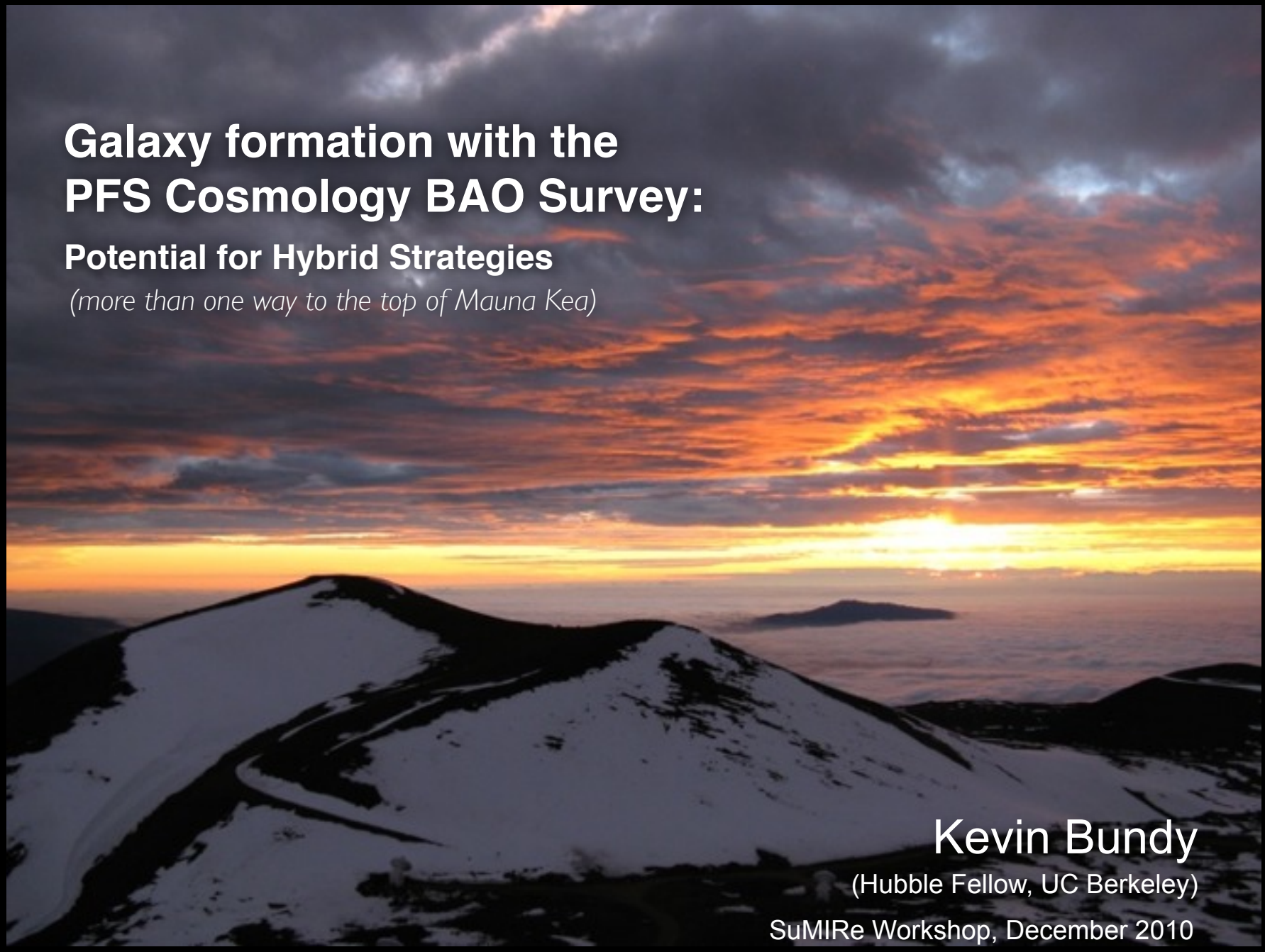
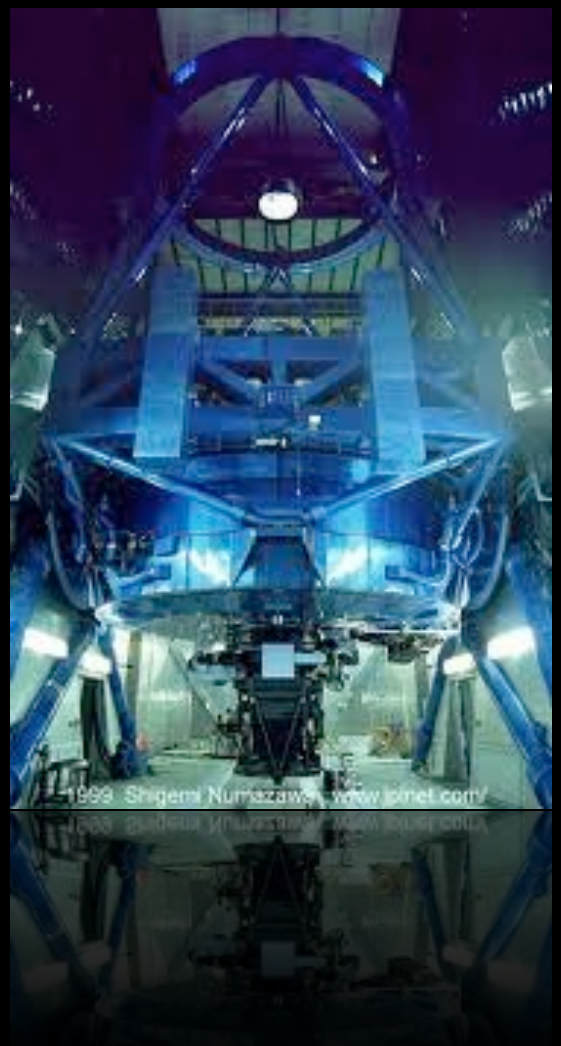

Galaxy formation with the
PFS Cosmology BAO Survey:
Potential for Hybrid Strategies
(more than one way to the top of Mauna Kea)
Kevin Bundy
(Hubble Fellow, UC Berkeley)
SuMIRe Workshop, December 2010

A PFS Cosmology Survey thought experiment:

Goals:

1. Enable breakthrough galaxy science.
2. Maximize unique potential for cosmology.



The galaxy formation fantasy is the SDSS at z~1

Spec-z survey Wish List

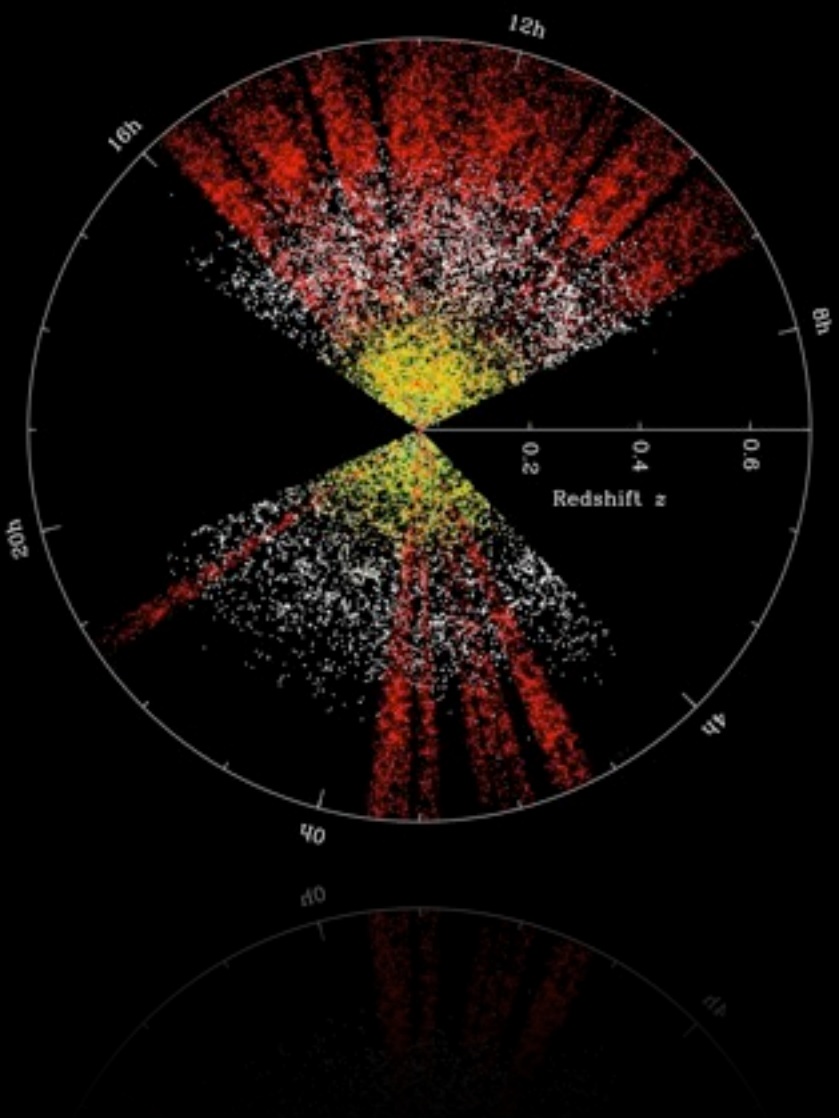
1. Mass complete to z~1.. > log M = 10.5
2. SDSS like volume. V > 0.2 Gpc3
3. High sampling/success rate.. > 70%
4. Strong S/N.. > 10
5. Wide wavelength range
6. Blue sensitivity

Be realistic... DEEP2 took over 100 nights on Keck

Cosmologist's desires are BAO at z~1

BAO requirements

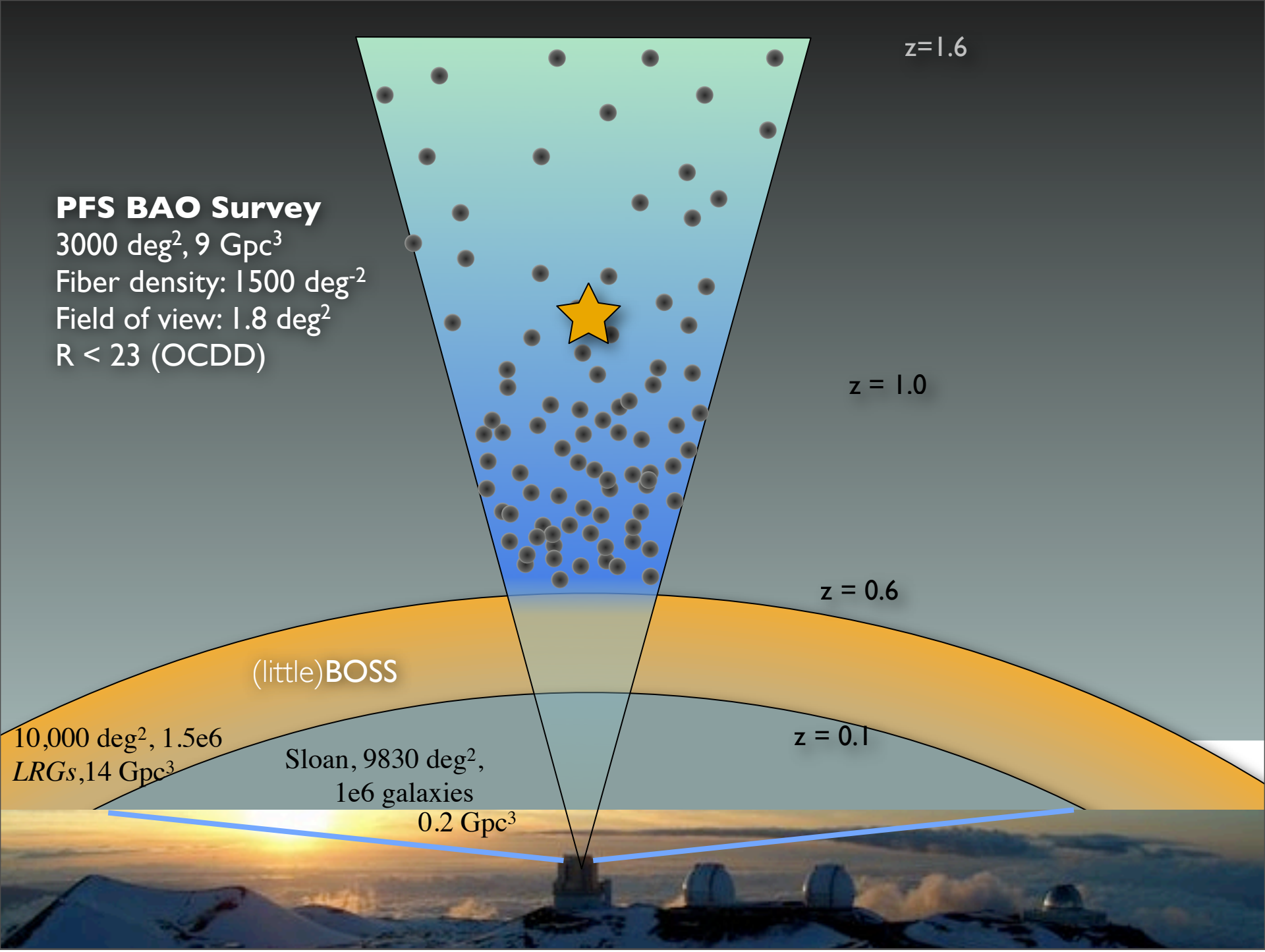
1. Volume! V > 5 Gpc^3 for 5% σ_w
2. Sampling $2e10^{-4} < n < 4e10^{-4}$
3. S/N ~ 1-3

