

Shocks in Galaxy Cluster Outskirts: The Case of A3667

Emma Storm

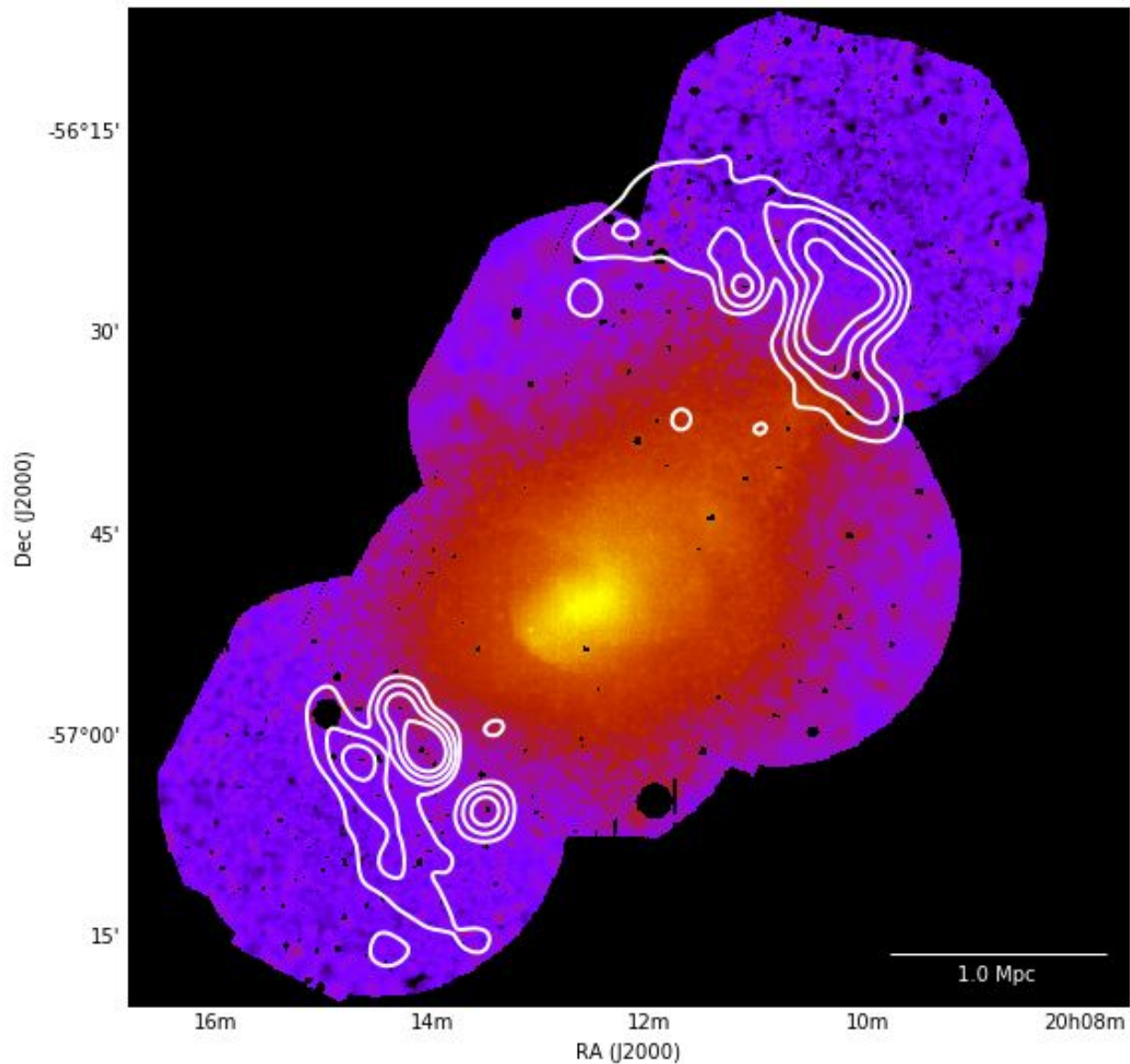
GRAPPA

Universiteit van Amsterdam

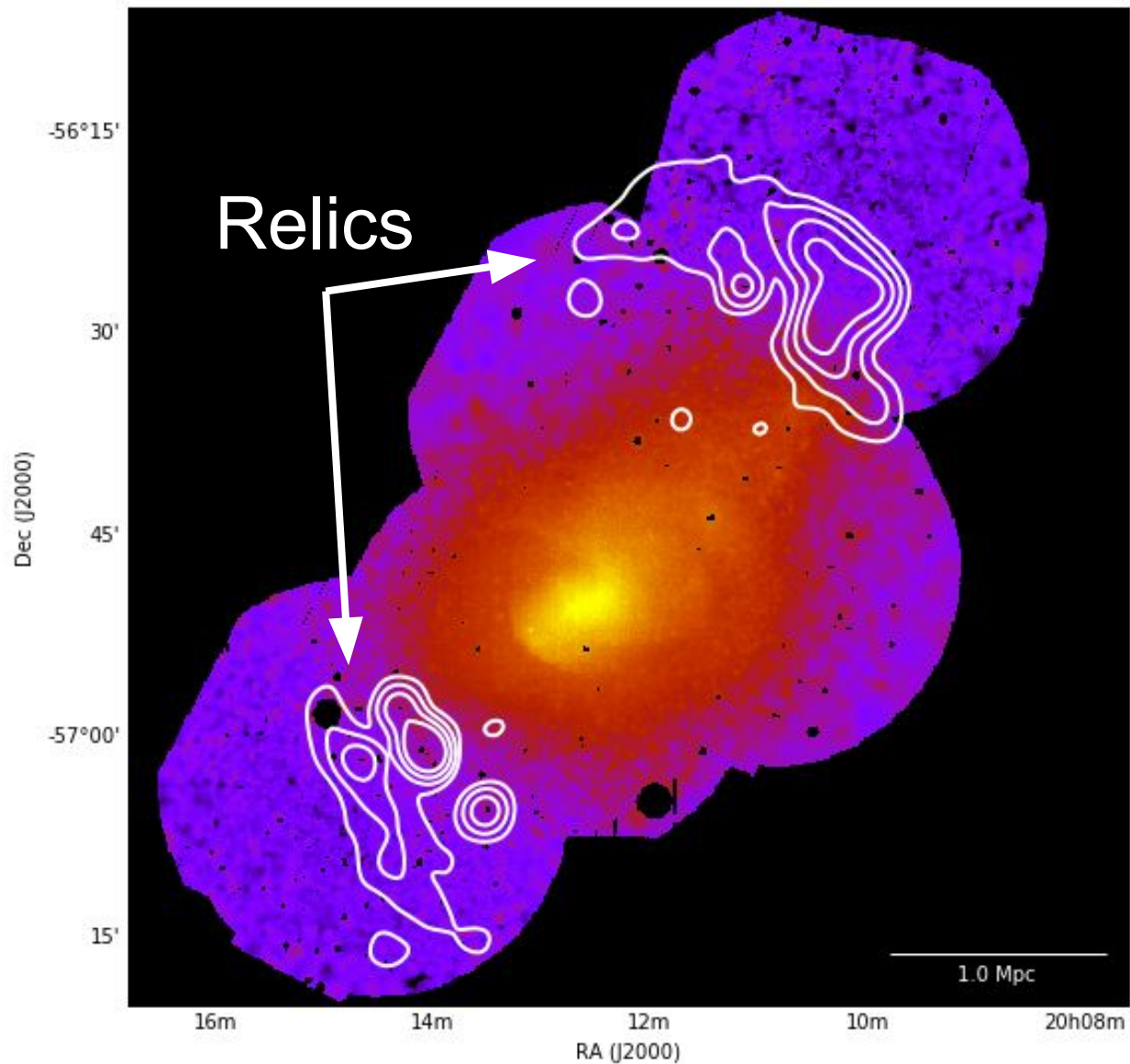
17 June 2016

Hotspots in the XMM Sky

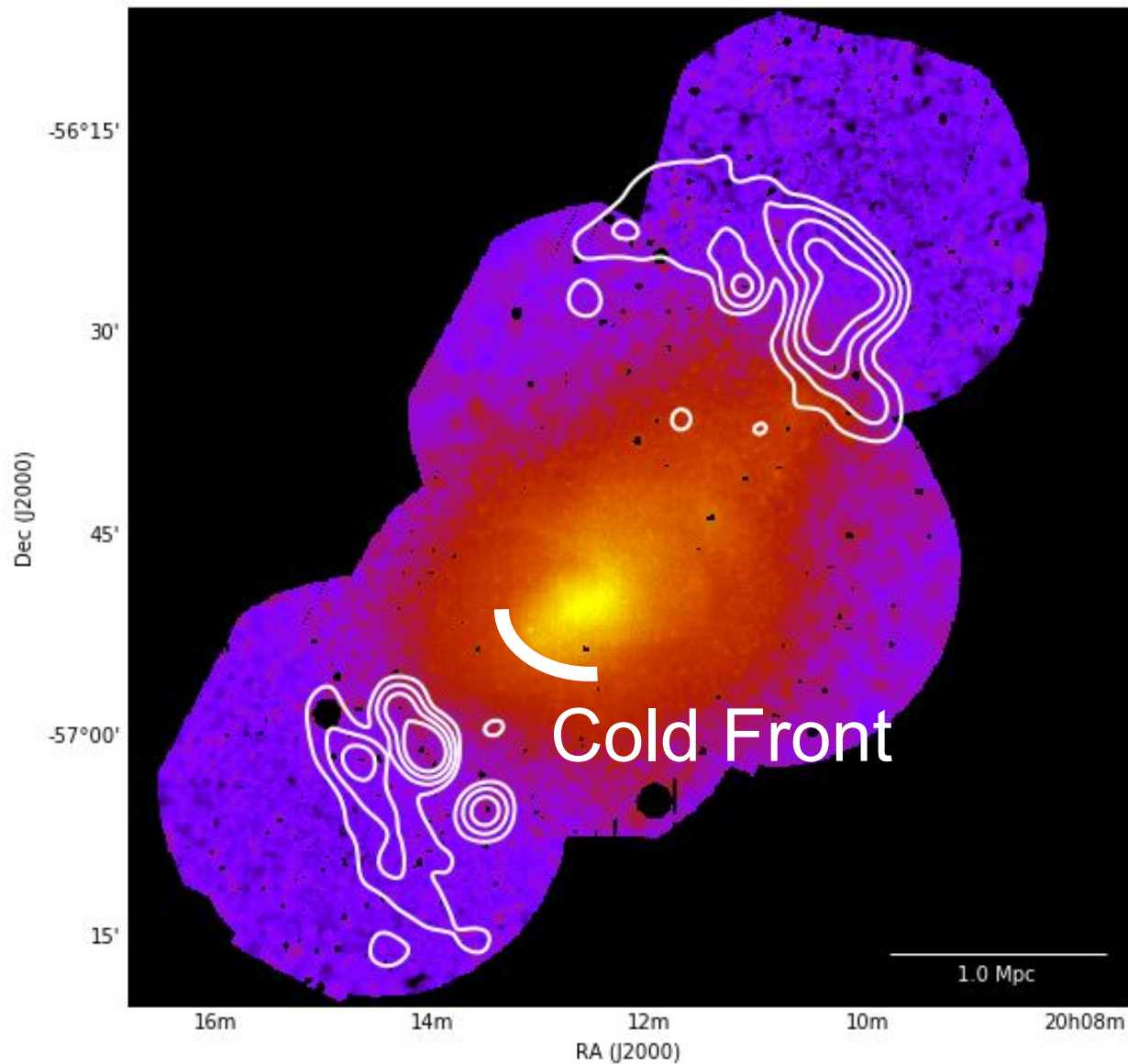
A3667: A Merging Cluster



