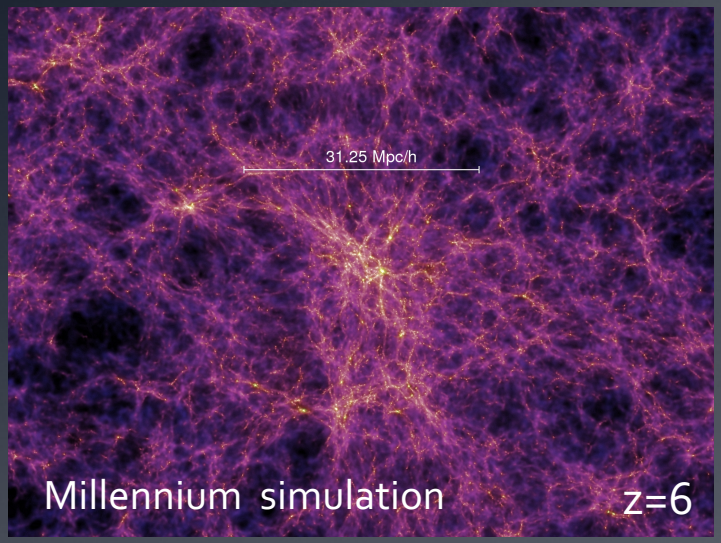
Caught in the act

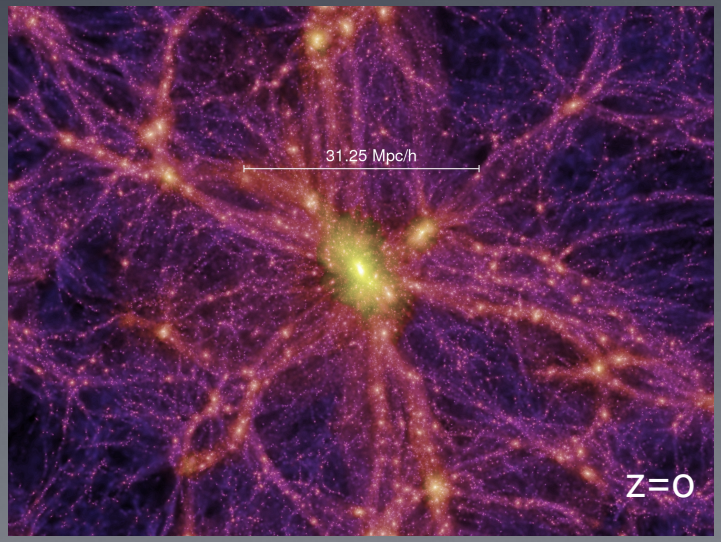
Massive cluster formation at z=3-7 witness by SPT/ APEX/ALMA



Axel Weiss MPIfR

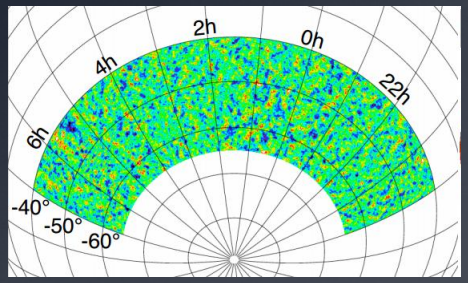
SPT collaboration

Miller T.B., Hill R., Cunningham D., Wang, G., Chapman S.C., Hayward, C. , D. Vieira, J. Marrone, D., Spilker, J., de Breuck, C.

