Günther Hasinger

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There was beer and wine at the party, and pretzels, of course. And, appropriately for the occasion, lots of Leibniz-brand butter cookies – a fitting celebration for **GÜNTHER HASINGER** *and the 1.55 million euro Leibniz Prize 2005. The Director at the* **MAX PLANCK INSTITUTE FOR EXTRATERRESTRIAL PHYSICS** *in Garching was the first astronomer in 15 years to be awarded the prestigious honor. But the path that led Hasinger to the stars has not been without its detours.*

PHOTOS: FELIX BRANDL/MAX PLANCK INSTITUTE FOR EXTRATERRESTRIAL PHYSICS

The band is called *Saffran*. The songs have names like "Heavy Maggie," "For You" and "Floating." And the critics rave: *Saffran* is a master of harmony and sets just the right rhythmic accents. The instrumentals are unusually convincing, and the vocals superb. *Saffran* is reminiscent of *Gentle Giant*. Nice saxophone, but not jazzy. A flute, too, but not folksy. And playing the latter is none other than Günther Hasinger.

Twenty-year-old Günther Hasinger sports glasses and straight, brown, shoulder-length hair; aside from the flute, he also plays a mean bass. In the mid-1970s, *Saffran* was considered one of the great hopes of the German music scene. The Munich-based group recorded one album before the label deal fell through – the session never made it onto vinyl. A photo of the band was featured on the cover of the teen magazine BRAVO: Günther Hasinger and his four band members sitting on stone steps. He is wearing jeans and a red and white sweater, looking somewhat shyly into the camera.

Not long afterwards, *Saffran* broke up. Günther Hasinger, born April 28, 1954 in Oberammergau, almost became a rock star. Today, he is one of the stars of the astronomy scene. He has been a visiting astronomer at Caltech, spring lecturer at Princeton and, since March, winner of the Leibniz Prize.

We sit in his second-floor office, and noise from nearby construction fills the room. The Garching campus has been in a state of change since the Technical University Munich began moving some of its departments here, including mathematics, computer science, mechanical engineering, chemistry and physics. Together with the four Max Planck Institutes, the neutron reactor FRM II and the European Southern Observatory, the area under construction will become what politicians have dubbed an "Excellence Cluster" – certainly fertile ground for a scientist, especially an astronomer. Hasinger's office is located at the Max Planck Institute for Extraterrestrial Physics, where he has been Director since 2001. Back to the roots, as it were, since this is where his journey began. "My path to the stars ran in a zigzag," says Hasinger, smiling impishly (which he does often and gladly), and begins his story.

TINKERING WITH THE MIXING BOARD

The career of most astronomers looks something like this: at the age of seven, the fascination with the first book about planets; age twelve, membership at the local astronomy club; age fifteen, construction of a telescope; then studies in astrophysics, a Ph.D. and postdoctoral qualification. Günther Hasinger's career followed a somewhat different course. He actually wanted to study medicine, perhaps because his mother was a doctor. He turned down a slot to study biochemistry at the University of Clausthal-Zellerfeld. During this time, he was playing with the band, which needed more than just musicians – it needed someone to run the sound equipment. Someone like Hasinger: "If there was some soldering to be done, I was the man," he says.

And there was a lot of soldering to be done. Over time, the rocker became an expert on the inner workings of the speakers and amps – which had very little to do with cell organelles and glycolysis. Soon, the desire to become a sound engineer arose. This required, among other things, a degree in physics. So, in October 1975, Günther Hasinger enrolled to study physics at Ludwig Maximilian University in Munich.

During his first semester, he learned the binary language Algol and programmed games like Mastermind and Lunar Lander. At some point, the punch card age came to an end, and a keyboard and monitor replaced the teletypewriter. Now it was possible to communicate directly with the computer. The young man was fascinated by the new possibilities.

The reason Hasinger is neither a sound engineer nor a computer scientist today has to do with Rudolf Kippenhahn, then Director at the Max Planck Institute for Astrophysics – and with a celestial phenomenon. But then, at the time, students considered Kippenhahn's lectures to be a "phenomenon," too. "They were an event to which students regularly brought their dates," Hasinger recalls, smiling a bit more playfully than usual. At any rate, his interest in astronomy was triggered.

