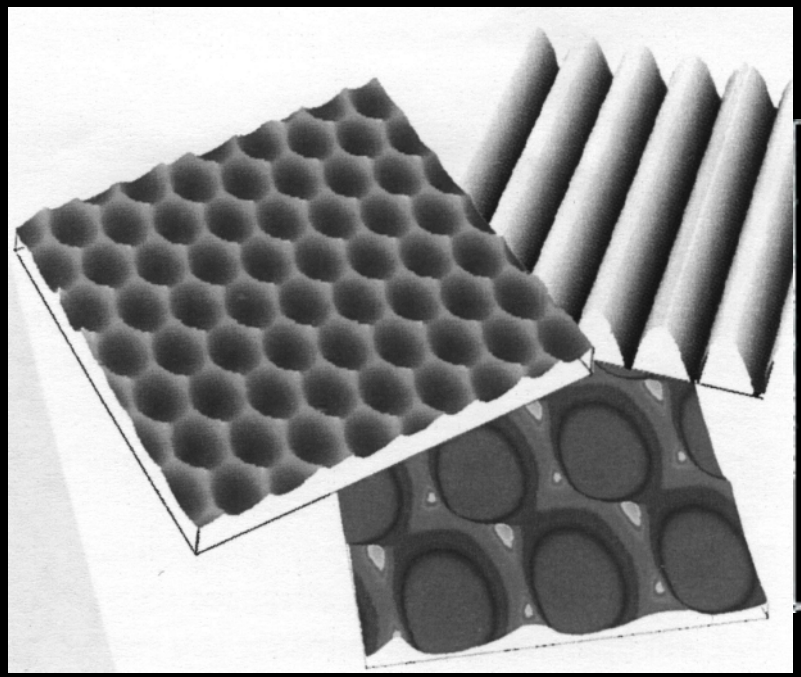
Influence of spatial and temporal profiles of UV-laser light source for photo-cathode RF-GUN on electron-beam emittance

Hiromitsu Tomizawa : SPring-8/JASRI

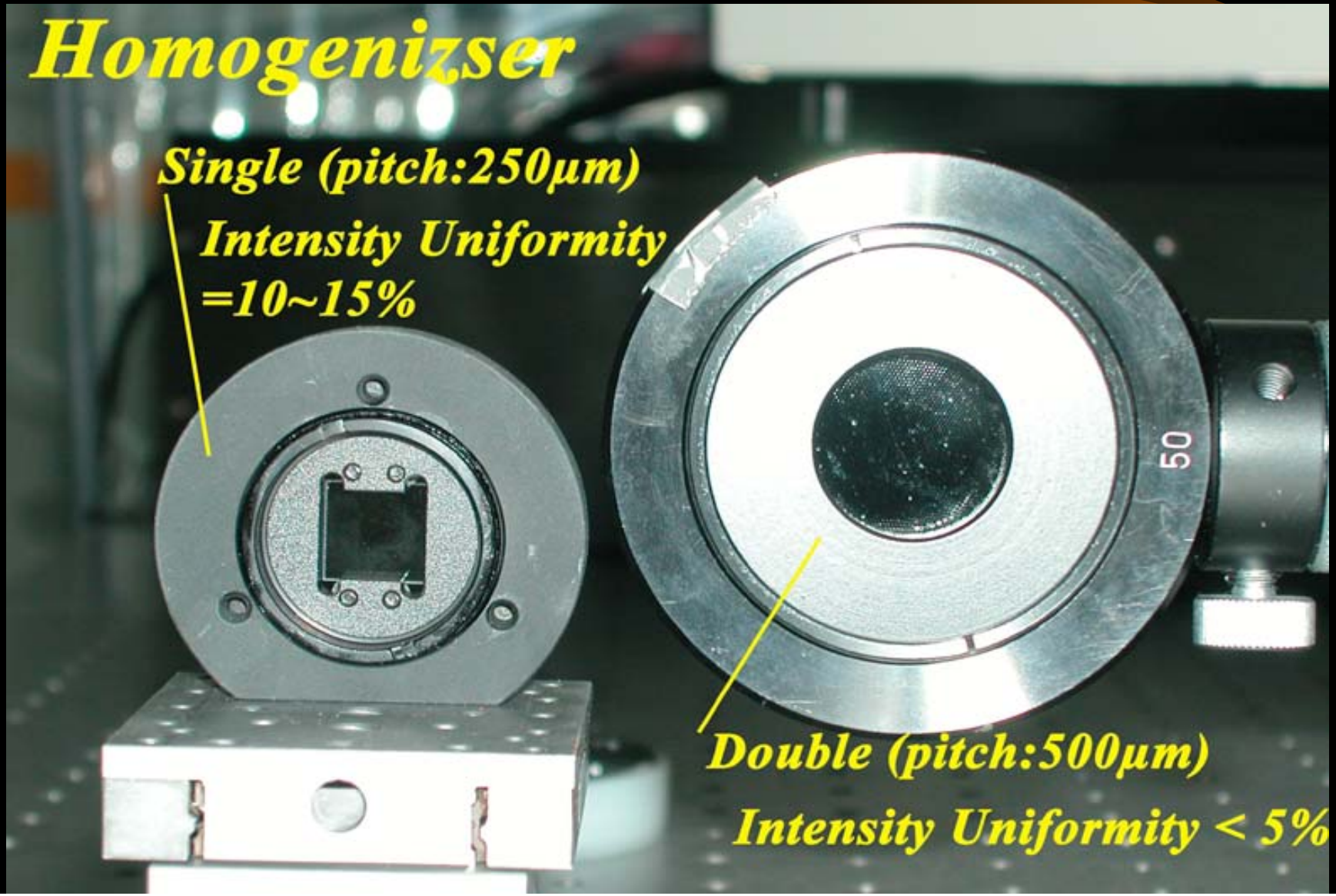
1. **Guiding principle for production of low-emittance electron beam**
2. **Experimental Setup**
3. **Improvement of spatial laser profile**
4. **Experimental Results of Emittance**
5. **Summary & Discussion**

