

# Graphene-inspired multi-purpose containment device (hexagonal bag)

## Dedicated to Prof. Annalisa Fasolino, on the occasion of her retirement

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A pattern for a hexagonal bag that can be used for small items. The hexagonal shape combined with variegated yarn looks a little like a heatmap plot on a hexagonal unit cell. The size of the final product can be adjusted to fit the user's needs. No sewing is required, apart from attaching the button and darning in 4 ends.

PACS numbers:

### I. INTRODUCTION

Annalisa seems to like small bags. A number of times when we were at conferences together, I noticed her buying some as souvenirs. At the COST meeting in Istanbul, for example, both of us ended up going home with a number of pretty little bags. She also likes hexagonal shapes and lattices, as well as handicrafts. So, for her retirement party, I decided to knit her a small hexagonal bag.

There are a number of different knitting patterns for bags with hexagons [1] or hexagonal bags [2]. However, none of these patterns fit my needs for this project, because they were either too large, or not worked in the round, and therefore do not have the nice heat-plot-like circular colour pattern that I wanted. So I decided to design one of my own. It is based on the knit-in-the-round hexagon that has been around for a while [1, 3–5], and that can be knit inside-out as well as outside-in [3]. The result is shown in figure 1.

### II. MATERIALS, EQUIPMENT, AND TECHNICAL INFORMATION

**Yarn.** I used 46 m of DROPS Big Delight, in colourway berry muffin. Any yarn should work, but some kind of colour change will look nice and produce the interesting circular colour pattern.

**Needles.** You will also need at least 7, preferably 9 double-pointed needles. DROPS recommends size 5mm needles for Big Delight. The lighter the needles are, the better. A few years ago, together with Inka Locht, I had already tried knitting an inside-out hexagon, and discovered that it was extremely fiddle. In the beginning, there are very few stitches per needle and the needles tend to fall out. Inka and I concluded that you need very light needles with rough surfaces for good traction, such as wood or bamboo. For this project I used bamboo. You can also make the start a little less fiddly by keeping the stitches on 3 needles instead of 6 for a while in the beginning, and by knitting very tightly.

**Gauge.** The gauge is not important, because the size of the bag can be adjusted easily (see below). It's probably a good idea to go a bit on the tight side, so that it will keep its shape a little better. My gauge was ap-



FIG. 1: The finished product, along with some graphite pencils for scale. The diameter is approximately 12 cm.



FIG. 2: The back.

proximately 18 stitches and 36 rows for 10 cm  $\times$  10 cm in garter stitch. The resulting bag was approximately 12 cm across.

**Miscellaneous.** A matching button for the closure. A tapestry needle to darn in the ends. Abbreviations are listed in table I.

k	knit
p	purl
s	slip one purl-wise
yo	yarn over
k2tog	knit two stitches together
ssk	slip one stitch knit-wise, twice, then pass both stitches back to the left needle purl-wise, and knit them together into the back of the loop
ssp	slip one stitch knitwise, twice, then pass both stitches back to the left needle as one knitwise and purl them together
k3tog	knit two stitches together
sssk	slip one stitch knit-wise three times, then pass all three stitches back to the left needle purlwise, and knit them together into the back of the loop
wt	slip one stitch purlwise onto the right needle, bring the yarn to the other side, then slip the stitch back. Turn the work to begin the next row.
kbl	knit one stitch into the back of the loop

TABLE I: Abbreviations.

### III. THE BACK HEXAGON

The first hexagon is knit using the same approach as [4], i.e. from the centre outwards. The result is shown in figure 2.

Cast on six stitches on double-pointed needles. Join and knit in the round.

Round 1: Purl (p) all stitches.

Round 2: Knit (k) all stitches.

Round 3: (p1, yarn over (yo))  $\times 6$ , resulting in 12 stitches.

Round 4: k all stitches, knitting the yo-s from the previous round into the back of the loop.

Round 5: p all stitches.

Round 6: k all stitches.

Split the stitches over 6 double-pointed needles. Use some scrap yarn or another marker to indicate the beginning of the round [6].

Round 7: (p1 yo, p to end of needle, yo)  $\times 6$ .

Round 8: As round 4.

Repeat rounds 5 through 8 an even number of times, until the hexagon is big enough for what you want to put in the bag. You should end up with a number of stitches on each needle that is divisible by 4. At this point I had 12 stitches per needle. We'll call this number  $4n$  (so for me  $n = 3$ ).

Knit a few rounds of stockinette stitch, which will form the outer edge. I used 2 rounds. Figure 3 shows what it will end up looking like.



FIG. 3: The edge.



FIG. 4: The front of the bag, showing the opening, modified hexagon, and flap with loop.

### IV. THE FRONT

The front hexagon is knit in the opposite direction, from the outside in. It should not be a full hexagon, because of the opening at the top. I constructed this almost-hexagon shape using short rows. This is shown in figure 4.

Round  $a + 1$ : Knit two needles ( $8n$  stitches). Cable cast-on  $6n + 1$  stitches. This will be the front side of the gap. Skip the next two needles from the back hexagon, which will later become the flap.

Pass the last one of the cable cast-on stitches onto the 5th needle from the back hexagon, and knit it together with the first stitch from that needle. Knit to the beginning of round point.

Round  $a + 2$ : Purl all stitches. Split the newly cast-on stitches that are left evenly over two needles, with  $3n$

stitches each. These will be called the short-row needles. You should now start doing short rows instead of knitting in the round. Each time you knit/purl a bit deeper into the short-row needles. After turning, you knit/purl back to the point that has so far been the beginning of the round.

