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Infrared signature of an enormous intergalactic shock wave revealed by the Spitzer Space Telescope

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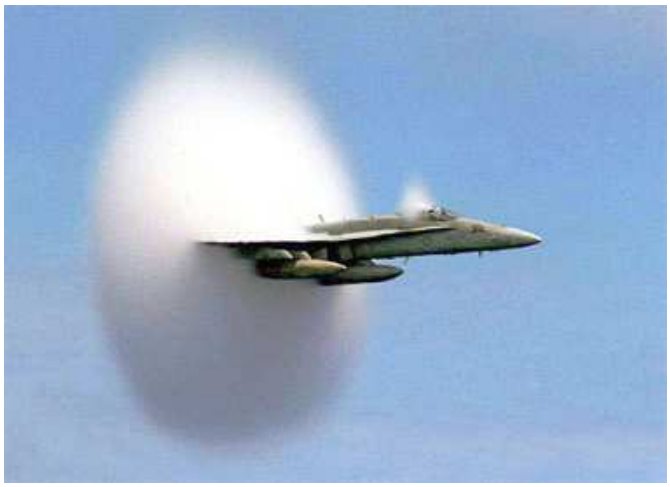
Recent infrared observations made with NASA's Spitzer Space Telescope have revealed the presence of a huge intergalactic shock wave, or "sonic boom" in the middle of Stephan's Quintet, a group of galaxies which is now the scene of a gigantic cosmic cataclysm. This discovery, made by an international research team including scientists from the Max Planck Institute for Nuclear Physics (MPIK) in Heidelberg, provides a local view of what might have been going on in the early universe, when vast mergers and collisions between galaxies were commonplace.

Image: The central region of Stephan's Quintet, showing the complex web of galaxy-galaxy and galaxy-intergalactic medium interactions. The intergalactic shock wave, triggered by the 1000 km/s infall velocity of the intruder galaxy NGC7319b, is delineated by the ridge of Hydrogen emission (shown in green) which runs vertically through this image. NGC7319b is the compact blob, seen both in optical light (coded blue) and in infrared continuum (coded red) immediately to the right of this ridge.



When astronomers using NASA's Spitzer Space Telescope turned their attention to a well-known group of galaxies called Stephan's Quintet, they were, quite simply, shocked at what they saw. There, sweeping through the group, lurks one of the biggest shock waves ever seen.

Image: A commonly encountered shock wave is the sonic shock produced by supersonic aircraft, such as this US navy jet on a fast low flyby over the sea. As a supersonic jet exceeds the speed of sound (or Mach 1), it catches up with its own sound waves. The sound waves become compressed together into a cone-shaped "shock" which travels outwards towards the ground, producing the familiar "sonic boom". The sonic shock is invisible to us, but its presence can sometimes be revealed in humid conditions by the condensation of water vapour into droplets in the flow downstream of the shock, forming a conical cloud behind the tail of the jet.

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For decades, astronomers using optical telescopes have known that the galaxies in this group, located about 300 million light years away, have a very distorted distribution of visible light from stars, indicating that the galaxies have experienced encounters in the past, and are now engaged in further collisions. But this, as it turns out, is only part of the drama. Recently, astronomers have become able to measure what, apart from the stars, is present in Stephan's Quintet. By looking in the radio and X-rays they discovered huge quantities of gas - about 100,000 million solar masses, mainly composed of hydrogen and helium - in the space between the galaxies, more than all the gas inside the galaxies themselves.

Now, a team of scientists from Caltech, USA and from the Astrophysics Department of the Max Planck Institute for Nuclear Physics (MPIK) in Heidelberg, Germany, together with other collaborators from the USA and Australia, have turned the Spitzer Space Telescope, equipped with a super-sensitive infrared spectrograph,