# AGN Science Collaboration

Sebastian F. Hoenig

University of Southampton

# AGN Science Collaboration: Overview

**Current membership:** 9 full members, 70 associate members

**Chair:** William (Niel) Brandt, Penn State, US, wnbrandt@gmail.com

**Main goals:**

- ***Maximise the AGN science return of Rubin Observatory's LSST***
- ***Give feedback to the project to ensure excellent AGN science***
- ***Educate the broader community about LSST AGN science***

**Current main task:** Work on priorities identified in the AGN SC Roadmap

**LSST:UK Point of Contact:** Sebastian Hoenig, Uni Southampton, s.hoenig@soton.ac.uk

# AGN Science Collaboration: Subgroups

**Variability** (Sebastian Hoenig/Ohad Shemmer)

- facilitate AGN variability science
  e.g. spectroscopic/photometric/disk reverberation mapping, identification of extreme variability, forecasting, etc.

**Photo-z** (Roberto Assef)

- coordinate AGN-specific photo-z methods
  e.g. multi-wavelength context, fitting methods, reliability test/metrices, etc.

**Selection** (Jan-Torge Schindler, Gordon Richards, Niel Brandt)

- develop and coordinate effective selection methods from LSST data
  e.g. colour selection, variability selection, selection biases, test samples, etc.

**Follow-up** (Franz Bauer/Xiaohui Fan)

- identify suitable follow-up resources and strategies
  e.g. spectroscopy, multi-wavelength data, coordination of proposals, etc.

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# AGN Science Collaboration: Membership

**Three membership tiers:**

- Associate (standard upon entry)
- Full (upon taking up tasks)
- Core (support roles for SC members)

**Applications and instructions:**
https://agn.science.lsst.org/

**Important**:
Make yourself familiar with the AGN Roadmap

| Country | Number of Members |
|---|---|
| USA | 39 |
| Chile | 8 |
| United Kingdom | 8 |
| Australia | 3 |
| Italy | 3 |
| Serbia | 3 |
| China | 2 |
| Poland | 2 |
| Canada | 1 |
| Germany | 1 |

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# AGN Science Collaboration: Recent work

**Cadence White Papers (2017)**

- Active Galaxy Science in the LSST Deep-Drilling Fields (Brandt+2018, arXiv:1811.06542)
  → definition of fields, cadences, and depths required for AGN science cases

**OMEGACAM proposal for precursor data (2020)**

- Deep and cadenced multi-band observations of deep field area not currently covered by other surveys
  → led by international members

**LSST Cadence Notes (2021)**

- AGN SC response to survey operation simulations
  → definition of metrics and running simulations to inform observatory; papers should be available soon

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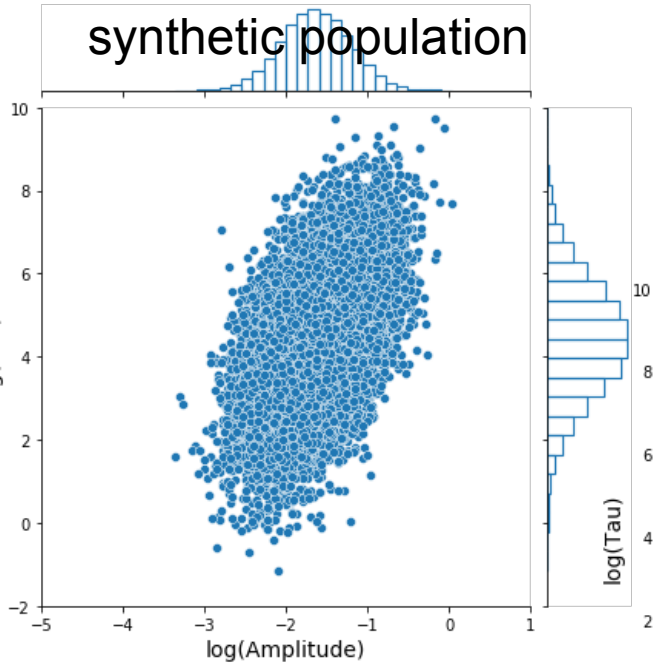
# AGN Science Collaboration: Recent work

