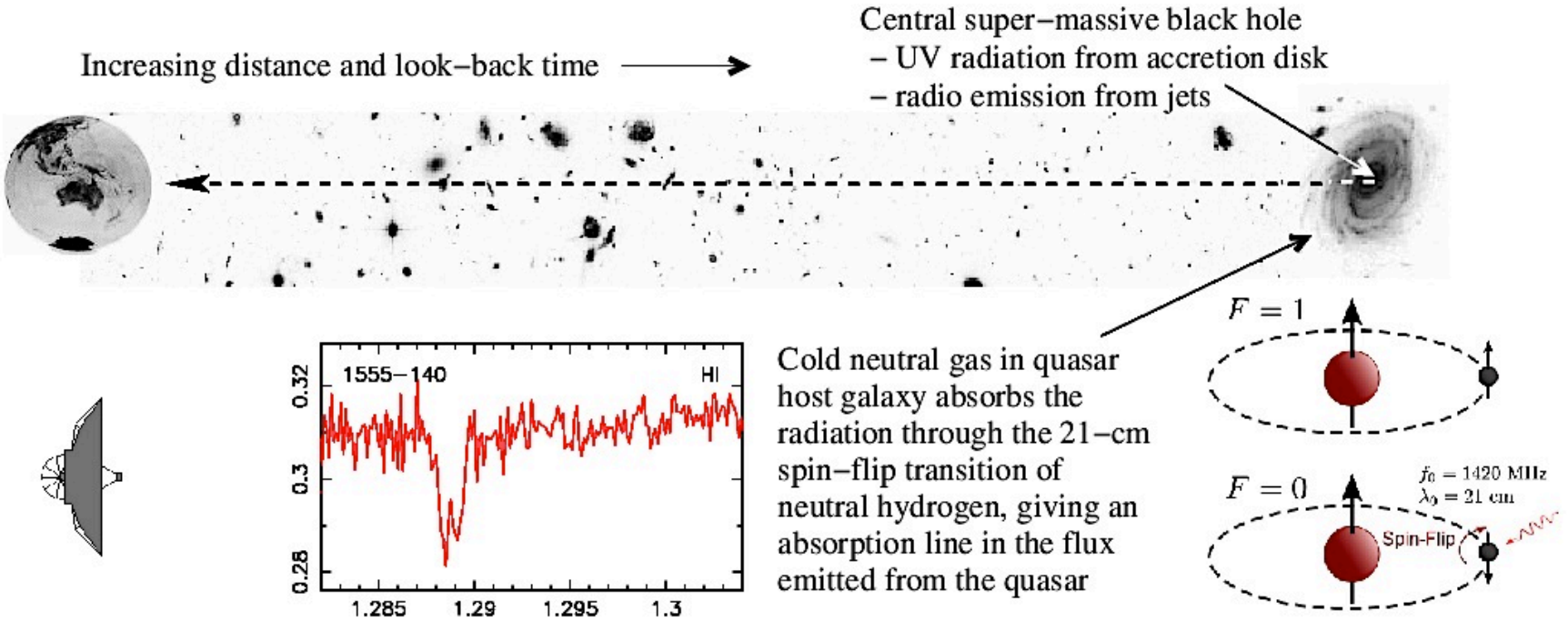