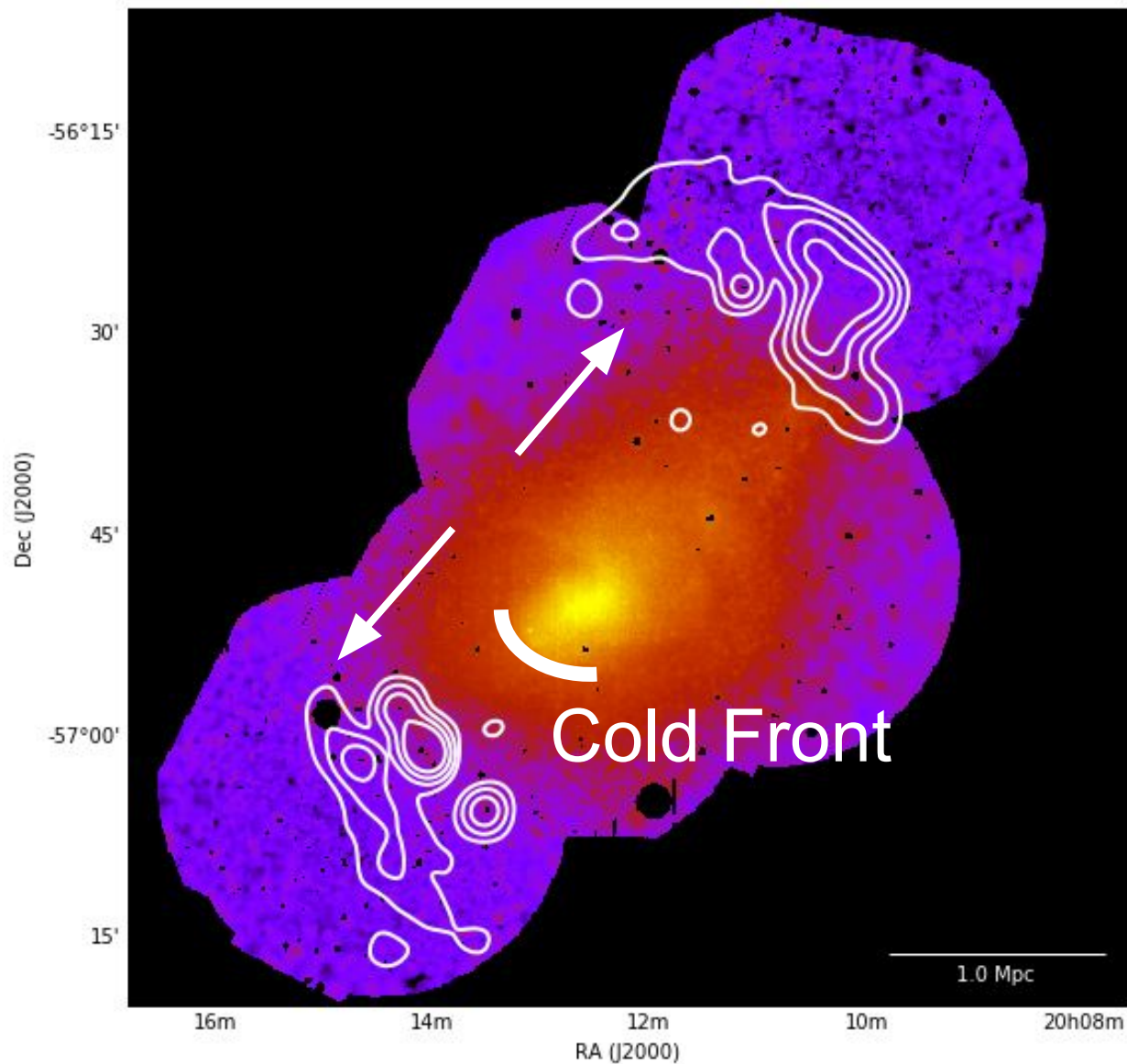
A3667: A Merging Cluster



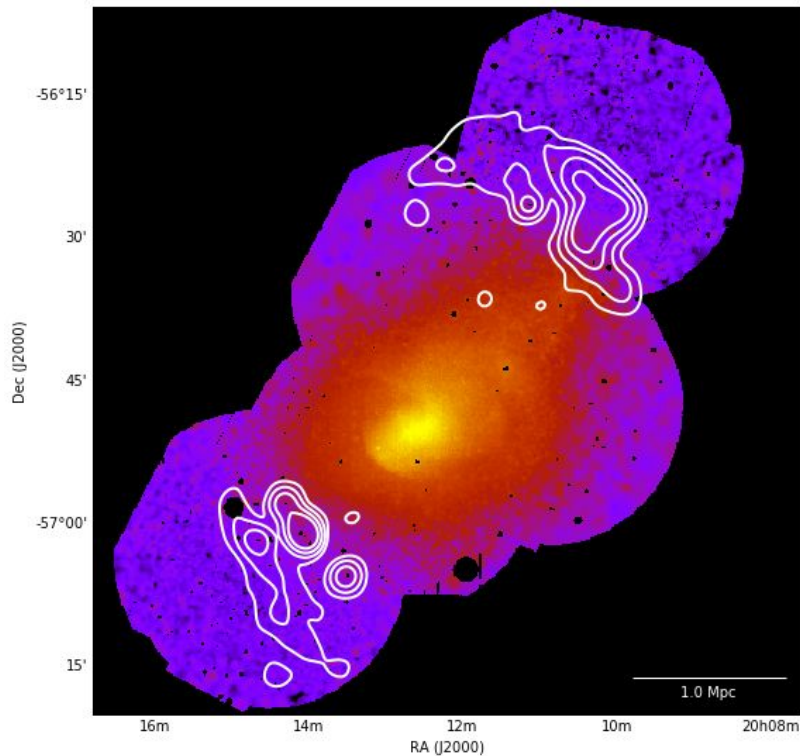
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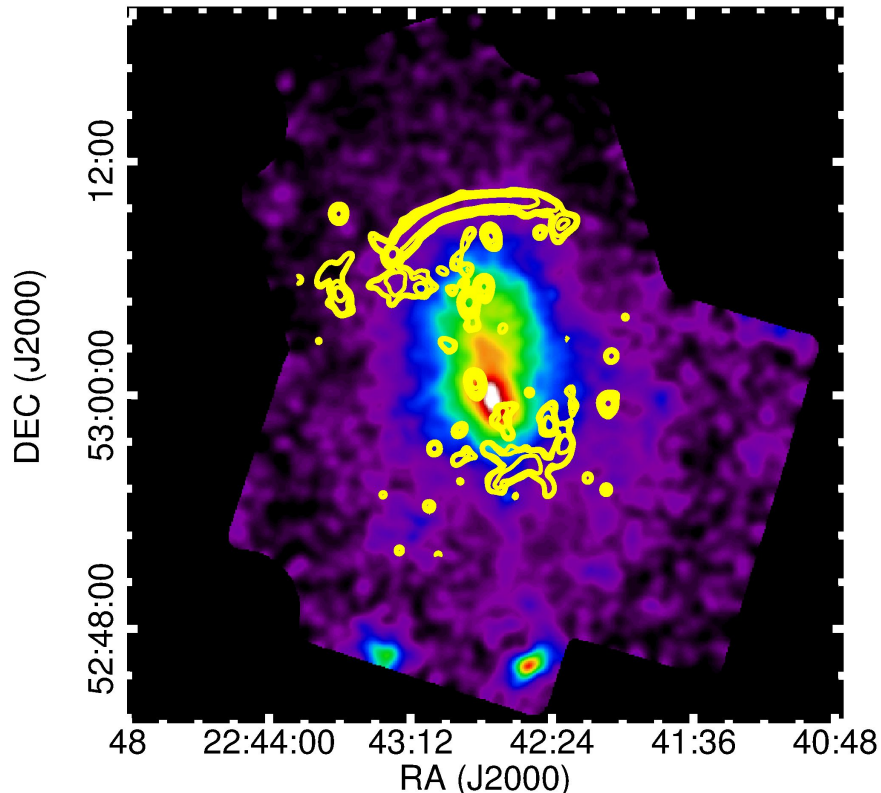
A3667: A Merging Cluster



- Mergers drive shocks
- Shocks accelerate cosmic rays
- CR electrons produce synchrotron radiation