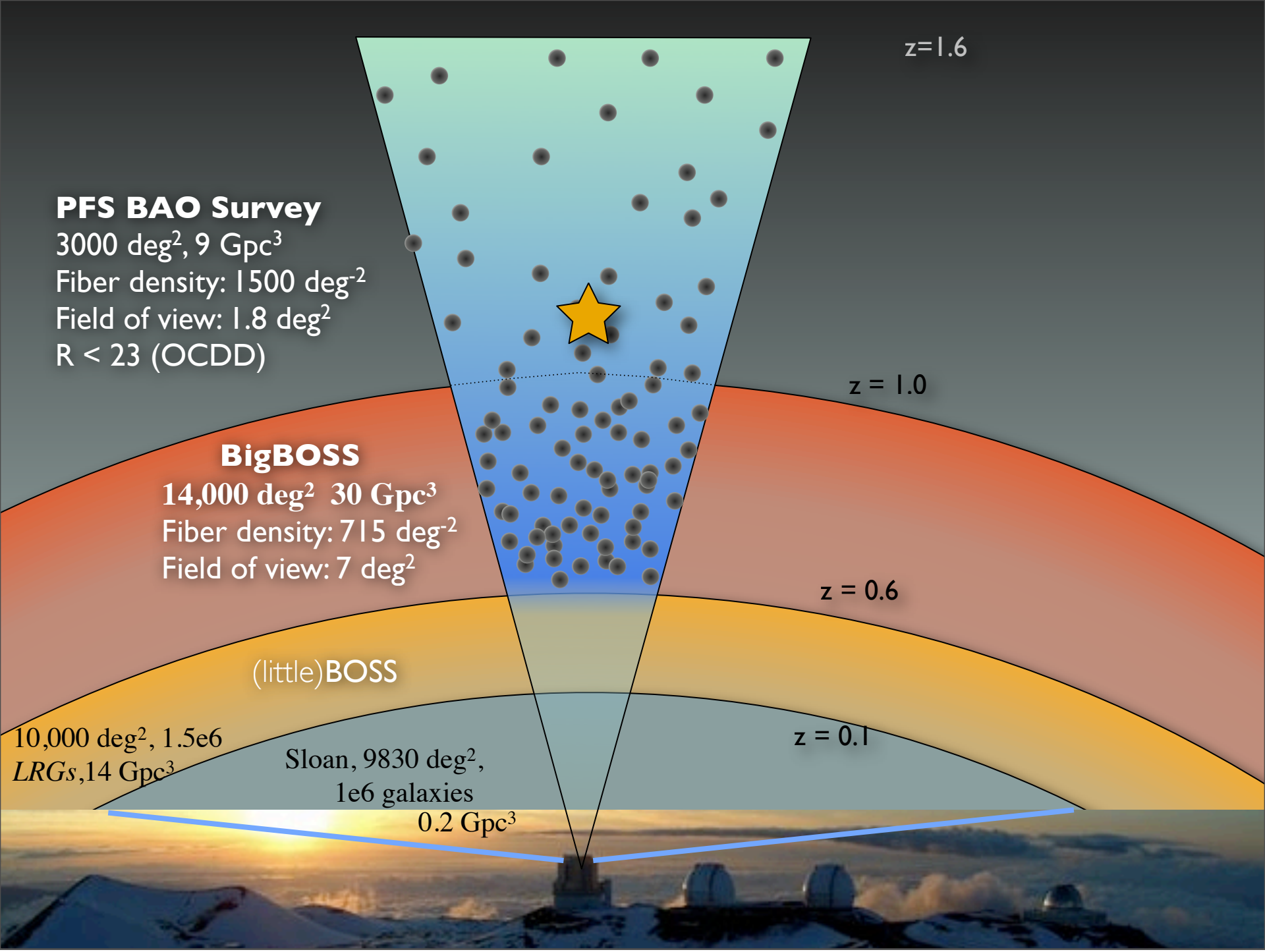


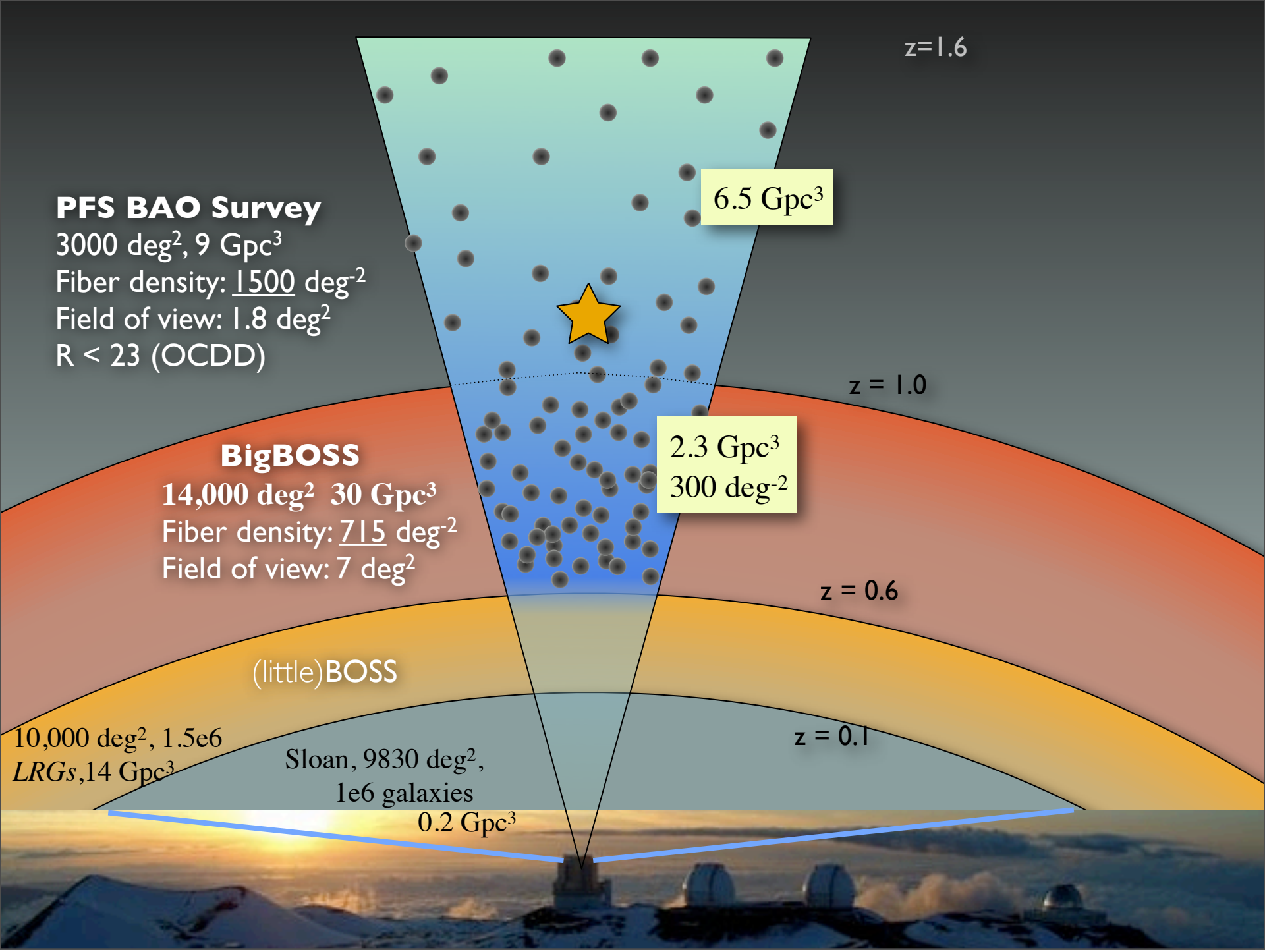
A problem marriage for BAO and galaxy formation

BAO requirements	... for galaxy formation
1. Volume! $V > 5$ Gpc^3 for 5% σ_w	Way overkill (only want 0.2)
2. Sampling $2e10^{-4} < n < 4e10^{-4}$	Log M=11.3 (not 10.5), or not complete
3. S/N ~ 1-3	Too low for extracting spectral info (need 10)

Let's choose both!