3-2. Spatial profile shaping with Microlens array

- Transmission: ~ 80%
- It is possible to shape laser profile as Silk-hat, using with a convex lens

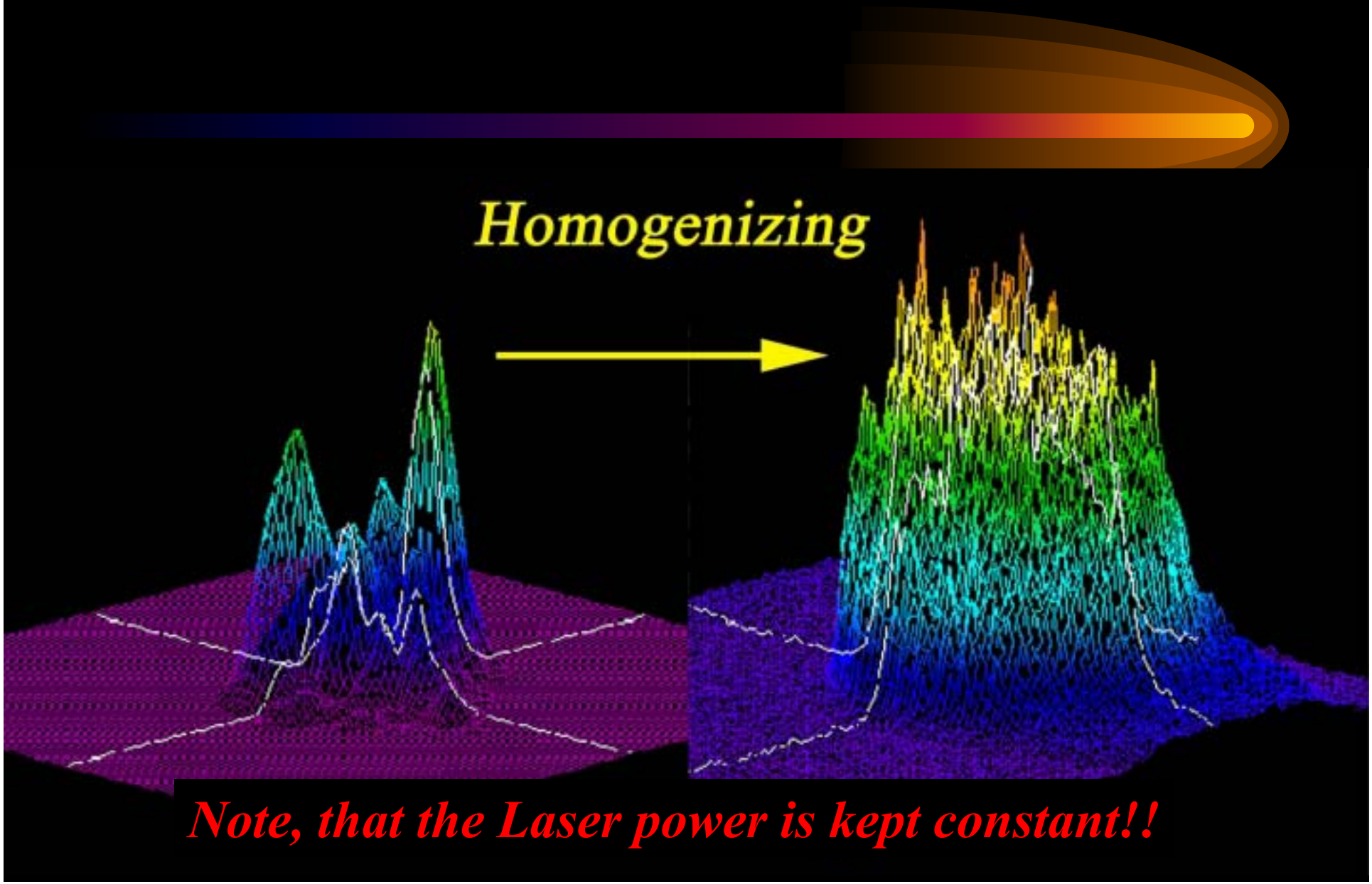


3-2-1. Picture of Microlens array as Homogenizer



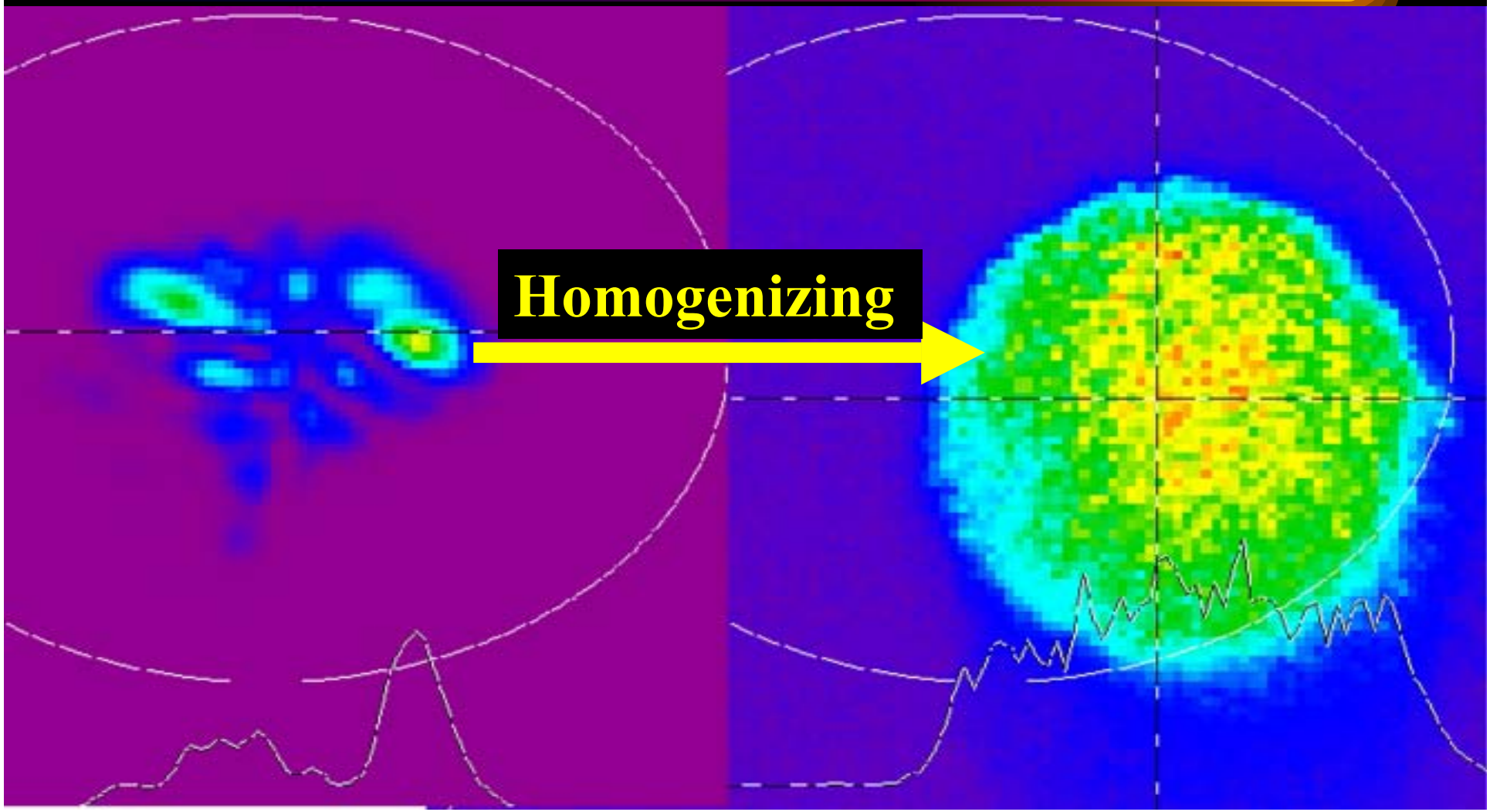
3-2-2. Installation of Homogenizer in the Transport optical systems

3-3. Result of spatial laser profile shaping



Note, that the Laser power is kept constant!!

3-3-1. Laser spot image on the cathode



5-2. Planned Diagnostics & Improvement

- Long-time Stability of Oscillator (> 1 week)
- Installing Pulse-Shaping optics (SLM + Stretcher)
- Regen System for UV-Laser ($Ce^{3+}:LiCaAlF_6$??)
- Surface physics of Cathode
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