Ellipses and hyperbolas of decompositions of even numbers into pairs of prime numbers.

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July 7, 2023

Abstract

This is just an attempt to associate sums or differences of prime numbers with points lying on an ellipse or hyperbola.

Certain pairs of prime numbers can be represented as radius-distances from the focuses to points lying either on the ellipse or on the hyperbola.

The ellipse equation can be written in the following form: $|p_k| + |p_t| = 2n$

The hyperbola equation can be written in the following form: $||p_k| - |p_t|| = 2n$

Here p_k and p_t are prime numbers ($p_1 = 2$, $p_2 = 3$, $p_3 = 5$, $p_4 = 7$,...),

k and t are indices of prime numbers,

$2n$ is a given even number,

$k, t, n \in N$.

If we construct ellipses and hyperbolas based on the above, we get the following:

1) there are only 5 non-intersecting curves (for 2n=4; 2n=6; 2n=8; 2n=10; 2n=16). The remaining ellipses have intersection points;

2) there is only 1 non-intersecting hyperbola (for 2n=2) and 1 non-intersecting vertical line. The remaining hyperbolas have intersection points.

1. The ellipses of decomposition of even numbers into prime numbers.

Let's represent the equation of decomposition of an even number into two prime numbers as an ellipse equation:

$$|p_k| + |p_t| = 2n$$

where p_k and p_t are prime numbers ($p_1 = 2$, $p_2 = 3$, $p_3 = 5$, $p_4 = 7$,...),
k and t are indices of prime numbers,
$2n$ is a given even number,
$k, t, n \in N$.

Consider the following equation:

$$|p_{min}| + |p_{max}| = 2n = 2a$$

where p_{min} is the smallest prime number that satisfies the above equation,
$p_{max} = (2n - p_{min})$ is the largest prime number that satisfies the above equation,
$2n = 2a \Rightarrow a = n$ (semi-major axis).

Then there are ellipse parameters:
perifocal distance $r_p = p_{min}$
apofocal distance $r_a = p_{max}$
focal distance (linear eccentricity) $c = F1F2/2 = (r_a - r_p)/2 = (p_{max} - p_{min})/2 = n - p_{min}$
semi-major axis $a = (r_a + r_p)/2 = (p_{max} + p_{min})/2 = 2n/2 = n$
semi-minor axis $b = \sqrt{a^2 - c^2} = \sqrt{((p_{max} + p_{min})/2)^2 - ((p_{max} - p_{min})/2)^2} = \sqrt{p_{max} * p_{min}}$
focal parameter $f_p = (b^2)/a = (\sqrt{p_{max} * p_{min}})^2/n = (p_{max} * p_{min})/n = (2n - p_{min}) * p_{min}/n$
eccentricity $e = c/a = (n - p_{min})/n = 1 - p_{min}/n$
directrix $d = a^2/c = n^2/(n - p_{min})$
flattening $f = (a - b)/a = 1 - b/a = 1 - (\sqrt{p_{max} * p_{min}})/n$

Each even number corresponds to 1 unique decomposition ellipse.

If $2n \to \infty$ then $p_{max} \to \infty$.
Then focal parameter $f_p = (p_{max} * p_{min})/n = (2n - p_{min}) * p_{min}/n = (2 - p_{min}/n) * p_{min} \to 2 * p_{min}$
eccentricity $e = c/a = (n - p_{min})/n = 1 - p_{min}/n \to 1$ (ellipse turns into a parabola)
flattening $f = 1 - b/a = 1 - (\sqrt{p_{max} * p_{min}})/n = 1 - (\sqrt{(2n - p_{min}) * p_{min}})/n \to 1 - (\sqrt{2n * p_{min}})/n = 1 - \sqrt{2 * p_{min}/n} \to 1$

Conclusion: when $2n \to \infty$ and $p_{max} \to \infty$, the length of the minor axis of the ellipse lags behind the length of the major axis and the ellipse is stretched along the major axis.

Hypothesis of intersecting decomposition ellipses: there are only 5 non-intersecting curves (fo $2n = 4,\ 2n = 6,\ 2n = 8,\ 2n = 10,\ 2n = 16$). The remaining ellipses have intersection points.

The decompositions of the numbers 4 and 6 can be represented as circles with radii 2 and 3, respectively.

Decompositions of even numbers ≥ 8 are ellipses.

Canonical equation of an ellipse:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

or

$$\frac{x^2}{n^2} + \frac{y^2}{p_{maj} * p_{min}} = 1$$

Let's define the intersection points of the ellipses.

$$\begin{cases} \frac{x^2}{n_1^2} + \frac{y^2}{p_{1max}*p_{1min}} = 1 \\ \frac{x^2}{n_2^2} + \frac{y^2}{p_{2max}*p_{2min}} = 1 \end{cases}$$

$$\begin{cases} y^2 = (1 - x^2/n_1^2) * p_{1max} * p_{1min} \\ y^2 = (1 - x^2/n_2^2) * p_{2max} * p_{2min} \end{cases}$$

$$(1 - x^2/n_1^2) * p_{1max} * p_{1min} \;=\; (1 - x^2/n_2^2) * p_{2max} * p_{2min}$$

$$p_{1max} * p_{1min} - \frac{x^2 * p_{1max} * p_{1min}}{n_1^2} \;=\; p_{2max} * p_{2min} - \frac{x^2 * p_{2max} * p_{2min}}{n_2^2}$$

$$\frac{x^2 * p_{2max} * p_{2min}}{n_2^2} - \frac{x^2 * p_{1max} * p_{1min}}{n_1^2} \;=\; p_{2max} * p_{2min} - p_{1max} * p_{1min}$$

$$x^2 * (\frac{p_{2max} * p_{2min}}{n_2^2} - \frac{p_{1max} * p_{1min}}{n_1^2}) \;=\; p_{2max} * p_{2min} - p_{1max} * p_{1min}$$

$$x^2 \;=\; \frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}$$

$$x \;=\; \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}}$$

$$y \;=\; \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}}$$

$$y \;=\; \pm\sqrt{(1 - x^2/n_2^2) * p_{2max} * p_{2min}}$$

A necessary condition for the existence of ellipse intersection points:

$$\begin{cases} \frac{p_{2max}*p_{2min} - p_{1max}*p_{1min}}{(p_{2max}*p_{2min})/n_2^2 - (p_{1max}*p_{1min})/n_1^2} > 0 \\ (1 - x^2/n_1^2) * p_{1max} * p_{1min} > 0 \\ (1 - x^2/n_2^2) * p_{2max} * p_{2min} > 0 \end{cases}$$