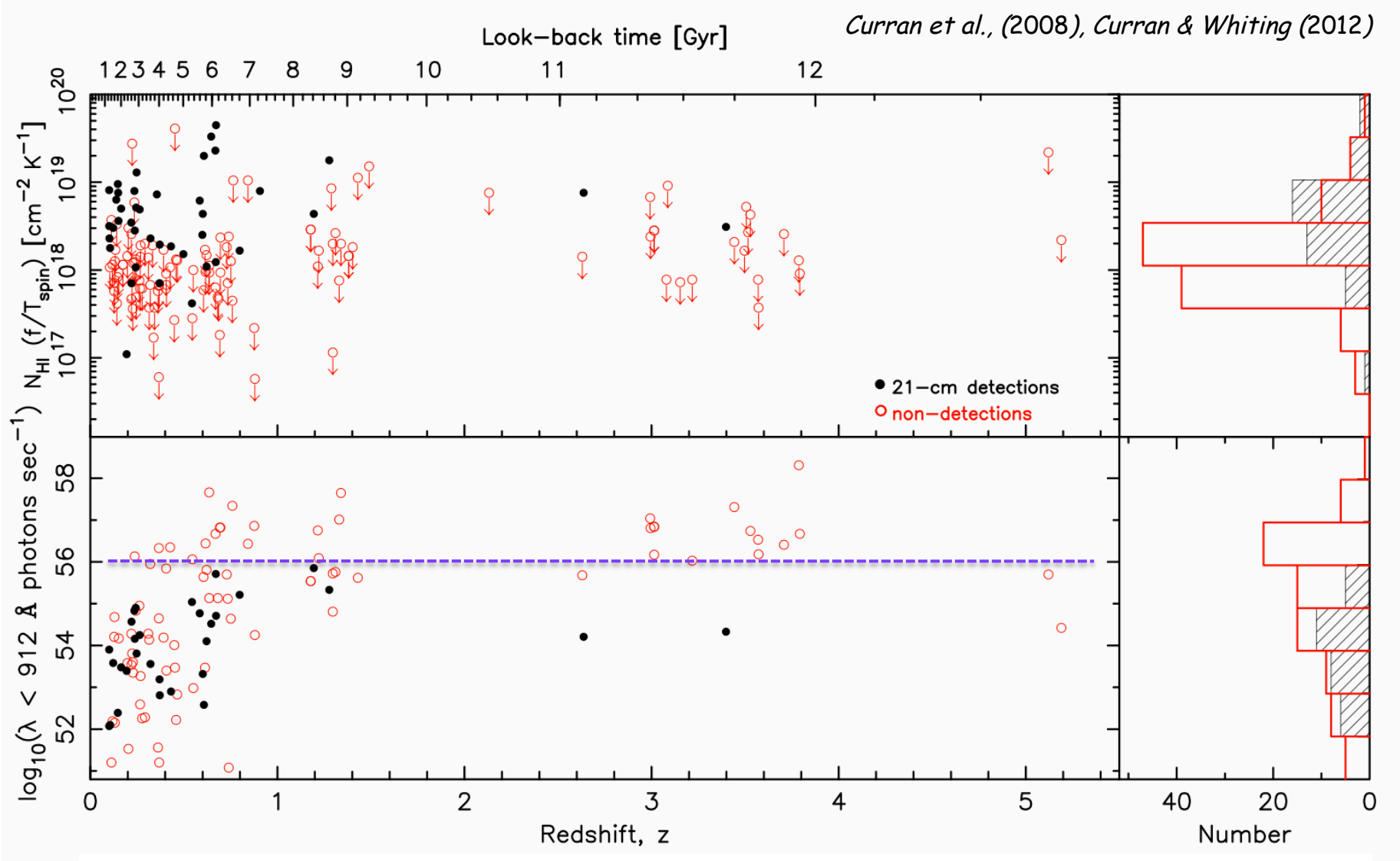


