



A repeating fast radio burst source localised to a nearby spiral galaxy

Marcote et al.2020

<https://arxiv.org/pdf/2001.02222.pdf>

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**A repeating
fast radio burst source
localised to a
nearby spiral galaxy**

What is FRB?

The observation of this repeating FRB

How to find the host galaxy?

What is the property



3 Fast radio burst(FRB)



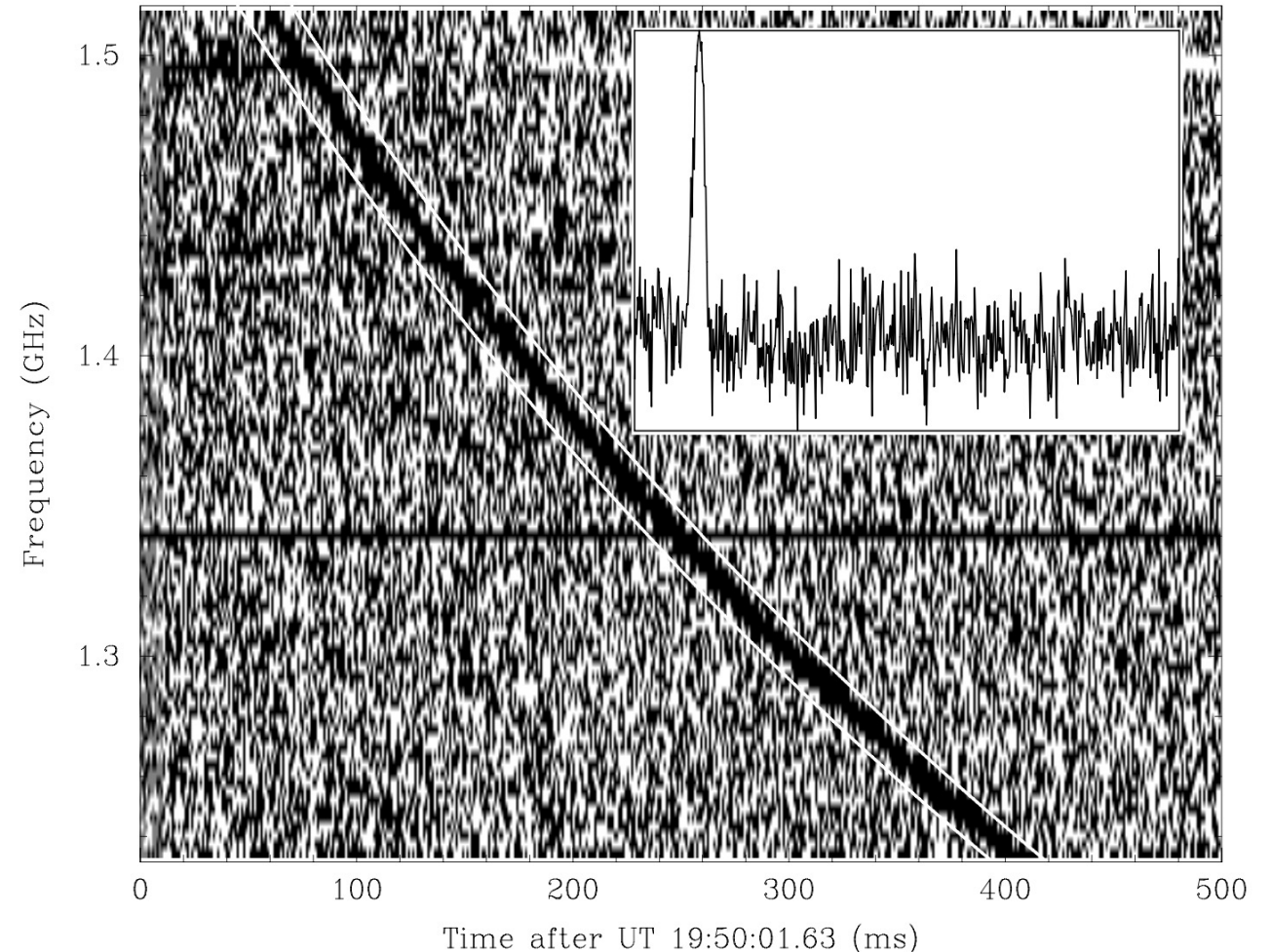
Firstly reported in 2007 :
Lorimer Burst