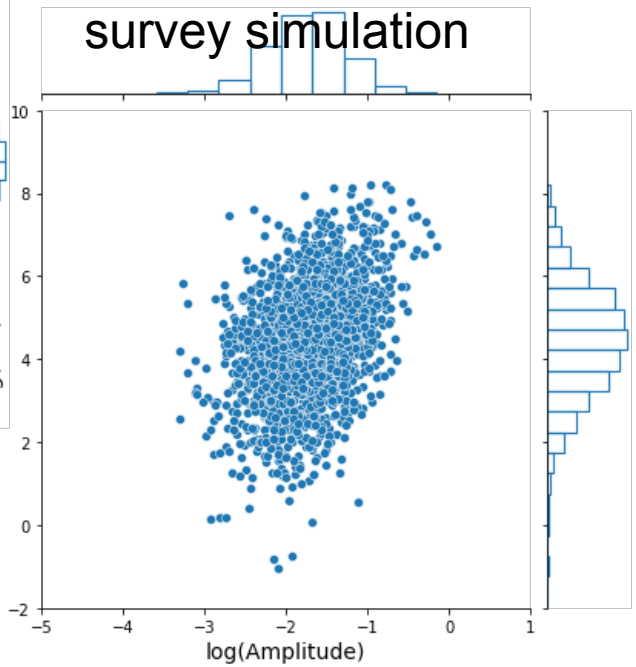
Rubin Observatory

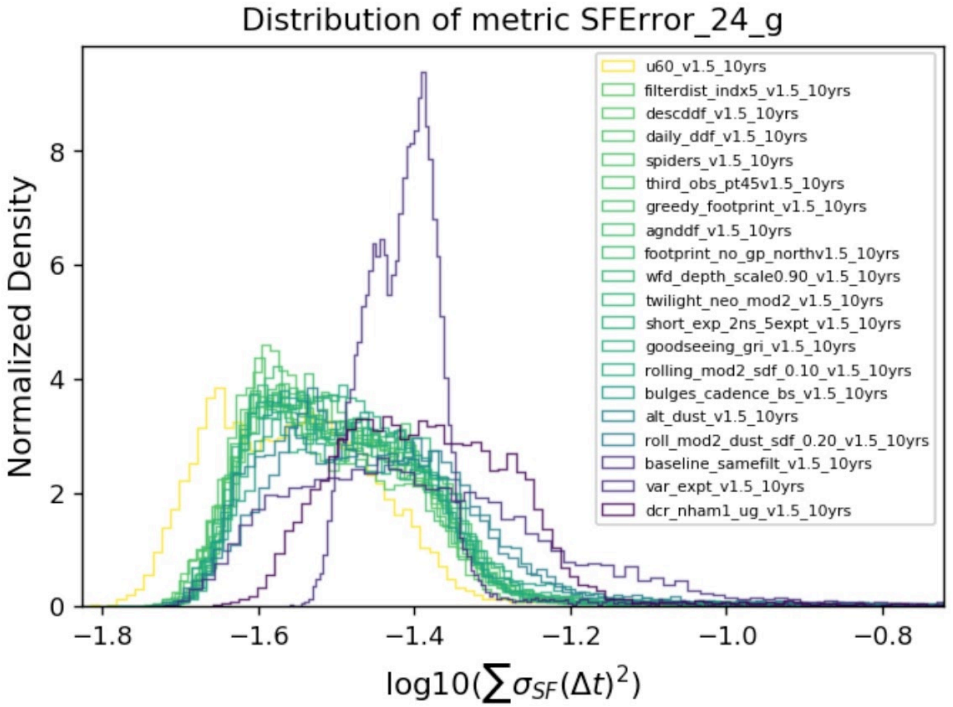
Weixiang Yu & Gordon Richards

Damped random walk synthetic population




