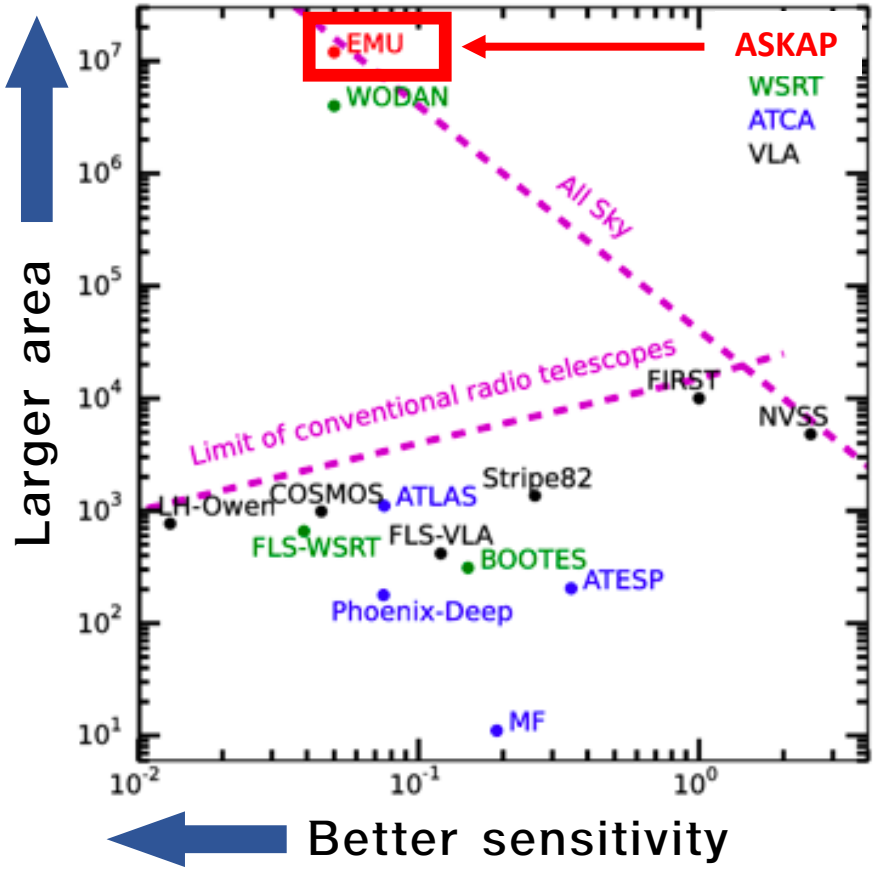
Discovery of a Radio Relic in the Massive Merging Cluster SPT-CL J2023-5535 from the ASKAP-EMU Pilot Survey

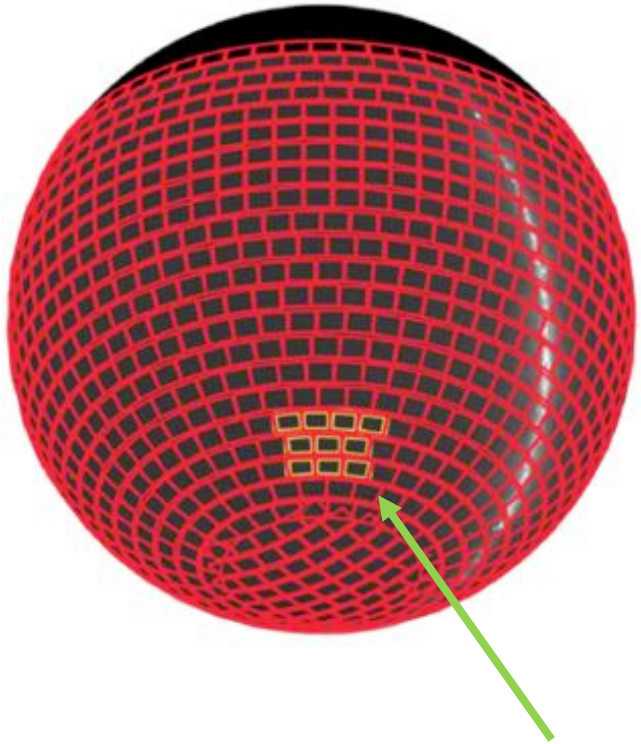
HyeongHan Kim, M. James Jee, Lawrence Rudnick, David Parkinson, Kyle Finner, Mijin Yoon, Wonki Lee, Gianfranco Brunetti, Marcus Brüggen, Jordan D. Collier, Andrew M. Hopkins, Michał Michałowski, Ray P. Norris, Chris Riseley

