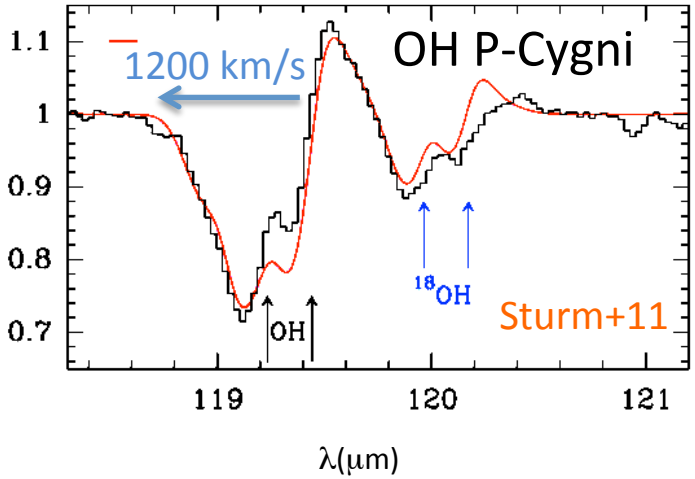
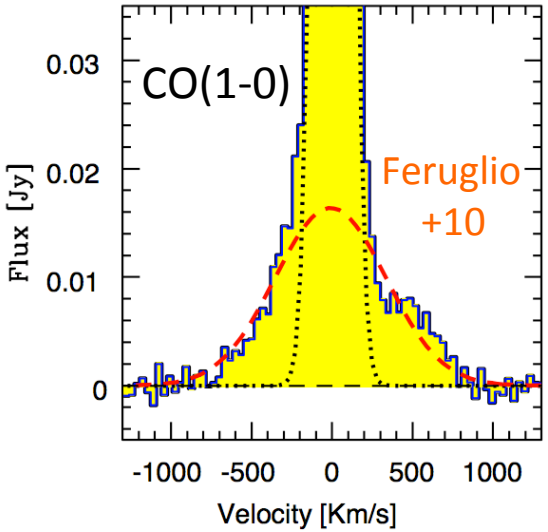
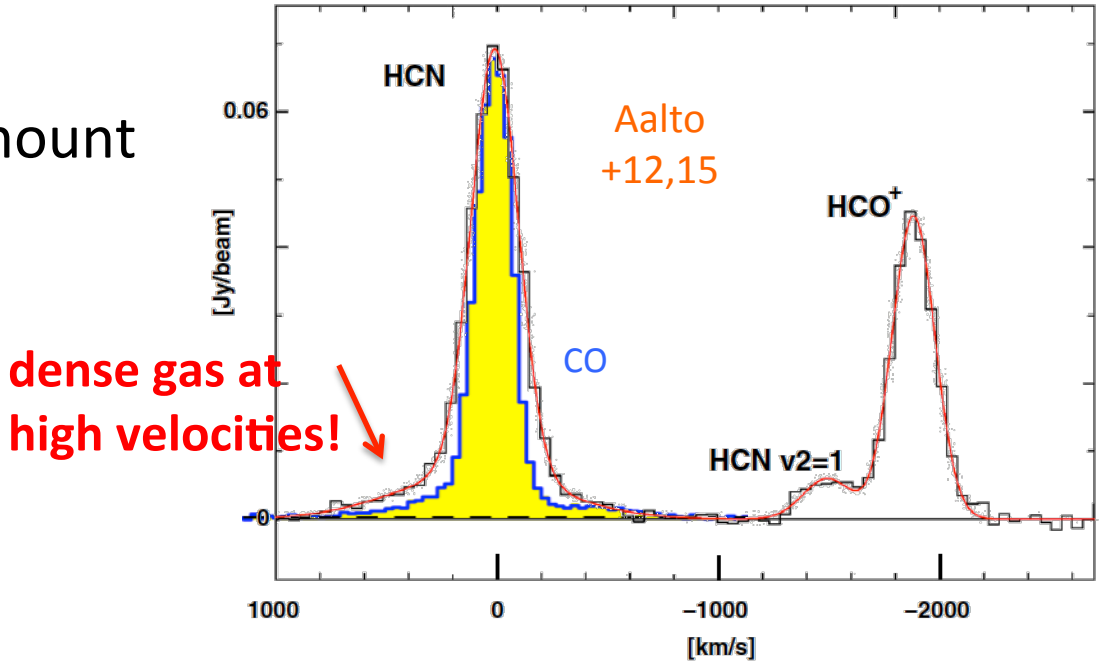
Powerful AGNs (QSOs) can seriously "hurt" their host galaxies

