

LEBT beam data

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4th June 2014, FETS Mtg

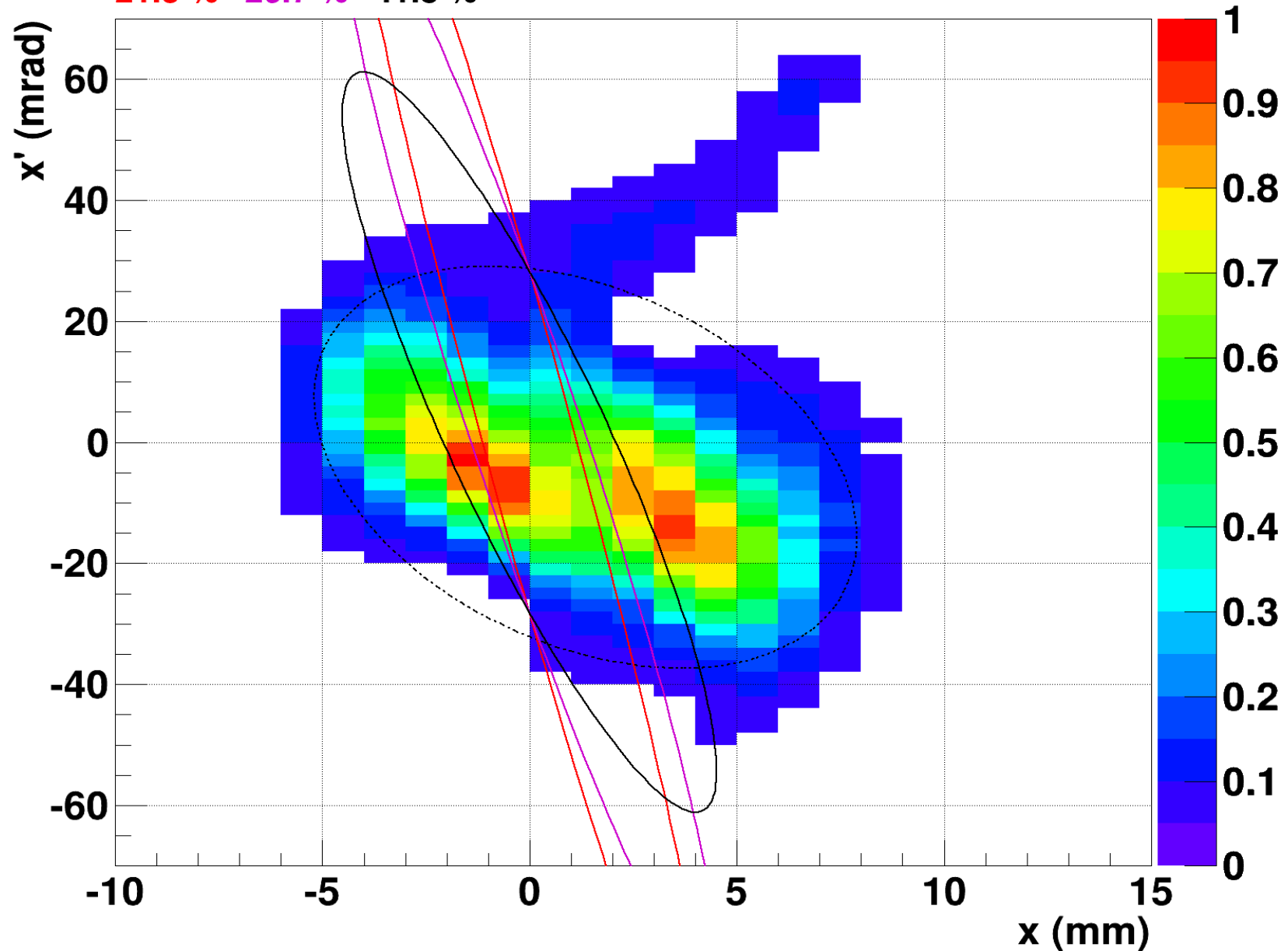
Introduction

- Plots of LEBT emittance scanner data for 65 keV beam
 - Data taking campaign over past few weeks by Christoph, Scott, Dan
- x-x' and y-y' profile scans at end of LEBT
 - Plot headings correspond to
 - Run number, Horiz then Vert scan, 3 solenoid currents (S1-S2-S3), PA settings
 - Data runs have fixed solenoid currents $S1 = 130$ A, $S2 = 80$ A
 - S3 (reversed current polarity) varied about -220 A: -140 to -245 A
 - Removed spurious “noise”; intensity threshold = 5% maximum intensity
 - Intensity weighted $\langle xx \rangle$, $\langle x x' \rangle$, $\langle x' x' \rangle \Rightarrow$ data Twiss 100% (dotted) ellipse
 - Measured rms emittance = 100% ellipse area/4
- Emittance scans compared to RFQ acceptance
 - Ideal, matched case (red ellipse)
 - Transmission $\sim 90\%$ case for $\gamma = 0.65 \gamma_0$ (purple ellipse)
 - Transmission $\sim 75\%$ case for $\gamma = 0.30 \gamma_0$ (black ellipse)
- Intensity fractions quoted within the RFQ acceptance (for the 3 cases)

Run 638 H 130-080-220A; 13A, 21kV

$\alpha_x = 0.37$, $\beta_x = 0.21$, $\gamma_x = 5.41$; norm rms $\epsilon_x = 0.60$

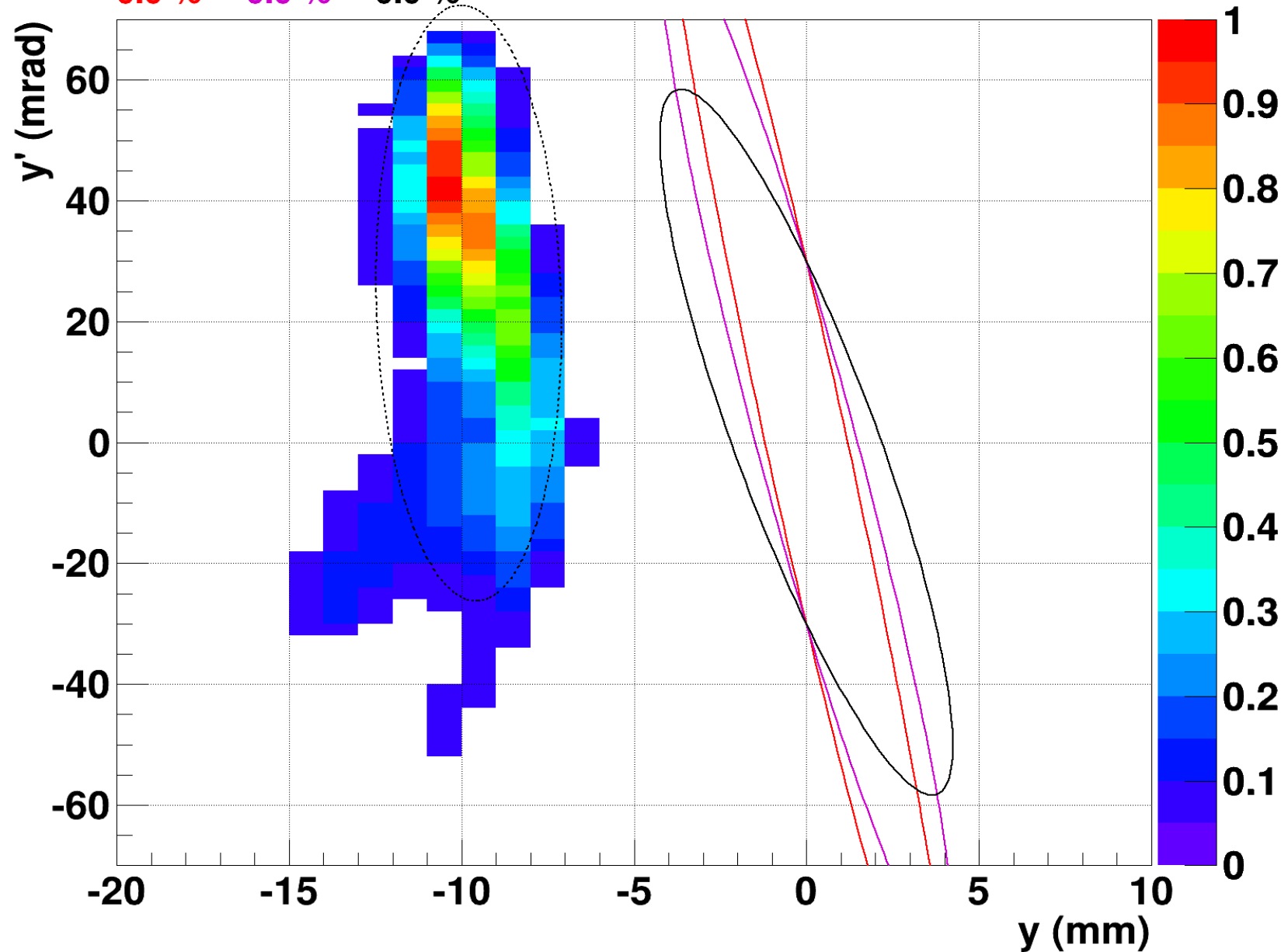
21.3 % 26.7 % 41.8 %



Run 639 V 130-080-220A; 13A, 21kV

$\alpha_y = 0.08$, $\beta_y = 0.05$, $\gamma_y = 18.38$; norm rms $\epsilon_y = 0.39$

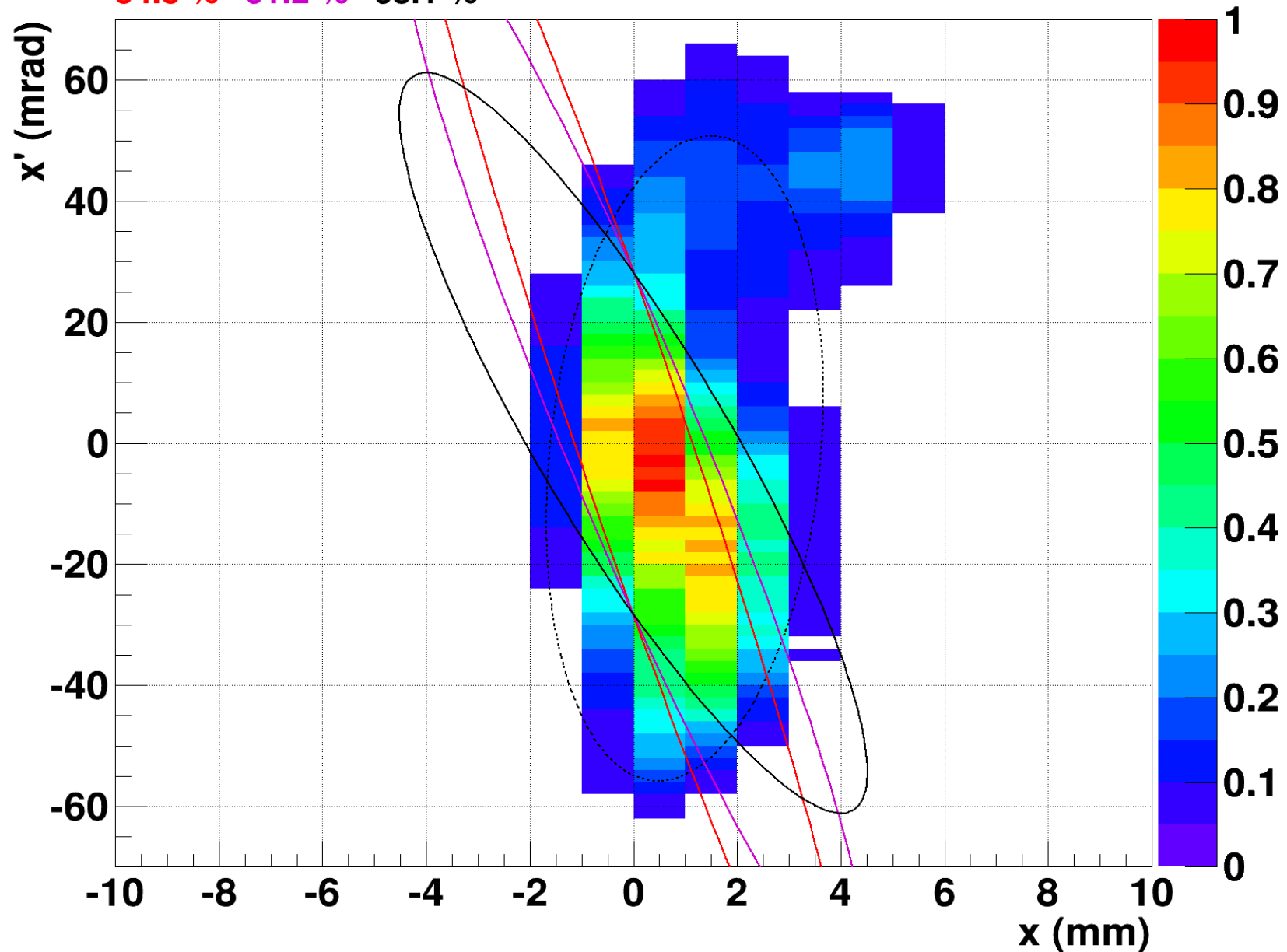
0.0 % 0.0 % 0.0 %



Run 641 H 130-080-220A; 11A, 18kV

$\alpha_x = -0.19$, $\beta_x = 0.05$, $\gamma_x = 20.32$; norm rms $\epsilon_x = 0.41$

