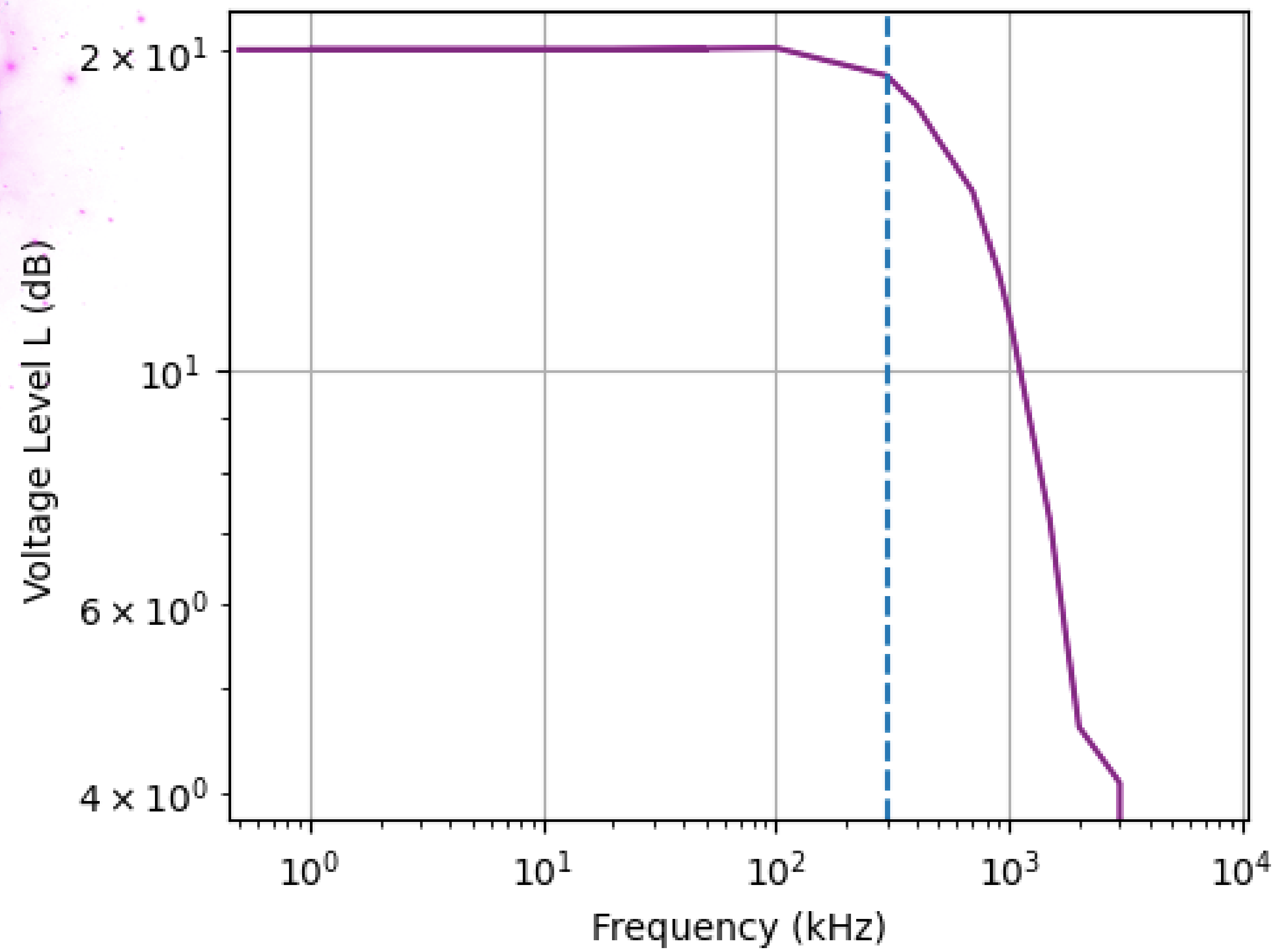
Dr Dan Marrone

Instrumentation lab

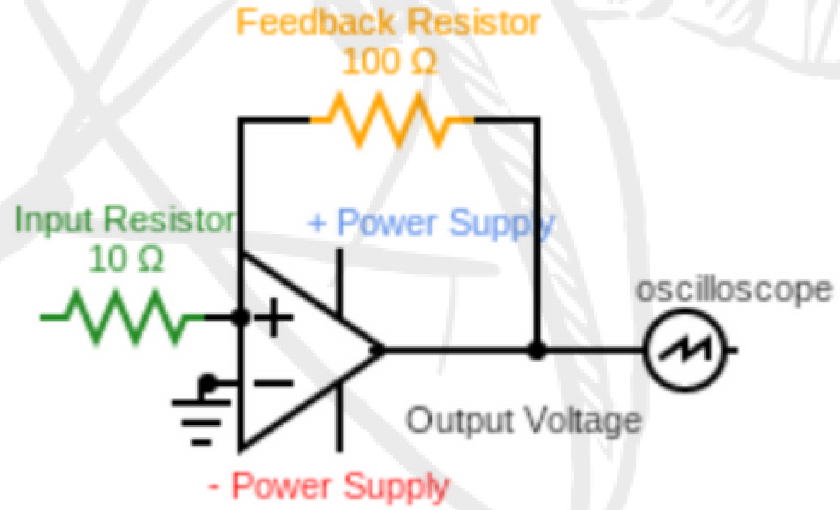
Suhani Surana

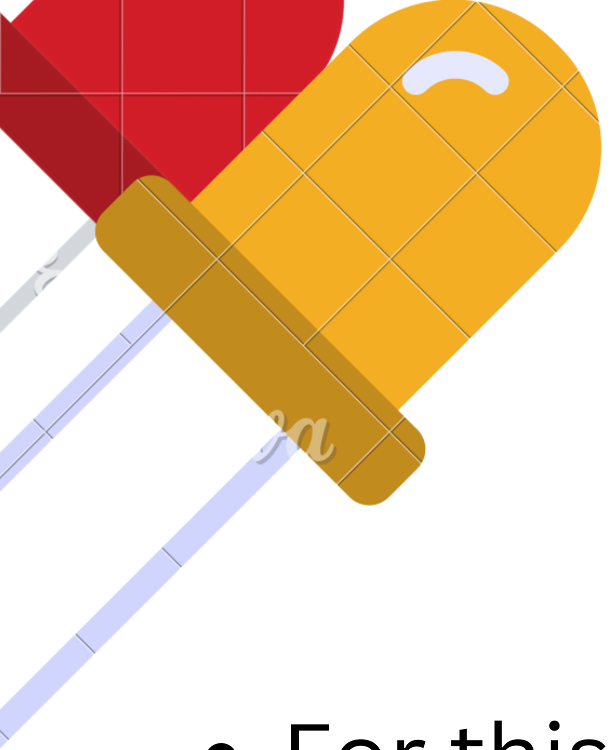
Analysing Op-Amps



This plot represents gain vs frequency, with an op-amp that results in a gain of 10.

