

## Ćwiczenie nr 5

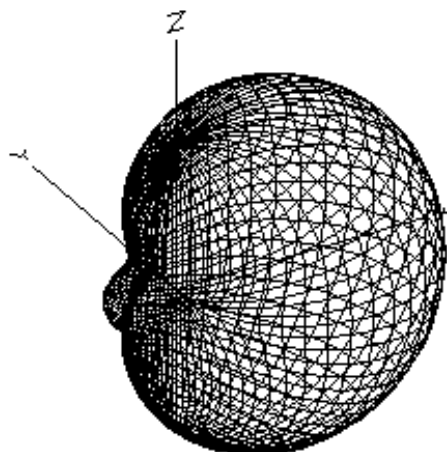
# 5-elementowa antena Uda-Yagi

### Podpunkt 1

a)

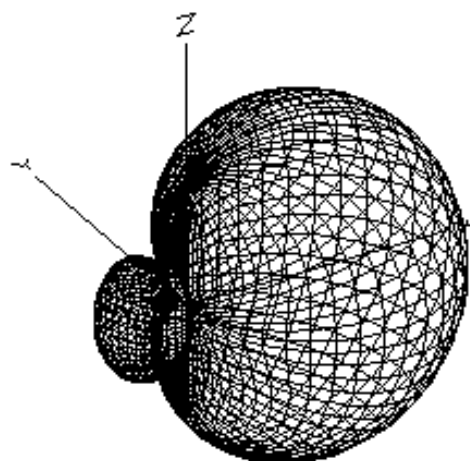
Rys. 1. Diagram kierunkowy przestrzenny dla  $f=190\text{MHz}$

EZNEC Demo



Rys. 2. Diagram kierunkowy przestrzenny dla  $f = 206\text{MHz}$

EZNEC Demo

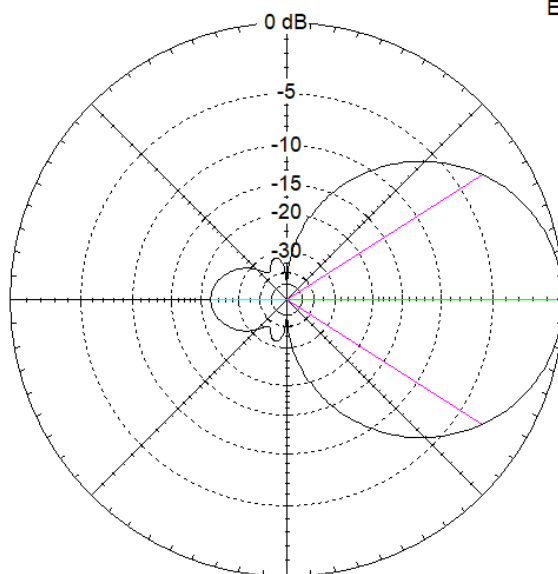


b)

*Diagram kierunkowy w płaszczyźnie horyzontalnej X (xOy) dla  $f = 190\text{MHz}$*

Total Field

EZNEC Demo



190 MHz

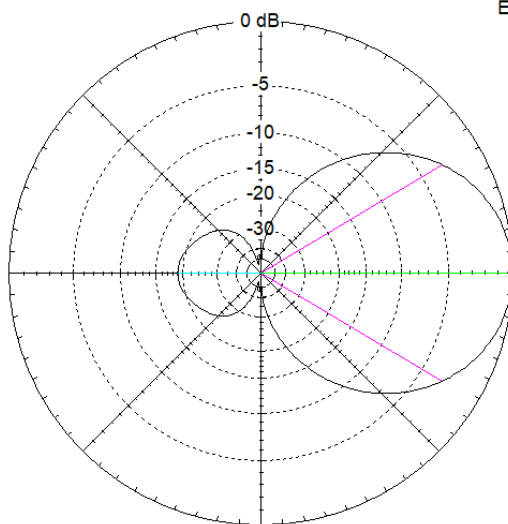
Azimuth Plot  
Elevation Angle 0,0 deg.  
Outer Ring 7,67 dBi  
  
Slice Max Gain 7,67 dBi @ Az Angle = 0,0 deg.  
Front/Back 22,09 dB  
Beamwidth 65,2 deg.; -3dB @ 327,4, 32,6 deg.  
Sidelobe Gain -14,42 dBi @ Az Angle = 180,0 deg.  
Front/Sidelobe 22,09 dB

