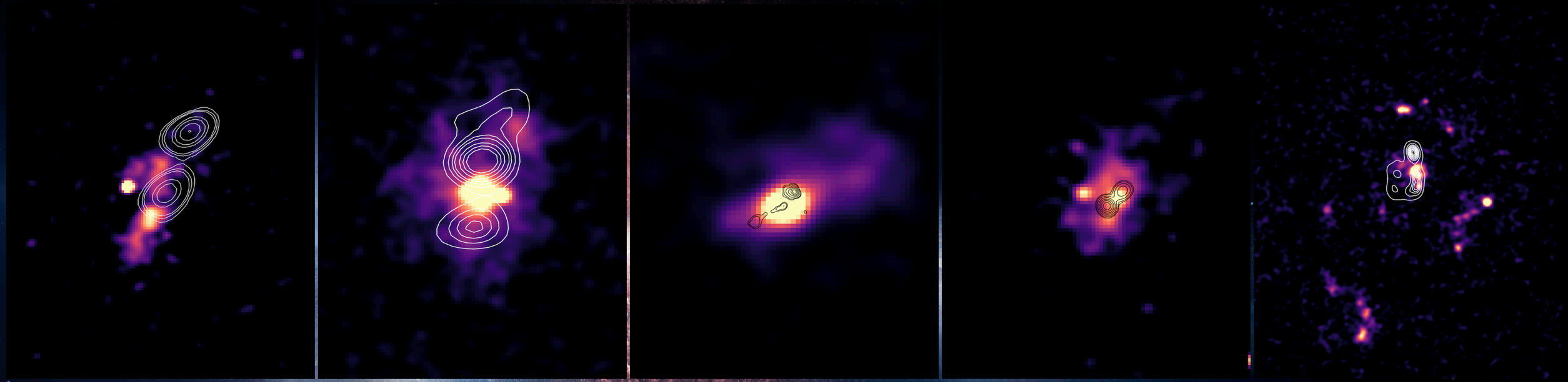
CO-EVOLUTION OF STAR FORMATION & JET ACTIVITY IN CSS RADIO SOURCES



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6th Workshop on Compact Steep Spectrum and GHz-Peaked Spectrum Radio Sources, May 2021

COLLABORATION

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OBJECTIVE

Multi-wavelength program to understand the CSS phase of radio-galaxy evolution and its impact on feedback

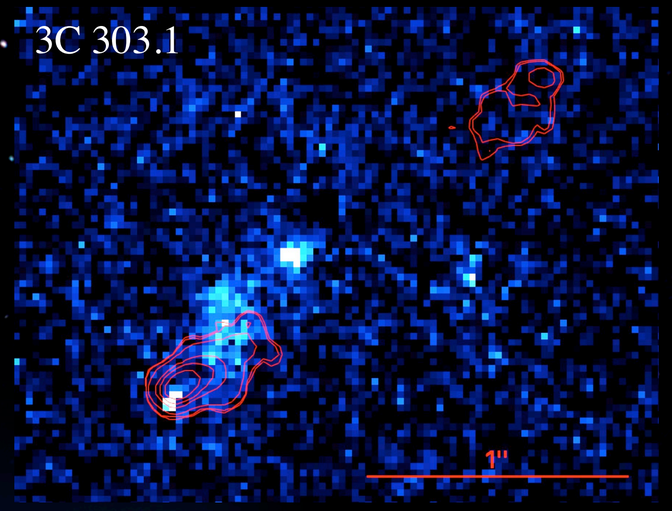
- **Search for evidence of enhanced star formation during CSS phase**
- **Jet-induced star formation is expected to be a natural consequence of radio jets propagating though ISM**

Rees 1989; Begelman and Cioffi 1989; De Young 1989; Daly 1990

- **And so should be a key signature of radio jet feedback**

Gaibler et al. 2012; Fragile et al. 2017

STRATEGY: CHARACTERIZING STAR-FORMING REGIONS



(Labiano et al. on 3C 303.1) HST/ACS/HRC/F330W UV band continuum emission + VLA contours of radio lobes