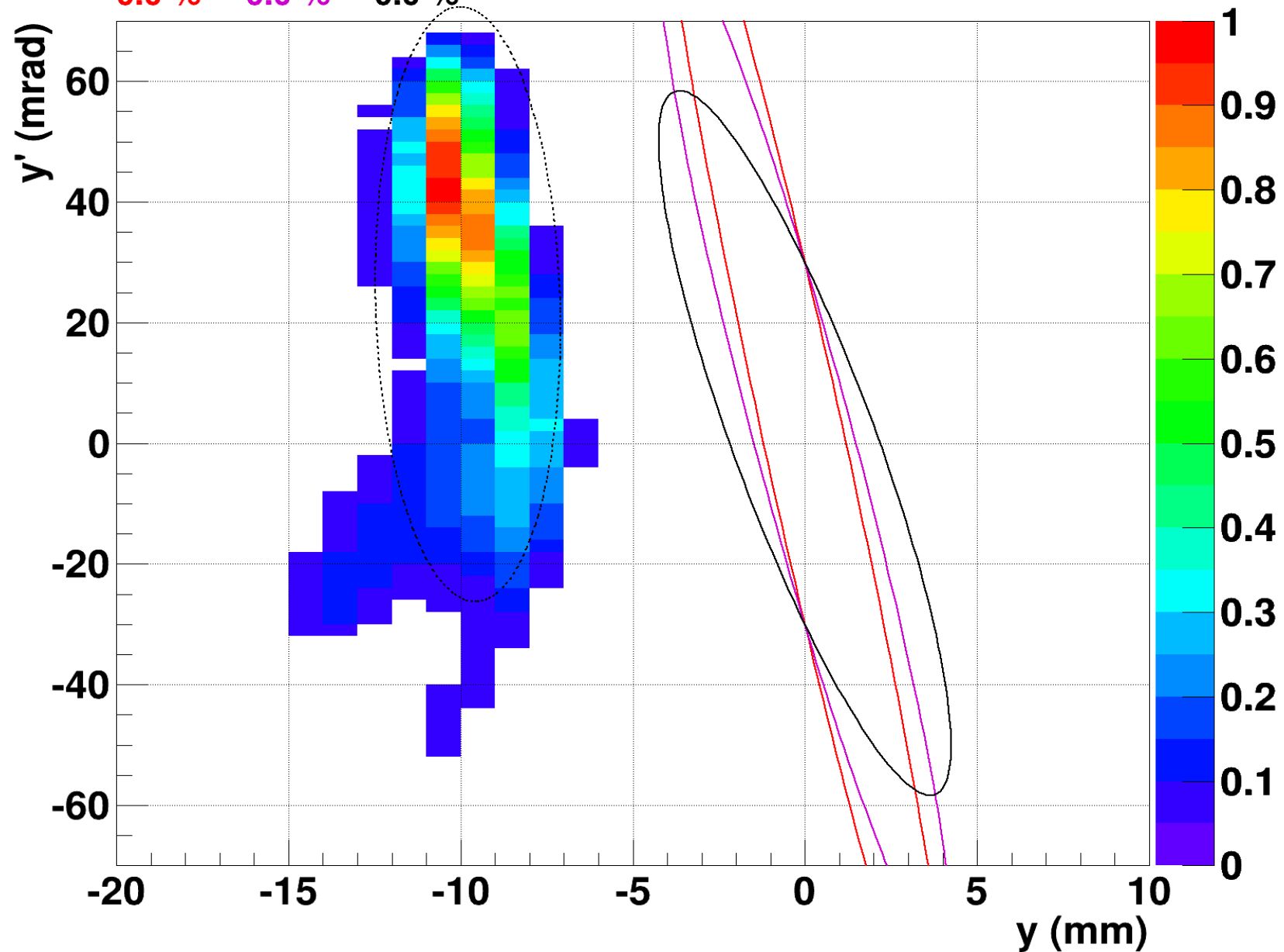
54.8 % 61.2 % 68.1 %



Run 640 V 130-080-220A; 11A, 18kV

$\alpha_y = 0.08$, $\beta_y = 0.05$, $\gamma_y = 18.38$; norm rms $\epsilon_y = 0.39$

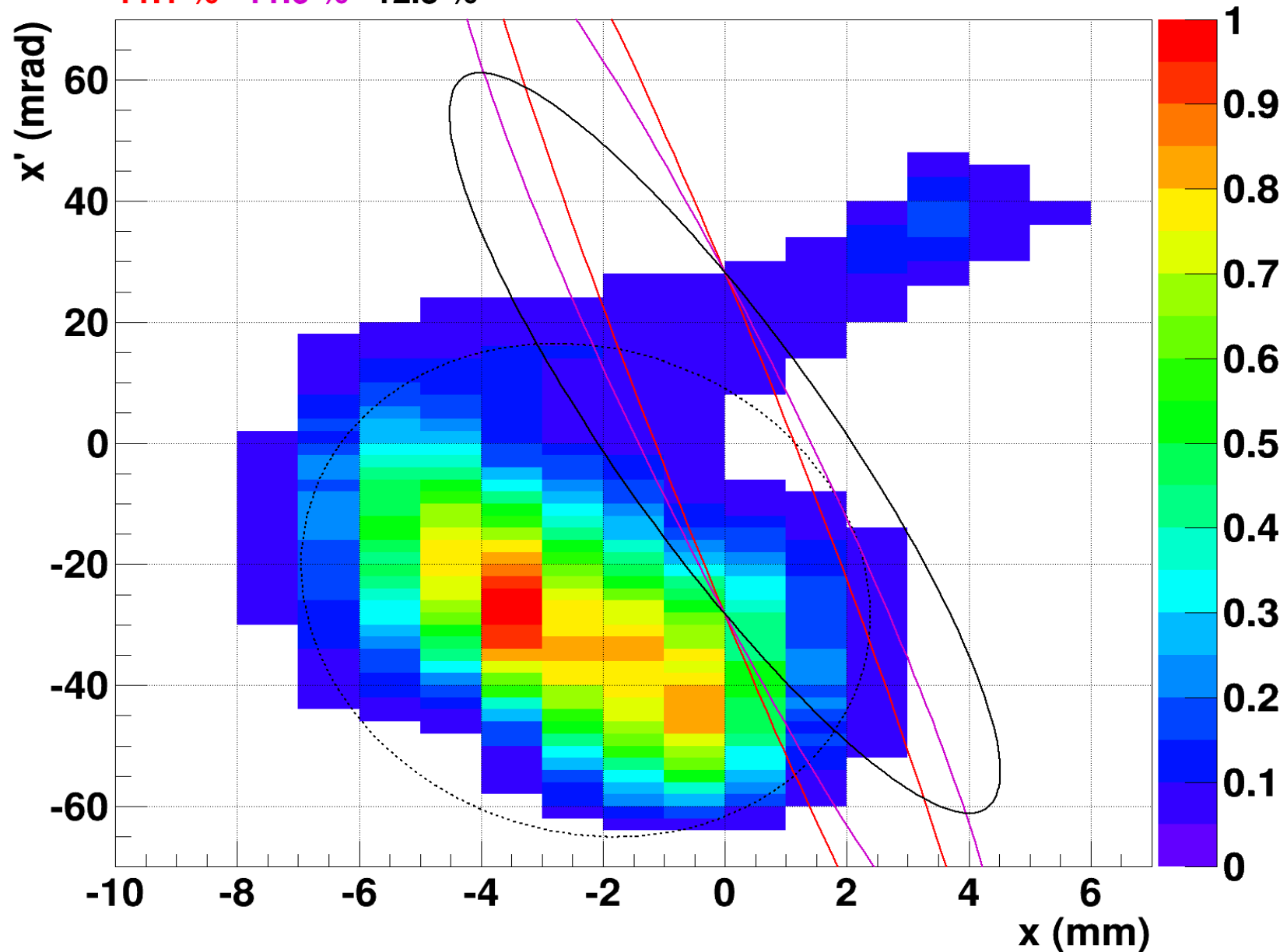
0.0 % 0.0 % 0.0 %



Run 642 H 130-080-220A; 15A, 22kV

$\alpha_x = 0.10$, $\beta_x = 0.12$, $\gamma_x = 8.78$; norm rms $\epsilon_x = 0.56$

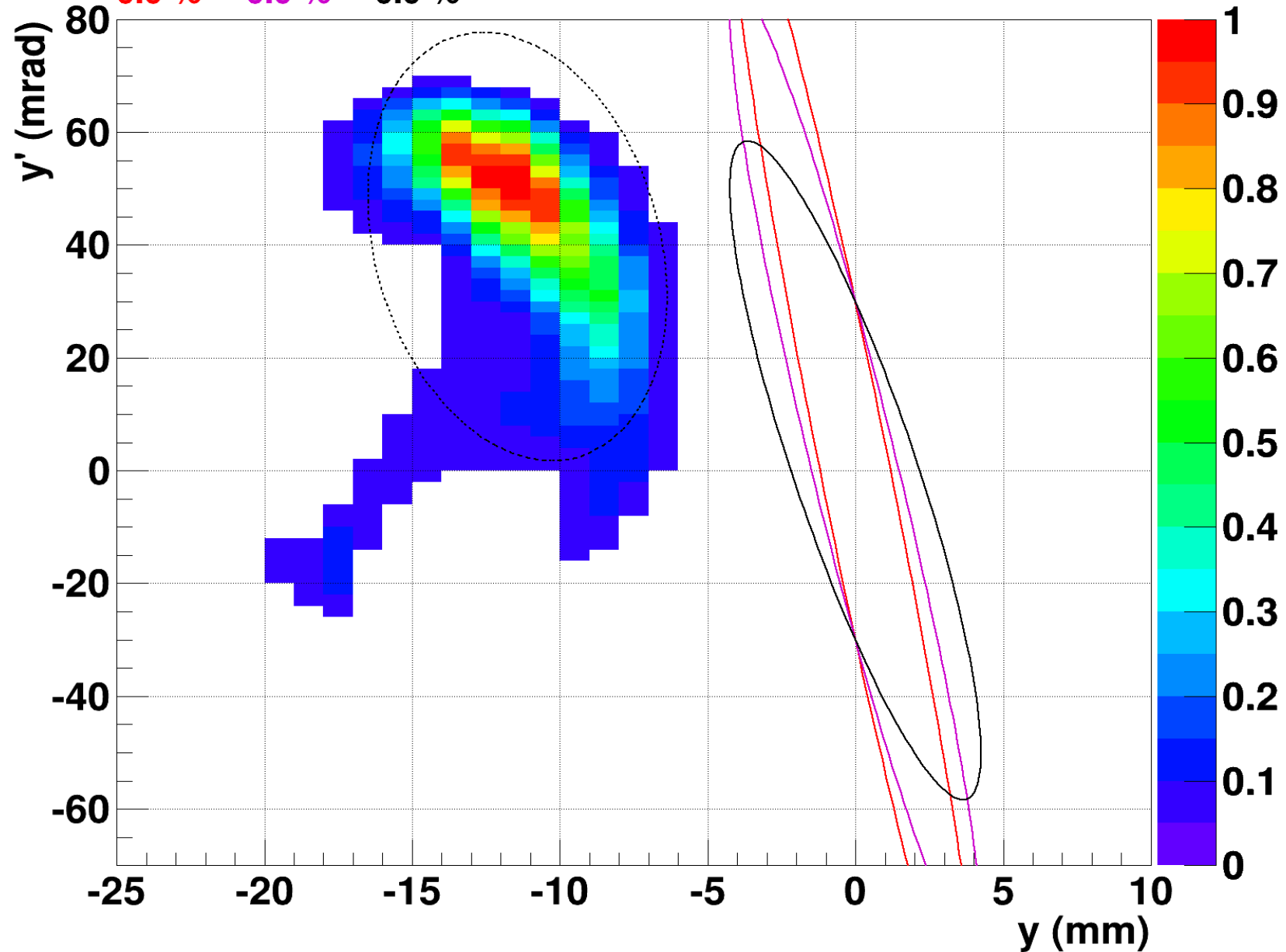
11.1 % 11.6 % 12.3 %



Run 643 V 130-080-220A; 15A, 22kV

$\alpha_y = 0.24$, $\beta_y = 0.14$, $\gamma_y = 7.71$; norm rms $\epsilon_y = 0.55$