Cursor Az 0,0 deg.  
Gain 7,67 dBi  
0,0 dBmax

*Diagram kierunkowy w płaszczyźnie horyzontalnej H (xOy) dla  $f = 206\text{MHz}$*

Total Field

EZNEC Demo



206 MHz

Azimuth Plot  
Elevation Angle 0,0 deg.  
Outer Ring 8,37 dBi  
  
Slice Max Gain 8,37 dBi @ Az Angle = 0,0 deg.  
Front/Back 19,0 dB  
Beamwidth 61,6 deg.; -3dB @ 329,2, 30,8 deg.  
Sidelobe Gain -10,63 dBi @ Az Angle = 180,0 deg.  
Front/Sidelobe 19,0 dB

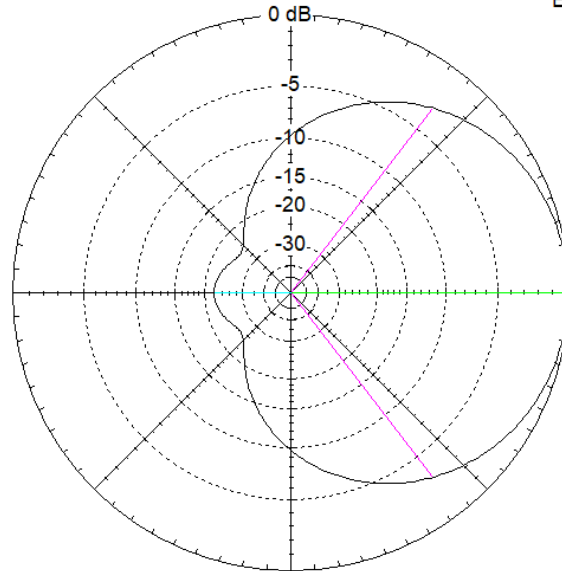
Cursor Az 0,0 deg.  
Gain 8,37 dBi  
0,0 dBmax

c)

*Diagram kierunkowy w płaszczyźnie wertykalnej V (xOz) dla  $f=190\text{MHz}$*

Total Field

EZNEC Demo



190 MHz

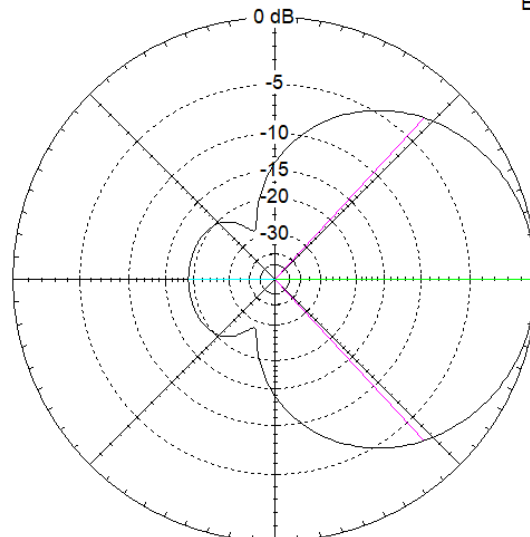
Elevation Plot  
Azimuth Angle 0,0 deg.  
Outer Ring 7,67 dBi  
  
Slice Max Gain 7,67 dBi @ Elev Angle = 0,0 deg.  
Front/Back 22,09 dB  
Beamwidth 104,8 deg.; -3dB @ 307,6, 52,4 deg.  
Sidelobe Gain -14,42 dBi @ Elev Angle = 180,0 deg.  
Front/Sidelobe 22,09 dB

Cursor Elev 0,0 deg.  
Gain 7,67 dBi  
0,0 dBmax

*Diagram kierunkowy w płaszczyźnie wertykalnej V (xOz) dla  $f=206\text{MHz}$*

Total Field

EZNEC Demo



206 MHz

Elevation Plot  
Azimuth Angle 0,0 deg.  
Outer Ring 8,37 dBi  
  
Slice Max Gain 8,37 dBi @ Elev Angle = 0,0 deg.  
Front/Back 19,0 dB  
Beamwidth 94,6 deg.; -3dB @ 312,7, 47,3 deg.  
Sidelobe Gain -10,63 dBi @ Elev Angle = 180,0 deg.  
Front/Sidelobe 19,0 dB