So began the journey to the stars. Hasinger had already chosen astrophysics and optics as his minor concentrations, and was scheduled to complete a 14-day internship at the Bogenhausen observatory. His job there was to record the orbital period of a binary star system – two suns orbiting each other. As he watched, a point of light flared in the constellation Cygnus. With such a nova, material flows from one star to another, causing the surface to heat up until hydrogen fusion begins, and massive amounts of energy are released in a sudden burst. The relatively close and very bright *Nova Cygni 1978* gave the astronomer a unique opportunity to observe the process in detail.

Since Hasinger was then the only person at the Bogenhausen observatory who knew how to use the spectrograph, his fate was sealed. For


PHOTO: PRIVATE

Let it rock: Günther Hasinger in the 1970s, playing with the band *Saffran*.

weeks, the intern had to focus the starlight at the spectroscope whenever the weather permitted. On September 21, 1978, a date which Hasinger will not soon forget, it was over: "Oktoberfest began and, all at once, the sky over Munich became so bright that there was no way for the observations to continue."

The long nights spent with the nova left a deep impression on the young student. That semester, he attended a lecture on X-ray astronomy by Joachim Trümper, Director at the Max Planck Institute for Extraterrestrial Physics. This put Hasinger's zigzagging to end for good: he never again strayed from astrophysics – more specifically, X-ray astronomy. His research since then has focused on subjects like "The X-ray Background and Cosmology" and "X-ray Instrumentation and the Telescope," confirming that Hasinger is a tinkerer and a contemplator – something of a practical theoretician among astronomers. "For me, the ultimate is designing an instrument, building it and using it to obtain results," he says. That is the philosophy that underlies his science. Recently, he even discovered some black holes as he scanned the heavens. How?

A diffuse light filled the entire sky: the so-called cosmic X-ray background. Neither the naked eye nor optical telescopes can see it, because the Earth's atmosphere blocks these waves of energy. Satellites equipped with an X-ray eye, however, can.

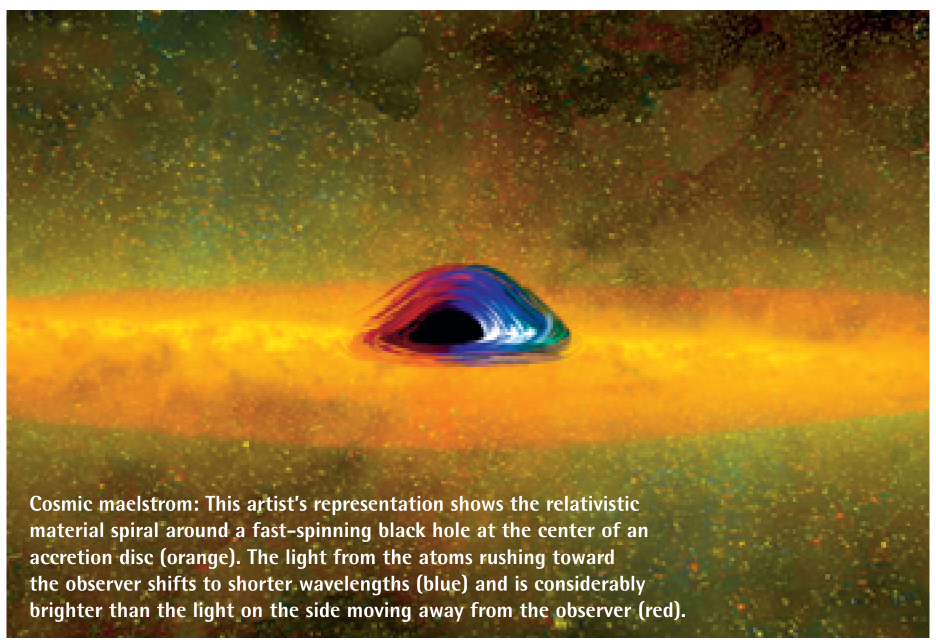
In the mid-1990s, Günther Hasinger, along with Maarten Schmidt, Joachim Trümper and later Nobelist Riccardo Giacconi demonstrated that this glowing background is actually fed by numerous discrete sources – similar to the way Galileo used his telescope in the 17th century to discern that the Milky Way is composed of myriad individual stars. With the help of X-ray satellites, the scientists were able to look through the Lockman Hole in the constellation Ursa Major. Since, in this direction, there is very little in the way of absorbent materials such as dust and hydrogen clouds, the window of observation opens into the deep recesses of space, to far-off extragalactic objects.