Case 1:

$$\begin{cases} p_{2max} * p_{2min} - p_{1max} * p_{1min} > 0 \\ (p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2 > 0 \\ (1 - x^2/n_1^2) * p_{1max} * p_{1min} > 0 \\ (1 - x^2/n_2^2) * p_{2max} * p_{2min} > 0 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} > p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 > (p_{1max} * p_{1min})/n_1^2 \\ 1 - x^2/n_1^2 > 0 \\ 1 - x^2/n_2^2 > 0 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} > p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 > (p_{1max} * p_{1min})/n_1^2 \\ x^2 < n_1^2 \\ x^2 < n_2^2 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} & > & p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 & > & (p_{1max} * p_{1min})/n_1^2 \\ -n_1 & < x & < n_1 \\ -n_2 & < x & < n_2 \end{cases}$$

Case 2:

$$\begin{cases} p_{2max} * p_{2min} & - & p_{1max} * p_{1min} & < & 0 \\ (p_{2max} * p_{2min})/n_2^2 & - & (p_{1max} * p_{1min})/n_1^2 & < & 0 \\ (1 - x^2/n_1^2) * p_{1max} * p_{1min} & > & 0 \\ (1 - x^2/n_2^2) * p_{2max} * p_{2min} & > & 0 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} & < & p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 & < & (p_{1max} * p_{1min})/n_1^2 \\ 1 - x^2/n_1^2 & > & 0 \\ 1 - x^2/n_2^2 & > & 0 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} & < & p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 & < & (p_{1max} * p_{1min})/n_1^2 \\ x^2 & < & n_1^2 \\ x^2 & < & n_2^2 \end{cases}$$

$$\begin{cases} p_{2max} * p_{2min} & < & p_{1max} * p_{1min} \\ (p_{2max} * p_{2min})/n_2^2 & < & (p_{1max} * p_{1min})/n_1^2 \\ -n_1 & < x & < n_1 \\ -n_2 & < x & < n_2 \end{cases}$$

The note.
Two concentric ellipses intersect each other if $a_2 > a_1$ and $b_2 < b_1$ or $b_2^2 < b_1^2$.
That is, the conditions for the intersection of ellipses can be represented as:

$$\begin{cases} n_2 & > & n_1 \\ \sqrt{p_{2max} * p_{2min}} & < & \sqrt{p_{1max} * p_{1min}} \end{cases}$$

$$\begin{cases} n_2 & > & n_1 \\ p_{2max} * p_{2min} & < & p_{1max} * p_{1min} \end{cases}$$

where $a_2 = n_2,\ a_1 = n_1,\ b_2 = \sqrt{p_{2max} * p_{2min}},\ b_1 = \sqrt{p_{1max} * p_{1min}},\ b_2^2 = p_{2max} * p_{2min},$ $b_1^2 = p_{1max} * p_{1min}$.

Examples of intersecting and non-intersecting decomposition ellipses.

Let $2n = 4,\ n = 2$, then $p_{min} = p_{max} = 2$, since $p_{min} + p_{max} = 2 + 2 = 4$.
In this case, the decomposition curve is a circle with radius r = 2.

Now let $2n = 6,\ n = 3$, then $p_{min} = p_{max} = 3$, since $p_{min} + p_{max} = 3 + 3 = 6$.
In this case, the decomposition curve is a circle with radius r = 3.

For $2n = 4$ and $2n = 6$, we have two concentric circles as decomposition curves, which cannot intersect each other in any way.

Let $2n = 8,\ n = 4$, then $p_{min} = 3,\ p_{max} = 5$, since $p_{min} + p_{max} = 3 + 5 = 8$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 4$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{3 * 5} = \sqrt{15}$.
$b^2(2n = 8) = p_{min} * p_{max} = 3 * 5 = 15$

Let $2n = 10,\ n = 5$, then $p_{min} = 3,\ p_{max} = 7$, since $p_{min} + p_{max} = 3 + 7 = 10$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 5$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{3 * 7} = \sqrt{21}$.
$b^2(2n = 10) = p_{min} * p_{max} = 3 * 7 = 21$

$21 > 15 \Rightarrow$ decomposition ellipses for $2n = 8$ and $2n = 10$ do not intersect.

Let $2n = 12,\ n = 6$, then $p_{min} = 5,\ p_{max} = 7$, since $p_{min} + p_{ma}x = 5 + 7 = 12$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 6$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{5 * 7} = \sqrt{35}$.
$b^2(2n = 12) = p_{min} * p_{max} = 5 * 7 = 35$

$35 > 21 \Rightarrow$ decomposition ellipses for $2n = 10$ and $2n = 12$ do not intersect.

Let $2n = 14,\ n = 7$, then $p_{min} = 3,\ p_{max} = 11$, since $p_{min} + p_{max} = 3 + 11 = 14$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 7$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{3 * 11} = \sqrt{33}$.
$b^2(2n = 14) = p_{min} * p_{max} = 3 * 11 = 33$

$33 < 35 \Rightarrow$ decomposition ellipses for $2n = 12$ and $2n = 14$ intersect.

Let $2n = 16,\ n = 8$, then $p_{min} = 3,\ p_{max} = 13$, since $p_{min} + p_{max} = 3 + 13 = 16$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 8$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{3 * 13} = \sqrt{39}$.
$b^2(2n = 16) = p_{min} * p_{max} = 3 * 13 = 39$

$39 > 33 \Rightarrow$ decomposition ellipses for $2n = 14$ and $2n = 16$ do not intersect.

Let $2n = 18,\ n = 9$, then $p_{min} = 5,\ p_{max} = 13$, since $p_{min} + p_{max} = 5 + 13 = 18$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 9$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{5 * 13} = \sqrt{65}$.
$b^2(2n = 18) = p_{min} * p_{max} = 5 * 13 = 65$

$65 > 39 \Rightarrow$ decomposition ellipses for $2n = 16$ and $2n = 18$ do not intersect.

Let $2n = 20,\ n = 10$, then $p_{min} = 3,\ p_{max} = 17$, since $p_{min} + p_{max} = 3 + 17 = 20$.
In this case, the decomposition curve is an ellipse.
Semi-major axis $a = n = 10$.
Semi-minor axis $b = \sqrt{p_{min} * p_{max}} = \sqrt{3 * 17} = \sqrt{51}$.
$b^2(2n = 20) = p_{min} * p_{max} = 3 * 17 = 51$
$51 < 65 \Rightarrow$ decomposition ellipses for $2n = 18$ and $2n = 20$ intersect.