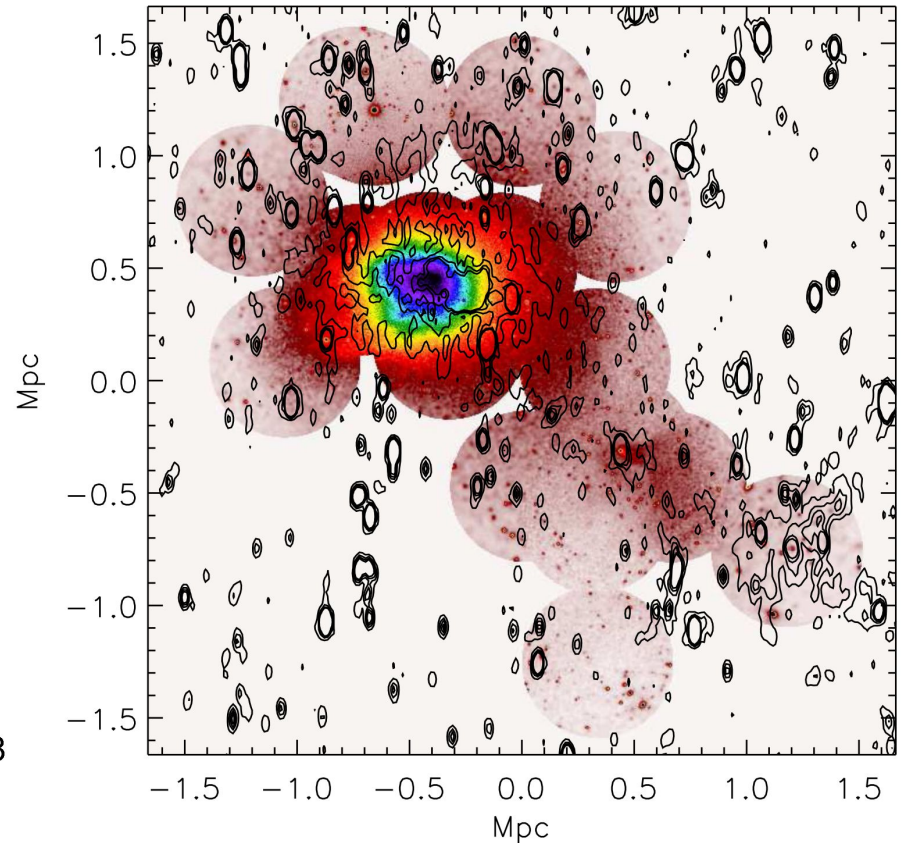
The Relic-Shock Connection

CIZA J2242.8+5301



Akamatsu+ 2015, A&A, 582, 57

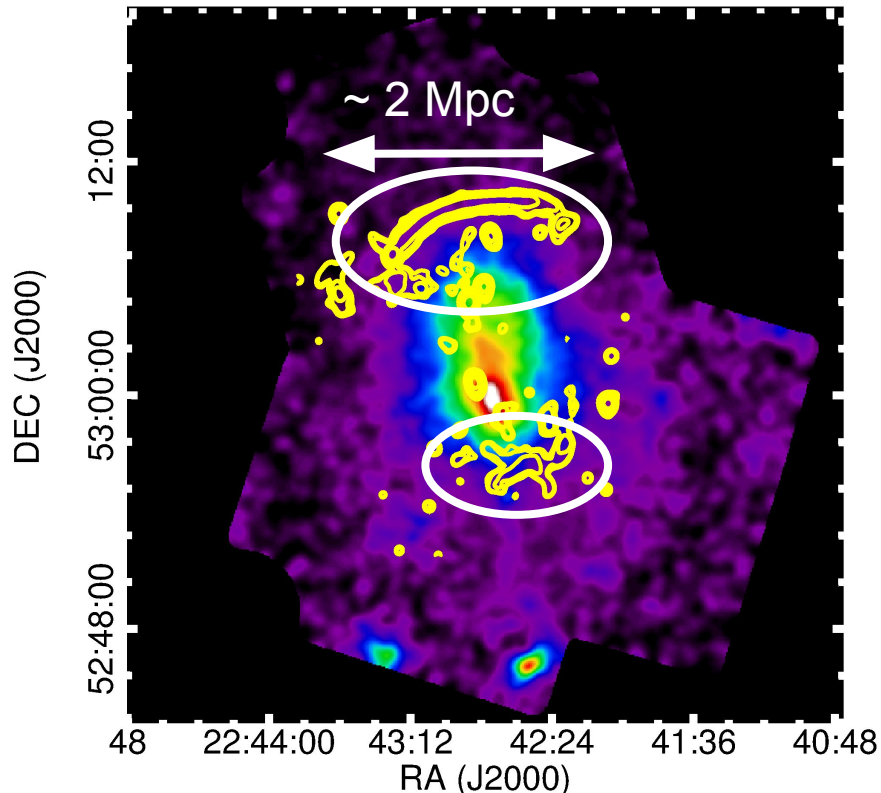
Coma Cluster



Ogrea+ 2013, MNRAS, 433, 1701

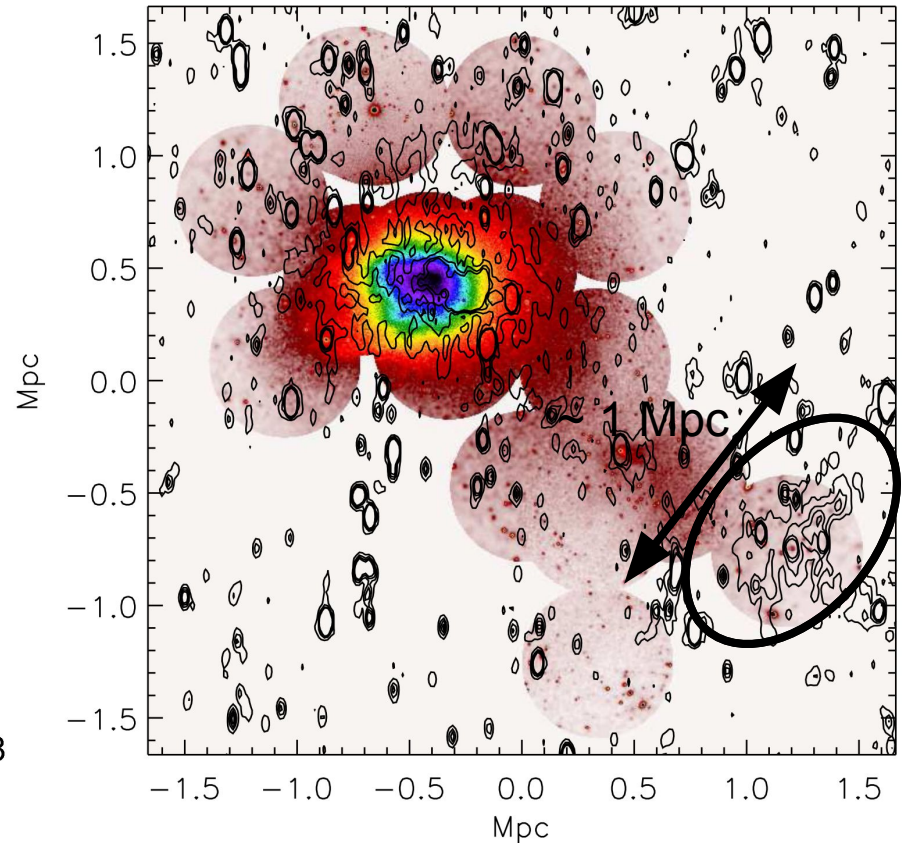
The Relic-Shock Connection

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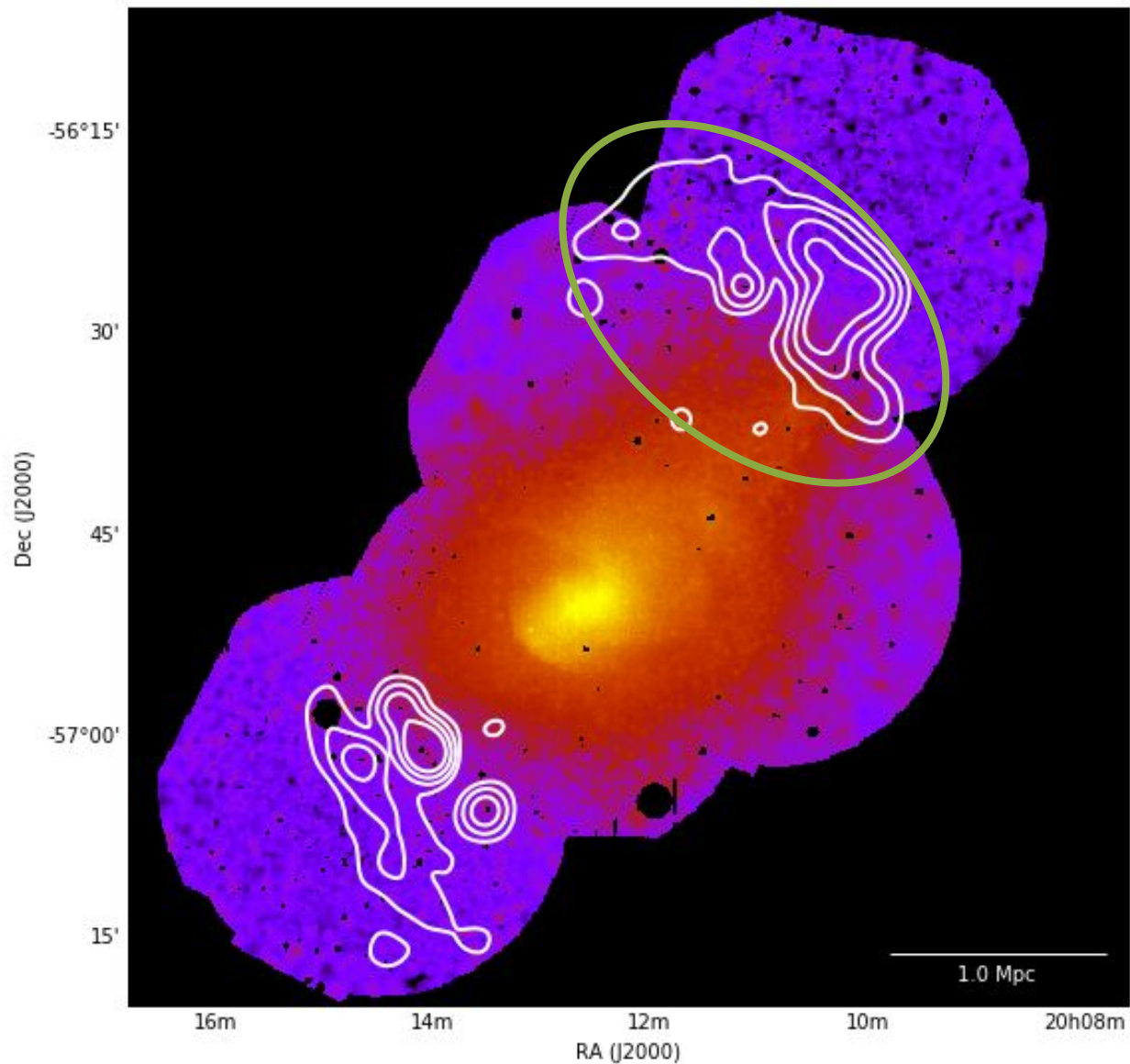
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Coma Cluster