Cursor Elev 0,0 deg.  
Gain 8,37 dBi  
0,0 dBmax

## Podpunkt 2

- Dla  $f = 190\text{MHz}$

Płaszczyzna horyzontalna:

$$\text{SWR} = 1,32$$

$$G_{\max} = 7,67 \text{ dBi}$$

$$\text{HPBW} = 65,2 \text{ deg}$$

Płaszczyzna wertykalna:

$$\text{SWR} = 1.32$$

$$G_{\max} = 7,67 \text{ dBi}$$

$$\text{HPBW} = 104,8 \text{ deg}$$

- Dla  $f = 206\text{MHz}$

Płaszczyzna horyzontalna:

$$\text{SWR} = 1,44$$

$$G_{\max} = 8.37 \text{ dBi}$$

$$\text{HPBW} = 61,6 \text{ deg}$$

Płaszczyzna wertykalna:

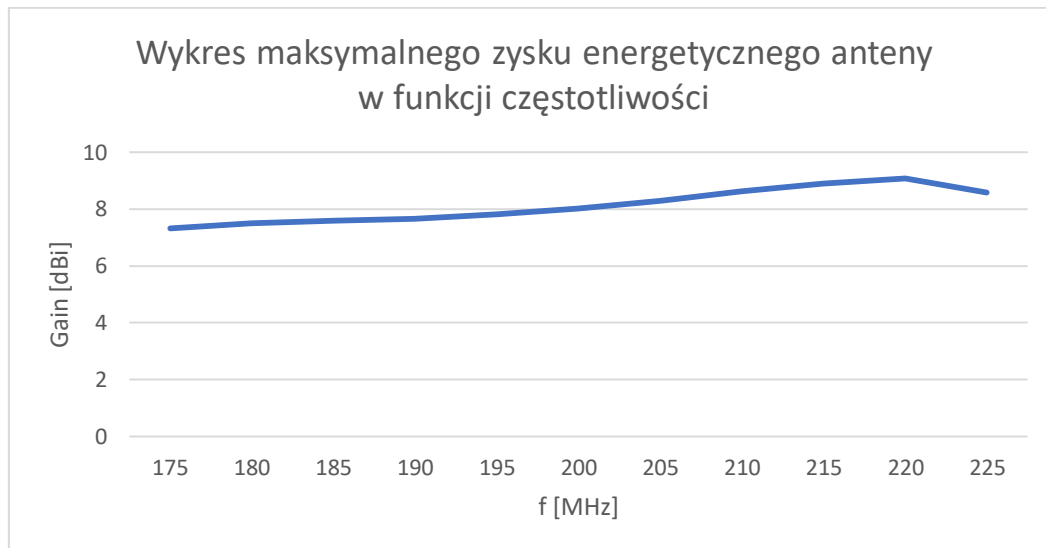
