Equilibria all the way to the separatrix

Siena Hurwitz, Matt Landreman

- It is difficult to model stellarator separatrices generally as they have sharp corners at the x-points
- If we could model these, we could ideally compute MHD equilibria up to the separatrix
- This is especially helpful for designing island divertors!
- **Question:** Can we find a low-order series solution for surfaces with sharp corners?

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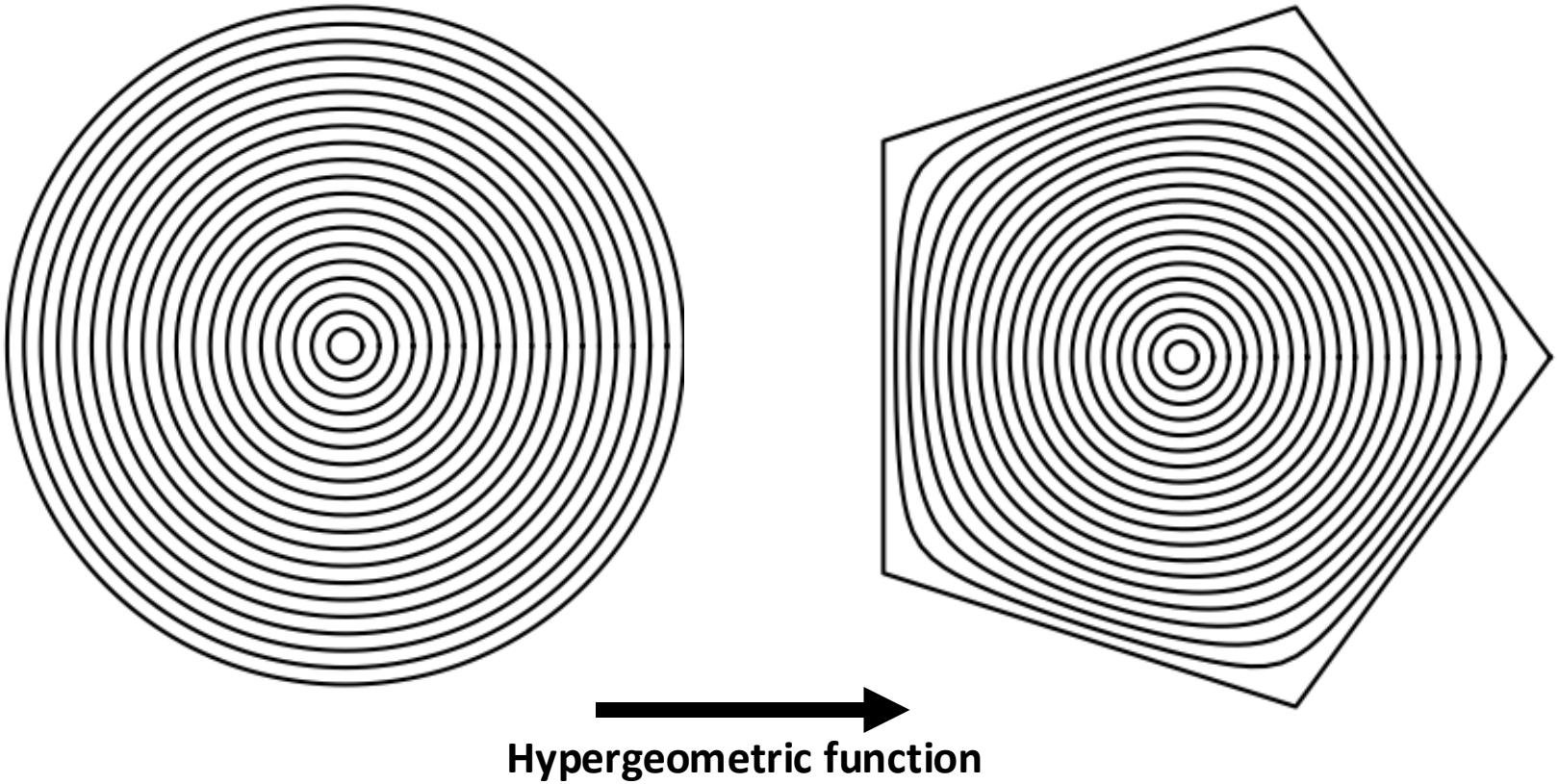
- Perform the complex mapping from a unit disc w to a regular N-gon $P(w)$,

