

# Charge increase / emittance measurement guideline

1. Increase of laser pulse energy at photocathode by adjusting polarization
2. Choosing the right light level for beamlets in emittance measurements

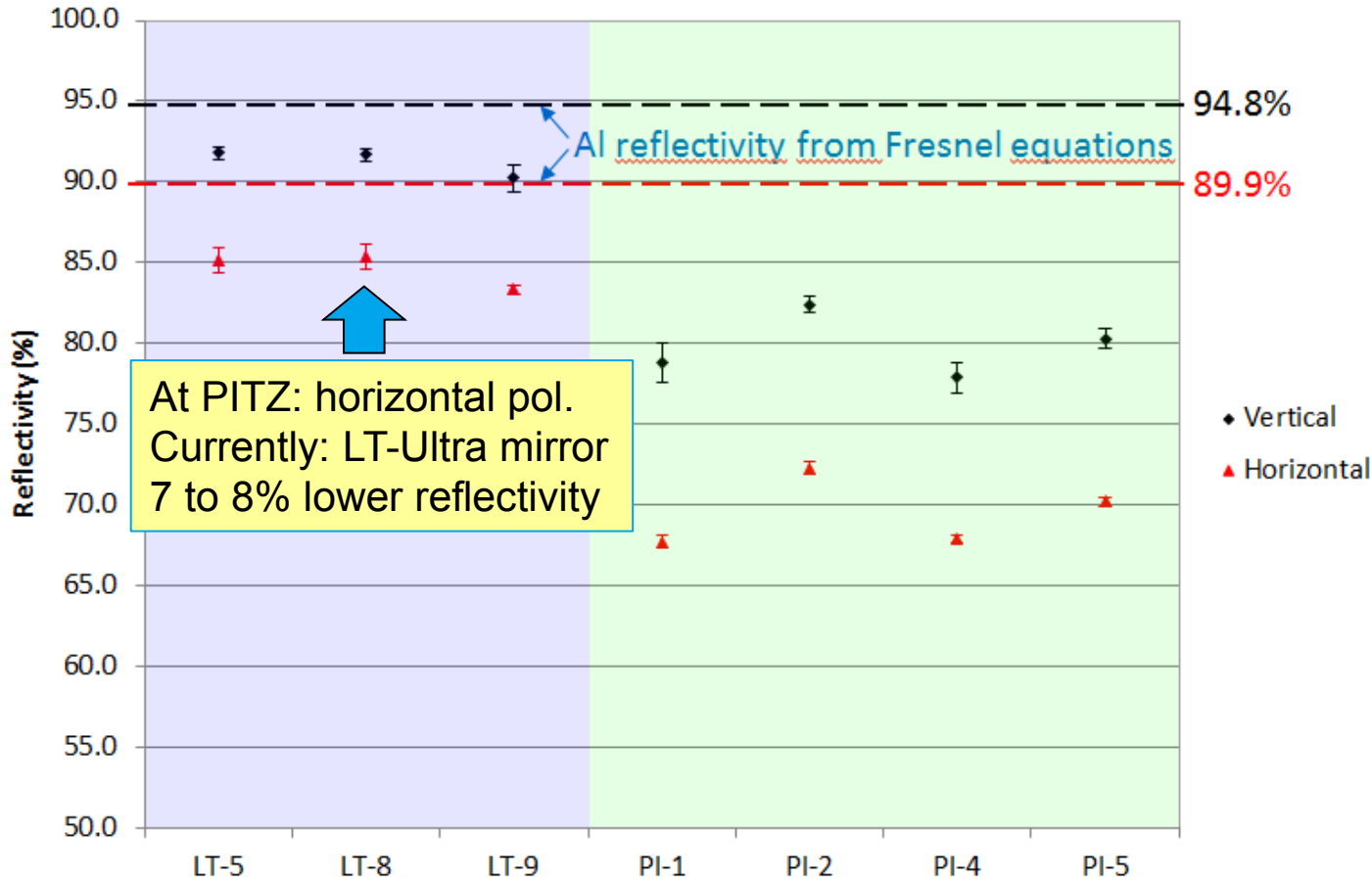
Matthias Gross

Charge increase / emittance measurement guideline

Place, Date

# Characterization of Vacuum Mirror Reflection (from 2011)

Vacuum Mirror Reflectivity for both Polarizations



At PITZ: horizontal pol.  
Currently: LT-Ultra mirror  
7 to 8% lower reflectivity