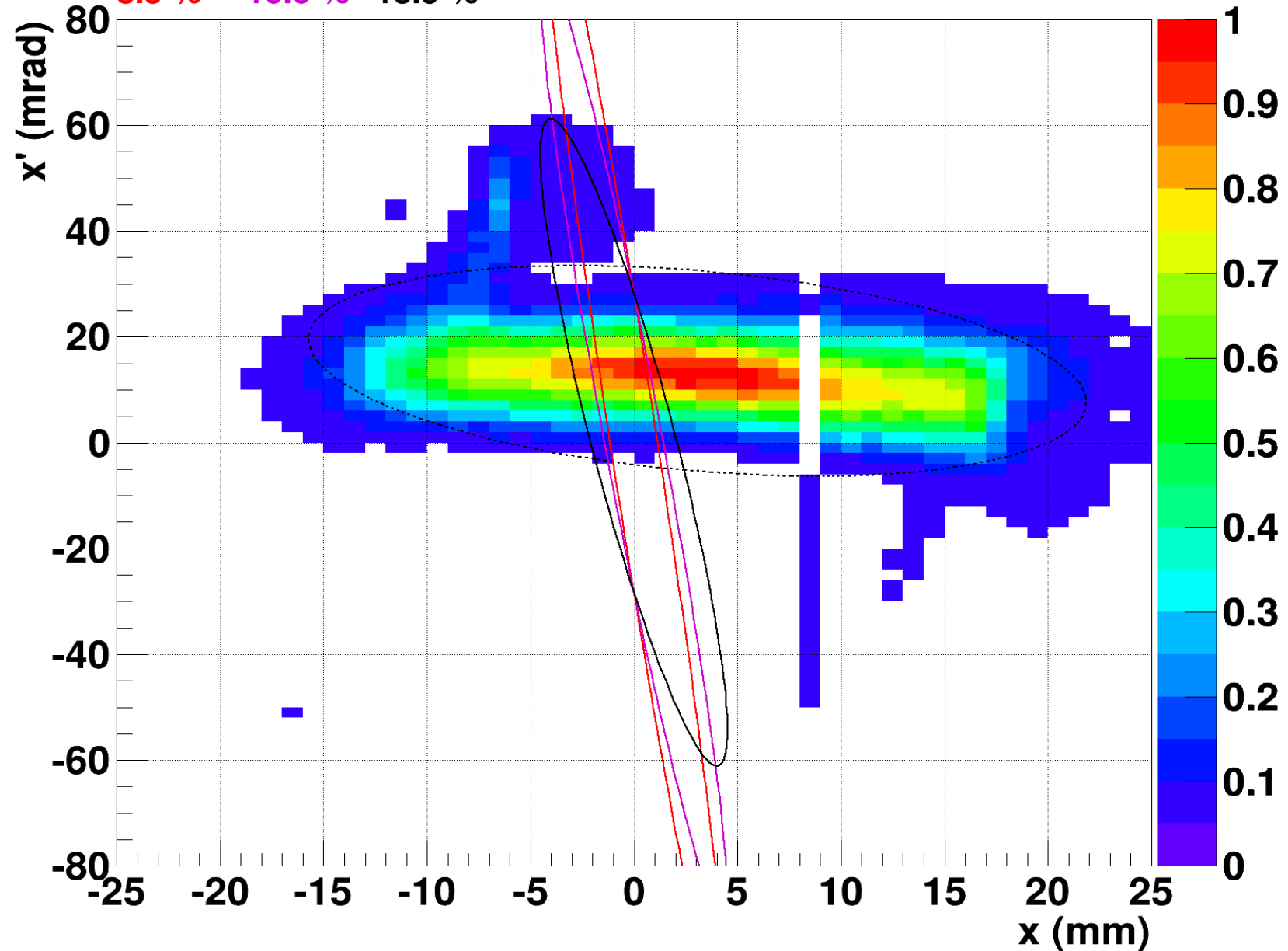
0.0 % 0.0 % 0.0 %



Run 687 H 130-080-140A; 11.5A, 21kV

$\alpha_x = 0.32$, $\beta_x = 0.99$, $\gamma_x = 1.11$; norm rms $\epsilon_x = 1.05$

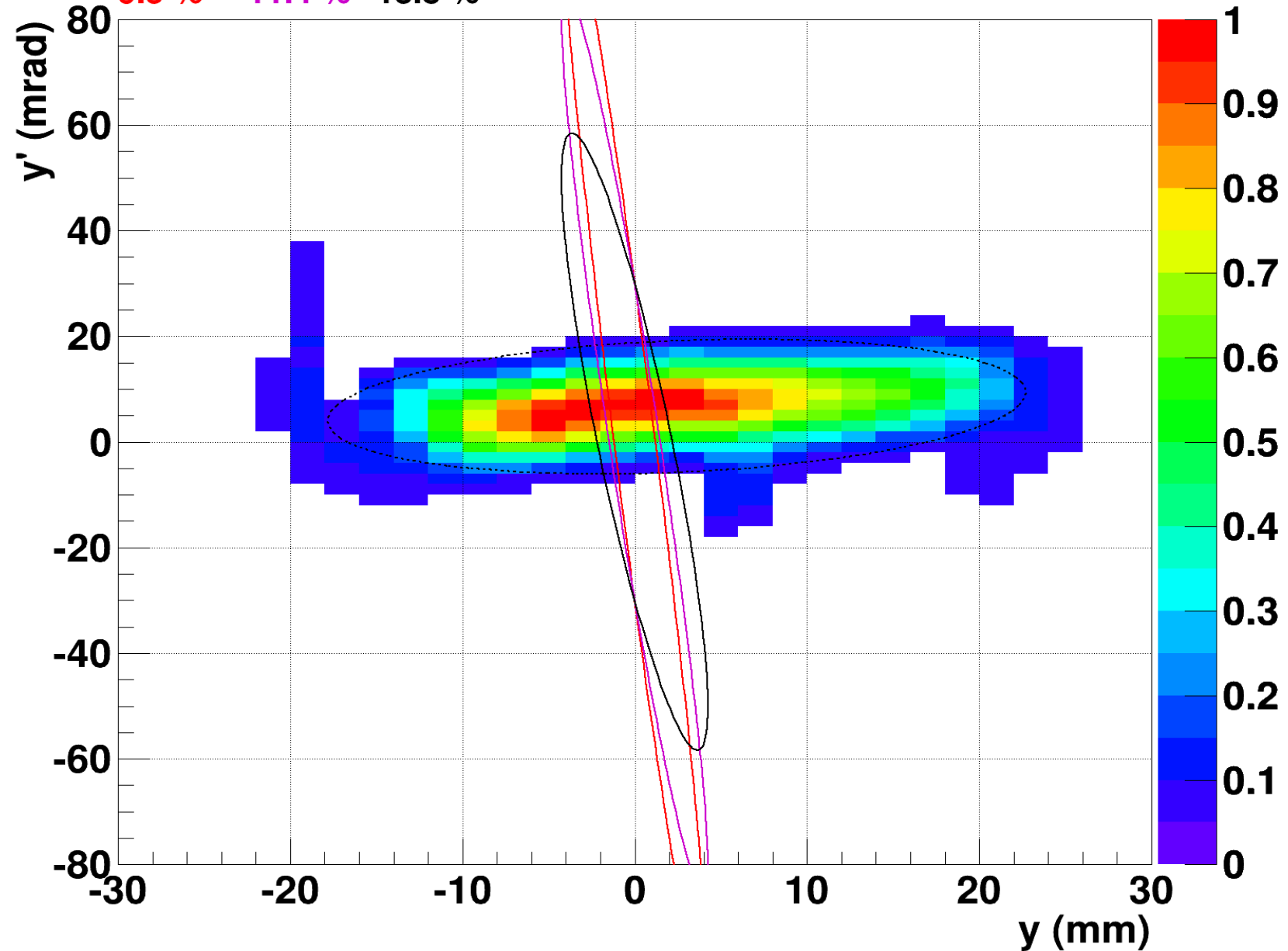
8.5 % 10.0 % 13.9 %



Run 664 V 130-080-140A; 11.5A, 21kV

$\alpha_y = -0.22$, $\beta_y = 1.62$, $\gamma_y = 0.64$; norm rms $\epsilon_y = 0.74$