Examples of intersection points.

Let $2n_1 = 12$ and $2n_2 = 14$, then $n_1 = 6,\ n_2 = 7$

$$\begin{cases} 12 = 7 + 5 \\ p_{1max} = p_{1max}(12) = 7 \\ p_{1min} = p_{1min}(12) = 5 \end{cases}$$

$$\begin{cases} 14 = 11 + 3 \\ p_{2max} = p_{2max}(14) = 11 \\ p_{2min} = p_{2min}(14) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}} = \pm\sqrt{\frac{11 * 3 - 7 * 5}{(11 * 3)/7^2 - (7 * 5)/6^2}} \approx \pm 2.5874$$

$$y = \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}} \approx \pm\sqrt{(1 - 2.5874^2/6^2) * 7 * 5} \approx \pm 5.3377$$

Intersection points S of two ellipses with coordinates:
S1(2.5874; 5.3377)
S2(-2.5874; 5.3377)
S3(2.5874; -5.3377)
S4(-2.5874; -5.33773)

Let $2n_1 = 18$ and $2n_2 = 20$, then $n_1 = 9,\ n_2 = 10$

$$\begin{cases} 18 = 13 + 5 \\ p_{1max} = p_{1max}(18) = 13 \\ p_{1min} = p_{1min}(18) = 5 \end{cases}$$

$$\begin{cases} 20 = 17 + 3 \\ p_{2max} = p_{2max}(20) = 17 \\ p_{2min} = p_{2min}(20) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}} = \pm\sqrt{\frac{17 * 3 - 13 * 5}{17 * 3/10^2 - 13 * 5/9^2}} \approx \pm 6.9187$$

$$y = \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}} \approx \pm\sqrt{(1 - 6.9187^2/9^2) * 13 * 5} \approx \pm 5.1563$$

Intersection points S of two ellipses with coordinates:
S1(6.9187; 5.1563)
S2(-6.9187; 5.1563)
S3(6.9187; -5.1563)
S4(-6.9187; -5.1563)

Let $2n_1 = 24$ and $2n_2 = 26$, then $n_1 = 12,\ n_2 = 13$

$$\begin{cases} 24 = 19 + 5 \\ p_{1max} = p_{1max}(24) = 19 \\ p_{1min} = p_{1min}(24) = 5 \end{cases}$$

$$\begin{cases} 26 = 23 + 3 \\ p_{2max} = p_{2max}(26) = 23 \\ p_{2min} = p_{2min}(26) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}} = \pm\sqrt{\frac{23 * 3 - 19 * 5}{23 * 3/13^2 - 19 * 5/12^2}} \approx \pm 10.1688$$

$$y = \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}} \approx \pm\sqrt{(1 - 10.1688^2/12^2) * 19 * 5} \approx \pm 5.1751$$

Intersection points S of two ellipses with coordinates:
S1(10.1688; 5.1751)
S2(-10.1688; 5.1751)
S3(10.1688; -5.1751)
S4(-10.1688; -5.1751)

Let $2n_1 = 42$ and $2n_2 = 44$, then $n_1 = 21,\ n_2 = 22$

$$\begin{cases} 42 = 37 + 5 \\ p_{1max} = p_{1max}(42) = 37 \\ p_{1min} = p_{1min}(42) = 5 \end{cases}$$

$$\begin{cases} 44 = 41 + 3 \\ p_{2max} = p_{2max}(44) = 41 \\ p_{2min} = p_{2min}(44) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}} = \pm\sqrt{\frac{41 * 3 - 37 * 5}{41 * 3/22^2 - 37 * 5/21^2}} \approx \pm 19.3628$$

$$y = \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}} \approx \pm\sqrt{(1 - 19.3628^2/21^2) * 37 * 5} \approx \pm 5.2651$$

Intersection points S of two ellipses with coordinates:
S1(19.3628; 5.2651)
S2(-19.3628; 5.2651)
S3(19.3628; -5.2651)
S4(-19.3628; -5.2651)

Let $2n_1 = 48$ and $2n_2 = 50$, then $n_1 = 24,\ n_2 = 25$

$$\begin{cases} 48 = 43 + 5 \\ p_{1max} = p_{1max}(48) = 43 \\ p_{1min} = p_{1min}(48) = 5 \end{cases}$$

$$\begin{cases} 50 = 47 + 3 \\ p_{2max} = p_{2max}(50) = 47 \\ p_{2min} = p_{2min}(50) = 3 \end{cases}$$

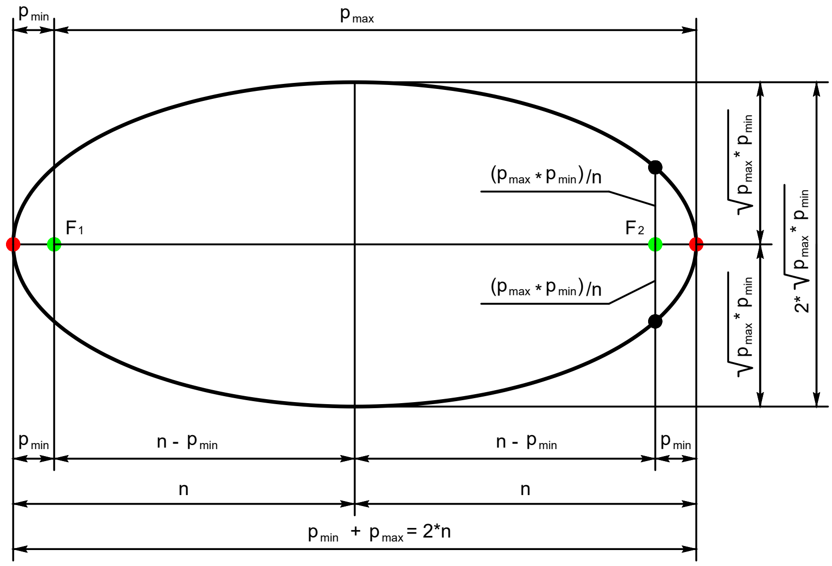
$$x = \pm\sqrt{\frac{p_{2max} * p_{2min} - p_{1max} * p_{1min}}{(p_{2max} * p_{2min})/n_2^2 - (p_{1max} * p_{1min})/n_1^2}} = \pm\sqrt{\frac{47 * 3 - 43 * 5}{47 * 3/25^2 - 43 * 5/24^2}} \approx \pm 22.3861$$

$$y = \pm\sqrt{(1 - x^2/n_1^2) * p_{1max} * p_{1min}} \approx \pm\sqrt{(1 - 22.3861^2/24^2) * 43 * 5} \approx \pm 5.2861$$