Recovered from survey simulation

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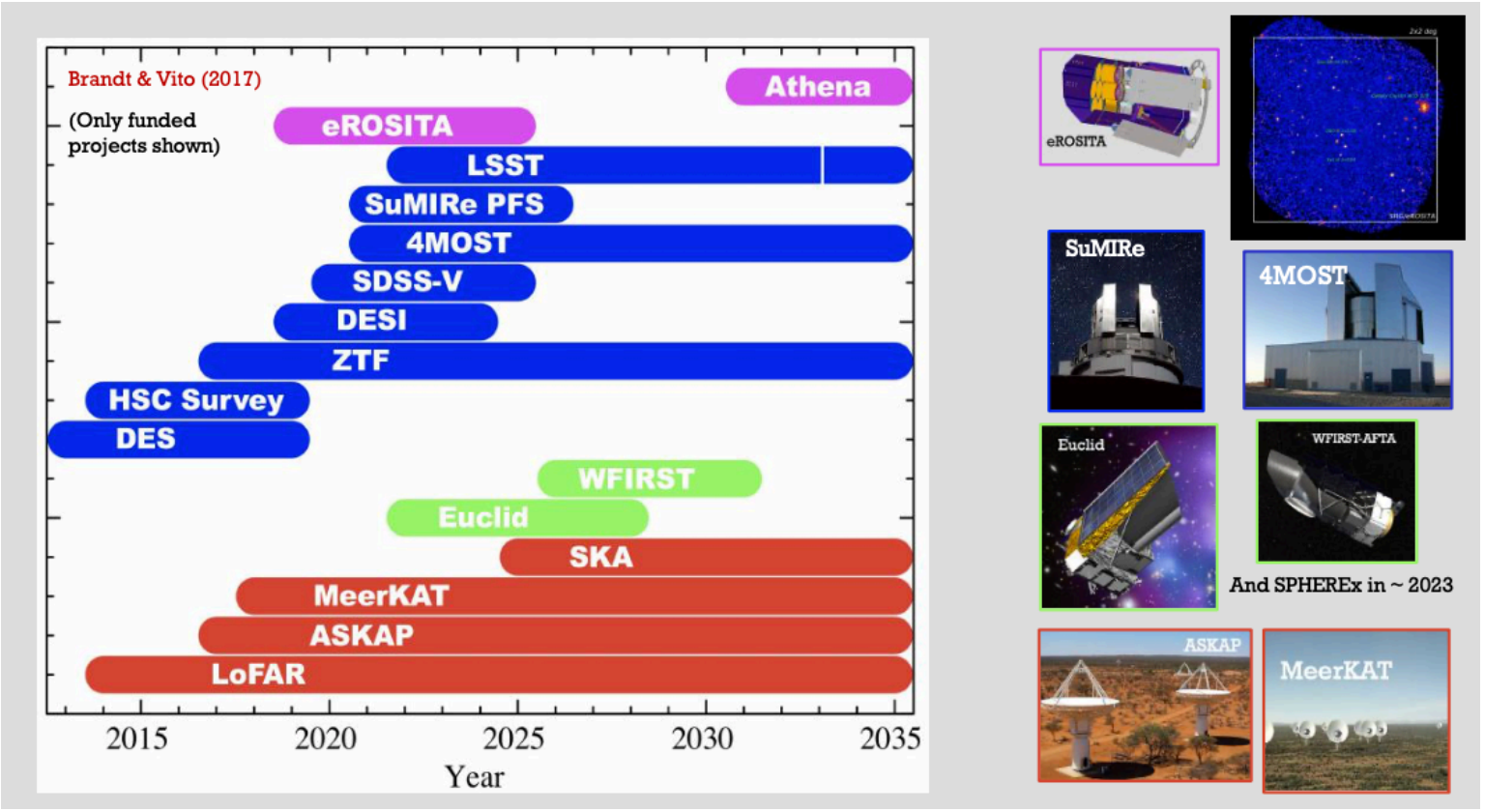
# AGN Science Collaboration: Preparations