massive AGN-driven molecular outflows

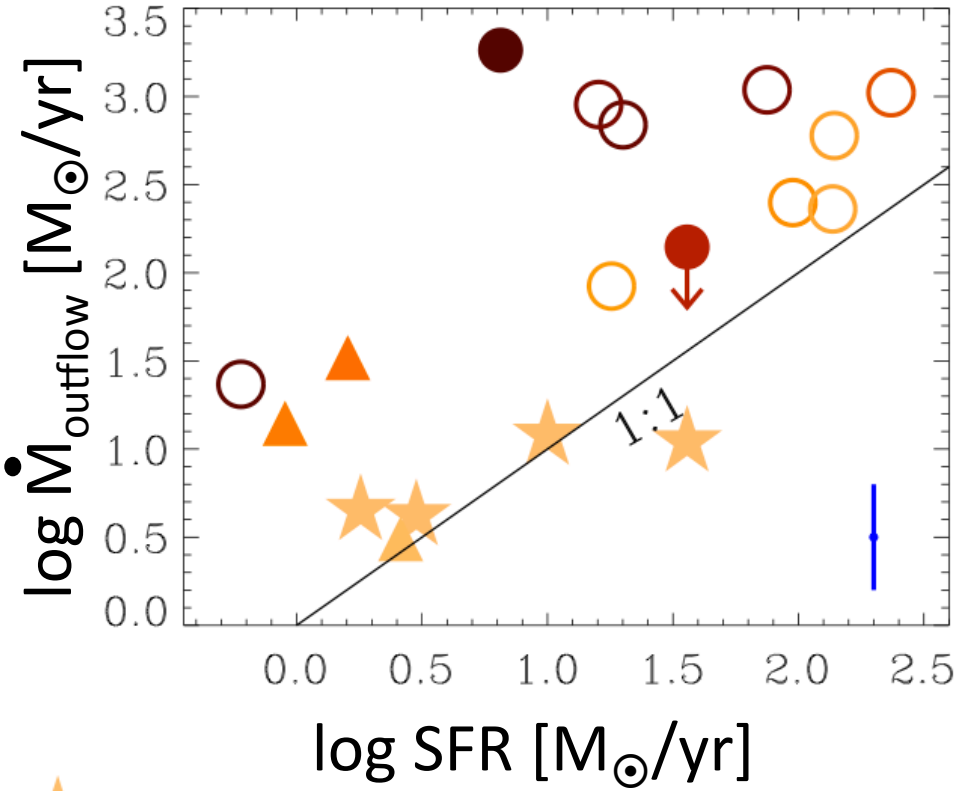




even outflows of large amount of DENSE molecular gas

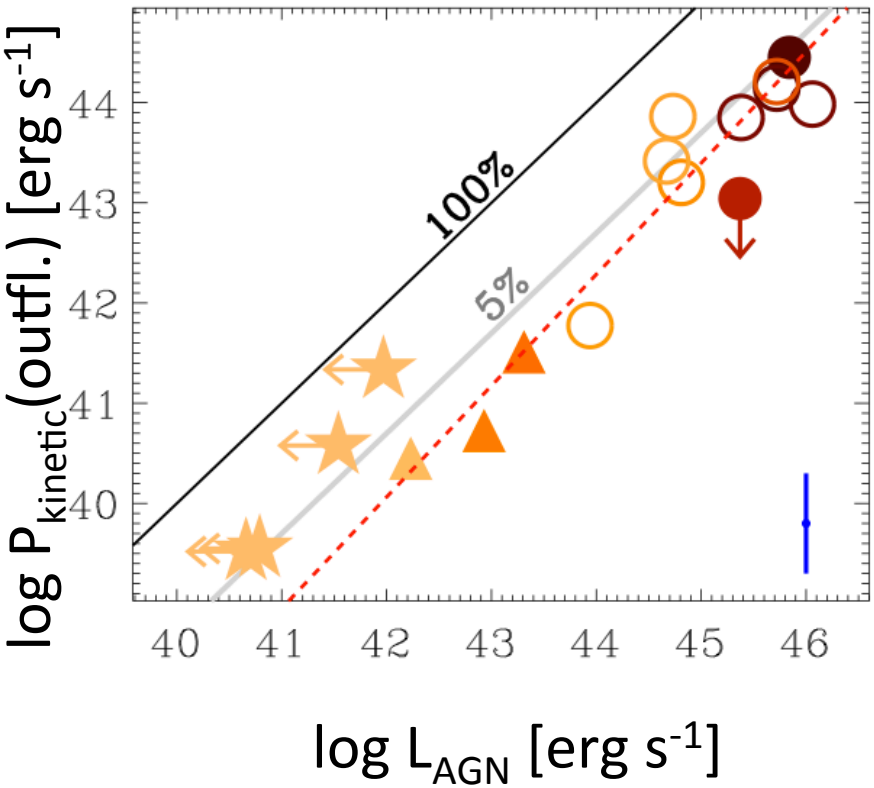


Outflow rate can be boosted by a large factor by an AGN



Cicone+13

