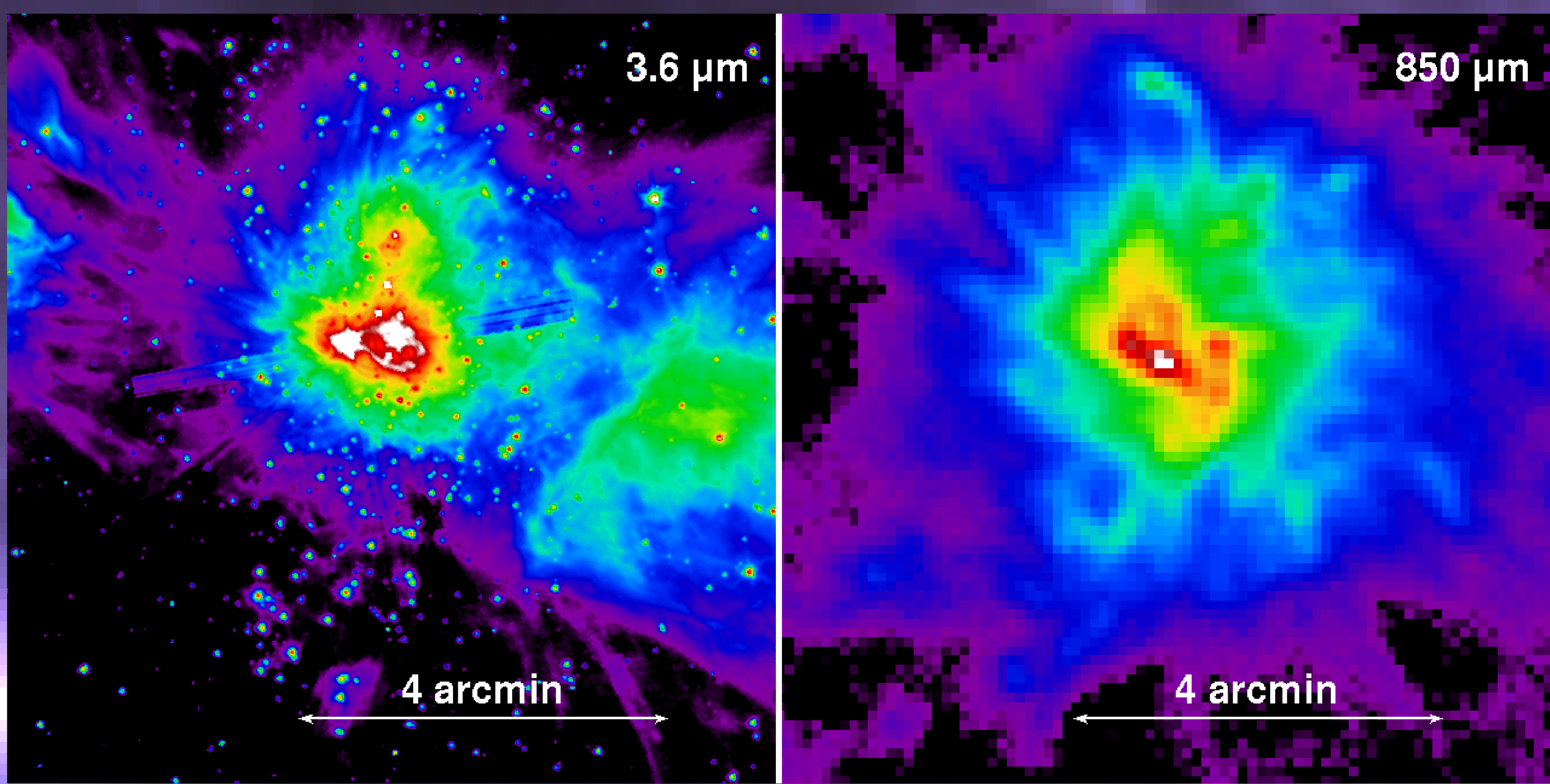
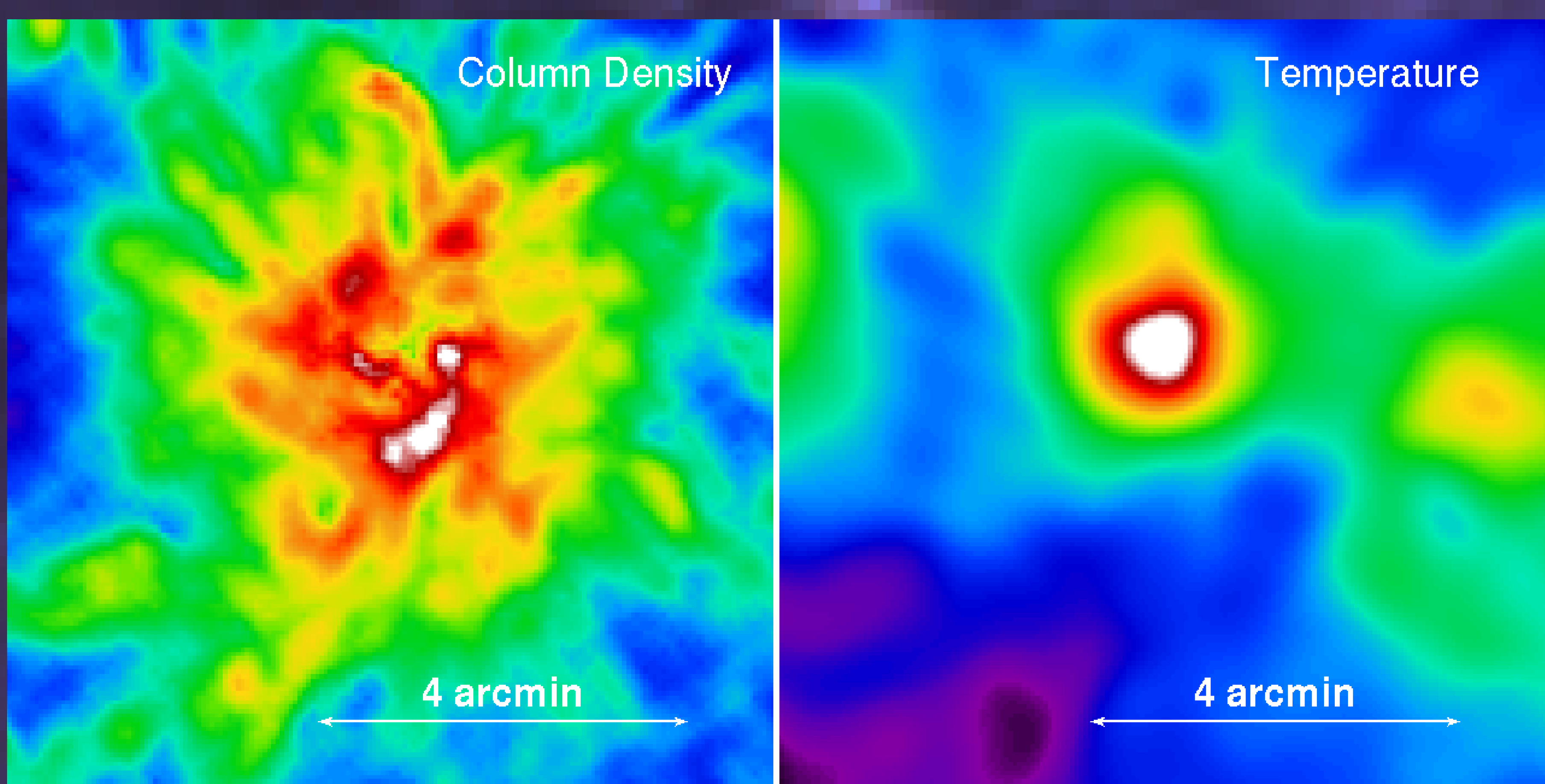
GRAVITY VS RADIATION IN MON R2