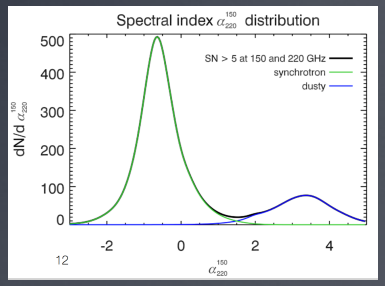


PC candidates from the SPT survey

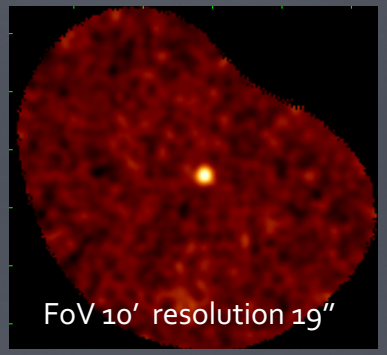
SPT survey– 2500 deg²

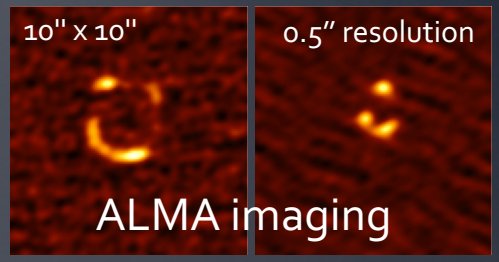


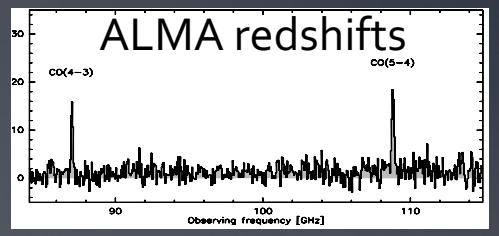
SPT colors 2/1mm



