BACK-IN-TIME VOID FINDER:

Dynamical void identification for precision cosmology

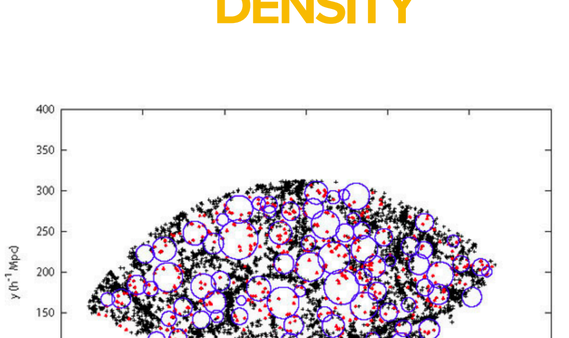
In collaboration with: *Sofia Contarini, Federico Marulli, Lauro Moscardini, Elena Sarpa, Giulia Degni*

No unique definition of cosmic void

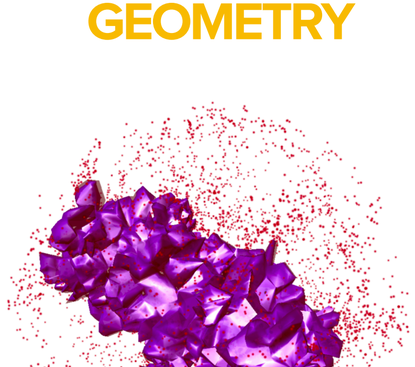
Three different classes of methods

SHOT NOISE!

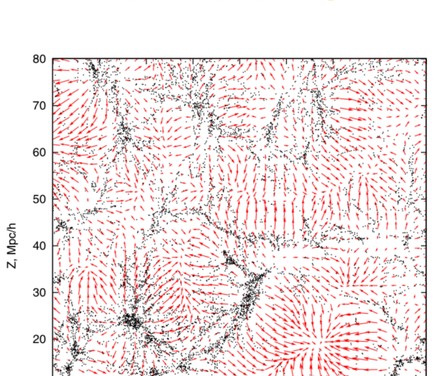
DENSITY



GEOMETRY



DYNAMIC

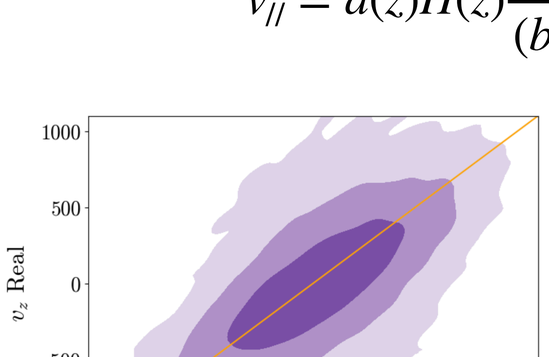


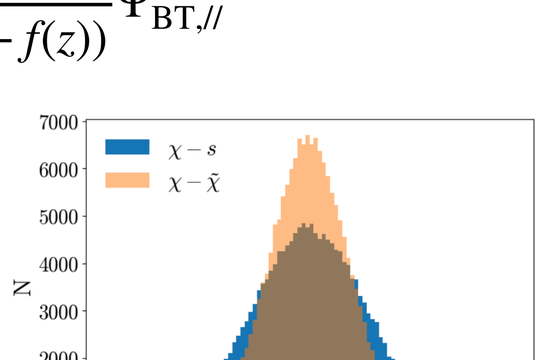
- Use of cosmic tracers to sample the displacement (velocity) field instead of the density field
- Overcoming the typical issues associated with geometry- and density-based methods