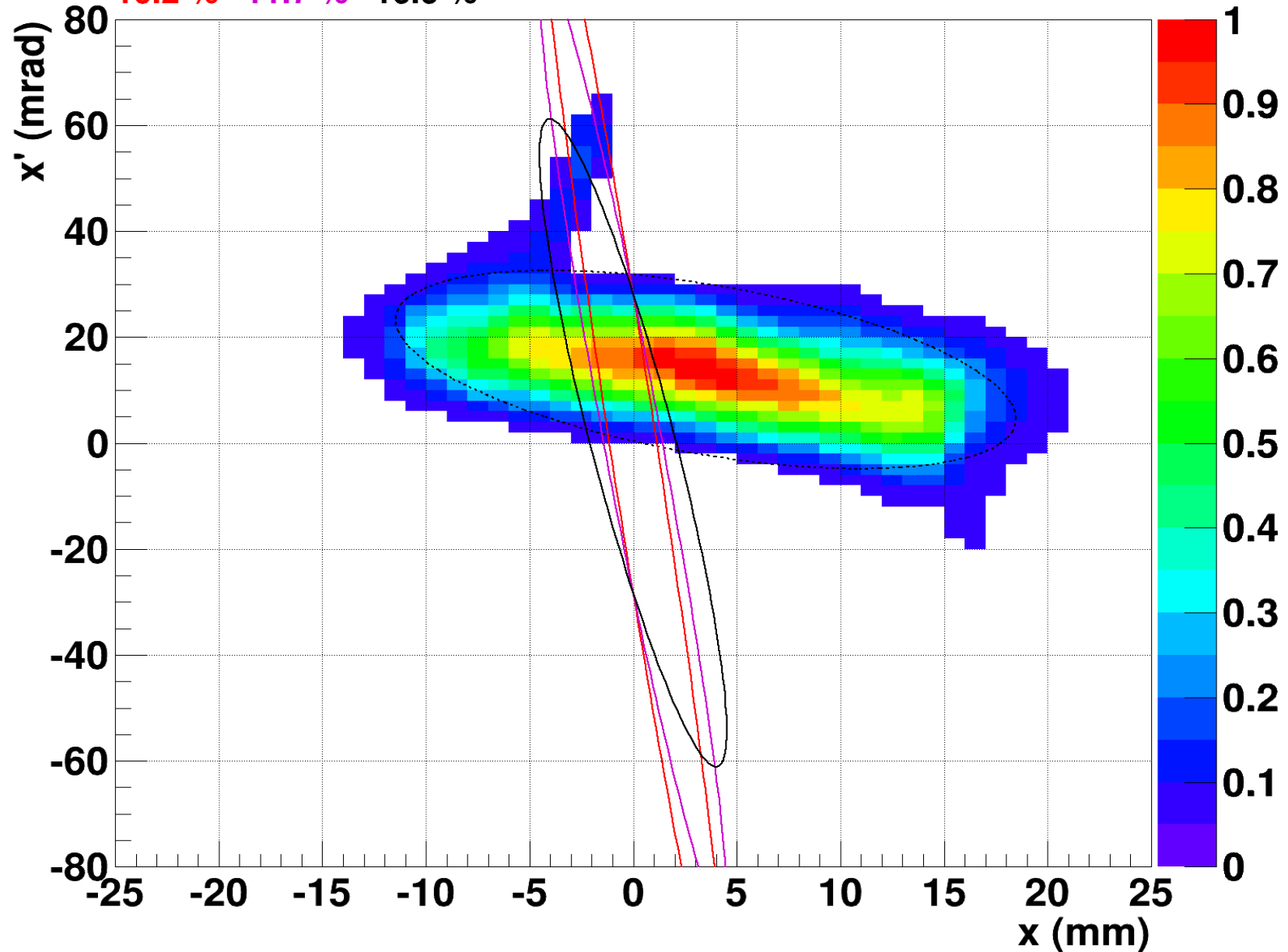
9.5 % 11.4 % 13.8 %



Run 686 H 130-080-160A; 11.5A, 21kV

$\alpha_x = 0.58$, $\beta_x = 0.92$, $\gamma_x = 1.45$; norm rms $\epsilon_x = 0.71$

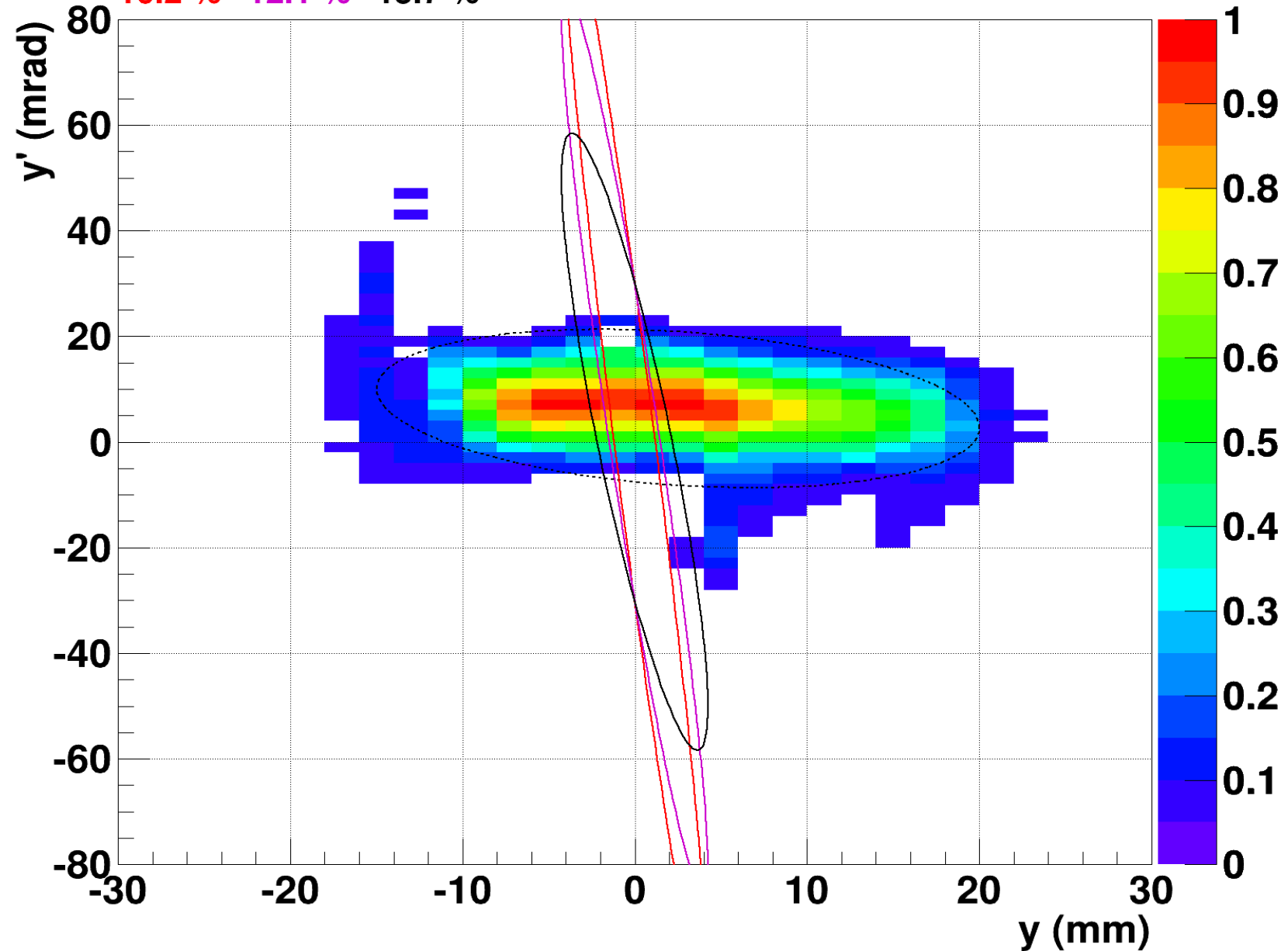
10.2 % 11.7 % 16.6 %



Run 663 V 130-080-160A; 11.5A, 21kV

$\alpha_y = 0.25$, $\beta_y = 1.20$, $\gamma_y = 0.88$; norm rms $\epsilon_y = 0.75$

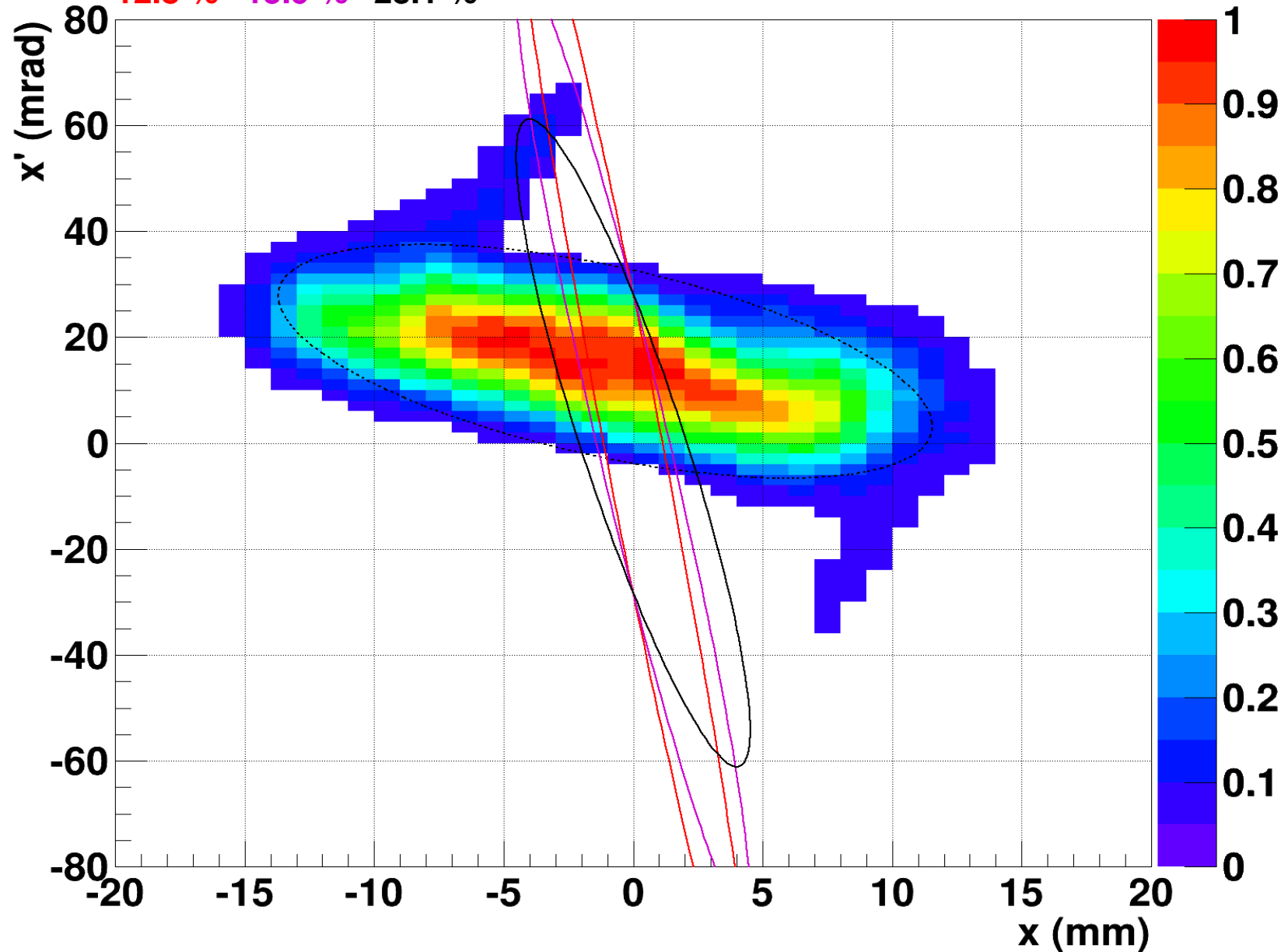
10.2 % 12.1 % 15.7 %



Run 685 H 130-080-180A; 11.5A, 21kV

$\alpha_x = 0.68$, $\beta_x = 0.69$, $\gamma_x = 2.11$; norm rms $\epsilon_x = 0.68$

