Part 7
Summary

https://doi.org/10.1017/S0252921100031146 Published online by Cambridge University Press

Conference Dinner: Areg Mickaelian, Ed Khachikian

Conference Banquet:
Phil Outram, Lily Hovhanessyan, Caryl Gronwall, James Manners,
Omar Almaini, Vicki Sarajedini, Kate Isaak

https://doi.org/10.1017/S0252921100031146 Published online by Cambridge University Press

AGN SURVEYS
ASP Conference Series, Vol. 284, 2002
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Conference Summary

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Abstract. This conference on *AGN Surveys* has proved to be a significant milestone in our understanding of the redshift distribution of optically selected QSOs, and in our initial understanding of the cosmic distribution of AGN from the first far-infrared and X-ray deep fields. It has also set the stage for continuing debates concerning the multiwavelength properties of AGN, the cosmological distribution of "obscured" AGN, and the "orientation versus evolution" debate on the nature of the sources discovered at different wavelengths. Much of this debate could have been anticipated from previous studies of the complete samples of optically-selected AGN provided to us by the pioneering work carried out by the staff of the Byurakan Astronomical Observatory over the past 40 years.

1. Introductory Remarks

On behalf of the Scientific Organizing Committee I would like to sincerely thank the Local Organizing Committee and the entire staff of the Byurakan Astrophysical Observatory (BAO) for their hard work in preparing for this IAU Colloquium and for their gracious hospitality in hosting this week's conference on the observatory grounds. To have been able to hold this meeting on *AGN Surveys* at the BAO is indeed a fitting tribute to the memory of Beniamin Markarian.

I would also like to thank all of the speakers and poster presenters for their collective effort in making this meeting a great success. Each of the meeting sessions has been well attended and the large number of oral contributions and posters presentations have provoked lively discussion. In the four full days of talks we have managed to thoroughly cover the full wavelength spectrum of AGN Surveys – past, present, and future – and to provide what I believe is the first truly comprehensive picture of the AGN phenomenon out to redshifts $z \sim 6$, and covering a wide range of total luminosity ($M_B \sim -7$ to -30). Although the breadth and depth of modern all-sky surveys now routinely carried out from space and on the ground has provided us with tens of thousands of cataloged AGN, it is clear from the talks at this meeting that the "Markarian Lists" generated from the First and Second Byurakan Surveys remain as one of the most important sources of objects for *detailed* studies of the AGN phenomenon.

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For many of the participants at this meeting this has been a first visit to the BAO as well as to Armenia in general. The opportunity to explore the Observatory grounds and to talk with many of the staff who were directly involved with the early FBS has reminded many of us both of the energy and dedication required to carry out such a pioneering survey, and also of what can still be accomplished with modest-sized telescopes when they are equipped with modern wide-field detectors.

On a more personal note, I suspect that my introduction to astronomy in Armenia and to the work carried out at the BAO parallels that of many of the non-Armenian astronomers at this meeting. Although I was aware of Ambartsumian through his famous text – "Stellar Evolution and Astrophysics" (1947) – my first real connection with the Byurakan Astrophysical Observatory came both from reading the proceedings of IAU Symposium 29, which was held at the BAO in May, 1966, and from reading the Conference Proceedings of the 1968 Tucson meeting on AGN, where Ed Khachikian presented the now famous first lists of objects from the BAO survey for "Galaxies with Ultraviolet Continuum", which he termed "Markarian galaxies" (e.g. Khachikian 1968).

During the mid 1980's I spent considerable time studying the complete lists of Markarian galaxies, which were published in *Astrofizika* (25 papers) over a sixteen year span (Markarian 1967; ...; Markarian, Lipovetskii & Stepanian 1982). I did this because these objects were turning up in significant numbers as cross-IDs with luminous infrared galaxies (LIGs), then being compiled from the *Infrared Astronomical Satellite* (*IRAS*) all-sky survey. I quickly learned the benefit of having access to a wide-field, systematic, well-calibrated, extragalactic survey, where the majority of the objects had published redshifts. I also found it somewhat surprising that objects discovered in a survey for UV-excess galaxies would have significant overlap with luminous, far-infrared-selected galaxies.

