Star Formation in the Host Galaxies of Radio-Quiet Quasars

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Introduction

The far-infrared (FIR) and radio luminosities of star forming galaxies are involved in a tight linear empirical correlation over a wide range of galaxy types and magnitudes. Besides, the contribution of star formation in the radio emission of radio-quiet quasars (RQQs) is still an open issue. Generally, disentangling the share of the active galactic nuclei (AGNs) and host galaxies in the spectral energy distributions (SEDs) is not trivial.

According to the evolutionary sequence, originally proposed by Sanders (1988), a major merger of gas-rich galaxies triggers both intense star formation (SF) and quasar activity and the resulting system is an ultra luminous Infrared galaxy (ULIRG). It can be observed as a quasar after the removal of the obscuring material due to feedback processes that may also involve the AGN itself. There is no consensus yet regarding the time delay between the merger driven SF and the quasar activity.

Considering the above arguments, we initiated a study on the star formation in RQQs. The FIR-to-UV SEDs are constructed and fitted with models accounting for both the AGN and the host galaxy. We present the results for Mrk 477, the closest obscured quasar (z=0.0377).

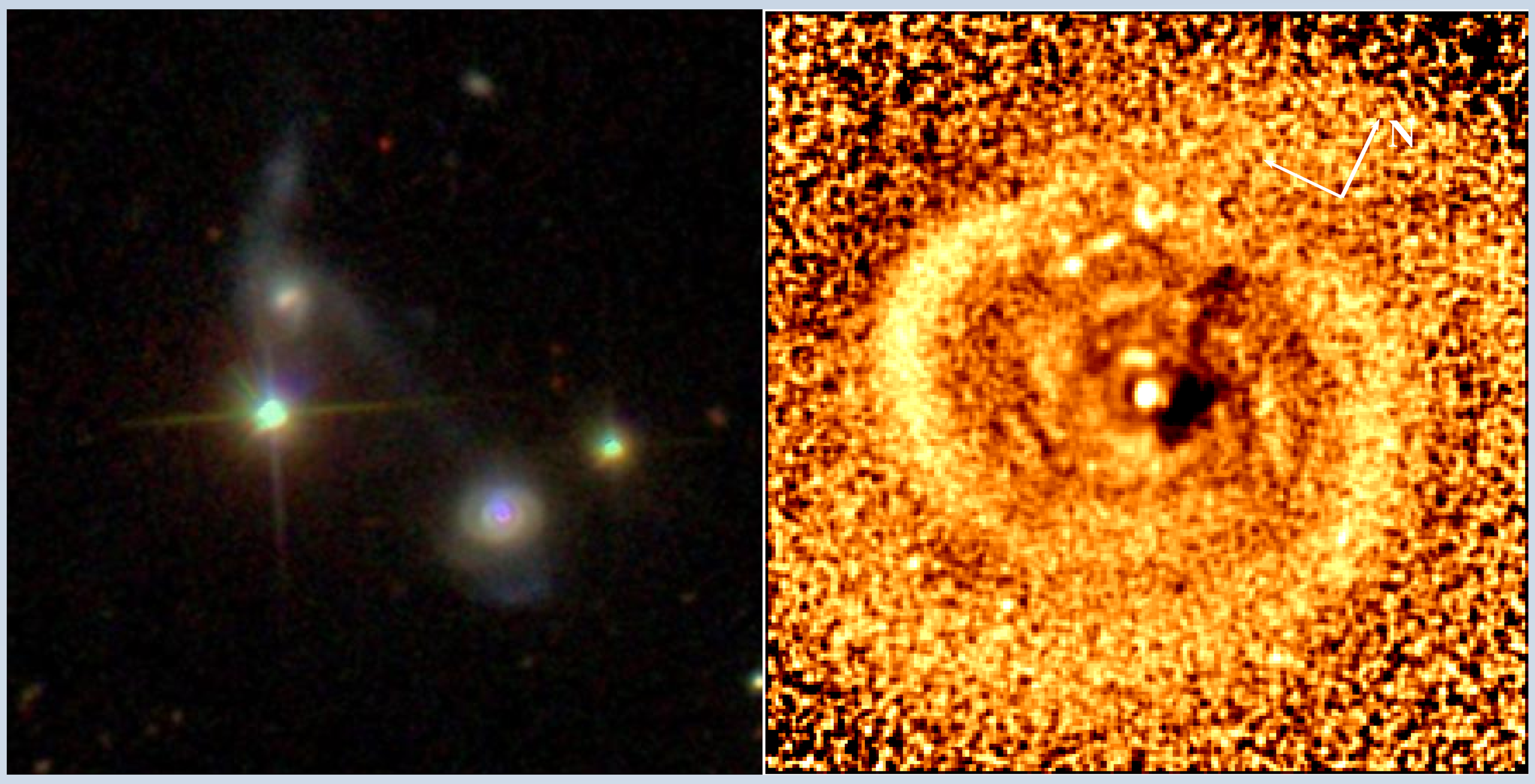

Fig. 1a. Left panel: SDSS true colour image of Mrk 477 (2′x2′).
Fig. 1b. Right panel: HST structure map; the bars are 1 arcsec long.

Object	region	E^{G}_{B-V}	τ [Gyr]	age [log yr]	SFR_{opt} [$M_{\odot}yr^{-1}$]	SFR_{IR} [$M_{\odot}yr^{-1}$]	E^{BBB}_{B-V}
Mrk 477	galaxy	0.15	4.66	9.23	5.0	11.3	0.63
	CNR	0.49	0.33	6.9	28.3	-	-

Table. 1. SED fitting parameters of Mrk 477.