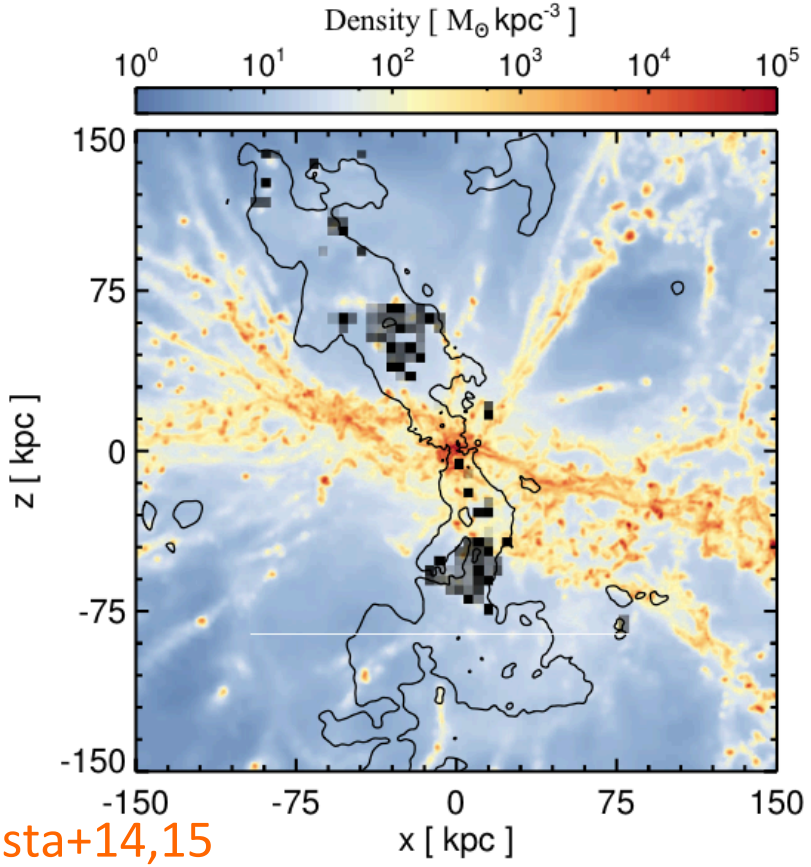
Kinetic power & momentum rate in agreement with AGN-driven winds models



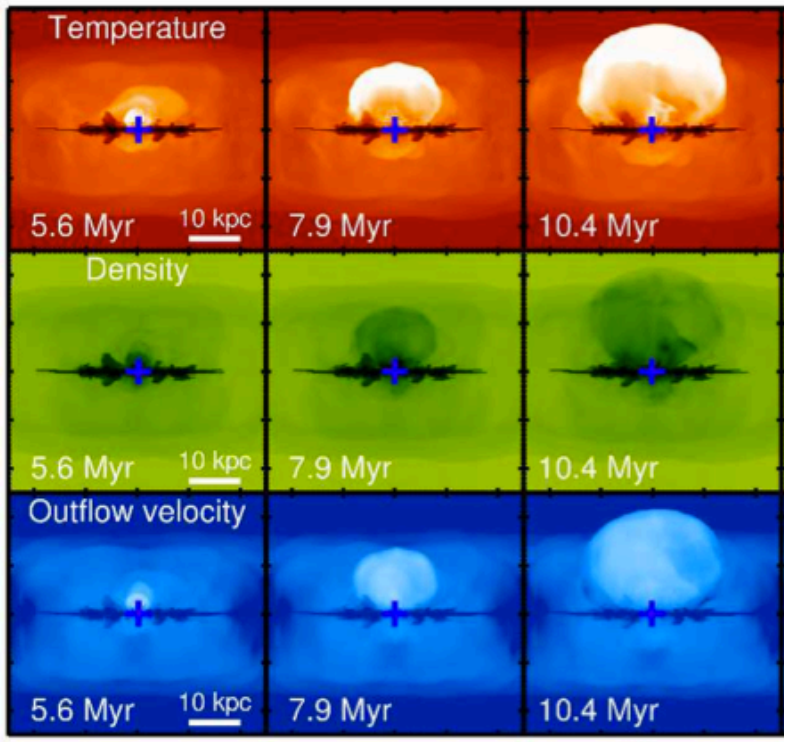
In terms of energy & momentum rate AGNs can quench the host galaxy and stop BH accretion
-> BH-sigma relation [King+10, etc.]

