Gone with the Wind:
Watching Galaxy Transformation in Abell 2125

W. Keel (U Ala.), F. Owen (NRAO), M. Ledlow (Gemini Obs.), D. Wang (U Mass.)

Dense environments clearly foster the transformation of galaxies, but it has proven difficult to untangle the roles of various processes in cluster environments. We have found a uniquely strong case for ongoing stripping of gas from the galaxy C153 in Abell 2125. The cluster, at z=0.25, includes merging subsystems with a relative line−of−sight velocity near 2000 km/s. C153, identified using the VLA as a strong radio source powered by star formation, is the brightest cluster member with activity of this kind, and part of the less populous blueshifted grouping. Several lines of evidence indicate that it is being swept by a stripping event.

(1) A tail of ionized gas is seen in [O II] emission, which extends at least 70 kpc toward the cluster core, coinciding with a soft X−ray feature seen in the Chandra observations reported by Wang et al.
(2) HST WFPC2 images reveal disturbed and clumpy morphology, including luminous star−forming complexes and chaotic dust features.
(3) The spectral energy distribution and Gemini GMOS absorption−line spectrum indicate a massive burst of star formation ~10^8 years ago superimposed on an older and much fainter population.
(4) The stellar and gas kinematics are decoupled, with multiple gas velocity systems including counter−rotating components.

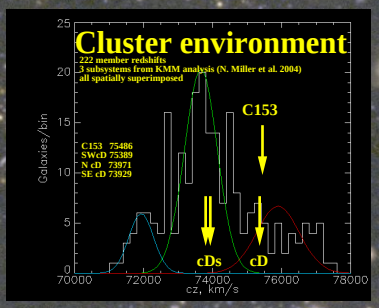
The large velocity difference between the galaxy and (most of the) intracluster medium may contribute to the signatures being more prominent than hitherto seen. The starburst age is consistent with estimates of the time since the closest encounter of the major subsystems during the cluster−level merger. We continue to explore whether a starburst outflow or tidal damage has added to the role of stripping by the ICM, and how star formation has proceeded in the gas after leaving the galaxy disk.

This work was supported by NASA through HST grant GO−07279.01−96A and Chandra grant GO1−2126, and by the NSF through facilities at NRAO, Kitt Peak, and Gemini−North.

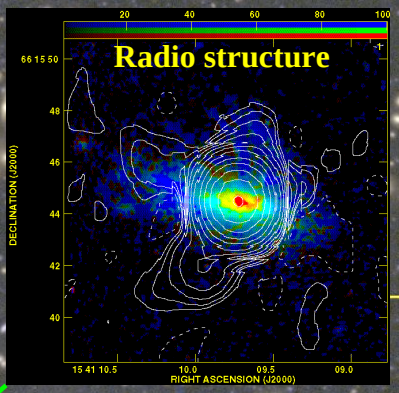
Galaxy morphology

WFPC2 V/I imaging (emitted B/R) shows:
- disturbed morphology
- isophotal twist in inclined disk
- chaotic dust structure
- luminous knots to N and E sides
- reddened core

Cluster environment



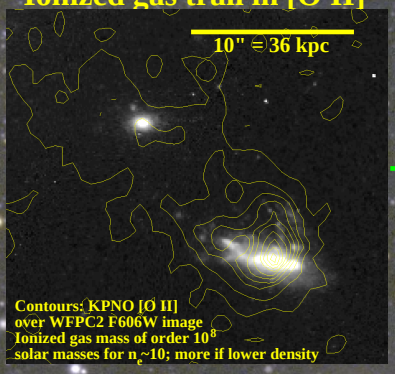
Radio structure



20−cm contours over WFPC2 I image, showing polar "lobes" and disk emission.

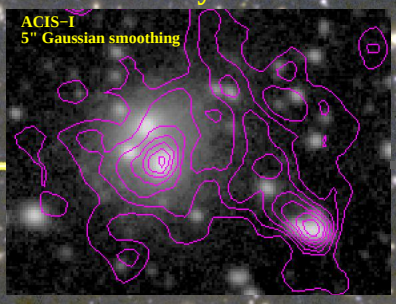
C153

Ionized gas trail in [O II]



Contours: KPNO [O II] over WFPC2 F606W image
Ionized gas mass of order 10^8 solar masses for n_e~10; more if lower density

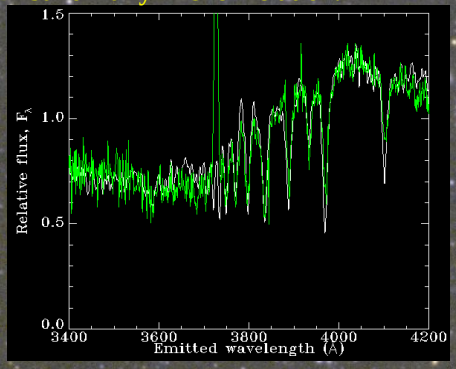
Soft X−ray trail



Contours at 0.5−2 keV over the KPNO R data, showing a trail matching the [O II] structure, and possibly extending further.

Star−formation history

Integrated GMOS spectrum (green) and composite Bruzual/Charlot model (white), showing a starburst of ~4×10^9 solar masses about 10^8 years ago dominating an older 10−Gyr population. This fits with C153 lying 1.7 magnitudes bright in the B−band Tully−Fisher relation.



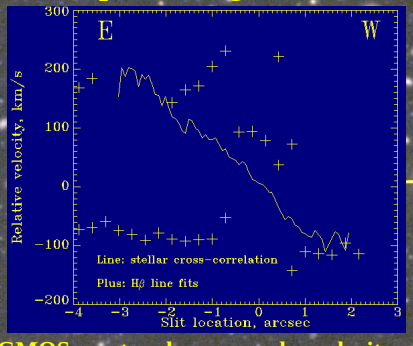
A violent stripping event

- Δv~2000 km/s, so ρv^2 is high
- closest large, gas−rich galaxy to cluster core, likely also true in 3D
- starburst 10^8 years ago
- downstream star formation continues
- [O II] and soft X−ray trails show much of ISM being removed
- decoupled stellar and gas motions
- fuelling of radio AGN?

Further questions

Velocity field in tail
Mechanism of X−ray emission
Shock ionization of departing ISM?
Role of any starburst wind

Decoupled star/gas motions



GMOS spectra show a regular velocity behavior for stars, but multiple components and irregular behavior for line emission. This fits with pressure stripping but not for tidal effects by themselves. The stellar rotation curve indicates a dynamical mass of almost 10^{12} solar masses within 10 kpc.

Background: KPNO Mosaic field of Abell 2125, BVR, 14x18 arcminutes