Targeting Incompleteness in the DESI Bright Galaxy Survey

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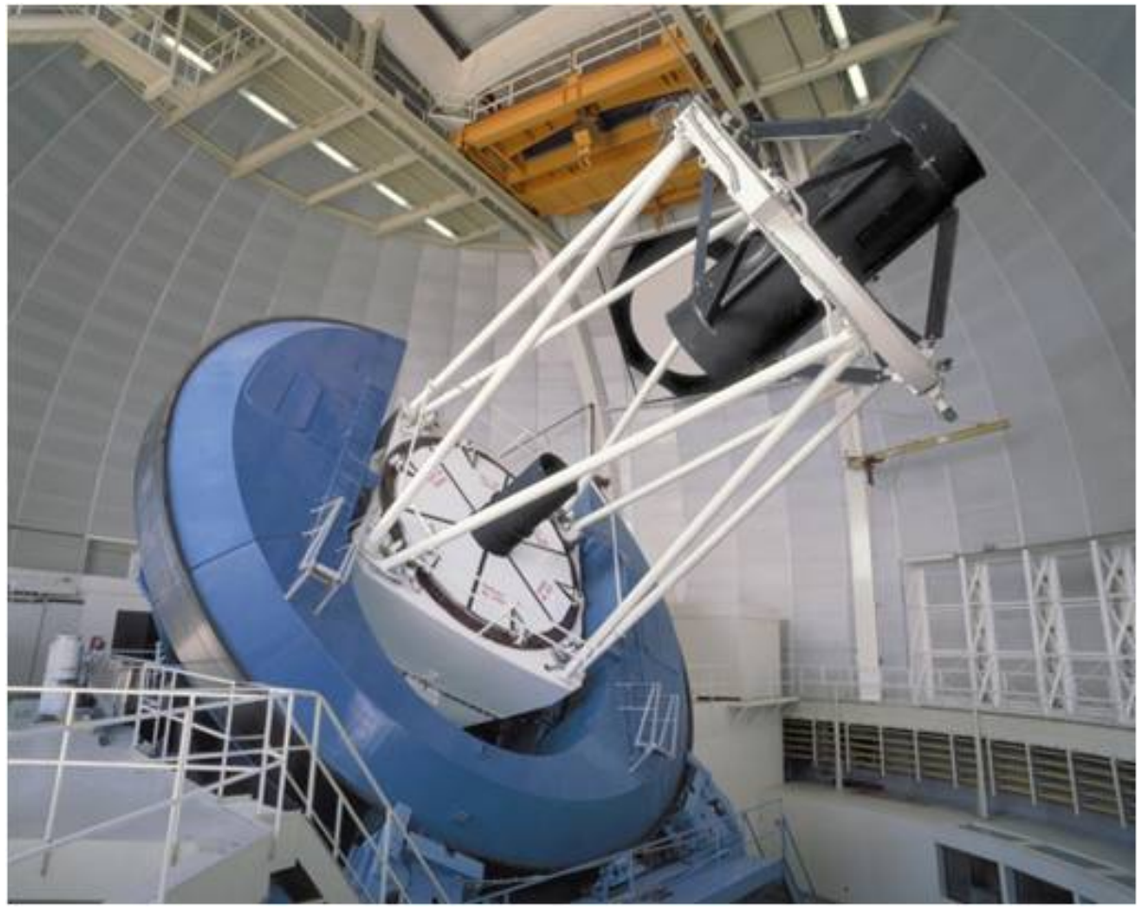
Outline

- DESI Bright Galaxy Survey
- Fibre assignment algorithm
- Incompleteness
- Correcting clustering measurements
- Results of applying correction

Dark Energy Spectroscopic Instrument (DESI)

