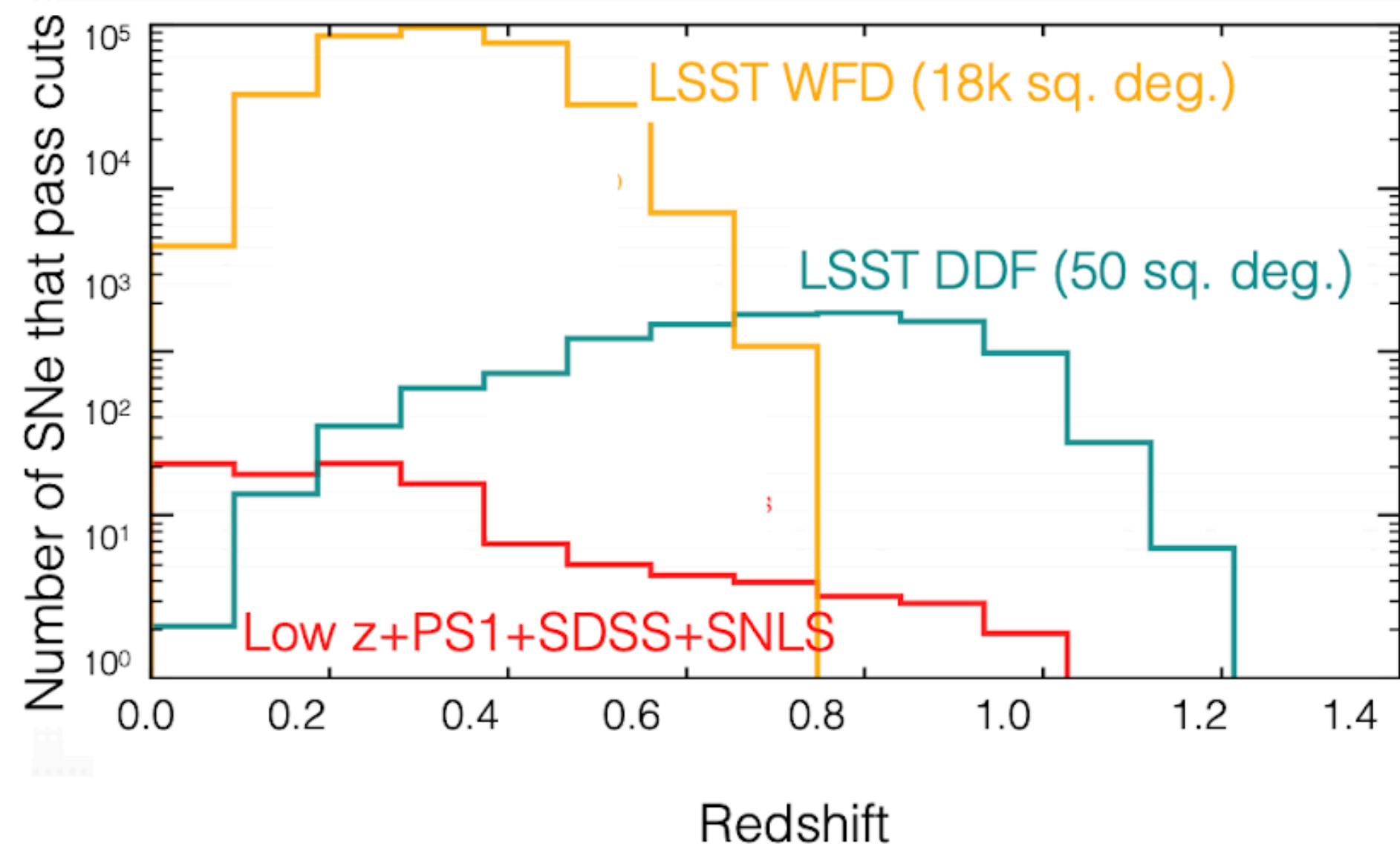


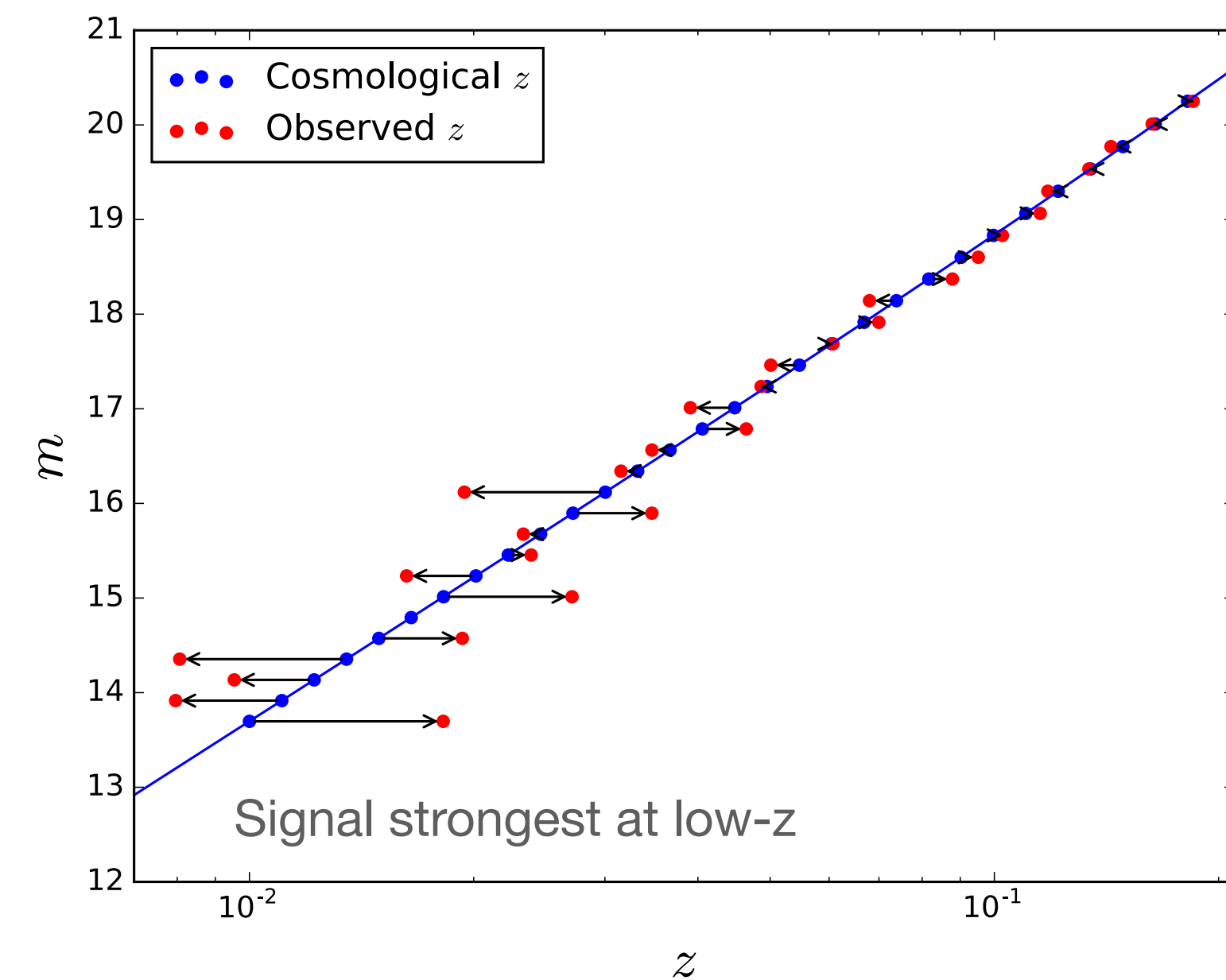
Peculiar Velocities With Type Ia Supernovae: Abundant Discoveries to a Low-z Hubble Diagram

Vera C. Rubin Observatory LSST (and other searches) a source for discovery of SNe over 10 years: ~ 50k (unclassified) SNe Ia at $z < 0.15$...



from Mandelbaum et al. 2019
also Blazek et al. Astro 2020 White Paper
previous slide