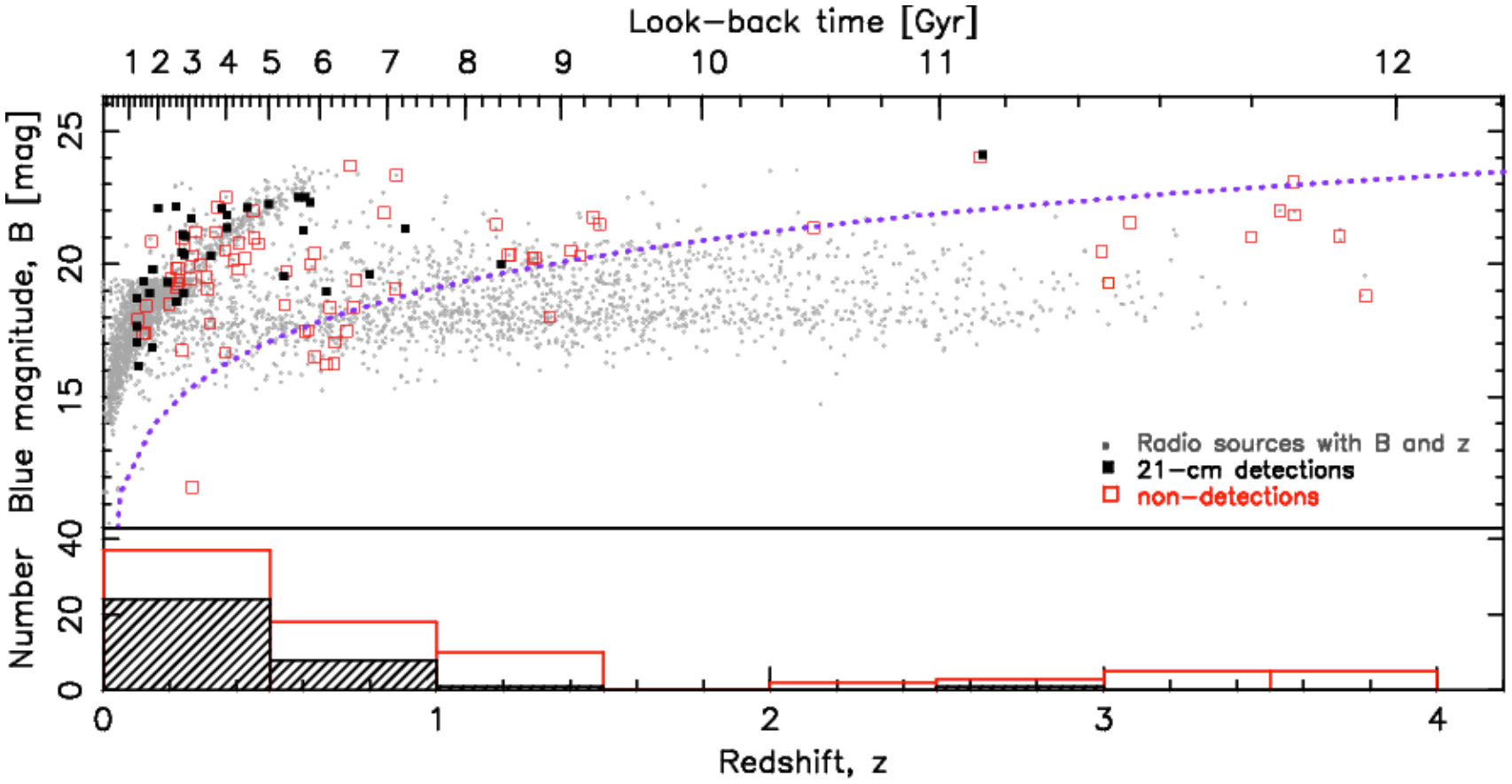
In absorption, the 21-cm transition of neutral hydrogen (HI):