For more details, HyeongHan et al. (2020)

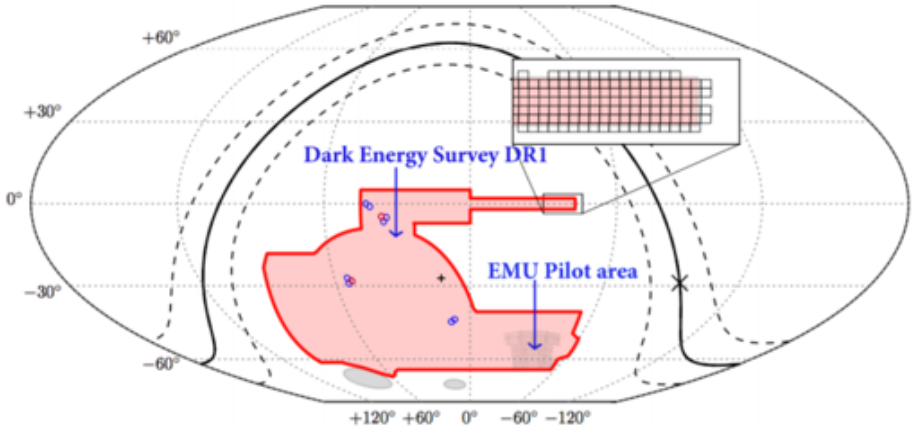
ASKAP-EMU Survey

✓ Radio continuum survey that will cover 75% of the entire sky

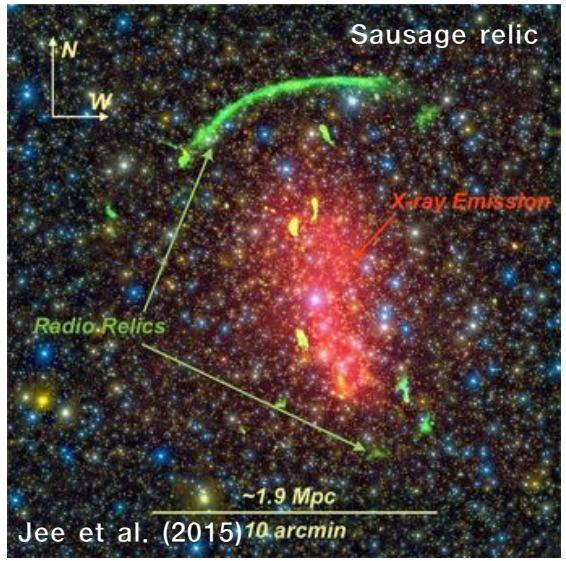


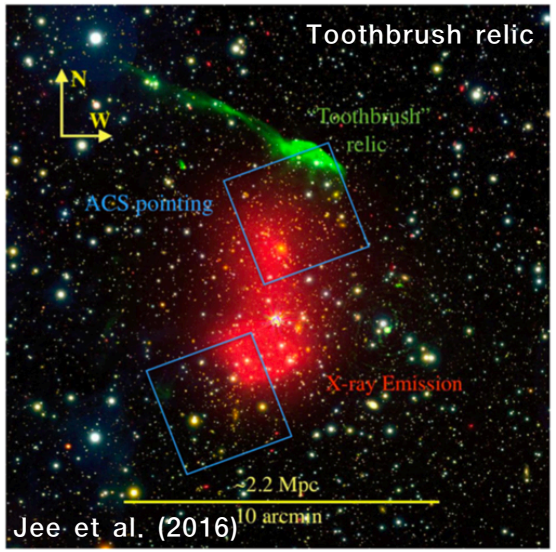


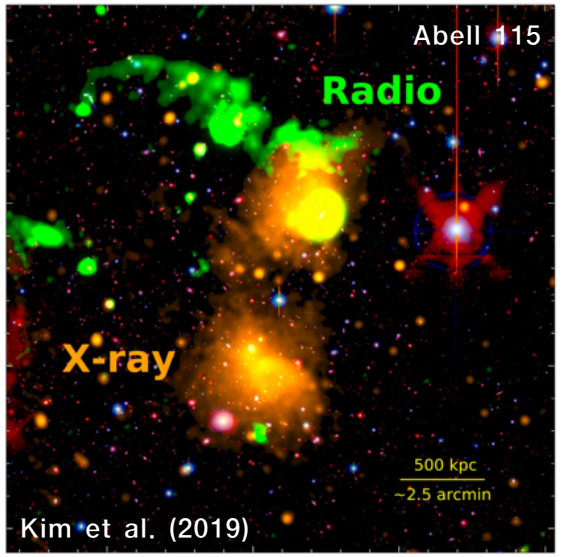