Brief : ~ms

Bright : luminosity $\sim 10^{41} - 10^{43}$
erg/s

Radio: observation band :
400MHz – 8GHz

Physical origin: unknown

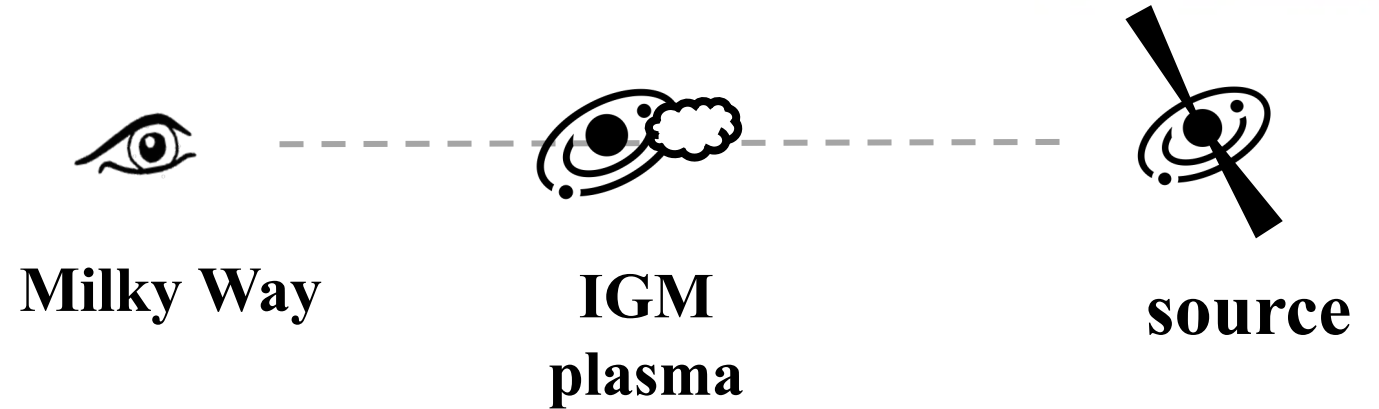


4 Fast radio burst(FRB)

DM estimate:
Dispersion Measurement

Integral of the free electron
column density on the
propagation path

Extragalactic :
 $DM > DM_{MW}$
Source beyond the Milky Way



$$DM = \int_0^d n_e dl$$

$$DM = DM_{MW} + DM_{IGM} + DM_{host}$$



5 Repeating FRBs



Before this work

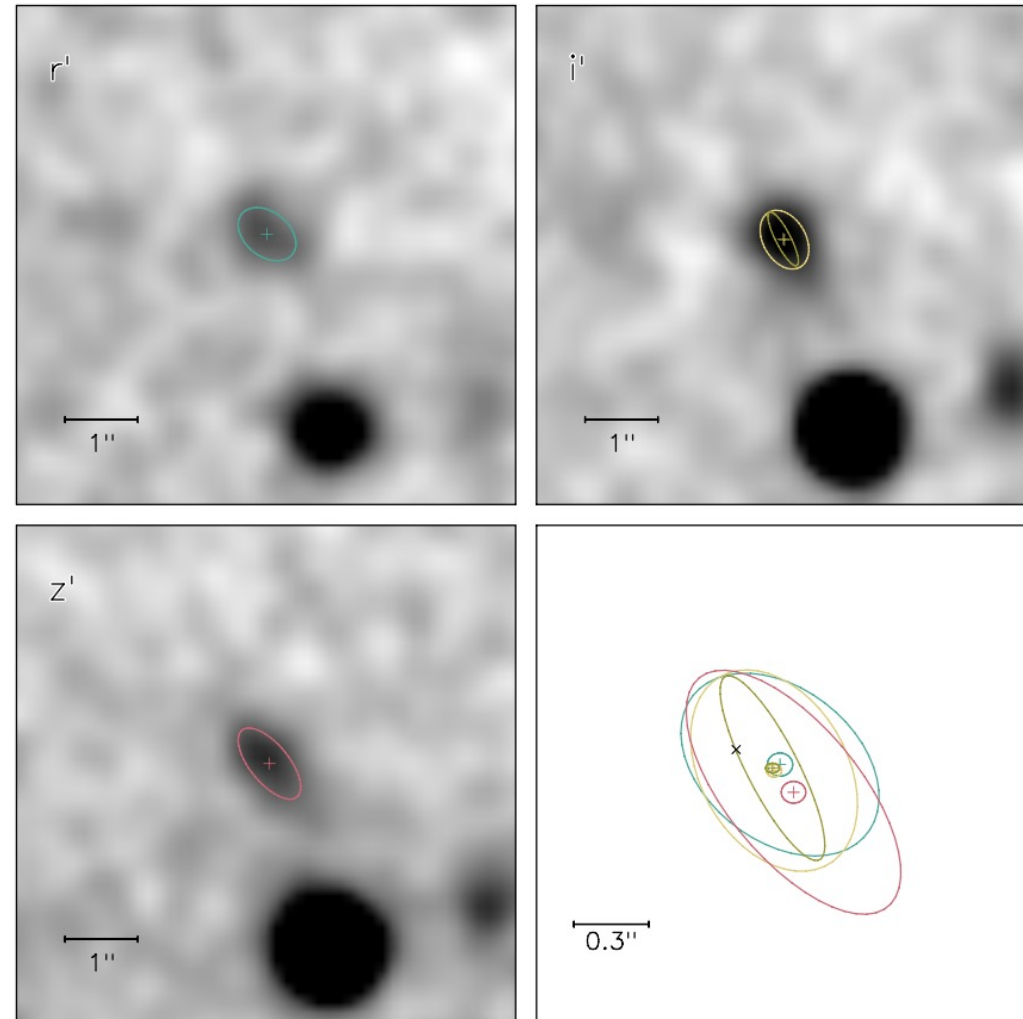
Number of FRBs : over a hundred

Repeating FRBs : 11

Localised host galaxy : 4

Repeat and localised host galaxy : 1
FRB 121102

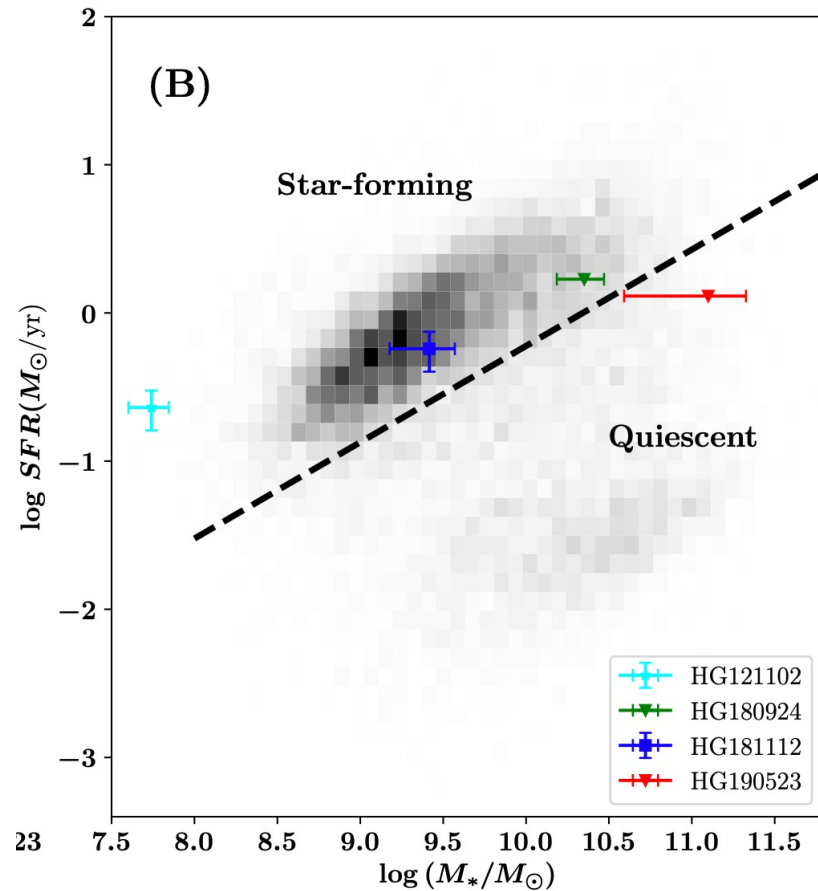
Finding the localised galaxy is
important, but very difficult