Can AGN-driven outflows really quench star formation over the entire galaxy, or even in its central region ?

Simulations:



Costa+14,15



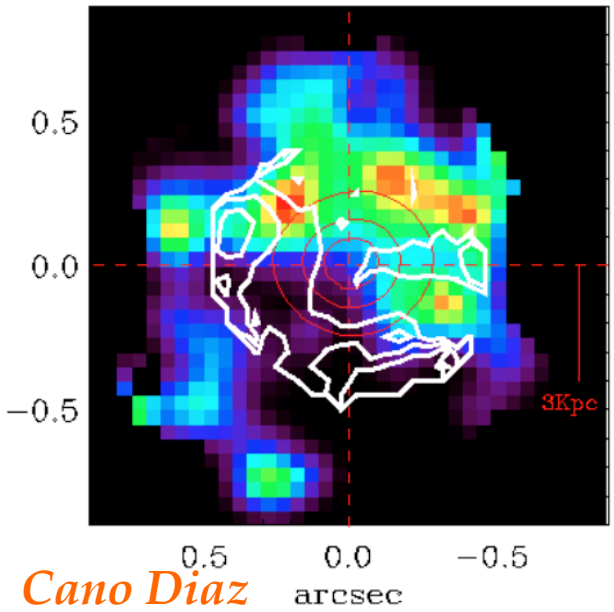
Gabor+14, Roos+15

- **Outflowing gas mostly escapes through low density, least resistance regions**
- **Does not stop inflow**
- **Does not escape the halo, rains back onto the galaxy**

Observations:

Outflows in the most powerful quasars at z~1-2

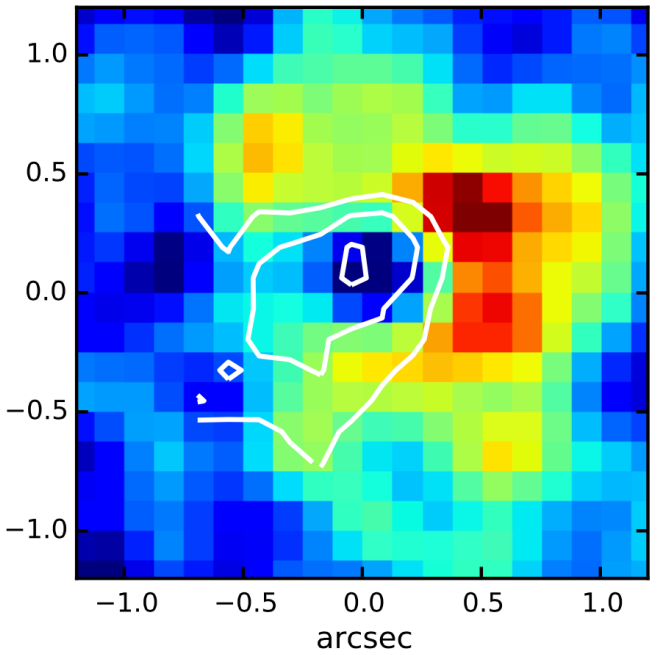
(epoch when quenching in most massive galaxies must occur)



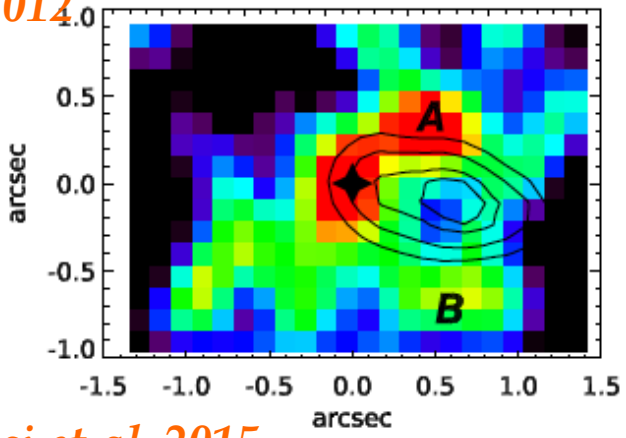
Cano Diaz et al. 2012

Color: narrow Hα = SFR

Contours: high velocity gas (outflow) from [OIII]



