Development of a 3D X-ray Backscatter Imaging Technique for NDE

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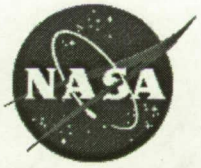
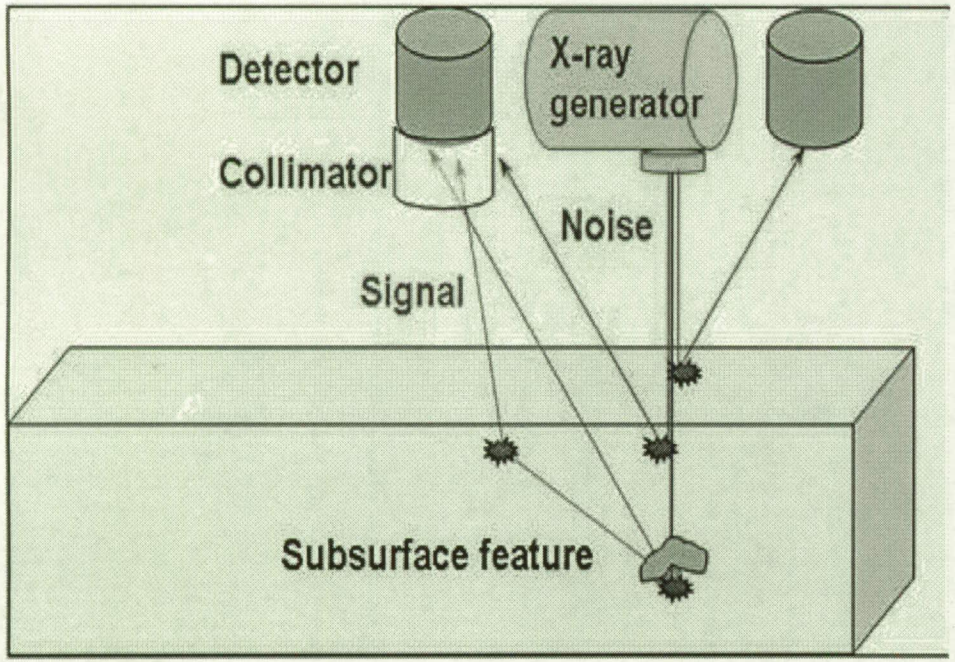
Objective

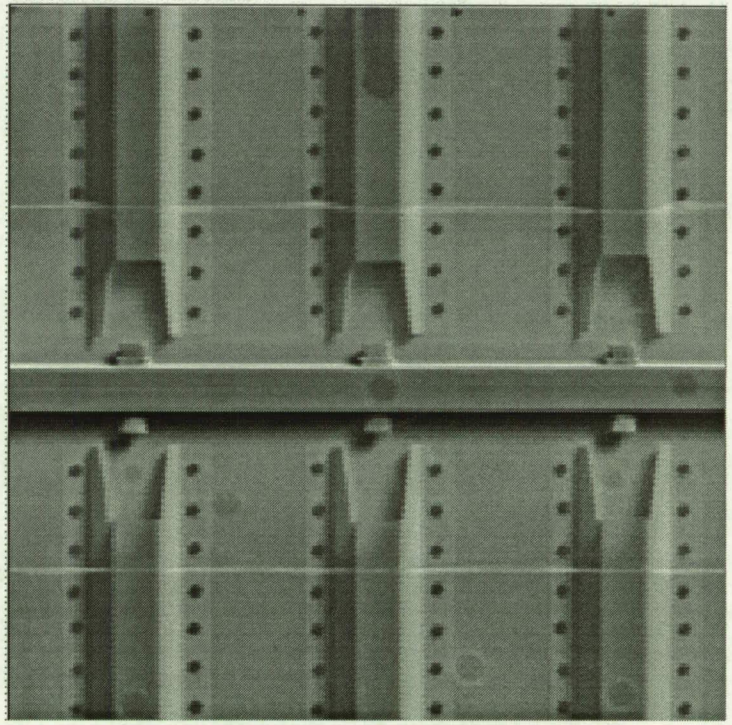


- Develop and demonstrate 3D X-ray backscatter NDE techniques to allow the depth and size estimation of defects in aerospace structures.

Proposed project is a collaboration with USA NDE group (Dr. Bence Bartha, Martin Born) and ASRC (Jeff Carlson) with Ellen Arens and Stan Starr from Applied Physics Lab.