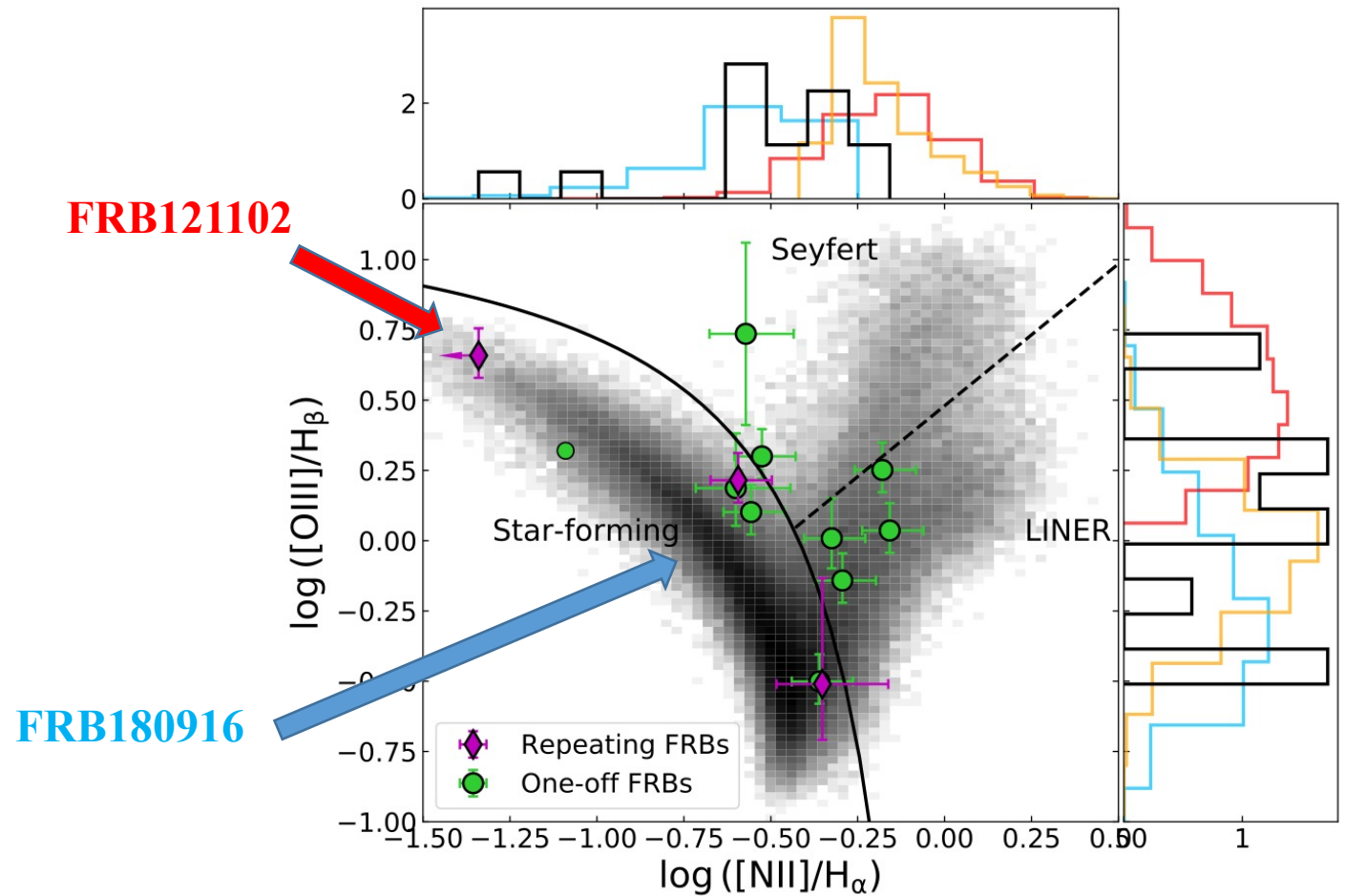
6 Repeating FRBs



whether repeating and apparently non-repeating FRB sources have demonstrably different environments ?



Prochaska et al.2019



Bhandari et al.2021

Firstly discovered by CHIME/FRB

European VLBI Network and Effelsberg observations

4 bursts with S/N 9.5~46

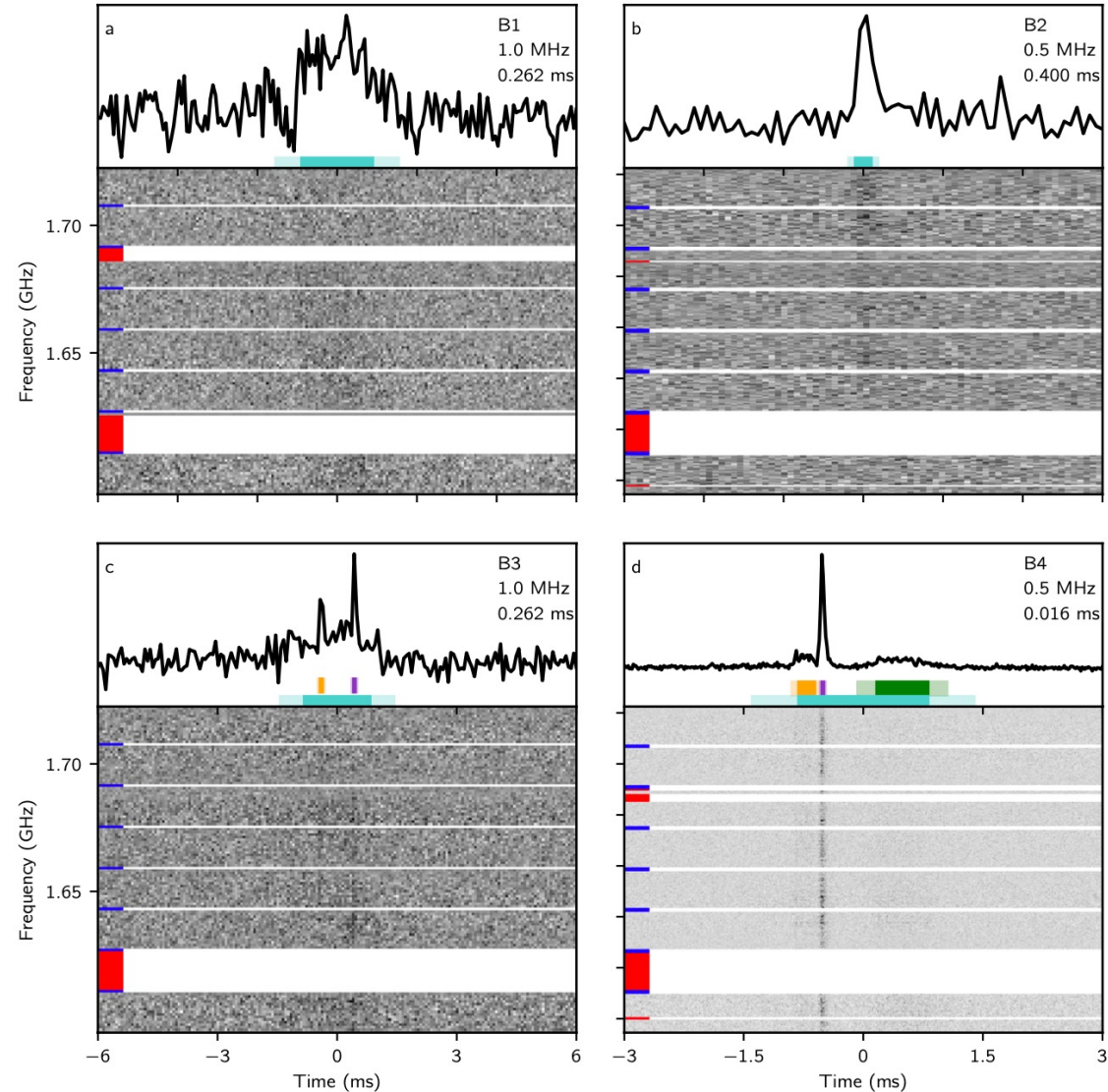
$DM = 348.76 \pm 0.1 \text{ pc cm}^{-3}$