Beam position:



Vacuum Mirror Info:

LT-#: LT-Ultra Precision Technology GmbH  
→ Al-coated stainless steel 1.4429

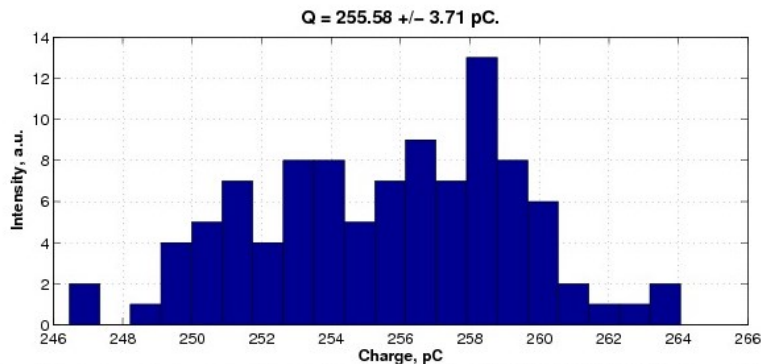
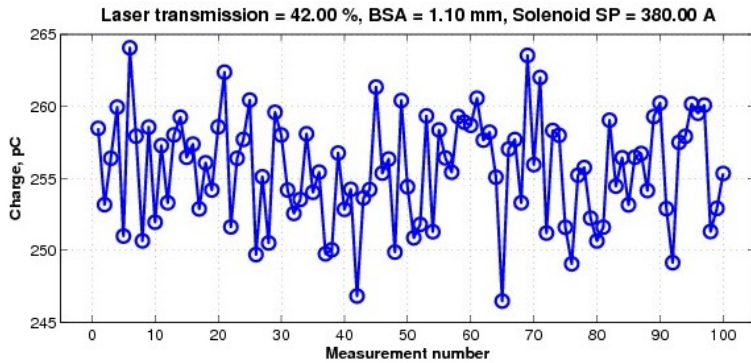
PI-#: Pilz Optics  
→ Al-coated monocrystalline silicon

LT-Ultra mirrors have significantly higher reflectivity, close to the theoretical value



# Idea: Insert $\lambda/2$ plate at Laser to Rotate Polarization

24.05.2015 M. Gross, O. Lishilin  
05:57 Charge check

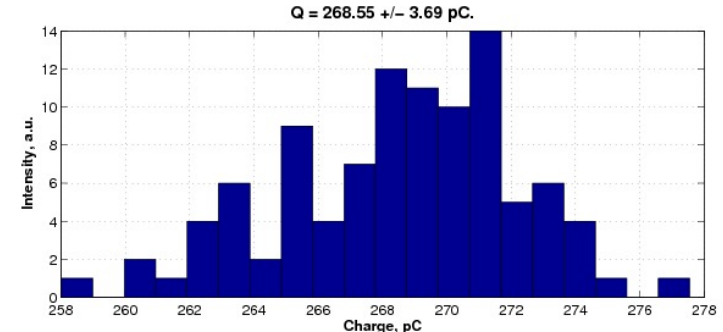
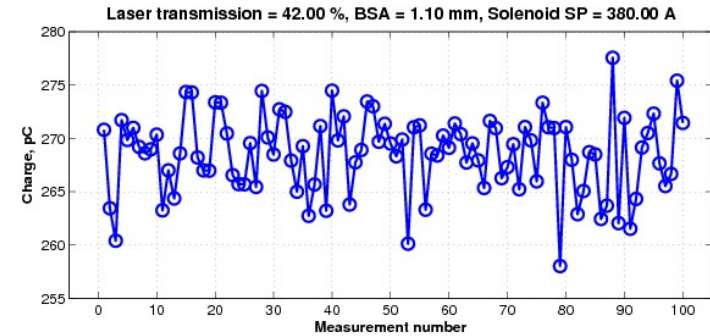


Data saved to /doocs/measure/ChargeMeasurements/2015/20150523N/charge\_0555.txt  
Charge measurement using Low.FC2.