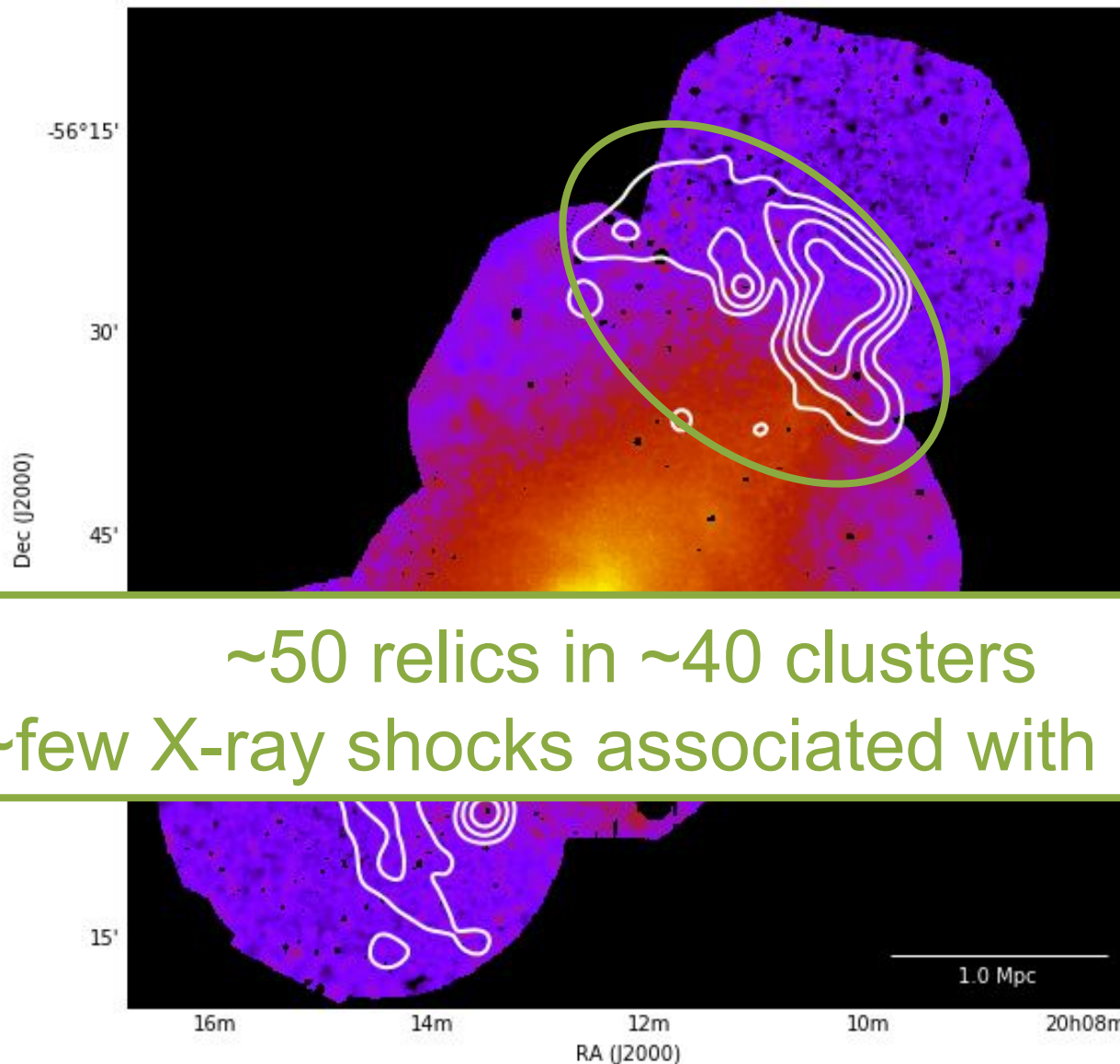


Ogrea+ 2013, MNRAS, 433, 1701

The Relic-Shock Connection

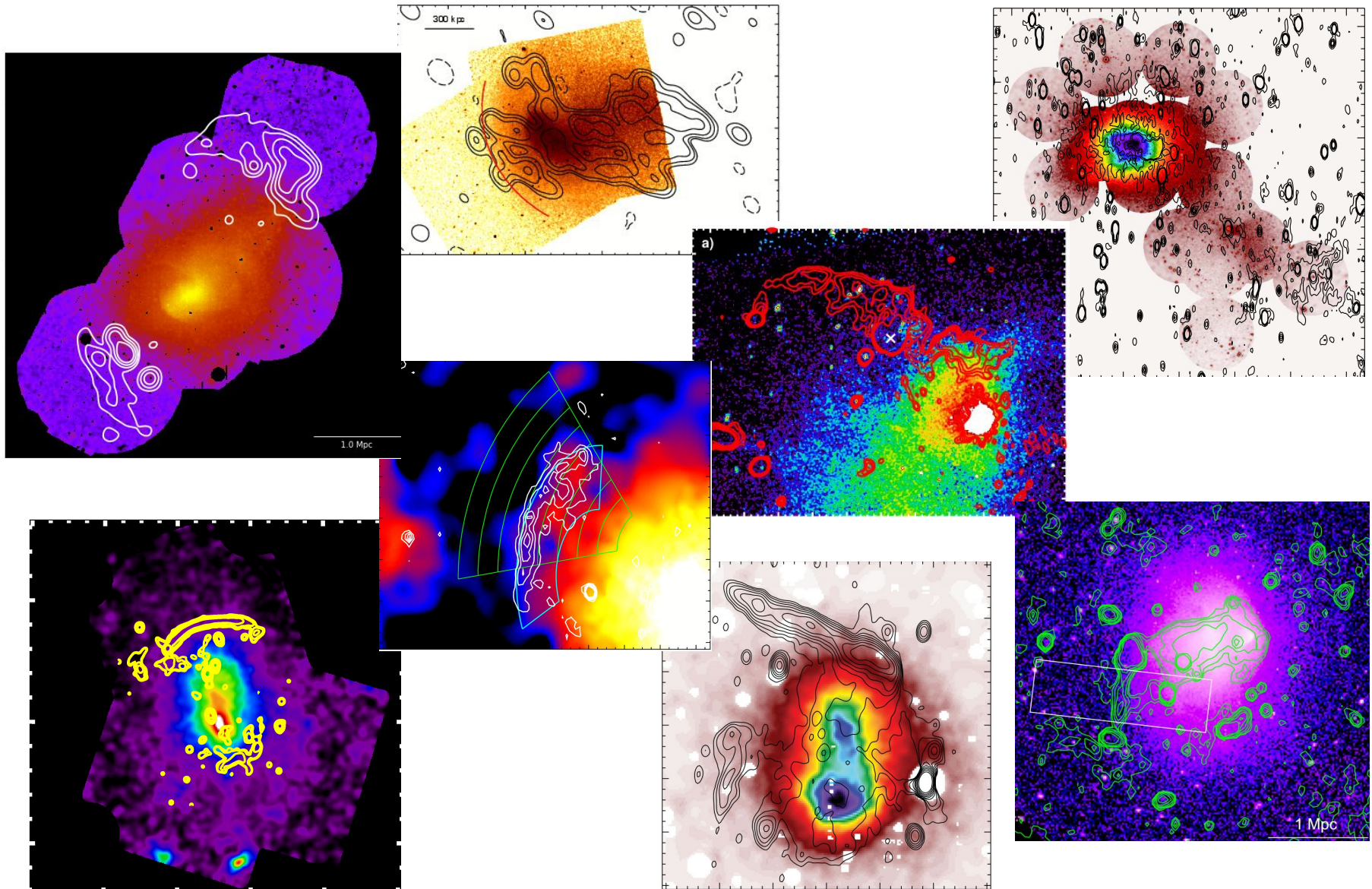


The Relic-Shock Connection

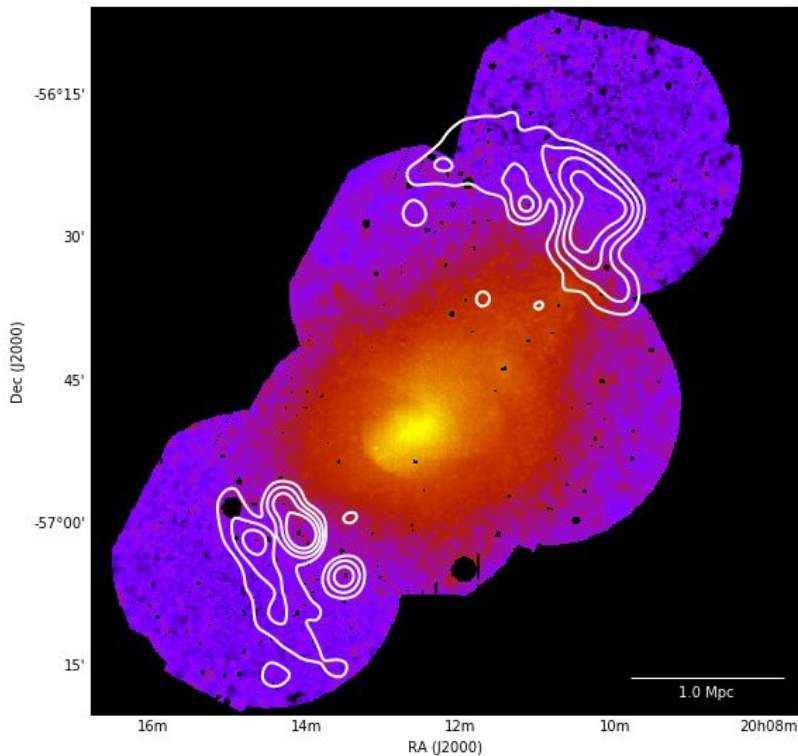


~50 relics in ~40 clusters
~few X-ray shocks associated with relics