Fitted using Gaussian distribution

B3 and B4 show sub burst

Central frequency: 1.7GHz

Bandwidth : 128MHz



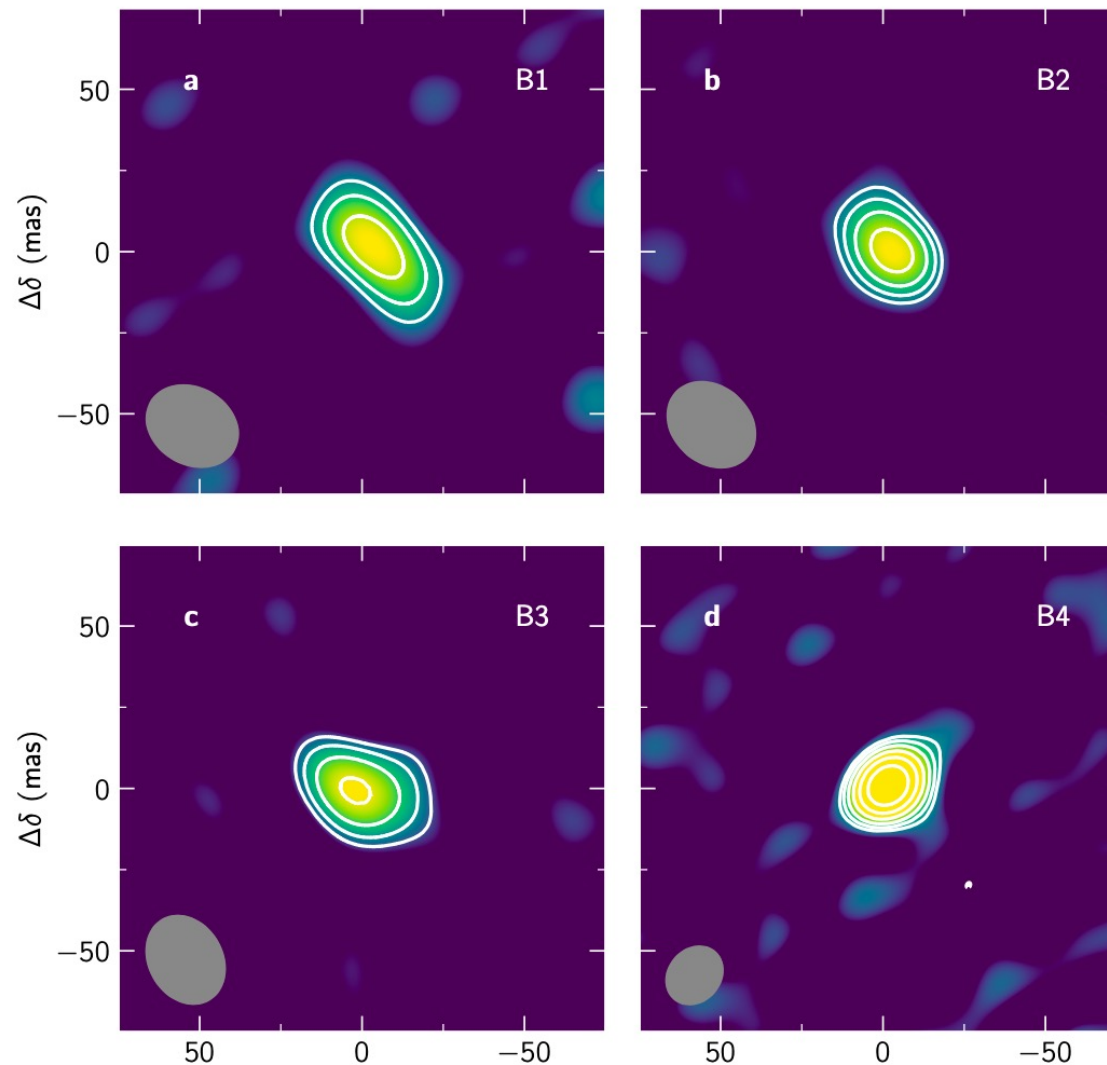
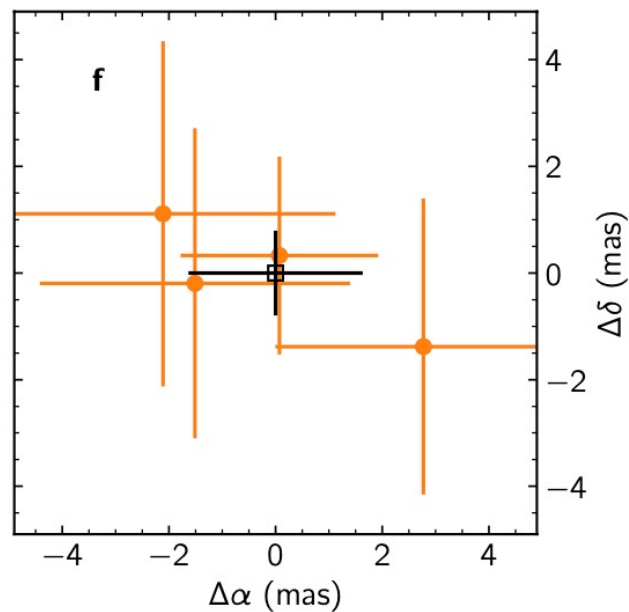
8 FRB 180916.J0158+65