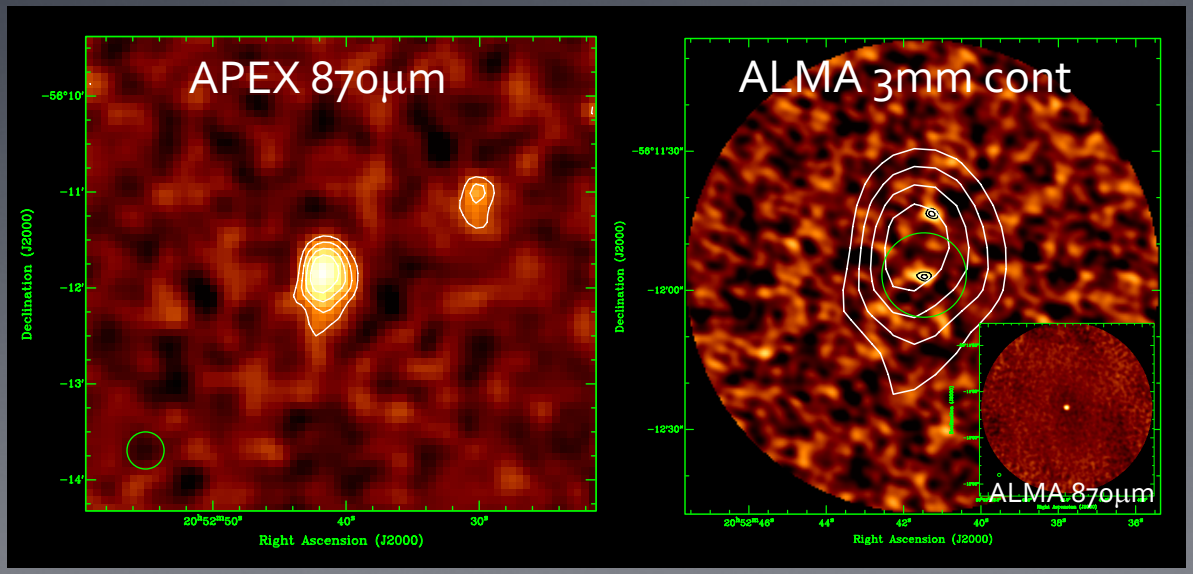
APEX 870μm

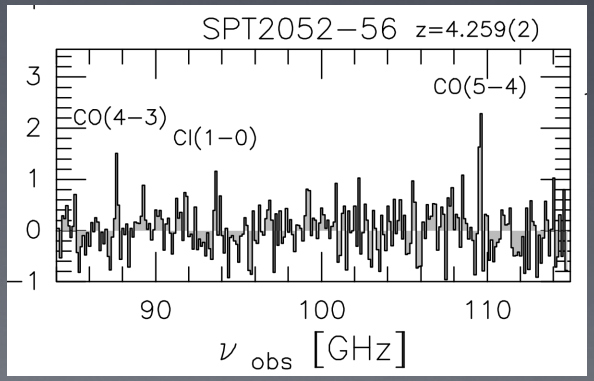






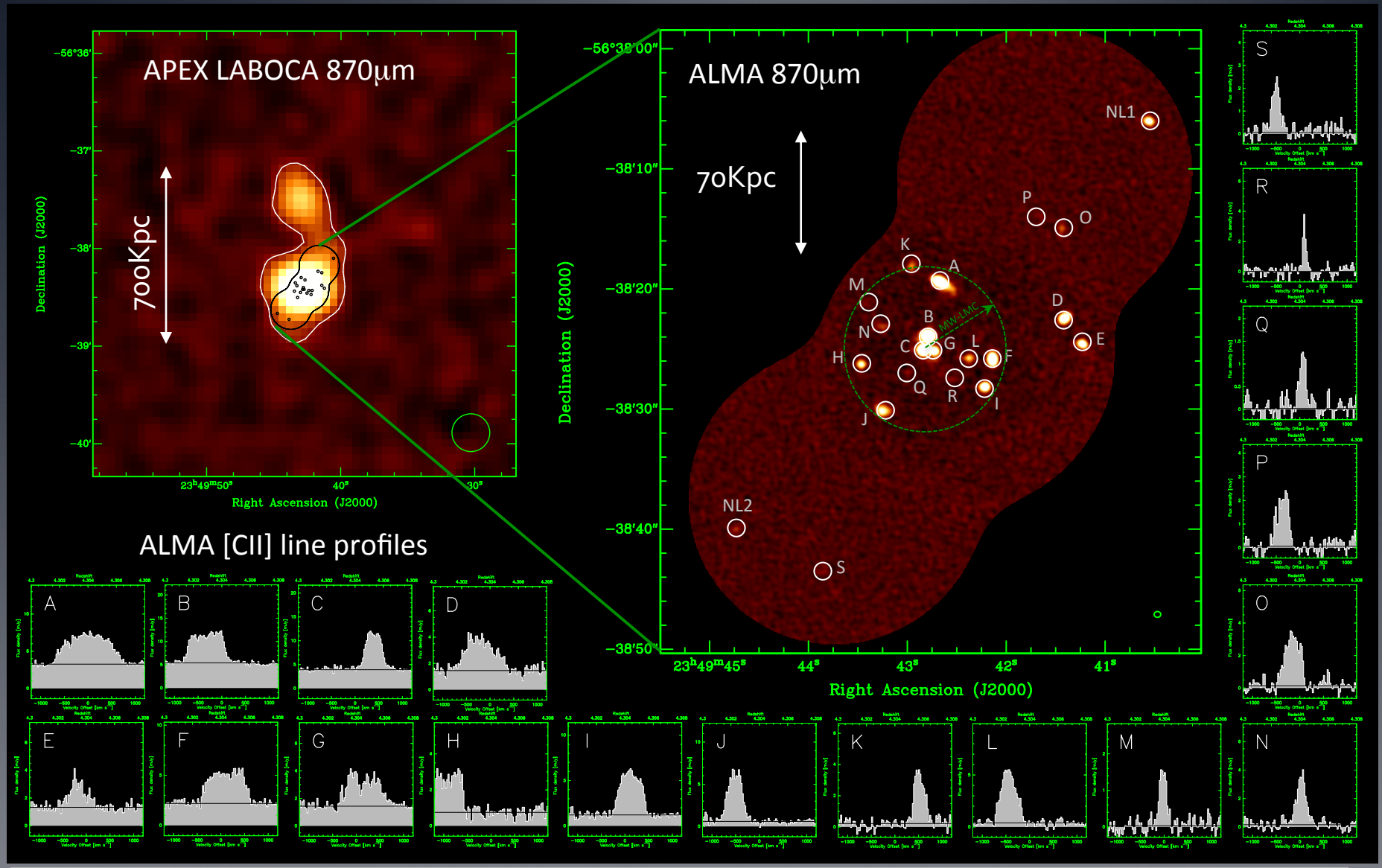
SPT – APEX/Laboca point sources => lensed DSFGs (z=2-7)





Extended Laboca Sources => PC candidates (in particular if they are multiples)