$$\text{SWR} = 1,44$$

$$G_{\max} = 8,37 \text{ dBi}$$

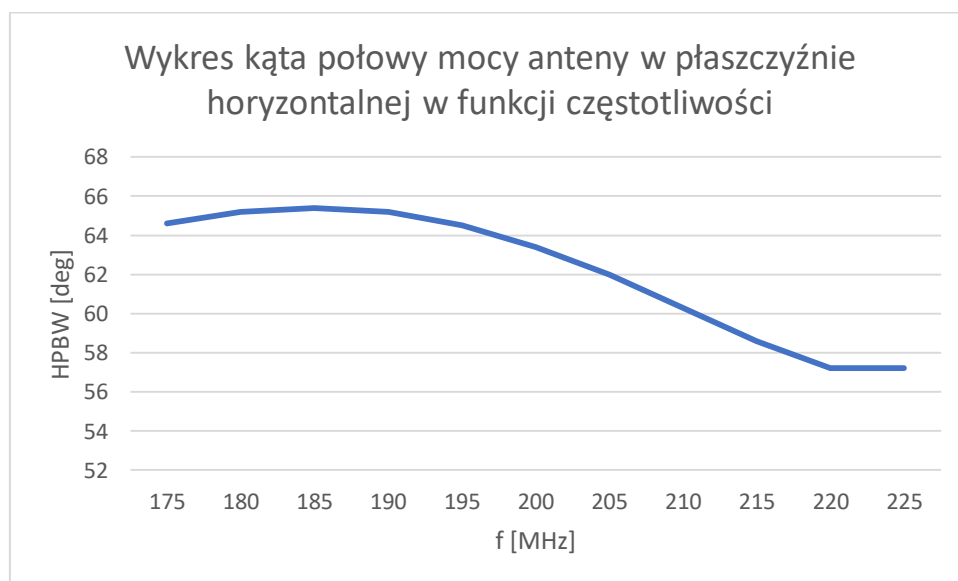
$$\text{HPBW} = 94,6 \text{ deg}$$

### Podpunkt 3

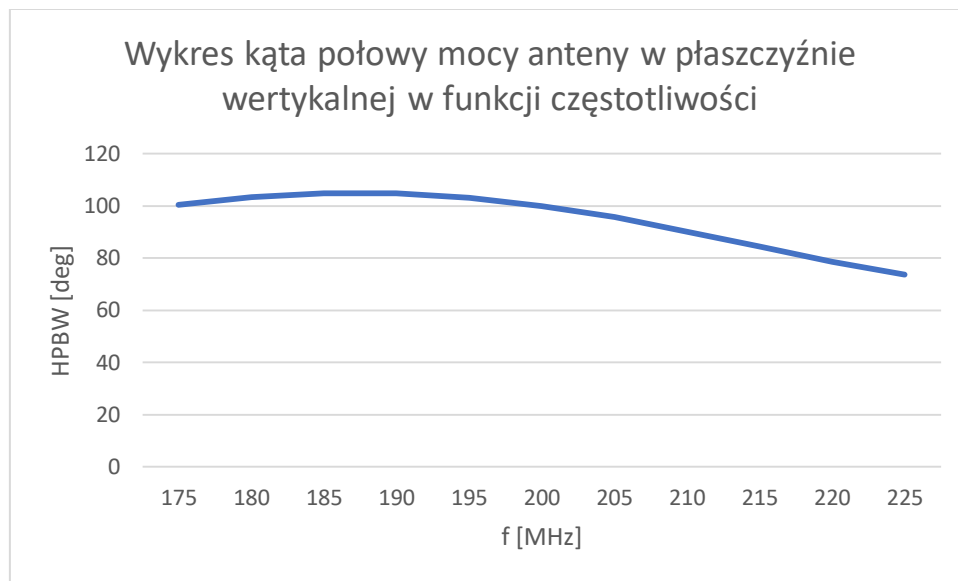
a)



b)

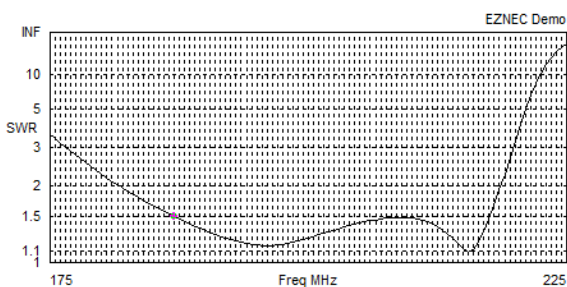


c)



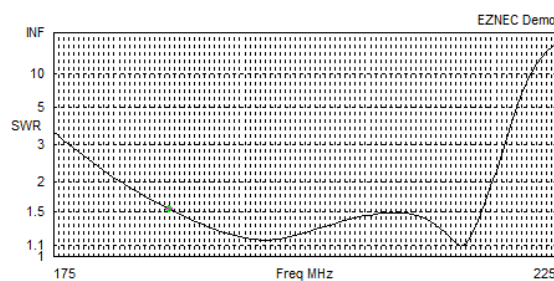
## Podpunkt 4

### współczynnik fali stojące



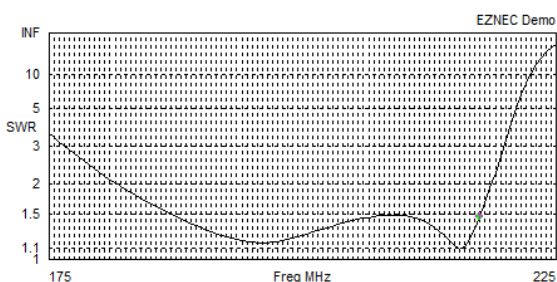
Freq 187 MHz  
 SWR 1.49  
 Z 59.48 at -18.21 deg.  
 = 56.5 - j 18.59 ohms  
 Refl Coeff 0.1975 at -126.82 deg.  
 = -0.1184 - j 0.1581  
 Ret Loss 14.1 dB