Pilot survey area

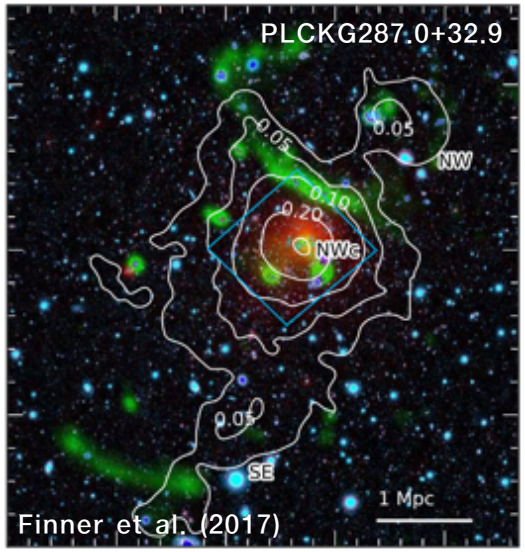


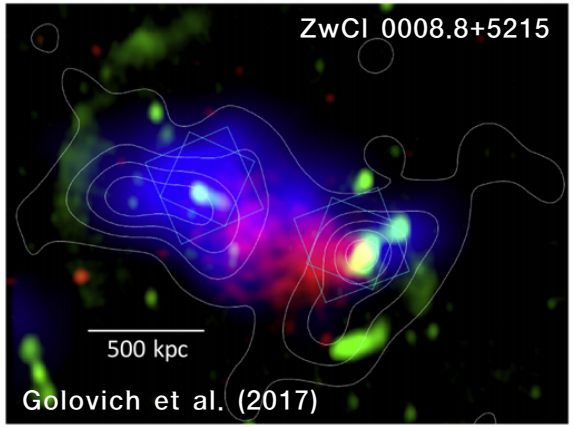
Radio Relics in Merging Galaxy Clusters

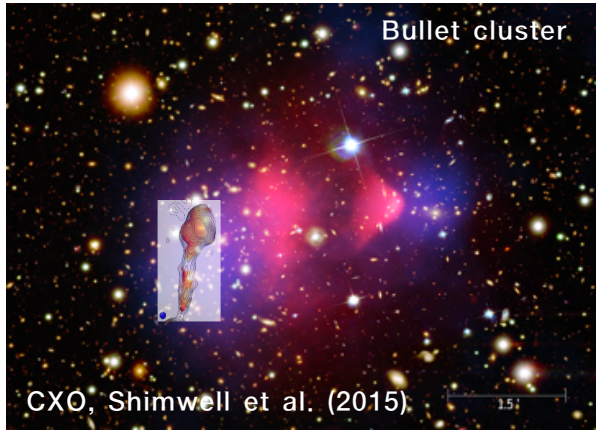


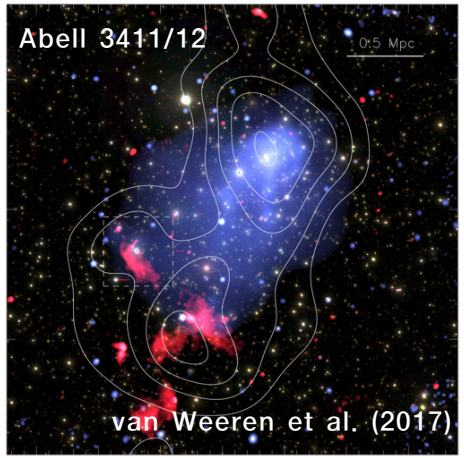


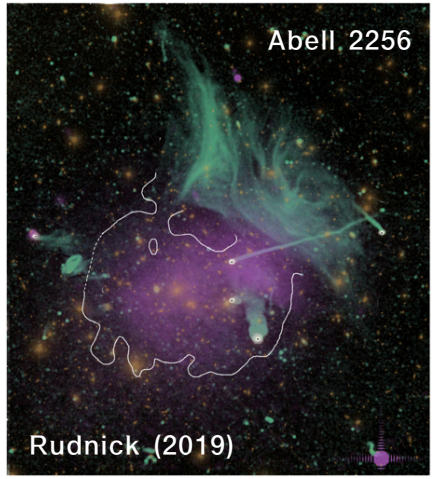