X-Ray Backscatter





Conceptual diagram of Lateral Migration Radiography system developed by Dr. Ed Dugan of UF. This technology has been successfully adopted by UF/LM/MSFC for use in inspecting ET TPS.

Orion Heat Shield

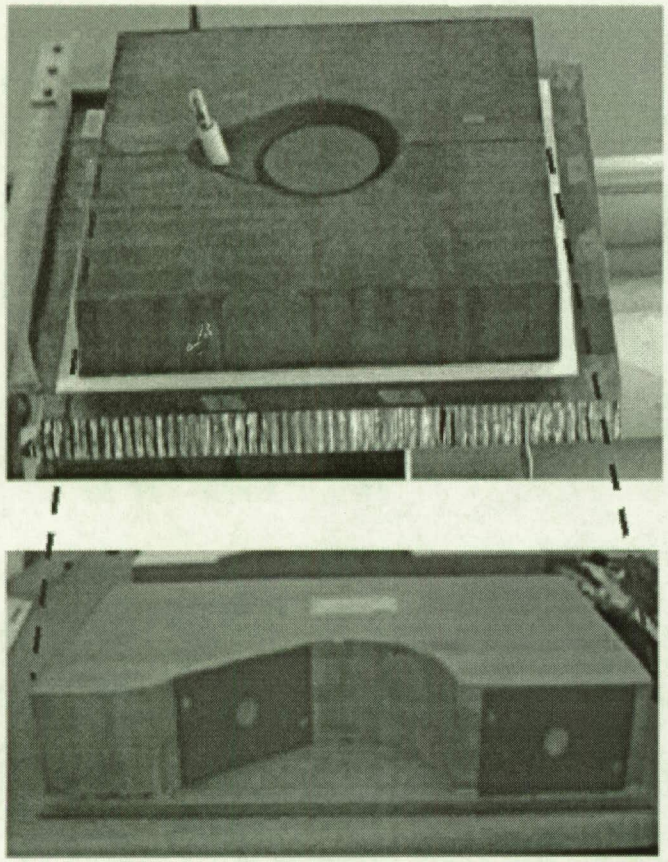
KSC has a prototype LM heat shield with PICA tiles adhered to base-plate with RTV for evaluation of handling and NDE techniques (along with other NDE samples). One sided X-ray techniques would be very useful for such structures.