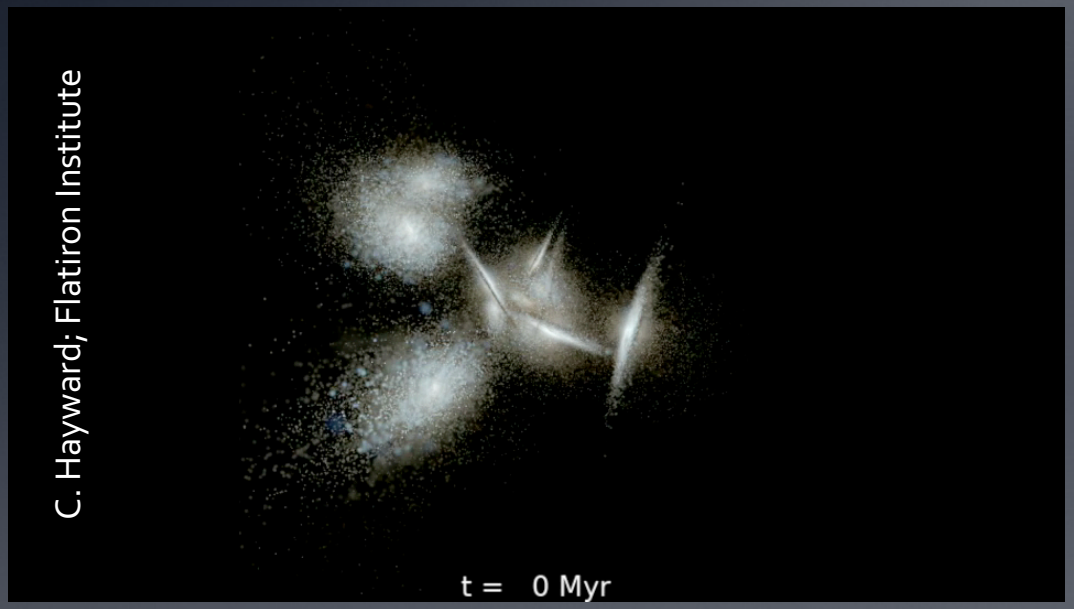
Proto-cluster core SPT2349-56 @ z=4.3

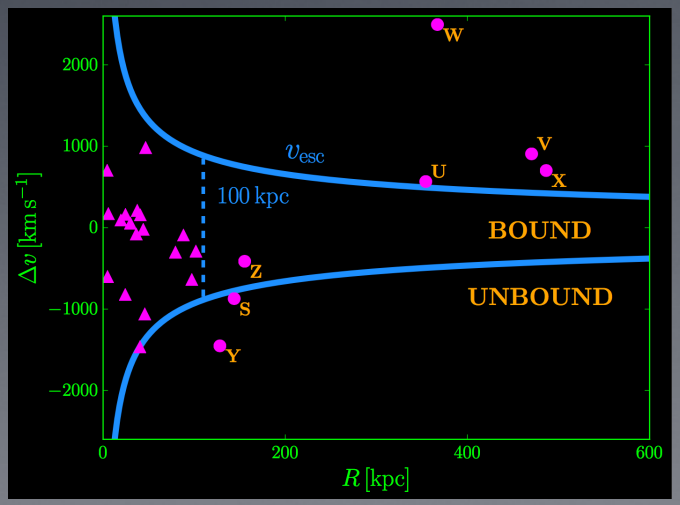


update on Miller T.B., et al. 2018, Nature, 556, 469

19 individual members

Witnessing BCG formation

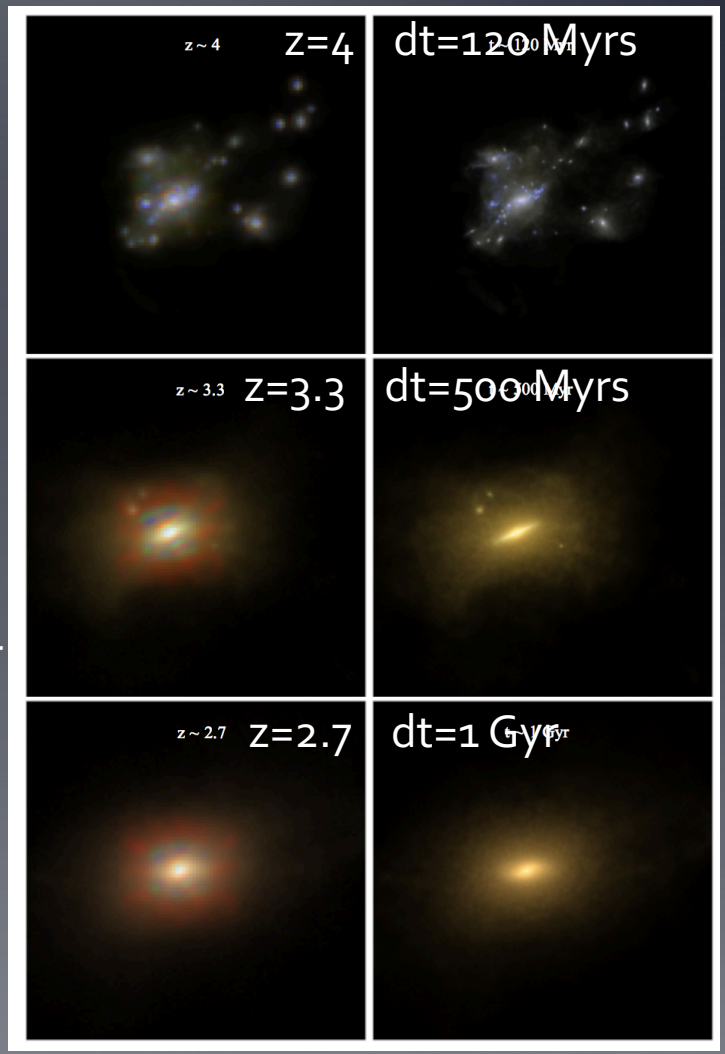




BCG in place after ~500Myr

M_* increases 4x in this event