Source # 1  
 Z0 75 ohms



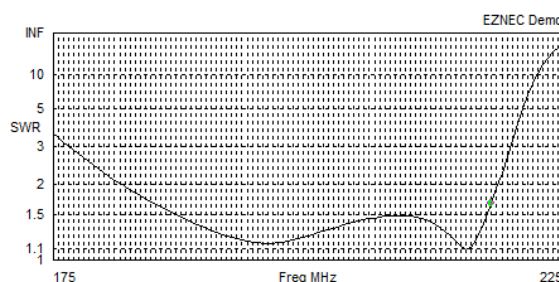
Freq 186.5 MHz  
 SWR 1.53  
 Z 59.27 at -19.57 deg.  
 = 55.85 - j 19.85 ohms  
 Refl Coeff 0.2084 at -125.36 deg.  
 = -0.1206 - j 0.17  
 Ret Loss 13.6 dB

Source # 1  
 Z0 75 ohms



Freq 217.5 MHz  
 SWR 1.46  
 Z 52.74 at -7.89 deg.  
 = 52.24 - j 7.243 ohms  
 Refl Coeff 0.1874 at -159.09 deg.  
 = -0.175 - j 0.06689  
 Ret Loss 14.5 dB

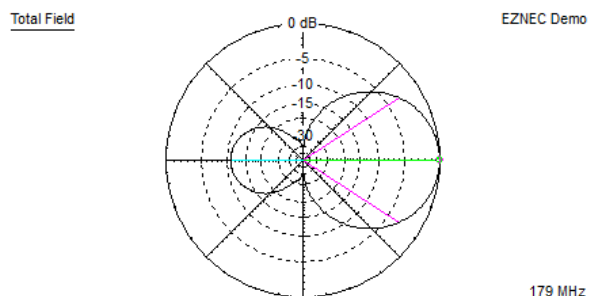
Source # 1  
 Z0 75 ohms



Freq 218 MHz  
 SWR 1.66  
 Z 45.77 at -6.18 deg.  
 = 45.51 - j 4.93 ohms  
 Refl Coeff 0.2479 at -168.17 deg.  
 = -0.2427 - j 0.05083  
 Ret Loss 12.1 dB

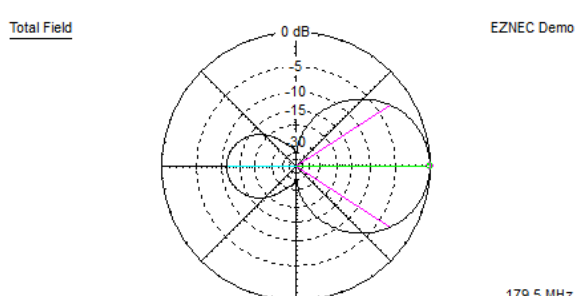
Source # 1  
 Z0 75 ohms

### zysk energetyczny



Azimuth Plot  
 Elevation Angle 0.0 deg.  
 Outer Ring 7.49 dBi  
 Cursor Az 0.0 deg.  
 Gain 7.49 dBi  
 0.0 dBmax

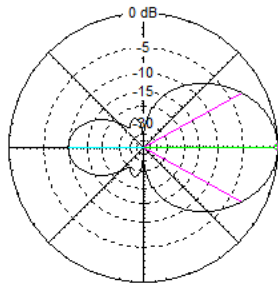
Slice Max Gain 7.49 dBi @ Az Angle = 0.0 deg.  
 Front/Back 10.93 dB  
 Beamwidth 65.2 deg.; -3dB @ 327.4, 32.6 deg.  
 Sidelobe Gain -3.44 dBi @ Az Angle = 180.0 deg.  
 Front/Sidelobe 10.93 dB



Azimuth Plot  
 Elevation Angle 0.0 deg.  
 Outer Ring 7.5 dBi  
 Cursor Az 0.0 deg.  
 Gain 7.5 dBi  
 0.0 dBmax

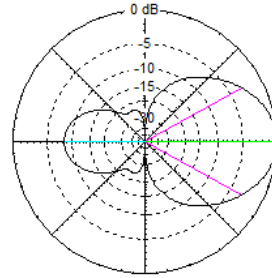
Slice Max Gain 7.5 dBi @ Az Angle = 0.0 deg.  
 Front/Back 11.32 dB  
 Beamwidth 65.2 deg.; -3dB @ 327.4, 32.6 deg.  
 Sidelobe Gain -3.82 dBi @ Az Angle = 180.0 deg.  
 Front/Sidelobe 11.32 dB

