Constraining Cosmology using Galaxy-Galaxy Lensing and Galaxy Clustering

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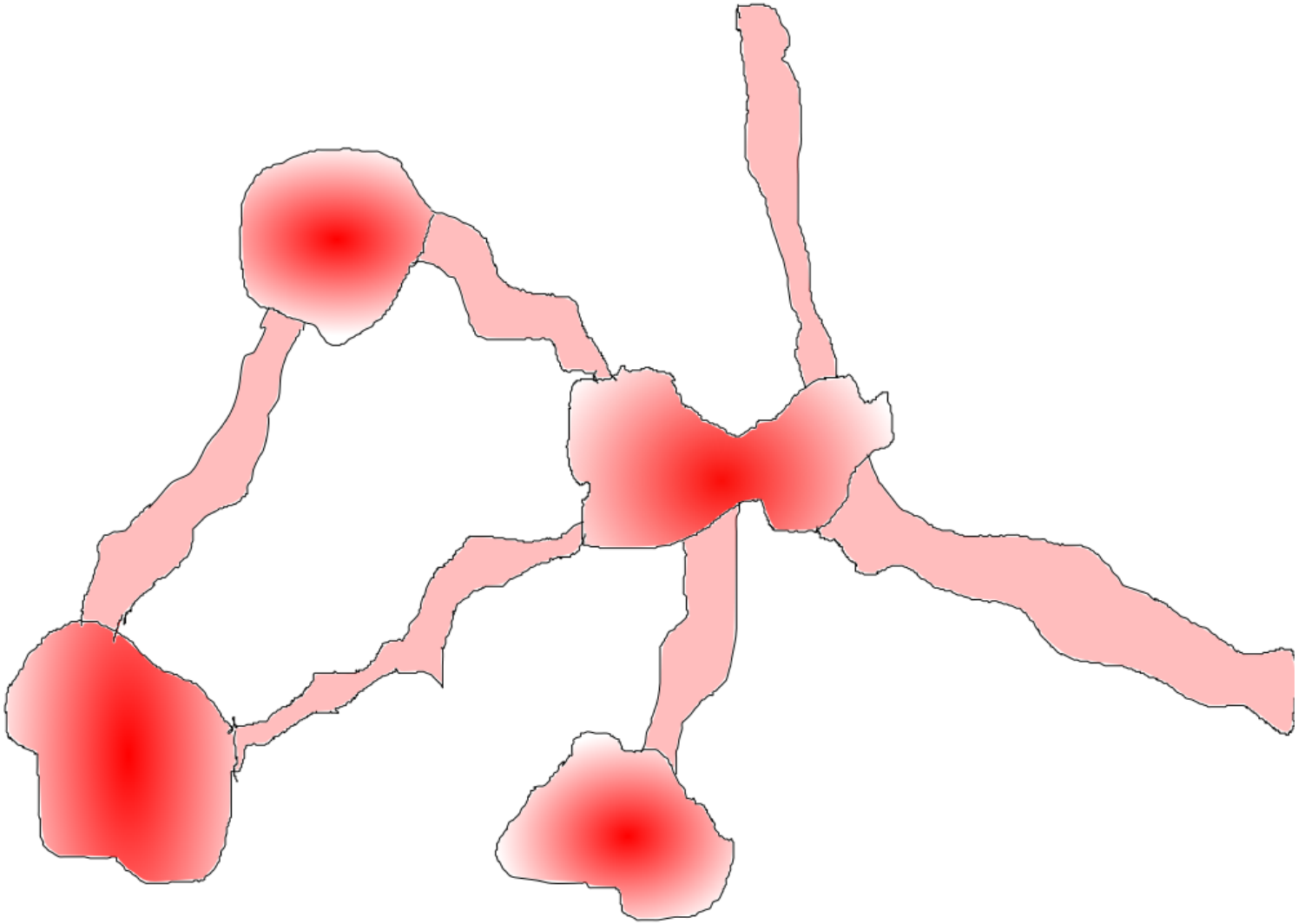
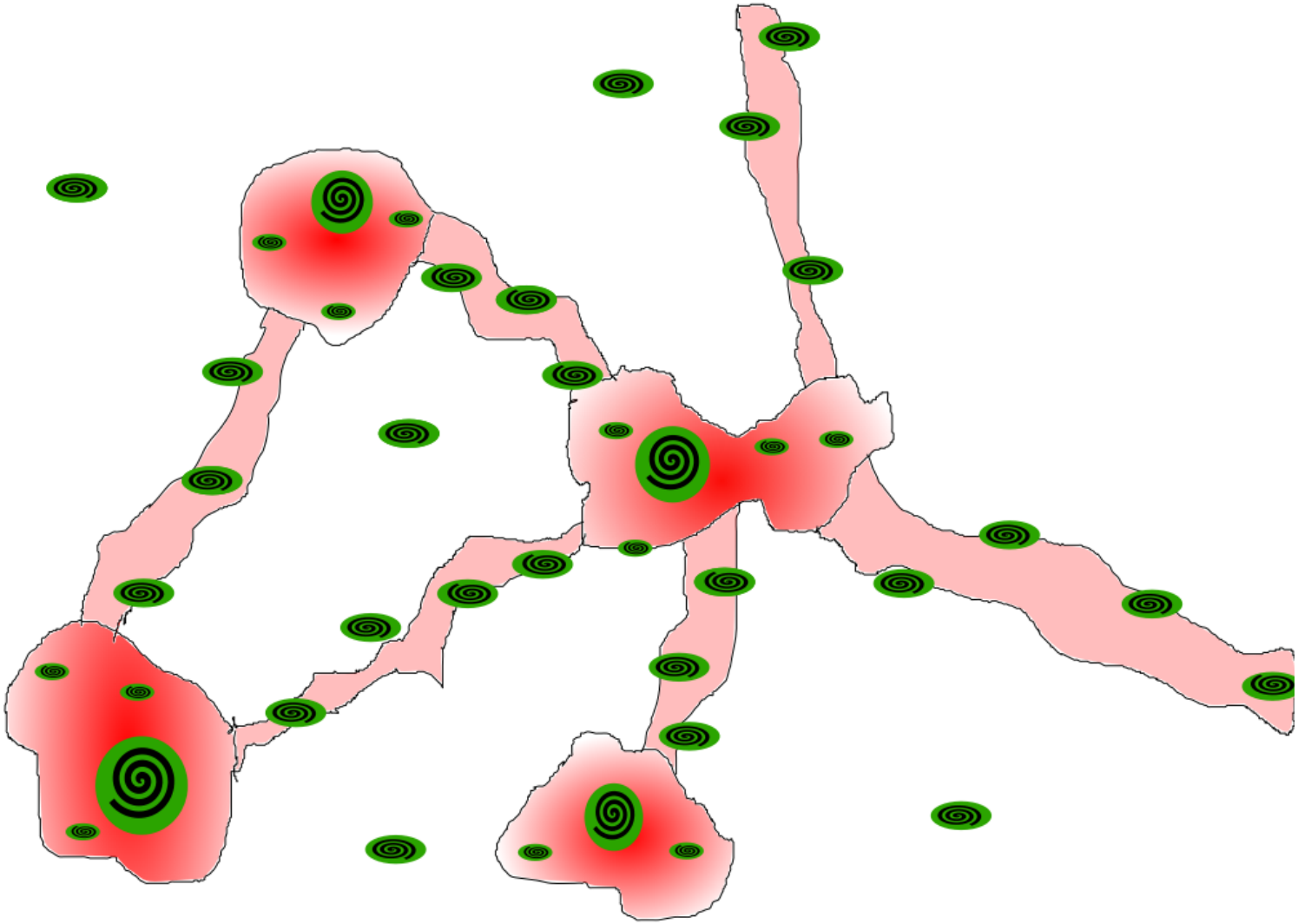
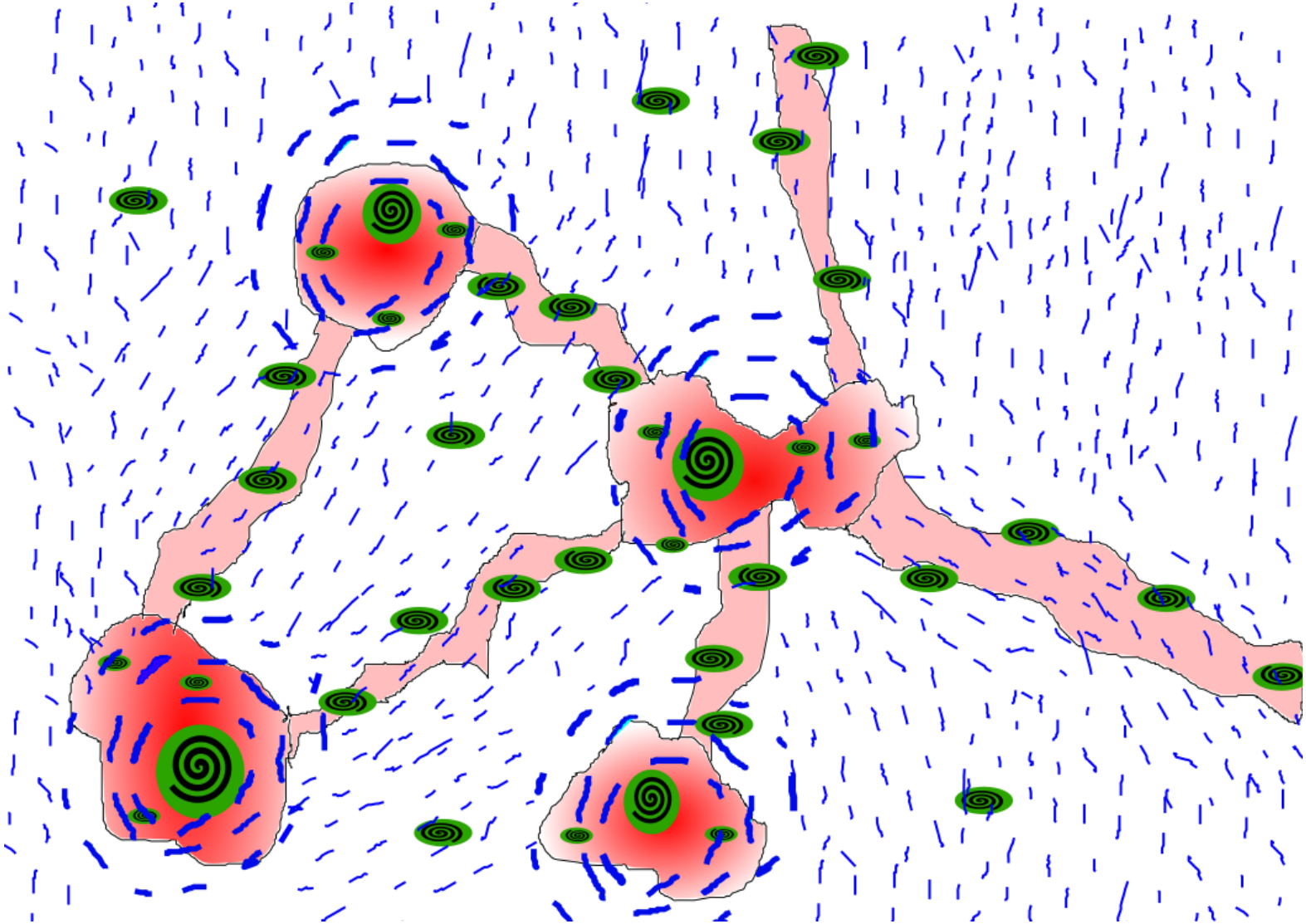
The Dark Matter Distribution



