# Comparison of the focal length of the  solenoid

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# ➢ Focal length

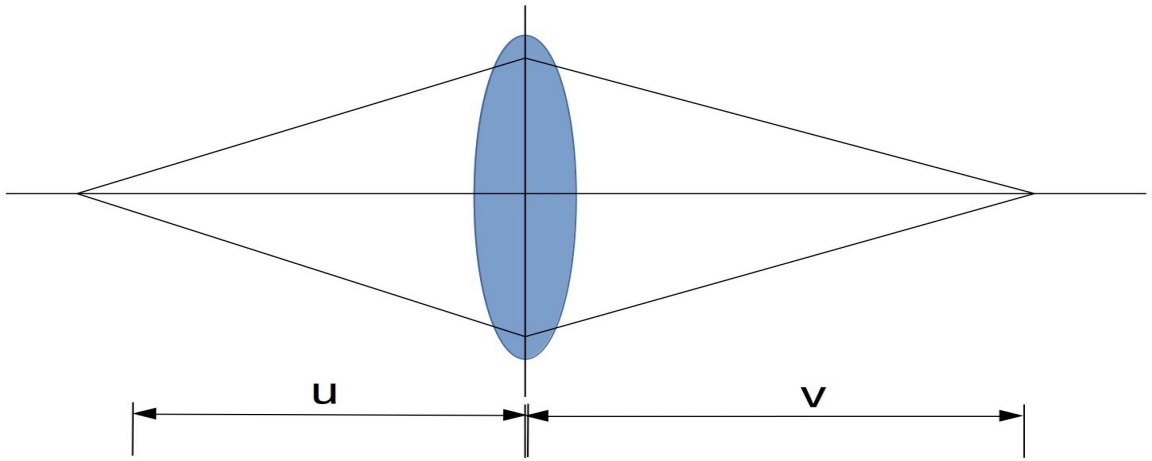
- For a solenoid

$$\frac{1}{f} = \frac{e^2 B_z^2 dz}{4\beta_z^2 \gamma^2 m^2 c^2}$$

- From optics, lens equations

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

where, u-distance to the object, v-distance to the image



# ➢ Current on each focus

| Lens | Viewer | Current 03/23 (A) | Current 03/29 (A) |
|---|---|---|---|
| 1 | 1 | 3.056 | 3.049 |
| 1 | 2 | 2.872 | 2.870 |
| 2 | 1 | 2.988 | 2.981 |
| 2 | 2 | 2.349 | 2.343 |

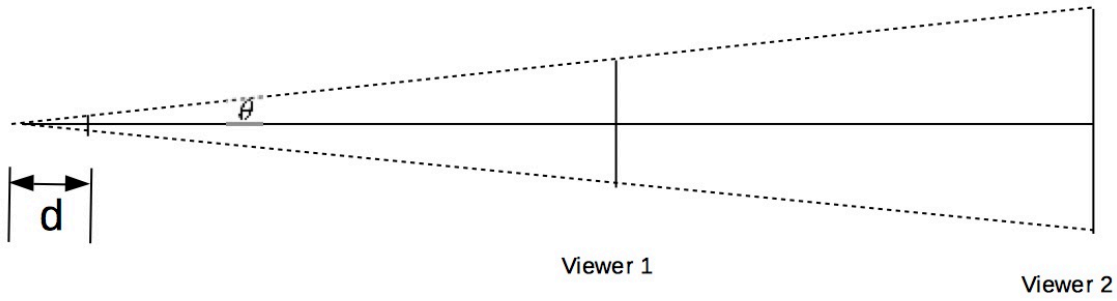
## ➢ Calculated focal length values from lens equation and from current

| Lens | Viewer | $f = \frac{uv}{u+v}$ (mm) | $f$ from the current 03/23 (mm) | $f$ from the current 03/29 (mm) |
|---|---|---|---|---|
| 1 | 1 | 333.33 | 271.515 | 271.515 |
| 1 | 2 | 375.00 | 306.64 | 306.64 |
| 2 | 1 | 293.33 | 284.42 | 284.42 |
| 2 | 2 | 495.00 | 461.276 | 461.276 |

- Without using the correction.
- Therefore all these values are fixed.