European Very-long-baseline-interferometry Network

5.5h observation

EVN, 4 burst to find the position



9 Localised galaxy

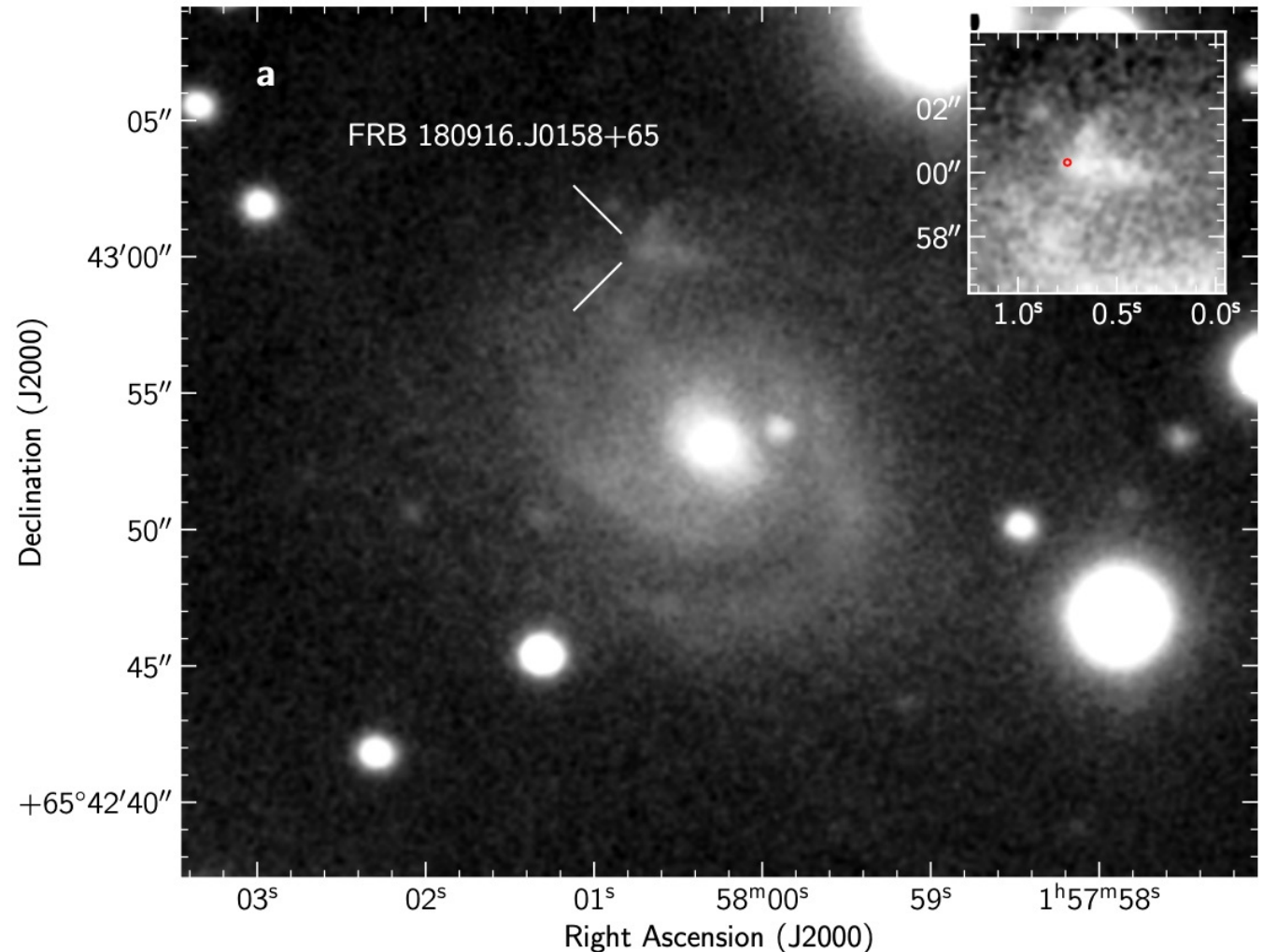


EVN position shows a spatially coincident with a galaxy in SDSS

Gemini-North telescope to observation

Deep optical imaging reveals that the host is a nearly face-on spiral galaxy

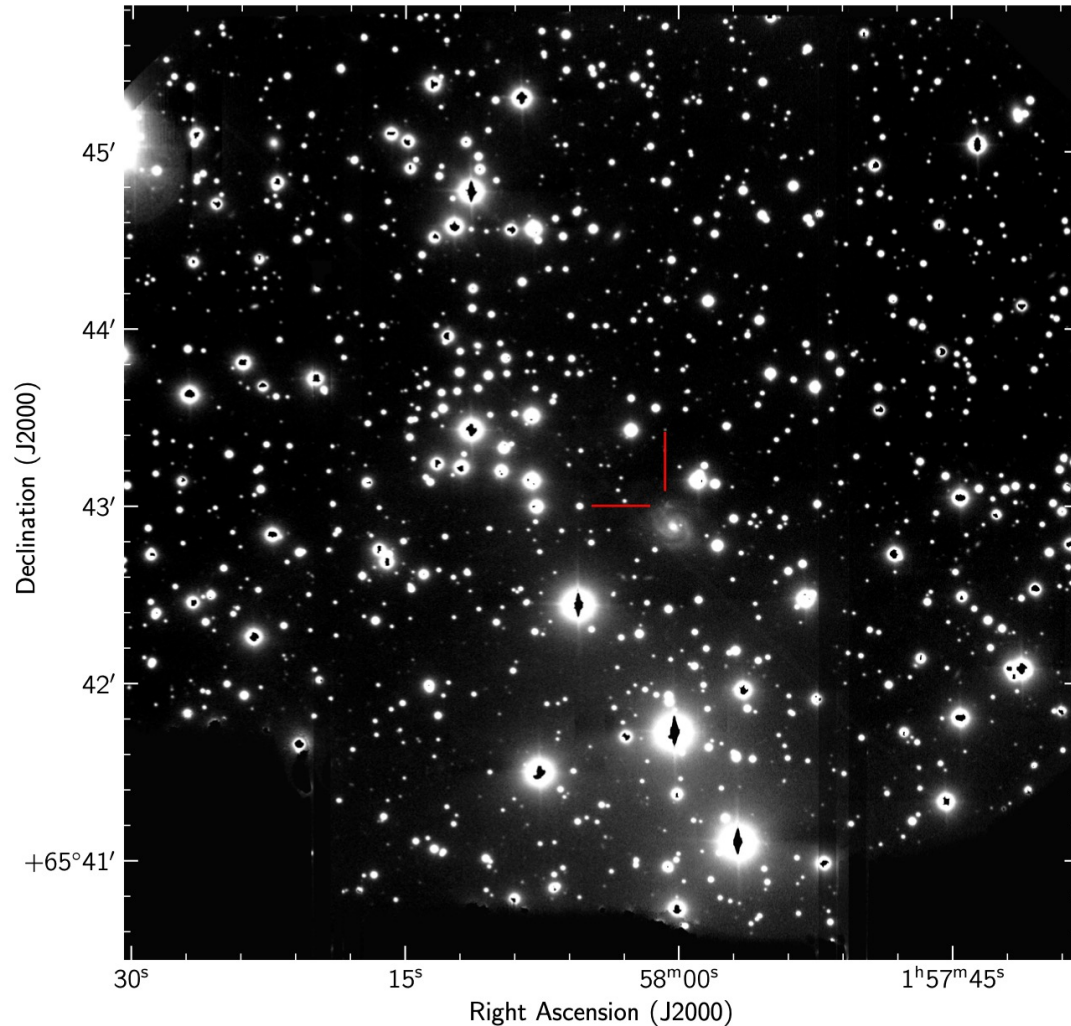
About **7 arcsec** from the core of the host galaxy



10 Localised galaxy



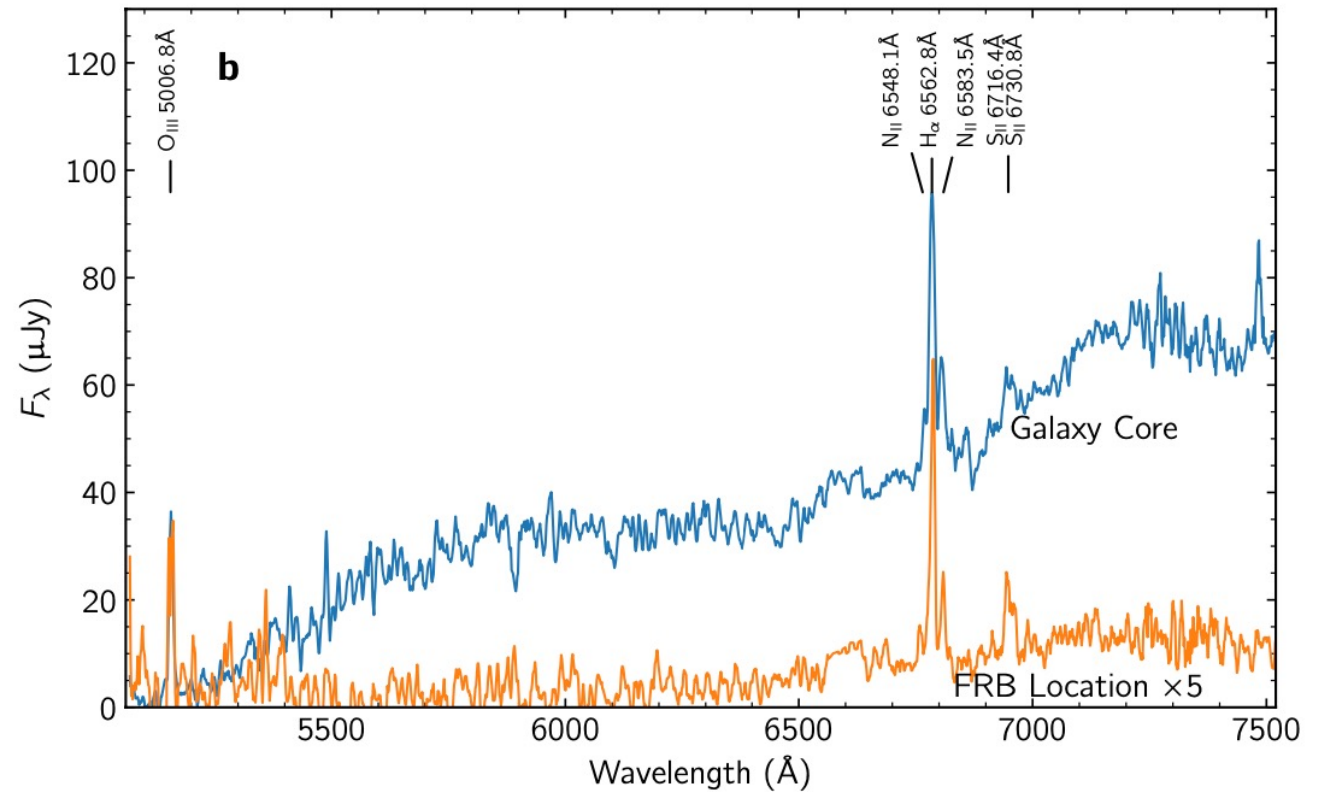
EVN position shows a spatially coincident with a galaxy in SDSS