USA
United Space Alliance

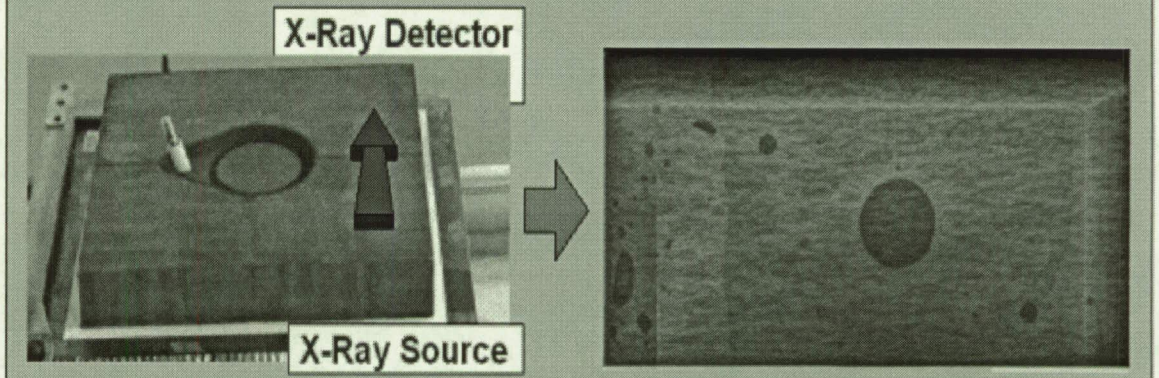
Orion Heat Shield TPS

NASA

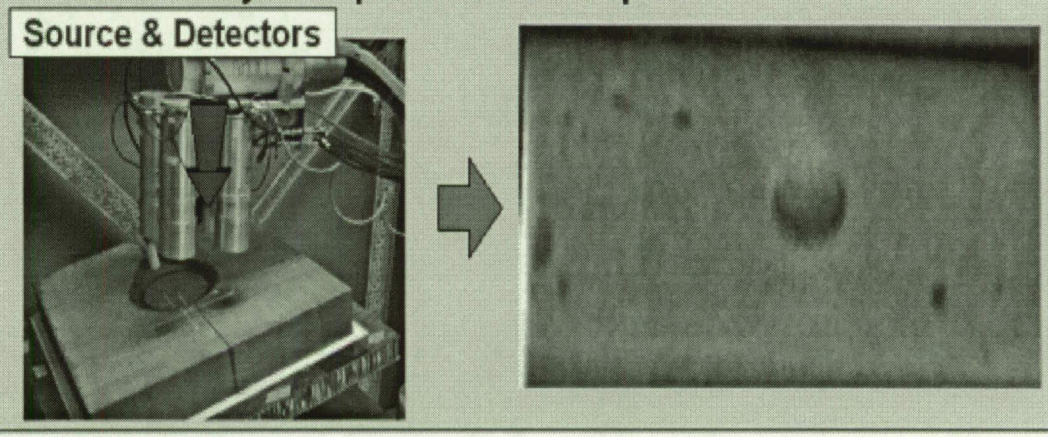
Orion TPS sample with RTV voids built into PICA block bond line:



Traditionally, through-transmission X-Ray, with access to two sides of the specimen, is necessary to image the RTV voids:



Backscatter X-Ray can produce comparable data by scanning only the top surface of the specimen:



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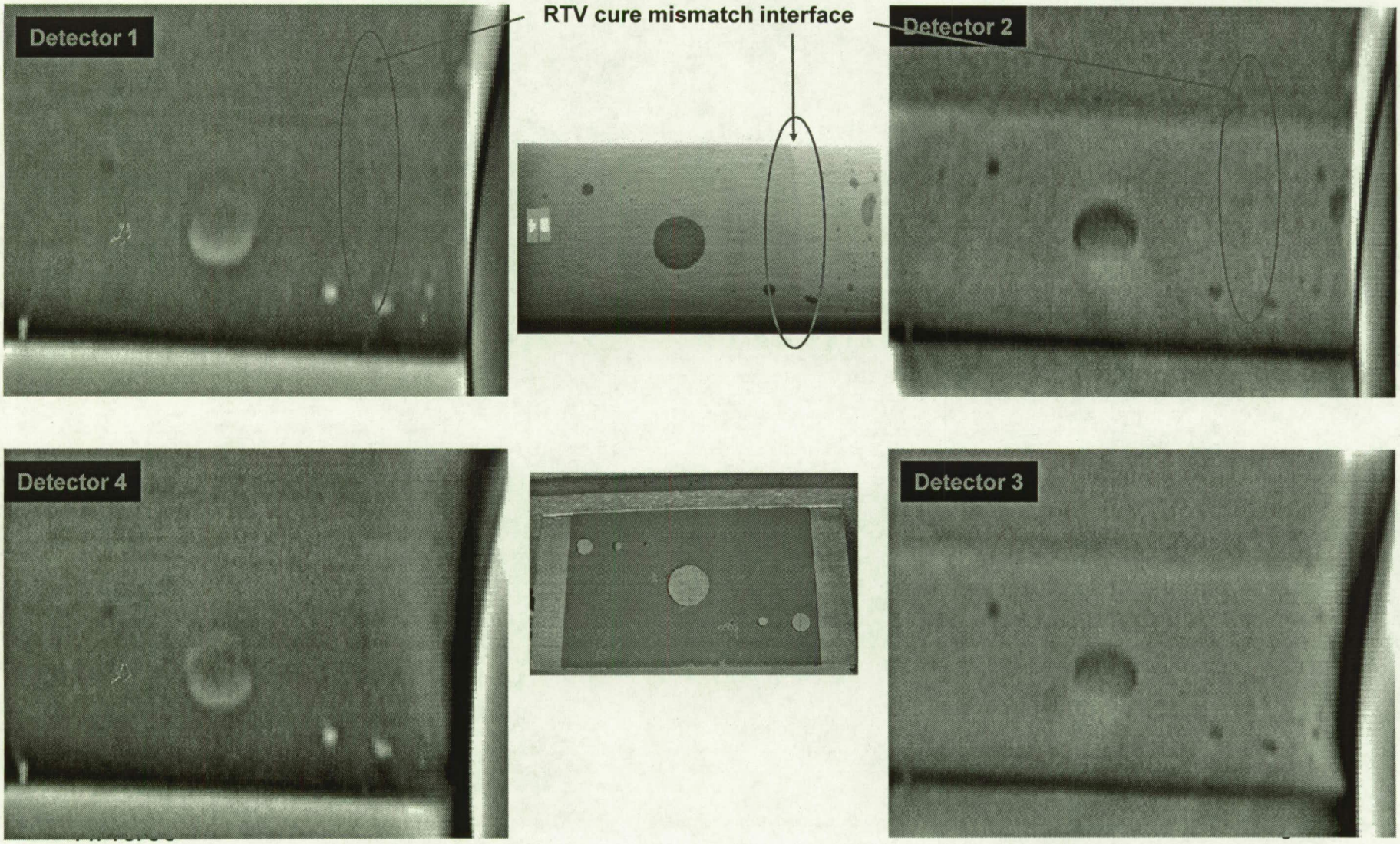
PICA Scan 22 degree tilt