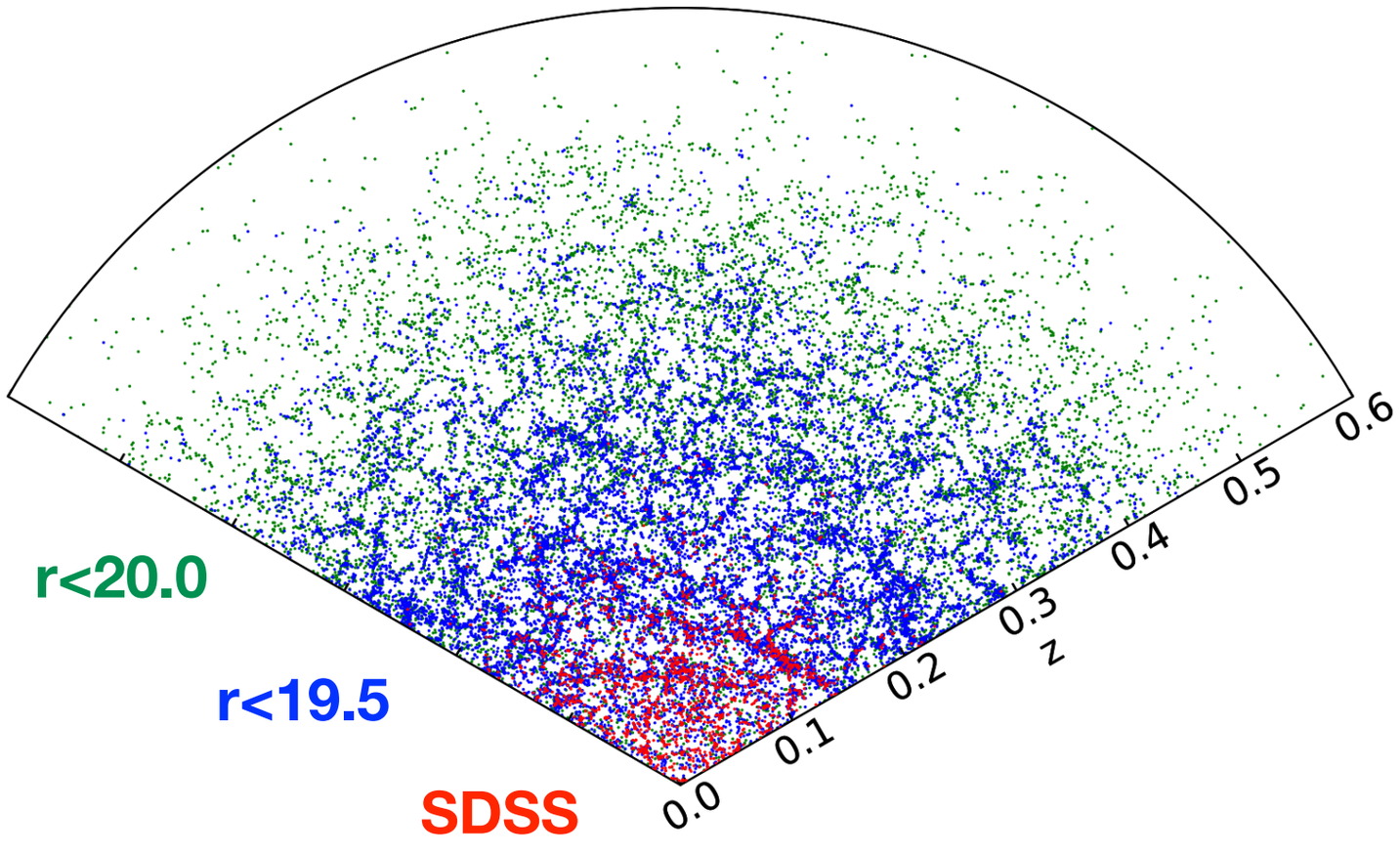
- Spectroscopic galaxy survey
- Mayall Telescope, Kitt Peak, Arizona
- Beginning end of 2019
- Primary aim to measure dark energy and growth of structure through BAO and RSD
  - Dark time survey
  - BGS
  - Milky Way survey