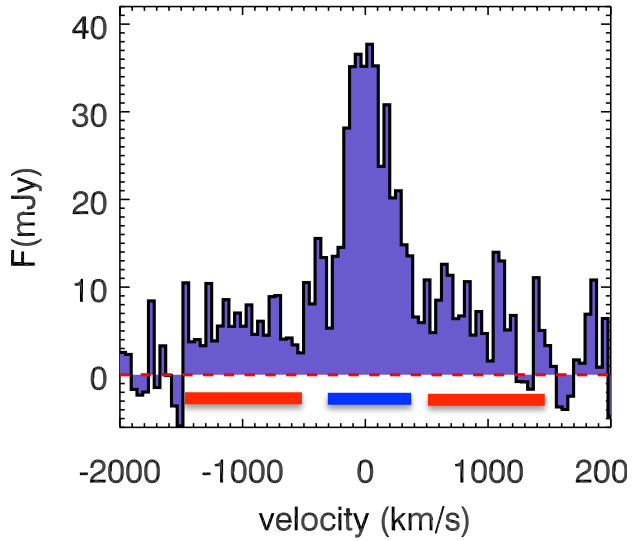
Carniani et al. 2015



Cresci et al. 2015

Star formation is suppressed in those regions affected by the quasar driven outflow, but star formation proceeds happily (at ~100 Msun/yr) elsewhere

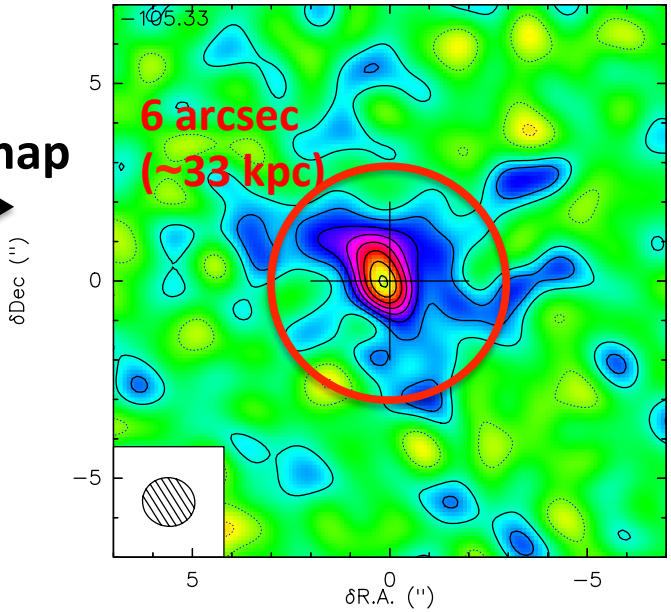
Outflows in the most luminous QSOs at z~6 traced with [CII]158μm

