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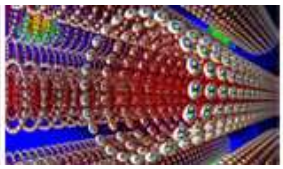

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Astronomers find that Universe shines twice as bright

The Andromeda Galaxy
© Robert Gendler

Astronomers from UK Universities working with colleagues from Germany and Australia have calculated that the Universe is actually twice as bright as previously thought. In the latest Astrophysical Journal Letters (10th May), the astronomers describe how dust is obscuring approximately half of the light that the Universe is currently generating.

Lead author Dr Simon Driver from the University of St Andrews said, “For nearly two decades we’ve argued about whether the light that we see from distant galaxies tells the whole story or not. It doesn’t; in fact only half the energy produced by stars actually reaches our telescopes directly, the rest is blocked by dust grains.”

While astronomers have known for some time that the Universe contains small grains of dust, they had not realised the extent to which this is restricting the amount of light that we can see. The dust absorbs starlight and re-emits it, making it glow. They knew that existing models were flawed, because the energy output from glowing dust appeared to be greater than the total energy produced by the stars!

Dr Driver said, “You can’t get more energy out than you put in so we knew something was very wrong. Even so, the scale of the dust problem has come as a shock - it appears that galaxies generate twice as much starlight as previously thought.”

The team combined an innovative new model of the dust distribution in galaxies developed by Dr Cristina Popescu of the University of Central Lancashire and Prof Richard Tuffs of the Max Plank Institute for Nuclear Physics, with data from the Millennium Galaxy Catalogue, a state-of-the-art high resolution catalogue of 10,000 galaxies assembled by Driver and his team using the Isaac Newton Telescope on La Palma among others.

Using the new model, the astronomers could calculate precisely the fraction of starlight blocked by the dust. The key test that the new model passed was whether the energy of the absorbed starlight equated to that detected from the glowing dust.

“The equation balanced perfectly”, said Dr Cristina Popescu, “and for the first time we have a total understanding of the energy output of the Universe over a monumental wavelength range.”

“The results demonstrate very clearly that interstellar dust grains have a devastating effect on our measurements of the energy output from even nearby galaxies” says Prof Richard Tuffs, “with the new calibrated model in hand we can now calculate precisely the fraction of starlight blocked by the dust.”

The Universe is currently generating energy, via nuclear fusion in the cores of stars, at a whopping rate of 5 quadrillion Watts per cubic light year – about 300 times the average energy consumption of the Earth’s population.

“For over 70 years an accurate description of how galaxies, the locations where matter is churned into energy, form and evolve has eluded us. Balancing the cosmic energy budget is an important step forward,” said Dr Driver.

> “You can’t get more energy out than you put in so we knew something was very wrong.”
>
> Dr Simon Driver
> University of St Andrews

After carefully measuring the brightness of thousands of disc-shaped galaxies with different orientations, the astronomers matched their observations to computer models of dusty galaxies. From this they were able to calibrate the models and, for the first time, determine how much light is obscured when a galaxy has a face-on orientation. This then allowed them to determine the absolute fraction of light that escapes in each direction from a galaxy.

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While modern instruments allow astronomers to see further into space, they can't eliminate the obscuring effect from these tiny dust grains. "It is somewhat poetic that in order to discover the full glory of our Universe we first had to appreciate the very small" said Dr Alister Graham from the Swinburne University of Technology.

The work is set to continue but with a change of focus from the study of the Universe as a whole, to the study of individual galaxies. This requires two new facilities which are coming online this year. The first is the VISTA telescope, which will soon commence operations in Chile and the second is the Herschel satellite due for launch later in the year.

“VISTA will enable us to see right through the dust while Herschel will directly detect the dust glow” says Dr Liske of the European Southern Observatory.

UK astronomers enjoy full access to both of these facilities through the UK’s membership, paid by the Science and Technology Facilities Council (STFC), of the European Southern Observatory and the European Space Agency which are responsible for operating these facilities.

“Although the Universe appears to be squandering its resources twice as fast as we previously thought, there’s still plenty of juice in the tank; for now” says Dr Ivan Baldry of Liverpool John Moores University.

This research has been funded by the STFC, the Australian Research Council, the Max-Planck Society and a Livesey award from the University of Central Lancashire.

Note to Editors

The Millennium Galaxy Catalogue consists of data from the Anglo-Australian Telescope, The Australian National University's 2.3 m telescope at Siding Spring Observatory, the Isaac Newton Telescope and the Telescopio Nazionale Galileo at the Spanish Observatorio del Roque de Los Muchachos, La Palma, of the Instituto de Astrofisica de Canarias, and also from the Gemini and ESO New Technology Telescopes in Chile.

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- Richard Tuffs - Max-Planck Institute fur Nuclear Physics, Germany
- Alister Graham - Swinburne University of Technology, Australia
- Jochen Liske - European Southern Observatory, Germany
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Images

High resolution images showing galaxies known to contain dust obscuring the stars are available from the Swinburne University website.

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