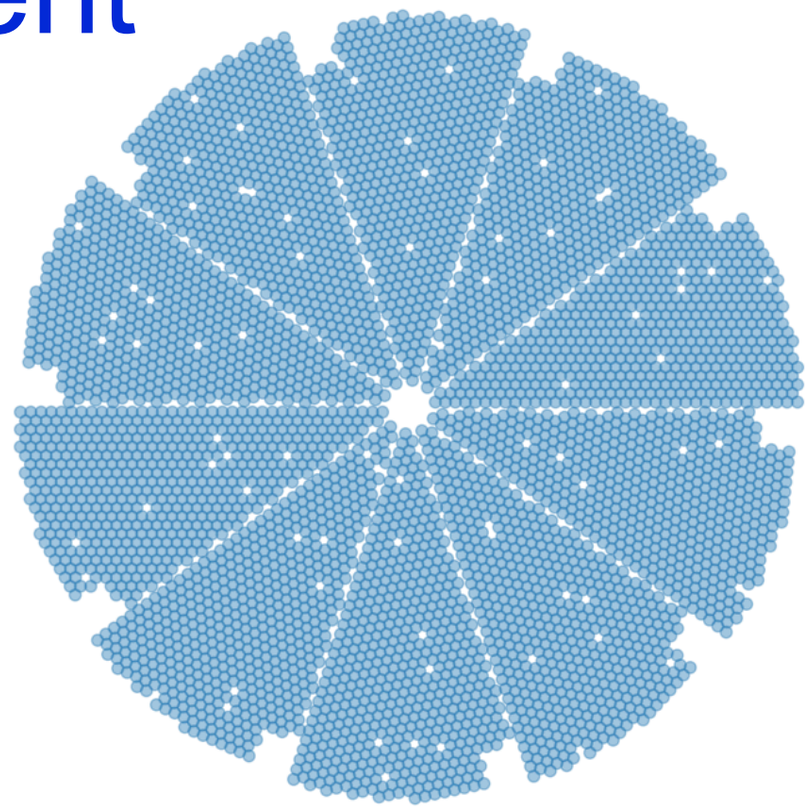
credit: desi.lbl.gov

Bright Galaxy Survey (BGS)

- Aim to create very complete catalogue of bright, low z galaxies (>10 million galaxies, median z ~ 0.2)
- Takes place during bright time
- Two priority tiers:
  r<19.5 and 19.5<r<20.0
- 14,000 sq deg
- 3 passes of sky
- Like SDSS but bigger and deeper