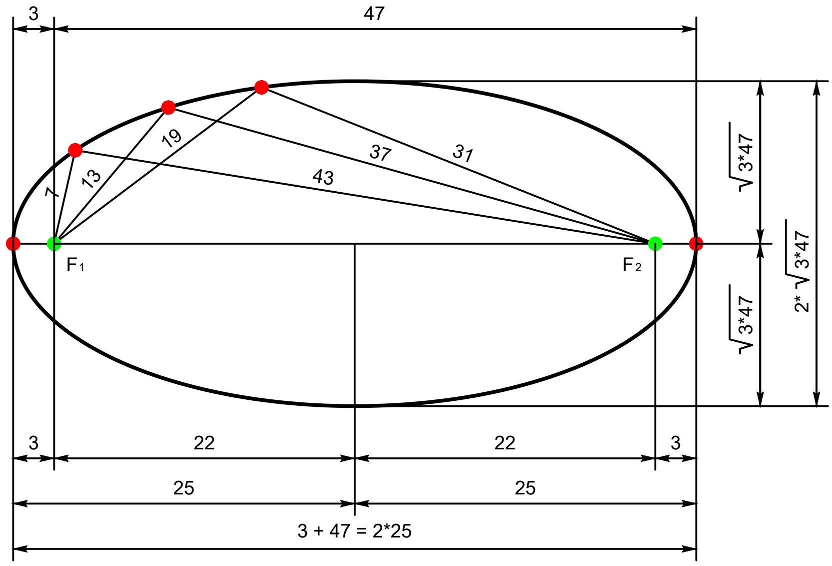
Intersection points S of two ellipses with coordinates:
S1(22.3861; 5.2861)
S2(-22.3861; 5.2861)
S3(22.3861; -5.2861)
S4(-22.3861; -5.2861)

It is interesting to know whether there are still non-intersecting decomposition ellipses? Is the proposed hypothesis correct? How to check it? The questions remains open.

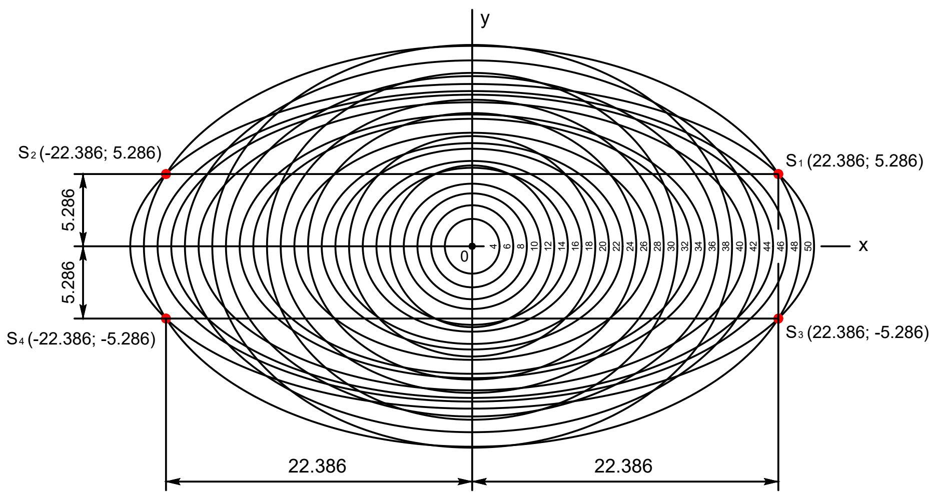
Ellipse of the decomposition of an even number into the sums of two prime numbers



Ellipse of the decomposition of the number 50 into the sums of two prime numbers



Family of ellipses of decompositions of even numbers into the sum of 2 prime numbers



2. The hyperbolas of decomposition of even numbers into prime numbers.

Let's represent the equation of decomposition of an even number into two prime numbers as an hyperbola equation:

$$||p_k| - |p_t|| = 2n$$

where p_k and p_t are prime numbers ($p_1 = 2$, $p_2 = 3$, $p_3 = 5$, $p_4 = 7$,...),
k and t are indices of prime numbers,
$2n$ is a given even number,
$k, t, n \in N$.

Consider the following equation:

$$||p_{major}| - |p_{minor}|| = 2n = 2a$$

where p_{minor} is the smallest prime number that satisfies the above equation,
$p_{major} = (p_{minor} + 2n)$ is the largest prime number that satisfies the above equation,
$2n = 2a \Rightarrow a = n$ (semi-major axis of a hyperbola).

Then there are hyperbola parameters:
semi-major axis of a hyperbola $a = n$
perifocal distance (pericentric distance) $r_p = p_{minor} = p_{min}$
apofocal distance $r_a = p_{major} = p_{maj}$
focal distance (linear eccentricity) $c = n + p_{min}$
semi-minor axis of a hyperbola (impact parameter) $b = \sqrt{c^2 - a^2} = \sqrt{(n + p_{min})^2 - n^2} =$
$= \sqrt{(2n + p_{min}) * p_{min}} = \sqrt{p_{maj} * p_{min}}$
focal parameter $f_p = (b^2)/a = p_{maj} * p_{min}/n$
eccentricity $e = c/a = (n + p_{min})/n = 1 + p_{min}/n$
directrix $d = a^2/c = n^2/(n + p_{min})$
hyperbola asymptote equation $y = \pm(b/a) * x = \pm(\frac{\sqrt{p_{maj} * p_{min}}}{n}) * x$

To simplify the hyperbola equation can be written in the following form:

$$||p_{maj}| - |p_{min}|| = 2n$$

Each even number corresponds to 1 unique decomposition hyperbola.
Canonical equation of a hyperbola:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

or

$$\frac{x^2}{n^2} - \frac{y^2}{p_{maj} * p_{min}} = 1$$

If $2n \to \infty$ then $p_{maj} \to \infty$
then focal parameter $f_p = (2n + p_{min}) * p_{min}/n = (2 + p_{min}/n) * p_{min} \to 2 * p_{min}$
eccentricity $e = c/a = 1 + p_min/n \to 1$ (hyperbola turns into a parabola)
flattening $f = 1 - b/a = 1 - (\sqrt{p_{maj} * p_{min}})/n = 1 - (\sqrt{(2n + p_{min}) * p_{min}})/n \to 1 - (\sqrt{2n * p_{min}})/n =$
$1 - \sqrt{2 * p_{min}/n} \to 1$
Conclusion: $2n \to \infty$ and $p_{maj} \to \infty$, hyperbola stretches along the horizontal axis.