24.05.2015 M. Gross, O. Lishilin  
06:33 Maximal achievable charge (measure with Low.FC2) for lambda half plate at  
42deg - increased by 5%

Lambda half plate rotation angle a little off what expected: crystal inserted with an offset? Or other polarization rotation effects in laser beam line?

Standard: 256pC  
With lambda half plate: 269pC



Data saved to /doocs/measure/ChargeMeasurements/2015/20150523N/charge\_0633.txt  
Charge measurement using Low.FC2.

- Increase from 256pC to 269pC → 5% higher
- Higher charge corresponding to reflection increase (single measurement)



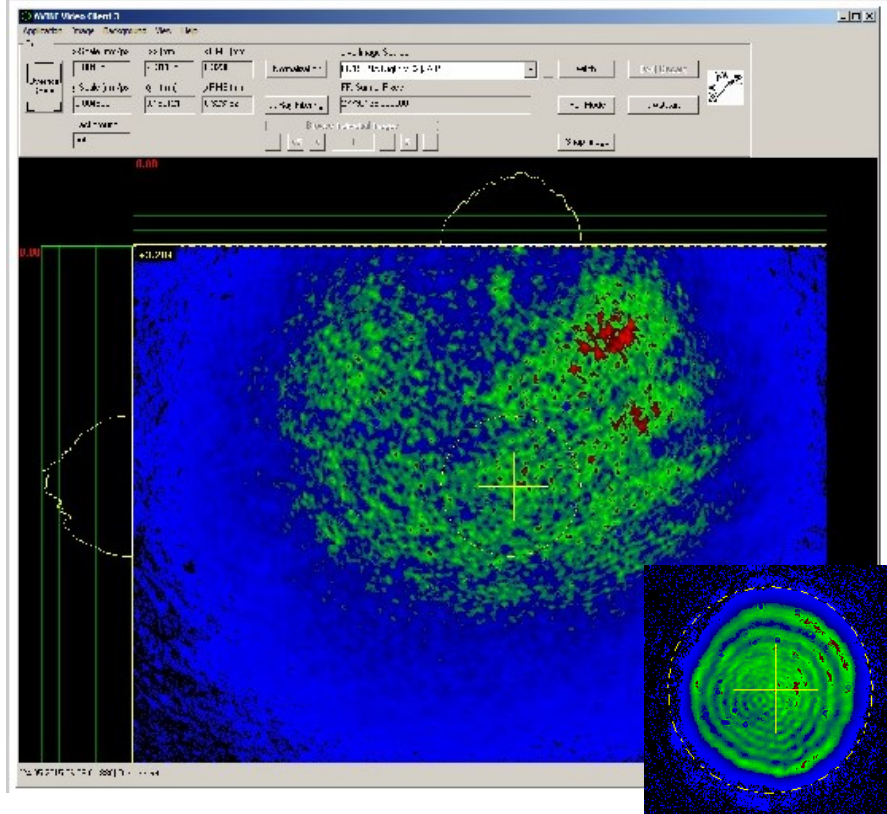
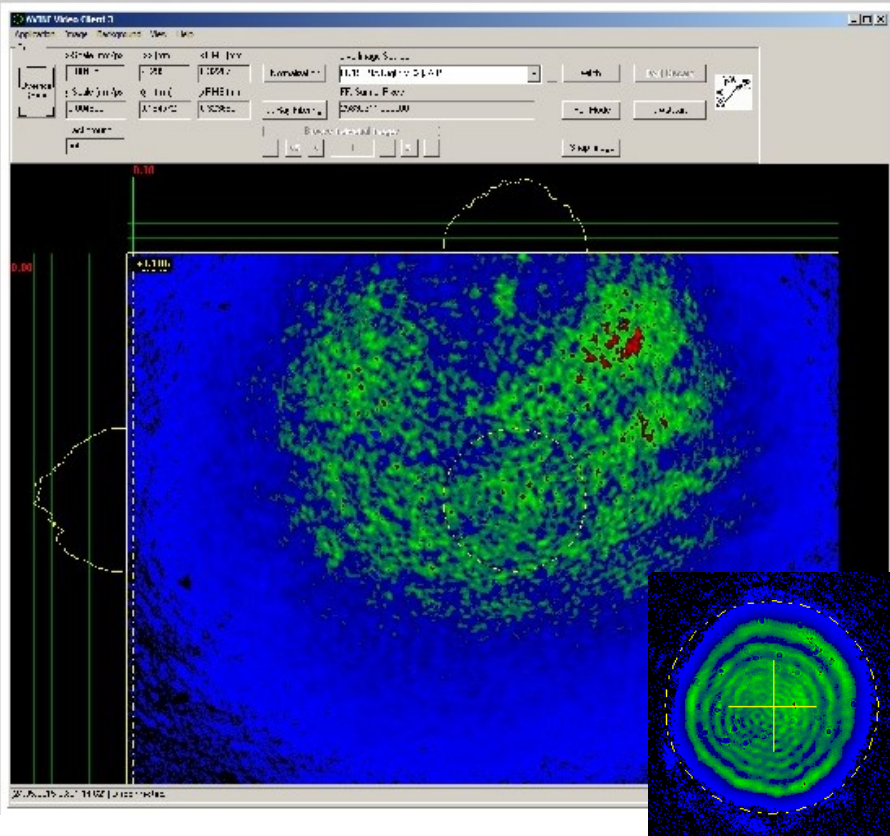
# Check of laser distribution at VC2 (open aperture; 1.1mm)