H α emission line: Star-forming galaxy

Redshift 0.0337 ± 0.0002

Luminosity distance : 149 ± 0.9 Mpc



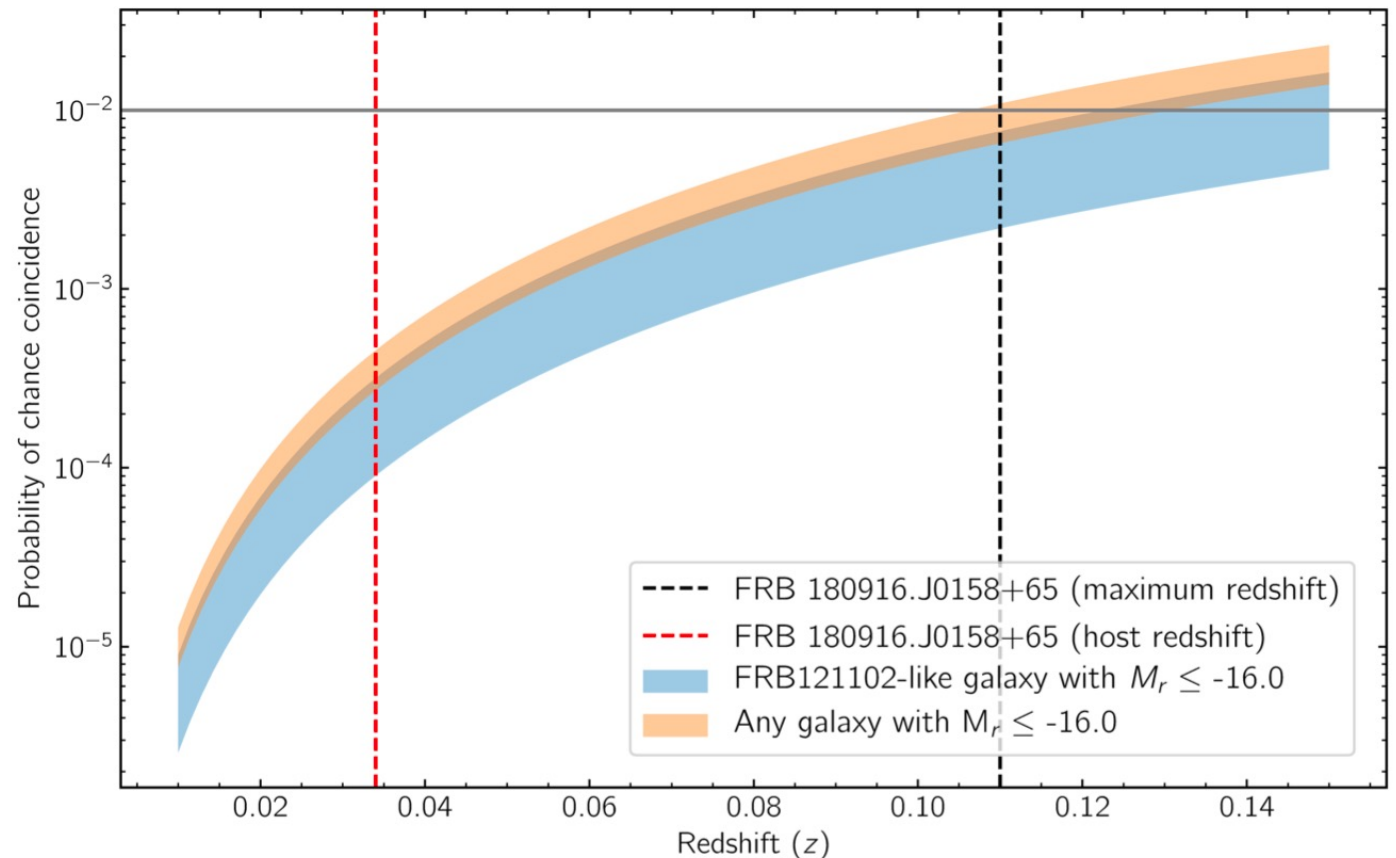
11 ❄️ Coincidence?



Probability of a chance alignment

The horizontal grey line represents the 1% probability

At the redshift of the host galaxy, $z = 0.0337$, the chance coincidence probability is $P \ll 0.1\%$, and at the maximum possible redshift of ~ 0.11 derived from the observed DM the **probability is 1%**