X-ray Attenuation Effects

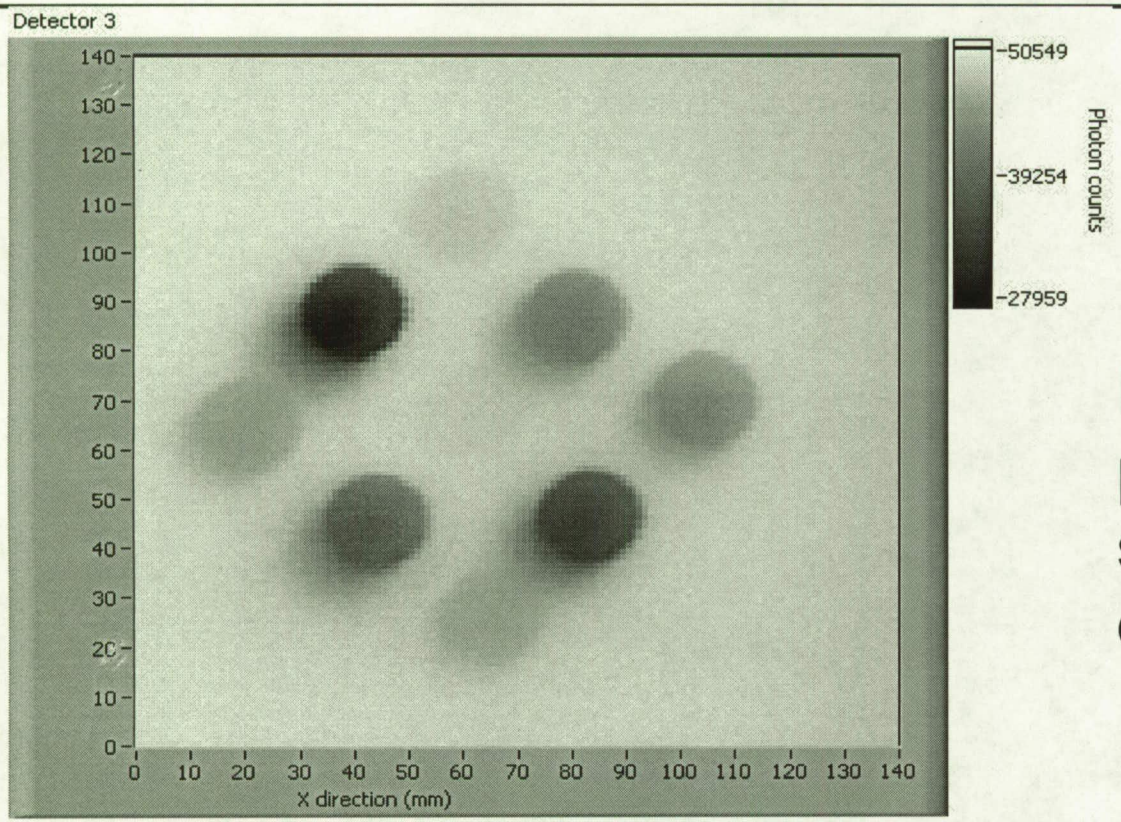


Image of Copper pennies between successive sheets of Aluminum.

- Backscatter also provides depth versus attenuation information that must be modeled differently than transmission X-ray since some types of X-ray interactions scatter (producing signal) versus absorption which does not.

Proposed Approach

- Year 1: Develop demonstrations on Orion TPS and test structures using existing hardware system by tilting sample and performing simple image processing.
- Year 2: Build tilting stage for existing X-ray hardware and automated software.

This technique can be used with any material amenable to X-ray backscatter including inspection of the interior systems of the Orion crew module through the exterior skin.