The decompositions of the numbers 0 can be represented as vertical line.
Decompositions of even numbers ≥ 2 can be represented as are hyperbolas.

Hypothesis of intersecting decomposition hyperbolas: there is only 1 non-intersecting hyperbola (for $2n = 2$) and 1 non-intersecting vertical line. The remaining hyperbolas have intersection points.

Let's define the intersection points of the hyperbolas.

$$\begin{cases} \frac{x^2}{a_1^2} - \frac{y^2}{b_1^2} = 1 \\ \frac{x^2}{a_2^2} - \frac{y^2}{b_2^2} = 1 \end{cases}$$

$$\begin{cases} y^2 = (x^2/a_1^2 - 1) * b_1^2 \\ y^2 = (x^2/a_2^2 - 1) * b_2^2 \end{cases}$$

$$(x^2/a_2^2 - 1) * b_2^2 \;=\; (x^2/a_1^2 - 1) * b_1^2$$

$$x^2 * b_2^2/a_2^2 - b_2^2 \;=\; x^2 * b_1^2/a_1^2 - b_1^2$$

$$x^2 * b_2^2/a_2^2 \;-\; x^2 * b_1^2/a_1^2 \;=\; b_2^2 - b_1^2$$

$$x^2 * (b_2^2/a_2^2 - b_1^2/a_1^2) \;=\; b_2^2 - b_1^2$$

$$x^2 = \frac{b_2^2 - b_1^2}{b_2^2/a_2^2 - b_1^2/a_1^2}$$

$$x = \pm\sqrt{\frac{b_2^2 - b_1^2}{b_2^2/a_2^2 - b_1^2/a_1^2}}$$

$$\begin{cases} b_2^2 = p_{2maj} * p_{2min} \\ b_1^2 = p_{1maj} * p_{1min} \\ a_2^2 = n_2^2 \\ a_1^2 = n_1^2 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}}$$

$$\begin{cases} y^2 = (x^2/n_1^2 - 1) * p_{1maj} * p_{1min} \\ y^2 = (x^2/n_2^2 - 1) * p_{2maj} * p_{2min} \end{cases}$$

$$\begin{cases} y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \\ y = \pm\sqrt{(x^2/n_2^2 - 1) * p_{2maj} * p_{2min}} \end{cases}$$

Necessary conditions for the existence of intersection points hyperbolas:

$$\begin{cases} x^2 = \frac{b_2^2 - b_1^2}{b_2^2/a_2^2 - b_1^2/a_1^2} \;>\; 0 \\ y^2 = (x^2/a_1^2 - 1) * b_1^2 \\ y^2 = (x^2/a_2^2 - 1) * b_2^2 \end{cases}$$

Case 1:

$$\begin{cases} b_2^2 - b_1^2 \;>\; 0 \\ b_2^2/a_2^2 - b_1^2/a_1^2 \;>\; 0 \\ x^2/n_1^2 - 1 \;>\; 0 \\ x^2/n_2^2 - 1 \;>\; 0 \end{cases}$$

$$\begin{cases} b_2^2 \ > \ b_1^2 \\ b_2^2/a_2^2 \ > \ b_1^2/a_1^2 \\ x^2/n_1^2 \ > \ 1 \\ x^2/n_2^2 \ > \ 1 \end{cases}$$

$$\begin{cases} p_{2maj} * p_{2min} \ > \ p_{1maj} * p_{1min} \\ p_{2maj} * p_{2min}/n_2^2 \ > \ p_{1maj} * p_{1min}/n_1^2 \\ x^2 \ > \ n_1^2 \\ x^2 \ > \ n_2^2 \end{cases}$$

$$\begin{cases} p_{2maj} * p_{2min} \ > \ p_{1maj} * p_{1min} \\ p_{2maj} * p_{2min}/n_2^2 \ > \ p_{1maj} * p_{1min}/n_1^2 \\ -n_1 > x \ \cup \ x \ > \ n_1 \\ -n_2 > x \ \cup \ x \ > \ n_2 \end{cases}$$

Consider the inequality:

$$p_{2maj} * p_{2min}/n_2^2 \ > \ p_{1maj} * p_{1min}/n_1^2$$

$$\begin{cases} p_{2maj} = 2n_2 + p_{2min} \\ p_{1maj} = 2n_1 + p_{1min} \end{cases}$$

$$(2n_2 + p_{2min}) * p_{2min}/n_2^2 \ > \ (2n_1 + p_{1min}) * p_{1min}/n_1^2$$

$$2n_2 * p_{2min}/n_2^2 \ + \ p_{2min}^2/n_2^2 \ > \ 2n_1 * p_{1min}/n_1^2 \ + \ p_{1min}^2/n_1^2$$

$$2 * p_{2min}/n_2 \ + \ p_{2min}^2/n_2^2 \ > \ 2 * p_{1min}/n_1 \ + \ p_{1min}^2/n_1^2$$

$$2 * p_{2min}/n_2 \ - \ 2 * p_{1min}/n_1 \ + \ p_{2min}^2/n_2^2 \ - \ p_{1min}^2/n_1^2 \ > \ 0$$

$$2 * (p_{2min}/n_2 \ - \ p_{1min}/n_1) \ + \ (p_{2min}/n_2 \ - \ p_{1min}/n_1) * (p_{2min}/n_2 \ + \ p_{1min}/n_1) \ > \ 0$$

$$(p_{2min}/n_2 \ - \ p_{1min}/n_1) * (2 \ + \ p_{2min}/n_2 \ + \ p_{1min}/n_1) \ > \ 0$$

$2 \ + \ p_{2min}/n_2 \ + \ p_{1min}/n_1 \ > \ 0$, because $p_{2min}/n_2 \ > \ 0$ and $p_{1min}/n_1 \ > \ 0$

$$p_{2min}/n_2 \ - \ p_{1min}/n_1 \ > \ 0$$

$$p_{2min}/n_2 \ > \ p_{1min}/n_1$$

Let us replace the inequality $p_{2maj} * p_{2min}/n_2^2 > p_{1maj} * p_{1min}/n_1^2$ by the inequality $p_{2min}/n_2 > p_{1min}/n_1$.