The Relic-Shock Connection

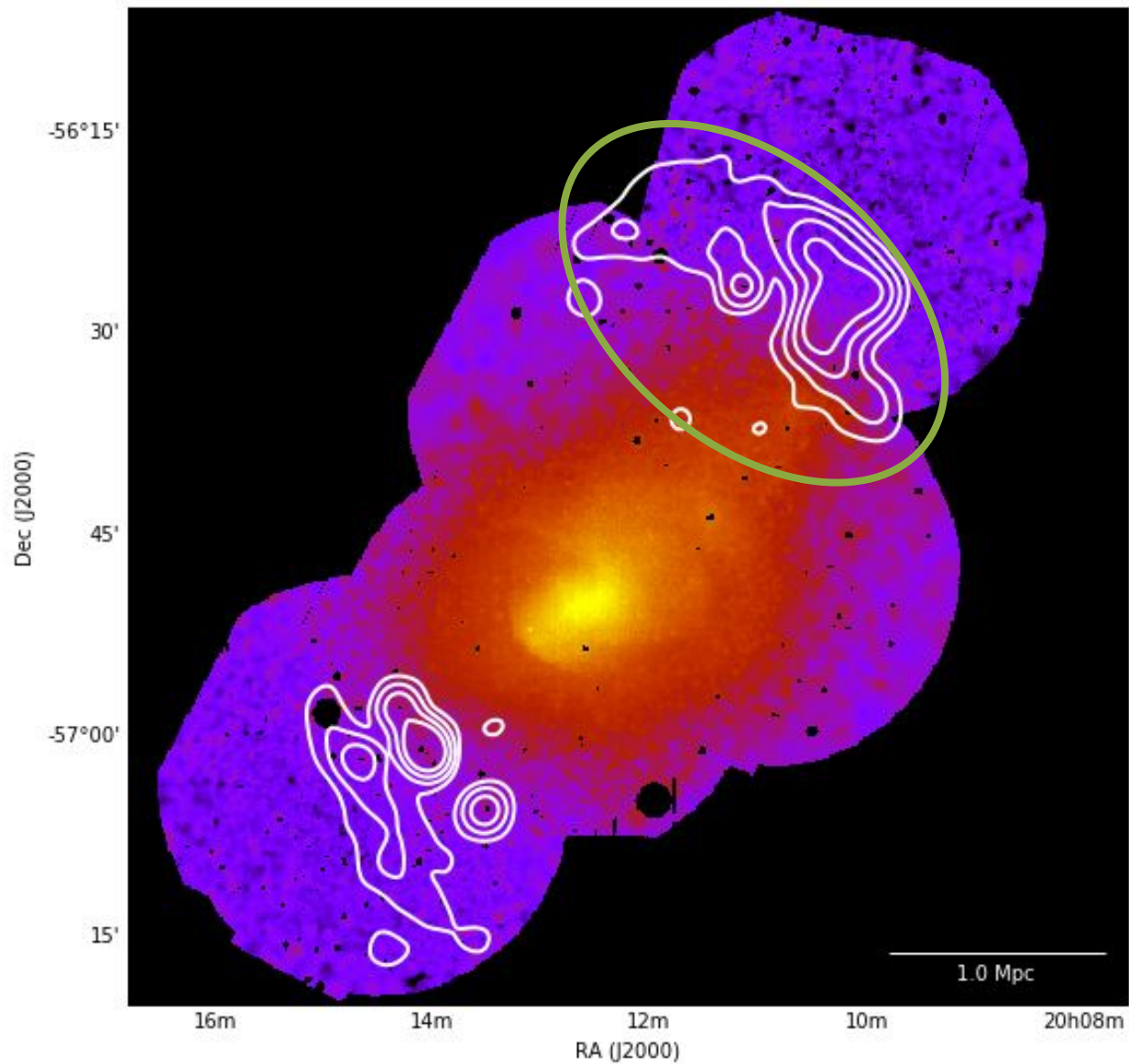


The Relic-Shock Connection

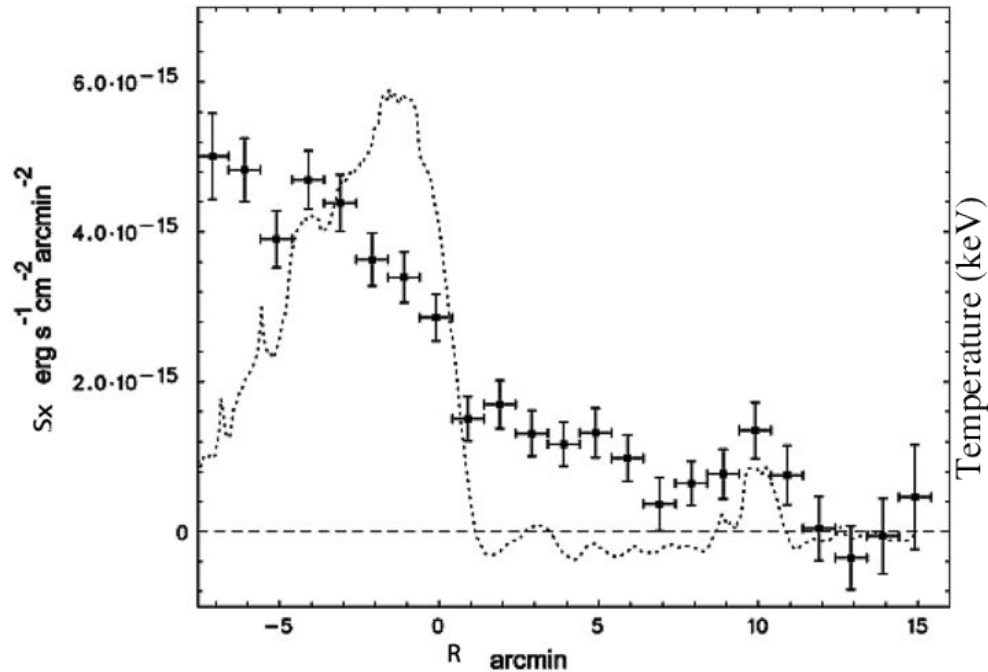


- Acceleration mechanism: DSA?
 - Primary or hadronic?
- Relics associated with weak X-ray shocks
 - $M \lesssim 3$: inefficient