z=1.6
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
z = 1.0
z = 0.6
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³


z=1.6
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
z = 1.0
BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
z = 0.6
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³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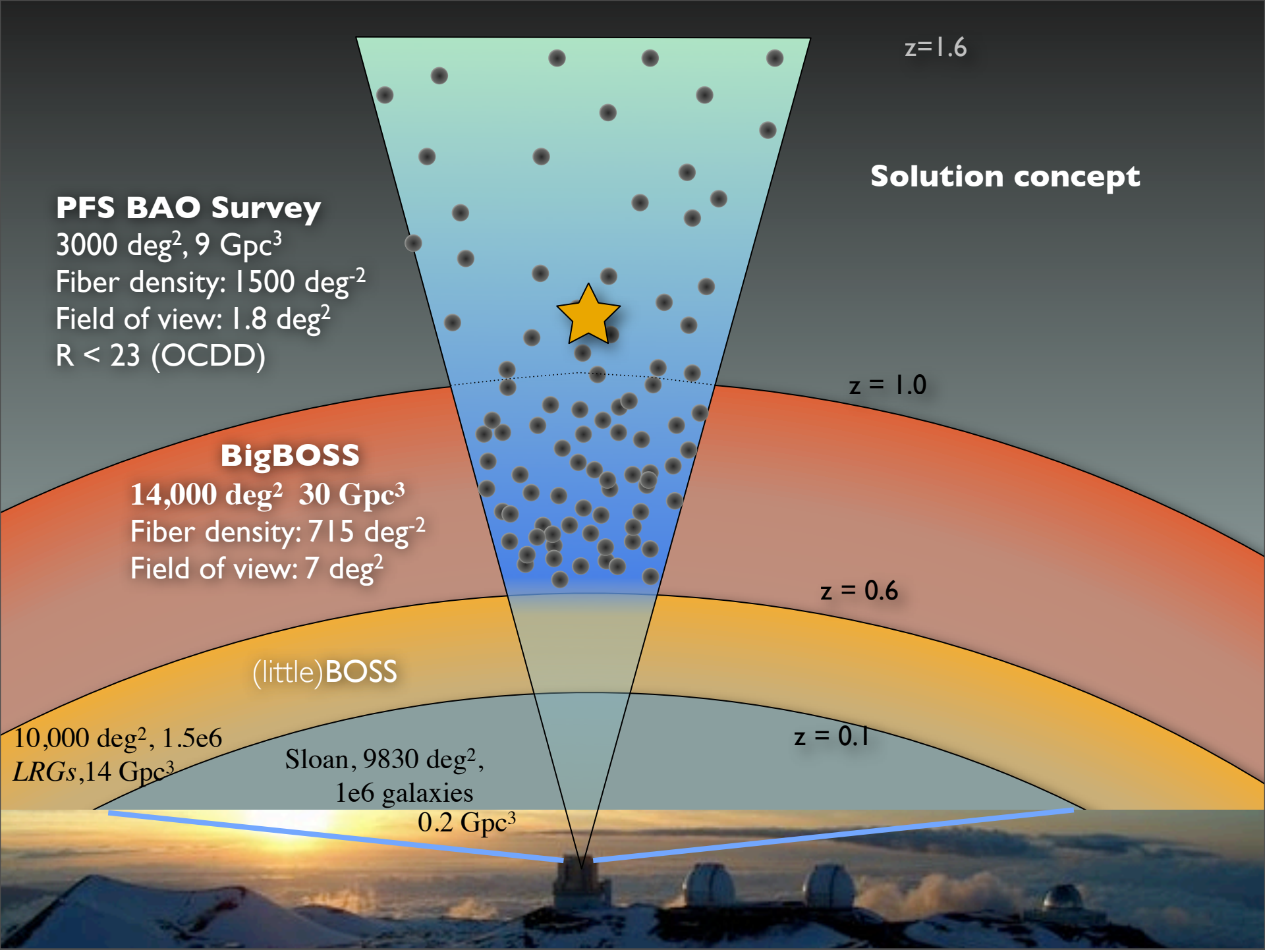
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
6.5 Gpc³
z = 1.0
2.3 Gpc³
300 deg⁻²
BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
z = 0.6
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³