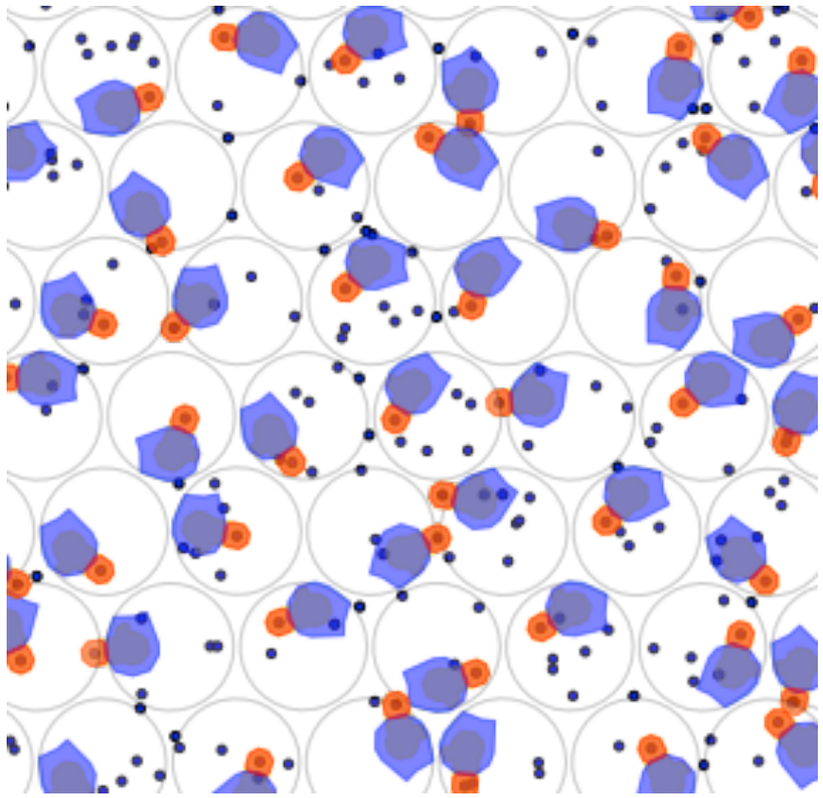


Fibre Assignment



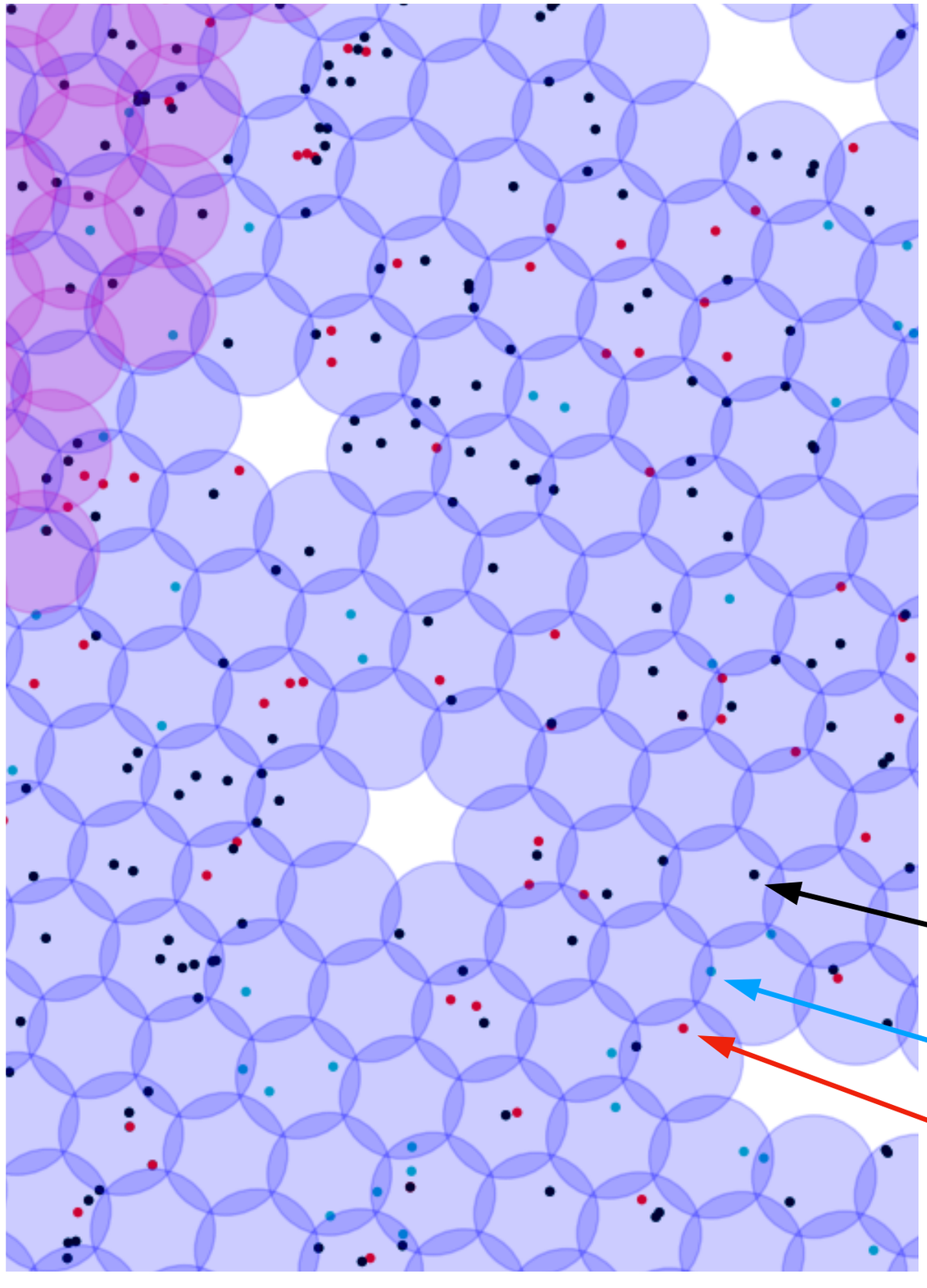
- DESI tile contains 5000 fibres
- Each fibre controlled by robotic fibre positioner, can target any galaxy with its 6mm patrol region
- Each galaxy given a random sub-priority
- Place fibre on galaxy in patrol region with highest sub-priority

