The fundamental relation between HI mass and radio luminosity from line and continuum simulations

Hayato shimabukuro (Nagoya university)
Matt Jarvis(University of Oxford)

Introduction

As next generation radio telescope, SKA(Square Kilometer Array) is planned. By using this telescope, we expect to be able to observe large field of view in wide range frequency. For optimizing the design of this new telescope and observing programs for efficient realization of any scientific goals, European SKADS(SKA Design Study) developed SKADS simulated skies (S3) simulations. In our study, we investigated the some fundamental relations expected in SKA observation using part of S3 simulations.
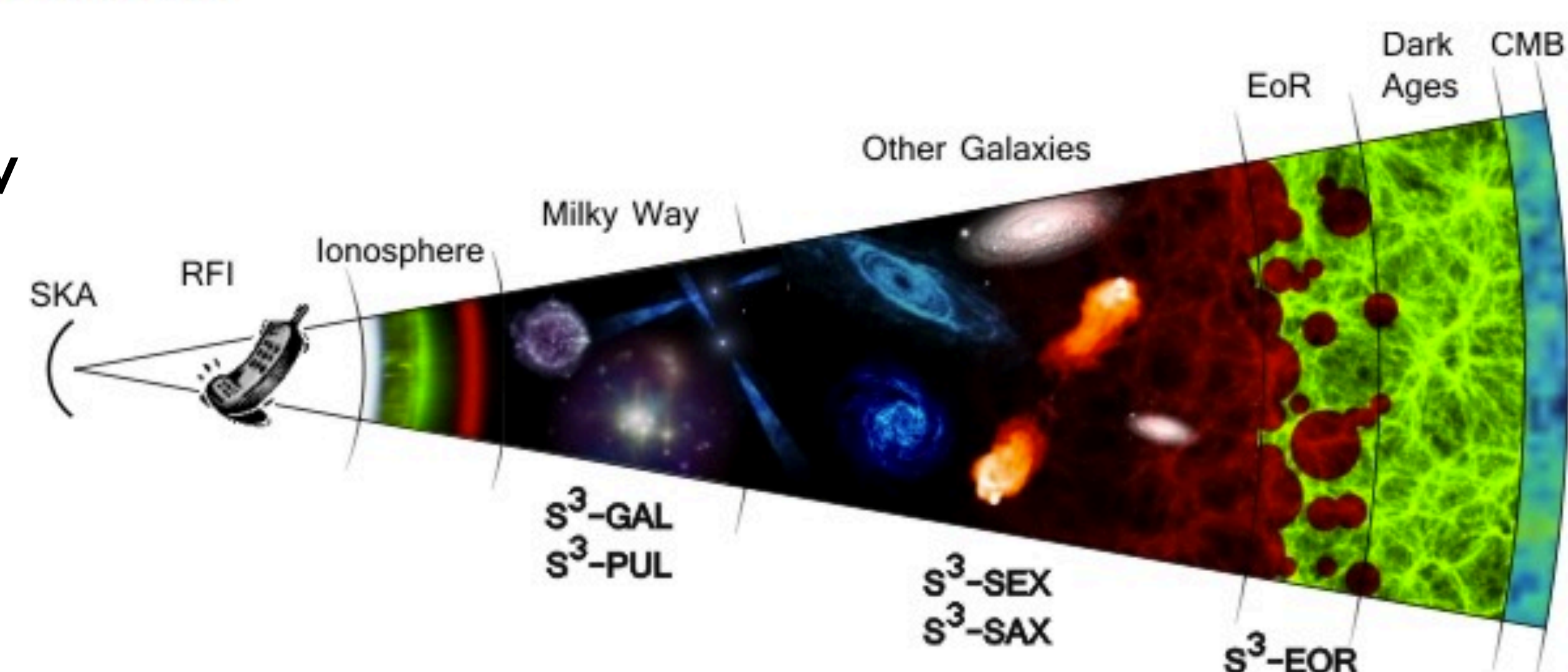
Simulation

In our study, we use S3-SEX(simulation of extragalactic radio continuum sources,Wilman et al 2008) and S3-SAX(semi-analytic simulations of HI atomic and molecular hydrogen(H2), Obreschkow et al 2009) simulations.

S3-SEX simulation is based on "semi-empirical"method, which means that sources are drawn from observed (or extrapolated) luminosity functions and they distribute under the dark matter density field with biases which reflect large scale clustering. We can get radio fluxes, radio source position,redshift ...etc from this simulation.