- Traces the *cool* component of the neutral gas. That is, the raw material for star formation, which in turn forms planets and all heavy elements.
- Unlike the Lyman-α transition of HI (which traces *all* of the neutral gas), can be observed at $z = 0$ by ground-based telescopes (cf. $z > 1.7$).
- Unlike 21-cm emission, can be readily detected at $z > 0.1$, since absorption strength only dependent upon column density and background flux.



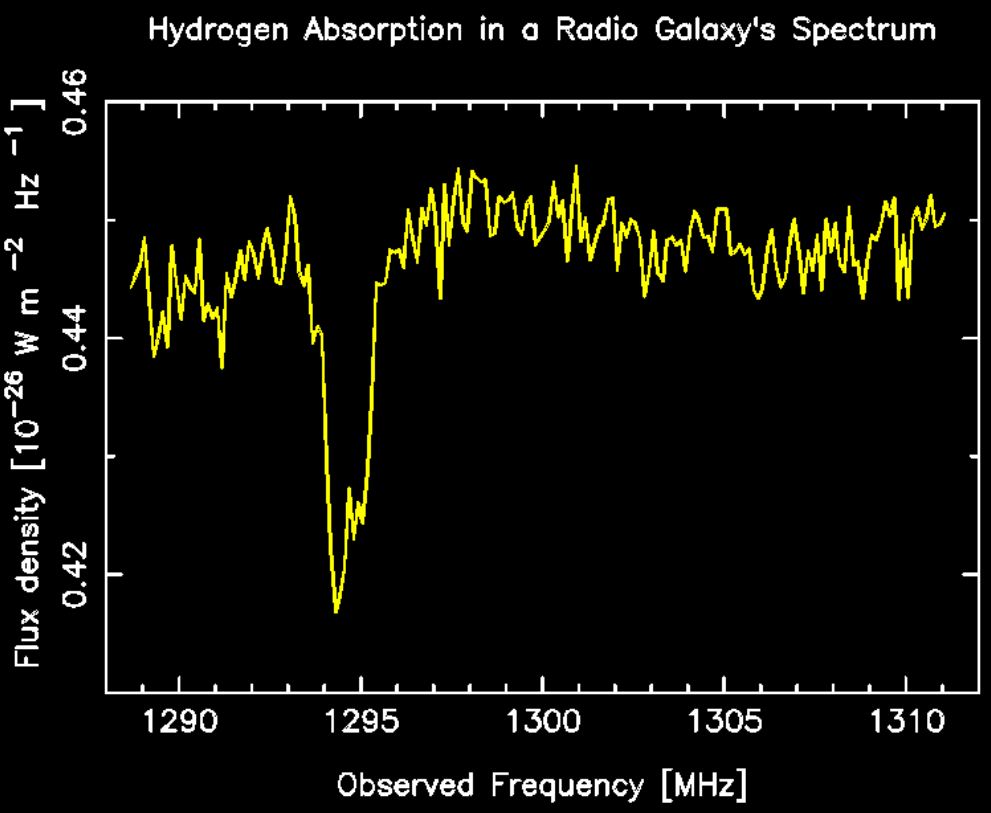
High redshift selection biases towards most UV luminous (L_{UV} > 10^{23} W Hz^{-1}) objects, in which gas is completely ionised (confirmed through a similar dearth in associated MgII absorption around L_{UV} > 10^{23} W Hz^{-1} QSOs, *Curran et al.*, submitted).

Traditional optical selection biases towards object in which gas is completely ionised even faint objects ($B \approx 23$) at $z > 3$ yields objects extremely UV luminous in the rest-frame ($L_{UV} \approx 10^{23}$ W Hz^{-1}) -> target optically faint, radio-loud, sources at high-z. However…