- hot, massive stars key diagnostics of recent star formation
- UV continuum emission a direct signature of young stellar population
- morphologically characterize the generic star formation (due to gas infall) and that associated with kpc-scale radio sources (possibly triggered by jet activity)

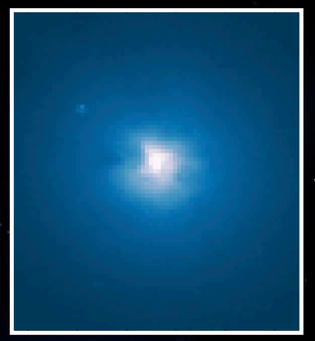
OUR SAMPLE

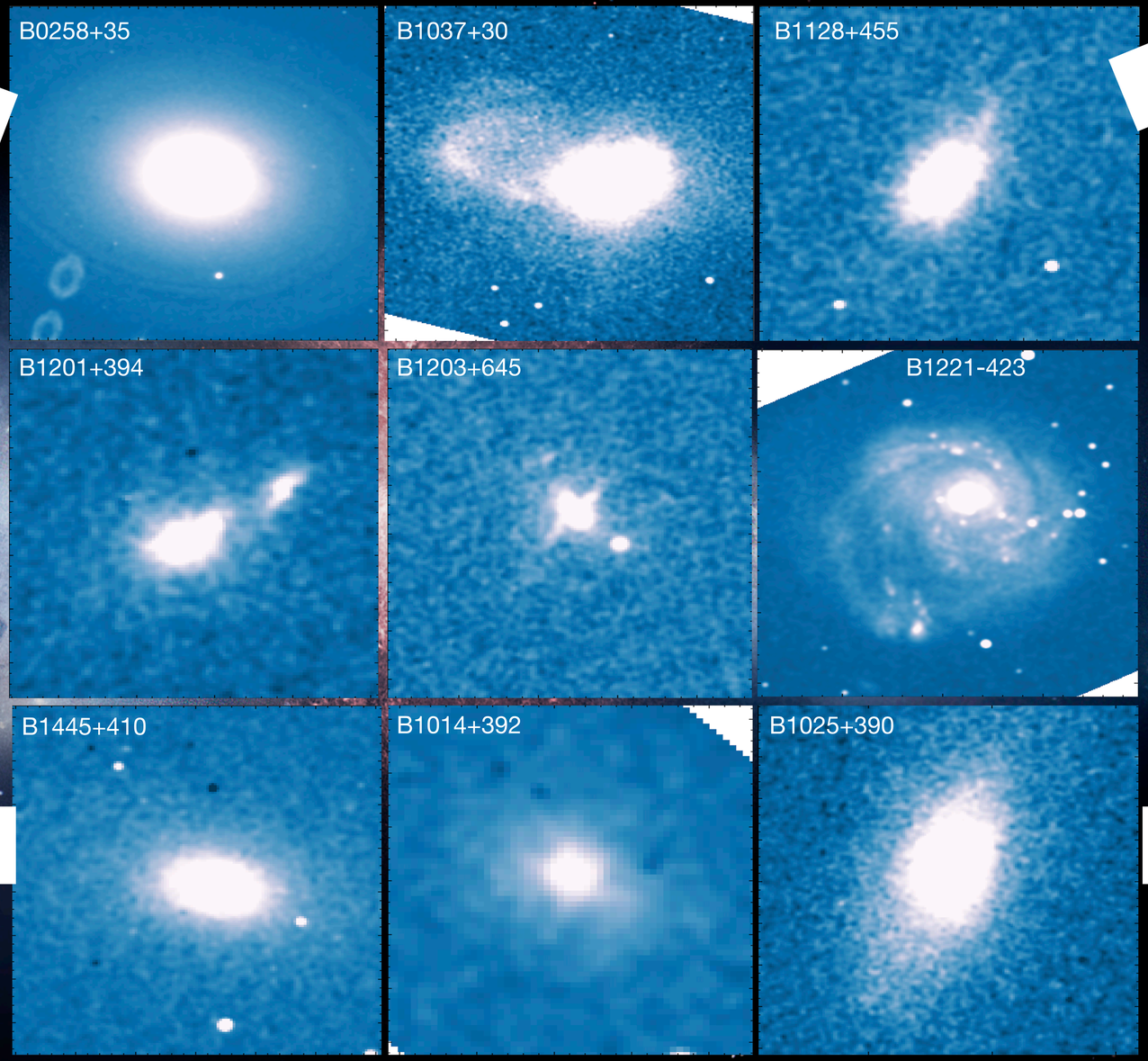
- high-resolution HST/WFC3 imaging for 9 CSS galaxies
- nearby sources, with z < ~ 0.6, thus eliminating strong effects of evolution with cosmic time
- radio source sizes are ~ 1 – 8” so as to have good resolution along the radio source with HST/WFC3