Then the conditions for intersection of hyperbolas can be written as follows:

$$\begin{cases} p_{2maj} * p_{2min} \ > \ p_{1maj} * p_{1min} \\ p_{2min}/n_2 \ > \ p_{1min}/n_1 \\ -n_1 > x \ \cup \ x \ > \ n_1 \\ -n_2 > x \ \cup \ x \ > \ n_2 \end{cases}$$

Case 2:

$$\begin{cases} b_2^2 - b_1^2 \ < \ 0 \\ b_2^2/a_2^2 - b_1^2/a_1^2 \ < \ 0 \\ x^2/n_1^2 - 1 \ > \ 0 \\ x^2/n_2^2 - 1 \ > \ 0 \end{cases}$$

$$\begin{cases} b_2^2 \ < \ b_1^2 \\ b_2^2/a_2^2 \ < \ b_1^2/a_1^2 \\ x^2/n_1^2 \ > \ 1 \\ x^2/n_2^2 \ > \ 1 \end{cases}$$

$$\begin{cases} p_{2maj} * p_{2min} \ < \ p_{1maj} * p_{1min} \\ p_{2maj} * p_{2min}/n_2^2 \ < \ p_{1maj} * p_{1min}/n_1^2 \\ x^2 \ > \ n_1^2 \\ x^2 \ > \ n_2^2 \end{cases}$$

$$\begin{cases} p_{2maj} * p_{2min} \ < \ p_{1maj} * p_{1min} \\ p_{2maj} * p_{2min}/n_2^2 \ < \ p_{1maj} * p_{1min}/n_1^2 \\ -n_1 > x \ \cup \ x \ > \ n_1 \\ -n_2 > x \ \cup \ x \ > \ n_2 \end{cases}$$

$$\begin{cases} p_{2maj} * p_{2min} \ < \ p_{1maj} * p_{1min} \\ p_{2min}/n_2 \ < \ p_{1min}/n_1 \\ -n_1 > x \ \cup \ x \ > \ n_1 \\ -n_2 > x \ \cup \ x \ > \ n_2 \end{cases}$$

The note.
$\tan\alpha = b/a,\ \tan\alpha_2 = b_2/a_2,\ \tan\alpha_1 = b_1/a_1$
$b = \sqrt{p_{maj} * p_{min}},\ b_2 = \sqrt{p_{2maj} * p_{2min}},\ b_1 = \sqrt{p_{1maj} * p_{1min}}$
$a = n,\ a_2 = n_2,\ a_1 = n_1,\ a_2 > a_1,\ n_2 > n_1,\ 2n_2 > 2n_1,\ n_2 > n_1.$

Condition for the existence of intersection points hyperbolas:
an angle between the asymptote of hyperbola and the horizontal axis must increase $\alpha_2 > \alpha_1$ for $n_2 > n_1$.

$$\tan\alpha_2 \ > \ \tan\alpha_1$$

$$\frac{b_2}{a_2} \ > \ \frac{b_1}{a_1}$$

$$\frac{\sqrt{p_{2maj} * p_{2min}}}{n_2} \ > \ \frac{\sqrt{p_{1maj} * p_{1min}}}{n_1}$$

$$\frac{b_2^2}{a_2^2} \ > \ \frac{b_1^2}{a_1^2}$$

$$\frac{p_{2maj} * p_{2min}}{n_2^2} \ > \ \frac{p_{1maj} * p_{1min}}{n_1^2}$$

or which is the same

$$p_{2min}/n_2 \ > \ p_{1min}/n_1$$

Examples of intersecting and non-intersecting decomposition hyperbolas.

For simplification, we take as the main criterion of intersection: $p_{2min}/n_2 \ > \ p_{1min}/n_1$

Let $2n = 2,\ n = 1$, then $p_{min} = 3,\ p_{maj} = 5$, since $||p_{maj}| - |p_{min}|| = ||5| - |3|| = 2$, $p_{min}/n = 3/1 = 3$.

Let $2n = 4,\ n = 2$, then $p_{min} = 3,\ p_{maj} = 7$, since $||p_{maj}| - |p_{min}|| = ||7| - |3|| = 4$, $p_{min}/n = 3/2 = 1.5$

$1.5 < 3 \Rightarrow$ decomposition hyperbolas for $2n = 4$ and $2n = 2$ do not intersect.

Let $2n = 6,\ n = 3$, then $p_{min} = 5,\ p_{maj} = 11$, since $||p_{maj}| - |p_{min}|| = ||11| - |5|| = 6$, $p_{min}/n = 5/3 \approx 1.6667$

$1.6667 > 1.5 \Rightarrow$ decomposition hyperbolas for $2n = 6$ and $2n = 4$ intersect.

Let $2n = 8,\ n = 4$, then $p_{min} = 3,\ p_{maj} = 11$, since $||p_{maj}| - |p_{min}|| = ||11| - |3|| = 8$, $p_{min}/n = 3/4 = 0.75$

$0.75 < 1.6667 \Rightarrow$ decomposition hyperbolas for $2n = 8$ and $2n = 6$ do not intersect.

Let $2n = 10,\ n = 5$, then $p_{min} = 3,\ p_{maj} = 13$, since $||p_{maj}| - |p_{min}|| = ||13| - |3|| = 10$, $p_{min}/n = 3/5 = 0.6$

$0.6 < 0.75 \Rightarrow$ decomposition hyperbolas for $2n = 10$ and $2n = 8$ do not intersect.

Let $2n = 12,\ n = 6$, then $p_{min} = 5,\ p_{maj} = 17$, since $||p_{maj}| - |p_{mi}n|| = ||17| - |5|| = 12$, $p_{min}/n = 5/6 \approx 0.8333$

$0.8333 > 0.6 \Rightarrow$ decomposition hyperbolas for $2n = 12$ and $2n = 10$ intersect.

Let $2n = 14,\ n = 7$, then $p_{min} = 3,\ p_{maj} = 17$, since $||p_{maj}| - |p_{min}|| = ||17| - |3|| = 14$, $p_{min}/n = 3/7 \approx 0.4286$

$0.4286 < 0.8333 \Rightarrow$ decomposition hyperbolas for $2n = 14$ and $2n = 12$ do not intersect.