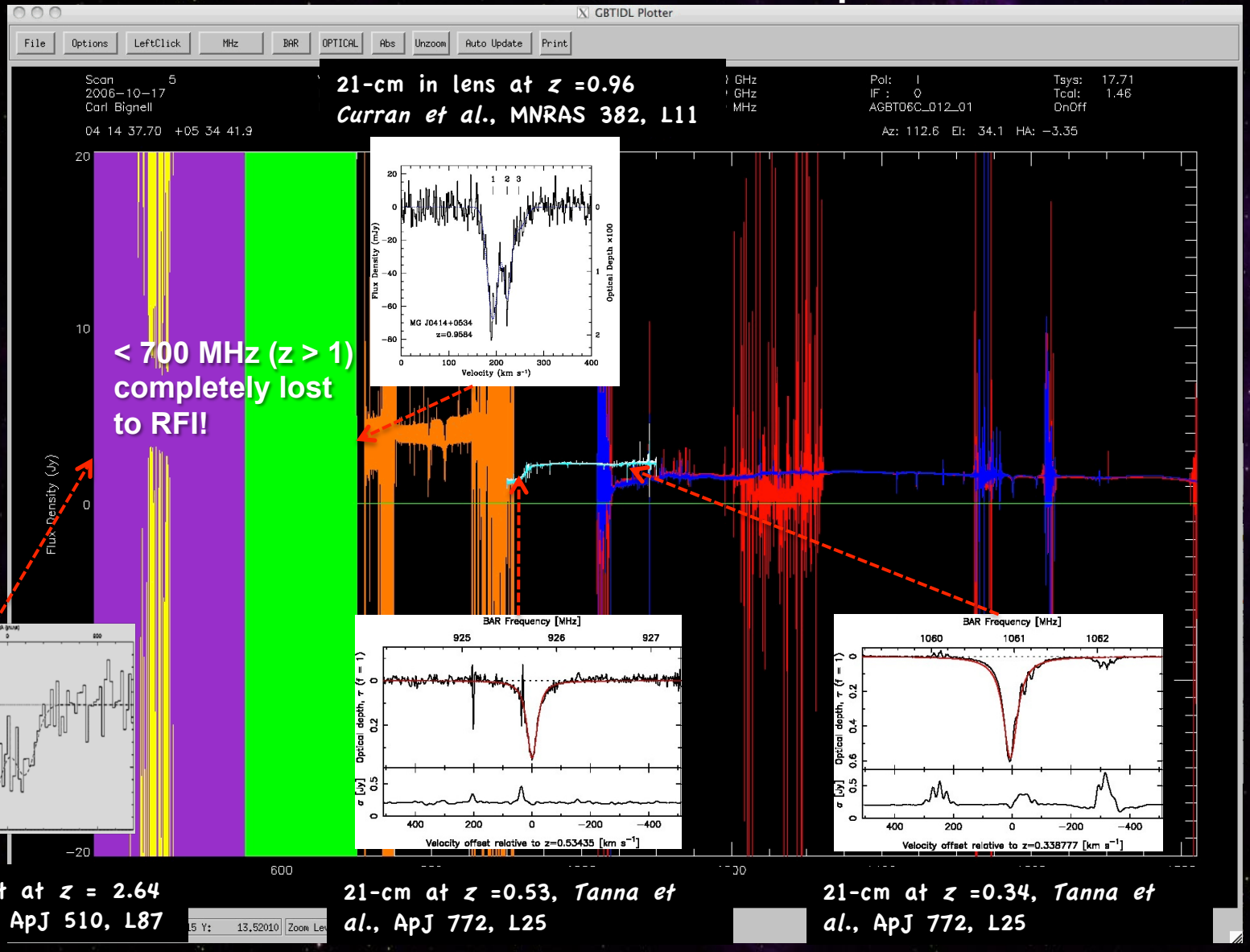


Since gas completely ionised (*Curran & Whiting*, 2012) even SKA won't be able to detect 21-cm absorption in $z > 3$ radio sources of known (optical) redshift!

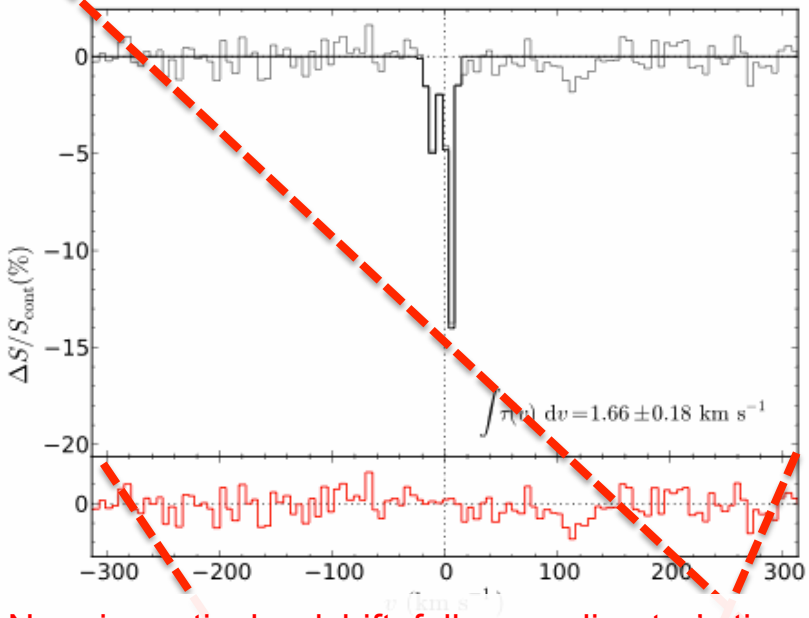
No optical spectrum which means absorption could be anywhere at $z_{abs} \leq z_{QSO}$ where z_{QSO} is unknown $\Rightarrow$ ***SPECTRAL SCAN***