Row  $a + 3$ : (ssk, k to two stitches before end of needle, k2tog)  $\times 2$ . On the first short-row needle: ssk, knit to turning point, wt. The turning point is two stitches past the last turning point [7] on this short-row needle, or, if there is none, then turn after knitting 2 stitches of the short-row needle (i.e. directly after the ssk).

Row  $a + 4$ : k back to the beginning of round point (so that's part of one short-row needle, and two regular needles). Do not turn work.

Row  $a + 5$ : (p2tog, p to two stitches before end of needle, ssp)  $\times 2$ . On the short-row needle: p2tog, p to turning point, wt. The turning point is two stitches past the last turning point, or, if there is none, then turn after purling 2 stitches of the short-row needle (i.e. directly after the p2tog).

Row  $a + 6$ : p back to the beginning of round point. Do not turn work.

Row  $a + 7$ : k to turning point, wt. The turning point is one stitch past the last turning point.

Row  $a + 8$ : k back to the beginning of round point.

Row  $a + 9$ : p to turning point, wt. The turning point is one stitch past the last turning point.

Row  $a + 10$ : p back to the beginning of round point.

Repeat the last 8 rows several more times, until you have one stitch less on each short-row needle than on the regular needles.

Then repeat rows  $a + 3$  through  $a + 6$  one more time.

The next turning points would be at the end of each of the short-row needles, and all needles now have the same number of stitches. So now we can just start working in the round again.

Round  $b + 1$ : k all stitches.

Round  $b + 2$ : p all stitches.

Round  $b + 3$ : (ssk, k to two stitches before end of needle, k2tog)  $\times 6$ .

Round  $b + 4$ : p all stitches.

Repeat these last 4 rounds several more times, until you are left with 2 stitches on each needle. You can now redistribute the stitches as you like on fewer needles, which will make the last few rounds more manageable.

Round  $c + 1$ : k all stitches.

Round  $c + 2$ : p all stitches.

Round  $c + 3$ : k2tog  $\times 6$ .

Cut the yarn, leaving enough to attach a button.

Pull the yarn through the remaining 6 stitches.

Attach the button.

## V. THE FLAP

There are now two needles left from the back hexagon. These stitches will form the flap. I tried to make a reason-

able selvage edge at the sides, but there may be better ways to do this.

Row  $d + 1$ : With the back hexagon towards you, start by picking up one stitch in the corner just right of the right needle. k all stitches on both needles. Finish the row by picking up a stitch in the corner to the left of the left needle.

Row  $d + 2$ : kbl, k2tog, k to 3 stitches before the end, ssk, s1.

Row  $d + 3$ : kbl, ssk, k to 2 stitches before the end of the needle, k2tog, (next needle) ssk, k to 3 stitches before end of the needle, k2tog, s1.

Row  $d + 4$ ,  $d + 5$ , and  $d + 6$ : kbl, k to one stitch before the end, s1.

Repeat the last 4 rows until you have 4 stitches left on each needle. To make the knitting less fiddly, at this point just put all the stitches on one needle.

Row  $f + 1$ : kbl, k3tog, sssk, s1.

Row  $f + 2$ : kbl, k2, s1.

Row  $f + 3$ : kbl, k3.

Form a loop for the button to go through by making an i-cord of the appropriate length using the last two stitches that you have just knitted, and grafting them onto the other 2 stitches.

## VI. IDEAS FOR MODIFICATIONS

There are obviously many possible modifications and additions. The hexagons could be knitted in stockinette stitch, along the lines of [3], though it might be nice to then still use two purl rounds to form the beginning and end of the edge. Embellishments and interesting stitch patterns could be added to the front and/or back hexagon. One could also add lining, or a shoulder strap. The bag could be felted, provided the yarn is suitable. Instead of a button closure, it would also be possible to use a zipper. In that case the front hexagon should not be knitted with short rows, but as a full hexagon from the outside in, i.e. cable cast-on  $8n + 1$  stitches, and after the initial setup (rounds  $a + 1$  and  $a + 2$ ) instead of row  $a + 3$  directly continue with  $b + 3$ , and instead of making a flap just bind off.

## VII. ACKNOWLEDGEMENTS

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- [1] *Coney Island Bag*, Eunny Jang, in: Knitting daily, Interweave Press LLC, <https://www.interweave.com/article/knitting/free-bag-patterns-by-interweave-staff-weekend-2010/>.
- [2] *Hexagon purse knitting pattern*, Barbara Breiter, <https://www.ravelry.com/patterns/library/honeycomb-clutch-purse>.
- [3] *Hexagons*, Jen Reilly, <http://sageyarn.blogspot.no/2011/12/hexagons.html>.
- [4] *Mosaic*, DROPS Design, <https://www.garnstudio.com/pattern.php?id=5174&cid=17>.
- [5] *Hexagon cowl*, Juliet Bernard, [http://www.blacksheepwools.com/media/wysiwyg/hexagon\\_cowl.pdf](http://www.blacksheepwools.com/media/wysiwyg/hexagon_cowl.pdf)
- [6] You can also use 3 needles here instead, at least for a few more rounds. If you do you should make sure to also mark the point where each needle should be split up, so that you can follow the rest of the instructions as if you have 6 needles. A similar trick will work at the end of the front hexagon when you go from the outside in and end up with very few stitches per needle.
- [7] Be aware that when you are using wt, the gap appears one stitch after the previous turning point.