z=1.6
Solution concept
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
z = 1.0
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z = 0.6
(little)BOSS
10,000 deg², 1.5e6
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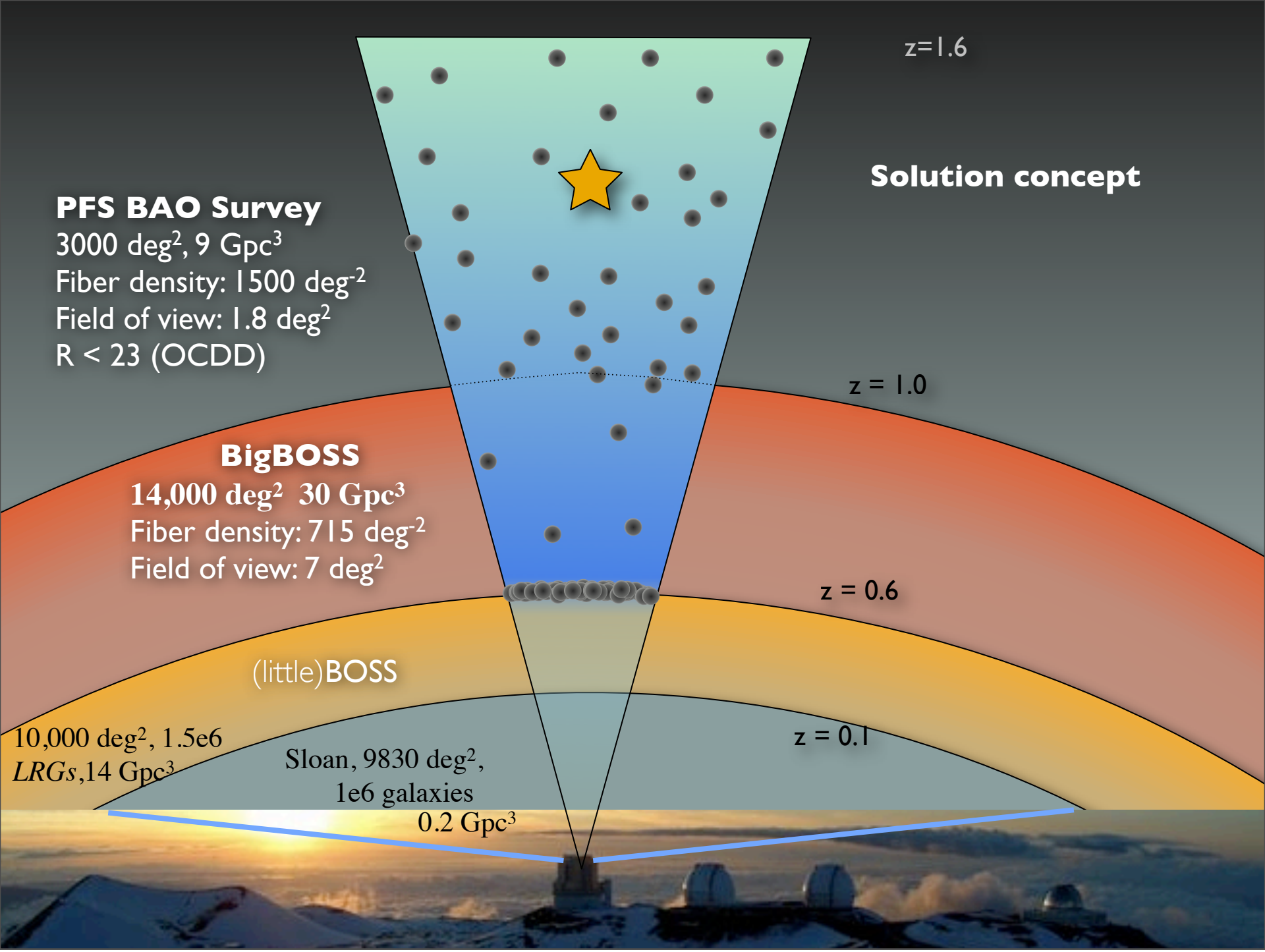
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Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
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BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
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(little)BOSS
10,000 deg², 1.5e6
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Sloan, 9830 deg²,
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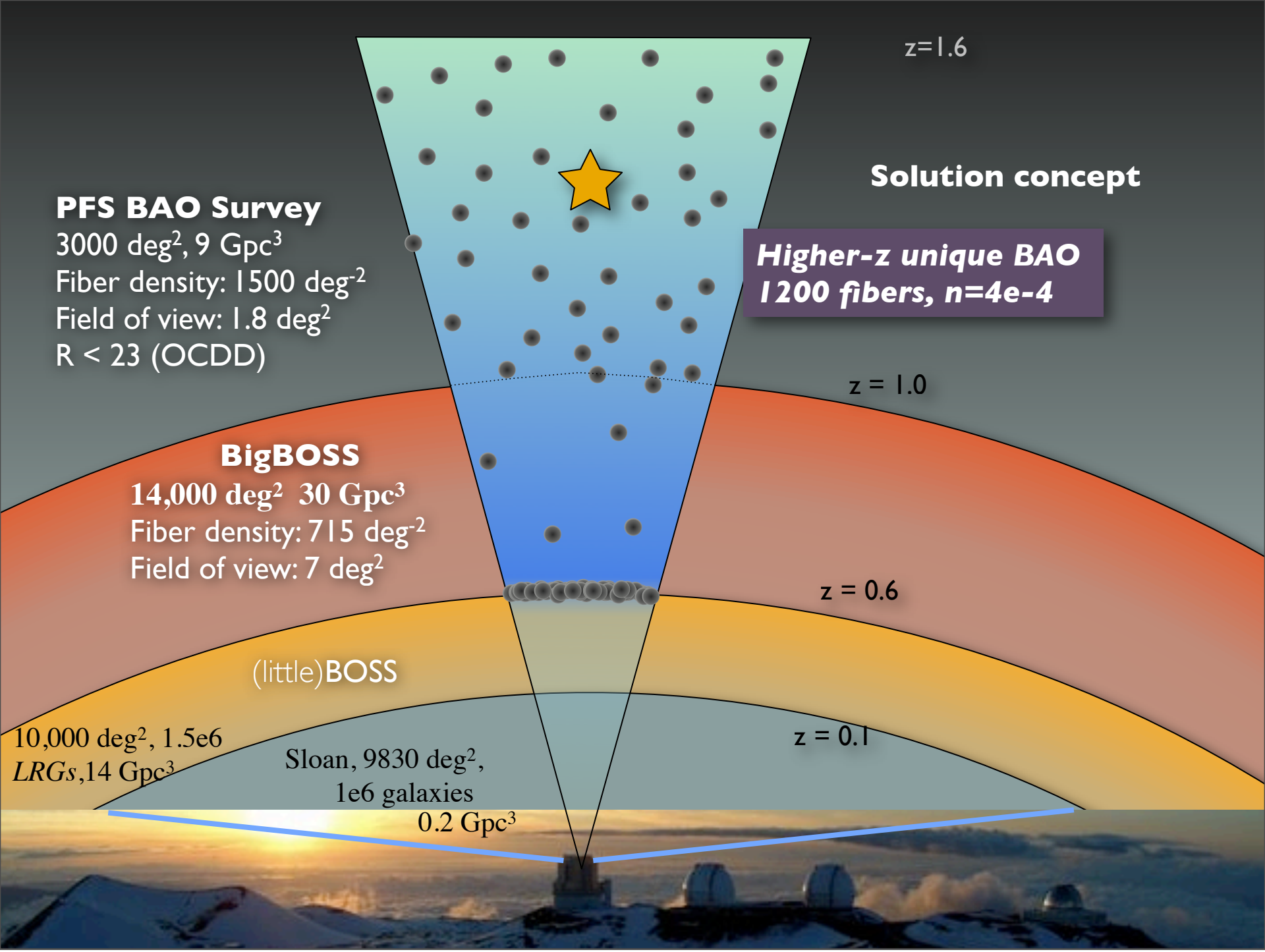
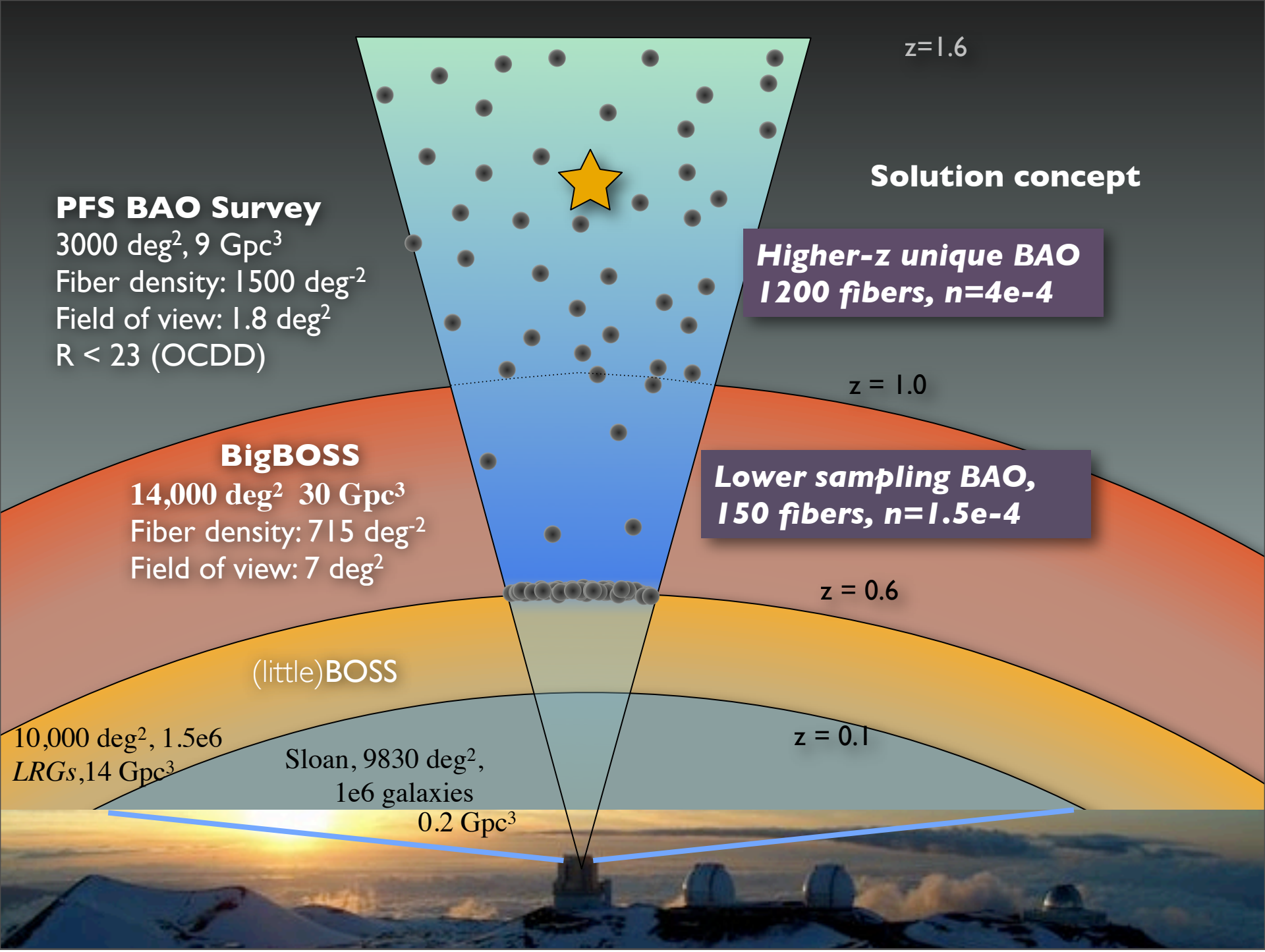
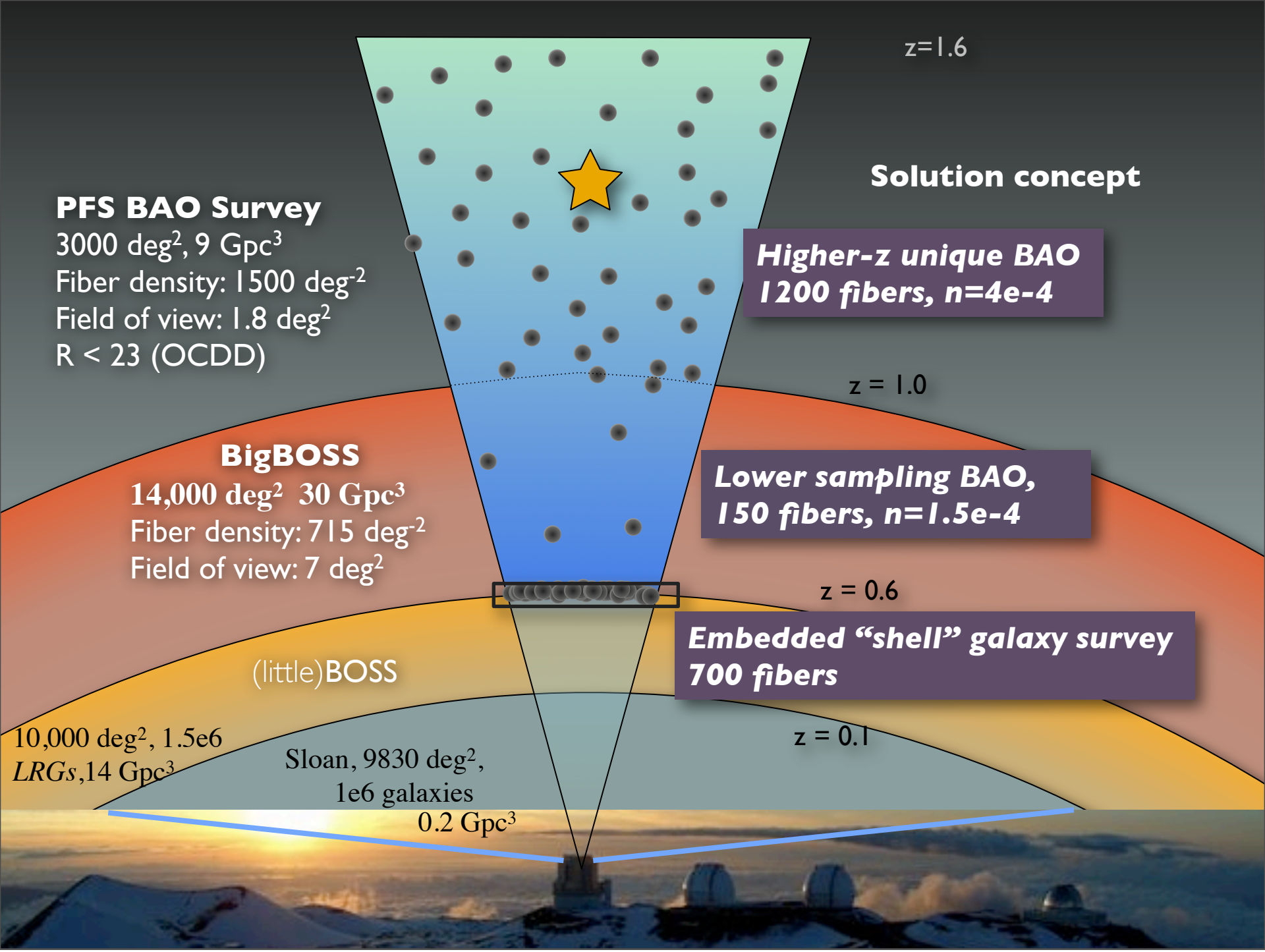