A3667: NW Relic Region

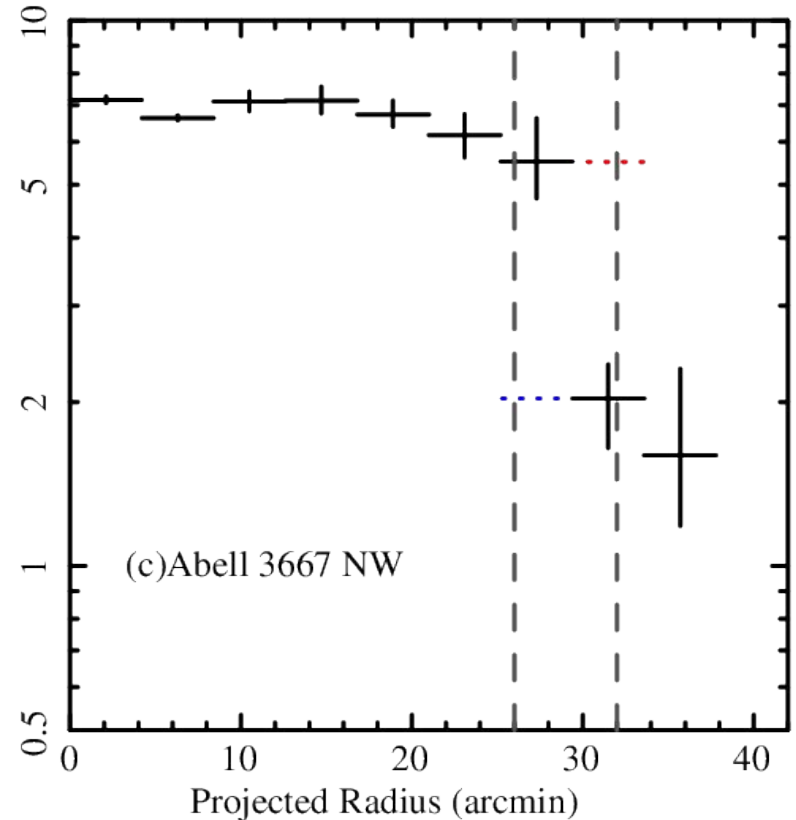


A3667: NW Relic Region



XMM

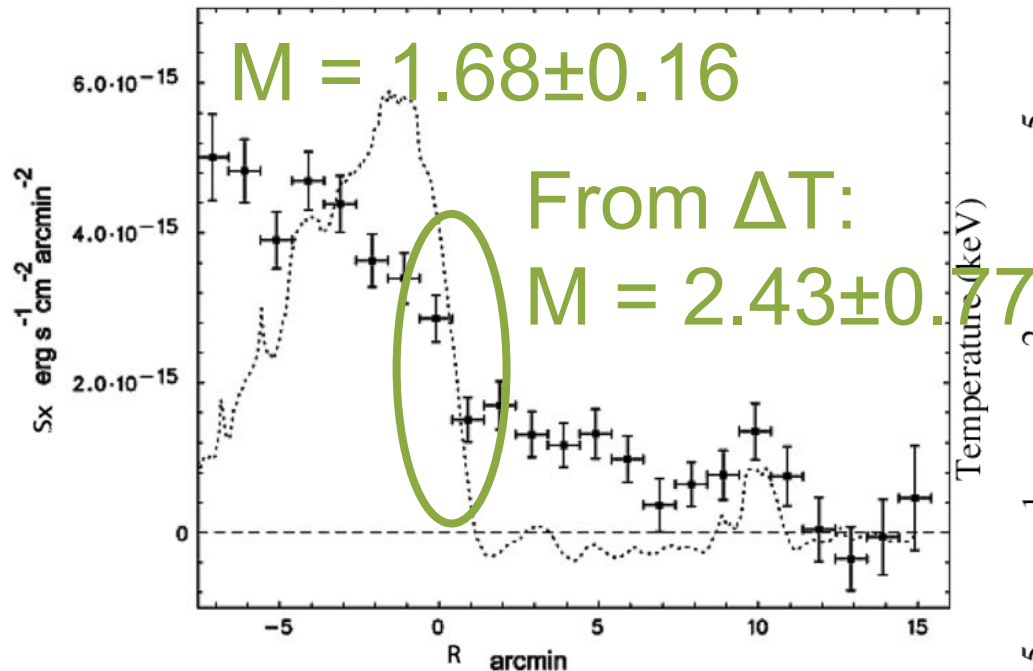
Finoguenov+ 2010, ApJ, 715, 1143



Suzaku

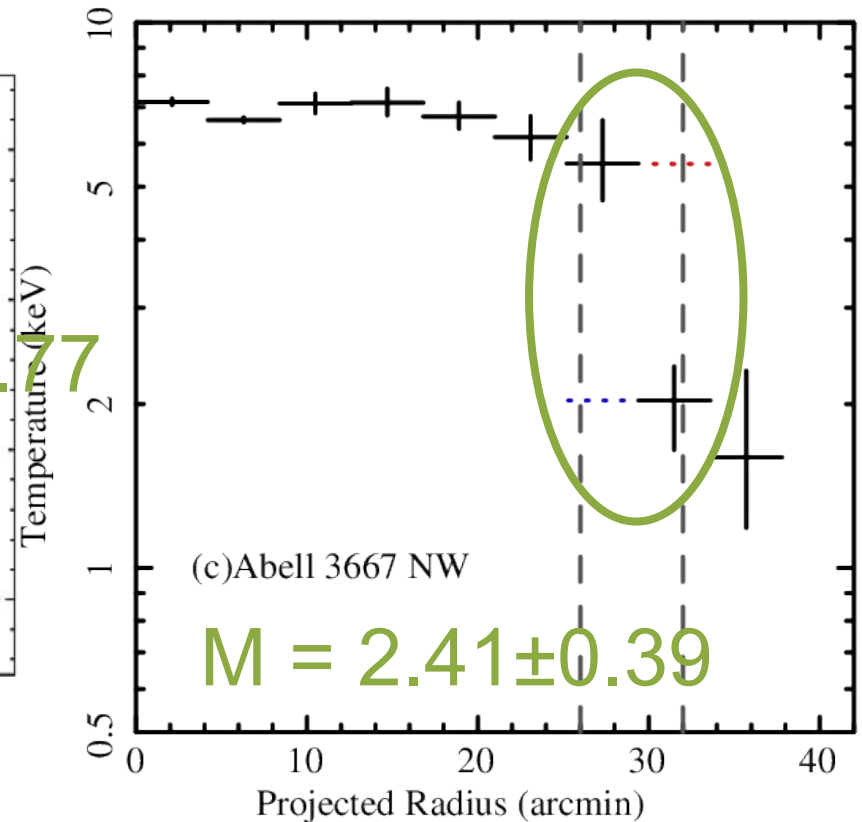
Akamatsu+ 2013, PASJ, 65, 16

A3667: NW Relic Region



XMM

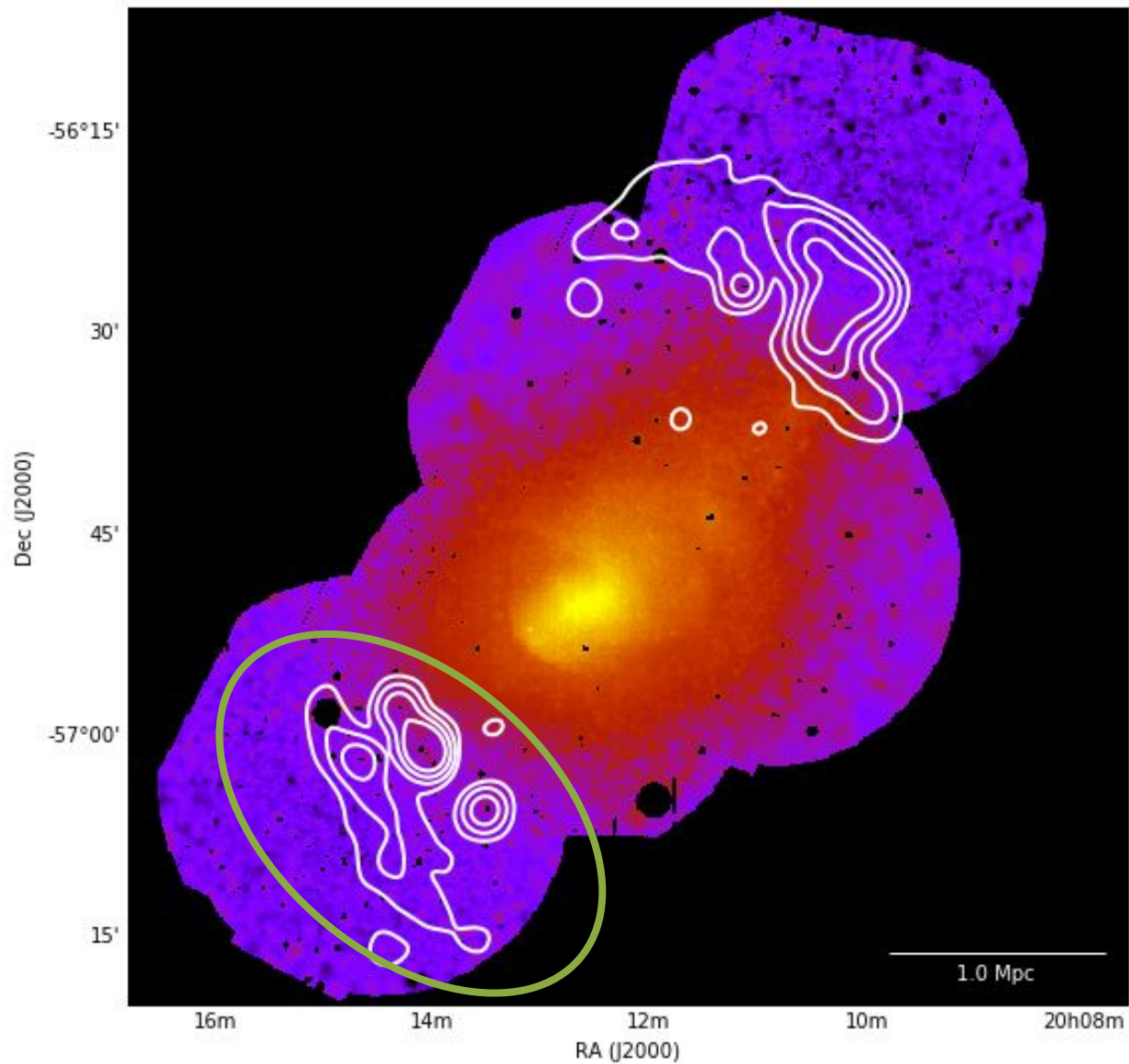
Finoguenov+ 2010, ApJ, 715, 1143



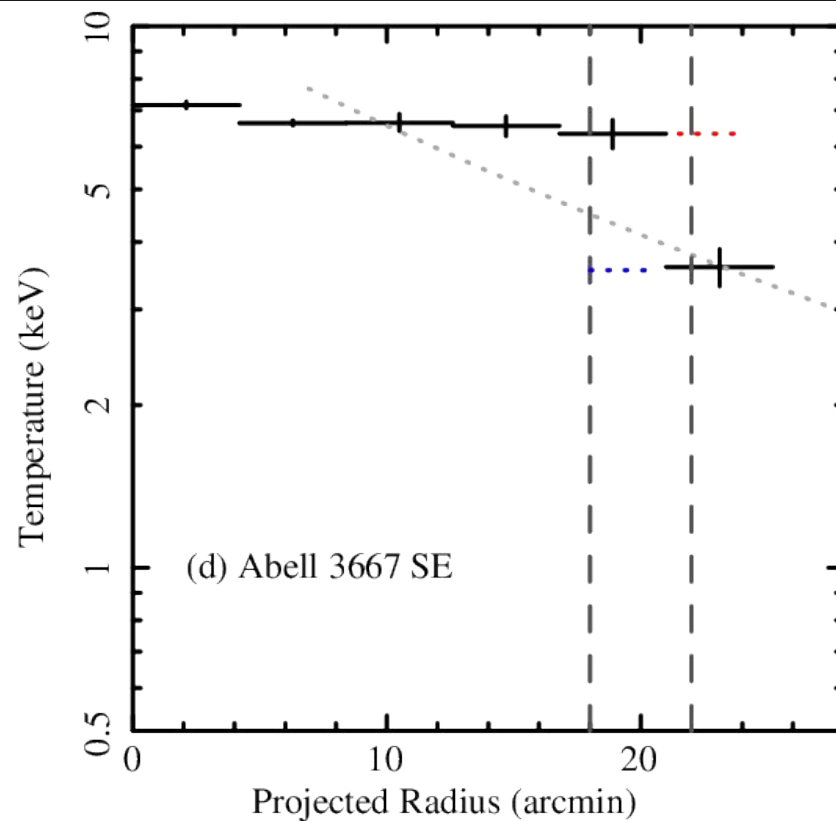
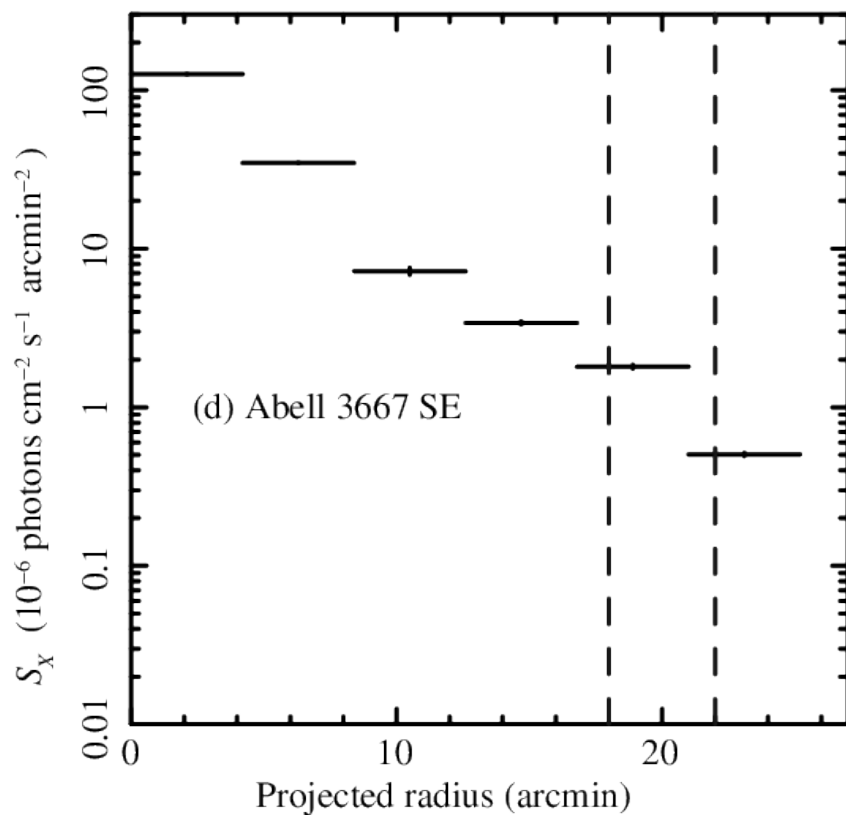
Suzaku