Standard setup

$\lambda/2$  plate inserted

24.05.2015 M. Gross, O. Lishilin  
06:01 Laser on VC2; open aperture

24.05.2015 M. Gross, O. Lishilin  
06:09 Laser on VC2; open aperture - lambda half plate inserted  
Distribution is unchanged  
Lambda half plate at 0deg

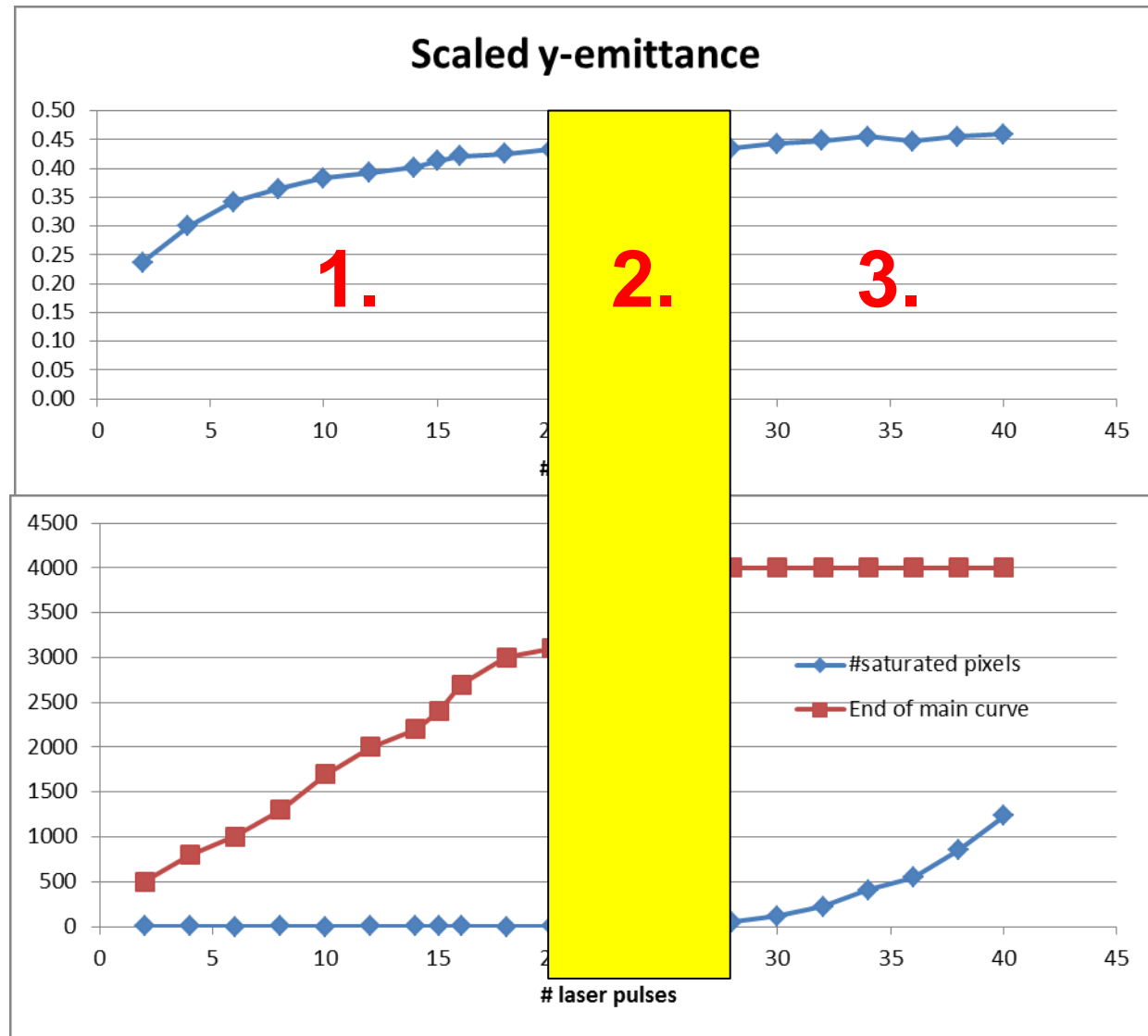


➤ No loss of beam quality

# What is the correct intensity to measure emittance?

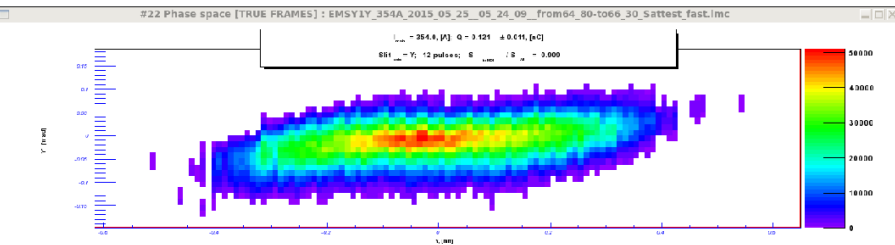