arXiv:1611.00037



credit: Jaime Forero-Romero

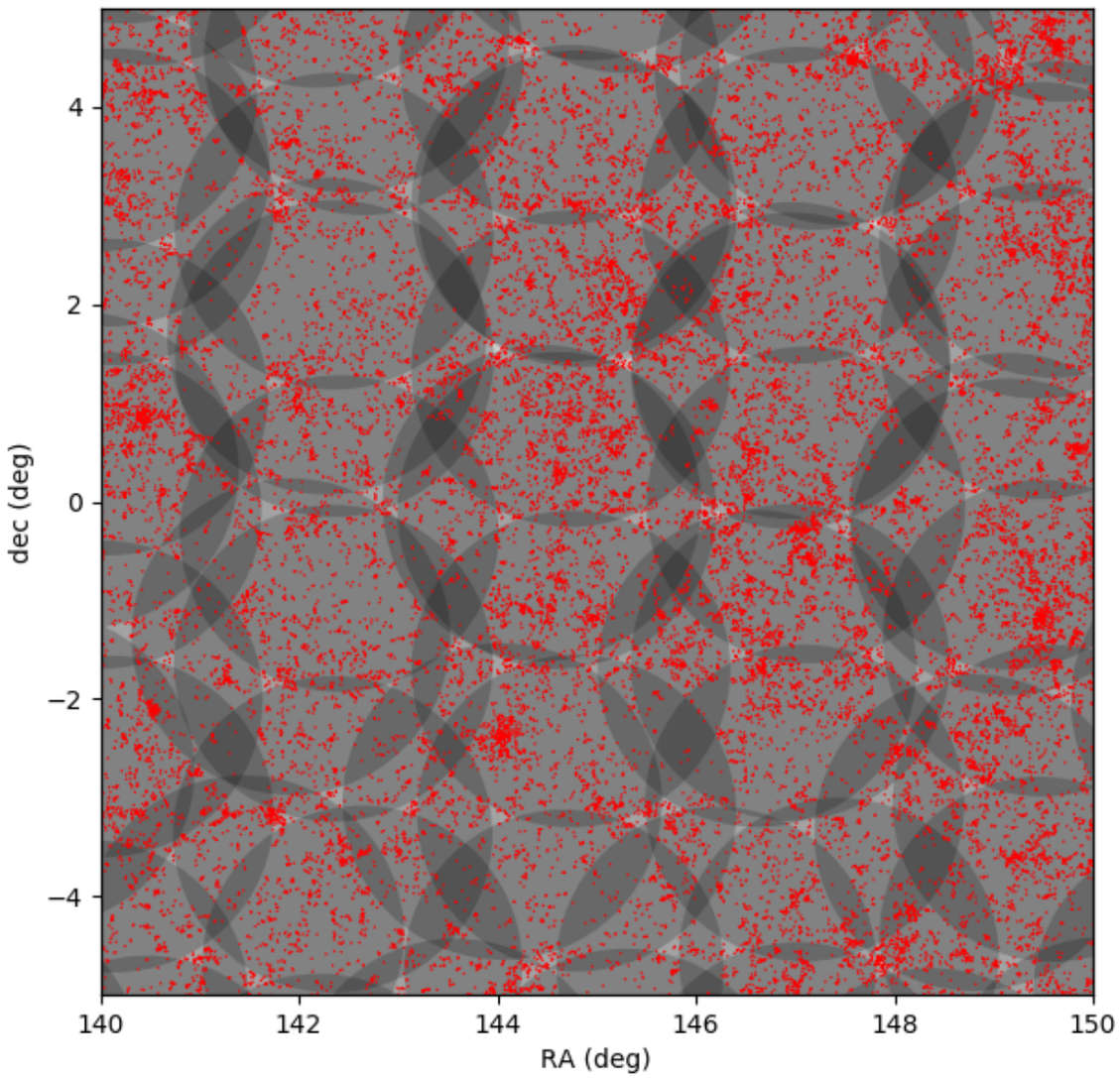
Fibre Incompleteness

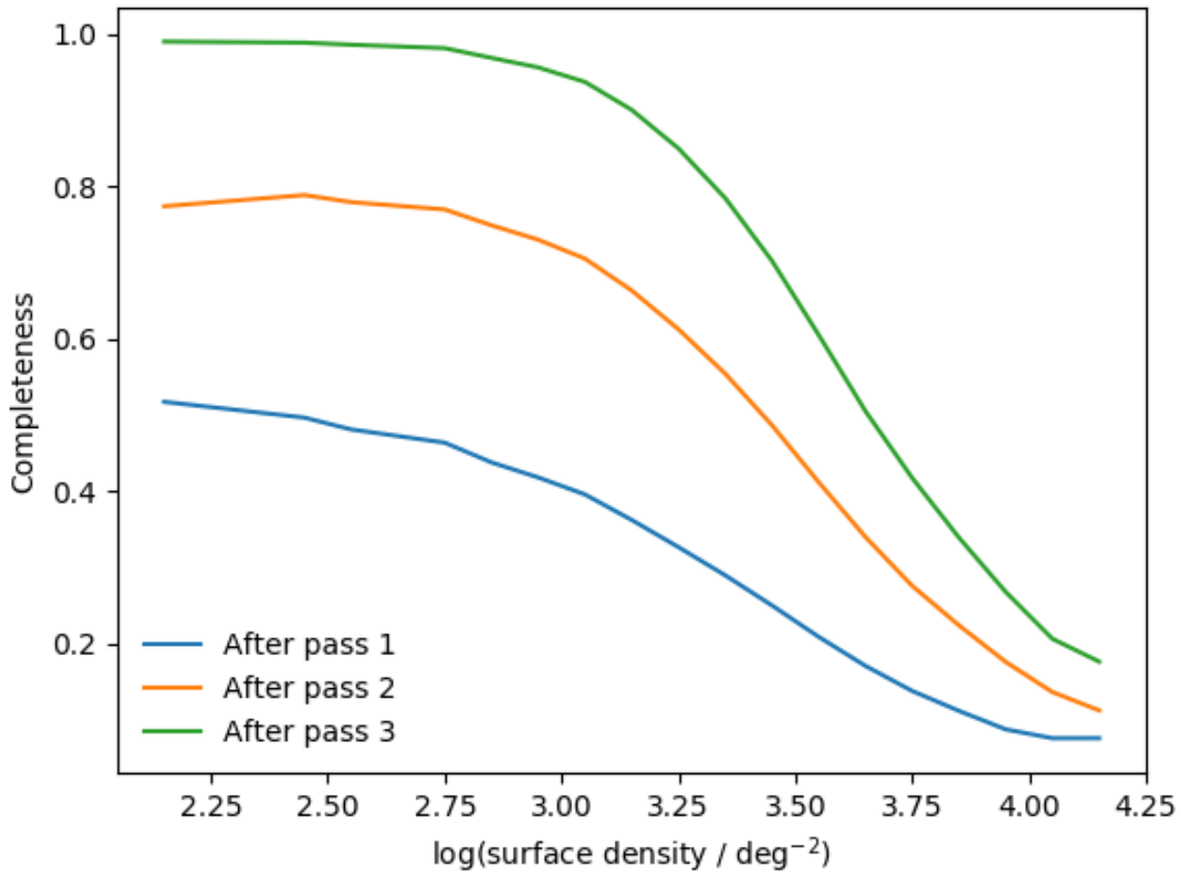


- Not possible to assign a fibre to every galaxy!
- Gaps in tile
- Fibre collisions
- More galaxies than fibres
- Priority 2 never targeted if fibre can target priority 1 galaxy
- Impact on clustering measurements non-trivial

Fibre Incompleteness

Galaxies not assigned a fibre





Low completeness in high density regions even after 3 passes

Correcting Galaxy Clustering Measurements

- Pair-weighting method of Bianchi & Percival (2017)

$$\xi(\vec{s}) = \frac{DD(\vec{s}) - 2DR(\vec{s}) + RR(\vec{s})}{RR(\vec{s})}$$ Landy Szalay estimator

- Run fibre assignment 100s (or 1000s) of times to get probability of targeting each galaxy pair, p_{ij}