Methods

We built the SEDs using the (total) flux data from Herschel, IRAS, WISE, 2MASS, SDSS, and GALEX. High-resolution data were involved in constructing SEDs, representative of the circum-nuclear region (CNR) and of regions indicative of higher SF activity. Structure maps were created. The SEDs were fitted with the AGNfitter code accounting for the emission of the accretion disk (blue), torus (violet), host galaxy stellar population (SP, orange), and cold dust (green) related to the SF regions (Calistro Rivera et al. 2016). The CNR SEDs were constructed after the AGN subtraction and fitted with host galaxy SP model.

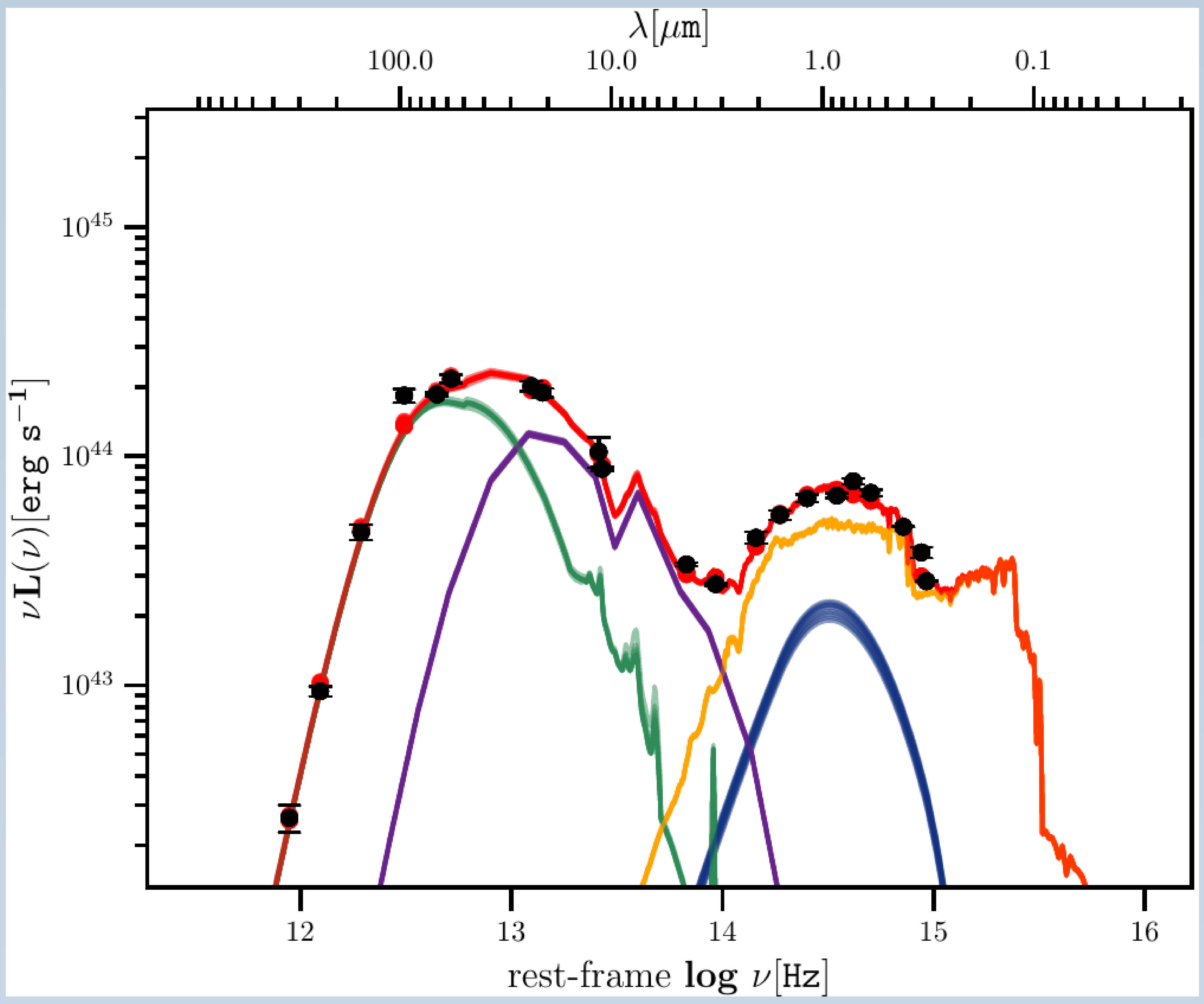

Fig. 2. SED fit of Mrk 477.

Results and Discussion

Mrk 477 is a RQQ (z = 0.0377) hosted by an ULIRG. A tidal bridge to the companion about 50″ to the north-east, as well as counter-tails could be outlined (Fig. 1a). The innermost regions are scrutinized using a high-resolution structure map (Fig. 1b), which reveals a prominent dust lane and disturbed structure. The SED decomposition is shown in Fig. 2. The resulting SF parameters (history, age, rates in the optical and infrared, etc.) are listed in Table 1. The CNRs appear a site of powerful starburst. Thus, the central few hundred parsecs are a scene of interplay between the medium and a denser outflow, most probably triggered by the radio jet (Villar Martin et al. 2015), although the object is considered radio-quiet. The age of the CNR SF is ~8x10^{6} yr (see Table 1), in consistence with the results of Heckman et al. (1997). The AGN typical lifetimes range of (10^{6}–10^{8}) yr narrows to (20–40)x10^{6} yr for bright quasars (Hopkins & Hernquist 2009). So, there may be a delay between the SF triggering and AGN or both could have occurred quasi-simultaneously.

We estimate high reddening for both objects with the trend of an increase towards the centre in consistence with the results based on integral field spectroscopy (García-Marín et al. 2009). Also, going inwards, the SFR gets higher and the SP younger. The CNR SP ages could favour both scenarios - of concurrent SF and AGN, as well as of a time delay between them.

References

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