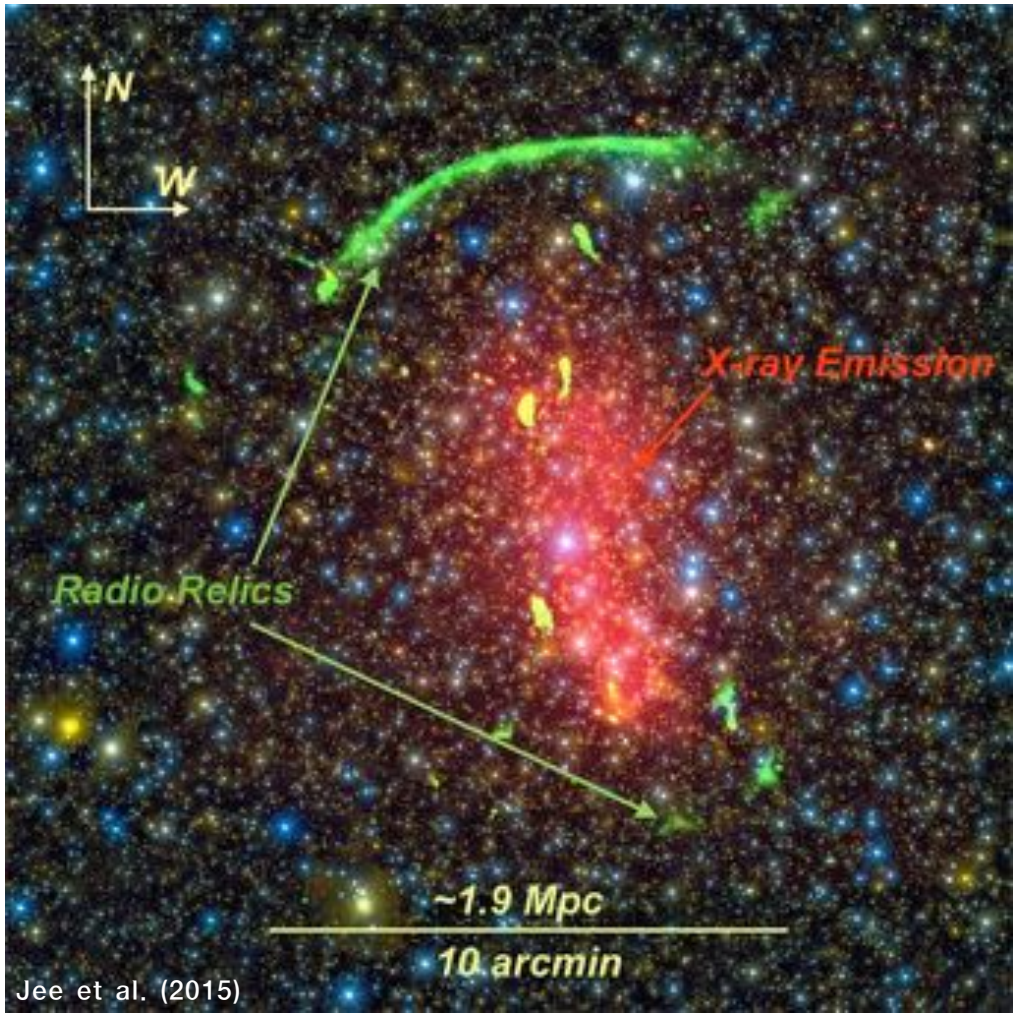








Radio Relics in a Merging Galaxy Cluster



1. Cluster mergers exert vast amount of energies and generate a merger shock.

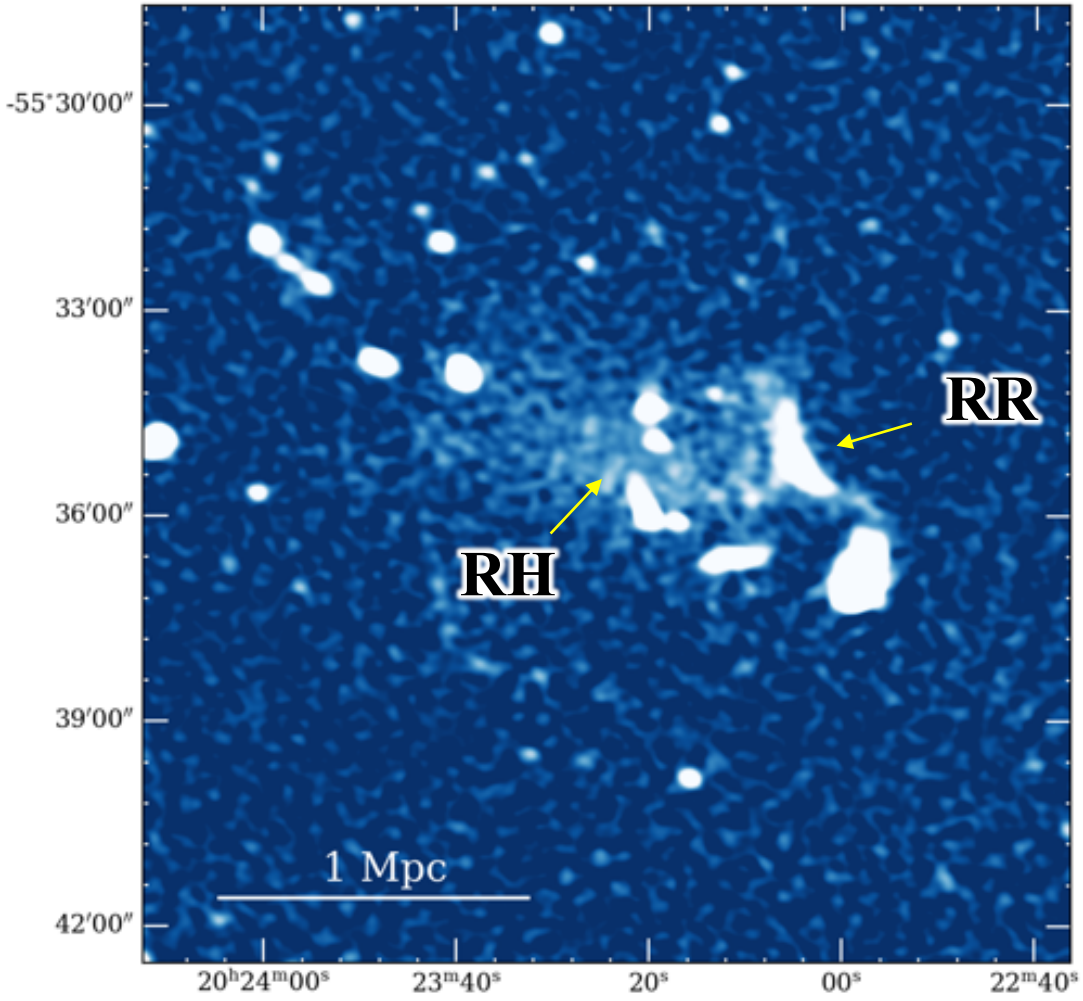
2. The shock injects energies into electrons and