- Pair weight $w_{ij} = \frac{1}{p_{ij}}$

- Weighted DD counts $DD(\vec{s}) = \sum w_{ij} \frac{DD^{(p)}(\theta)}{DD(\theta)}$

parent sample

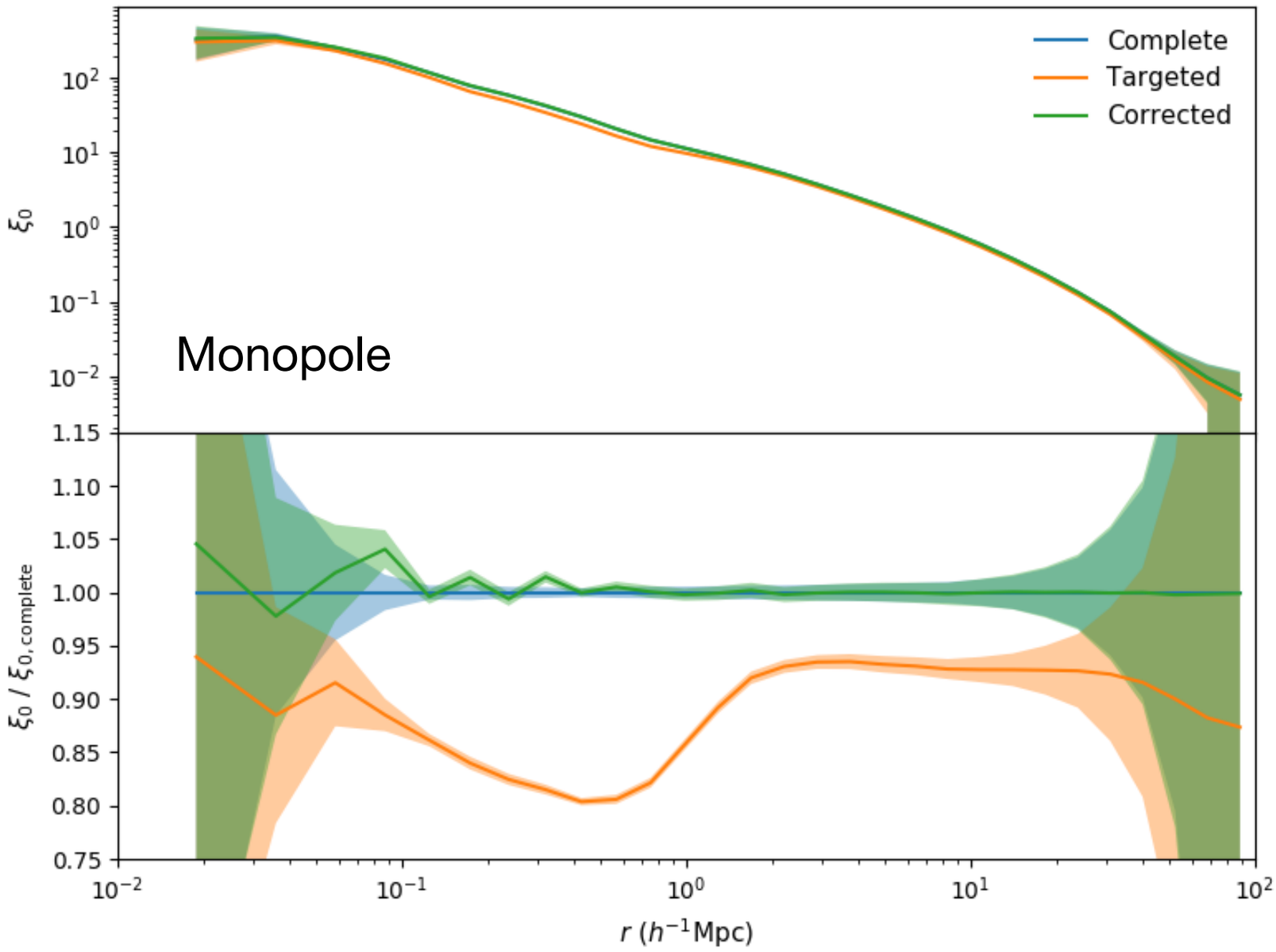
targeted sample (with weights)

- Unbiased (if p_{ij} >0 for all pairs)

Angular weight (reduce variance)