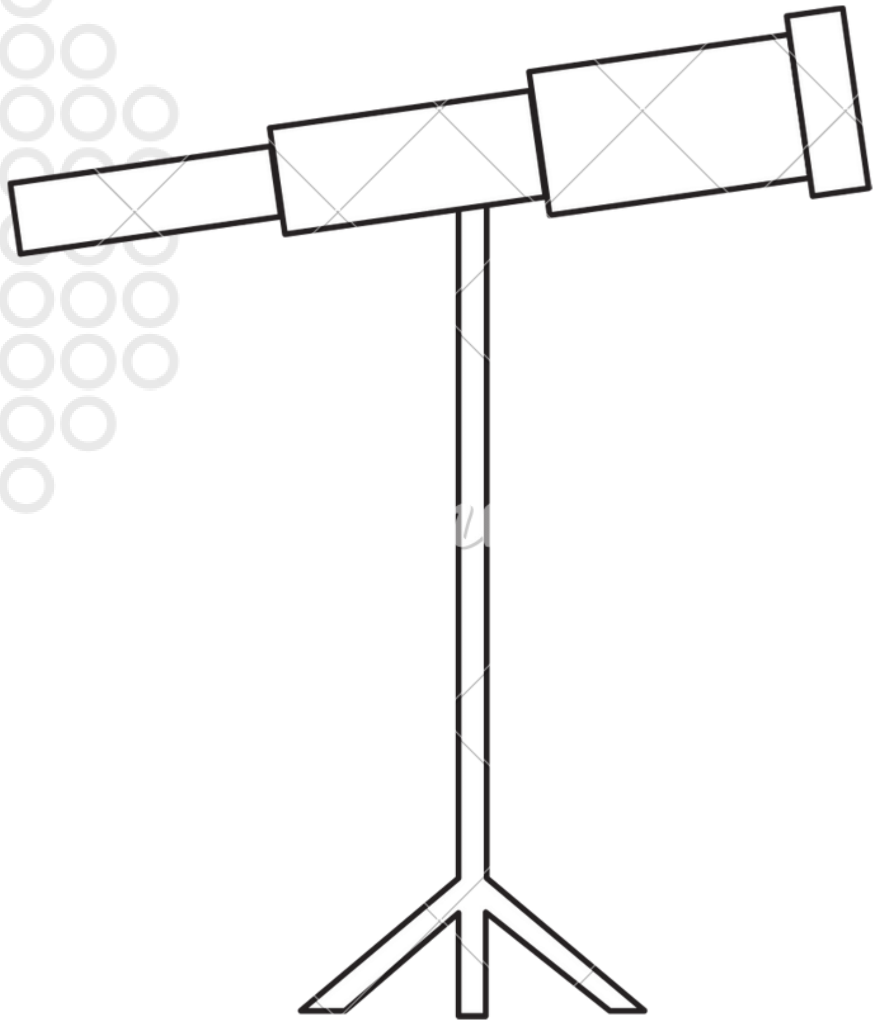
- A circuit with an op Amp
- Returns an inverted output (180 degrees out of phase)
- Resistors reduce the electricity in the circuit:
  - in our pupose they control the gain
- Feedback resistor takes some of the output and feeds it to the input.