from WN Brandt AGN SC talk

**LSST will play an important role in AGN science in the 2020s and beyond**

- 50M+ AGN at z ≲ 9-10

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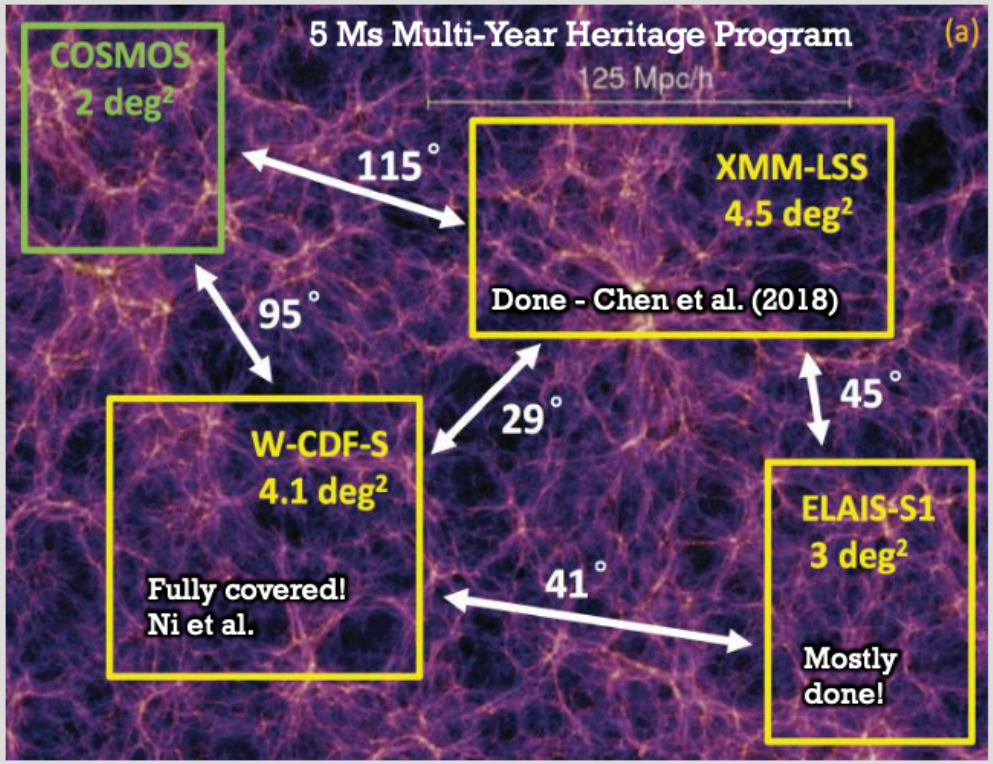
# AGN Science Collaboration: Preparations




**The XMM-SERVS survey: new *XMM-Newton* point-source catalog for the XMM-LSS field**

C.-T.J. Chen(陳建廷)[1,2*], W.N. Brandt[1,2,3], B. Luo[4,5], P. Ranalli[6], G. Yang[1,2], D.M. Alexander[7], F.E. Bauer[8,9,10], D.D. Kelson[11], M. Lacy[12], K. Nyland[12], P. Tozzi[13], F. Vito[1,2], M. Cirasuolo[14], R. Gilli[15], M.J. Jarvis[16,17], B.D. Lehmer[18], M. Paolillo[19], D.P. Schneider[1,2], O. Shemmer[20], I. Smail[7], M. Sun[21,22], M. Tanaka[23], M. Vaccari[17,24], C. Vignali[25,15], Y.Q. Xue[21,22], M. Banerji[26], K.E. Chow[27], B. Häußler[28], R.P. Norris[29,27], J.D. Silverman[30], and J.R. Trump[31]

