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### CSI: X-Ray Fingerprints

## Micro-X-Ray Fluorescence Also Provides Spectroscopic Information

December 1, 2006 — Ordinary invasive fingerprinting techniques, such as dusting, are prone to damaging evidence. Micro-X-ray fluorescence images fingerprints without touching them. By stimulating atoms to emit signature wavelengths of light, MXRF also provides chemical information -- such as traces of soil or saliva left in the fingerprints -- in addition to the print pattern itself.

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LOS ALAMOS, N.M. -- Popular television crime shows solve cases in an hour. But in real life, cracking a case isn't a quick, easy game -- especially when it comes to finding fingerprints.

...And it was no game when thieves robbed Tatiana Bonilla's home, stealing pricey jewelry. "The police didn't find anything ... It was never solved, and it's been a year," she says.

Police dusted for fingerprints in Bonilla's home, but some fingerprinting techniques can alter a print, erasing valuable clues. Now, chemists have a new, non-invasive way to detect prints --

using X-rays to find chemicals within print patterns.

"You can also get chemical information in addition to the print pattern itself, so you can tell, for instance, that there's some unusual element that's located in that fingerprint," Chris Worley, an analytical chemist at Los Alamos National Laboratory, tells DBIS.

The process, called micro X-ray fluorescence (MXRF), zaps a print with a tiny X-ray beam that mixes with atoms left behind from sweat or evidence. Next, the atoms give off



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information, revealing what chemicals are present. Chemicals, like potassium, then form an image of a fingerprint.

"This is a new way of visualizing fingerprints in cases where perhaps we couldn't detect a fingerprint with the traditional methods," Worley says.

Scientists say the MXRF technique could be used to better track down missing children. Children's fingerprints are more difficult to detect -- the new method could better detect prints based on chemicals left behind in a child's fingerprints due to food, soil or saliva.

**BACKGROUND:** Scientists at Los Alamos National Laboratory have developed a new fingerprint visualization technique using X-rays that leaves prints intact and reveals chemical markers that could give investigators new clues for tracking criminals and missing persons. Traditional fingerprinting methods involve treating samples with powders, liquids, or vapors to add color to the print, so it can easily be photographed. This process is known as contrast enhancement. However, dusting for fingerprints can sometimes alter the prints, erasing valuable forensic clues. Children's fingerprints are especially difficult to detect.

**HOW MXRF WORKS:** The new technique uses a process called micro-X-ray fluorescence (MXRF), which rapidly reveals the elemental composition of a sample by shining a thin beam of X-rays onto it without disturbing the sample. All chemical elements emit and absorb radiation at a "signature" frequency of light. For instance, sodium emits primarily orange light, while oxygen (used in neon lights) emits green light. Scientists can pass collected light through an instrument called a spectrograph to spread it into a spectrum, much like visible light spreads into a rainbow of colors by a prism. By carefully studying how the spectrum becomes brighter or darker at each wavelength, scientists can tell what chemical elements are present in a given sample.

**WHAT THEY FOUND:** The researchers used MXRF to detect the sodium, potassium and chlorine from salts excreted in human sweat -- which is sometimes present in detectable quantities in fingerprints. Since those salts are deposited along the ridge patterns in a fingerprint, it is possible to use the elemental analysis to produce a visual image of that fingerprint for analysis. It is especially useful for tracking down lost or missing children: the new method can detect prints based on chemical markers left behind in the child's fingerprints due to the presence of food, soil or saliva, and this information can be used to track down evidence of the child's movements.

**ABOUT X-RAYS:** Like visible light, X-rays are wavelike forms of electromagnetic energy (light) carried by tiny particles called photons. The only difference is the higher energy level of the individual photons, and the corresponding shorter wavelength of the rays, which make them undetectable by the human eye. X-ray photons have

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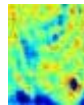


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energies that range from hundreds to thousands of eV, much higher than those of visible photons. X-ray makes it possible to see the outline of bones and organs, while a CT scan makes it possible to form a full three-dimensional computer model of a patient's body. Doctors can even examine a narrow slice at a time. The X-ray beam moves all around the patient, scanning from hundreds of different angles, and the computer takes all that information to compile a 3D image of the body.

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