Behind the individual lights of the X-ray background are hundreds of millions of black holes. Thanks to their irresistible pull, these gravity traps ensnare interstellar material, or even entire stars. In today's universe, almost all galaxies have massive black holes at their core – there is even one at the center of the Milky Way (MAXPLANCKRESEARCH 1/2003, p. 56 ff).

When material falls into the chasm of a black hole, it races around the cosmic maelstrom at nearly the speed of light, heating up so much that, before disappearing, it releases highly energized radiation as a sort of last call for help. If they are well fed at the center of active galaxies, the black holes, which themselves are invisible, are among the most brilliant objects in space.

The chemical elements in the clouds surrounding black holes radiate X-rays with characteristic wavelengths, providing a fingerprint by means of which they can be identified. Iron atoms are especially well suited for astronomical detective work, since this metal is the most prevalent in the cosmos, and it emits large amounts of radiation when heated, leaving a distinctive mark (line) in the spectrum.

Much like the police snag speeders using radar traps, astronomers establish the high speeds at which iron atoms revolve around a black hole by way of shifts in the wavelengths of the light. Due to the great mass of black holes, this relativistic Doppler effect is coupled with the gravitational red shift – and both phenomena are in line with the theory of relativity. The special theory of relativity postulates that clocks run more slowly the faster they move through space. According to the general theory of relativity, the same slowdown also happens to clocks in the proximity of large masses. Applied to electromagnetic radiation, this means that the wavelength of the light emitted by iron atoms is altered at the longer, red end of the spectrum. This results in a wider, asymmetrical line – a sort of smeared fingerprint.



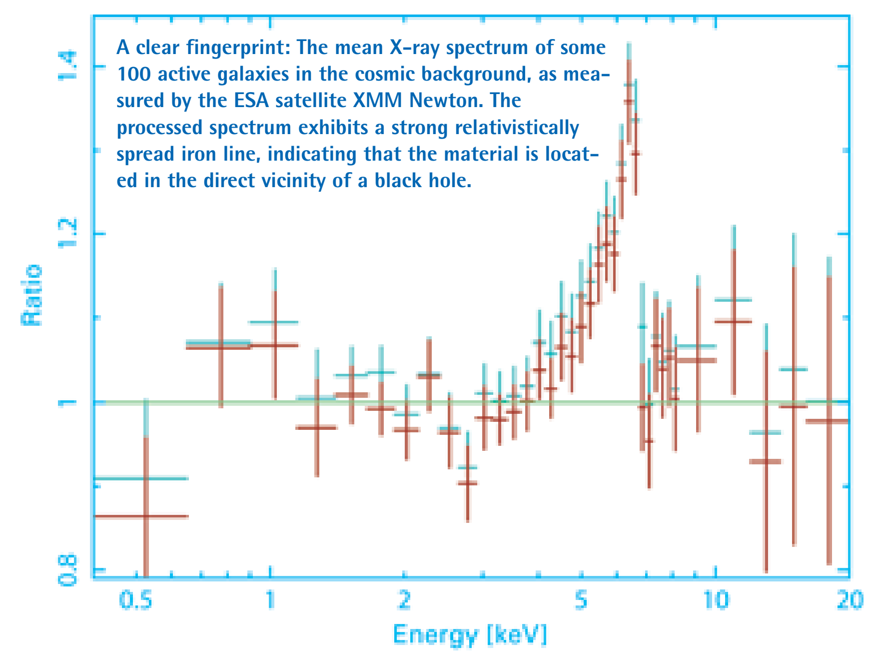
Cosmic maelstrom: This artist's representation shows the relativistic material spiral around a fast-spinning black hole at the center of an accretion disc (orange). The light from the atoms rushing toward the observer shifts to shorter wavelengths (blue) and is considerably brighter than the light on the side moving away from the observer (red).

