Revisiting old (AGN) friends – what’s changed in their spectral looks

The ‘friends’ to be revisited here are:
- Fairall 9
- IC 4329A
- Mkn 926

Winkler (1992)
In the 1970’s the list of identified Seyfert galaxies reached 100 AGN on that list have now been studied (sometimes exhaustively) for >40 years; their ‘medium term’ evolution can now be explored. This in turn may yield clues about the structure and physical mechanisms driving AGN.

- **What spectral features are stable in the medium term?**
- **What are the timescales of any observed spectral changes?**
- **How do the observed spectral changes constrain the location, size and structure of the various emission line regions?**
- **Are the spectral changes observed reconcilable with currently popular AGN models?**
Spectral changes to look out for – broad lines

Does the broad line width change?

NLSy1 = NLSy1 forever?

Line profile changes?

Humps?

Strength of He lines, especially He II

He I He II

He I
Spectral changes to look out for – IM/narrow lines

Iron band (Fe II) strength

Coronal line strength

High ionisation vs low ionisation line strength

[H Winkler, IAU Symposium 356, Addis Ababa, Ethiopia, 2019]
Observations

SAAO 1.9 m – new grating spectrograph
(significantly better performance than was possible in the 1980s!)

- All three targets re-observed on 9 Jul 2019
- 2 x 1200 s integrations
- 2.7” slit widths
- arc spectra & spectrophotometric standards
- reasonably clear, but small variations due to thin cloud and seeing fluctuations possible
Fairall 9

The 9th object on what was aimed to be a southern equivalent of the Markarian survey turned out to have an exceptionally bright, quasar-like nucleus with very strung, broad emission lines.

Does this serendipitous discovery also mark the birth of AGN astronomy in Africa?

This precipitated a flurry of further observations of this target.

Discovered at SAAO by Tony Fairall (1943 – 2008)

Ward et al (1978)
Fairall 9 – fading 1981-1984 (& partial recovery)

Clavel et al (1991)

Wamsteker et al (1985)

Reverberation study: H-beta delay ~23 days (Santos-Lleo et al, 1997)

Optical spectroscopy increasingly rarer in last 20 years

Marziani et al (2002)
This spectrum is remarkably similar to the 1986-1989 aggregate spectrum (Winkler, 1992)

While seemingly never having regained the brightness levels of the 1970’s, no noticeable medium-term changes are detected in the spectrum of Fairall 9. The basic characteristics (line widths, iron bands, narrow lines, etc.) are retained over 30 years later.
IC 4329 A – an obscured quasar?

1972 discovery spectrum (Disney, 1973)

Malkan et al (1998)

High Balmer decrement

A persistent hump 30-35 Å redward of the H-beta peak

H Winkler, IAU Symposium 356, Addis Ababa, Ethiopia, 2019
While the broad line strength and profile exhibits ongoing change, other spectral features have remained stable since discovery.
Mkn 926 (MCG –02-58-022)

Mkn 926 was identified as a broad-line Seyfert during a programme to identify strong x-ray sources by Ward et al in 1978.

At that time and in the subsequent few years, Mkn 926 remained bright, and a claimant to the ‘nearest quasar’ title.

Reverberation mapping studies produced conflicting results (H-beta lags found between 2 and 52 days).
Mkn 926 - Fading luminosity

Mkn 926 was one of the most luminous nearby AGN, even being categorised as a quasar.

(adjusted) magnitudes from Doroshenko & Terebizh (1981), Mallama (1984), de Ruiter & Lub (1986), Hamuy & Maza (1987), Winkler et al (1992), Winkler (1997)

Infrared data from Glass (2004) highlights further decline until 2000
Mkn 926 - comparing the bright & faint phases

The high and low phases have been sustained for much longer periods than in the previous two examples.

This is a genuine changing look AGN, and it is yet to be determined if and when it will recover to the brightness levels observed in the early to mid 1980’s.

H Winkler, IAU Symposium 356, Addis Ababa, Ethiopia, 2019
Mkn 926 - spectra during the faint phase

During the faint phase the emission-line spectrum somewhat resembles that of a LINER or BLRG

Unusually strong low-ionization emission lines

SAAO spectrum from May 1999

Broad line profiles for the 2004 SDSS spectrum

Balmer profile
Here the luminosity has never recovered the levels achieved in the bright phase.

However other spectral features have persisted:- e.g. the absence of Fe II and the comparatively strong low ionization lines.

Thank you for listening to this talk.