Quasar Science with early *James Webb* Observations

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Introduction. The link between massive galaxies and the central super-massive black holes (SMBHs) that seem ubiquitous in them is now thought to be vital to the understanding of galaxy formation and evolution ([1], [2]). As such, huge observational and theoretical effort has been invested in trying to measure and understand the physics involved in these enigmatic systems.

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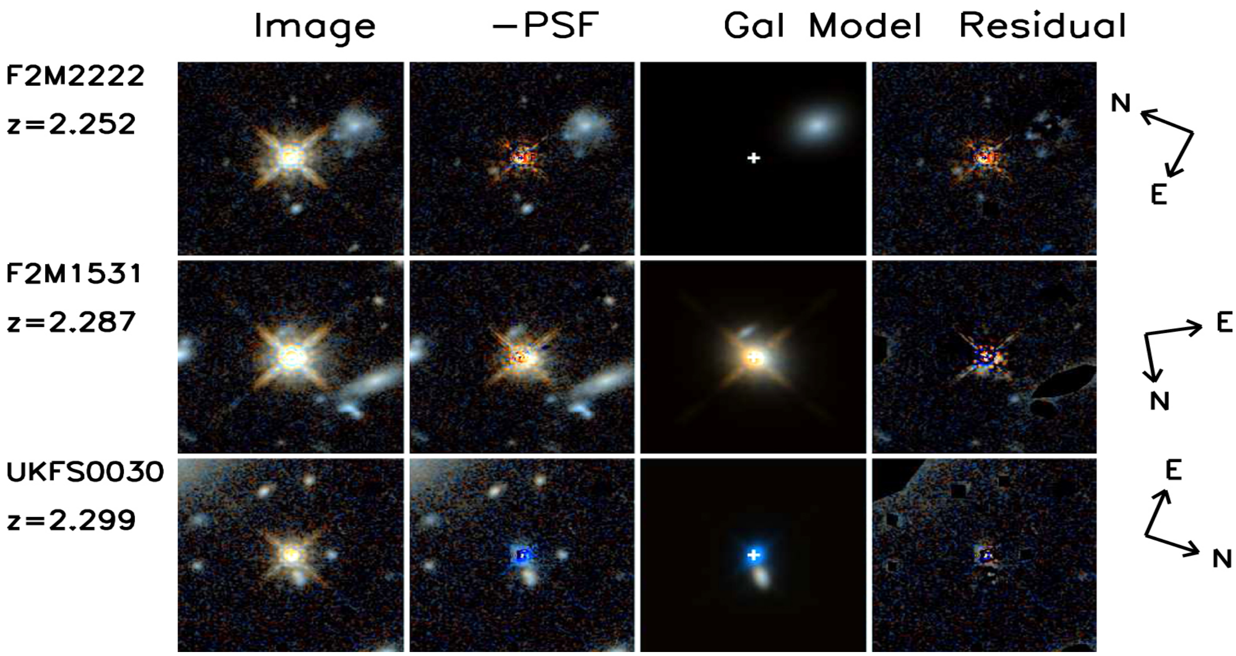

Figure 1: *From: Glikman et al., 2015, ApJ, 806, 218; their Figure 5.* Two color HST images of the eight lower-redshift quasars studied in this paper imaged with F105W and F160W. Each row represents a separate object. The first column is the original image shown at a scale of 8 8. The second column shows the residual image after subtracting only the point-source component. The third column shows the model for all but the point-source component; the blank frame is a source to which no host component could be fit. The final panel shows the full residual including masked regions and is indicative of the overall goodness of fit. Evidence of mergers and disrupted host galaxies is seen in most the sources. We apply the redgreenblue color-combining algorithm of Lupton et al. (2004) to our images, and we average the count rate from the F105W and F160W images to produce the green frame.

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Mid-IR properties of QSOs and JWST. The discovery of extremely red QSOs (ERQs) with $r - [22] > 14$ colours from the WISE All-Sky Survey and spectroscopy from SDSS and BOSS, seems to provide a key observational clue to the "major merger" evolutionary theory for QSO activity ([17],[24]). However, the large fraction of AGN which remain heavily obscured will need mid-infrared spectroscopy in order to understand the role this optically hidden population play in the evolution of galaxies and the integrated light of the Universe. Given the fellowship timescale, this makes a natural bridge to the *James Webb Space Telescope* and observations with the Edinburgh-built MIRI spectrograph.