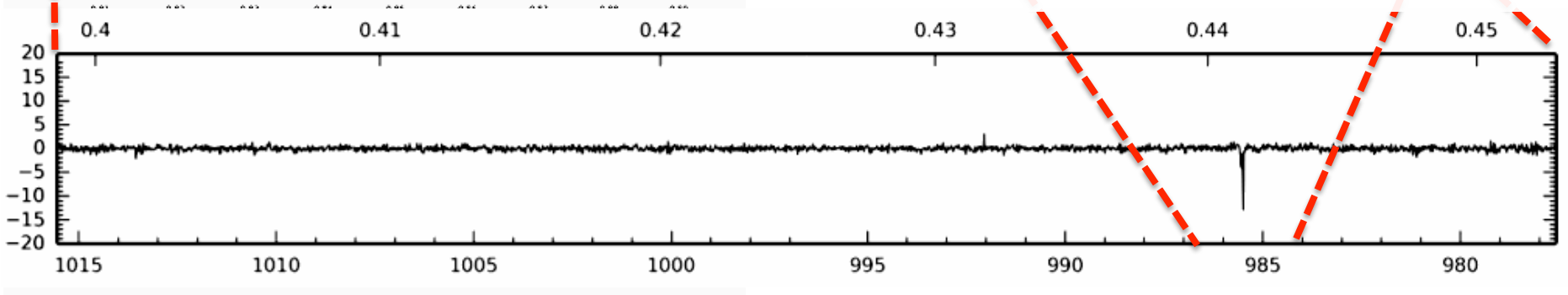
Spectral scan towards a very red (V – K = 10.26) quasar with the Green Bank Telescope



ASKAP BETA array 1015 – 700 MHz (z = 0.4 – 1.0, LBT = 4.2 – 7.7 Gyr) spectral scan towards PKS 1740-517 (*Allison, ACES team et al.*, in prep.)