accelerates them via diffusive shock acceleration.

3. We observe them as a radio relic.

ASKAP-EMU pilot survey

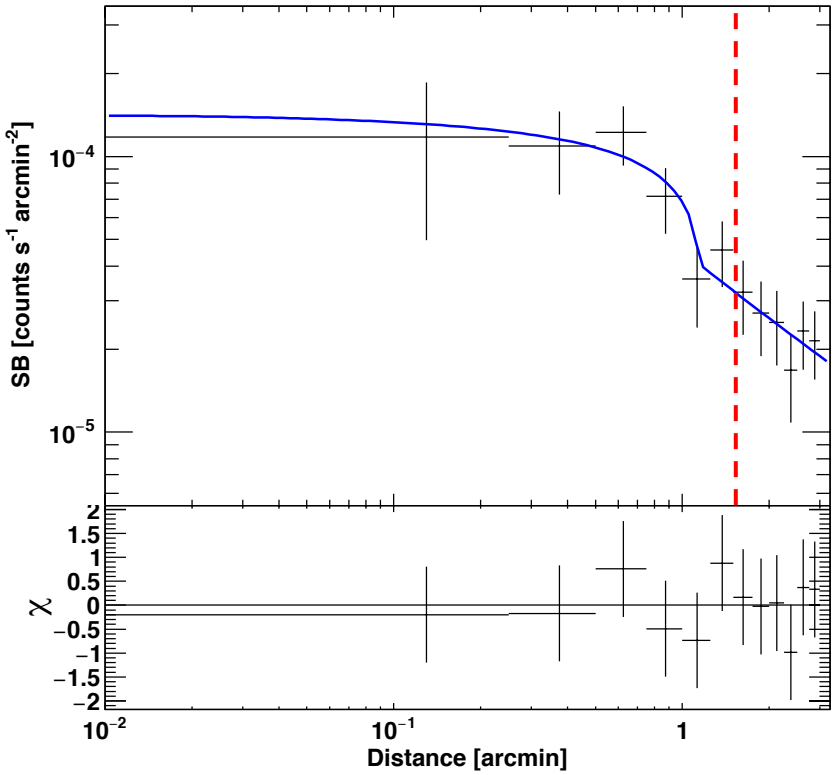
- A ~0.5 Mpc size radio relic (RR) is clearly resolved with a flat spectral index.
- Radio halo (RH) extends over ~1 Mpc.