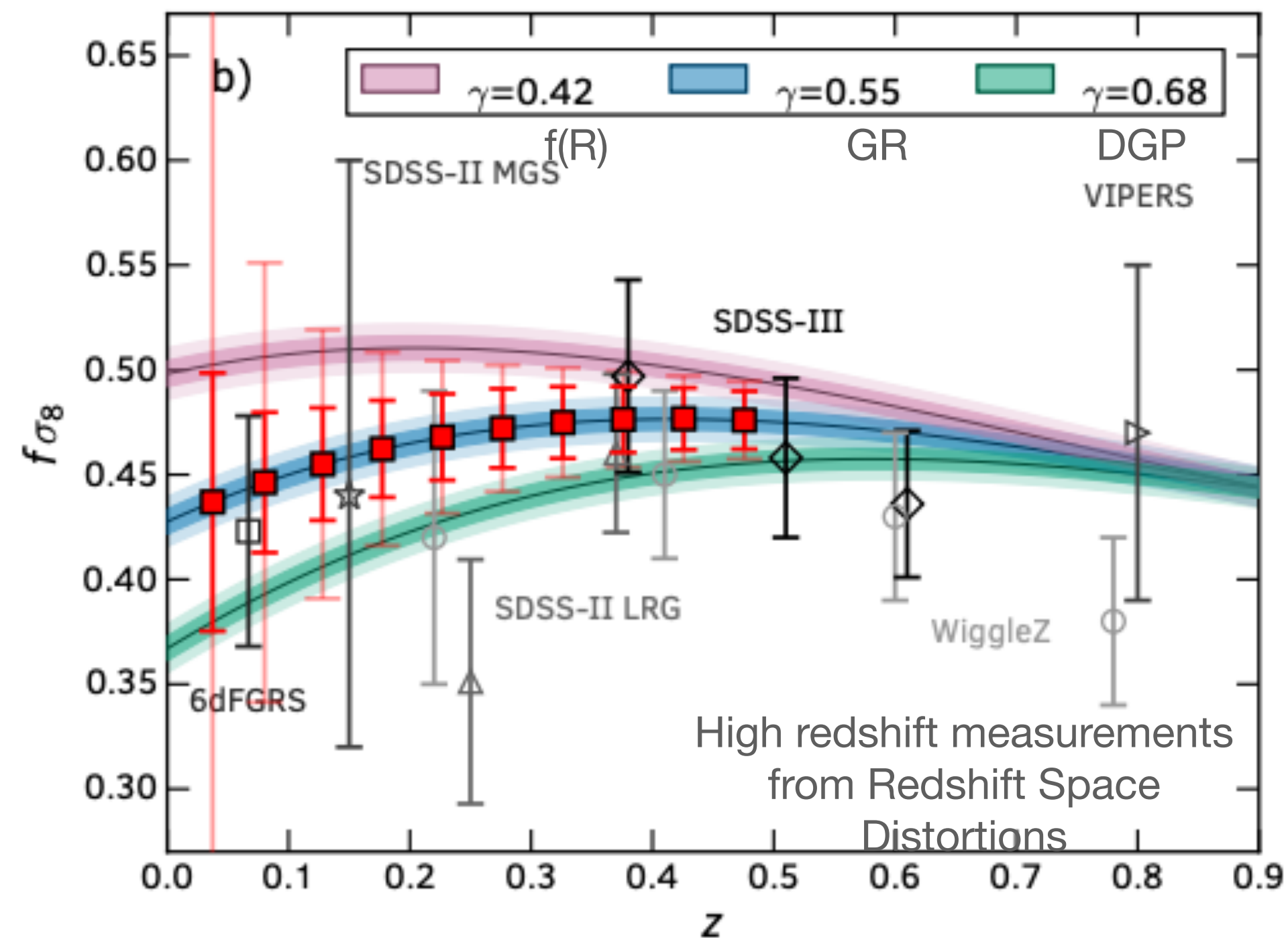
... we can put these discoveries on a Hubble Diagram with supplemental classification, redshift, and brightness...



... to measure peculiar velocities that appear as residuals away from the smooth Hubble Law