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**ABSTRACT**

We present an X-ray point-source catalog from the XMM-Large Scale Structure survey region (XMM-LSS), one of the XMM-Spitzer Extragalactic Representative Volume Survey (XMM-SERVS) fields. We target the XMM-LSS region with 1.3 Ms of new *XMM-Newton* AO-15 observations, transforming the archival X-ray coverage in this region into a 5.3 deg$^2$ contiguous field with uniform X-ray coverage totaling 2.7 Ms of flare-filtered exposure, with a 46 ks median PN exposure time. We provide an X-ray catalog of 5242 sources detected in the soft (0.5–2 keV), hard (2–10 keV), and/or full (0.5–10 keV) bands with a 1% expected spurious fraction determined from simulations. A total of 2381 new X-ray sources are detected compared to previous source catalogs in the same area. Our survey has flux limits of $1.7 \times 10^{-15}$, $1.3 \times 10^{-14}$, and $6.5 \times 10^{-15}$ erg cm$^{-2}$ s$^{-1}$ over 90% of its area in the soft, hard, and full bands, respectively, which is comparable to those of the XMM-COSMOS survey. We identify multiwavelength counterpart candidates for 99.9% of the X-ray sources, of which 93% are considered as reliable based on their matching likelihood ratios. The reliabilities of these high-likelihood-ratio counterparts are further confirmed to be ≈ 97% reliable based on deep *Chandra* coverage over ≈ 5% of the XMM-LSS region. Results of multiwavelength identifications are also included in the source catalog, along with basic optical-to-infrared photometry and spectroscopic redshifts from publicly available surveys. We compute photometric redshifts for X-ray sources in 4.5 deg$^2$ of our field where forced-aperture multi-band photometry is available; > 70% of the X-ray sources in this subfield have either spectroscopic or high-quality photometric redshifts.



from WN Brandt AGN SC talk

**Ground-truth sample for calibration of LSST AGN**

- ~12k X-rat detected AGN in deep fields

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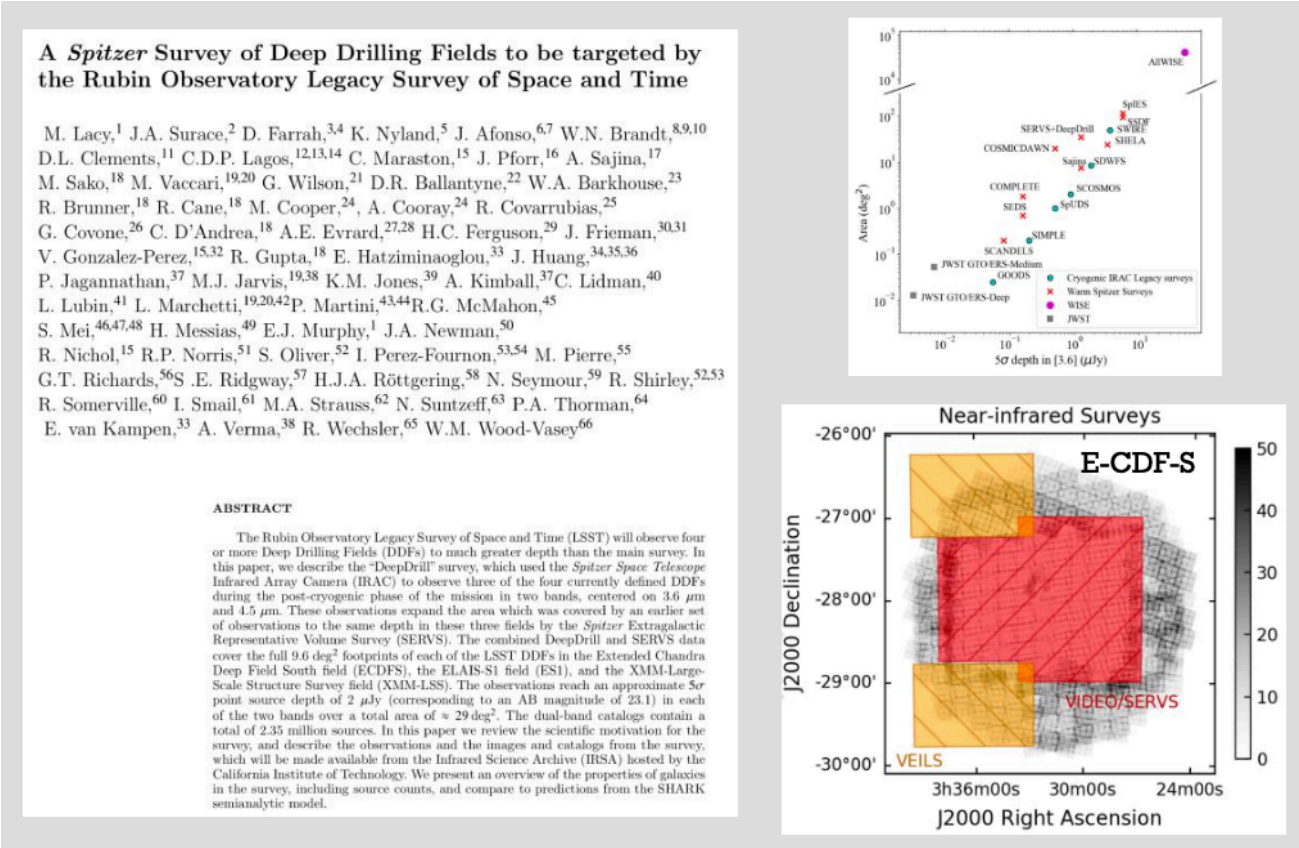
# AGN Science Collaboration: Preparations