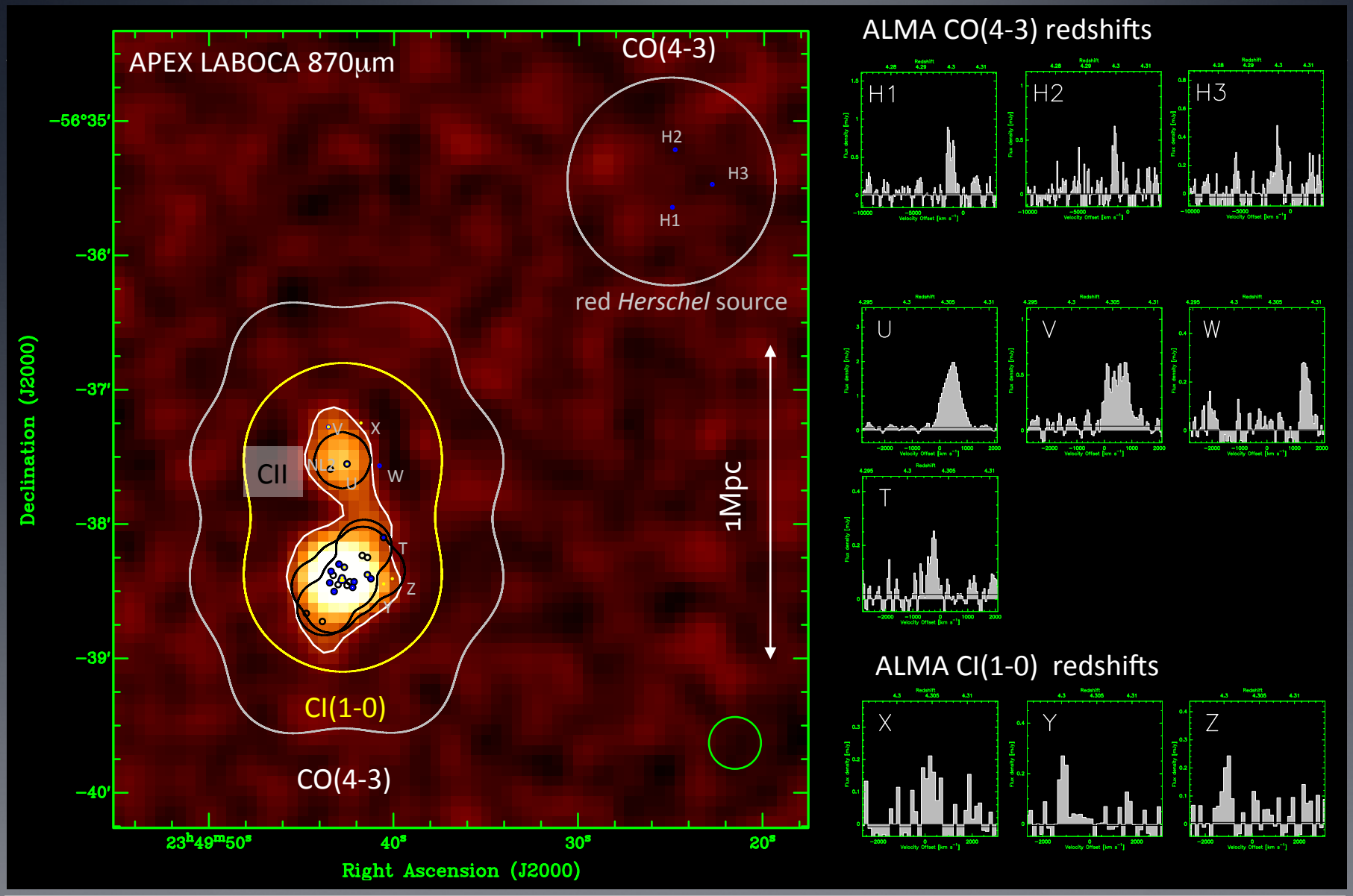
z=0: log(M_*) 12-13 M_{sol}



Mock JWST Simulation

Rennehan ea MNRAS 2019 arXiv: 1907.00977

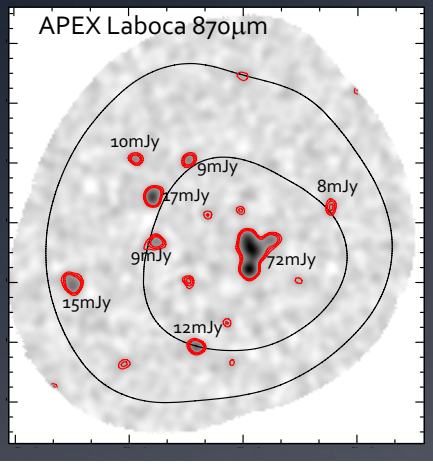
SPT2349-56 Environment



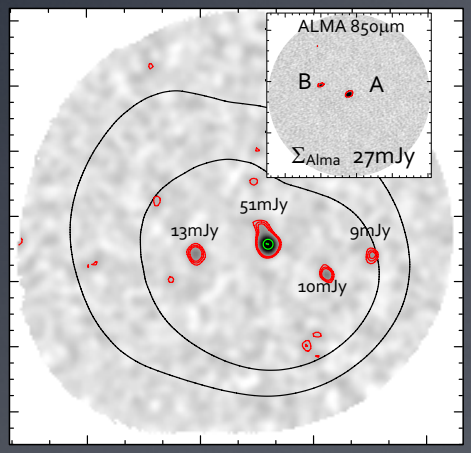
5 additonal sources identified in the northern Laboca structure; total 27 confirmed members