z=1.6
Solution concept
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
Higher-z unique BAO
1200 fibers, n=4e-4
z = 1.0
BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
z = 0.6
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³

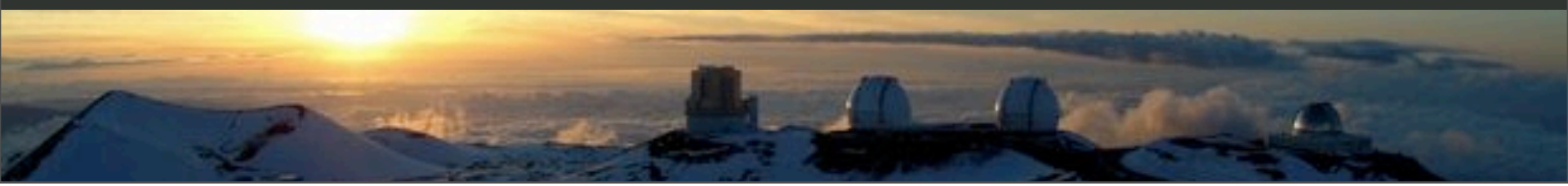

z=1.6
Solution concept
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
Higher-z unique BAO
1200 fibers, n=4e-4
z = 1.0
BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
Lower sampling BAO,
150 fibers, n=1.5e-4
z = 0.6
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³

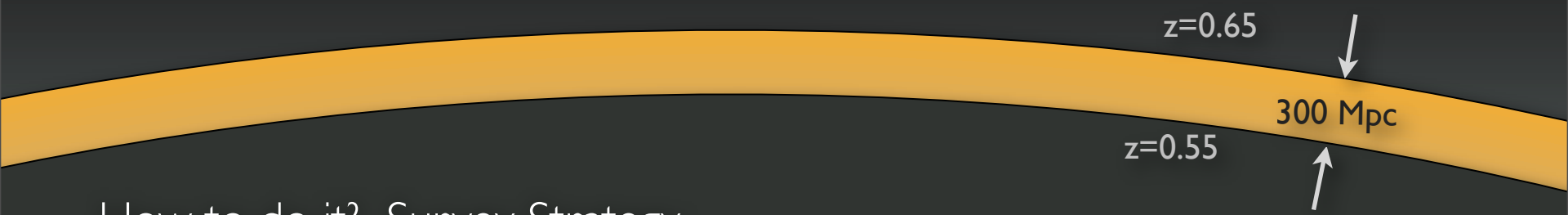

z=1.6
Solution concept
PFS BAO Survey
3000 deg², 9 Gpc³
Fiber density: 1500 deg⁻²
Field of view: 1.8 deg²
R < 23 (OCDD)
Higher-z unique BAO
1200 fibers, n=4e-4
z = 1.0
BigBOSS
14,000 deg² 30 Gpc³
Fiber density: 715 deg⁻²
Field of view: 7 deg²
Lower sampling BAO,
150 fibers, n=1.5e-4
z = 0.6
Embedded "shell" galaxy survey
700 fibers
(little)BOSS
10,000 deg², 1.5e6
LRGs,14 Gpc³
z = 0.1
Sloan, 9830 deg²,
1e6 galaxies
0.2 Gpc³

A mass-complete galaxy **shell** survey

- Log M > 10.5, 0.2 Gpc^3
- 90% sampling rates (DEEP2 was 30%)
- 1% clustering at 100 kpc → unique territory and science
- Bright galaxies (i<22) S/N ~ 8-10 → velocity dispersions, chemistry
- Covers all key lines: Ha, NII, OIII, Hb, OII, etc. → AGN, SFH, balmer decrement
- 0.2 Gpc^3 → Vanishing cosmic variance, statistics on rare samples