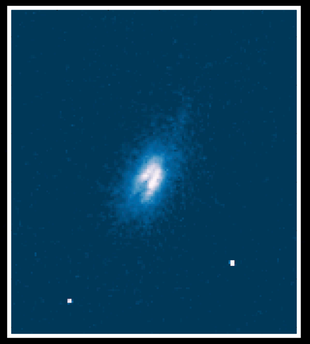
Source	Other name	z	radio size (arcsec)	proj. linear size (kpc)	Sample
(1)	(2)	(3)	(4)	(5)	(6)
B0258+35	NGC 1167	0.017	3.8	1.32	G05
B1014+392		0.536	6.1	39.03	F01
B1025+390	4C 39.32	0.361	3.2	16.28	F01
B1037+30	4C 30.19	0.091	3.3	5.63	G05
B1128+455	B3	0.404	0.9	4.91	F01
B1201+394	B3	0.445	2.1	12.14	F01
B1203+645	3C 268.3	0.371	1.4	7.25	O98
B1221-423	PKS	0.171	1.5	4.40	B06
B1445+410	B3	0.195	8.1	26.41	F01

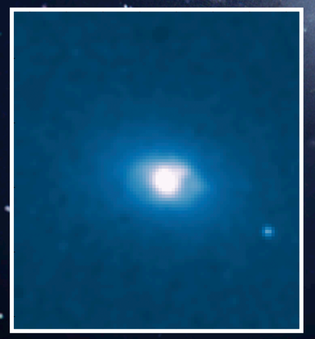
Derived from well-defined samples: G05 (Giroletti et al. 2005) = low power CSS; F01 (Fanti et al. 2001) = moderate power CSS; O98 (O’Dea 1998 = Stanghellini et al. 1997 plus Fanti et al. 1990); B06 (Burgess & Hunstead 2006) = southern 3C equivalent.