$$P(w) = {}_2F_1(2/N, 1/N; (N+1)/N; w^N)w,$$



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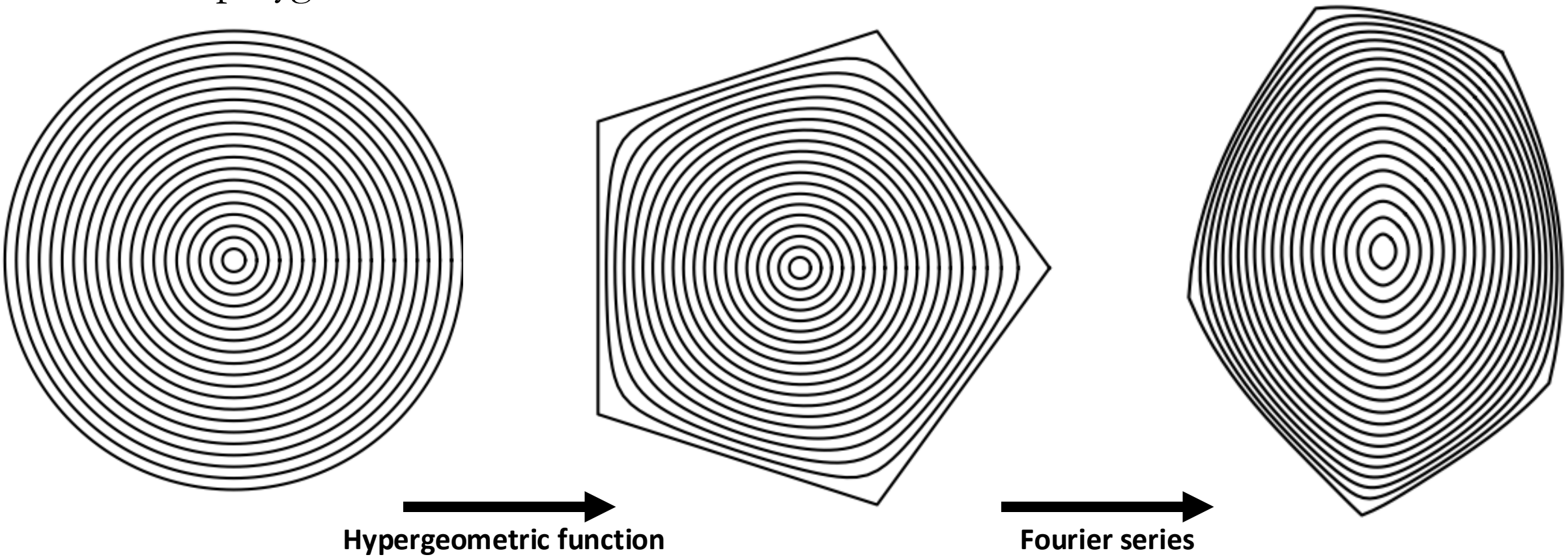
$$P(w) = {}_2F_1(2/N, 1/N; (N+1)/N; w^N)w,$$

- Apply a secondary map with the usual Fourier representation from the polygon to a curved polygon