	Halo	Relic
S_{943MHz} (mJy)	31.3 ± 0.6	16.2 ± 0.2
$S_{1.4GHz}$ (mJy)	20.8 ± 0.3	12.0 ± 0.3
$P_{1.4GHz}$ (10^{24} W Hz^{-1})	3.4 ± 0.01	1.8 ± 0.01
Spectral index (α)	-1.04 ± 0.05	-0.76 ± 0.06



Chandra X-ray Analysis

~20 ks exposure



Density jump

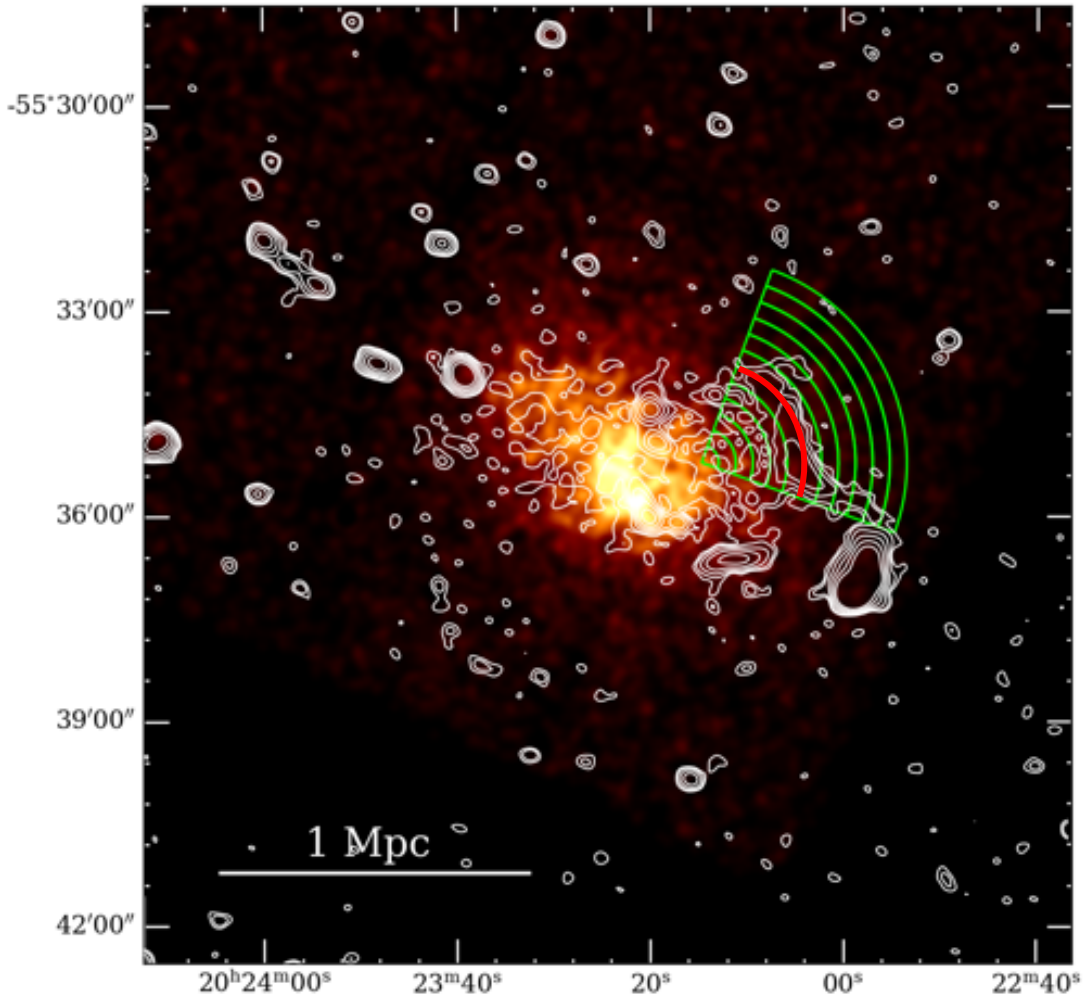
$C = 1.8 \pm 0.5$

$\mathcal{M} = 1.6 \pm 0.5$

Temperature jump