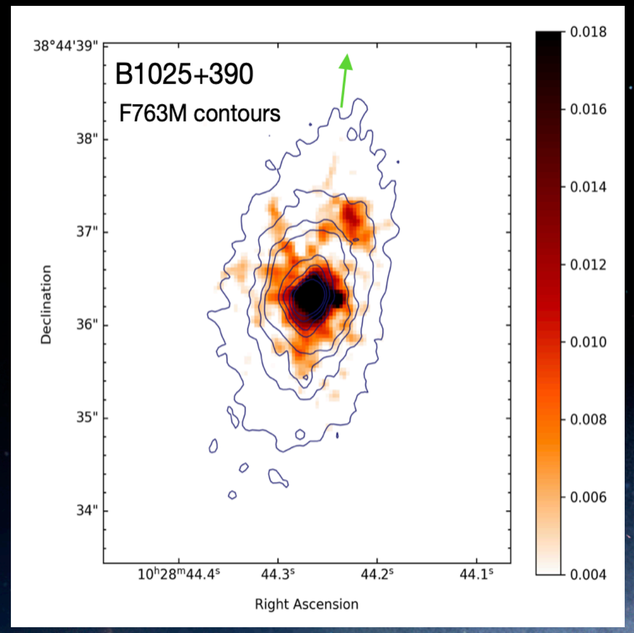
MORPHOLOGIES

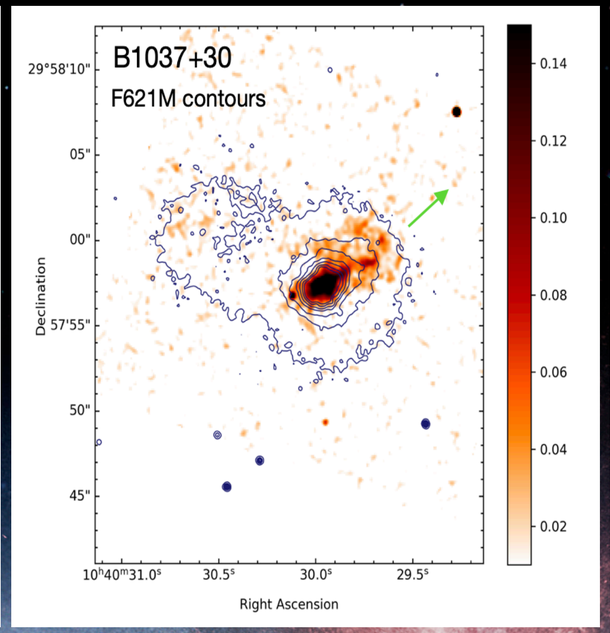


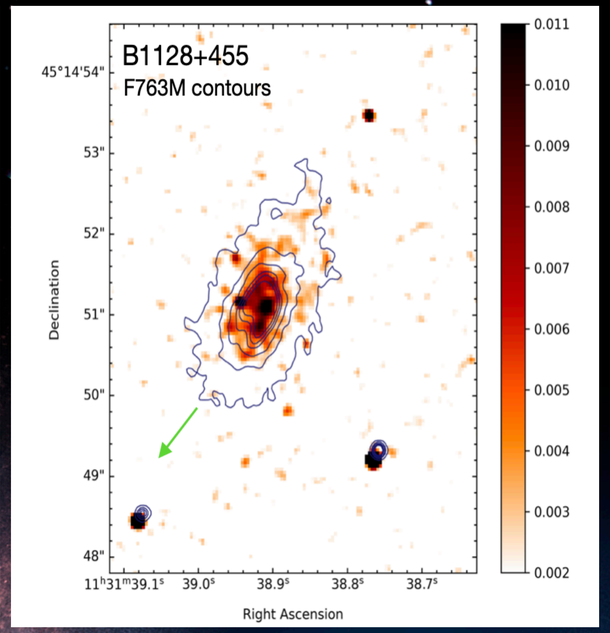


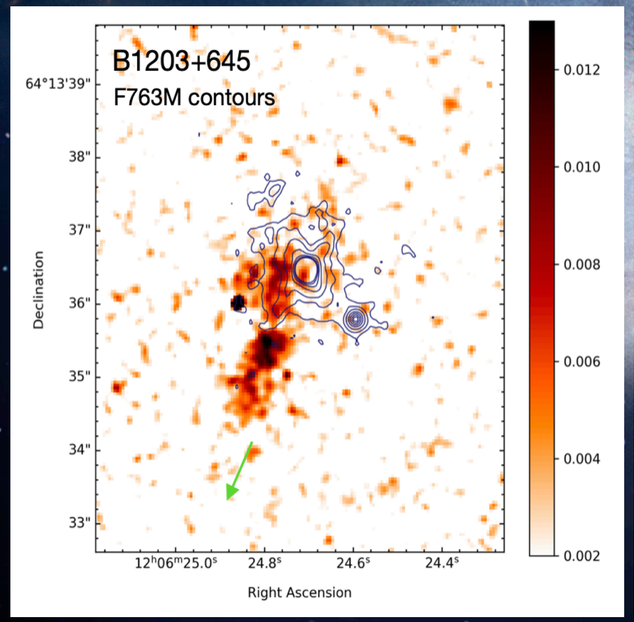