2. Scientific Highlights

The oral presentations given on Days 1, 2 and 4 of this meeting (Day 3 was reserved for the Conference excursion) each covered a specific wavelength range(s) of AGN surveys, while Day 5 presented a more general discussion of AGN phenomena and ended with several talks on Future Projects relating to AGN surveys. I found it most useful to keep to the same chronology in this closing talk.

For each of the four full days of oral presentations I will first give a brief summary of the scientific highlights presented in the invited and contributed talks, followed by a bulleted list of the items that stood out to me as being the most interesting new results. I then list what I feel are some of the major outstanding questions raised by the presentations, followed by my suggested answers (when the weight of the data seemed to provide an answer).

2.1. Day 1 - Optical Surveys for AGN

Ed Khachikian opened the meeting with a brief history of Markarian's scientific career and reminded us of the importance of the First Byurakan Survey (FBS), begun in 1965. Using some of the original objective prism spectra, he then reminded us of the spectral classification schemes developed for describing the

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different spectral types discovered among these UV-excess galaxies. He also used specific examples to point out the variety of morphologies found in the central regions of these objects, including double nucleus galaxies, galaxies with radio jets, and "star-like" nuclei.

The "final results" (after 27 years of work !) from the Second Byurakan Survey (SBS) that was begun in 1974 in parallel with the FBS, were summarized by *Jivan Stepanian.* The SBS was designed to provide a large well-defined sample of AGNs and QSOs down to $B \sim 19.5$, which is $\sim 2-3\times$ fainter than the FBS. Follow-up spectroscopy of SBS galaxies using 4-6 m telescopes provided evidence for a continuity of properties among the various spectral types – from classical BLSy1s through NLSy1s, Sy2s, to LINERs and starbursts. Additional results from multiwavelength follow-up studies of SBS fields, including comparisons with *ROSAT, IRAS, NVSS,* and *FIRST* were also presented.

More modern objective prism surveys of AGN continue to succeed in discovering substantial numbers of new AGN. *Caryl Gronwell* summarized the results from the KPNO International Spectroscopic Survey (KISS), which is less biased against redder Seyfert 2 and LINER galaxies, and provides a well-defined sample of nearby ($z < 0.1$) AGN for multiwavelength studies. Results include the finding that Sy 2s and LINERs are significantly redder in $(B-V)$ colors than Sy 1s, plus the rather surprising finding that the majority of AGN in the KISS sample follow the same radio-IR correlation as found for starburst galaxies.

Louis Ho brought us up to date on the latest in AGN statistics from studies of complete samples of nearby galaxies using the Palomar 200-inch telescope, and reminded us of the importance of studying the faint end of the AGN luminosity function. AGNs are most common in early-type systems: ~60% in E-Sbc galaxies compared to ~15-20% in late types. At least 40% of all galaxies with $B_{\rm T} < 12.5$ mag exhibit AGN-like spectra, i.e. Seyferts, LINERs, or transition objects (LINER/HII). LINERs make up nearly 2/3 of all AGN. They are further divided into two types depending of the detection of a weak broad-line component, with those of type-1 almost certainly being low-luminosity AGN while those of type-2 likely being a mixture of starburst and AGN.

Lutz Wisotzki summarized the highlights from the large objective prism Hamburg All-Sky Bright QSO surveys (the HQS and HES in the north and south, respectively). Over the past decade, the Hamburg surveys have greatly improved our knowledge of both the faint and bright end of the QSO luminosity function (LF). I found the comparisons with other surveys, showing general agreement in the surface density of QSOs, to be reassuring, including the $1.5\times$ higher surface density compared to the Palomar-Green survey, which finally rules out previous claims of extreme incompleteness of the PG sample. In a second invited talk (also delivered by Wisotzki) the evolution of the QSO luminosity function was discussed using a merged sample of six optical QSO surveys. The statistics now appear sufficient to discriminate between pure-luminosity evolution (PLE) and pure-density evolution (PDE). At low redshift ($z < 1$), PLE seems clearly favored, while at high redshift ($z = 1-3$), some form of luminosity-dependent density evolution seems to be required.