S3-SAX simulation is based on millennium simulation of cosmic structures and analytic model of HI and H2 properties in galaxy. This simulation provides how HI and H2 associate with HI and CO emission lines. We can get the HI mass,velocity data, line flux data,star formation late ...etc.
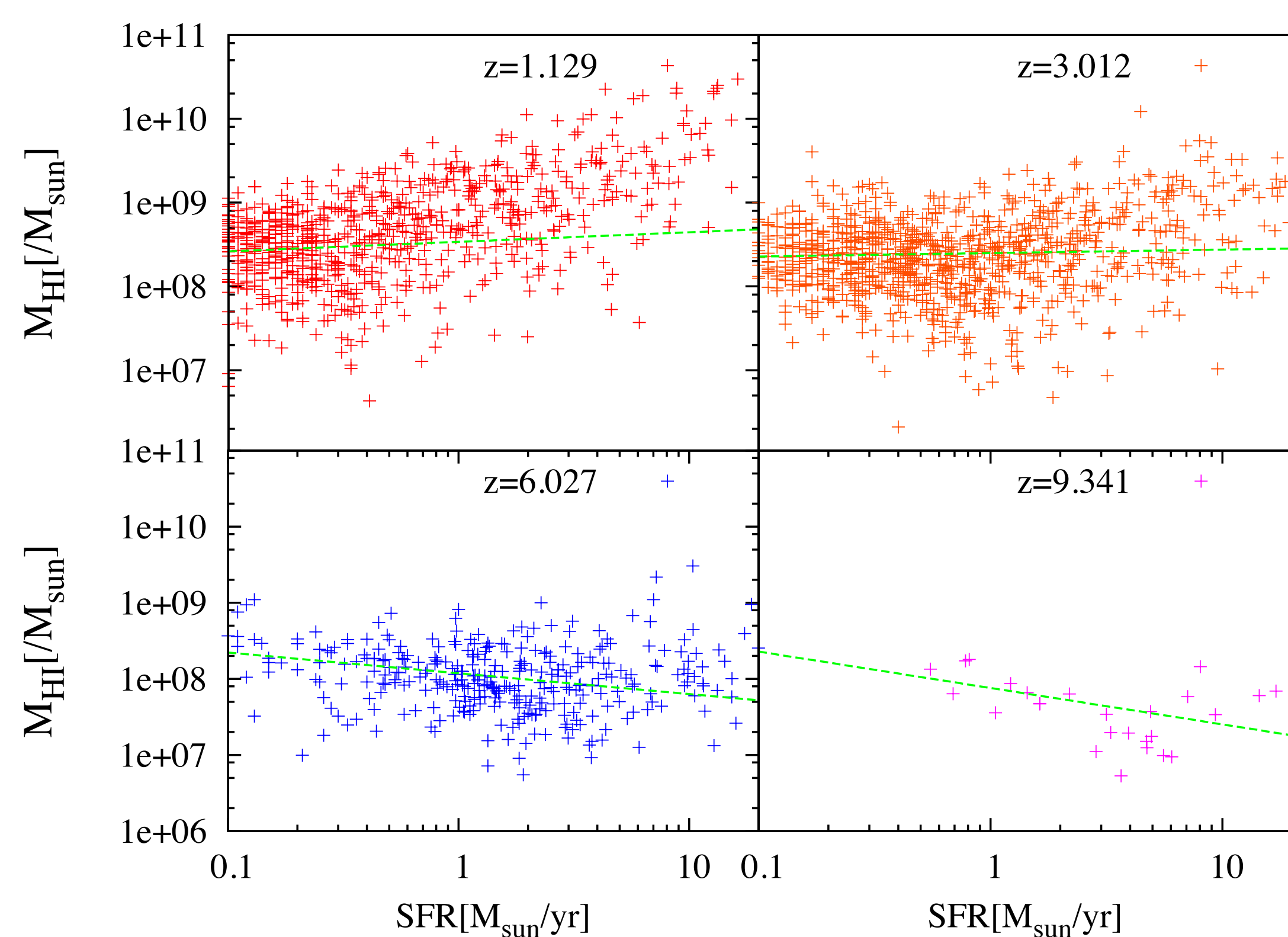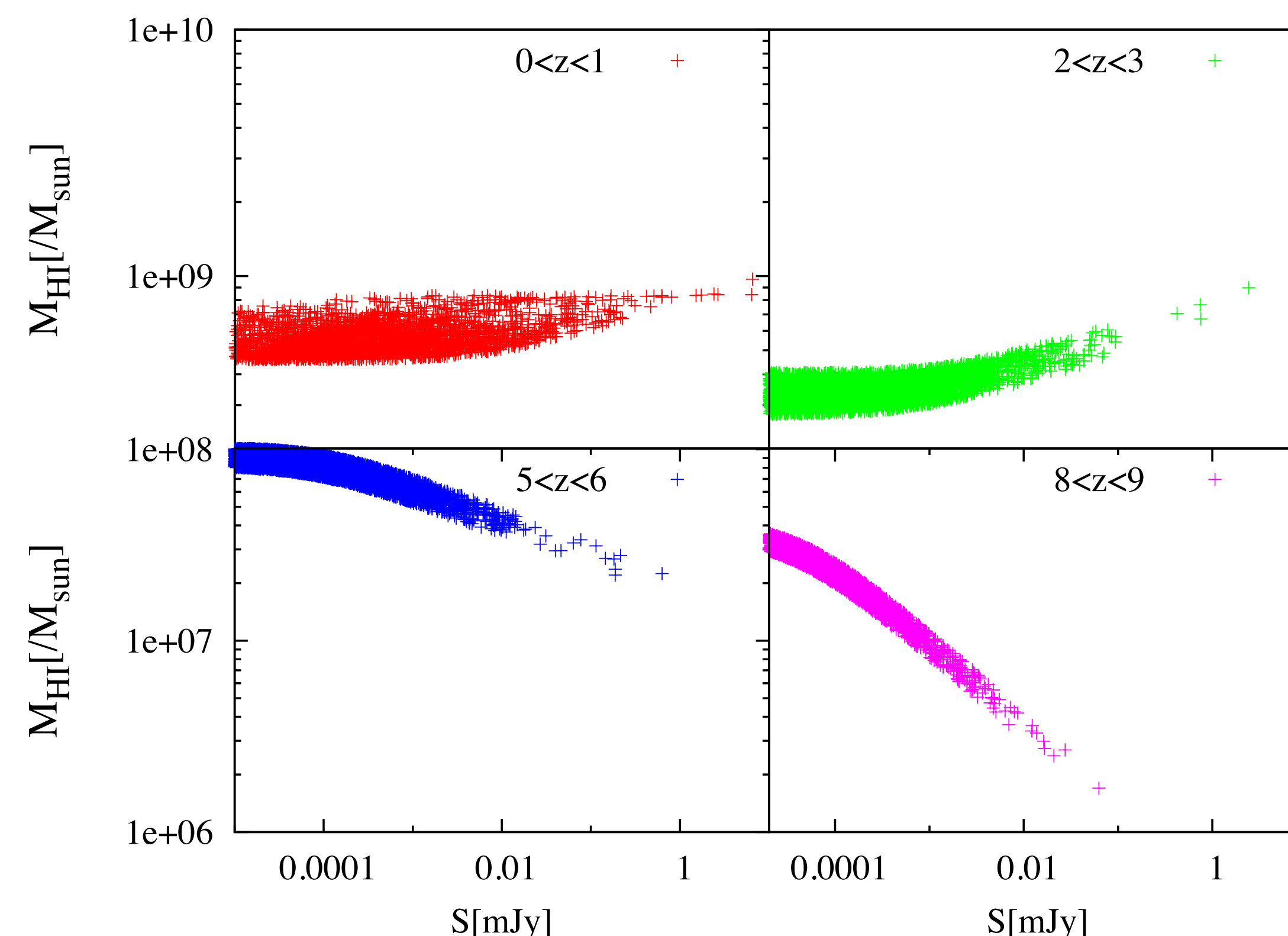

Simulation types

Result

FIG.1

FIG.2

First of all, we calculated the relation between star formation rate and HI mass from S3-SAX simulation(FIG.1). At z <~5, this relation is positive correlation, this is because that galaxies which produce many stars have heavy masses. Then this is consistent with our intuition. However, At high z (z >~5) this relation is anti-correlated. Galaxies which have larger star formation late have smaller HI masses.

In FIG.2, we plot the relation between luminosity from the galaxies which radiate radio continuum and HI mass. We get the radio continuum data from S3-SEX, and connect with HI mass of galaxies via the result of S3-SAX data. From this result, we can know that how the radio continuum galaxies correspond to HI masses.