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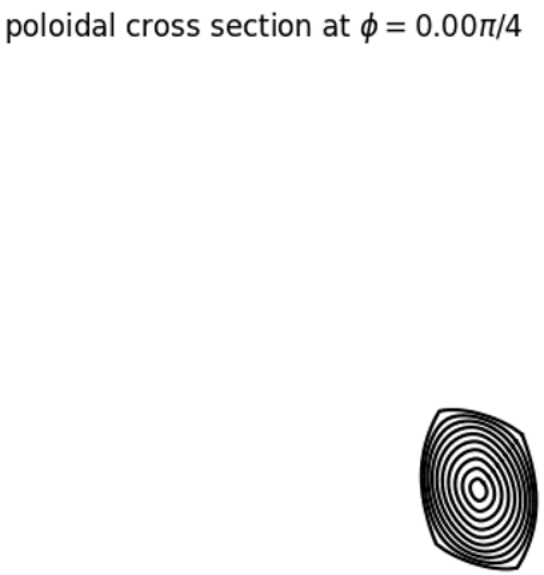
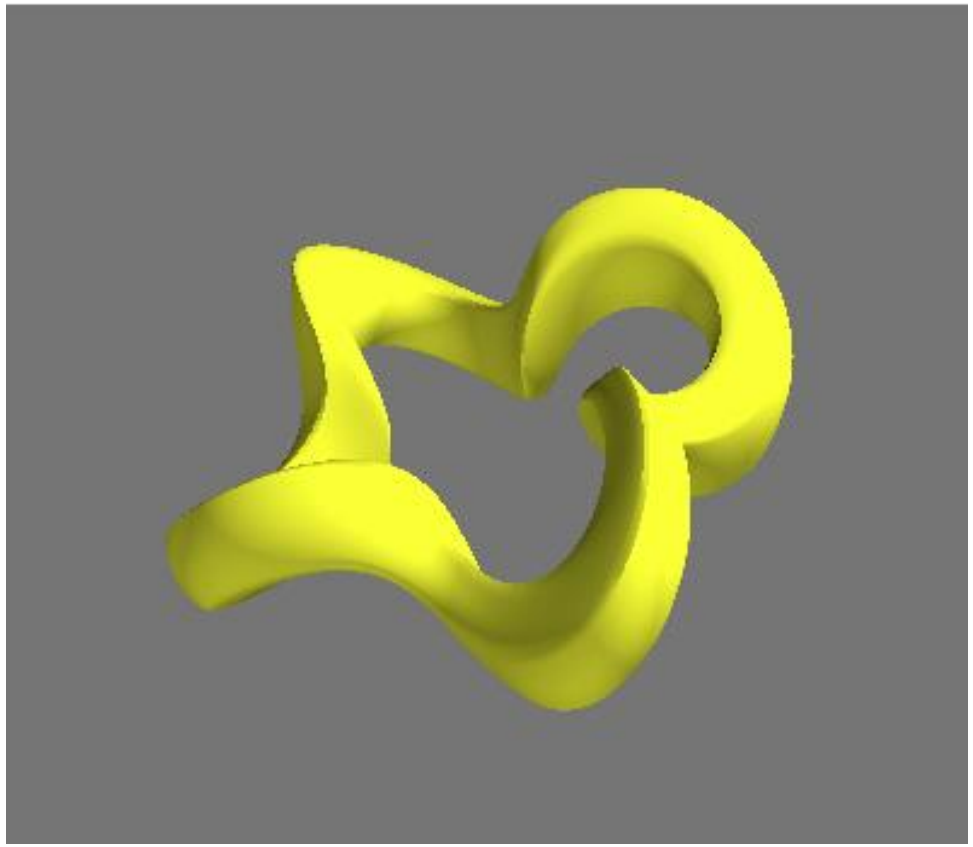
- To generate an arbitrary separatrix, deform the polygon with a map and sweep it about a toroidal angle. For example:





Link

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- Next steps:
  - Finish implementing model in DESC, confirm we can reproduce existing separatrices (such as W7-X's)
  - Evaluate some MHD equilibria!
  - Stage one optimization