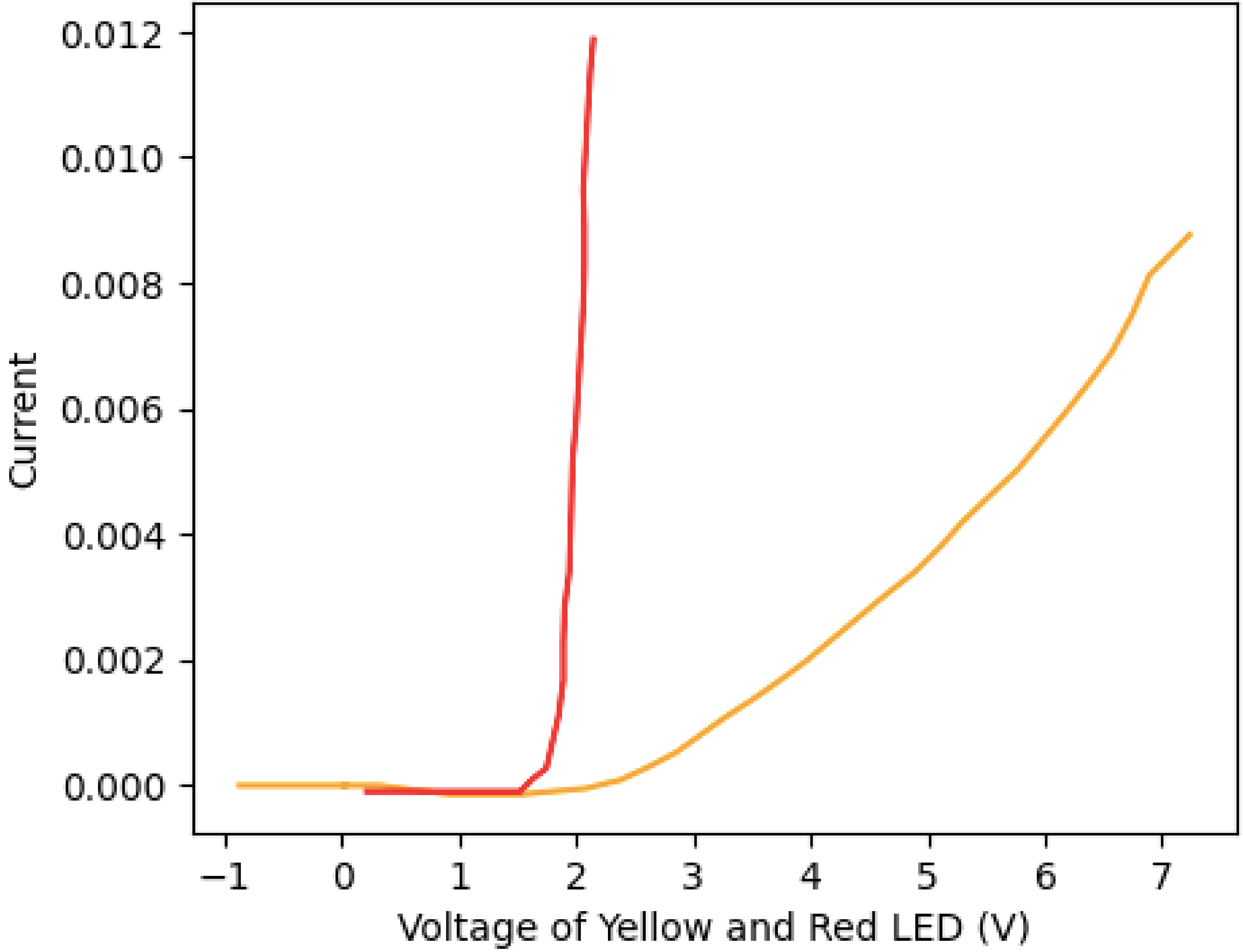




Diodes in Astronomy

- For this experiment, the same operational amplifier circuit was used, however, a resistor and diode were added to the circuit.
- Our initial experiment used a red LED, an then we used a yellow LED. The frequency, wave pattern, voltage supply, amplitude and offset were set constant.
- Purpose: I-V Curve of a red and yellow diode were obtained from the data.