Deep APEX/LABOCA 870μm imaging

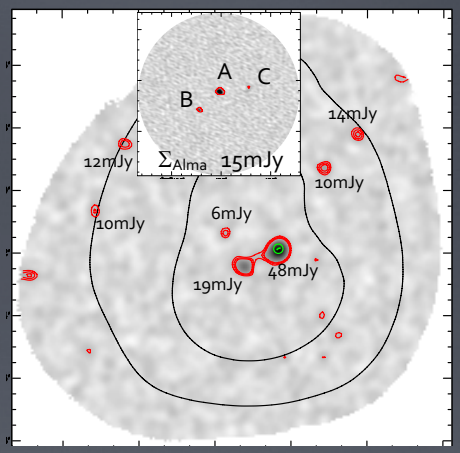
SPT0303-59 (z_{ph}=3.8)



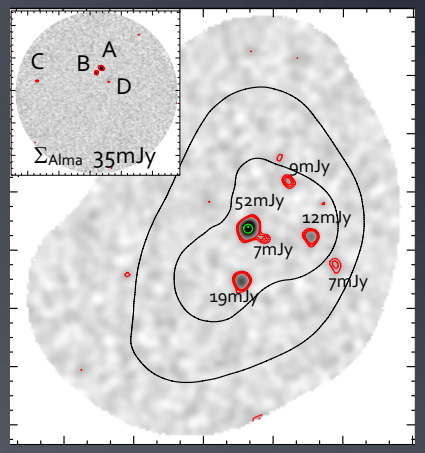
SPT0348-62 (z_{sp}=5.656)

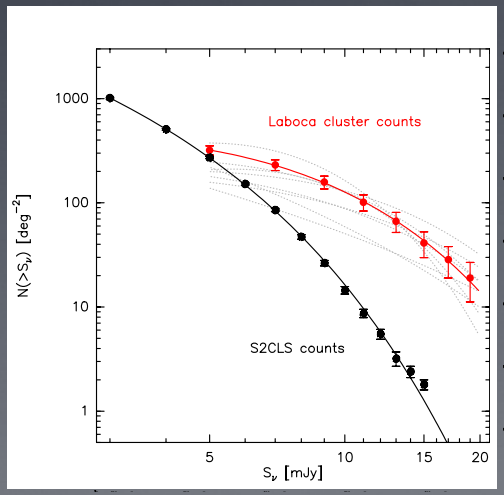


SPT0457-49 (z_{ph}=4.0)

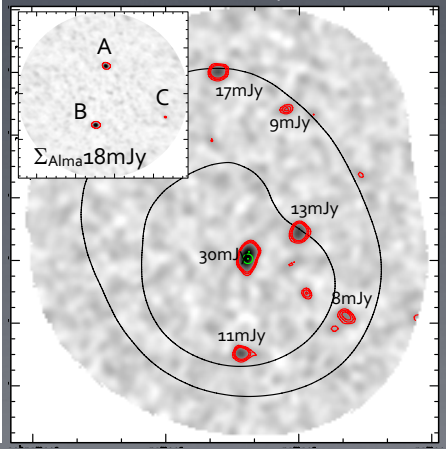


SPT0553-50 (z_{sp}=5.323)