# ➢ Correction values for different data sets

| Date | d (mm) | |
|---|---|---|
| | Viewer 1 | Viewer 2 |
| 03/23 | 208.99576850 | 255.74376776 |
| 03/29 | 396.52301005 | 436.33425895 |



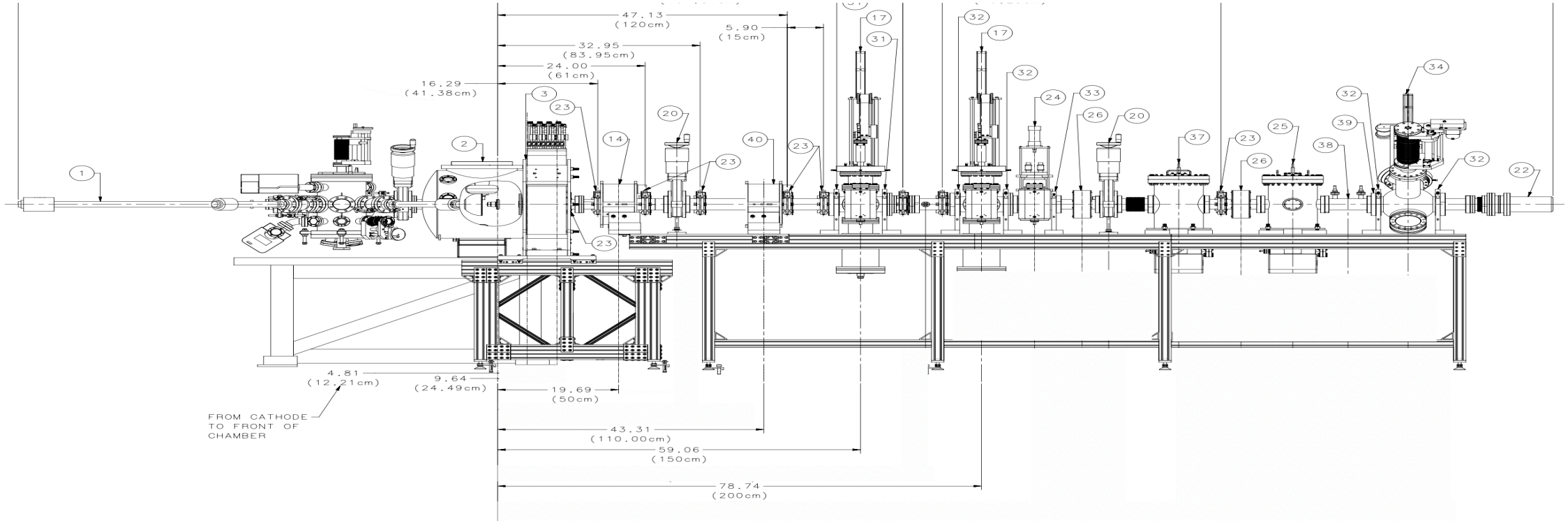
# ➢ Calculated focal length values from lens equation and from current

| Lens | Viewer | 03/23 | | 03/29 | |
|---|---|---|---|---|---|
| | | $f = \frac{uv}{u+v}$ (mm) | $f$ from the current (mm) | $f = \frac{uv}{u+v}$ (mm) | $f$ from the current (mm) |
| 1 | 1 | 414.8610 | 271.515 | 472.7192 | 271.515 |
| 1 | 2 | 502.5462 | 306.64 | 576.4814 | 306.64 |
| 2 | 1 | 306.3777 | 284.42 | 315.6350 | 284.42 |
| 2 | 2 | 540.9166 | 461.276 | 567.5333 | 461.276 |

With the correction

- Calculated distance to the photocathode using the focal length from the current

| Lens | Viewer | U 03/23 (mm) | U 03/29 (mm) |
|---|---|---|---|
| 1 | 1 | 372.7118 | 372.7118 |
| 1 | 2 | 385.4327 | 385.4327 |
| 2 | 1 | 984.3225 | 984.3225 |
| 2 | 2 | 946.2632 | 946.2632 |



- According to above calculations the u values for both data sets are the same as the currents which beam focus are almost same for both data sets.
- When compared with the actual u values it seems like the beam starts after the photocathode gun point.