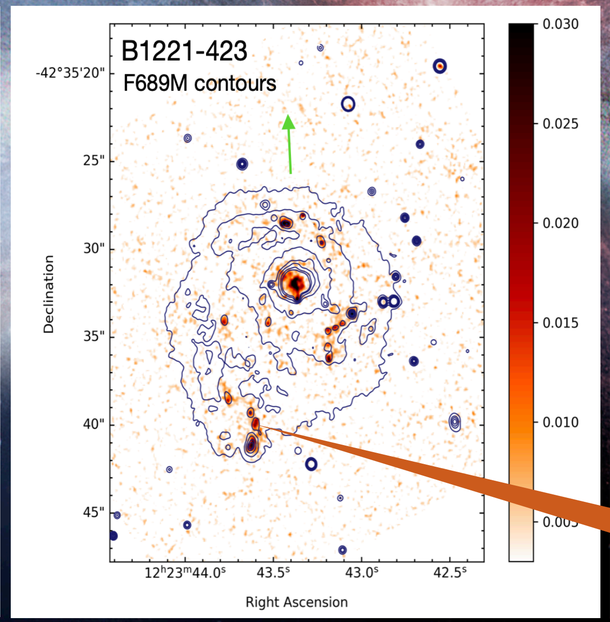


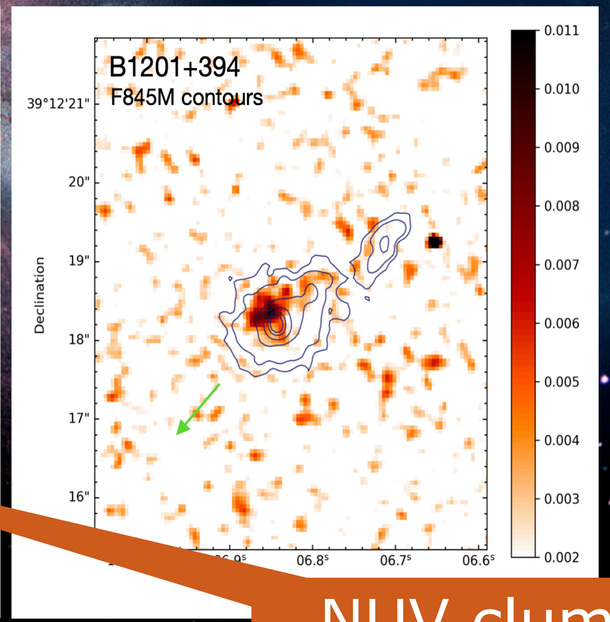












show extended UV-continuum emission

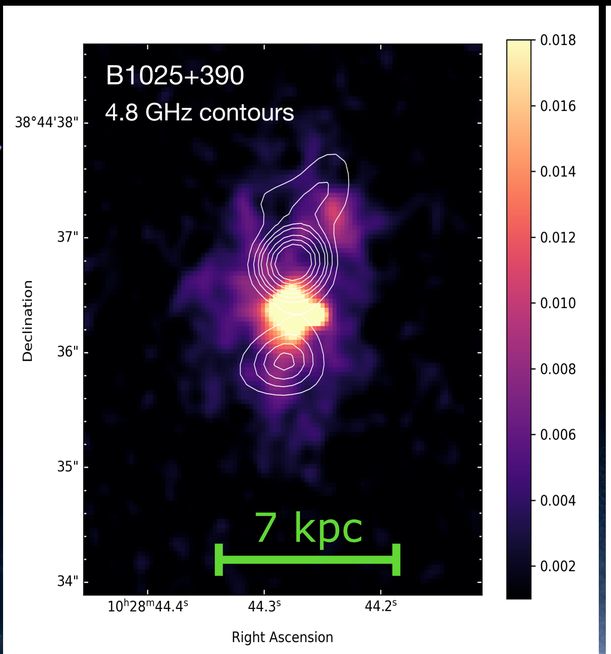
6/9 CSS detected in NUV (225-336 nm)