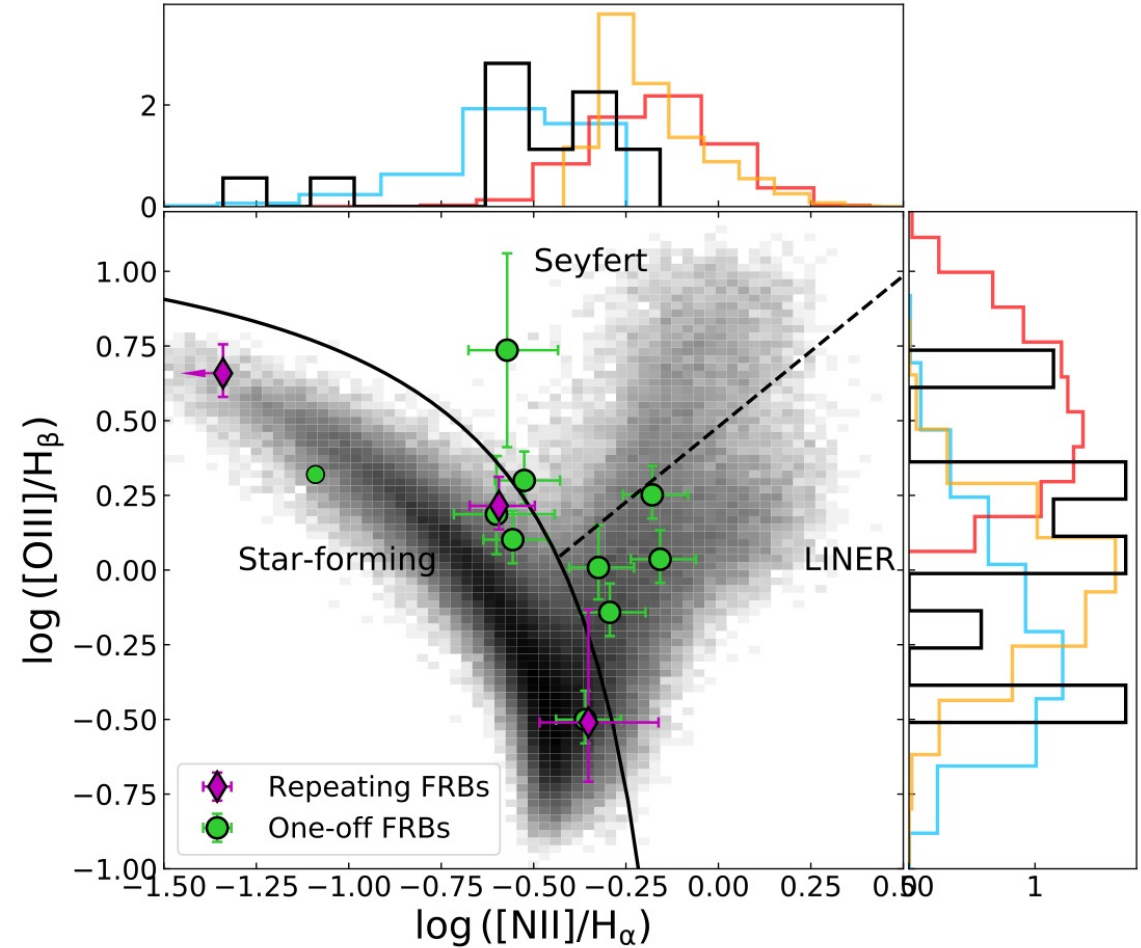
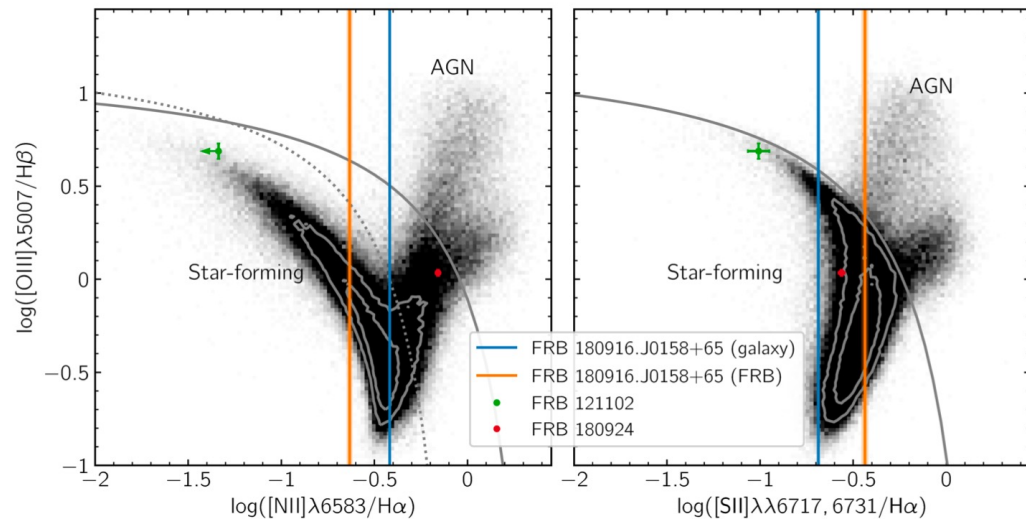
12 Repeating and non-repeating



Emission line flux ratios: allows multi-wavelength follow-up

The host galaxies of FRB 121102 and FRB 180924 are consistent with star-forming and AGN-dominated galaxies

line ratios are broadly consistent with a star-formation dominated galaxy



13 Compare with FRB121102



	FRB180916	FRB121102
DM	$348.76 \pm 0.10 \text{ pc cm}^{-3}$	$558.1 \pm 3.3 \text{ pc cm}^{-3}$
Z of the galaxy	0.0337 ± 0.0002	0.19273 ± 0.0005
Stellar mass of the galaxy	10^{10} solar mass	10^7 solar mass
Star formation rate of the galaxy	>0.016 solar mass /yr	0.4 solar mass /yr
Luminosity upper limit	10^{36} erg/s	10^{38} erg/s

a factor of **six closer** than the repeater FRB 12110217

five times higher metallicity than the dwarf host galaxy of FRB 121102

the upper limit implies that any such source associated with FRB 180916.J0158+65 must be at **least 400 times fainter** than the one associated with FRB 121102

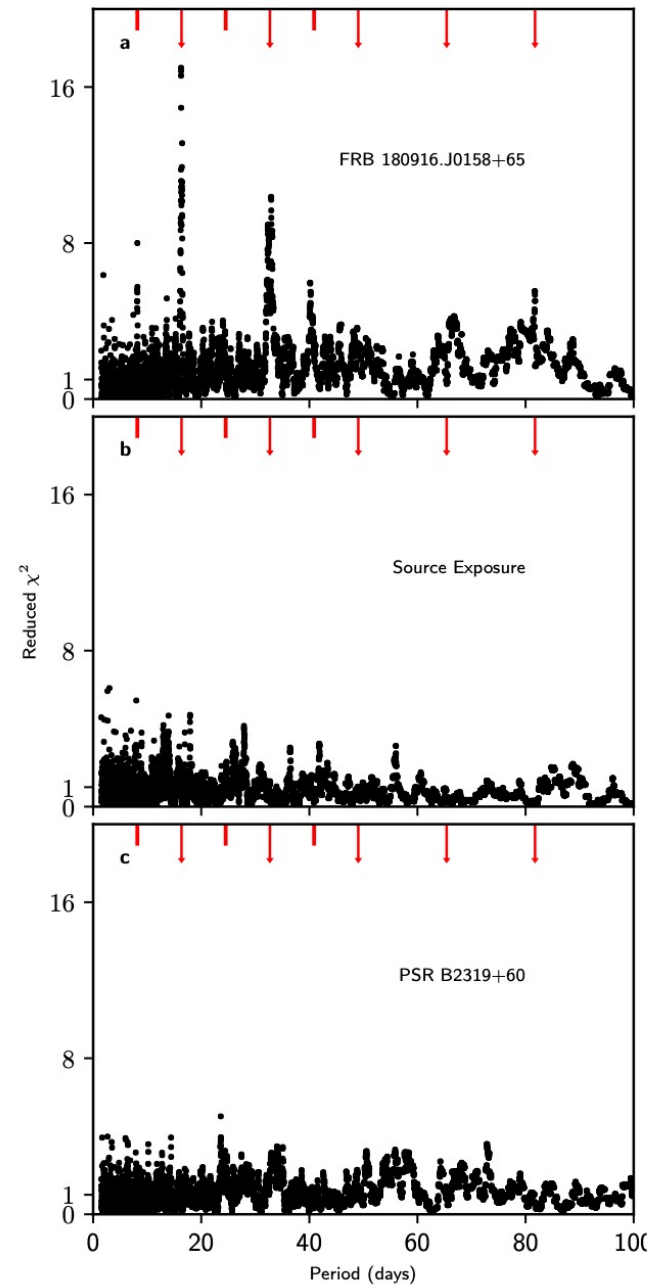


14 Period repeating

Observed burst:

The radiation activity of FRB 180916 repeats over a **period of 16.35 +/- 0.18 days**: emits a burst of radiation for approximately four days followed by an inactive period of about 12 days

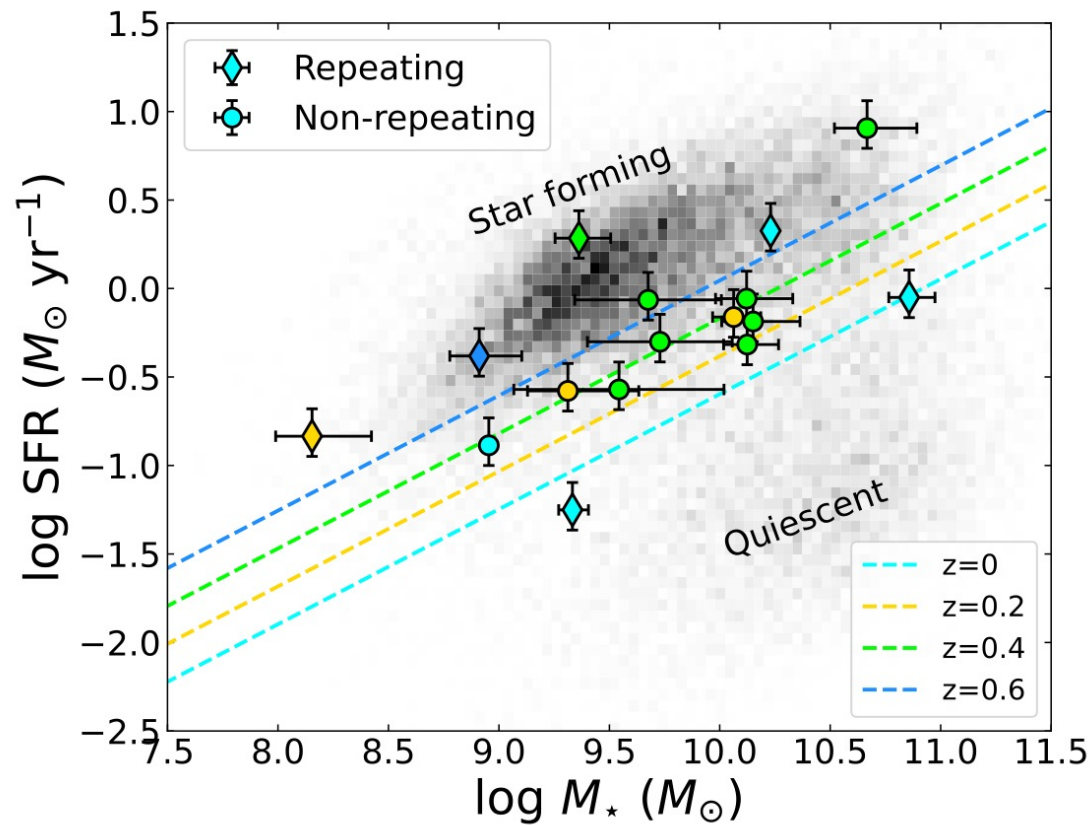
FRB121102 exhibits the same radio burst behavior every 157 days: radio bursts observed in a window lasting approximately 90 days followed by a silent period of 67 days ?



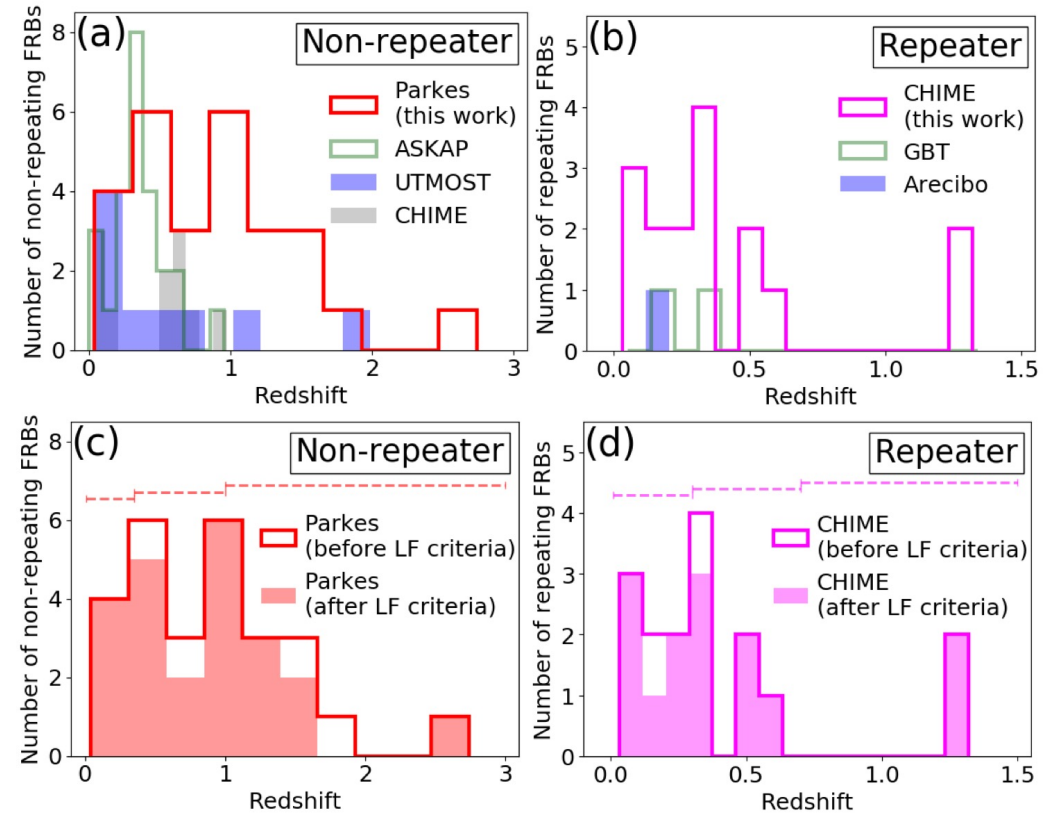
15 Repeating FRBs and non-repeating



whether repeating and apparently non-repeating FRB sources have demonstrably different environments ?



Bhandari et al.2021



Hashimoto et al.2020



- A repeating FRB localised to a nearby spiral galaxy , different from the prior repeating FRB with a dwarf galaxy
- The environment of this repeating FRB:repeating FRBs have a wide range of luminosities, and originate from diverse host galaxies and local environments.
- More samples and observations to figure out the nature of FRB, and the difference between repeating FRBs and non-repeating FRBs





How to improve the procedure to find the host galaxy?

Why the number of repeating FRBs is less than non-repeating FRBs?

Does FRB has strong connection with their environment?

The way to optimize the model.