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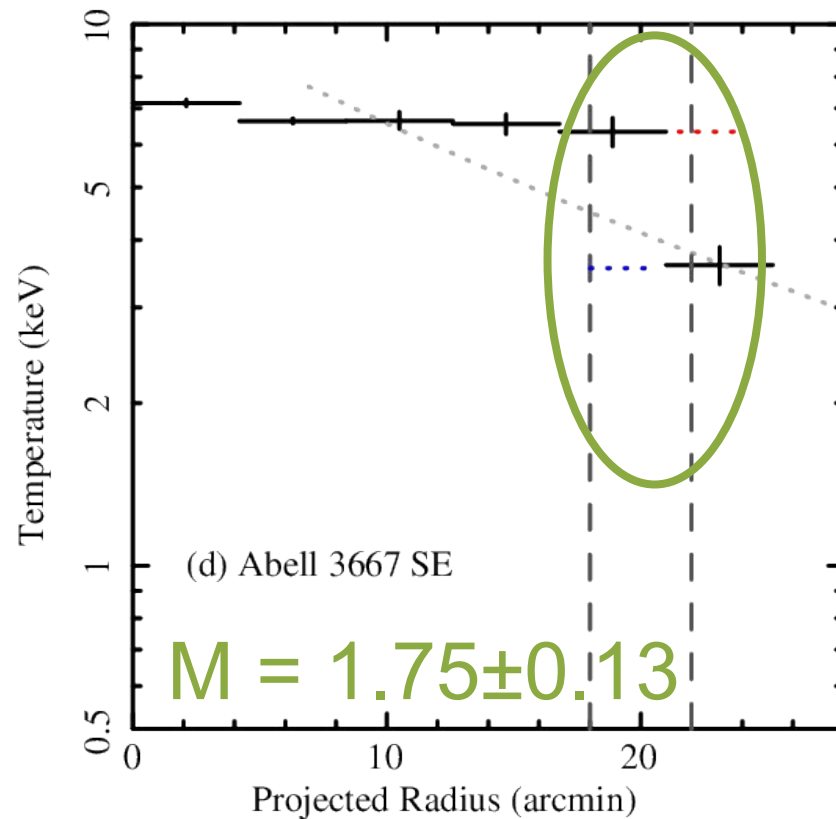
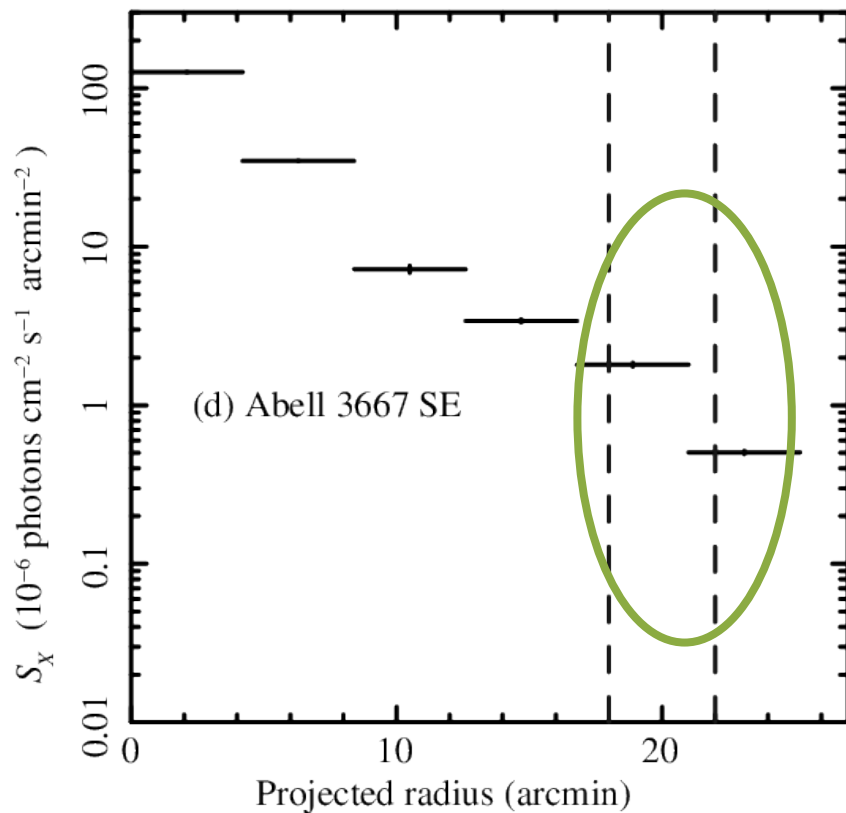
A3667: SE Relic Region



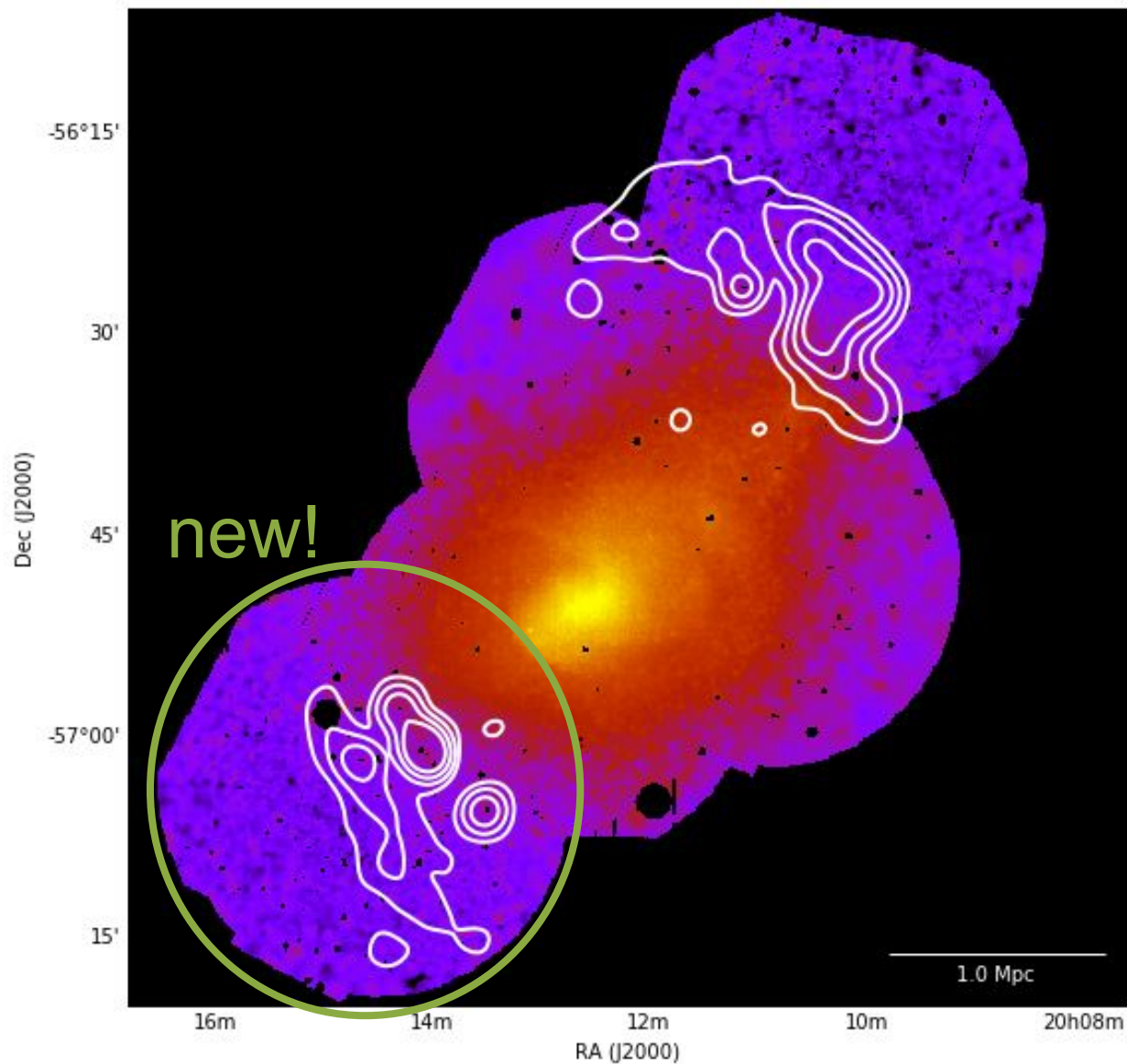
A3667: SE Relic Region (Suzaku)



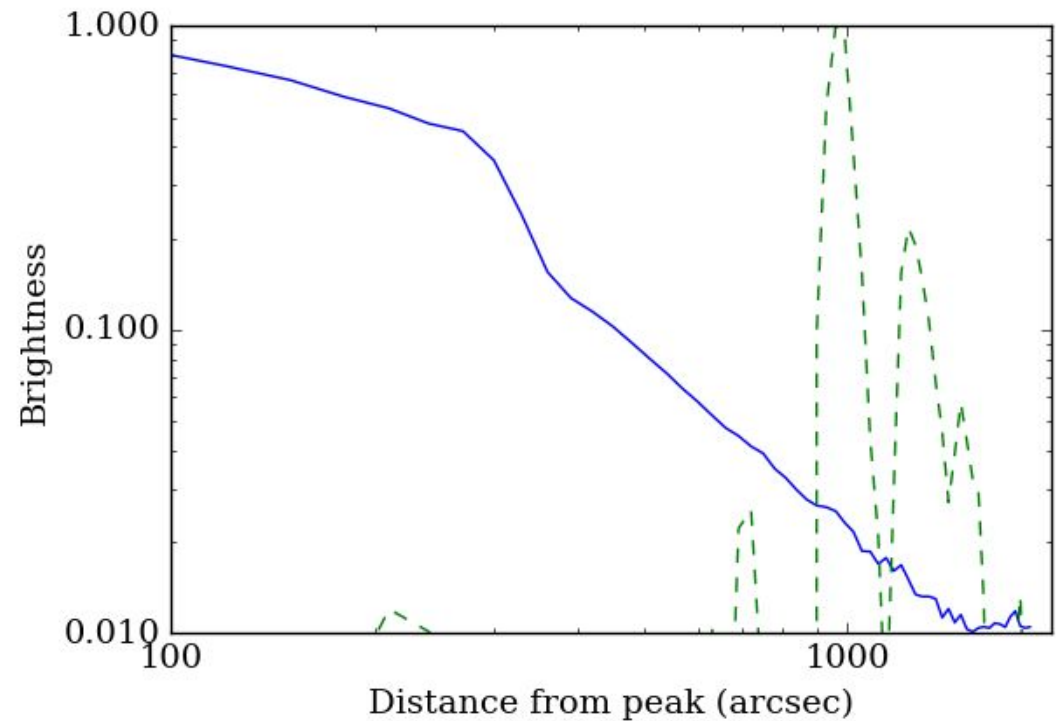
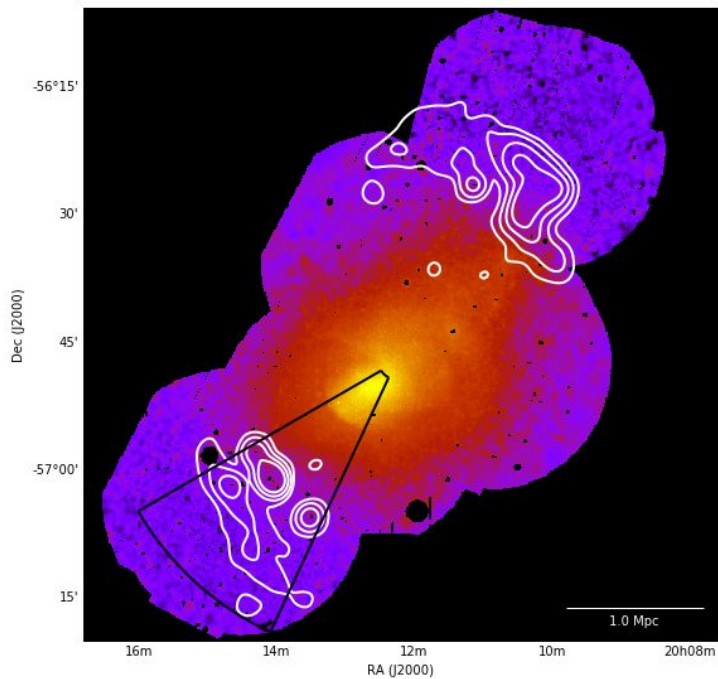
A3667: SE Relic Region (Suzaku)