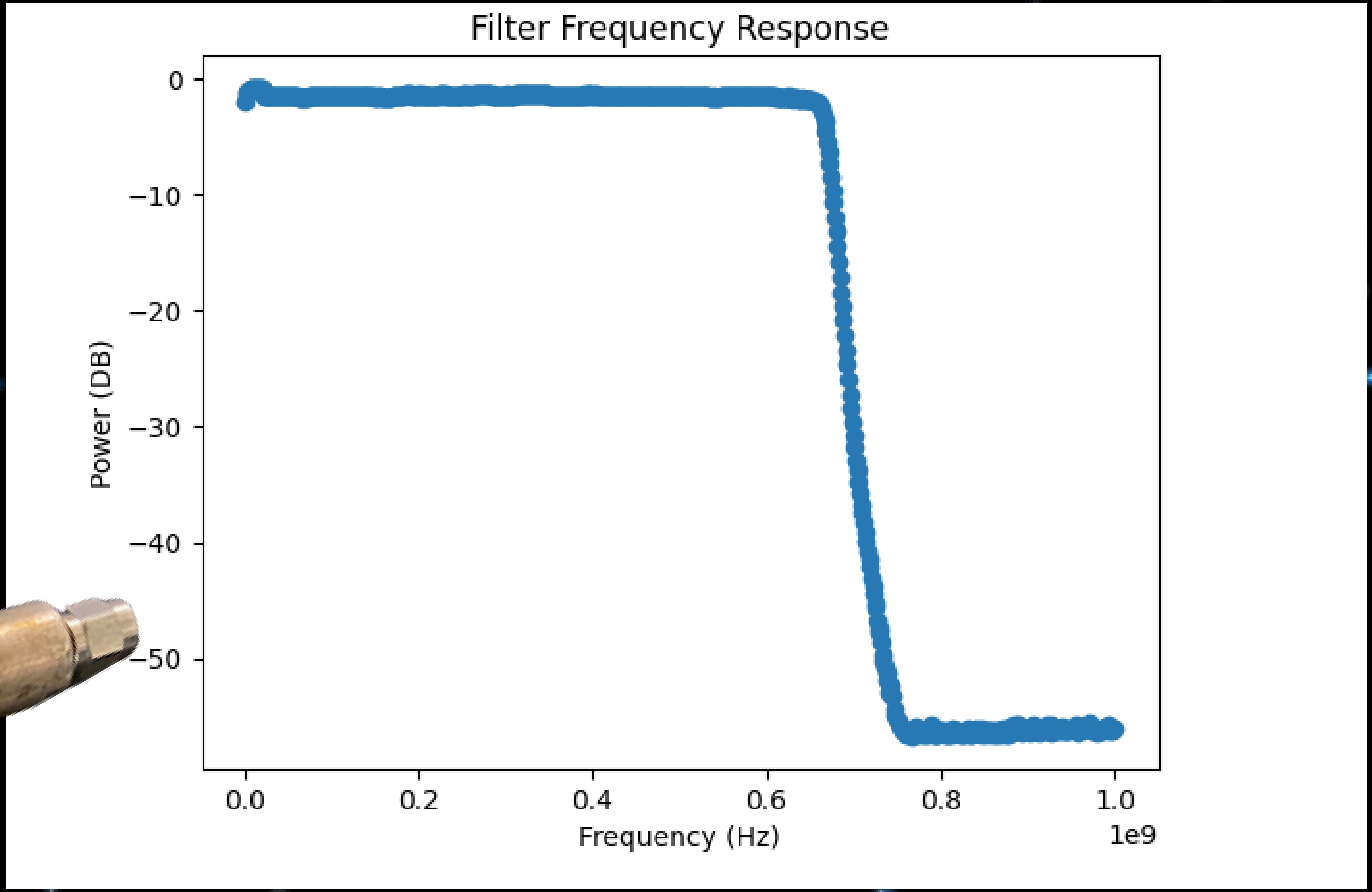


This plot represents gain vs frequency, with an op-amp that results in a gain of 10.