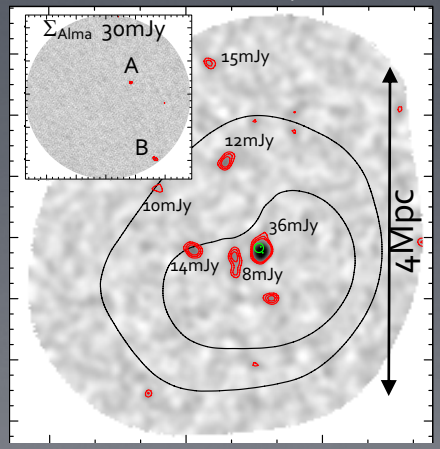




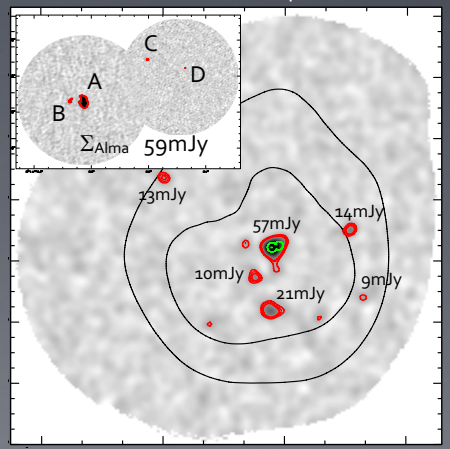
SPT2052-56 (z_{sp}=4.255)



SPT2335-53 (z_{sp}=4.757)



SPT0311-58 (z_{sp}=6.900)



Images:
Laboca & ALMA SNR

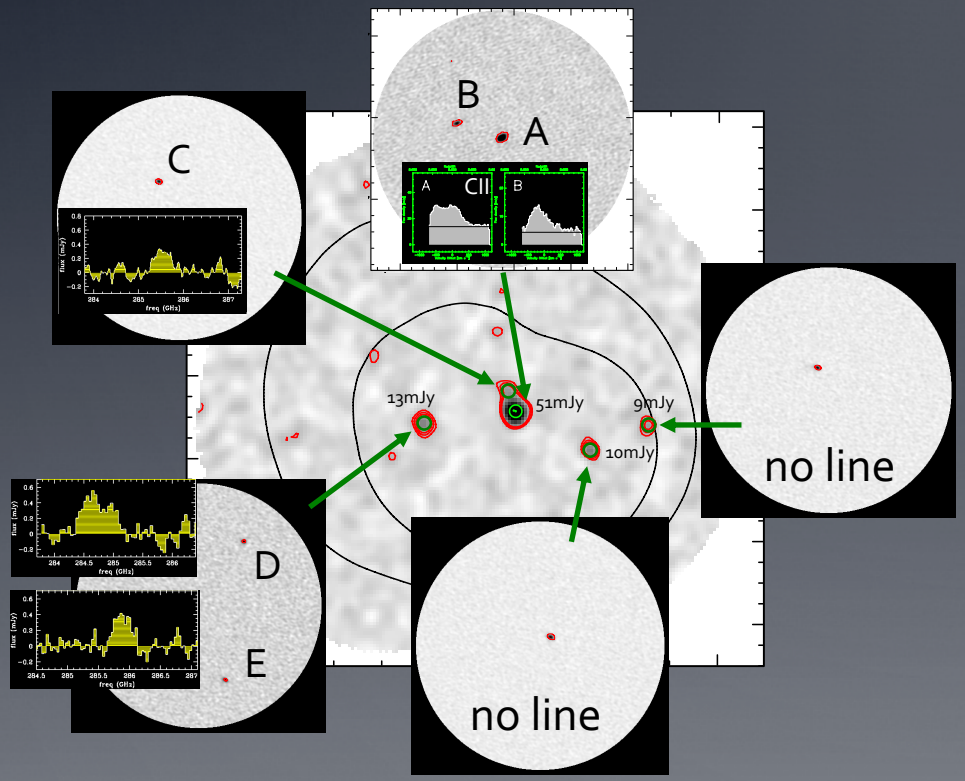
Laboca: 3,4 & 5 σ contours
ALMA: 4 σ contours

Laboca rms contours

ALMA primary beam & sources

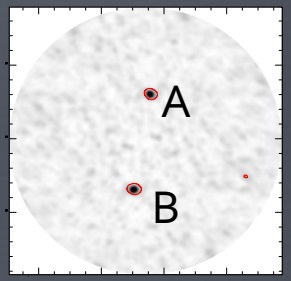
Ongoing ALMA line follow ups

SPT0348-62 (z=5.6)

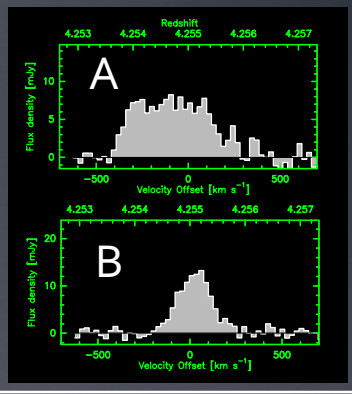


5/7 ALMA detected source are PC members
(non-detections could be due to limit v-coverage)