Additional properties of optically selected QSOs were presented in several contributed talks. *Phil Outram* discussed QSO power spectra from the 2DF Survey and found that the shape and amplitude of the QSO power spectrum

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are similar to galaxies at the present day, and are a factor of ~ 10 lower than that measured for Abell clusters. *Ken Mitchell* reviewed the properties of the 19 QSOs in the US Bright Quasar Sample and discussed the importance of this sample for helping define the extreme bright end of the QSO LF. *Helmut Meusinger* and *Vicki Sarajedini* showed how optical variability and proper motion studies could be used to efficiently discover new, primarily lower luminosity AGN, while *Dario Trevese* presented an analysis of the variability of QSOs in the optical band.

Highlights from Day 1 included:

- The "classical Seyfert" fraction of optically selected galaxies is ~10-15%.
- For optically selected galaxies the LINER fraction is ~35% (i.e. $\gtrsim 2/3$ of all AGN). This result is largely independent of galaxy luminosity.
- The LF for optically selected AGN appears to be very well determined over the range $M_B = -8$ to -21 in the "local volume" and for $M_B = -14$ to -28 out to $z \sim 1.5$. The LF exhibits strong positive evolution over the range $z = 0-1$ [i.e. $\propto (1+z)^{3.3}$ assuming PLE], is nearly invariant over the range $z = 1-3$, and shows a single power-law decline over the range $z = 3-6$.

Major questions raised (plus consensus answers) included:

Q1.1 Do all major optical AGN surveys give consistent LFs ?

Yes, within the statistical uncertainties. Claims from a few years ago of large differences, e.g. between the HES and the PG surveys seem to have largely disappeared.

Q1.2 Are the majority of LINERs classified as LLAGN true AGN ?

Yes, given the results presented by Luis Ho.

Q1.3 PLE vs. PDE vs. Z ?

Although the majority of published papers discuss the QSO LF in terms of PLE at all redshift, the results presented by Wisotzki seem to favor PDE at $z \lesssim 1$. At higher redshift the statistics are insufficient to distinguish between PLE and PDE, plus the shortened timescales would seem to argue for a mixture of both (i.e. PLE + PDE).

2.2. Day 2 - Infrared/Submillimeter Surveys for AGN

AGN *discovered* at infrared and Submillimeter wavelengths (as opposed to the infrared/submillimeter properties of optically selected AGN), is a relatively new area of AGN research. Although *IRAS* provided the first large samples of infrared-selected AGN over a decade ago, this subfield has received several new "shots in the arm", most recently from the all-sky near-infrared survey 2MASS, and over the past half-decade from the small deep-fields and targeted observations made by both *The Infrared Space observatory (ISO)* and the Submillimeter Common User Bolometer Array (SCUBA) on the James Clerk Maxwell Telescope (JCMT).

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It is probably fair to say that, in total, the results presented on Day 2 were the least familiar to the majority of those in the audience, and raised some of the longest discussions during the conference. Aside from the intrigue associated with the moniker "obscured AGN", these objects seem to be providing important new information related to the origin and evolution of the AGN population as a whole. My own personal hope is that these obscured AGN may provide a key link that will allow us to unify what has often been referred to as the "AGN zoo".

Sylvain Veilleux began the day by providing a refresher course on AGN emission line diagnostics (primarily optical/near-infrared). He reminded us that the field has evolved considerably from the early Seyfert 1/2 classification schemes (and several decimal classifications in-between !), which were based primarily on line-width, through the line-ratio classification schemes of Baldwin-Phillips-Terlevich, to the more recent line-ratio diagnostic diagrams of Veilleux-Osterbrock that attempt to decrease the effects of reddening by using line-pairs with small $\Delta\lambda$. New line ratios in the near-infrared have also been added, and the importance of high-ionization lines (e.g. CIV, FeVII, NeV, ...) was stressed. But problems still remain; aperture effects, shocks, metallicity, morphological bias were some of those mentioned, along with the most obvious - heavy obscuration.