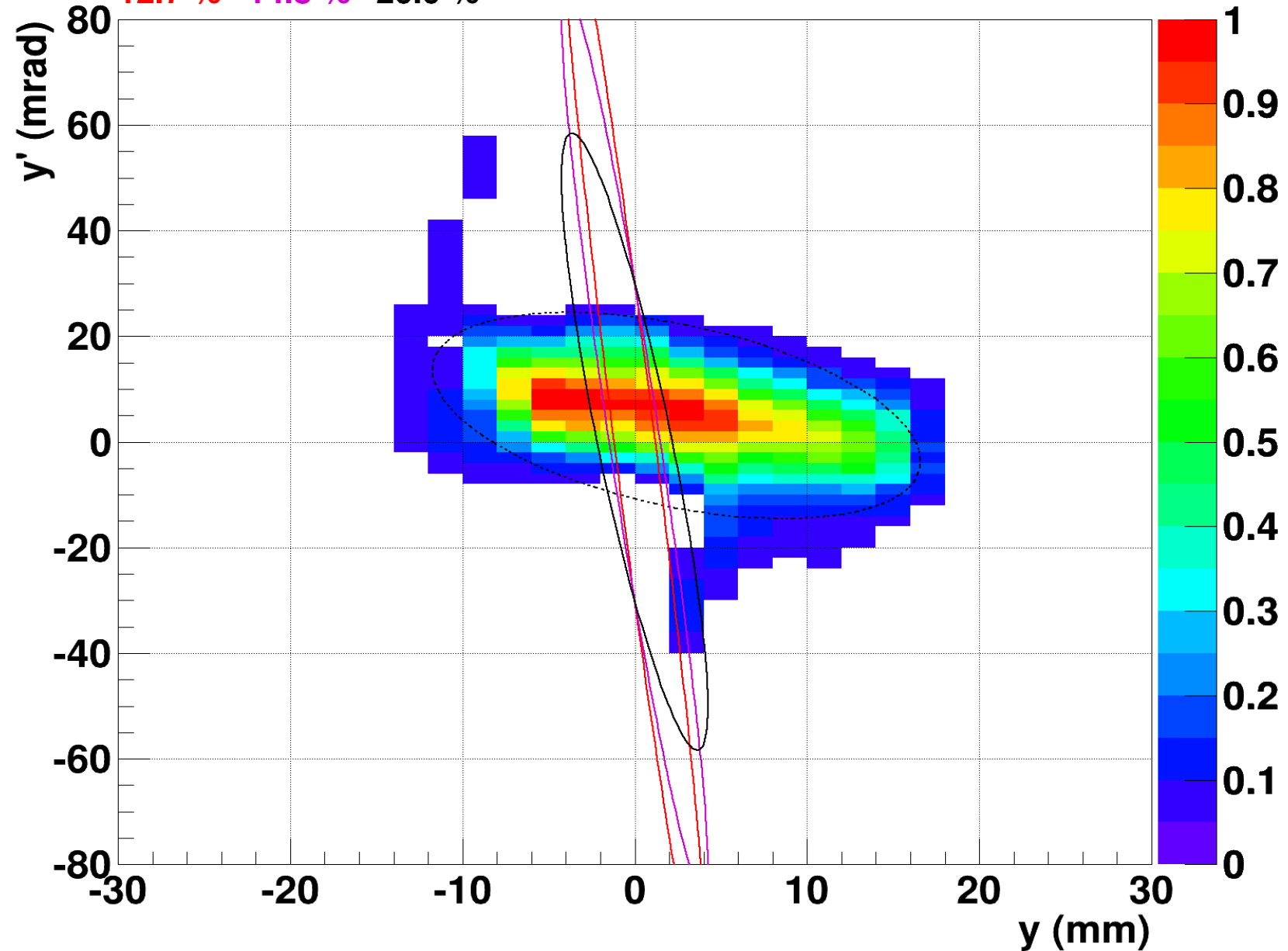
12.8 % 15.9 % 23.1 %



Run 657 V 130-080-180A; 11.5A, 21kV

$\alpha_y = 0.49$, $\beta_y = 0.81$, $\gamma_y = 1.54$; norm rms $\epsilon_y = 0.73$

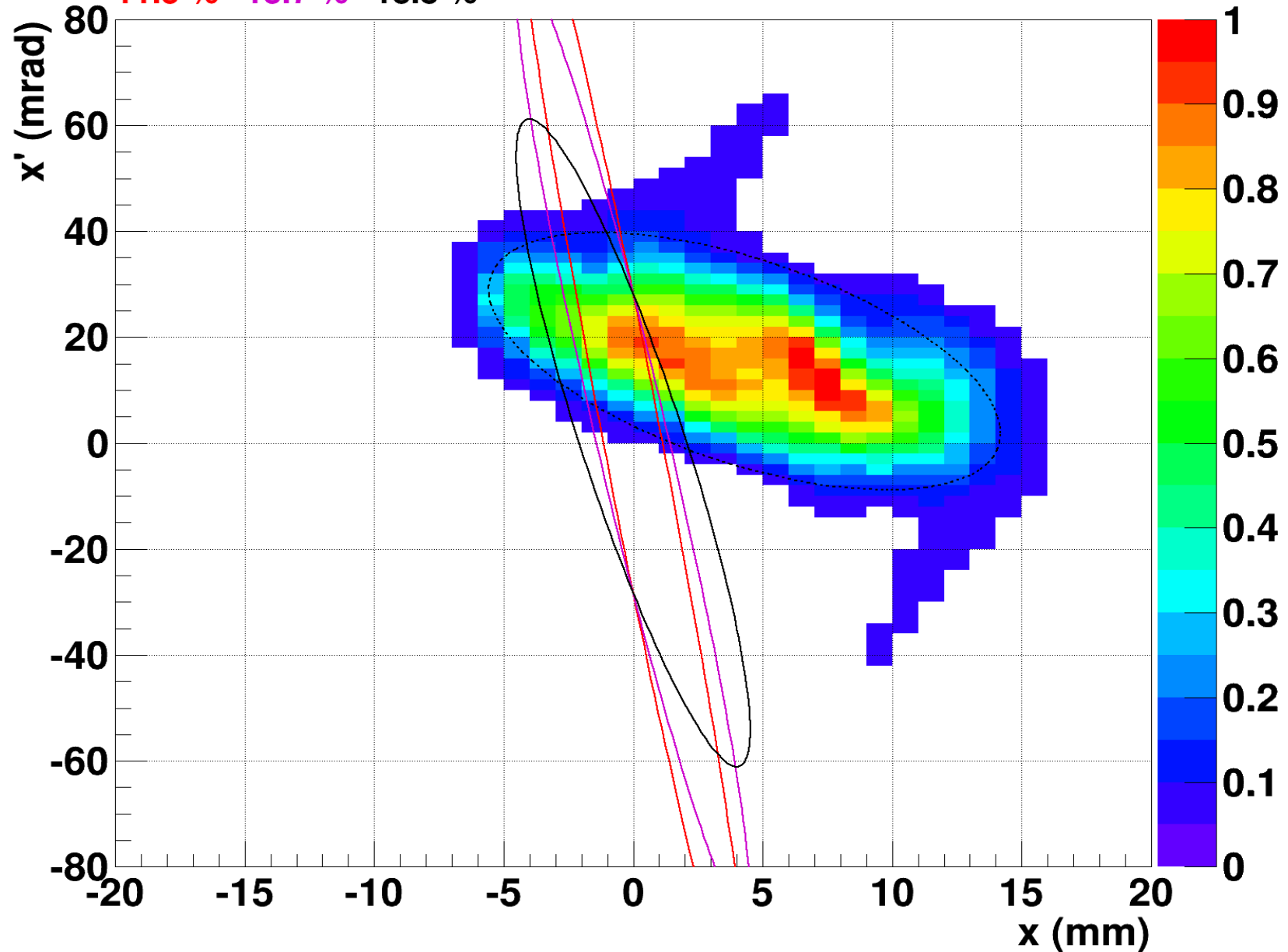
12.7 % 14.8 % 20.0 %



Run 683 H 130-080-200A; 11.5A, 21kV

$\alpha_x = 0.68$, $\beta_x = 0.49$, $\gamma_x = 2.96$; norm rms $\epsilon_x = 0.59$

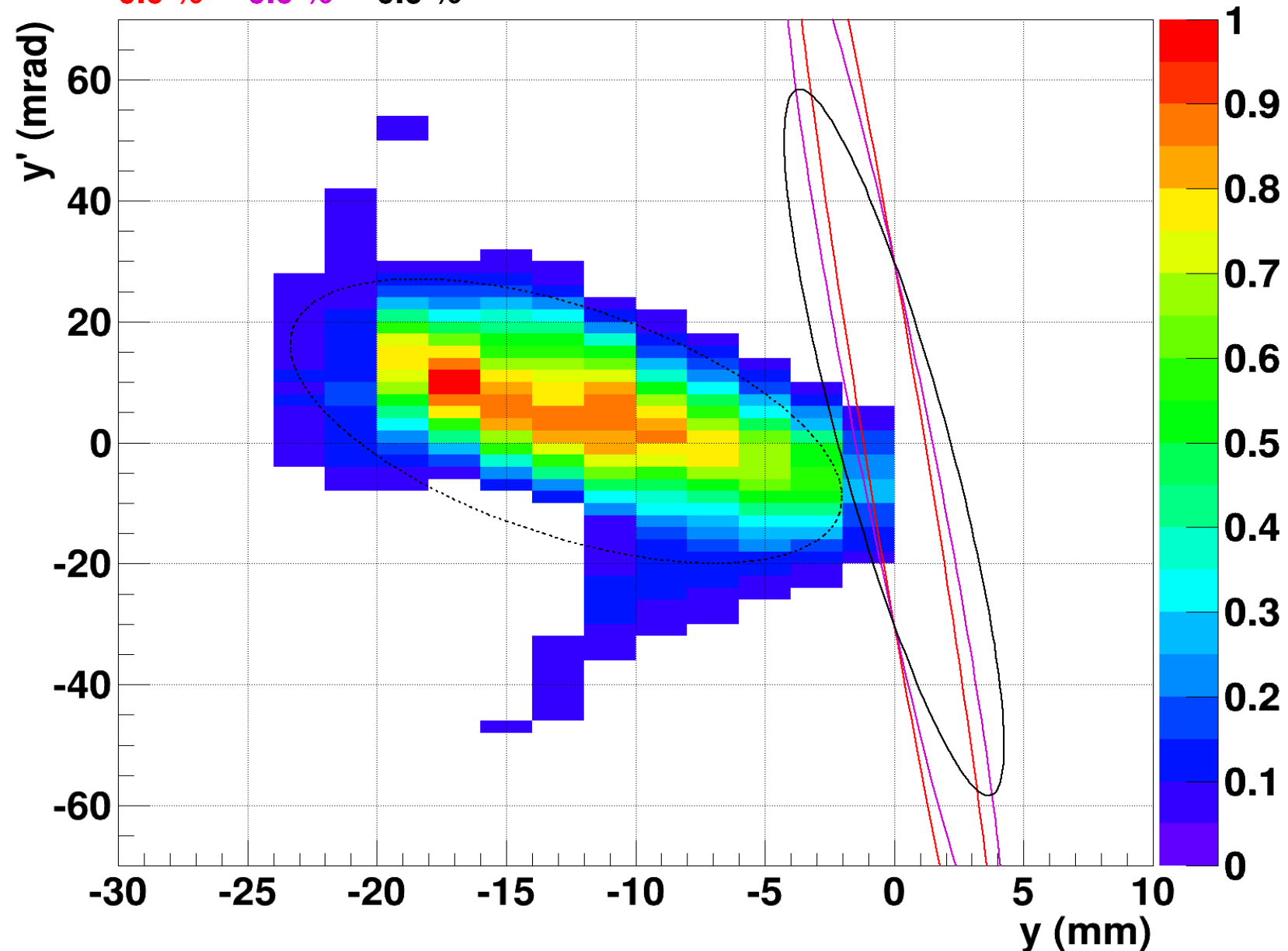
11.5 % 13.7 % 18.8 %



Run 655 V 130-080-200A; 11.5A, 21kV

$\alpha_y = 0.64$, $\beta_y = 0.54$, $\gamma_y = 2.62$; norm rms $\epsilon_y = 0.62$