CREATING FILTER FREQUENCY GRAPHS

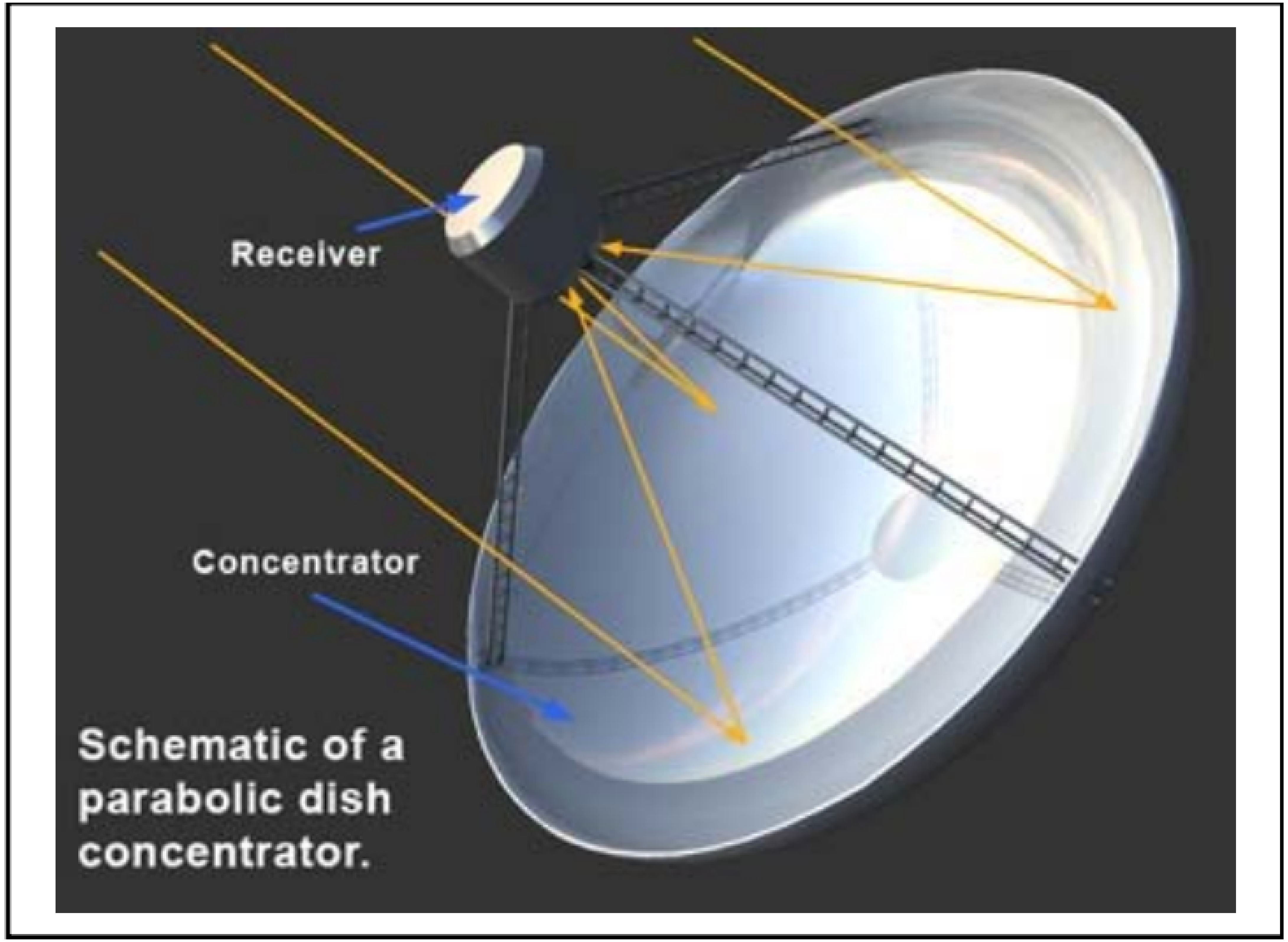
Use of a filter frequency graph?

- Frequency Response Curves are used to understand the behavior of a filter.
- It gives the quantitative analysis of the output spectrum of a system/device in response to an input.
- It gives a measure of the Magnitude (Amplitude/Gain) and Phase response w.r.t frequency.



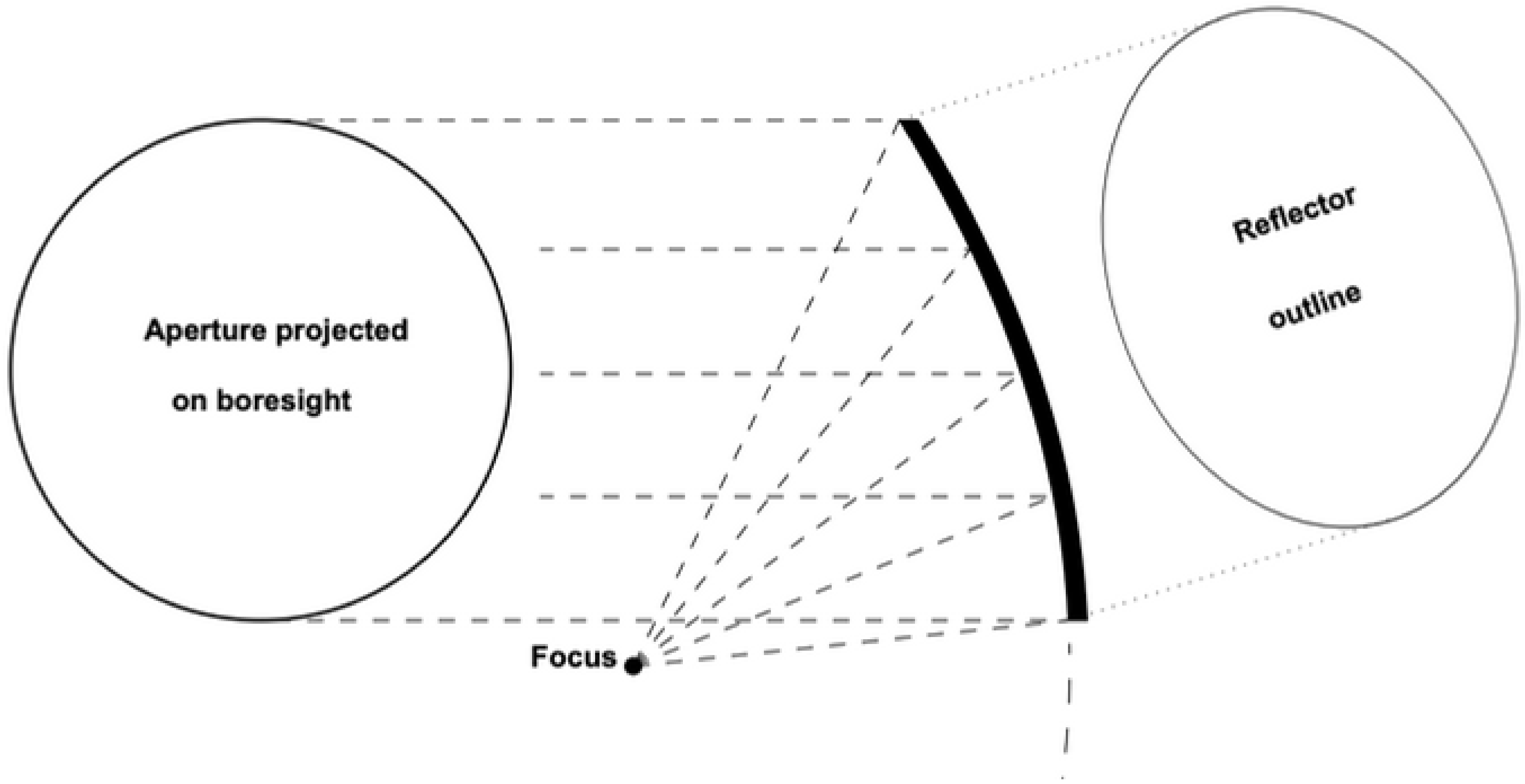
An example of a low pass filter frequency response plot