Roc Cutri then provided dramatic new evidence from the Two Micron All Sky Survey (2MASS) showing the existence of a substantial new population of "red AGN". He pointed out that nearly all AGN discovered in optical/UV surveys have near-infrared colors, $(J-K) < 2$. In a follow-up redshift survey of 413 2MASS extragalactic sources with $(J-K) > 2$, **72%** were found to be either Seyfert 1 or 2 ! He stated that the new 2MASS results suggest that 50–80% of all AGNs have been missed in existing optical/UV surveys. The implication for *SIRTF* is that *SIRTF* should discover ~25,000 "red AGN" deg^{-2}. The 2MASS "red AGN" contain the most polarized objects (11/89 had $P >$ 3%), are systematically underluminous in X-rays (nearly 2 orders of magnitude less than the mean for PGQSOs), and have inferred line-of-sight gas columns N(H)~10^{22} cm^{-2}. "Red AGN" appear to have ~ 5 mag of extinction on top of what is present in the "average" PGQSO. It was also pointed out, perhaps not surprisingly given the above description, that < 1% of the 2MASS "red AGN" have been discovered in surveys at other wavelengths. And finally, a word of caution that the 2MASS "red AGN" search was not sensitive to heavily obscured objects, implying that the 2MASS "red AGN" may only represent a fraction of the true size of the obscured AGN "iceberg".

Zeljko Ivezić then gave a summary of the exciting new results that have emerged from the early analyses of data from the Sloan Digital Sky Survey (SDSS) by matching SDSS sources with sources from 2MASS and the Faint Images of the radio Sky at Twenty-cm (FIRST) survey. Preliminary results include the finding that the optical colors of radio-loud quasars (RLQs) are ~ 0.05mag redder than the optical colors of radio-quiet quasars (RQQs), and that the fraction of quasars *with stellar colors* missed by the SDSS spectroscopic survey is probably not larger than 10%. There was some debate concerning the ability of SDSS to both detect and identify the "red AGN" population seen by 2MASS, and this issue was not clearly resolved during the conference.

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Ski Antonucci gave a somewhat provocative presentation focusing on what he termed "questionable interpretations" of AGN surveys. In particular, he focused on searches for polarized broad Hα lines in Sy 2s as a descriminant for various beaming models and models with circumnuclear tori. He pointed out (correctly in my opinion) that many previous statements claiming that Sy 1s and Sy 2s are intrinsically different, are flawed due to failure to select the samples by an isotropic property. Concerning the nature of the dominant energy source powering ultraluminous infrared galaxies (ULIGs), he noted the disparate results obtained from optical, near-infrared, mid-infrared and X-rays on the *same objects*, and pointed out that optical-infrared line emission is a diagnostic only to the depth penetrated by light of these wavelengths. In heavily obscured AGN this is likely often to be only the thin outer onion skin of a nuclear source which is buried behind column densities of order $\sim 10^{23} - 10^{24}\,\mathrm{cm}^{-2}$ (i.e. $A_V = 100 - 1000$). He also offered the opinion that "there is no accurate conversion from any particular starburst spectral feature to the bolometric luminosity of the associated starburst population".

Gene Smith brought us up to date on plans for the *SIRTF* Wide-area Infrared Extragalactic Legacy Survey (SWIRE) that will survey $\sim 67\,\mathrm{deg}^2$ in all 7 SIRTF imaging bands to much fainter flux levels than obtained by *IRAS* and *ISO*. SWIRE expects to detect ~25,000 "classical AGN" and perhaps several times as many dust-enshrouded AGN, and will allow us to trace cosmic evolution in the AGN population(s) out to $z \sim 3$.

Hervé Aussel summarized the results of *ISO* deep mid-infrared surveys at 15μm. Using data primarily from the Hubble Deep Field (HDF), he claimed that by making reasonable assumptions for the infrared/submillimeter spectral energy distributions (SEDs), he could show that the faint 15μm sources could account for the bulk of the infrared/submillimeter cosmic infrared background (CIB), which actually peaks between 100μm and 250μm. He went on to further state that the contribution of "type-2 AGN" to the CIB is likely to be $< 15\%$.

Yoshi Taniguchi presented results from both deep mid-infrared and far-infrared surveys with *ISO*, and pointed out the relatively large number of far-infrared sources being discovered at intermediate redshifts ($z \sim 0.3 - 0.8$), indicating strong evolution in the far-infrared source population at these redshifts.

Martin Haas presented a new mid-infrared/submillimeter diagnostic – the PAH 7.7μm-line-to-850μm-continuum flux ratio – that could be used to test for high mid-infrared extinction. He then used this ratio to show evidence for a hidden QSO in the archetypal ULIG Arp220.