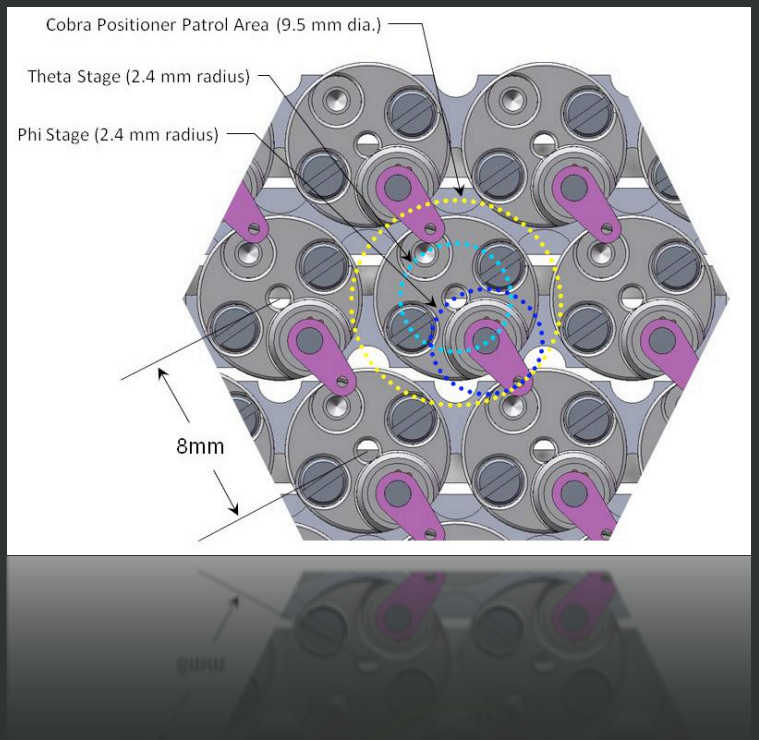
This is the galaxy survey Wish List!

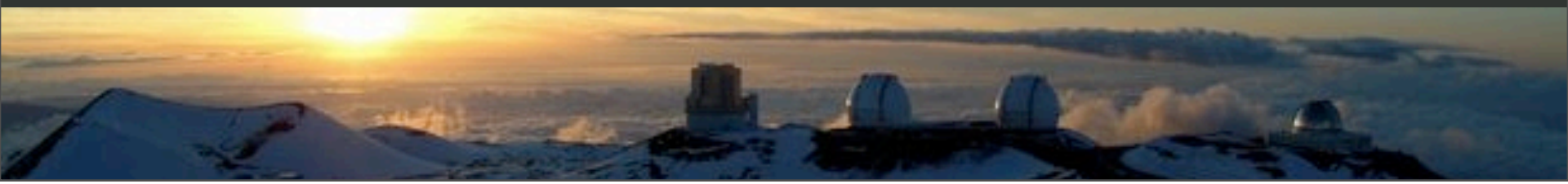


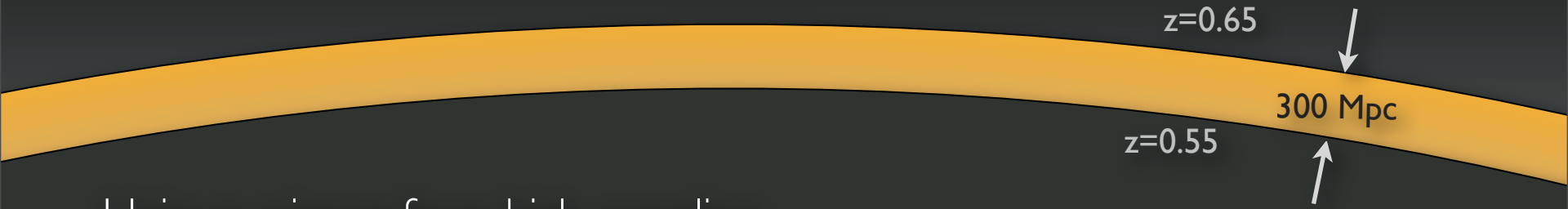


How to do it? Survey Strategy...

- Aggressive fiber re-deployment, 1minute
  - bright targets: i<21, 5 min, S/N 10
  - fainter targets: 21< i < 22, 30 min, S/N 10
- 2500 shell galaxies per PFS pointing
- 4.5e6 shell galaxies over 3200 deg^2
- Robust photo-z selection from HSC
  - *Synergy with HSC medium-band surveys!*

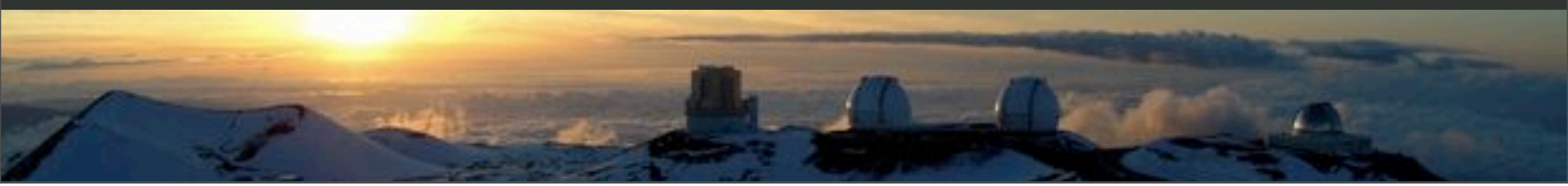






Unique science from high sampling in the **shell**

1. Identification of group/cluster satellites & filaments
   - Half of low-mass SDSS satellites fiber collided
   - Detailed environmental studies
   - Cluster (ACT) *masses*, velocity dispersion masses compared to lensing, confirmed richness
   - Dark matter profiles
2. Gas and galaxy formation: Cross correlation with absorbers (background QSO/galaxies)
3. Spec-z mergers, dV distributions
4. New cosmology probes



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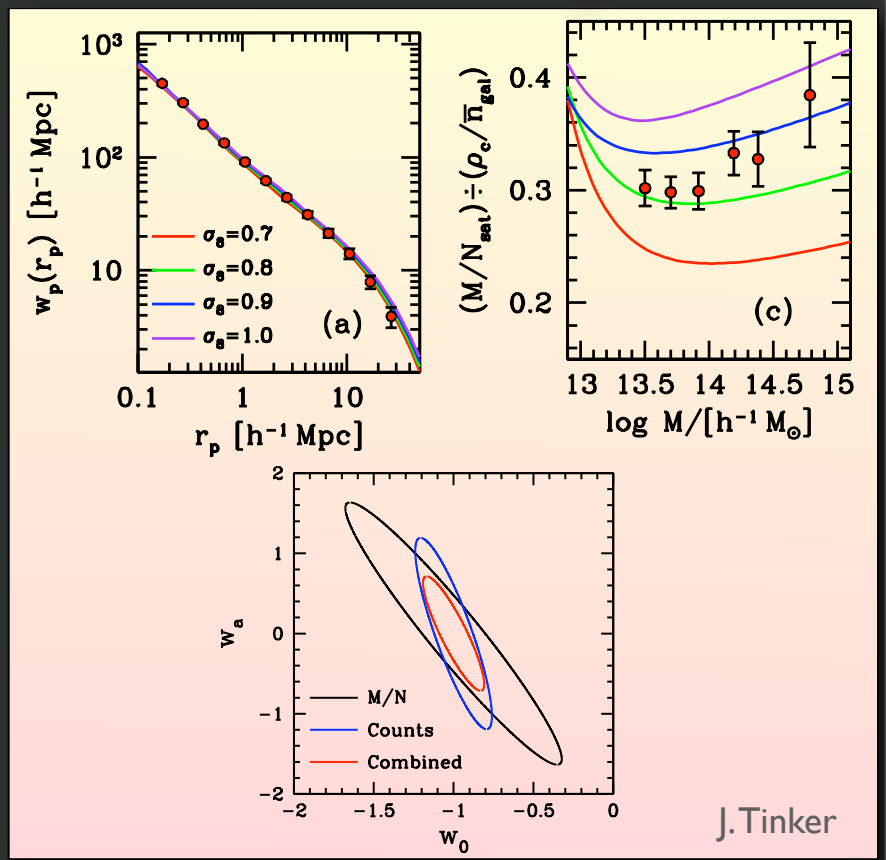