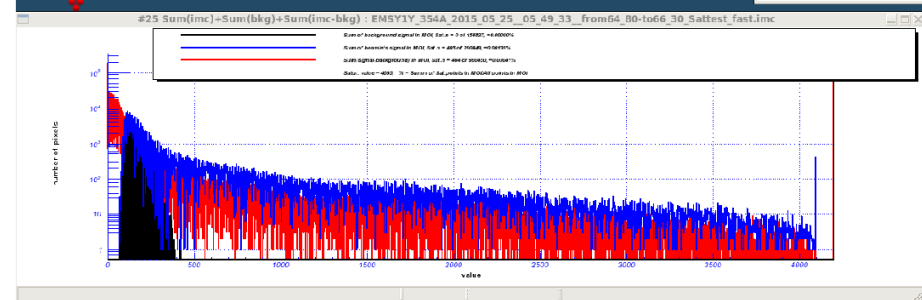
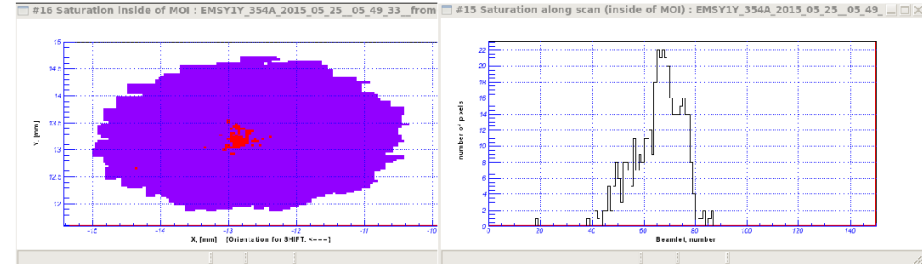
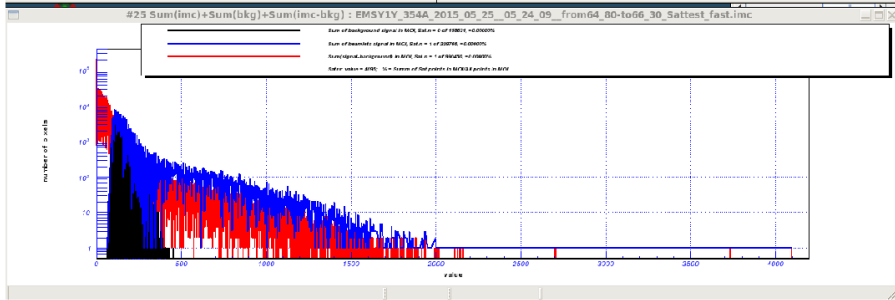
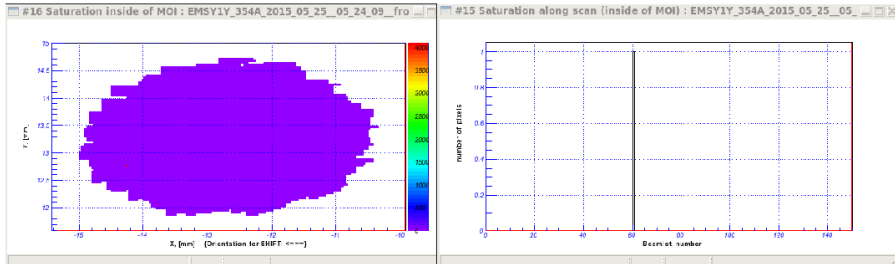
> To have saturation has less effect on the measured emittance than having not enough signal.

1. Saturation curve must not end below 3000
2. Saturation (hot spot) up to about 50 pixels can be tolerated - has no effect on measured emittance