Additional properties of infrared/submillimeter-selected QSOs were presented in several contributed papers. *Israel Matute* presented evidence for very strong evolution, $L_{15}(z) \propto (1+z)^3$, in the faint 15$\mu$m source population from analysis of an ISO deep survey in the ELAIS S1 region. *Henrique Schmitt* (in the spirit of Ski Antonucci's directive !) used a 60μm selection criteria to show evidence in support of the "Unified Model" in which Sy 2s contain a torus seen more edge-on than in Sy 1s. *Maria Marcha* presented preliminary results from the CLASS blazar survey of "Type 0" objects (weak or no emission lines) showing that, under the assumption that passive elliptical galaxies (PEGs) contain hidden BL Lac nuclei, that the flattening of the radio luminosity function (RLF) at low luminosities disappears. *Omar Almaini* then presented new evidence for

a very strong cross-correlation signal between Chandra faint X-ray sources and SCUBA 8 mJy 850μm sources, suggesting that both populations may be tracing the same large-scale structure at high redshift.

Highlights from Day 2 included:

- The number of new, near-IR-selected "red AGN" (2MASS vs. SDSS)
- AGN Diagnostic Lines - *"Veilleux's Ten Commandments"*
- The true number of new MIR/FIR/Submm-selected AGN

The major questions raised (+ consensus answers) included:

Q2.1 What is the new contribution from $(J-K)$-selected AGN ?

The results from ground-based follow-up spectroscopy of 2MASS extragalactic objects with $(J-K) > 2$ seems to clearly indicate that the great majority of these objects are Seyferts (many of type 1). Given that these objects have a comparable space density to optically-selected QSOs, this would indeed seem to indicate that the QSO population may be at least a factor of 2 larger than previously estimated from optical surveys.

Q2.2 What is the AGN fraction from MIR/FIR/Submm surveys ?

Optical and near-IR spectroscopy of luminous infrared galaxies (i.e. $L_{\rm ir} > 10^{11} L_{\odot}$) discovered in far-infrared/submillimeter surveys finds that only $\sim$10-15 % are Seyferts, consistent with optically selected luminous galaxies. Luminous galaxies discovered in the mid-infrared tend to have a higher percentage of Seyferts ($\sim$20–25 %); plus the most luminous galaxies (i.e. $L_{\rm ir} > 10^{12.3} L_{\odot}$) at all infrared/submillimeter wavelengths tend to have the highest fraction of Seyferts (i.e. $\gtrsim$ 50 %).

Q2.3 What are infrared-selected LINERs (AGN vs *B) ?

The evidence seems to favor a mixture of both *B and AGN powering these sources.

Q2.4 Is there evidence for an IR/Optical AGN-fraction change vs. z ?

None at present. Given the limited sensitivity of current FIR/Submm surveys it is not possible to separate trends with luminosity from trends with redshift.

2.3. Day 4 - X-Ray and Radio Surveys for AGN

Kazushi Iwasawa reviewed the X-Ray properties of "obscured AGN" using recent results from *ASCA, BeppoSax* and *Chandra*, and reminded us that studies of the X-ray background suggest that obscured AGN should significantly outnumber their unobscured counterparts. The surprising new findings include the fact that a significant number of X-Ray selected AGN have been discovered in objects where there is no optical signature of an AGN, or in the case of the most heavily obscured objects, no optical emission lines at all. The possibility

https://doi.org/10.1017/S0252921100031146 Published online by Cambridge University Press

that a significant number of "Compton thick" AGN (i.e. sources with obscuring columns, $N(\mathrm{H}) > 10^{25}\,\mathrm{cm}^{-2}$) may exist can not be ruled out from current data.

Andrea Comastri then discussed the AGN content of hard X-Ray surveys, focussing on sources discovered by *BeppoSax* and *XMM-Newton*. He stressed that their optical properties are quite varied, and that there is apparently no simple relation between optical and X-Ray absorption in individual objects.