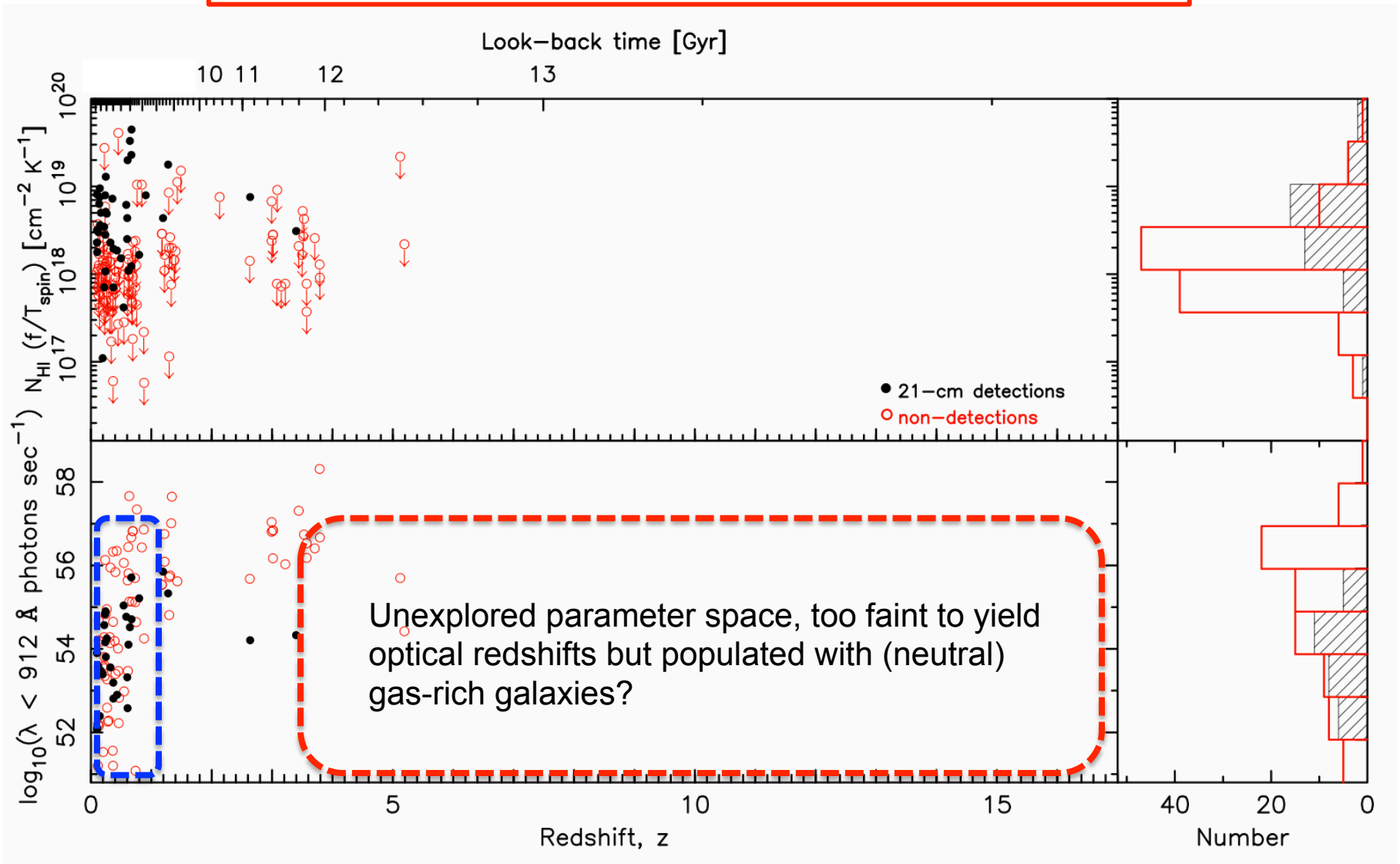


No prior optical redshift, follow up director's time on Gemini => z = 0.44 => associated