A *Spitzer* Survey of Deep Drilling Fields to be targeted by the Rubin Observatory Legacy Survey of Space and Time

M. Lacy,[1] J.A. Surace,[2] D. Farrah,[3,4] K. Nyland,[5] J. Afonso,[6,7] W.N. Brandt,[8,9,10] D.L. Clements,[11] C.D.P. Lagos,[12,13,14] C. Maraston,[15] J. Pforr,[16] A. Sajina,[17] M. Sako,[18] M. Vaccari,[19,20] G. Wilson,[21] D.R. Ballantyne,[22] W.A. Barkhouse,[23] R. Brunner,[18] R. Cane,[18] M. Cooper,[24], A. Cooray,[24] R. Covarrubias,[25] G. Covone,[26] C. D'Andrea,[18] A.E. Evrard,[27,28] H.C. Ferguson,[29] J. Frieman,[30,31] V. Gonzalez-Perez,[15,32] R. Gupta,[18] E. Hatziminaoglou,[33] J. Huang,[34,35,36] P. Jagannathan,[37] M.J. Jarvis,[19,38] K.M. Jones,[39] A. Kimball,[37] C. Lidman,[40] L. Lubin,[41] L. Marchetti,[19,20,42] P. Martini,[43,44] R.G. McMahon,[45] S. Mei,[46,47,48] H. Messias,[49] E.J. Murphy,[1] J.A. Newman,[50] R. Nichol,[15] R.P. Norris,[51] S. Oliver,[52] I. Perez-Fournon,[53,54] M. Pierre,[55] G.T. Richards,[56] S .E. Ridgway,[57] H.J.A. Röttgering,[58] N. Seymour,[59] R. Shirley,[52,53] R. Somerville,[60] I. Smail,[61] M.A. Strauss,[62] N. Suntzeff,[63] P.A. Thorman,[64] E. van Kampen,[33] A. Verma,[38] R. Wechsler,[65] W.M. Wood-Vasey[66]

ABSTRACT

The Rubin Observatory Legacy Survey of Space and Time (LSST) will observe four or more Deep Drilling Fields (DDFs) to much greater depth than the main survey. In this paper, we describe the "DeepDrill" survey, which used the *Spitzer Space Telescope* Infrared Array Camera (IRAC) to observe three of the four currently defined DDFs during the post-cryogenic phase of the mission in two bands, centered on 3.6 $\mu$m and 4.5 $\mu$m. These observations expand the area which was covered by an earlier set of observations to the same depth in these three fields by the *Spitzer* Extragalactic Representative Volume Survey (SERVS). The combined DeepDrill and SERVS data cover the full 9.6 deg$^2$ footprints of each of the LSST DDFs in the Extended Chandra Deep Field South field (ECDFS), the ELAIS-S1 field (ES1), and the XMM-Large-Scale Structure Survey field (XMM-LSS). The observations reach an approximate 5$\sigma$ point source depth of 2 $\mu$Jy (corresponding to an AB magnitude of 23.1) in each of the two bands over a total area of $\approx$ 29 deg$^2$. The dual-band catalogs contain a total of 2.35 million sources. In this paper we review the scientific motivation for the survey, and describe the observations and the images and catalogs from the survey, which will be made available from the Infrared Science Archive (IRSA) hosted by the California Institute of Technology. We present an overview of the properties of galaxies in the survey, including source counts, and compare to predictions from the SHARK semianalytic model.