Wolfgang Voges presented initial results from a comparison of the ROSAT All-Sky Survey (RASS) and SDSS concerning X-ray-variable AGN, where the goal is to obtain optical IDs for ~20,000 X-ray sources in the RASS. Results from the first follow-up observations at Apache Point covering $\sim 200\,\mathrm{deg}^2$ have detected more than 2000 new AGN of which many are also detected in X-rays.

Contributed talks by *Masayuki Akiyama* and *James Manners* presented results on ASCA and ROSAT sources, respectively. The ASCA results suggest a lack of absorbed luminous AGNs (i.e. a deficiency of type-2 QSOs). The ROSAT results suggest that QSOs are more variable at $z > 2$, suggesting that high-redshift QSOs may be accreting at a higher efficiency than local AGN.

Leonid Gurvits reviewed recent results from global and Space VLBI studies of quasars and other types of AGN, by showing the wealth of new data on the detailed sub-milliarcsecond radio structure in hundreds of sources. He presented convincing evidence that with large enough samples it may soon be possible to disentangle intrinsic evolutionary phenomena of parsec-scale radio structures, and thus to use VLBI radio data to possibly "age date" AGNs.

A contributed talk by *Carlos DeBreuck* presented preliminary results for a sample of 669 Ultra Steep Spectrum (USS) radio sources, a sample designed to find significant numbers of $z > 3$ radio galaxies. Initial ground-based follow-up spectroscopy finds a sample mean redshift of $z \sim 2.5$, suggesting that the USS selection technique indeed works. The sample also included the most distant radio galaxy known, at $z = 5.19$. *Pedro Augusto* then discussed a technique for selecting radio sources with the objective of studying the size and properties of the narrow-line emission region (NLR) in AGN, showing its promise for probing the evolution of the NLR in AGN as a function of redshift.

Highlights from day 4 included:

- The number of new heavily obscured X-ray selected AGN
- VLBI surveys and evolution of parsec-scale structures in the cores of AGN
- The efficiency of USS selection methods for selecting high-z RGs
- Evidence for BLAZAR unification (FRSQs vs. BL Lacs)

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Major questions raised (+ consensus answers) included:

Q4.1 The relative fraction of Compton-thick vs. Compton-thin AGN ?
Although surveys of optically selected Seyferts show evidence for unexpectedly large mean absorbing columns, i.e. $N(\mathrm{H}) \sim 10^{22-23}\,\mathrm{cm}^{-2}$, there is as yet no clear evidence to suggest a large population of Compton-thick objects, i.e. $N(\mathrm{H}) > 10^{25}\mathrm{cm}^{-2}$.

Q4.2 Can radio VLBI help unify/trace the evolution of AGN ?
Perhaps, given large enough samples.

Q4.3 Is it possible to select complete samples of high-z RGs and RLQs ?
USS selection techniques seem to provide such samples.

2.4. Day 5 - AGN Phenomena

John Hutchings reviewed current knowledge of the properties of the host galaxies of high-redshift QSOs, and pointed out the difficulties of PSF-removal in both space as well as ground-based AO imaging. Surveying statements in the literature, he gave several caveats to "host galaxy folklore", which included the oft repeated statements such as "all QSO hosts are ellipticals", "radio-loud QSOs have the most massive black holes", and "many hosts do not look irregular or peculiar (i.e. interactions are rare)". All such statements seem to be suspect.

Brigitte Rocca-Volmerange presented new results from 3D spectroscopy observations designed to study the ionisation processes in extended distant radio sources, with the intent of constraining the role of AGNs in the star formation history of the Universe.

Richard Green then summarized the demographics of supermassive black holes from studies of ellipticals with the *Hubble Space Telescope (HST)*. The "Magorrian relation", which shows that M_{BH} is strongly correlated with the velocity dispersion of the whole bulge, suggests that black hole formation may be an intrinsic aspect of bulge formation.

Wolfgang Duschl presented theoretical arguments to show that gas-rich galaxy-galaxy mergers can provide not only the "fuel" for quasar activity, but can also build a super-massive black hole on the timescale of the merger (i.e. in less than 10^9 yrs). The key theme in his scenario is that viscosity in self-gravitating accretion disks will naturally lead to a radial inflow of material to feed/build the central engine.