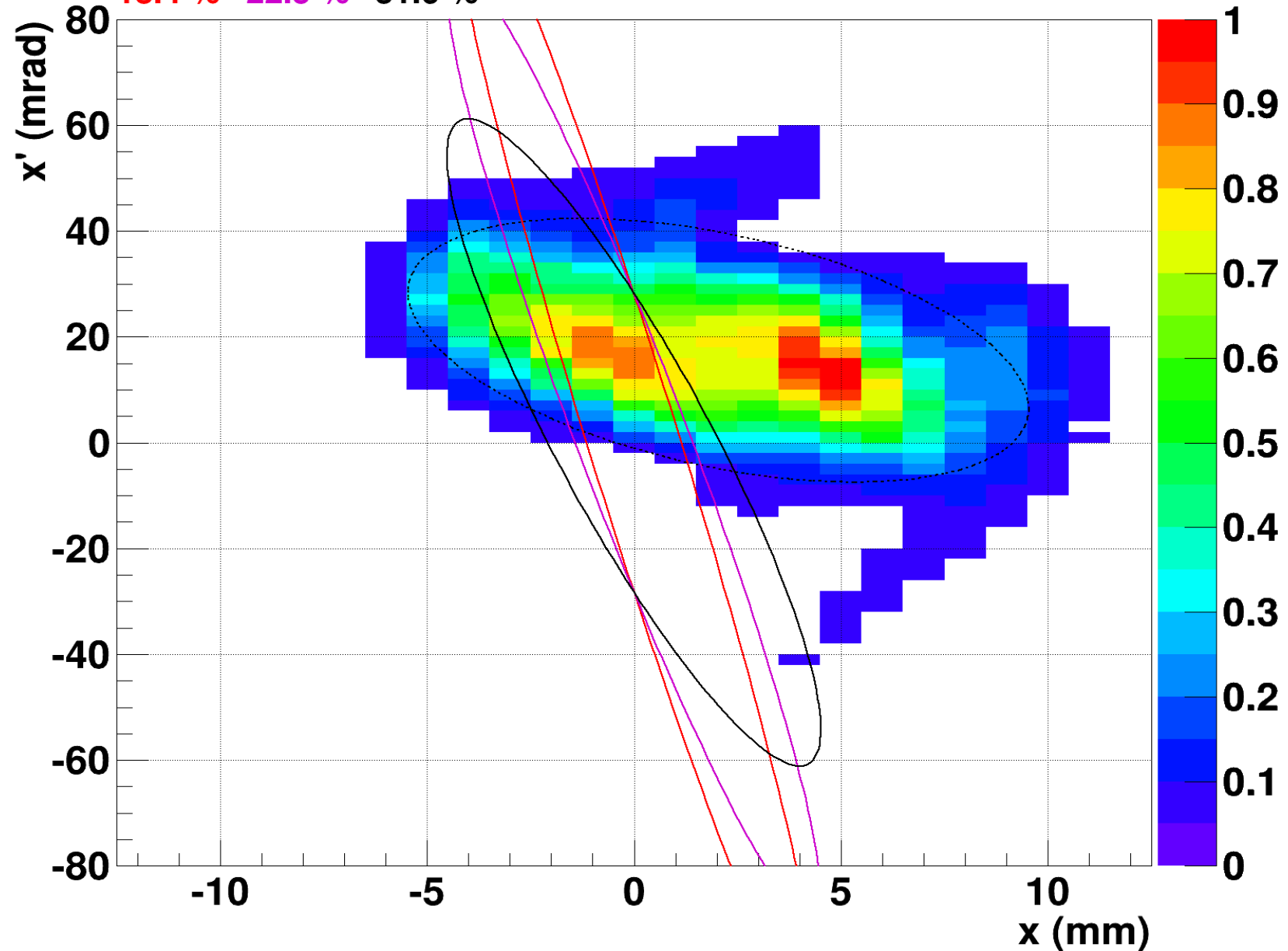
0.0 % 0.0 % 0.6 %



Run 681 H 130-080-220A; 11.5A, 21kV

$\alpha_x = 0.49$, $\beta_x = 0.34$, $\gamma_x = 3.70$; norm rms $\epsilon_x = 0.49$

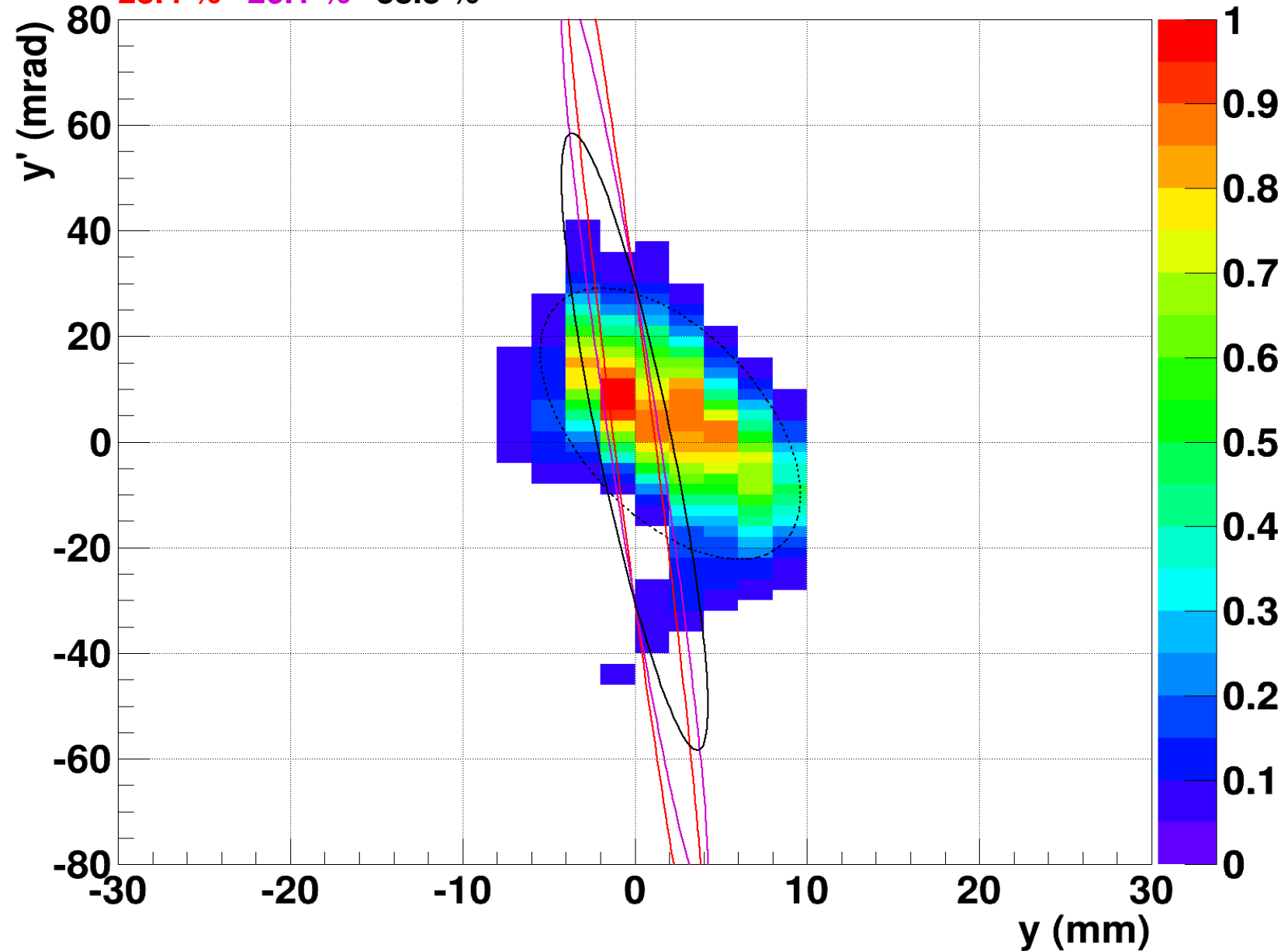
18.4 % 22.5 % 31.6 %



Run 658 V 130-080-220A; 11.5A, 21kV

$\alpha_y = 0.62$, $\beta_y = 0.35$, $\gamma_y = 4.00$; norm rms $\epsilon_y = 0.49$

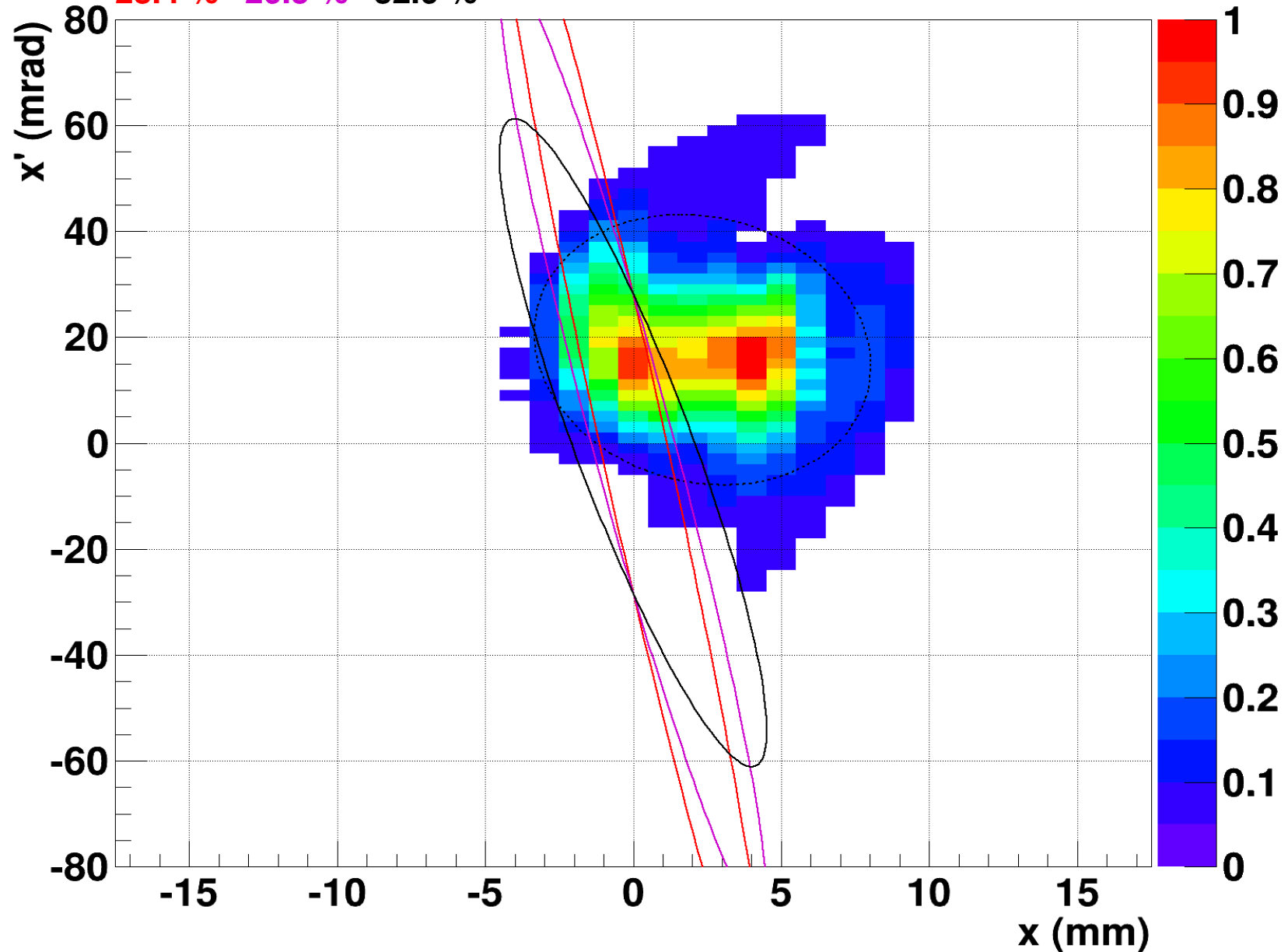
23.4 % 26.1 % 38.3 %



Run 676 H 130-080-240A; 11.5A, 21kV

$\alpha_x = 0.12$, $\beta_x = 0.22$, $\gamma_x = 4.52$; norm rms $\epsilon_x = 0.42$