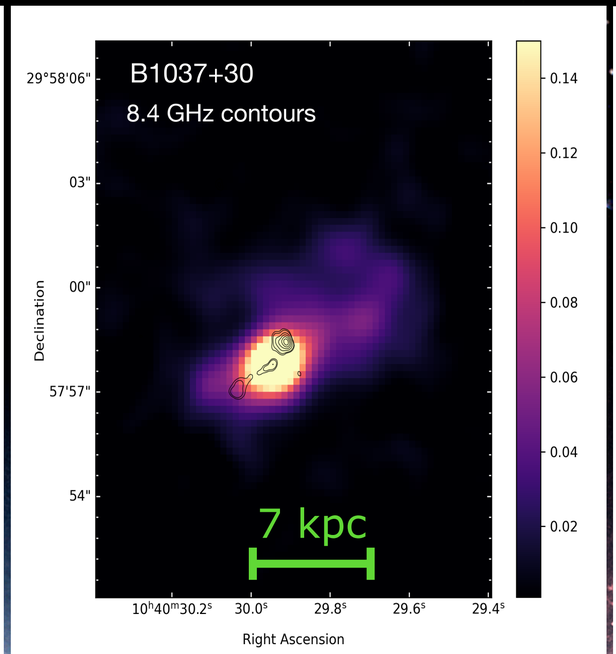
NUV clumps in spiral arms => likely HII regions

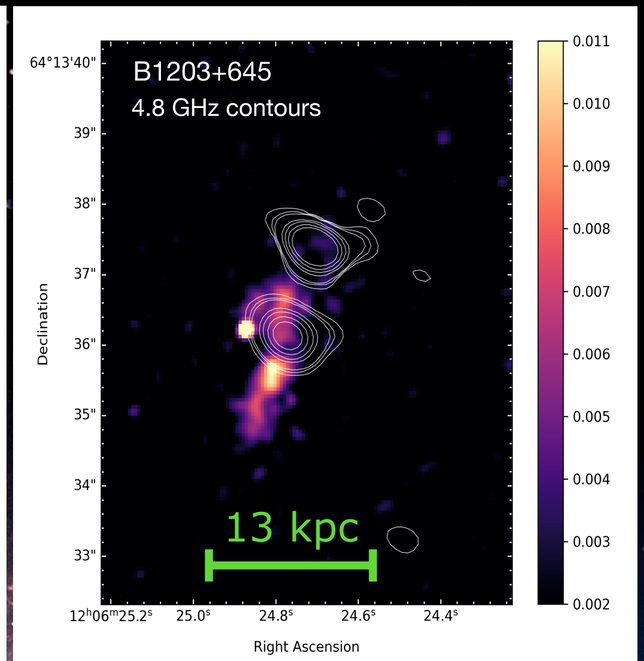
HST WFC3/UVIS data

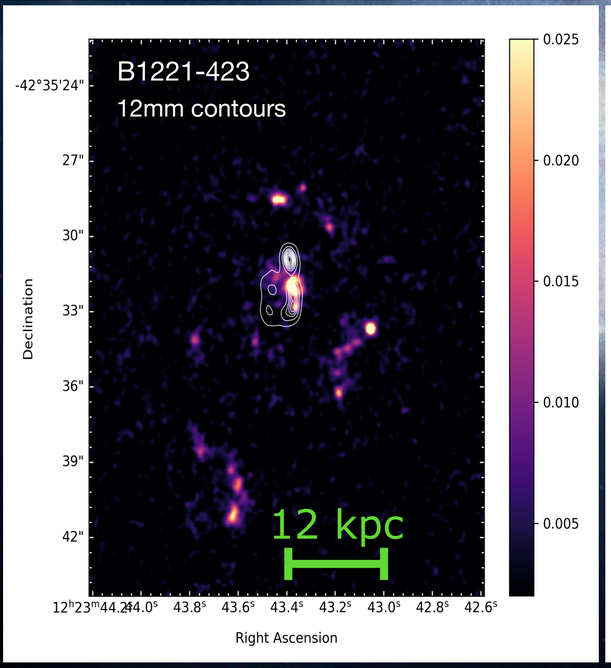
green arrows — orientation of radio source axis