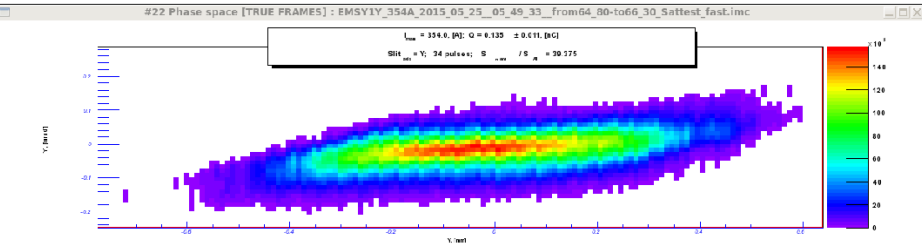


# 1. Intensity too low

# 3. Intensity too high



Parameters: Bin: 1200 to 316			
	Value	Unit	Min
Beamlet size	0.010	mm	0.005
Beamlet position	71.000	mm	70.000
Beamlet width	1.200	mm	1.000
Beamlet height	0.000	mm	0.000
Beamlet area	0.007	mm <sup>2</sup>	0.000
Beamlet volume	0.000	mm <sup>3</sup>	0.000
LIM	1.13K	mm	0.000
Q	0.121	DC	0.000
Q'	0.000	DC/mm	0.000
Q''	0.000	DC/mm <sup>2</sup>	0.000
Q'''	0.000	DC/mm <sup>3</sup>	0.000
Q''''	0.000	DC/mm <sup>4</sup>	0.000
Q'''''	0.000	DC/mm <sup>5</sup>	0.000
Q''''''	0.000	DC/mm <sup>6</sup>	0.000
Q'''''''	0.000	DC/mm <sup>7</sup>	0.000
Q''''''''	0.000	DC/mm <sup>8</sup>	0.000
Q'''''''''	0.000	DC/mm <sup>9</sup>	0.000
Q''''''''''	0.000	DC/mm <sup>10</sup>	0.000
Q'''''''''''	0.000	DC/mm <sup>11</sup>	0.000
Q''''''''''''	0.000	DC/mm <sup>12</sup>	0.000
Q'''''''''''''	0.000	DC/mm <sup>13</sup>	0.000
Q''''''''''''''	0.000	DC/mm <sup>14</sup>	0.000
Q'''''''''''''''	0.000	DC/mm <sup>15</sup>	0.000
Q''''''''''''''''	0.000	DC/mm <sup>16</sup>	0.000
Q'''''''''''''''''	0.000	DC/mm <sup>17</sup>	0.000
Q''''''''''''''''''	0.000	DC/mm <sup>18</sup>	0.000
Q'''''''''''''''''''	0.000	DC/mm <sup>19</sup>	0.000
Q''''''''''''''''''''	0.000	DC/mm <sup>20</sup>	0.000
Q'''''''''''''''''''''	0.000	DC/mm <sup>21</sup>	0.000
Q''''''''''''''''''''''	0.000	DC/mm <sup>22</sup>	0.000
Q'''''''''''''''''''''''	0.000	DC/mm <sup>23</sup>	0.000
Q''''''''''''''''''''''''	0.000	DC/mm <sup>24</sup>	0.000
Q'''''''''''''''''''''''''	0.000	DC/mm <sup>25</sup>	0.000
Q''''''''''''''''''''''''''	0.000	DC/mm <sup>26</sup>	0.000
Q'''''''''''''''''''''''''''	0.000	DC/mm <sup>27</sup>	0.000
Q''''''''''''''''''''''''''''	0.000	DC/mm <sup>28</sup>	0.000
Q'''''''''''''''''''''''''''''	0.000	DC/mm <sup>29</sup>	0.000
Q''''''''''''''''''''''''''''''	0.000	DC/mm <sup>30</sup>	0.000
Q'''''''''''''''''''''''''''''''	0.000	DC/mm <sup>31</sup>	0.000
Q''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>32</sup>	0.000
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Q'''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>35</sup>	0.000