Parabolas

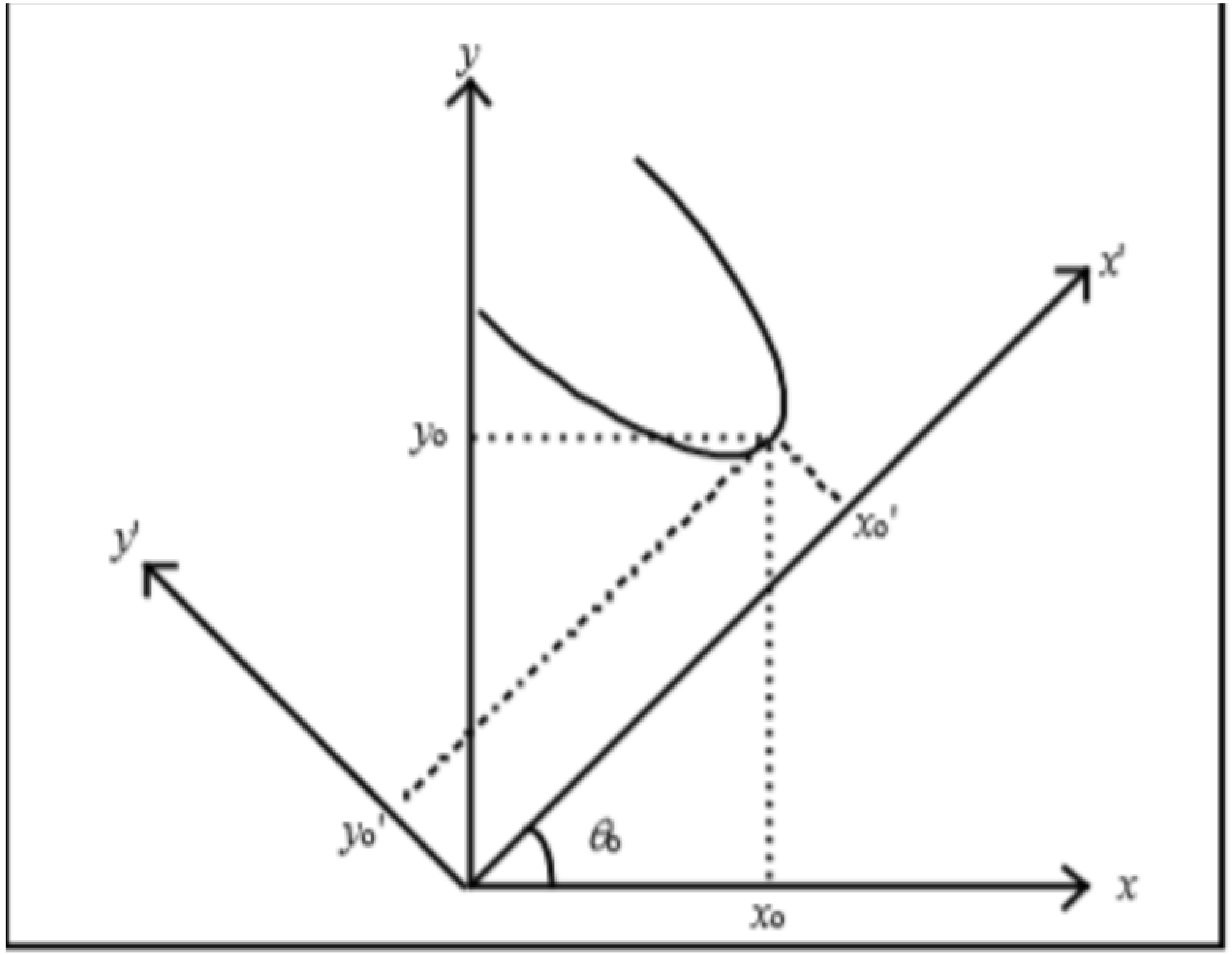


The parabola is the exact shape required to focus a plane wave to a single point. Hence parabolic dishes coherently (i.e. in phase) add electromagnetic radiation at a point and are central to many telescope designs in both the optical and radio.

