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Cool gas in brightest cluster galaxies

J. B. R. Oonk[1], W. Jaffe[1], M. N. Bremer[2] and N. Hatch[1]

[1]Leiden Observatory, Leiden University, Leiden, The Netherlands
email: oonk@strw.leidenuniv.nl

[2]H.H. Wills Physics Laboratory, University of Bristol, Bristol, United Kingdom

Abstract. Gas in galaxy clusters requires re-heating. We study the re-heating of the cool gas phases. Ionized and molecular gas is traced out to 20 kpc and found to be strongly coupled. The observed line emission may in part be explained by excitation due to hot, young stars.

Keywords. galaxies: galaxies: cooling flows, cD, clusters: general

Relaxed clusters of galaxies contain large quantities of gas at a variety of temperatures within their cores. To avoid catastrophic cooling, this gas needs to be re-heated. The details of this re-heating process are currently not understood.

To study the distribution and condition of the cool gas, HII and H_2, we performed deep K-band IFU observations of two clusters Abell 2597 and Sersic 159-03 with SINFONI on the VLT. These observations enable us, for the first time, to map this gas in the cores of these clusters. The distribution of the gas is filamentary and correlates well with the X-ray emission. Ionized and molecular gas is found to co-exist in both intensity and dynamics and is detected out to 20 kpc from the nucleus of the brightest cluster galaxy.

The gas near the nucleus partakes in rotation and shows a sharp increase in its velocity dispersion along the current radio axis, indicating that the gas here is stirred up by AGN outflows. Deep 5 GHz radio observations furthermore show that non-thermal plasma is spread throughout the cluster core on short timescales, $t \lesssim 10^7$ yr.

The H_2 lines are everywhere well fit by a single temperature LTE model, implying that this gas is warm, $T \sim 2300$ K. The total warm H_2 mass is $\sim 10^5$ $M_\odot$ and the total HII mass is $\sim 10^7$ $M_\odot$. The ratio of the Pa α to H_2 lines indicate a source of UV excitation rich in EUV to FUV photons (Jaffe *et al.* 2005 and Oonk *et al.* in prep.).

To study the source of excitation for the cool gas we performed deep FUV imaging with ACS-SBC on the HST and U imaging with FORS on the VLT for two clusters, Abell 2597 and Abell 2204. FUV and U continuum emission is found to exist in clumps and filaments out to 25 kpc from the nucleus of the brightest cluster galaxy. Comparing the FUV/U ratio to a black body curve we find a temperature $T_{BB} \sim 50000$ K for the young stars in cores of these clusters. Preliminary analysis suggests that the UV emission can account for the ionization seen in the Hα emission, but detailed analysis of optical line ratios indicates the need for additional heating mechanisms (Voit *et al.* 1997).

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References

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