FINDING HIS SCIENTIFIC PLAYGROUND

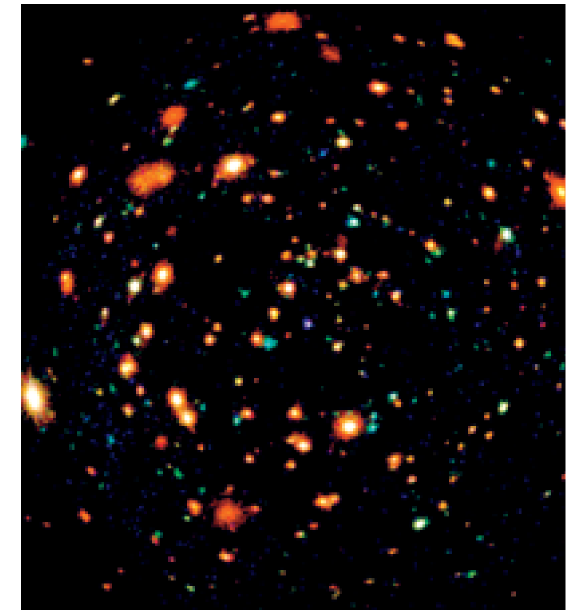
Günther Hasinger and his team discovered such an abnormal spectral fingerprint in the X-ray background. From the strength of the signals, the astronomers ascertained, for example, the number of iron atoms within the material. "We were surprised that the abundance of iron in the diet of these young black holes is approximately three times that of our own solar system, which was created much later," says Hasinger. The centers of galaxies in the early universe apparently had an extremely efficient means of producing iron – possibly because active galaxies contain many massive stars that spawn chemical elements, including iron, relatively quickly.

The broadness of the line indicates that the iron atoms come very close to the black hole, and thus that the majority of black holes in space are probably spinning very rapidly. As a result, the surrounding space is being stirred, too, like mixing a batter. As Hasinger explains, "That is why material flying around a black hole in the same direction can come very close to these monsters of mass without falling in. And it is here that the higher speeds and greater gravitational red shift can be measured."

These discoveries are being made with the help of the European X-ray satellite *XMM-Newton*. This is where the story comes full circle – for it is also thanks to Günther Hasinger that the orbiting observatory can see so precisely through the vastness of space. Unlike light waves, X-rays are not easily bundled. Only specially formed, extremely polished, low-dispersion mirrors can be used. This is the field that Hasinger chose for his thesis, in which he examines the technological problems faced in the polishing of X-ray surfaces ("Hasinger's Triangle") and contributes to the later appearance of the mirror from the *ROSAT* satellite in the GUINNESS BOOK OF WORLD RECORDS as the smoothest surface in the world. Scaled to the size of Germany's Lake Constance, the highest "mountain" on the mirror would be a ripple on the surface of the lake caused by a small pebble being thrown in.



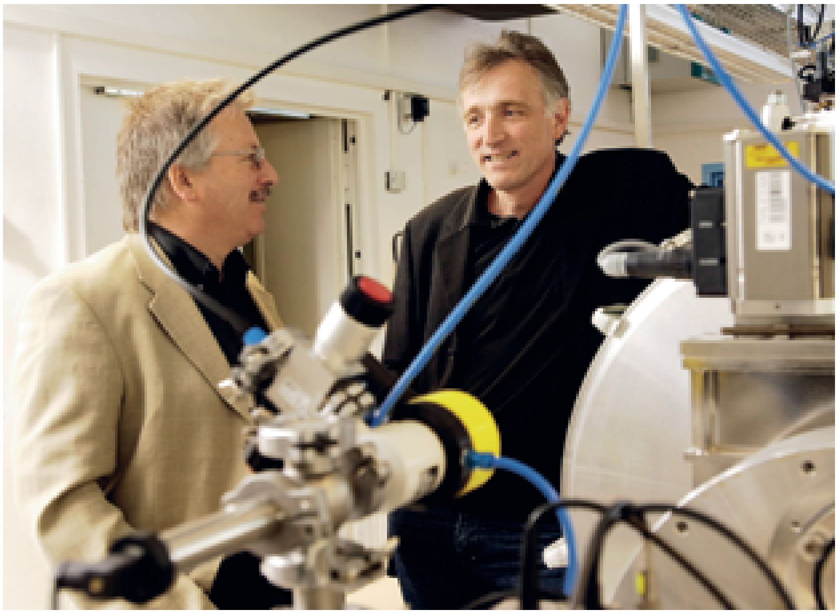
A clear fingerprint: The mean X-ray spectrum of some 100 active galaxies in the cosmic background, as measured by the ESA satellite XMM Newton. The processed spectrum exhibits a strong relativistically spread iron line, indicating that the material is located in the direct vicinity of a black hole.