from WN Brandt AGN SC talk

**Infrared contextual data required to enable "static" science cases**

- new data contribution from the UK

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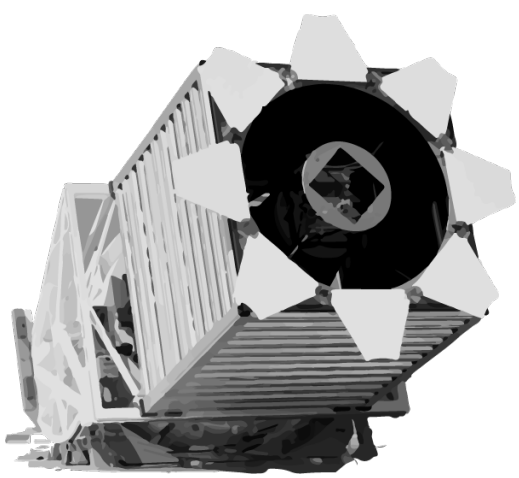
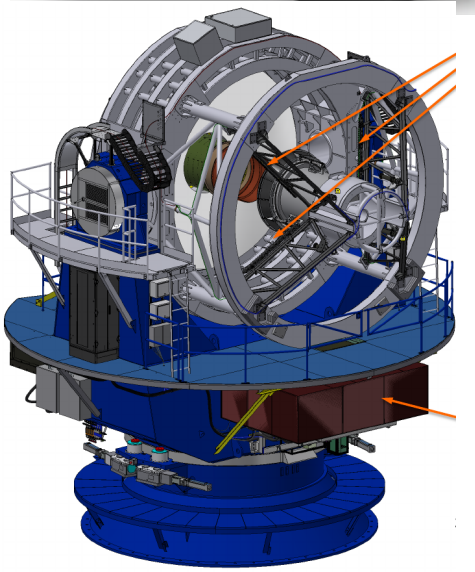
# AGN Science Collaboration: Preparations





**Spectroscopic surveys in support (and in requirement) of LSST AGN science**

- AGN SC as a platform to coordinate programmes

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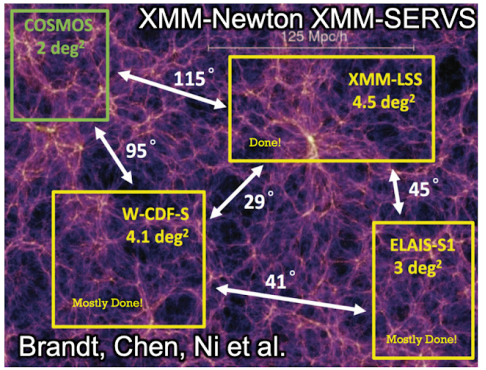
# AGN Science Collaboration: Summary

**Chair:** William (Niel) Brandt, Penn State, US, wnbrandt@gmail.com

**Website:** https://agn.science.lsst.org/

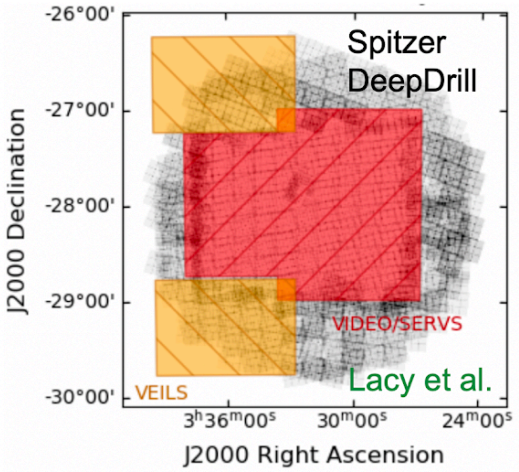
**Current membership:** 9 full members, 70 associate members
(not many UK members right now!)




**Main goal:** ***Maximise AGN science in LSST with a sample of 50M+ AGN out to z > 7***

**Science areas and subgroups:**

- variability (reverberation mapping, DRW, …)
- photo-z
- selection
- follow-up




**How to get involved:**

- Membership application form on the website
- state your interest and what you want to do

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