$T_{post} = 20 \pm 12$ keV;
$T_{pre} = 7.3 \pm 3.3$ keV

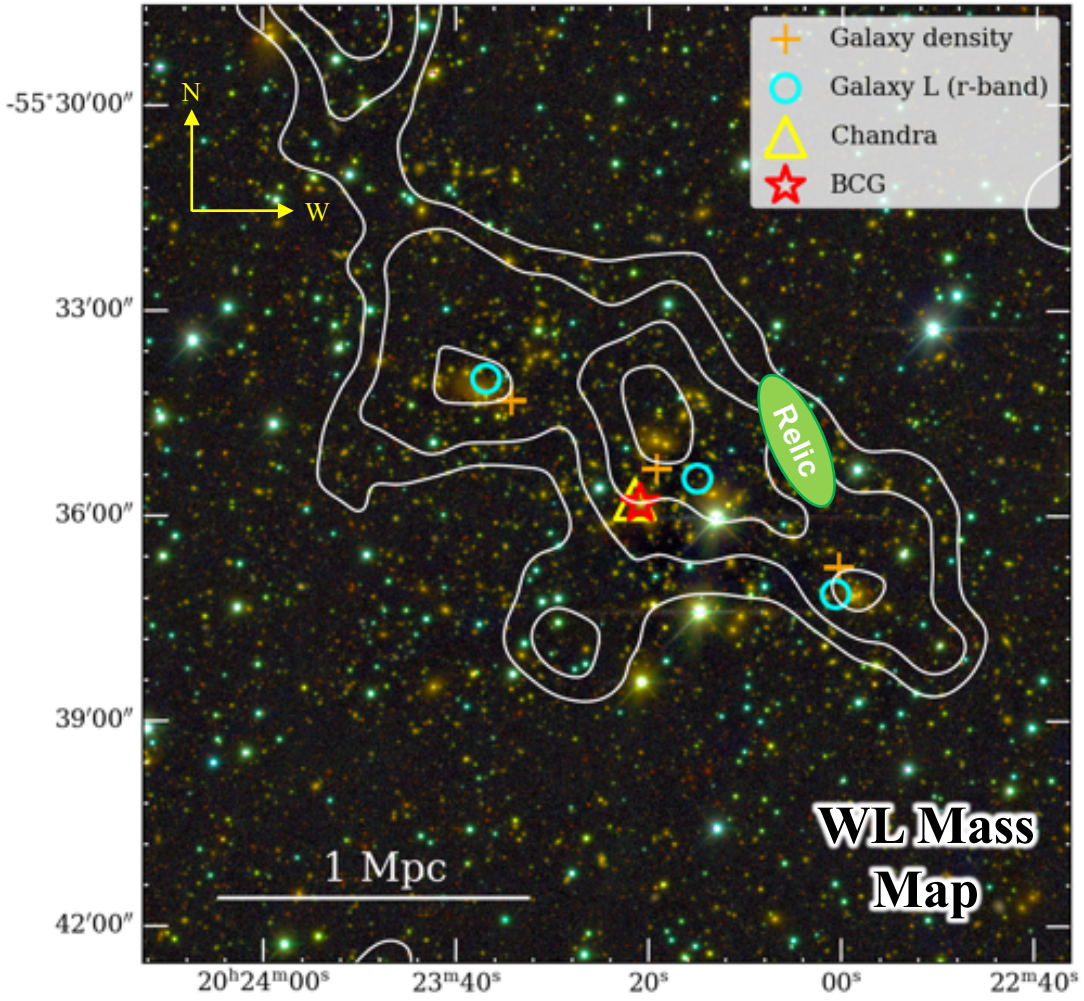
$\mathcal{M}$=2.5 $\pm$ 1.3



DECam – Weak Lensing

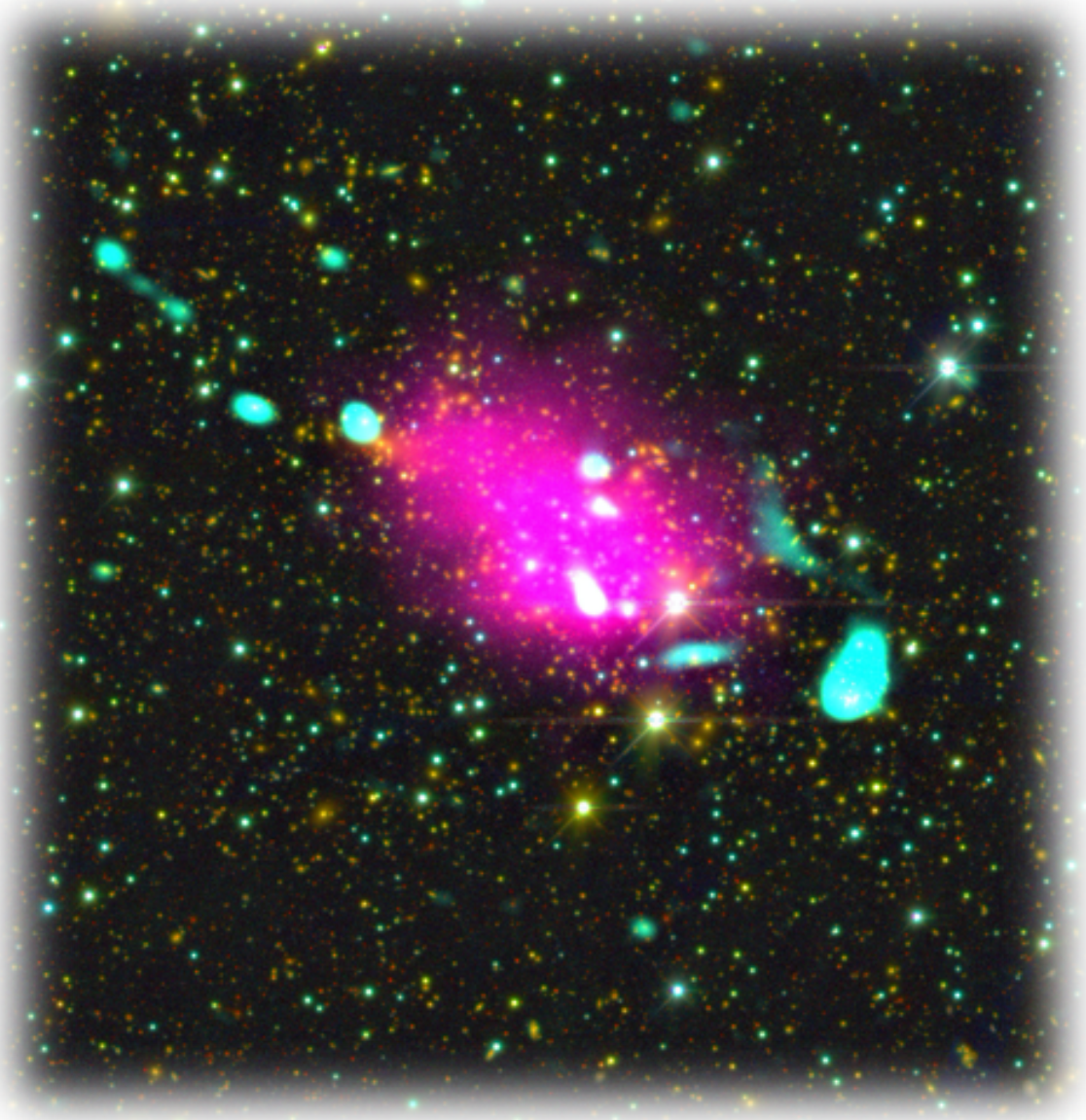
- SPT-CL 2023-5535 is composed of three subclusters.
- Each mass peak coincides with the galaxy density peaks.
- Merger happened between the eastern and central subclusters.

	M_{200c} $(10^{14} M_{\odot})$	Peak Significance (σ)
East	2.6 ± 1.6	3.6
Center	3.5 ± 1.7	5.0
West	1.5 ± 1.2	3.0



1. We discovered a radio relic in SPT-CL 2023-5535 from the ASKAP-EMU pilot survey.

2. With weak-lensing analysis, we identified three subclusters and constructed a merger scenario.



Thank you for listening!