Let $2n = 16,\ n = 8$, then $p_{min} = 3\, p_{maj} = 19$, since $||p_{ma}j| - |p_{min}|| = ||19| - |3|| = 16$, $p_{min}/n = 3/8 = 0.375$

$0.375 < 0.4286 \Rightarrow$ decomposition hyperbolas for $2n = 16$ and $2n = 14$ do not intersect.

Let $2n = 18,\ n = 9$, then $p_{min} = 5,\ p_{maj} = 23$, since $||p_{maj}| - |p_{min}|| = ||23| - |5|| = 18$, $p_{min}/n = 5/9 \approx 0.5556$

$0.5556 > 0.375 \Rightarrow$ decomposition hyperbolas for $2n = 18$ and $2n = 16$ intersect.

Examples of intersection points.

Let $2n_1 = 2$ and $2n_2 = 4$, then $n_1 = 1,\ n_2 = 2$

$$\begin{cases} p_{1maj} = p_{1maj}(2) = 5 \\ p_{1min} = p_{1min}(2) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(4) = 7 \\ p_{2min} = p_{2min}(4) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \ = \ \pm\sqrt{\frac{7*3-5*3}{7*3/2^2-5*3/1^2}} \ \approx \ \pm\sqrt{-0.6154}$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \ \approx \ \pm\sqrt{(-0.6154/1^2-1)*5*3} \ \approx \ \pm\sqrt{-24.2308}$$

$-0.6154 < 0$ and $-24.2308 < 0 \Rightarrow x$ and y are not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 2$ and $2n_2 = 4$ on the real plane.

Let $2n_1 = 4$ and $2n_2 = 6$, then $n_1 = 2,\ n_2 = 3$

$$\begin{cases} p_{1maj} = p_{1maj}(4) = 7 \\ p_{1min} = p_{1min}(4) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(6) = 11 \\ p_{2min} = p_{2min}(6) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \ = \ \pm\sqrt{\frac{11*5-7*3}{11*5/3^2-7*3/2^2}} \ \approx \ \pm 6.2836$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \ \approx \ \pm\sqrt{(6.2836^2/2^2-1)*7*3} \ \approx \ \pm 13.6488$$

Intersection points S of two hyperbolas with coordinates:
S1(6.2836; 13.6488)
S2(-6.2836; 13.6488)
S3(6.2836; -13.6488)
S4(-6.2836; -13.6488)

Let $2n_1 = 6$ and $2n_2 = 8$, then $n_1 = 3,\ n_2 = 4$

$$\begin{cases} p_{1maj} = p_{1maj}(6) = 11 \\ p_{1min} = p_{1min}(6) = 5 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(8) = 11 \\ p_{2min} = p_{2min}(8) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \ = \ \pm\sqrt{\frac{11*3-11*5}{11*3/4^2-11*5/3^2}} \ \approx \ \pm 2.3311$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(2.3311^2/3^2 - 1) * 11 * 5} \approx \pm\sqrt{-21.7925}$$

$-21.7925 < 0 \Rightarrow y$ is not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 6$ and $2n_2 = 8$ on the real plane.

Let $2n_1 = 8$ and $2n_2 = 10$, then $n_1 = 4,\ n_2 = 5$

$$\begin{cases} p_{1maj} = p_{1maj}(8) = 11 \\ p_{1min} = p_{1min}(8) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(10) = 13 \\ p_{2min} = p_{2min}(10) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} = \pm\sqrt{\frac{13 * 3 - 11 * 3}{13 * 3/5^2 - 11 * 3/4^2}} \approx \pm\sqrt{-11.9403}$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(-11.9403/4^2 - 1) * 11 * 3} \approx \pm\sqrt{-57.6269}$$

$-11.9403 < 0$ and $-57.6269 < 0 \Rightarrow x$ and y are not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 2$ and $2n_2 = 4$ on the real plane.

Let $2n_1 = 8$ and $2n_2 = 12$, then $n_1 = 4,\ n_2 = 6$

$$\begin{cases} p_{1maj} = p_{1maj}(8) = 11 \\ p_{1min} = p_{1min}(8) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(12) = 17 \\ p_{2min} = p_{2min}(12) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} = \pm\sqrt{\frac{17 * 5 - 11 * 3}{17 * 5/6^2 - 11 * 3/4^2}} \approx \pm 13.1962$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(13.1962^2/4^2 - 1) * 11 * 3} \approx \pm 18.0600$$

Intersection points S of two hyperbolas with coordinates:
S1(13.1962; 18.0600)
S2(-13.1962; 18.0600)
S3(13.1962; -18.0600)
S4(-13.1962; -18.0600)

Let $2n_1 = 10$ and $2n_2 = 12$, then $n_1 = 5,\ n_2 = 6$

$$\begin{cases} p_{2maj} = p_{2maj}(10) = 13 \\ p_{2min} = p_{2min}(10) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(12) = 17 \\ p_{2min} = p_{2min}(12) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \;=\; \pm\sqrt{\frac{17*5-13*3}{17*5/6^2-13*3/5^2}} \;\approx\; \pm 7.5776$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \;\approx\; \pm\sqrt{(7.5776^2/5^2 - 1) * 13 * 3} \;\approx\; \pm 7.1117$$

Intersection points S of two hyperbolas with coordinates:
S1(7.5776; 7.1117)
S2(-7.5776; 7.1117)
S3(7.5776; -7.1117)
S4(-7.5776; -7.1117)

Let $2n_1 = 12$ and $2n_2 = 14$, then $n_1 = 6,\ n_2 = 7$

$$\begin{cases} p_{1maj} = p_{1maj}(12) = 17 \\ p_{1min} = p_{1min}(12) = 5 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(14) = 17 \\ p_{2min} = p_{2min}(14) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \;=\; \pm\sqrt{\frac{17*3-17*5}{17*3/7^2-17*5/6^2}} \;\approx\; \pm 5.0746$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \;\approx\; \pm\sqrt{(5.0746^2/6^2 - 1) * 17 * 5} \;\approx\; \pm\sqrt{-24.1971}$$

$-24.1971 < 0 \Rightarrow y$ is not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 12$ and $2n_2 = 14$ on the real plane.