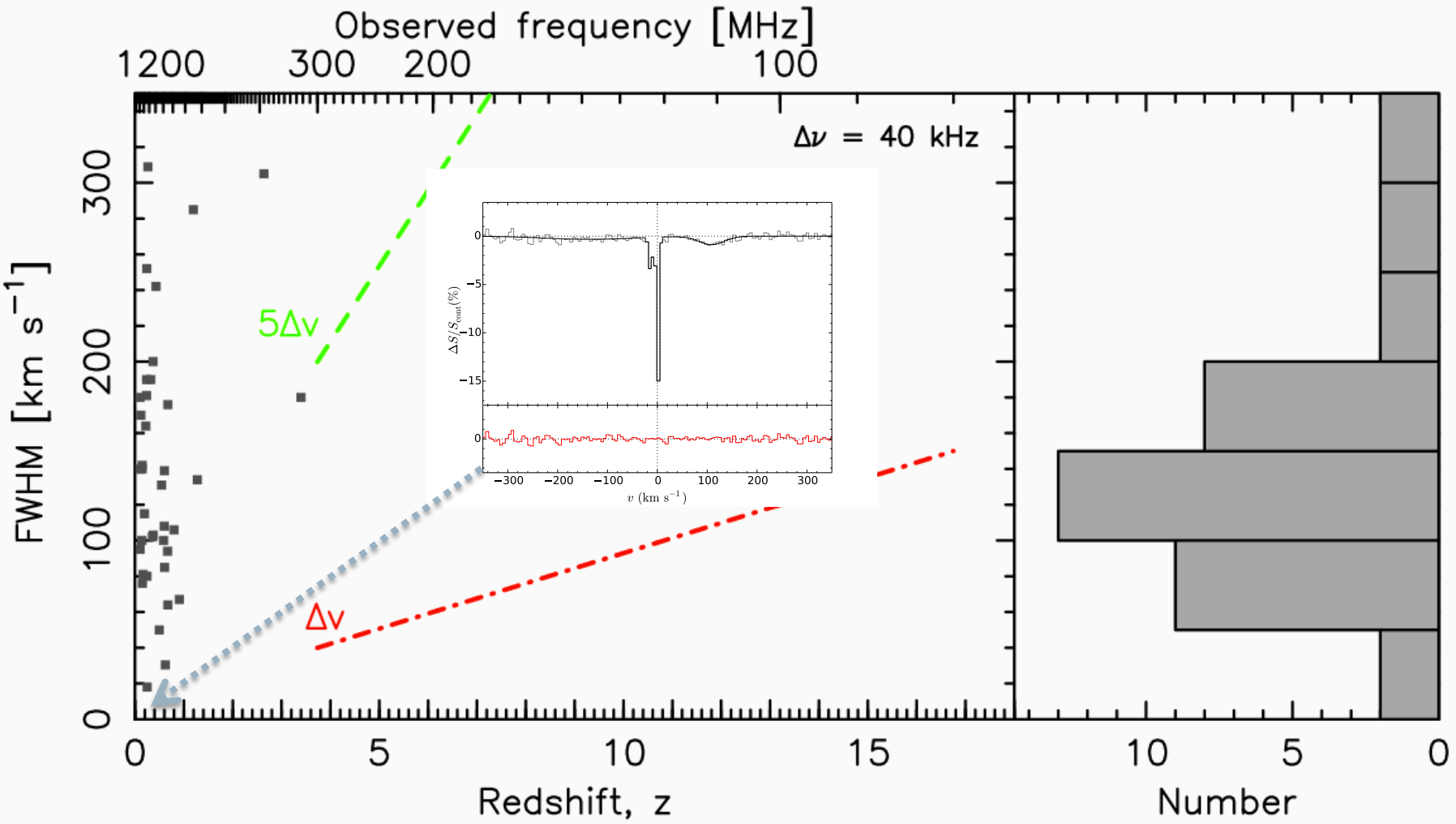


However, > 700 MHz restricts HI with *ASKAP* to z < 1.0 (< 7.7 Gyr)

300 - 80 MHz with *MWA* => 3.7 < z < 16.8 (11.9 – 13.4 Gyr)



However, spectral resolution could be an issue…



… with > 30 MHz instantaneous bandwidth would be nice!

Summary

Non-detection of associated HI 21-cm at high-z explained by UV luminosities of $L_{UV} > 10^{23}$ W Hz^{-1} ionising/exciting the neutral gas (*Curran et al,*. 2008).
Has been confirmed by *Grasha & Darling* (2011) & *Allison et al.* (2012).

The non-detection of HI 21-cm in these objects is *not* a sensitivity issue, but a consequence of *all of the gas being ionised* (as demonstrated by the model of *Curran & Whiting,* 2012, and lack of MgII absorption at $Q_{MgII} > 10^{56}$ sec^{-1}).

So even the SKA is unlikely to detect 21-cm absorption in the currently known (optically selected) z > 3 radio galaxies and quasars.

Spectral scans towards radio-loud, optically-faint objects are required in order to detect missing star-forming gas in high-z radio galaxies and quasars.

With *ASKAP* HI restricted to z < 1, which is currently well explored.

With ≤ 10 kHz spectral resolution, the MWA could, in principle, uncover a population of gas-rich galaxies at z > 3.7, hidden from optical spectroscopy.