References

[1]Fabian, 2012, ARAA, 50, 455
[2]Alexander et al., 2012, NewAR, 56, 93
[3]Schneider et al. 2010, AJ, 139, 2360
[4]Pâris et al., 2012, A&A, 548, A66
[5]Dawson et al. 2013, AJ, 145, 10
[6]Ross et al., 2012, ApJS, 199, 3

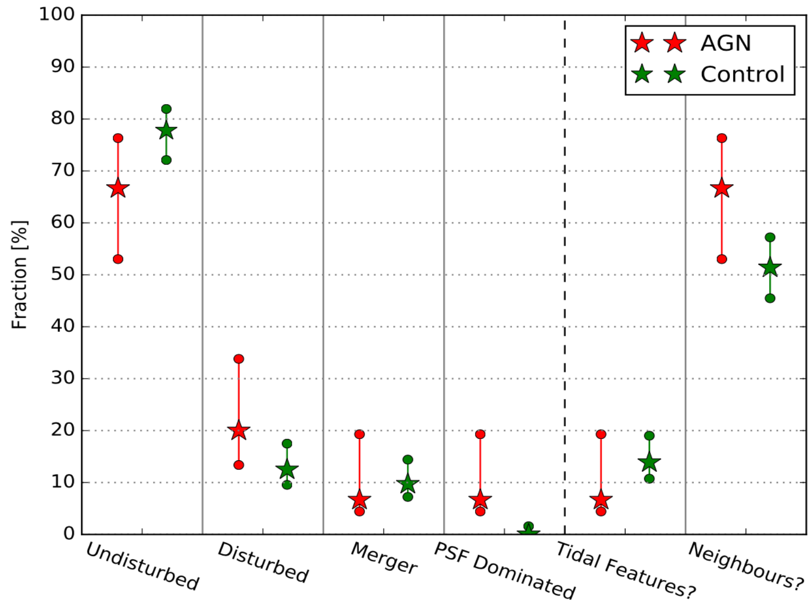

Figure 2: Villforth et al, arXiv:1611.06236v2; their Figure 4. Visual classification of all resolved AGN host galaxies and matched control galaxies. AGN are shown in red, control sample in green. The error bars show 1 confidence intervals calculated following Cameron (2011).

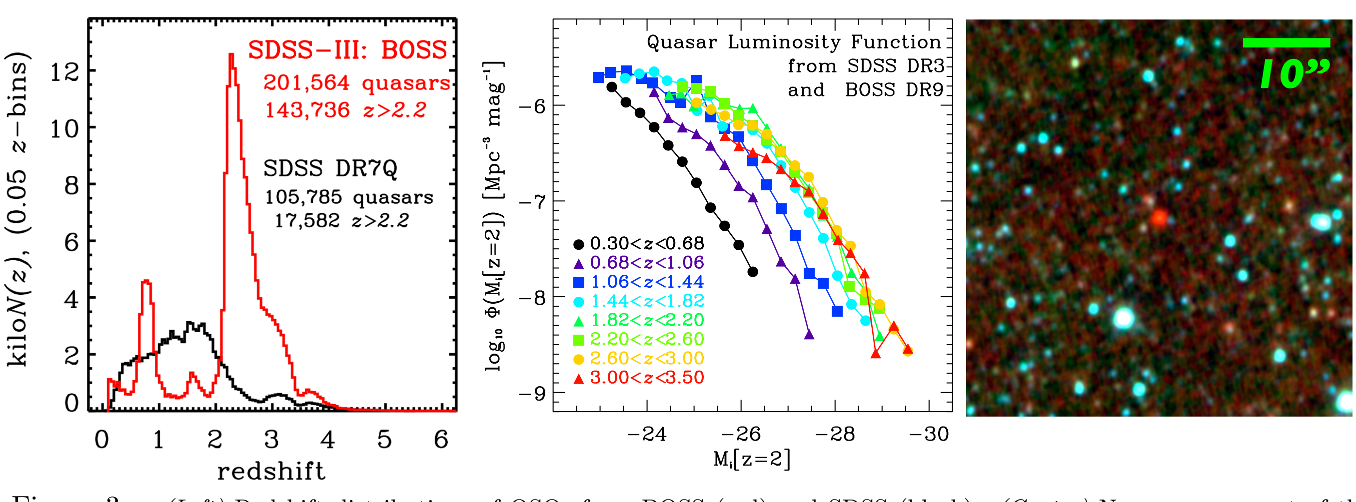

Figure 3: *(Left)* Redshift distributions of QSOs from BOSS (red) and SDSS (black). *(Centre)* New measurement of the optical QLF from [9] extending the SDSS DR3 results from [12] and finding a clear break in the QLF at all redshifts up to $z = 3.5$. *(Right)* A WISE 3.4, 4.6 and 12μm image of a $z = 2.59$ extremely red QSO, selected on its $r - [22]$ colour. This object has a 22μm flux indicative of $L_{IR} \gtrsim 10^{13.5} L_{\odot}$, and one interpretation could be we are witnessing the "birth" of an unobscured QSO.