Let $2n_1 = 14$ and $2n_2 = 16$, then $n_1 = 7,\ n_2 = 8$

$$\begin{cases} p_{1maj} = p_{1maj}(14) = 17 \\ p_{1min} = p_{1min}(14) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(16) = 19 \\ p_{2min} = p_{2min}(16) = 3 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} \;=\; \pm\sqrt{\frac{19*3-17*3}{19*3/8^2-17*3/7^2}} \;\approx\; \pm\sqrt{-39.9490}$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \;\approx\; \pm\sqrt{(-39.9490/7^2 - 1) * 17 * 3} \;\approx\; \pm\sqrt{-92.5796}$$

$-39.9490 < 0$ and $-92.5796 < 0 \Rightarrow x$ and y are not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 14$ and $2n_2 = 16$ on the real plane.

Let $2n_1 = 10$ and $2n_2 = 18$, then $n_1 = 5,\ n_2 = 9$

$$\begin{cases} p_{1maj} = p_{1maj}(10) = 13 \\ p_{1min} = p_{1min}(10) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(18) = 23 \\ p_{2min} = p_{2min}(18) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} = \pm\sqrt{\frac{23 * 5 - 13 * 3}{23 * 5/9^2 - 13 * 3/5^2}} \approx \pm\sqrt{-541.9014}$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(-541.9014/5^2 - 1) * 13 * 3} \approx \pm\sqrt{-884.3662}$$

$-541.9014 < 0$ and $-884.3662 < 0 \Rightarrow x$ and y are not real numbers, that is, there are no intersections of hyperbolas for $2n_1 = 10$ and $2n_2 = 18$ on the real plane.

Let $2n_1 = 14$ and $2n_2 = 18$, then $n_1 = 7,\ n_2 = 9$

$$\begin{cases} p_{1maj} = p_{1maj}(14) = 17 \\ p_{1min} = p_{1min}(14) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(18) = 23 \\ p_{2min} = p_{2min}(18) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} = \pm\sqrt{\frac{23 * 5 - 17 * 3}{23 * 5/9^2 - 17 * 3/7^2}} \approx \pm 12.9959$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(12.9959^2/7^2 - 1) * 17 * 3} \approx \pm 11.1708$$

Intersection points S of two hyperbolas with coordinates:
S1(12.9959; 11.1708)
S2(-12.9959; 11.1708)
S3(12.9959; -11.1708)
S4(-12.9959; -11.1708)

Let $2n_1 = 16$ and $2n_2 = 18$, then $n_1 = 8,\ n_2 = 9$

$$\begin{cases} p_{1maj} = p_{1maj}(16) = 19 \\ p_{1min} = p_{1min}(16) = 3 \end{cases}$$

$$\begin{cases} p_{2maj} = p_{2maj}(18) = 23 \\ p_{2min} = p_{2min}(18) = 5 \end{cases}$$

$$x = \pm\sqrt{\frac{p_{2maj} * p_{2min} - p_{1maj} * p_{1min}}{p_{2maj} * p_{2min}/n_2^2 - p_{1maj} * p_{1min}/n_1^2}} = \pm\sqrt{\frac{23 * 5 - 19 * 3}{23 * 5/9^2 - 19 * 3/8^2}} \approx \pm 10.4697$$

$$y = \pm\sqrt{(x^2/n_1^2 - 1) * p_{1maj} * p_{1min}} \approx \pm\sqrt{(10.4697^2/8^2 - 1) * 19 * 3} \approx \pm 6.3738$$

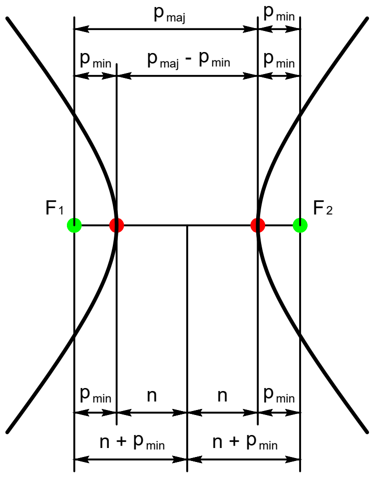
Intersection points S of two hyperbolas with coordinates:
S1(10.4697; 6.3738)
S2(-10.4697; 6.3738)
S3(10.4697; -6.3738)

S4(-10.4697; -6.3738)

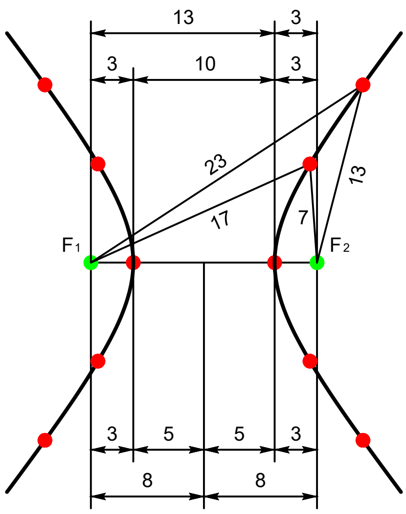
Unfortunately, I can't check all the hyperbolas of the decomposition of even numbers into prime numbers. There are infinitely many hyperboles of decomposition.

Are there still non-intersecting decomposition hyperboles?
Is the proposed hypothesis correct? How to check it? The questions remains open.

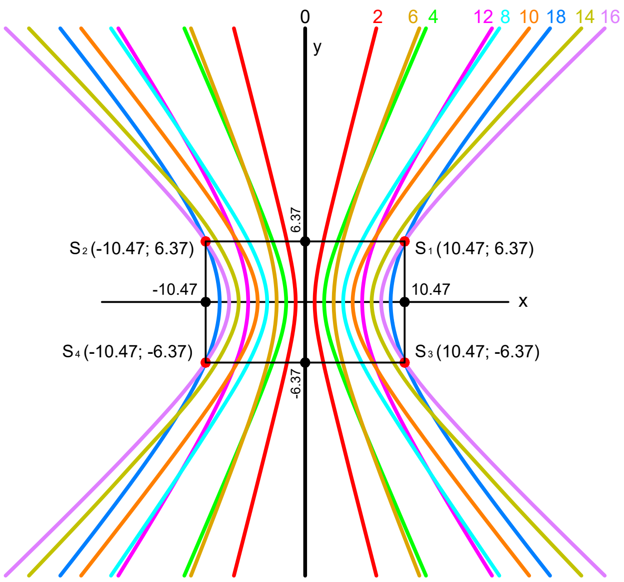
Hyperbola of the decomposition of an even number into pairs of differences of odd prime numbers



Hyperbola of the decomposition of an even number 10 into pairs of differences of odd prime numbers



Family of hyperbolas of decompositions into pairs of differences of odd prime numbers



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