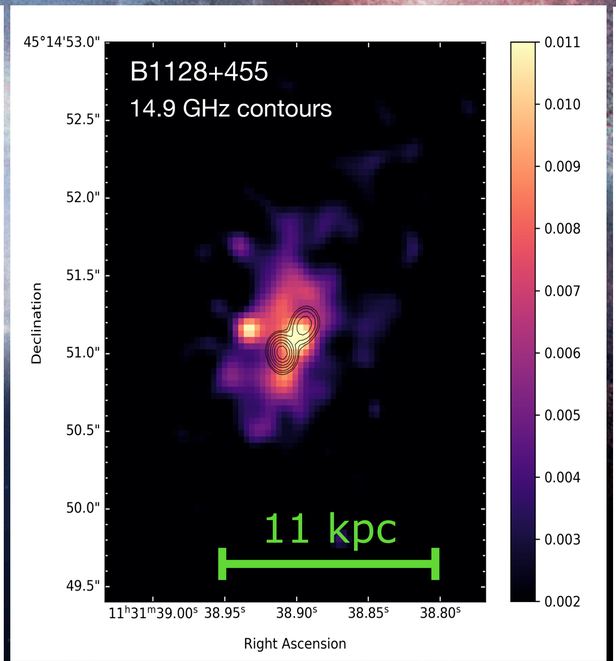
UV-radio alignment

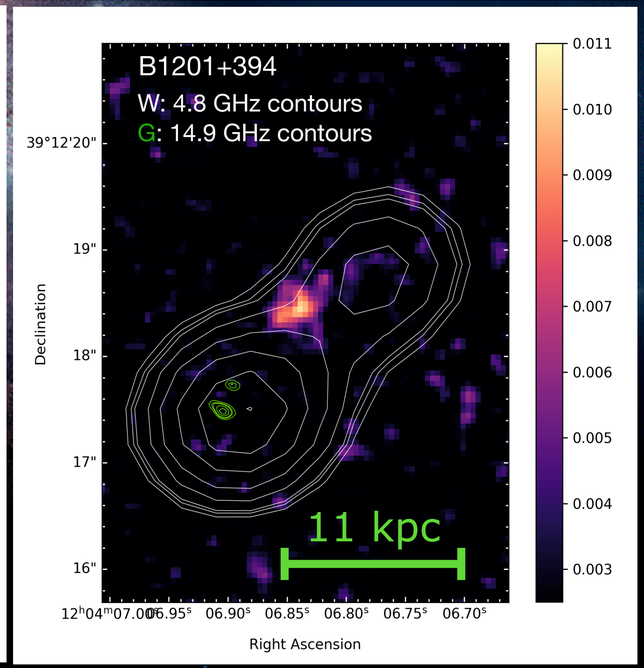












jet-related star formation?!

HST UV continuum images (Gaussian smoothed with a 2 pix kernel) + VLA radio contours

CAVEATS

- UV light extending beyond radio source => merger-induced star formation?

- contamination from AGN-related components: scattered AGN light and/or nebular continuum emission from AGN-ionized emission regions

Dickson et al. 1995; Tadhunter et al. 2002

- selection effect due to radio jets being triggered near dense UV-emitting gas structures

Morganti et al. 2011, Tadhunter et al. 2011, Dicken et al. 2012

MAIN FINDINGS & IMPLICATIONS

- ~ 5 out of 9 CSS sources show radio-UV alignment
  => candidates for jet-induced star formation

Jet-ISM interaction (radio-mode feedback?)

- 1/3rd of the sample have non-elliptical hosts

- disturbed morphological features- large scale tidal tails in B1037+30, faint extended arm-like structure in B1128+455, extended x-shaped filaments in B1203+645

merger histories / ongoing interactions

ONGOING WORK

- Photometric measurements from GALEX (NUV) and WISE (W3, W4) data to compute & compare SFRs in UV/IR
- SF modelling with Starburst99: comparing observed UV with continuous/instantaneous SF models to estimate mass & age of UV-emitting stars in our sources.
- Plan to acquire additional data: polarimetry & emission-line imaging to rule out AGN contributions in observed UV


THANK YOU