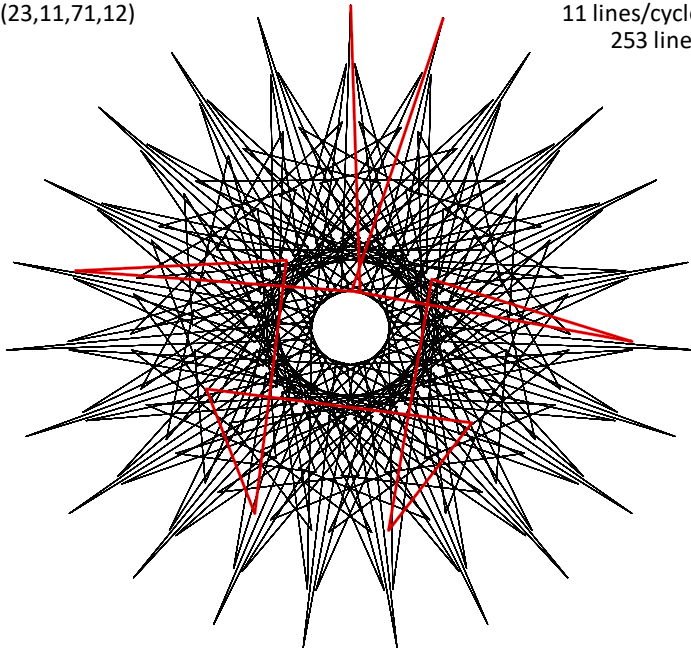


Needles with Shields

The original *Needles with Shields*. One of the more dramatic images from the past couple of years is this needles with shields image, Fig 5 in [GA 2023](#). This image is presented twice here to emphasize different points. This image is *one-time around*, [E5.2](#), because the first **11-line cycle ends at vertex 1, shown in red to the left**. This image is *single-step* of length 57, [E8.5.1](#), because **the first 57 lines are shown in red to the right**. A bit less than one fourth of the lines in the image are used ($0.225 = 57/253$) before the endpoint is within one of the top and the shield to the top needle is partially formed (the 58th line finishes the right side of the top needle's shield).

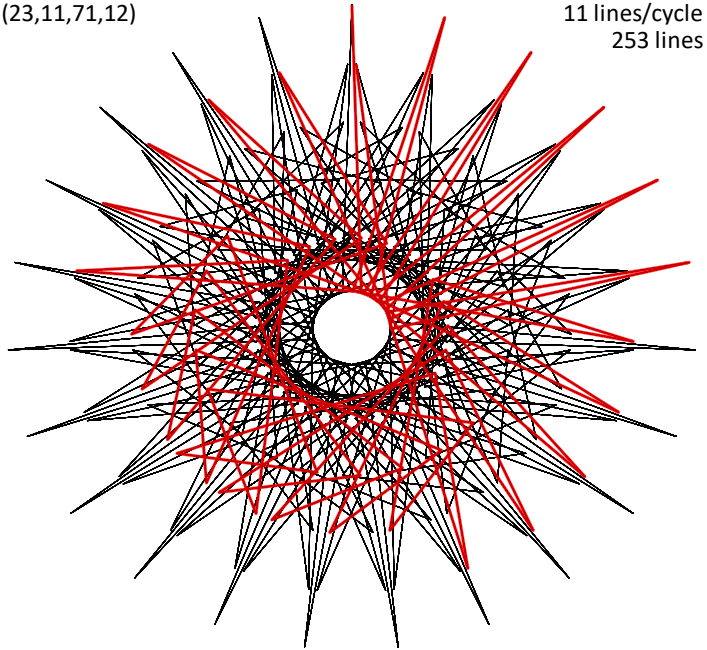
(n, S, P, J)
(23,11,71,12)

11 lines/cycle
253 lines



(n, S, P, J)
(23,11,71,12)

11 lines/cycle
253 lines

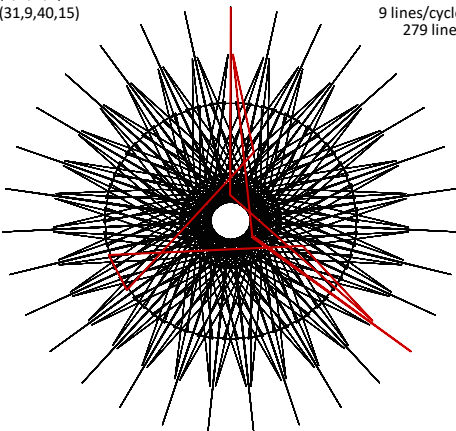


Tying this image to *single-step* of length 7. It is worth noting that using n and S from above with $k = 2$ produces $P = 72$, one more than the P that produced the above image ($72 = \text{ROUND}(2 \cdot 23 \cdot 11 / 7, 0)$). The 7th line ends at $E = -2$, and the result is not quite a needle with shield.

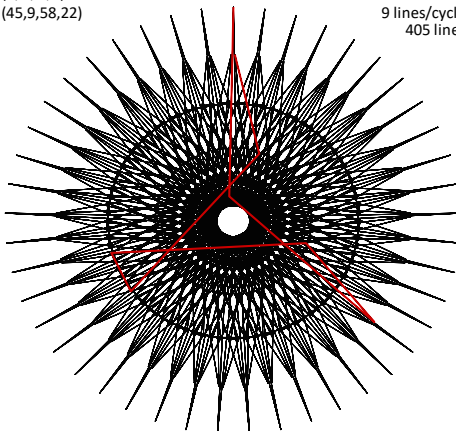
The images below bear a striking resemblance to the above image, but they are *single-step* of length 7. They were obtained from [versions of 3SST](#) in which J/n is large and hence the horizontal crossbar of the base image is low. To emphasize the needle, each of the shields is lower for these three images than the above image. This is accomplished by choosing a smaller value of $S = 9$ below instead of $S = 11$; the 8th line finishes the right side of the top needle's shield.

(n, S, P, J)
(31,9,40,15)

7th line ends at E = 1
9 lines/cycle
279 lines

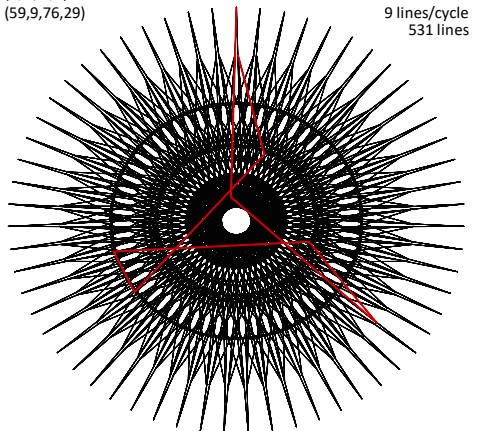


(n, S, P, J)
(45,9,58,22)



7th line ends at E = 1
9 lines/cycle
405 lines

(n, S, P, J)
(59,9,76,29)



One should also note that the base images for these n, J are most accurately thought of as 3SST, but they also resemble a spy plane due to the long narrow nose. It is not a spy plane because there is a cross-over at the end of the nose.