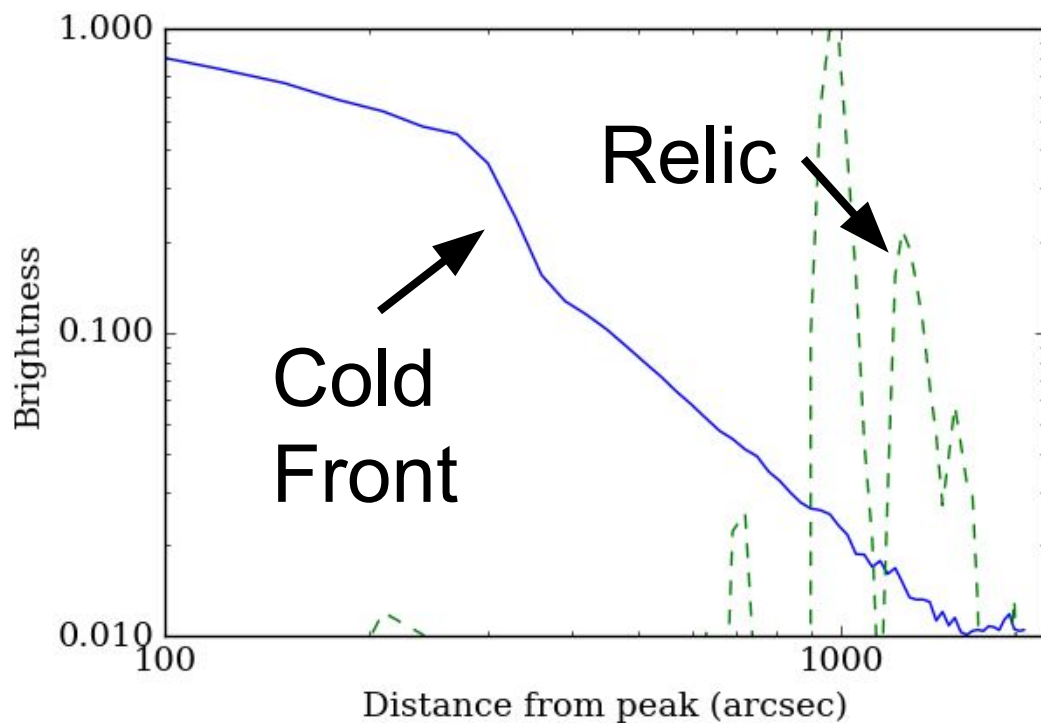
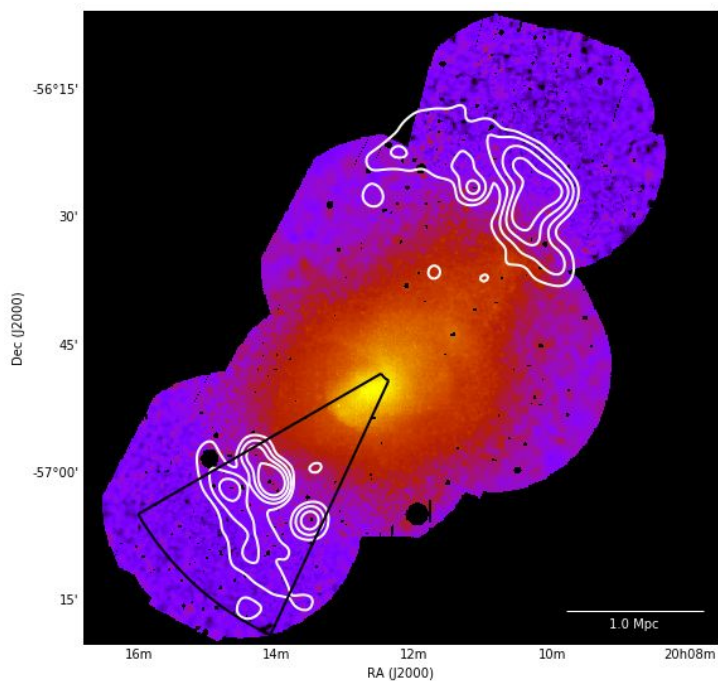
A3667: SE Relic Region (XMM)



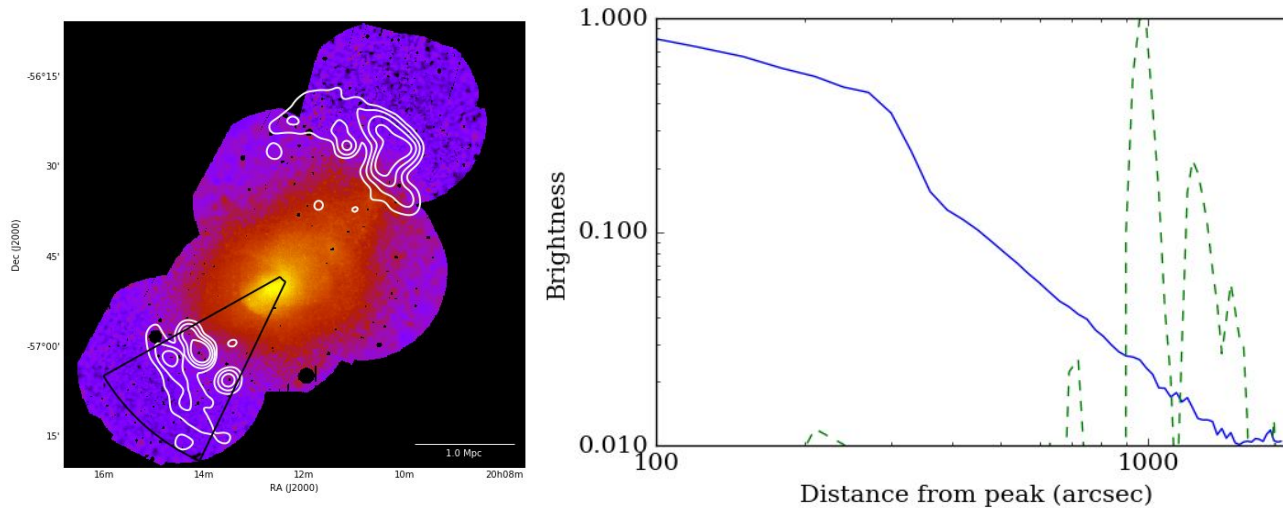
A3667 SE Relic: Where's the shock?



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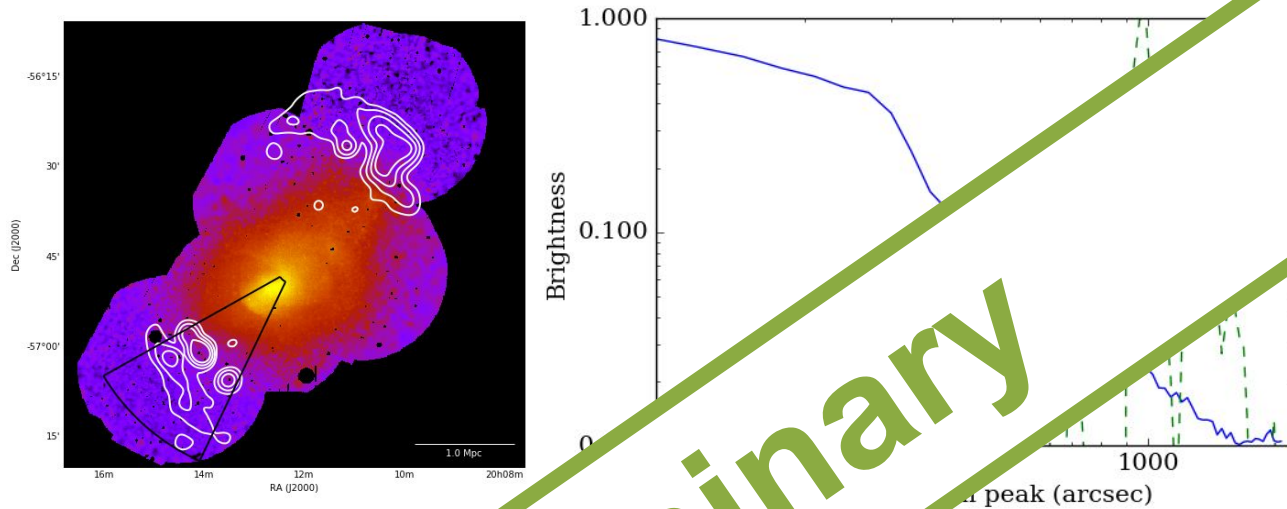


A3667 SE Relic: Where's the shock?



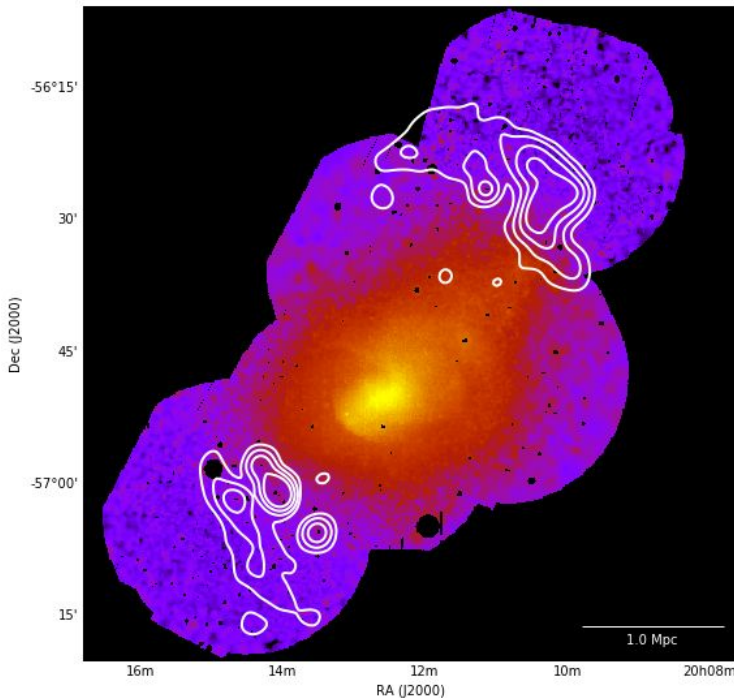
- Not enough data?
- Projection effects?
- Multiple weak shocks?
- Alternatives to DSA?

A3667 SE Relic: Where's the shock?



- No data?
- Ion effects?
- Multiple weak shocks?
- Alternatives to DSA?

The Outskirts of A3667: Summary



- Relics in outskirts → Cosmic rays + shocks
- X-ray shocks: difficult to observe
- No evidence for a shock associated with A3667 SE Relic
- Population studies with next-gen radio surveys