



A Gemini/GMOS-S Spectroscopic Study of Arp-Madore Galaxies

Cláudia Winge⁽¹⁾, Rogério Riffel⁽²⁾, Angela Krabbe⁽³⁾, Miriani Pastoriza⁽²⁾

(1) Gemini Observatory, Chile; (2) IF-UFRGS, Brasil; (3) UNIVAP, Brasil

This poster presents the initial results of a pilot study on the nuclear activity, star formation and stellar population characteristics of galaxy pairs from the Arp & Madore (1987) catalogue. The objects have been selected mainly from AM classes I (spirals with well defined arms, but showing signs of interaction, where the companion is less than half the size of the main galaxy), and II (interacting doubles where the companion is more than half the size of the main galaxy). These observations actually confirm the physical association of several of these systems, and provide the first study of the stellar and gas emission properties of the individual galaxies.

The data were obtained using the GMOS-S spectrograph at the Gemini-South telescope, under the "poor weather queue" programme GS-2007A-Q-240, between October 2007 and January 2008. Instrument configuration was the 0.5arcsec slit with the R150 grating, binned 2 x 4 pixels (spectral x spatial). Two grating settings were used, centred at 870 and 880nm, in order to cover the chip gaps. This setup provided full spectral coverage from 350nm to beyond 800nm (rest wavelength), at a spectral resolution of 11Å @ 656nm - just enough to separate the [NII]+H α blend, while at the same time covering the whole optical spectrum for redshifts up to ~0.2. The slit was aligned to include both (or two of the) galaxies, and to improve sky subtraction, the objects were nodded along the slit. Exposure time was 1hr on source (2x900sec per grating setting).

† see <http://www.gemini.edu/sciops/observing-with-gemini?q=node/10999>

Data reduction followed standard procedures, using the gemini.gmos IRAF package, with the exception that no flat field correction was applied to the spectral data presented here. This was due to the strong fringing effects present beyond 750nm, which severely degraded the quality of the data towards the red. For the large apertures extracted here (20pix ~ 5.8arcsec), this has no measurable effect in the data. The imaging data correspond to the acquisition images taken just prior to the spectroscopy to centre the objects in the slit. The Sloan r' filter was used, and reduction was standard (bias+flat-field).

Given the "poor-weather" nature of the programme, conditions varied significantly between and during observations. Table 1 presents information on the image quality as derived from the acquisition images. None of the observations was obtained under strict photometric conditions.

The underlying stellar population was modeled using the method described by Cid Fernandes et al (2005), where the full spectrum is synthesized using the Bruzual & Charlot (2003) models. The result is a model spectrum and several relevant parameters that characterize the stellar population mixture. The ones presented here (Table 1) are the (logarithm of the) mean stellar age, ($\log t_{\star}$) and the mean stellar metallicity, (Z_{\star}), both weighted by light.

After subtracting the stellar population model, the emission lines in the spectra were measured fitting multiple Gaussians with the proper constraints to blends such as H α + [NII]. In none of the objects more than one Gaussian was used to represent a single line.

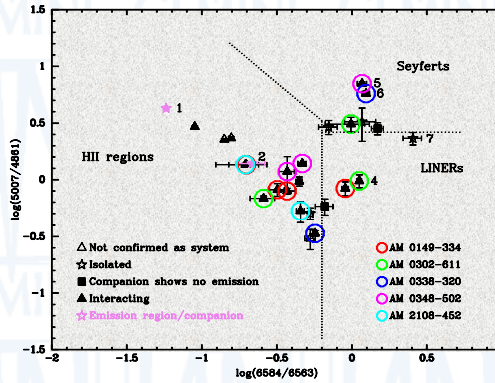


Figure 1: Observed line ratio [NII]/H α vs [OIII]/H β diagram for the objects in our sample. See Table 1 for the identification of objects 1-7. The circles indicate individual galaxies belonging to a given physical system.