The Galaxy Distribution



The Shear Field

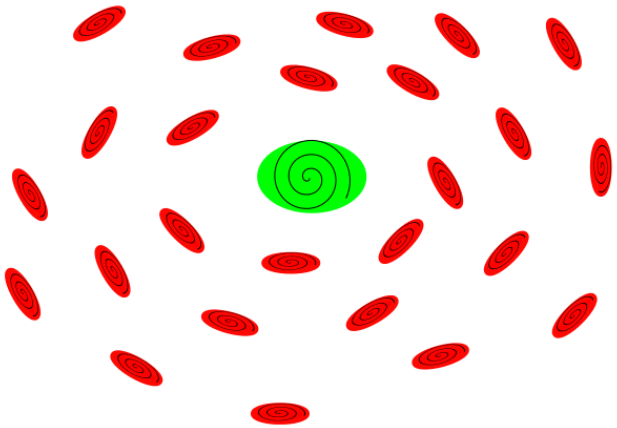


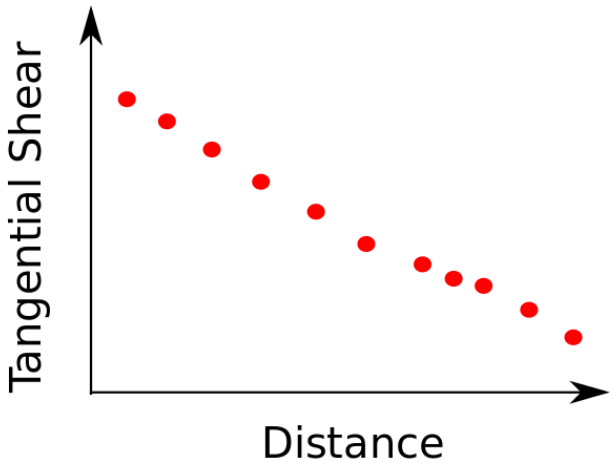
Recovering the Dark Matter Distribution from other Two Point Statistics (TPS)?