Total Field



EZNEC Demo

Total Field



EZNEC Demo

Azimuth Plot  
Elevation Angle 0.0 deg.  
Outer Ring 7.98 dBi

Cursor Az Gain  
0.0 deg. 7.98 dBi  
0.0 dBmax

Slice Max Gain 7.98 dBi @ Az Angle = 0.0 deg.  
Front/Back 9.94 dB  
Beamwidth 57.5 deg.; -3dB @ 331.2, 28.7 deg.  
Sidelobe Gain -1.96 dBi @ Az Angle = 180.0 deg.  
Front/Sidelobe 9.94 dB

226 MHz

Azimuth Plot  
Elevation Angle 0.0 deg.  
Outer Ring 7.48 dBi

Cursor Az Gain  
0.0 deg. 7.48 dBi  
0.0 dBmax

Slice Max Gain 7.48 dBi @ Az Angle = 0.0 deg.  
Front/Back 8.37 dB  
Beamwidth 57.8 deg.; -3dB @ 331.1, 28.9 deg.  
Sidelobe Gain -0.89 dBi @ Az Angle = 180.0 deg.  
Front/Sidelobe 8.37 dB

226.5 MHz

### Obliczenia

$$f_1 = 187 \text{ MHz}$$

$$f_2 = 217,5 \text{ MHz}$$

$$\Delta f = f_2 - f_1 = 30,5 \text{ MHz}$$

$$f_0 = \sqrt{f_1 * f_2} = 201,67 \text{ MHz}$$

$$B = \frac{\Delta f}{f_0} * 100\% = 15,12\%$$



### Podpunkt 5

a) Dla anteny bez direktora D1

Częstotliwość	Płaszczyzna V			Płaszczyzna H		
	HPBW [deg]	Gain [dBi]	SWR	HPBW [deg]	Gain [dBi]	SWR
190 MHz	104,6	7,74	1,65	65,4	7,74	1,65
206 MHz	93,2	8,41	3,7	61,4	8,41	3,7

b) Dla anteny bez direktora D2

Częstotliwość	Płaszczyzna V			Płaszczyzna H		
	HPBW [deg]	Gain [dBi]	SWR	HPBW [deg]	Gain [dBi]	SWR
190 MHz	119,2	6,76	1,35	68,8	6,76	1,35
206 MHz	127,6	6,51	1,46	69,0	6,51	1,46

### Podpunkt 6

**Tabela 1**

Populacja próbna  $\eta_A$  paśmie od 175 do 225 MHz

f [MHz]	$G_{\max}$ [dBi]	$g_{\max}$ [W/W]	$\Theta_H^{\deg}$ [deg]	$\Theta_V^{\deg}$ [deg]	$\eta_A$
175	7,33	5,407543	64,6	100,4	0,85018
180	7,51	5,636377	65,2	103,4	0,921112
185	7,59	5,741165	65,4	104,8	0,953857
190	7,67	5,847901	65,2	104,8	0,96862
195	7,81	6,039486	64,5	103,2	0,974505
200	8,03	6,353309	63,4	100	0,976413
205	8,3	6,76083	62	95,8	0,973423
210	8,62	7,277798	60,3	90,2	0,959552
215	8,9	7,762471	58,6	84,4	0,930646
220	9,08	8,090959	57,2	78,6	0,881786
225	8,59	7,227698	57,2	73,8	0,7396

$$\bar{\eta}_A = 0.921 \pm 0.0483$$

**Tabela 2**Populacja próbna  $\eta_A$  paśmie pracy  $\Delta f$  anteny

f [MHz]	$G_{\max}$ [dBi]	$g_{\max}$ [W/W]	$\Theta_H^{\deg}$ [deg]	$\Theta_V^{\deg}$ [deg]	$\eta_A$
187	7,62	5,78096	65,2	105	0,959359
190	7,67	5,847901	65,2	104,8	0,96862
193	7,75	5,956621	64,8	104	0,97309
196	7,85	6,095369	64,3	102,6	0,974771
199	7,98	6,280584	63,6	100,8	0,976028
202	8,13	6,501297	62,9	98,4	0,975417
205	8,3	6,76083	62	95,8	0,973423
208	8,49	7,063176	61	92,6	0,967131
211	8,68	7,379042	60	89	0,955181
214	8,85	7,673615	59	85,6	0,939443
217,5	9,01	7,961594	58	81,4	0,911165

$$\bar{\eta}_A = 0.961 \pm 0.0129$$