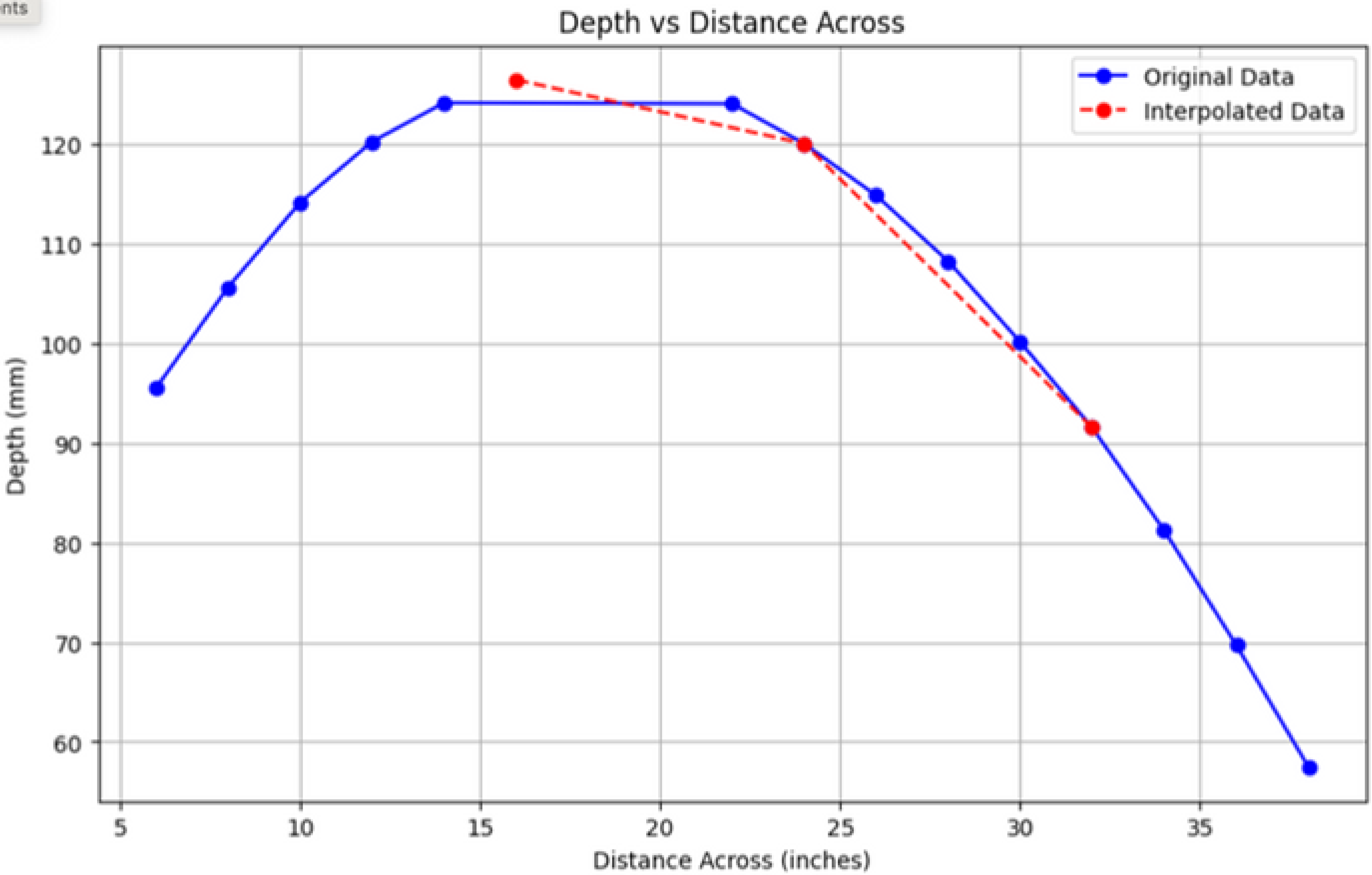
OFFSET-FED PARABOLIC DISH ANTENNAS



Tilted Parabola



ble of contents



Quadratic Least Square Regression

$$\begin{bmatrix} \sum x_i^4 & \sum x_i^3 & \sum x_i^2 \\ \sum x_i^3 & \sum x_i^2 & \sum x_i \\ \sum x_i^2 & \sum x_i & n \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} \sum x_i^2 y_i \\ \sum x_i y_i \\ \sum y_i \end{bmatrix}$$