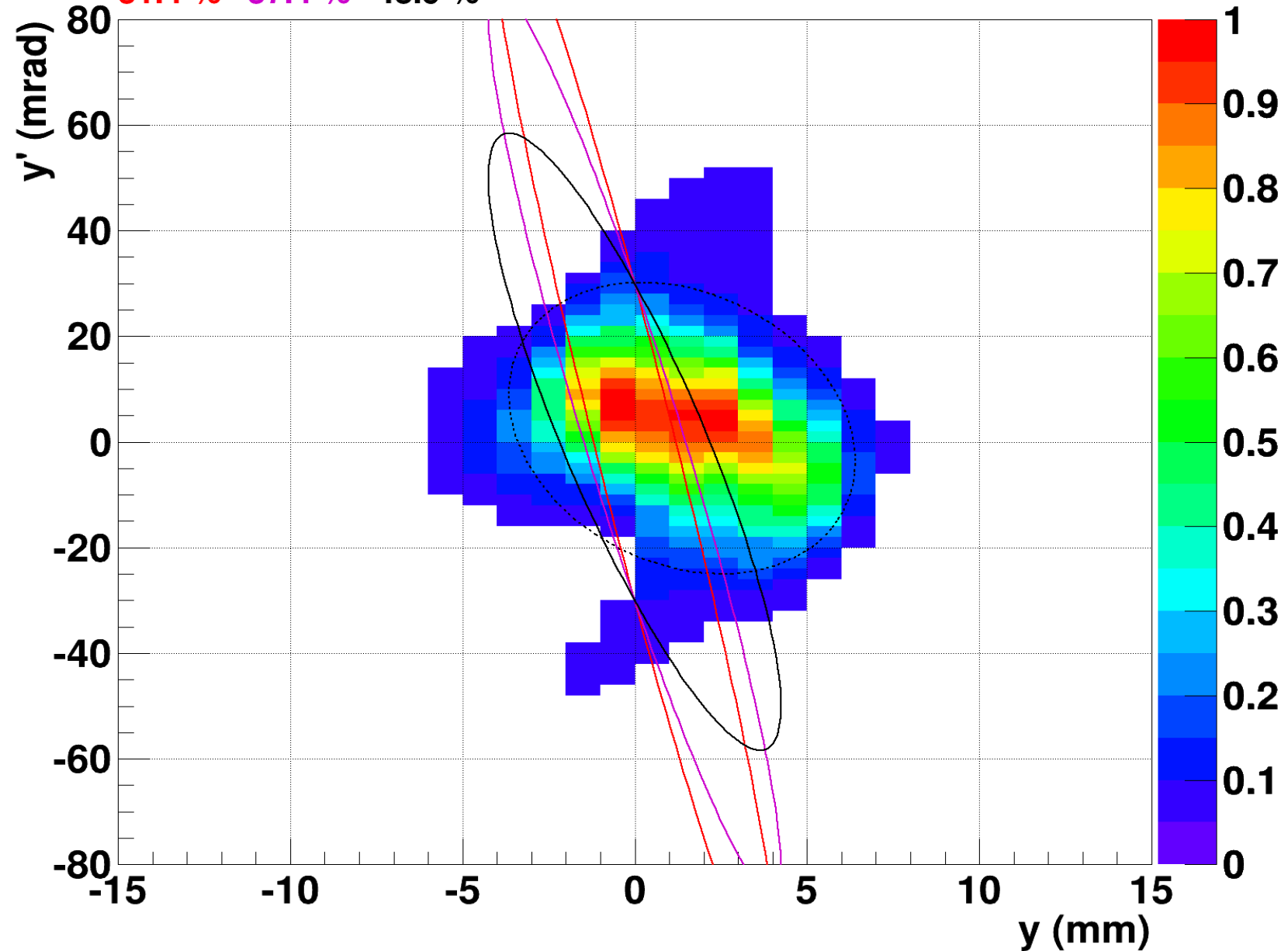
23.4 % 26.5 % 32.6 %



Run 660 V 130-080-240A; 11.5A, 21kV

$\alpha_y = 0.23$, $\beta_y = 0.19$, $\gamma_y = 5.63$; norm rms $\epsilon_y = 0.40$

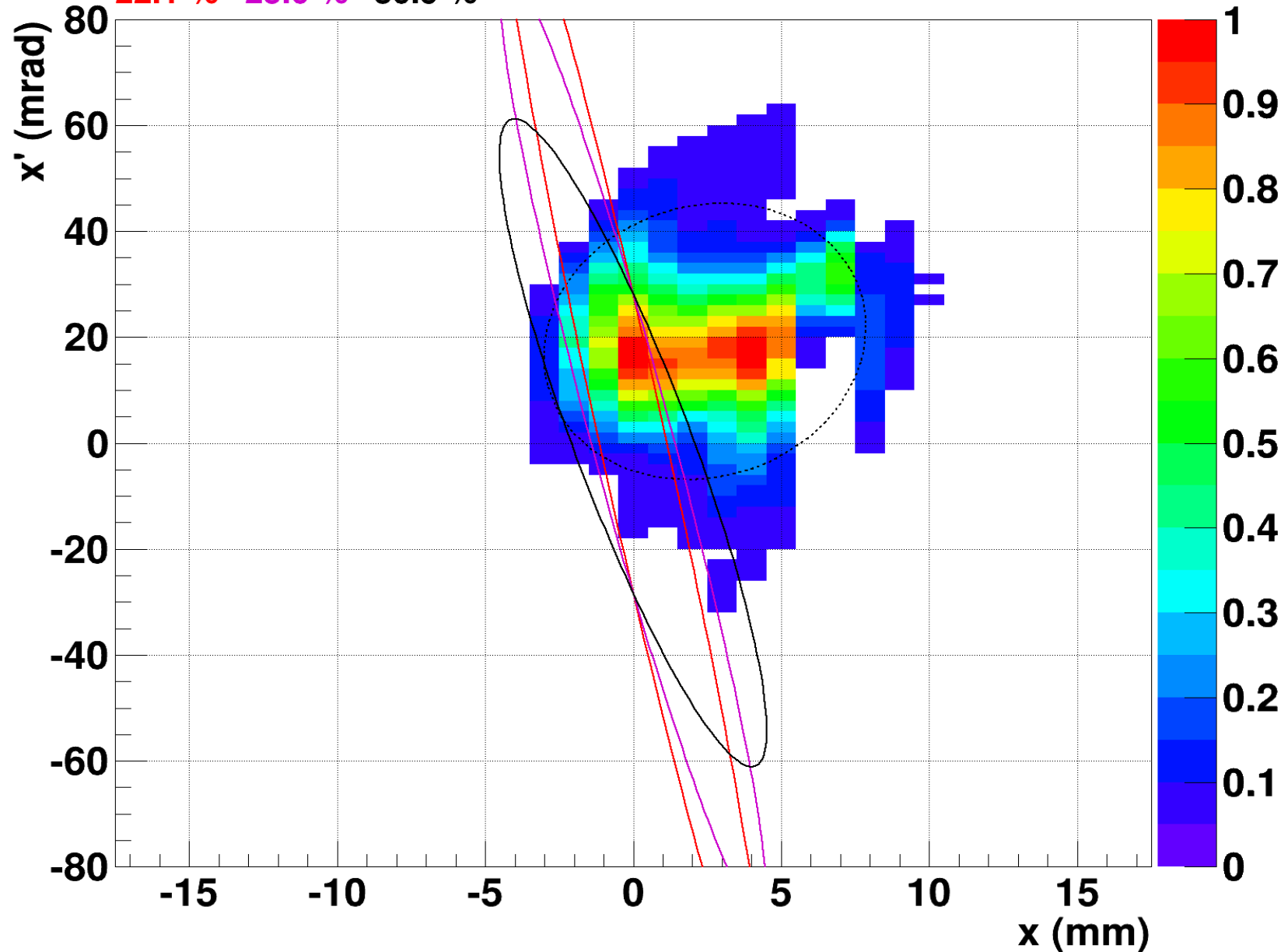
31.4 % 37.4 % 48.9 %



Run 677 H 130-080-245A; 11.5A, 21kV

$\alpha_x = -0.11$, $\beta_x = 0.21$, $\gamma_x = 4.82$; norm rms $\epsilon_x = 0.41$

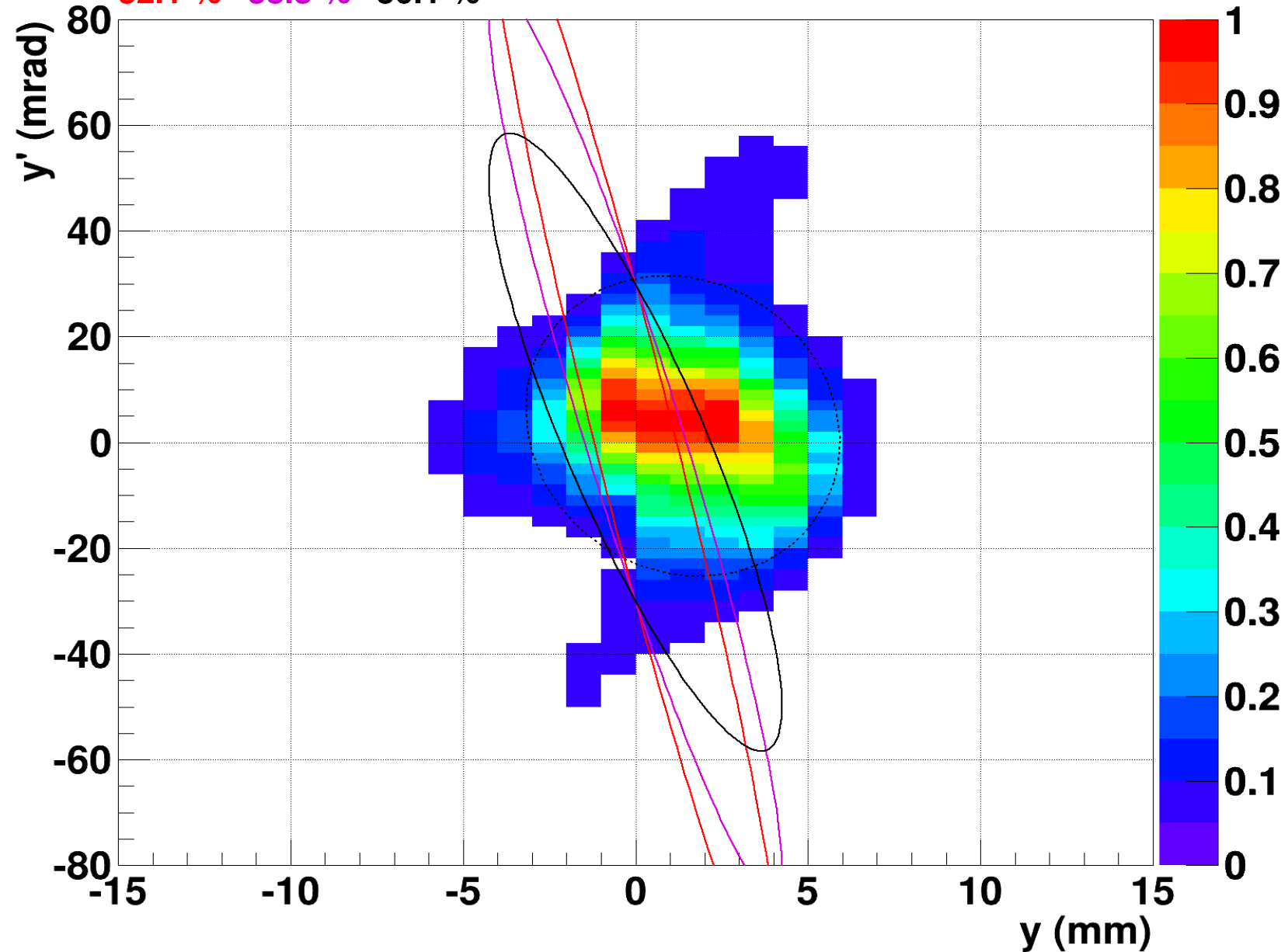
22.1 % 25.0 % 30.9 %



Run 661 V 130-080-245A; 11.5A, 21kV

$\alpha_y = 0.11$, $\beta_y = 0.16$, $\gamma_y = 6.28$; norm rms $\epsilon_y = 0.38$

