## The Host Galaxies of Fast Radio Bursts

Sandra Savaglio Department of Physics, University of Calabria

In collaboration with: Luciano Nicastro, Eliana Palazzi, Davide Pelliciari, Andrea Rossi INAF - Osservatorio di Astrofisica e Scienza dello Spazio, Bologna Matteo Cinus INAF - Osservatorio Atronomico, Cagliari Claudia Gatti University of Calabria

> FRB Italy Bologna, 7-9 May 2025

#### Some numbers

- First reported detection: in 2007 FRB 010724 (Lorimer Burst)
- First localisation & distance from host galaxy: in 2017 for FRB 121102A

	Total number	ΔΝ/Δτ	Repeaters
December 2023	759		51
June 2024	787	56.0	54
January 2025	838	87.4	56
April 2025	841	12.0	57

#### Progression

Current Status (as of May 2025): host identified for ~1/6 FRBs

- 137 localised FRBs: 115 one-offs & 22 repeaters
- A few have photometric redshift
- 8 have no redshift
- 4 without identified hosts

Large variety of nature of the host

#### Publications on samples of FRB host galaxies

Article	Known hosts	New hosts	Total hosts	Repeaters
Macquart+20	2	4	6	1
Heintz+20	7	5	12	3
Mannings+21	2	8	10	3
Bhandari+22	14	3	17	6
Gordon+23	12	11	23	6
Woodland+23	7	0	7	0
Bhardwaj+24	14	4	18	7
lbik+24	3	2	5	3
Law+24	10	11	21	0
Sharma+24	10	20	30	0
Shannon+24	21	22	43	1
Bernales-Cortes+25	12	0	12	1

## Spiral galaxies: FRB 201124A

Magnetar in hyper-accreting X-ray binary in a gas nebula

**1999 bursts in 54 days** (Xu et al., Nature 609, 685)



### Dwarf galaxies: FRB 121102A

With 157 days period



Tendulkar et al. (2017)

6563 15 *z* = 0.1927 011] 500 6717 6731 10  $\mathsf{F}_{\nu}$  ( $\mu$ Jy) SII [0III] 4959 Reference 4861 lost aalax Sky (scaled by 10%, offset by -3 µJ AMMAM. 8000 5500 6000 6500 7000 7500 8500 Wavelength (Å)

are

Dwarf galaxy Stellar mass: log (M $_*/M_{\odot}$ ) = 8.15 SFR = 0.8 M $_{\odot}$  yr<sup>-1</sup> Metallicity: 12 + log(O/H) < 8.4

Marcote et al. (2020, Nature, 577, 190)

### In a globular cluster: FRB 200120E

#### Near massive galaxy M81



## In mature and massive galaxies: FRB 220509

Initially identified as an elliptical



Then as a barred spiral



Bhardwaj et al. (2024)



Law et al. (2024)

Post star-burst z = 0.0894Stellar mass: log (M<sub>\*</sub>/M<sub>•</sub>) = 11.1 SFR = 0.08 M<sub>•</sub> yr<sup>-1</sup>

## Or distant and faint galaxies: FRB 210912A

#### No host, fainter than any FRB host known



Marnoch et al. (2023)

#### Redshift determined for 129 FRB host galaxies

#### 1 from is the FRB in the Milky Way



Difference between repeaters & one-off's not statistically significant

#### Stellar mass distribution of FRB host galaxies



#### Determining host parameters in a homogeneous way Star formation rates of FRB hosts



#### Determining host parameters in a homogeneous way

SFR vs. stellar mass of FRB hosts



#### Determining host parameters in a homogeneous way

**Optical extinction vs. stellar mass** of FRB hosts



# The whole sample of FRB hosts

Comparing with host galaxies of other transient events

- Short GRBs
- Long GRBs
- CC-SNe
- SNe la

### **Redshift distribution**



### Redshift distribution



(Long GRBs from the X-shooter sample, Krühler et al. 2015)

#### FRB hosts against hosts of other low-z transients



Adapted from Nicastro et al. (2021)

### Cosmic rates: FRBs vs. gamma-ray bursts (GRBs)



Chen, Jia, Dong, & Wang (2024)

### Conclusions

- All localized FRBs have a detected host, but one
- Total number of FRBs with known redshift & host: 128+1
- Interval (median) redshift: 0.00 1.35 (0.192)
- Many hosts are spiral & star-forming galaxies
- No significant differences between repeating-FRB hosts and one-off-FRB hosts
- Comparison with other low-z transient host populations do not show remarkable differences (but SN Ia)
- Number of localizations (hosts) will increase tenfold within the next few years
- To support this progress, we have created a database; we plan to make it publicly available
- One goal: is repeater host population different from one-off host population?

### The End