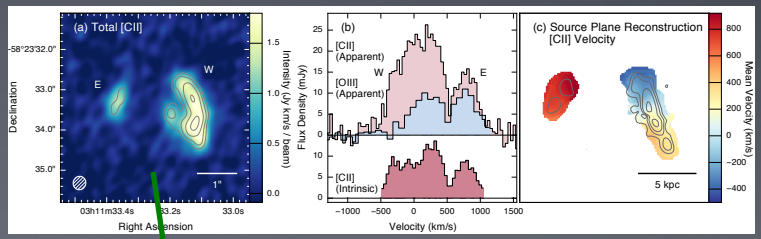
SPT2052-56 (z=4.2)

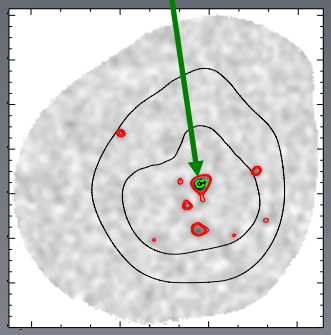


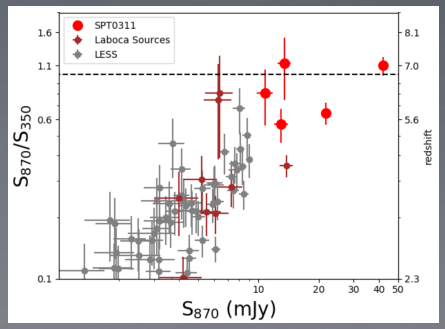
CII lines



SPT0311-58 (z=6.9)

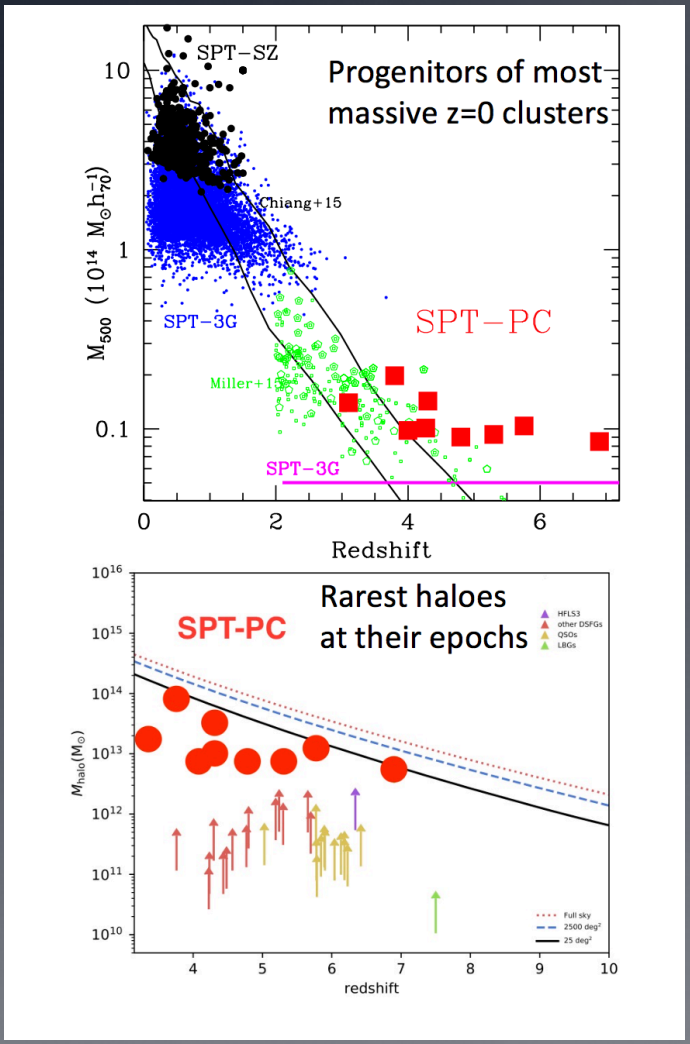






Marrone, D.P., et al., 2018, Nature, 553, 51

Summary



- Discovery of these PCs is only possible due to the synergy between large area surveys and sensitive interferometers in the submm

- SPT-PCs are unique systems to study the earliest phase of massive galaxy and cluster formation. They allow to study the evolution of the most massive DM halos out to z=7!

- BCGs form earlier than expected from most simulations and current observational wisdom (z~3 vs z~1-2)

High-z PCs will allow to study the evolution of the CO, CII and dust luminosity functions in cluster environments to investigate differences in the evolution between cluster and field galaxies.