A contributed talk by *Igor Karachentsev* presented the results of an imaging study of a distance limited sample of ~300 galaxies within 7 Mpc designed to search for AGN in nearby dwarf galaxies. *Michael Hawkins* then presented results from a 23-year monitoring program of 610 confirmed QSOs, which favor an accretion disk model for low luminosity AGN, but which suggest that the variations of more luminous AGN may be dominated by microlensing.

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Highlights from Day 5 included:

- Although QSO hosts appear to have a substantial bulge component, there is also evidence in many objects for a disk component as well as evidence for tidal features such as rings, loops and tails.
- The " Magorrian relation" strongly suggests that black hole growth and bulge growth are both linked through a common overall process (e.g. galaxy mergers)
- Theoretical evidence suggesting that self-gravitating gas disks provide a natural fuel source for feeding the growth of MBH

Day 5 raised a number of important questions that must eventually be answered if we are to finally understand the origin and evolution of AGN:

Q5.1 Do all QSOs reside in E-like hosts ?
Published evidence is contradictory, but some QSOs clearly contain a disk component.

Q5.2 What is the difference in RLQ vs. RQQ hosts ?
Current evidence is contradictory.

Q5.3 Is there strong evidence in support of coeval Bulge/MBH formation?
Evidence at present is circumstantial.

Q5.4 Does the "luminous" QSO phase last $\sim$ few $\times 10^8$ years ?
There is not enough evidence to date upon which to base accurate ages.

2.5. Future Projects

Joe Mazzarella presented the "new reality" that is now offered to the international astronomical community in the form of electronic services such as the National Extragalactic Database (NED). He showed how these powerful new services will, in the near future, likely evolve into a larger National Virtual Observatory (NVO).

Vahé Petrosian described new statistical methods that can be used for determining correlations among and distributions of physical parameters from multivariate data sets with general and arbitrary truncations and selection biases.

Serguei Dodonov proposed a photometric method for identifying stars, galaxies and QSOs in multi-band color surveys, using a library of color templates for comparison with observed objects.

Finally, *Areg Mickaelian* discussed plans to digitize the full FBS, which is the largest spectral survey in the Northern sky, containing low-dispersion spectra for $\sim$20,000,000 objects. Current plans are to make the digitized FBS available via the Internet and on CDs along with the appropriate interface for accessing the data. Digitization is clearly needed if the full discovery potential of the FBS is to be realised.

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3. Closing Remarks

The history of the BAO is closely tied to the stature and foresight of its first Director, Victor Ambartsumian. Its importance as an Observatory is in large part the result of the great effort carried out by its staff in producing the systematic wide-scale surveys of UV-excess extragalactic objects and in carrying out the important follow-up spectroscopic studies of the "Markarian" galaxies. Its importance to world astronomy was helped early on by the international exposure provided by Khachikian and his collaborators who carried out spectroscopic follow-up observations of the UV-excess galaxies using large telescopes, thereby demonstrating the importance of AGN in powering many of these objects.

This meeting has come at a propitious time when the availability of new large all-sky surveys now provides a more comprehensive understanding of the AGN phenomenon and of the cosmic evolution of AGN. It also comes at a time when the BAO appears to be at an important crossroads. In the future the BAO will need to choose carefully which projects it will pursue with its current suite of telescopes, and how to best enter into collaborative projects with other observatories.

The BAO must also find the means to insure access to the large data sets that are now freely available electronically through data centers such as NED and SIMBAD, and eventually through the NVO. The cost of the required terabytes of disk space and GHz-workstations continues to decrease, and a way must be found to provide such computer power to the BAO. Perhaps more problematic will be attaining a high speed link to the outside world, but resources *must* be found so that the staff of the BAO are not isolated from the international astronomical community. Once key projects are defined, the commitment of BAO staff and telescope resources can once again make its mark on world astronomy.

Acknowledgments. On behalf of all the conference participants, the Scientific Organizing Committee extends its deep appreciation to our hosts at the Byurakan Astrophysical Observatory and to the members of the Local Organizing Committee who worked hard to ensure the success of this international colloquium. The author also gratefully acknowledges support from a Senior Award from the Alexander van Humboldt-Foundation and the hospitality of the Max-Planck-Institut fur extraterrestriche Physik. Additional financial support was provided by the Research Council of the University of Hawaii, and by NASA JPL contract 961566.

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