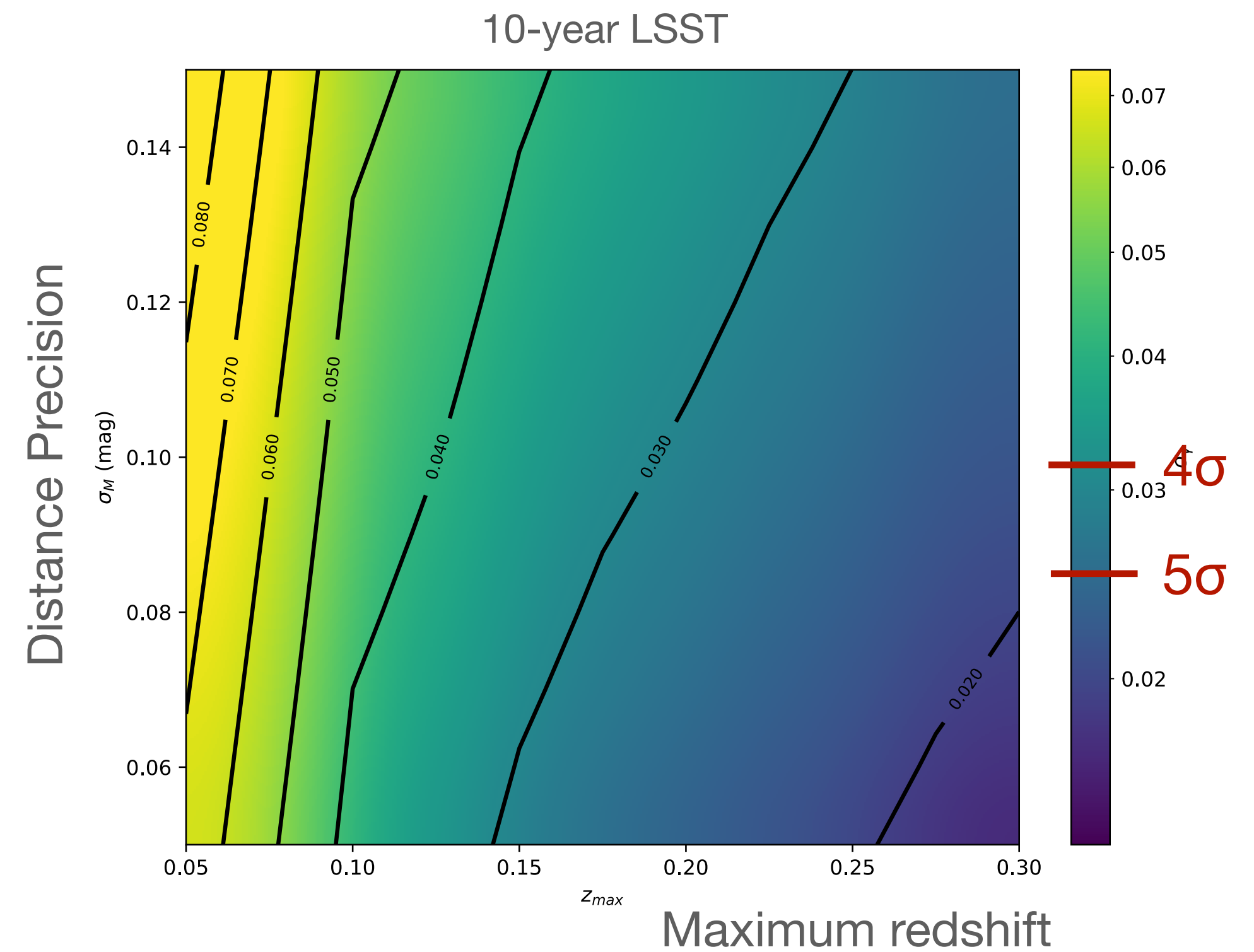
Peculiar Velocities With Type Ia Supernovae: Growth of Structure to Probe of Gravity

Spatial distribution of PV from these SNe come an unrivaled measurement of the growth of structure ($f\sigma_8$) at low redshifts ...



Red LSST SN projections from Howlett et al. (2017)

... depending on the **fraction** of discoveries placed on the Hubble diagram, **maximum redshift**, and **per SN distance precision** ...



... viable models of gravity can be distinguished by up to 5σ ...

... to be continued in Session 144...

Transient (SN Ia) Follow-up Network

Alex Kim (LBNL)

- **Overall science goal:** Enable the study of Dark Energy, Gravity, and other HEP science using transients discovered by Rubin and other public searches, through supplemental optical/NIR spectral/imaging follow-up
- **Collaboration model:** Complicated. Use Snowmass to figure this out,
 - DESC has intellectual investment and scientific stake in transient and non-transient spectroscopy
 - Rubin Observatory soliciting International In-Kind Contributions, several responses to which include transient follow-up that could be part of the Network
 - Private facilities will be used for follow-up
 - Private data supplement public transient searches, e.g., ZTF-II in the north
 - Other LSST Science Collaborations want similar network elements though driven by different science goals and requirements
- **Timescale:**
 - Now and later. 2-3 sigma PV results possible current and soon-to-be-online facilities if made available.. Precision 4-5 sigma PV science would require re-instrumentation of larger telescopes.
 - Doubt transient searches will stop after 10 years of Rubin

Transient (SN Ia) Follow-up Network

- **Scale of investment for US agencies, international partnerships, other investments:** Tiered by science case
 - Peculiar velocity / low redshift: one 2-m -- eight 4-m facilities
 - Expansion history / high redshift: one 4-m telescope -- one 10-m facilities
 - Refurbish older instruments, commitment of telescope resources; instrument R&D
 - Leverage planned/existing resources: older telescopes seeking work;, 4MOST, DESI, SNIFS
 - *Importance of science and risk mitigation should have us move away from current model of regularly applying for telescope time*
- **Desired support from the DOE laboratory system:** Collaboration building, interagency liaison, MOUs with partner institutions, instrument R&D; detectors; remote/automated observing; data management
- **R&D plan:** IFU spectroscopy; Germanium CCDs

Intersection with [146. Small Projects to Enhance Stage IV photometric surveys](#)