Object	IQ	ID	Vr (km/s)	<log t_{\star}>	<Z_{\star}>/Z_{\odot}	A _v stellar (mag)	Comment
AM 0012-235	1.14	A	19034	10.54	1.5	0.51	No emission, in system
	1.14	B	18921	10.38	1.45	0.97	Seyfert/Liner, in system
AM 0103-520	0.77	A	16480	9.57	1.6	0.92	Liner/SF, in system
	0.77	A'	16263	7.38	1.5	0.87	SF companion? (obj 2)
	2.26	B	16624	10.47	1.6	0.22	No emission, in system
	2.26	C	18688	10.42	1.8	0.19	Seyfert, isolated
AM 0149-334	0.63	A	8485	9.45	0.9	0.75	StarForming, in system
	0.63	B	8887	10.09	1.7	0.91	Liner, in system
	1.08	C	8586	8.48	1	0.53	StarForming, in system
	1.08	D	8534	8.86	1.7	0.67	StarForming, in system
AM 0237-525	2.04	A	16498	9.08	1.3	0.84	StarForming, not confirmed
AM 0302-611	1.75	A	8322	10.02	1.45	1.37	Liner, in system (obj 4)
	1.75	B	8509	8.83	1.45	0.72	StarForming, in system
	0.93	C	8598	10.44	1.35	0	No emission, in system
	0.93	D	8448	10.08	2.1	0.68	Seyfert, in system
AM 0305-824	0.54	A	4576	6.37	0.45	2.37	StarForming, RHII is obj 1
AM 0338-320	0.64	A	29058	8.41	1.65	0.54	StarForming, in system
	0.64	B	29039	9.71	1.1	1.3	Seyfert, in system (obj 6)
AM 0348-502	1.9	A	10714	10.11	1.6	0.33	Seyfert, in system (obj 5)
	0.72	B	10734	8.93	1.2	0.75	StarForming, in system
	0.72	C	10656	9.28	0.4	0.51	StarForming, in system
AM 0952-273	0.54	A	4298	7.97	1.45	0.87	StarForming, interacting
	0.54	B	19455	9.88	1.65	0.67	Seyfert, isolated
AM 2037-550	1.36	A	11377	7.6	0.45	1.07	StarForming, not confirmed
AM 2108-452	1.01	A	9638	9.15	1.45	1.16	StarForming, in system
	0.66	B	9526	9.87	2.05	0.37	No emission, in system
	1.01	C	9446	8.22	0.95	1.9	StarForming, in system
AM 2137-515	0.8	A	16950	10.25	1.9	0.36	Liner, isolated (obj 7)
	0.8	B	24684	8.89	0.9	0.39	StarForming, interacting
AM 2220-661	1.21	A	10408	9.62	2	0.89	StarForming, isolated

Table 1: Identification of the individual galaxies within each AM system. Column 2 is the image quality as measured from the direct image taken immediately prior to the spectroscopic observation (in arcsec). The redshift was measured using IRAF tasks rvidlines and xcor, for emission and absorption spectra, respectively. Age, metallicity and reddening are derived from the spectral synthesis.

Figure 2: Examples of the spectral synthesis results for the galaxies in four of the systems. The observed spectrum is shown in black, the stellar population synthesis in green and the residuals (gas emission) in red. The reddening value A_v corresponds to internal + Galactic. The bar is 30".

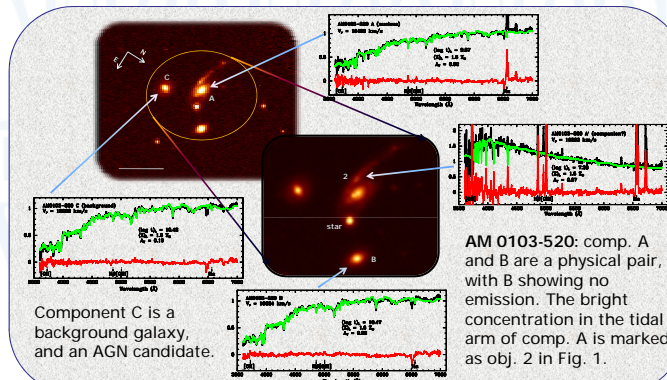
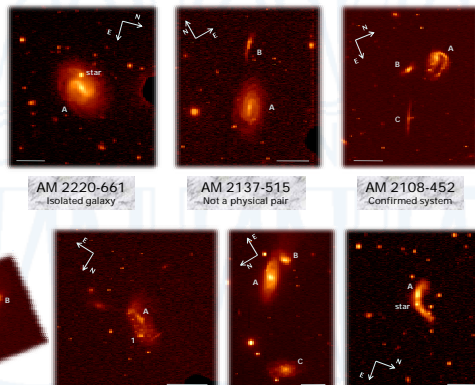
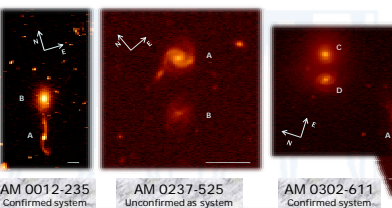
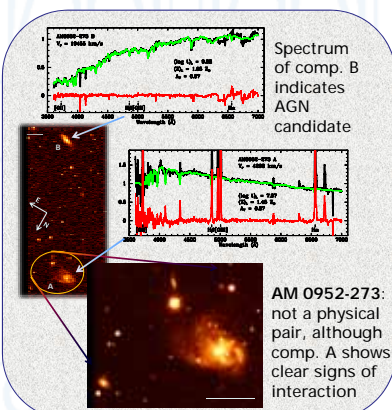
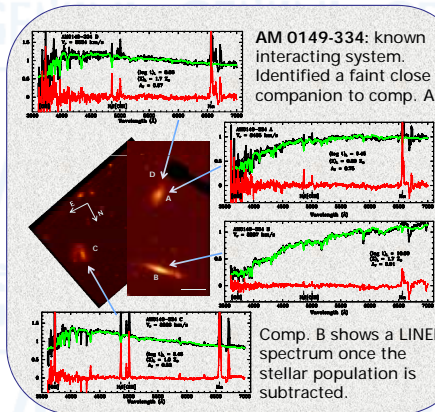


Figure 3: Images of remaining observed systems. The horizontal bar indicates 30".

Based on observations obtained at the Gemini Observatory, which is operated by AURA, Inc., under cooperative agreement with the NSF on behalf of the Gemini partnership. "Galaxies in Isolation", Granada, May 15-18, 2009. cwinge@gemini.edu