A keyhole in space: Astronomers can see far-off X-ray sources through the Lockman Hole in the constellation Ursa Major.

After completing his thesis, Günther Hasinger set his sights high – at least 40 kilometers high, which is the altitude achieved by the *HEXE* X-ray detector in the basket of a balloon. In the context of his post-graduate work at the Max Planck Institute for Extraterrestrial Physics, he constructed a CCD camera for this experiment. For the chip, he disassembled one of the first video cameras on the market at the time, and he built the controls from scratch. In addition, the doctoral candidate set his sights on the Crab Nebula – with lasting consequences.

The history of the nebula began in 1054, when Chinese astronomers suddenly observed "a new star" in the constellation Taurus, which for weeks was visible even during the day. What had happened? Out in space, a massive sun had ended its



A confab of two practitioners: Günther Hasinger discusses the latest in X-ray astronomy with colleague Peter Predehl.

life with a powerful explosion. Nearly a thousand years later, astronomers discovered a pulsar at the site of the cosmic calamity: an extremely concentrated neutron star some 20 kilometers in diameter. Since the star retained its angular momentum, the star corpse rotated rapidly on its axis, sending a cone of radiation out into space from its poles. Like the rays from a lighthouse that periodically pass over the Earth, the object flashes 30 times each second.

In reality, it is all much more complicated: astronomers register two main and one intermediate impulse each time. In his doctoral dissertation, Günther Hasinger explains that this is the result of intense magnetic fields, which transform some of the neutron star's signals into synchronous pulses (main pulses) and force others onto deformed paths (intermediate pulse). This construction is known as the "Trumpet Model," after its shape. It seems that Hasinger just can't get away from music.

Supernovae, neutron stars, black holes: material that is subjected to pressure, mass that warps the space time continuum, temperatures that reach into the hundreds of millions of degrees and objects that move at nearly the speed of light – these are the things that make radio astronomers feel alive. And it was in these things that Hasinger found his scientific playground in the mid-1980s. Joachim Trümper brought him into the *ROSAT* project, where he worked at the interface between hardware and software, developed algorithms for the processing of data and, ultimately, led the *Deep Survey* team, which explored the depths of the cosmos using the instruments built by the Max Planck Institute for Extraterrestrial Physics. By then Hasinger had become an established pioneer on the *ROSAT* project. "We used Trampelpfad software to process all the registered data."

Fighting To Save Space Research

It was during this period that the scientist's two "faces" began to really stand out: The practitioner redesigned the positioning software for *ROSAT*, performing "open heart surgery" on the satellite that, from then on, was stabilized in orbit with a magnetic compass system. The theoretician published a highly respected explanatory model on the spectral behavior of certain classes of X-ray binary stars. The "Z" shape of the radiation curve in the diagram quickly led Hasinger's colleagues to give him a new nickname: "Zorro."

At the end of the 1980s, Hasinger's interests focused on extragalactic astrophysics and cosmology. In 1994, he was appointed to a post as Director at the Astrophysical Institute Potsdam, where he went on to become Chairman of the Management Board four years later. In Potsdam, he made a successful push for construction of the Large Binocular Telescope (MaxPlanckResearch 4/2004, p. 63 ff.).

Today, he is fighting for the future of his field as a Max Planck Director and Chairman of the Council of German Observatories (Rat Deutscher Sternwarten). His smile quickly fades when this topic comes up. He recently initiated a campaign to "Save Basic Research in the National Space Program" in reaction to the threat of waning scientific competitiveness in Germany stemming from ongoing reductions in funding.

"We currently have our backs to the wall," says Hasinger. Funding has decreased by two-thirds over the past few years, and is quickly heading toward zero. "German scientists must once again be able to take part in European Space Agency (ESA) projects," he says, calling for a recommencement of the national mini-satellite program. In this context, he is fighting for the *ROSITA* and *XEUS* projects. More than 50 researchers have signed his appeal to the politicians.

Despite such difficulties, when asked about his hobbies, Günther Hasinger spontaneously replies "astrophysics." And music. This recurring theme once again confronted the father of two sons – one studying biotechnology, the other physics – in the fall of 2004: the album Blue in Ashes, recorded 30 years previously, was released on CD. All of the former members of *Saffran* met for a revival party. Rumor has it that they had a heavenly time. Helmut Hornung