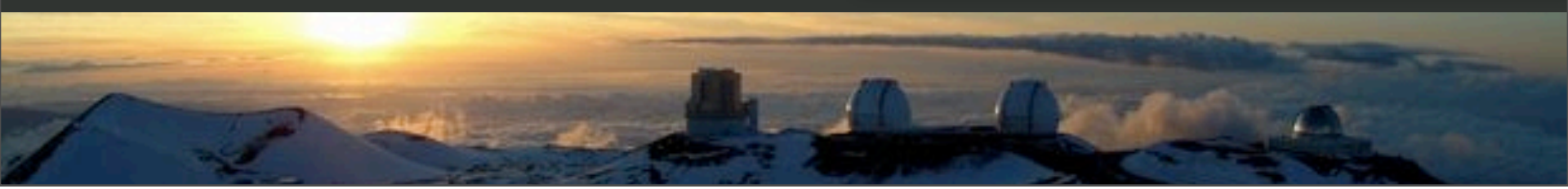

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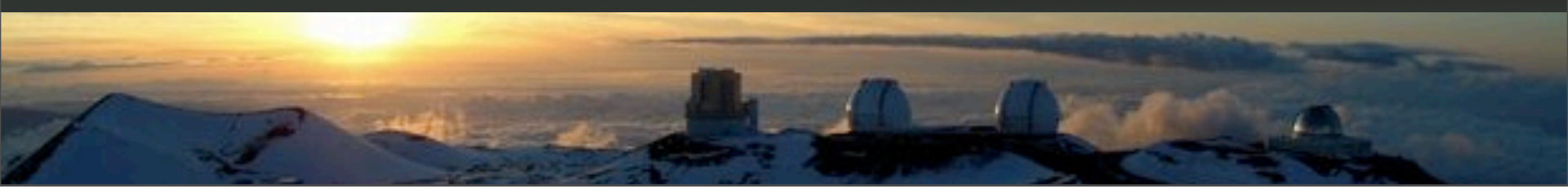

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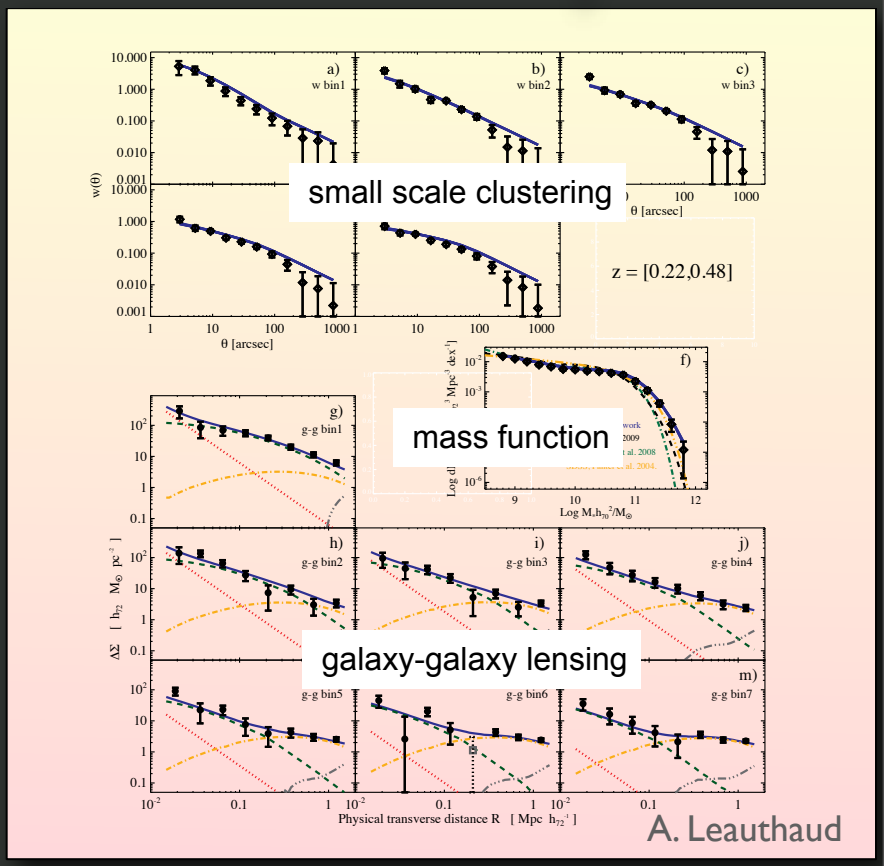
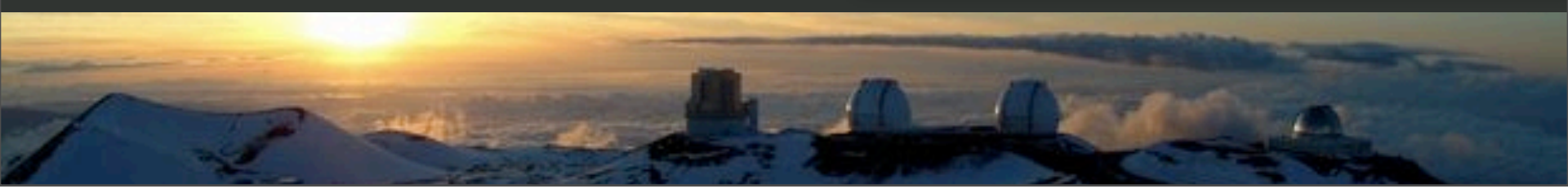
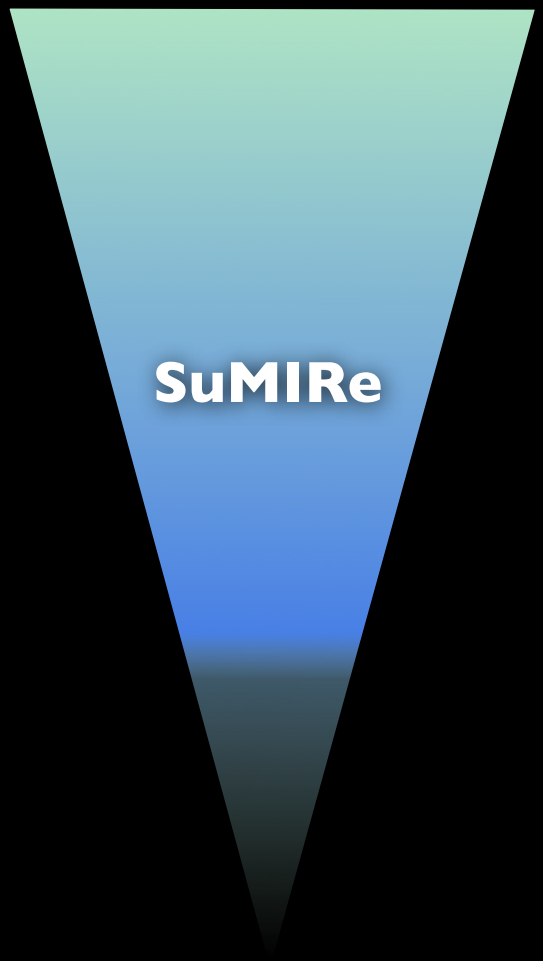




Summary: Hybrid strategies to marry galaxy and BAO science.

- Exploit unique power of Subaru for BAO by concentrating on z > 1.0

- An embedded shell at z=0.6 enables breakthrough, highly sampled galaxy science. Area, depth, and fiber density well suited to BAO component.



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