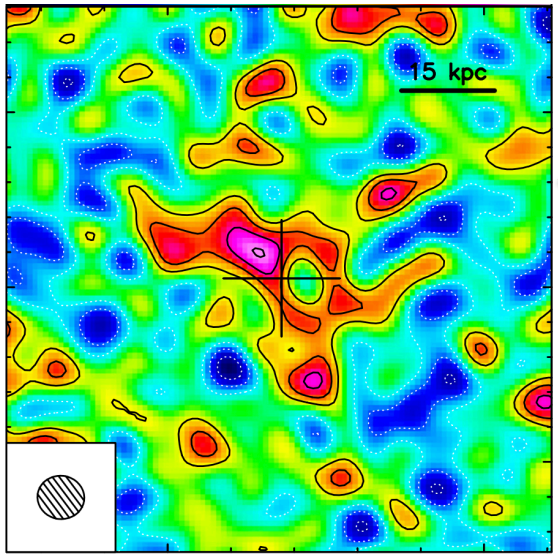


Velocity integrated map

Maiolino+12

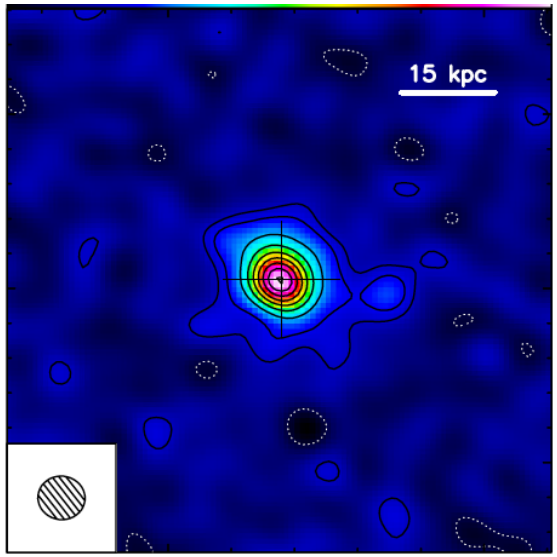
Cicone+15





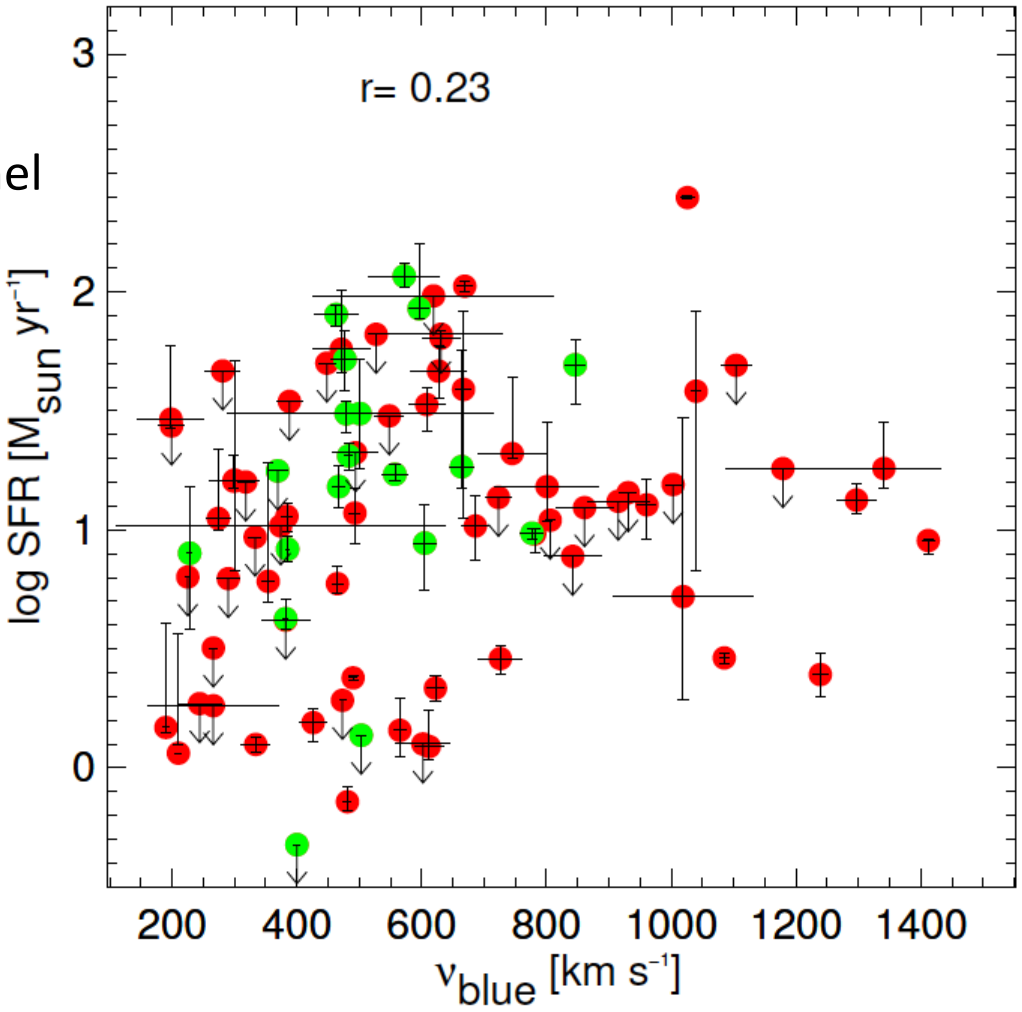
High velocity gas: outflow extending out to 30 kpc!

Low velocity gas: mostly within 1.5kpc forming stars at 1000 Msun/yr



Low redshift quasars (z<1)

SFR from
FIR-Herschel



No correlation between
outflow velocity and SFR

Balmaverde+15

Outflow velocity from [OIII] profile