Correcting Galaxy Clustering Measurements

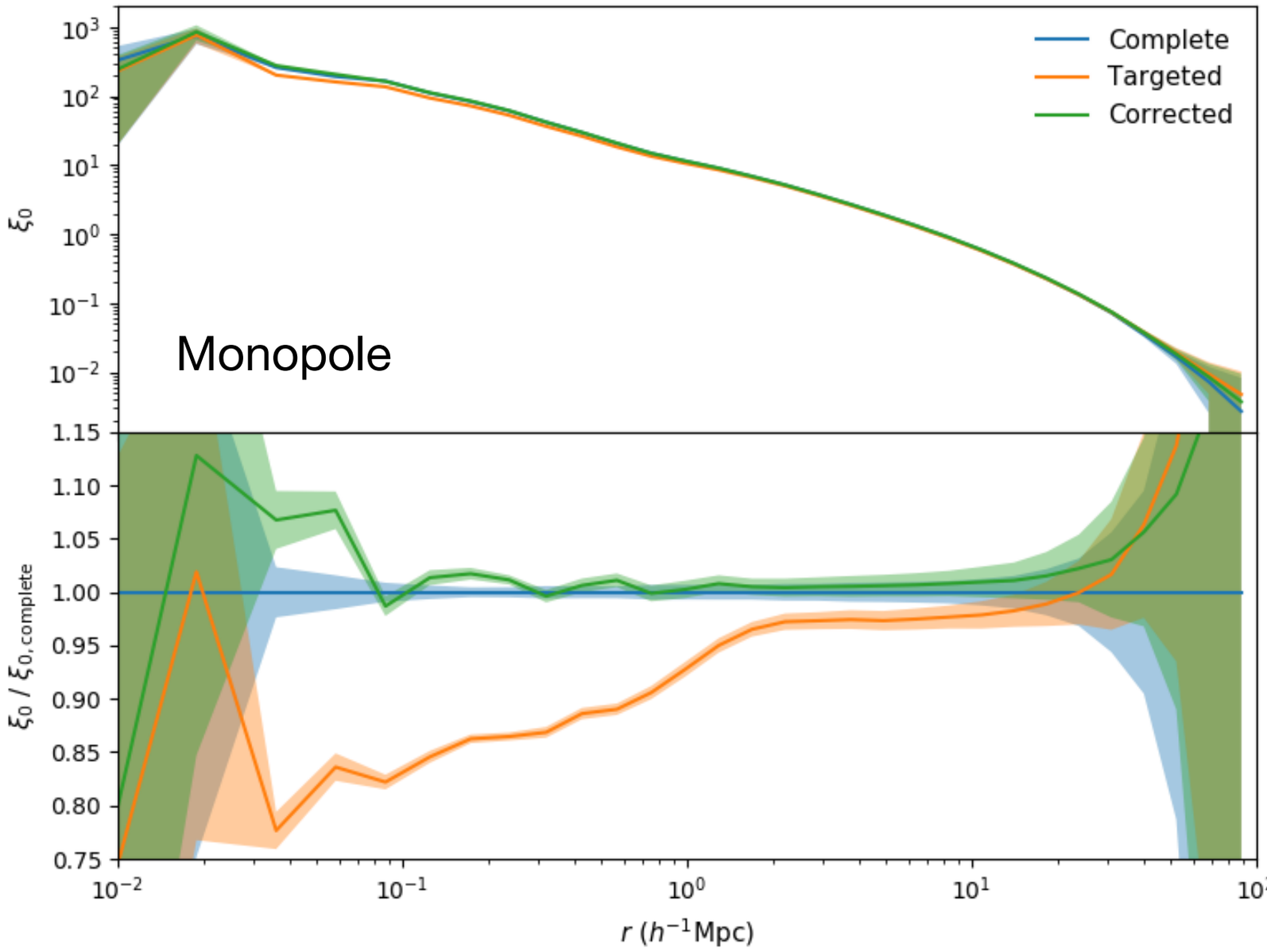
- MXXL BGS mock catalogue (Smith et al 2017)
- Bianchi & Percival method with simple fibre assignment scheme



$M_r < -21$
volume limited
sample

Correcting Galaxy Clustering Measurements

- 450 realisations of DESI fibre assignment algorithm



$M_r < -21$ volume limited sample

Still work in progress

Conclusions

- DESI aims to measure BAO and RSD
- Fibre incompleteness has strong affect on clustering measurements - needs to be corrected
- Inverse probability weighting (Bianchi & Percival)
- Works using a simple fibre assignment scheme, correcting actual DESI fibre assignment still a work in progress
- Aim to promote fraction of priority 2 galaxies to priority 1