T.S.M. Rayner[1], N. Schneider[2], M.J. Griffin[1], P. Tremblin[3,4],
F. Motte[4], P. Didelon[4], S. Bontemps[2], J. Dale[5] and the HOBYS Team
1: Cardiff University; 2: LAB/OASU Bordeaux; 3: Exeter University;
4: CEA-Saclay; 5: Excellence Cluster, Munich

Studying massive star-forming regions is the key to understanding extragalactic star-formation since only these bright, large, and massive molecular clouds can be observed in external galaxies. We thus investigated the galactic high-mass star-forming region Mon R2 with *Herschel*, and found strong gradients in its column density and temperature structure, presumably mainly due to radiative feedback processes. Very dense (column density > a few 10^{23} cm^{-2}) gas clumps with the most massive pre- and protostellar sources are found in the central region. The probability distribution function of column density shows a two-step power-law tail with a flatter slope for highest column densities that can be explained by an additional, external pressure due to expanding ionization fronts. Additionally, Mon R2 shows a pronounced hub-filament structure with star-formation taking place on the filaments as well, and these filaments may provide the gas to build up the high density gas reservoir in the central region. We intend to single out the contributions of free-fall collapse and radiation forced-collapse by linking the low/high-density mass and area fractions of the cloud with its pre- and protostellar content.