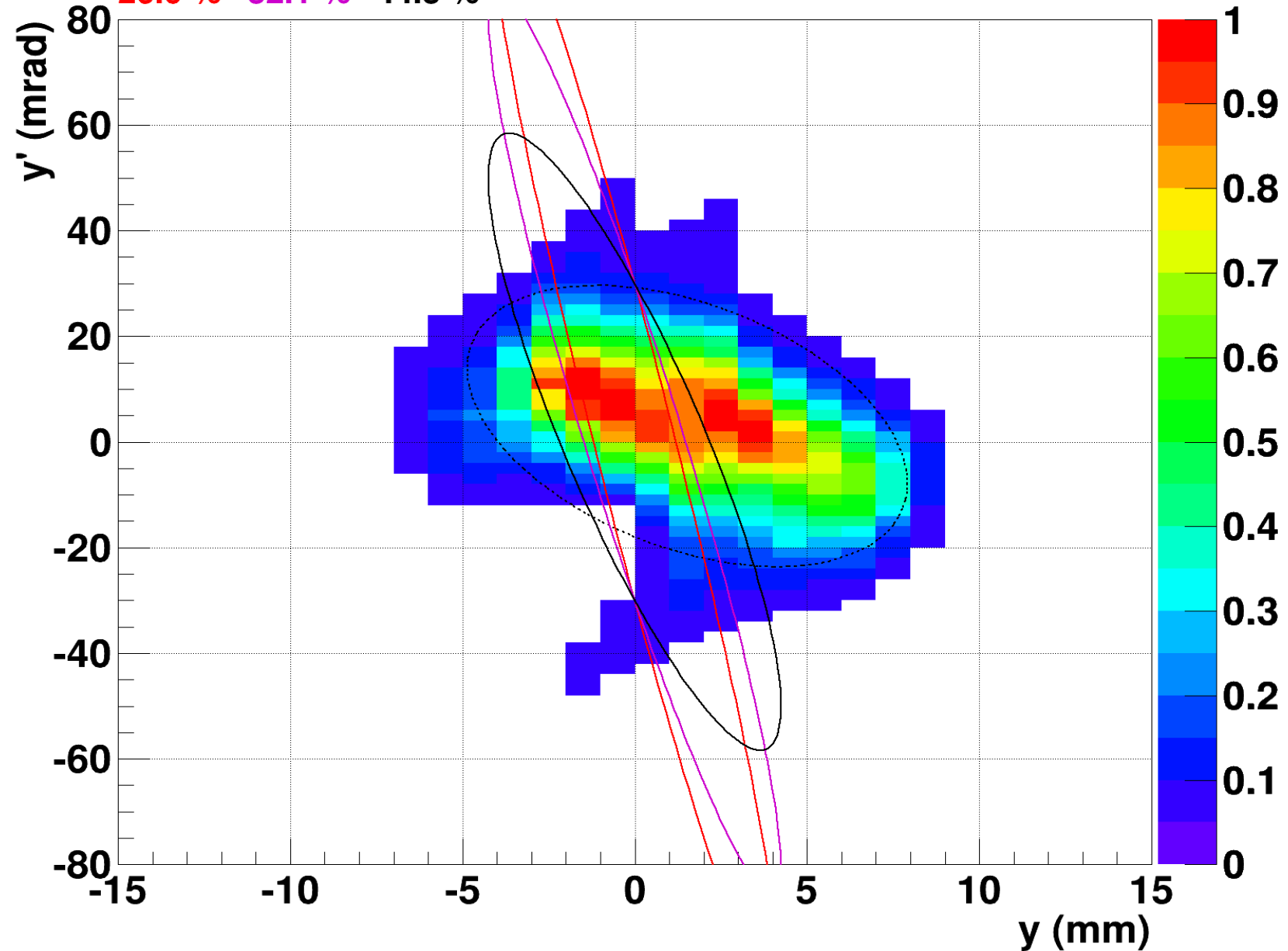
32.1 % 38.3 % 50.1 %



Run 662 V 130-080-230A; 11.5A, 21kV

$\alpha_y = 0.45$, $\beta_y = 0.26$, $\gamma_y = 4.57$; norm rms $\epsilon_y = 0.46$

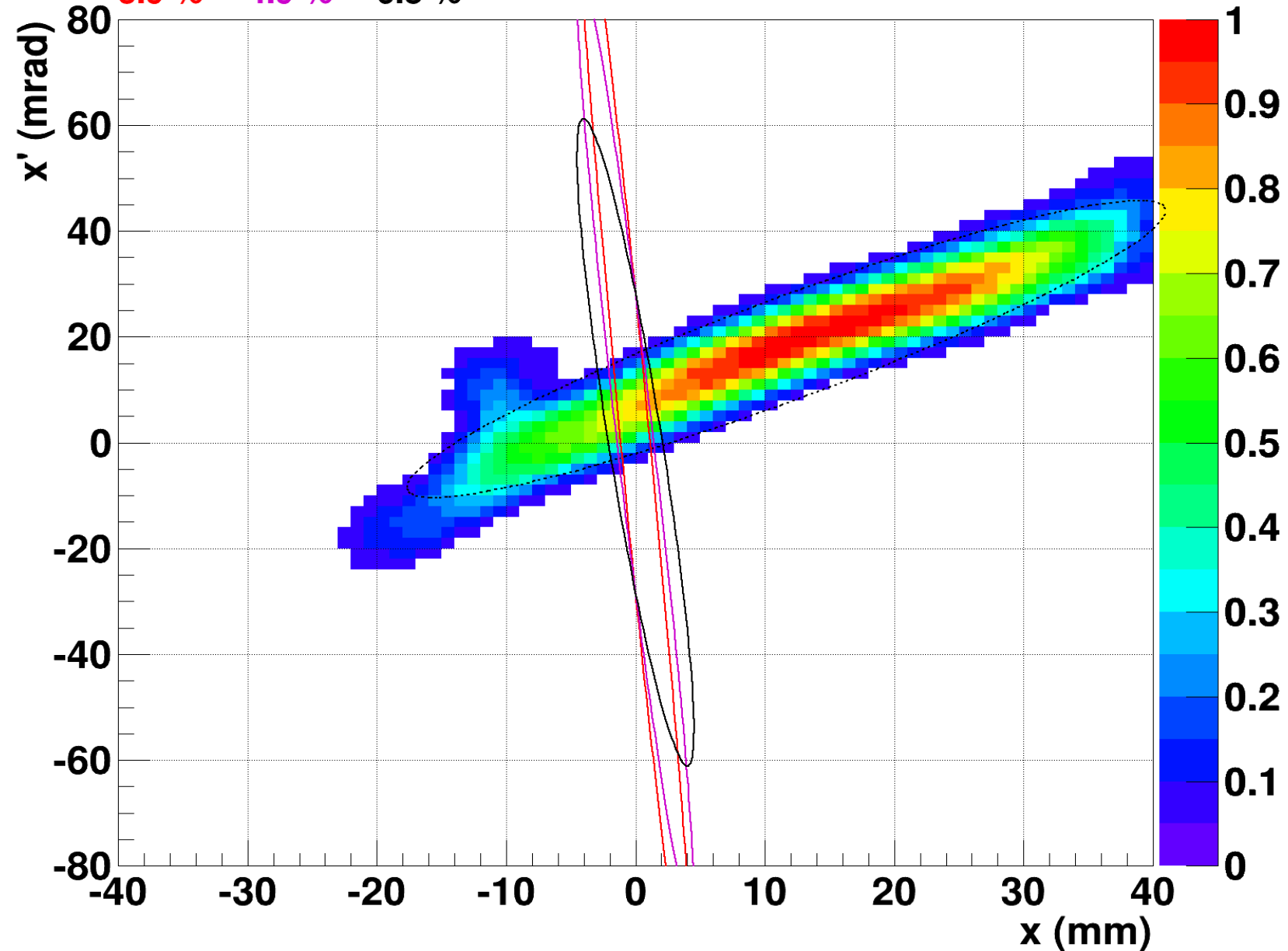
26.0 % 32.1 % 44.3 %



Run 688 V 130-080-000A; 11.5A, 21kV

$\alpha_x = -2.55$, $\beta_x = 2.86$, $\gamma_x = 2.62$; norm rms $\epsilon_x = 0.88$

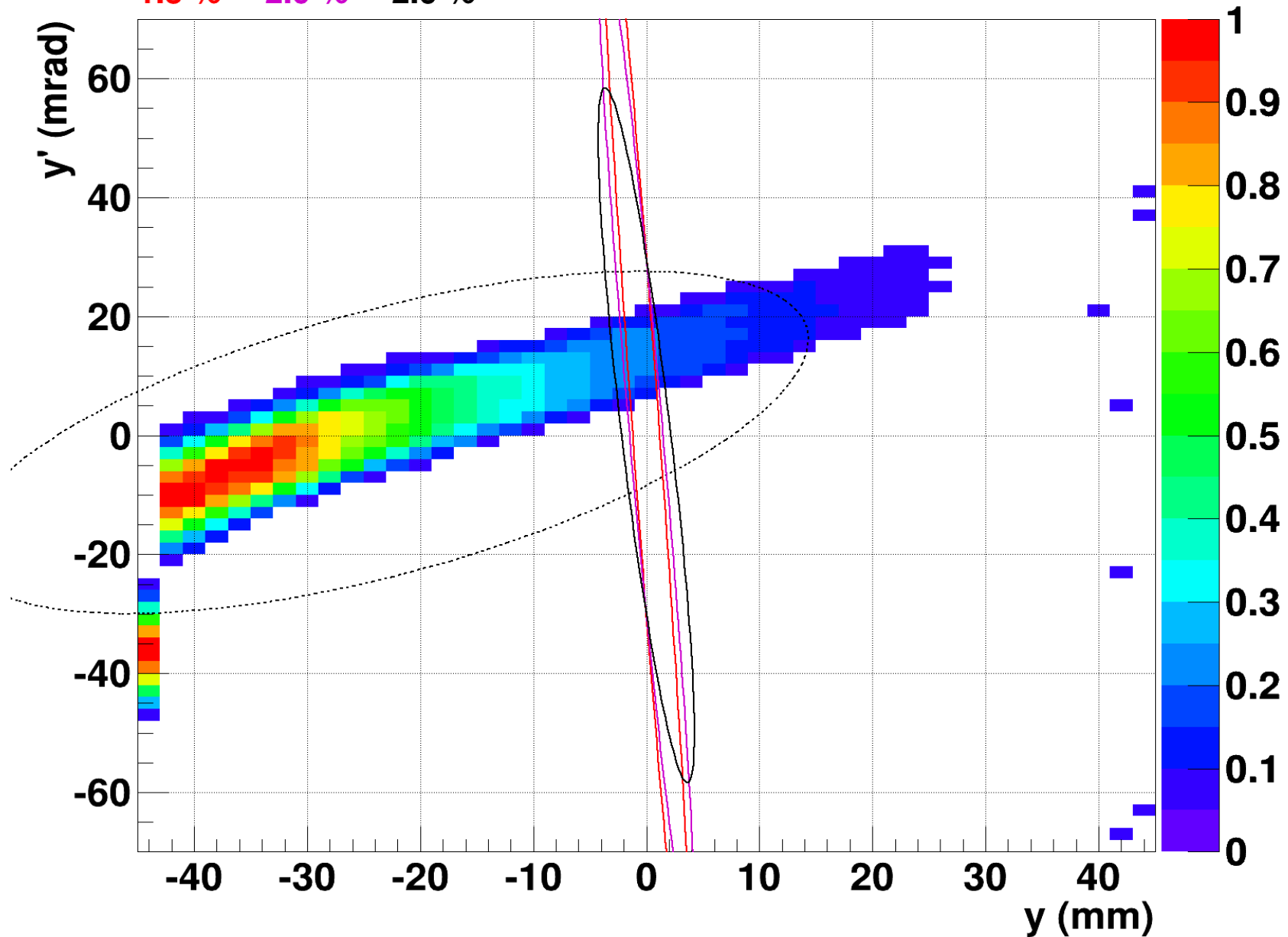
3.9 % 4.9 % 6.8 %



Run 654 V 000-000-000A; 11.5A, 21kV

$\alpha_y = -0.76$, $\beta_y = 1.64$, $\gamma_y = 0.96$; norm rms $\epsilon_y = 2.53$

1.3 % 2.0 % 2.6 %



GPT Sim: Solenoid currents range

I_1 (A)	I_2 (A)	I_3 (A)	RFQ eff (%)	Focus length (cm)
0	50 – 140	190 – 240	75 - 85	4 – >22
25	50 – 140	190 – 240	75 – 85	4 – >22
50	40 – 140	190 – 240	75 – 85	4 – >22
75	0 – 120	200 – 250	75 – 86	4 – 22
100	0 – 120	200 – 250	75 – 87	4 – 20
125	0 – 100	210 – 250	76 – 88	4 – 16
137	0 – 80	220 – 250	77 – 86	4 – 12
150	0 – 50	240 – 250	77 – 78	4 – 8
175	0 – 70	230 – 250	50 – 60	8 – 12
200	200 – 250	250	53 – 65	20 – >22

$I_1 \gtrsim 175$ A gives over-focusing of the beam inside LEBT
 $\Rightarrow$ high I_2 & I_3 needed to focus beam again