Combine "easily" measurable TPS:

- Galaxy Clustering (position-position)
- Galaxy-Galaxy Lensing (position-mass)

Is there a way to combine them in order to recover the dark matter distribution?





Combining Galaxy-Galaxy Lensing and Galaxy Clustering

One can define the cross-correlation coefficient:

$$r^{\xi}_{\mathrm{gm}} = \frac{\xi_{\mathrm{gm}}}{\sqrt{\xi_{\mathrm{gg}}\xi_{\mathrm{mm}}}}, \text{ with } \xi \text{ being any TPS}$$

$$\text{if } r^{\xi}_{\mathrm{gm}} \approx 1 \Rightarrow \xi_{\mathrm{mm}} \approx \frac{\xi^2_{\mathrm{gm}}}{\xi_{\mathrm{gg}}}$$

Baldauf et al. (2010) define a new TPS, Υ_{ij}, for which this is the case.

Υ_{gm} and Υ_{gg} can be used for cosmology (Mandelbaum et al. 2013).

Going beyond angular binning

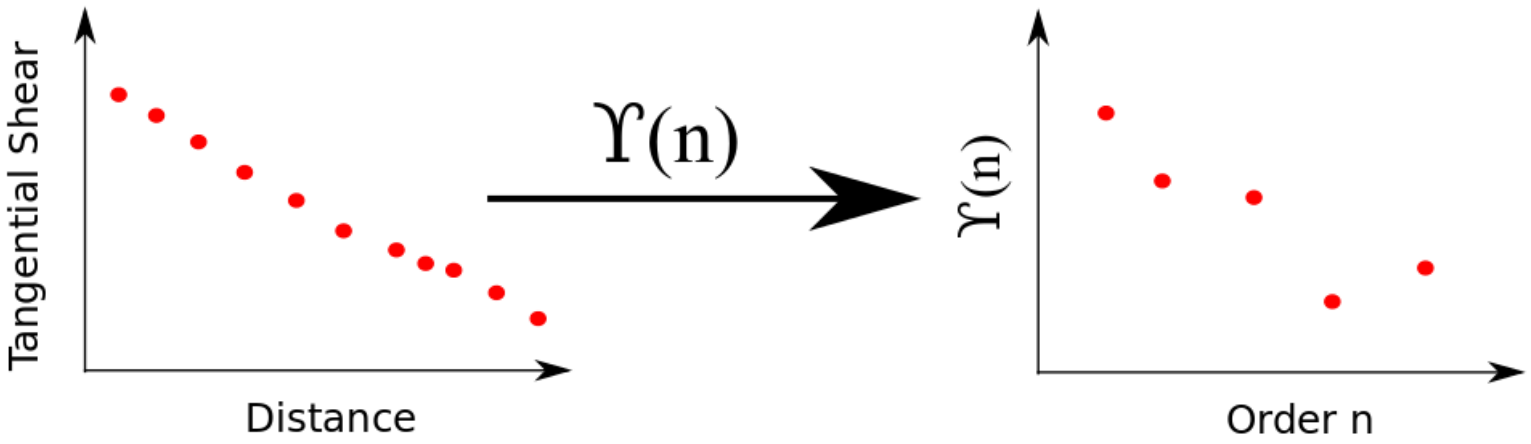
Υ is like a filter function to the measurement, which suppresses small scale influences.

Why not use a whole set of filters q_n?

$$\hat{\Upsilon}_{ij}(n) = \int_{\theta_{min}}^{\theta_{max}} \mathrm{d}\theta\, \theta\, \mathrm{q_n}(\theta)\, \gamma_\mathrm{t}(\theta)$$

Going beyond angular binning: $\Upsilon_{ij}(n)$

- Measurement independent of angular binning
- Natural way of data compression
- Contains all cosmological information of the signal
- Complementary to cosmic shear
- can be extended for combination with cosmic shear (COSEBIs, Schneider et al. 2010)



Progress and Plans

Progress:

- Development of formalism
- Computation of filter functions finished
- Several data sets ready for use

Plans:

- Test method on simulations
- Measure galaxy-galaxy lensing and galaxy clustering in the RCSLenS/KiDS
- Apply $\Upsilon_{ij}(n)$ to measurements
- Constrain cosmology
- Combine with cosmic shear (COSEBIs)

Conclusion

- Mandelbaum et al. 2013 proved suitability of $\Upsilon_{ij}(\theta)$ for cosmology
- Use whole set of filter functions
- Great data compression
- No angular binning
- Contains all cosmological information of the signal
- Complementary to cosmic shear
- Measurement is less complicated
- Will be applied to RCSLenS/KiDS in the next months