Q''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>36</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>37</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>38</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>39</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>40</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>41</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>42</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>43</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>44</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>45</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>46</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>47</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>48</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>49</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>50</sup>	0.000



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Beamlet height	0.000	mm	0.000
Beamlet area	0.007	mm <sup>2</sup>	0.000
Beamlet volume	0.000	mm <sup>3</sup>	0.000
LIM	1.13K	mm	0.000
Q	0.133	DC	0.000
Q'	0.000	DC/mm	0.000
Q''	0.000	DC/mm <sup>2</sup>	0.000
Q'''	0.000	DC/mm <sup>3</sup>	0.000
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Q'''''''''''''''''''''	0.000	DC/mm <sup>21</sup>	0.000
Q''''''''''''''''''''''	0.000	DC/mm <sup>22</sup>	0.000
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Q''''''''''''''''''''''''''	0.000	DC/mm <sup>26</sup>	0.000
Q'''''''''''''''''''''''''''	0.000	DC/mm <sup>27</sup>	0.000
Q''''''''''''''''''''''''''''	0.000	DC/mm <sup>28</sup>	0.000
Q'''''''''''''''''''''''''''''	0.000	DC/mm <sup>29</sup>	0.000
Q''''''''''''''''''''''''''''''	0.000	DC/mm <sup>30</sup>	0.000
Q'''''''''''''''''''''''''''''''	0.000	DC/mm <sup>31</sup>	0.000
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Q'''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>35</sup>	0.000
Q''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>36</sup>	0.000
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Q''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>40</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>41</sup>	0.000
Q''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>42</sup>	0.000
Q'''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>43</sup>	0.000
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Q''''''''''''''''''''''''''''''''''''''''''''''''''	0.000	DC/mm <sup>50</sup>	0.000





# 2. Intensity ok (lower end)

# 2. Intensity ok (higher end)