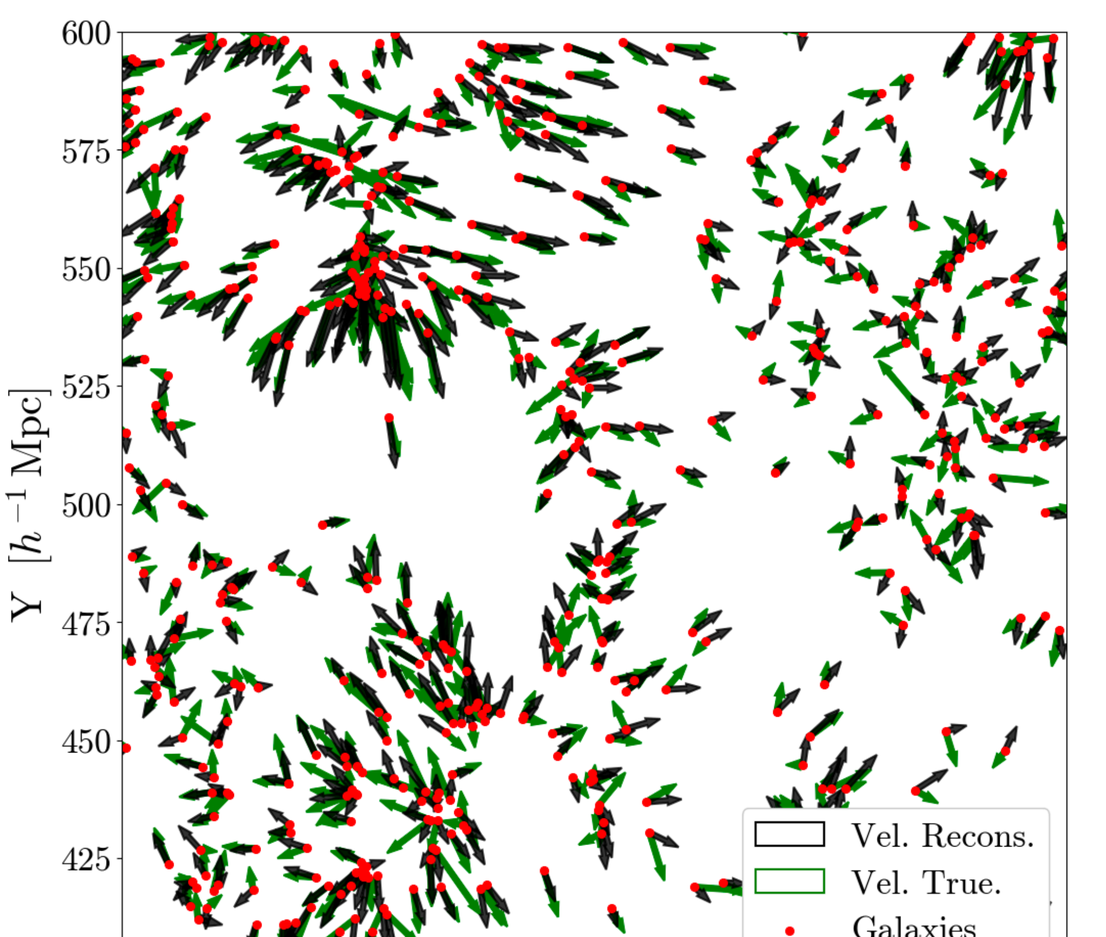
DISPLACEMENT FIELD RECONSTRUCTION

- **«Back-in-time» optimal transport**
- Assumption of a random catalogue
- No cosmological assumption for displacement calculation
- Real space reconstruction ($\Psi_{\rm BT} \neq \Psi$ if we deal with biased tracers… a little of Math is required), assuming a fiducial cosmology

$$v_{//} = a(z)H(z)\frac{f(z)}{(b(z)+f(z))}\Psi_{\rm BT,//}$$



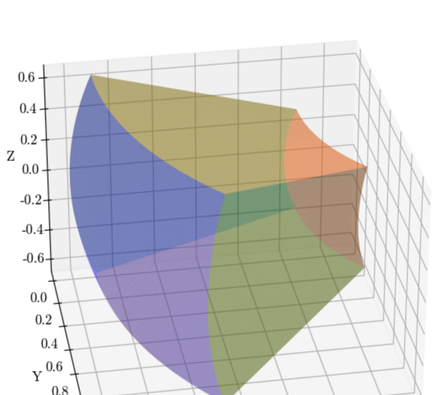




DIVERGENCE FIELD ESTIMATION

- Divergence calculated as the flux of Ψ_{BT} through surfaces of cells of **complex geometry**, fundamental to correctly account for $n(z)$!
- **Density contrast estimated through the relation:**

$$\nabla \cdot \Psi = -\delta$$



VOID IDENTIFICATION

- Identification of the local minima
- Watershed algorithm over divergence cells
- **Creation of non overlapping regions of the space with negative divergence**