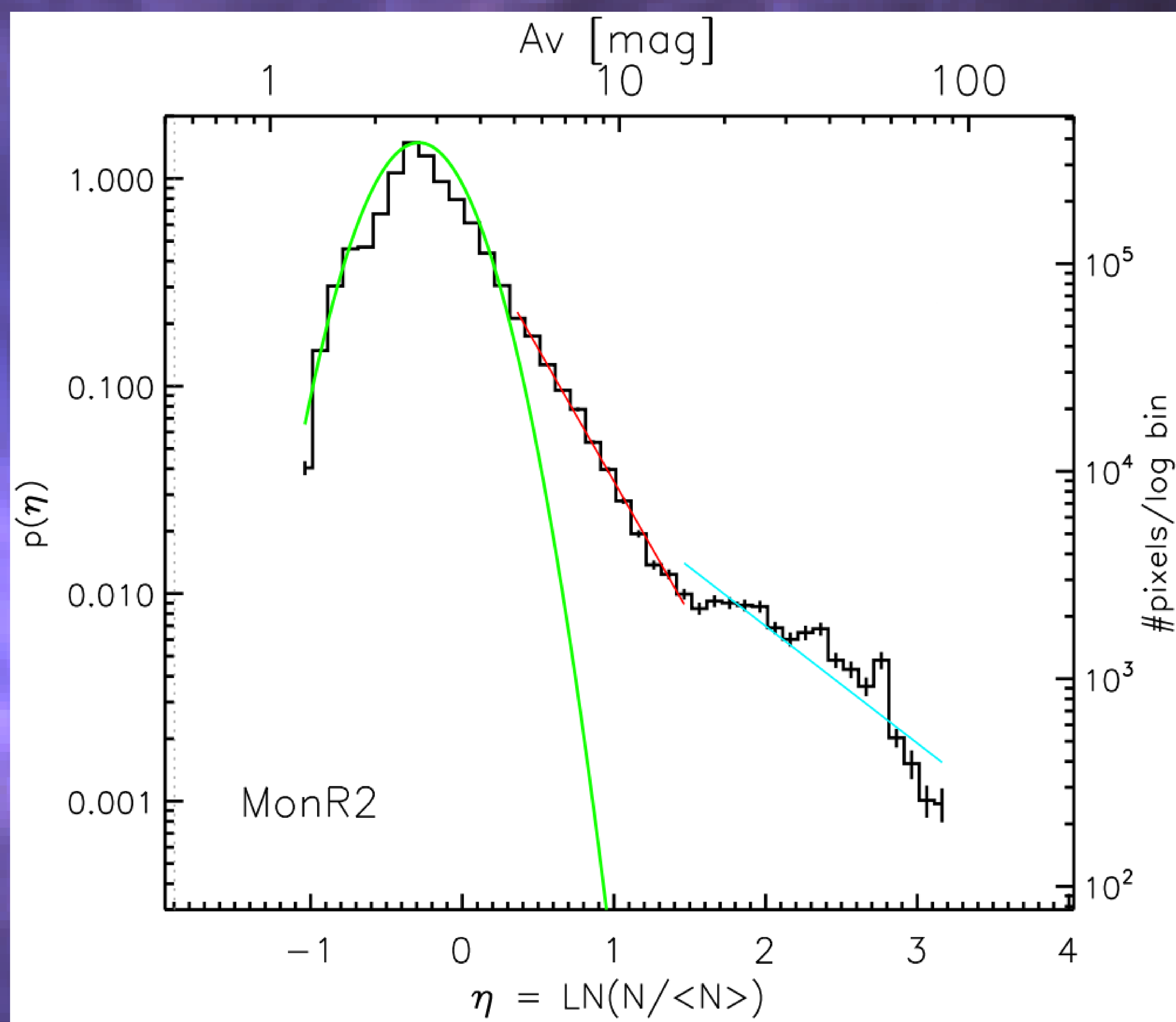


The Mon R2 molecular cloud lies 830 parsec away, in the constellation Monoceros. While it lies on the galactic plane, it is almost opposite the galactic centre, and so there is very little confusion present.
Mon R2 was observed with *Herschel* PACS and SPIRE, as part of the *Herschel* imaging survey of OB Young Stellar objects (HOBYS) with complementary data from the SCUBA-2 camera on JCMT, and the *Spitzer* telescope. At all wavelengths, one feature was easily visible: a dense hub of filamentary and protostellar material, shown above at 3.6 µm and 850 µm (both images cover the same area, 500”, or 2 pc, around this “central region”).
From these observations, temperature and column density maps of the region could be made, using a standard HOBYS dust model. The column density (left) and temperature maps of the central region are shown below.



The central region is, unusually, both dense and hot, containing young stars, dense star-forming material and an ultracompact HII region.

A probability distribution function, or PDF, was constructed for the column density map. This is essentially a normalised histogram showing the number of pixels at each level of column density, and is shown below.



A quiet region dominated only by turbulence will show a lognormal PDF. A similar shape can be seen in the Mon R2 PDF (in green), but with two tails out to high column densities. Higher-density filamentary regions will often show the steeper (red) tail; this is likely due to the gravity dominating these structures (in Mon R2, this comes from the filaments surrounding the central region). The second (blue) tail is more difficult to explain; it could be due to gravitational effects, but also could be due to feedback from the central HII region, or something else entirely. This tail is only due to the highest densities found in the central region.
In order to resolve the true nature of the Mon R2 central region, more information is needed. Kinematic data, especially, could be used to show whether the central region is collapsing due to gravity (or other external forces), being pushed out due to the HII region, or moving in an other way entirely. Measurements farther out will also tell us whether the central region is being fed by the surrounding filaments, which could allow for the formation of more massive stars than would otherwise form there.