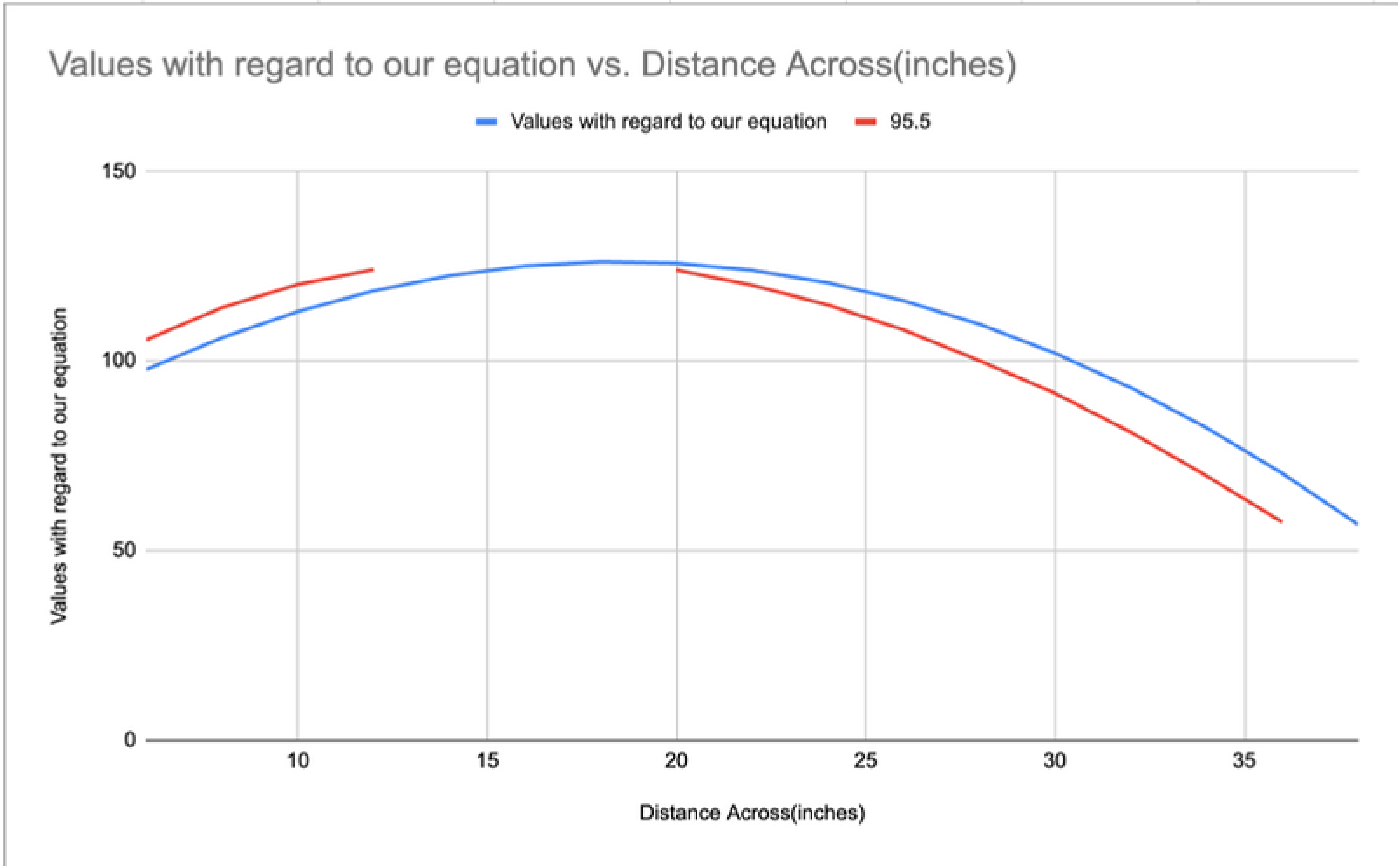
We can also use these formulas to find the values of a , b , and c :

$$a = \frac{(\sum x^2 y \sum xx) - (\sum xy \sum x^2)}{(\sum xx \sum x^2) - (\sum x^2)^2}$$

$$b = \frac{(\sum xy \sum x^2) - (\sum x^2 y \sum x^2)}{(\sum xx \sum x^2) - (\sum x^2)^2}$$

$$c = \frac{\sum y}{n} - b\left(\frac{\sum x}{n}\right) - a\left(\frac{\sum x^2}{n}\right)$$

-0.18280936173509482x^2 + 6.732380013852462x - 63.963251983918084


Values with regard to our equation vs. Distance Across(inches)
Values with regard to our equation
95.5
150
100
50
0
10
15
20
25
30
35
Values with regard to our equation
Distance Across(inches)

Using some trigonometry:

Let $y = a(x - h)^2 + k$ represent the equation of the parabola at vertex (h, k) on the xy plane

A two dimensional rotation is described as

$$x = x' \cos(\theta) + y' \sin(\theta)$$

$$y = -x' \sin(\theta) + y' \cos(\theta)$$

where (x', y') is a point on the $x'y'$ plane rotated by θ

Substituting these formulas into the equation of the parabola we get

$$-x' \sin\theta + y' \cos(\theta) = a(x' \cos(\theta) + y' \sin(\theta) - h)^2 + k$$