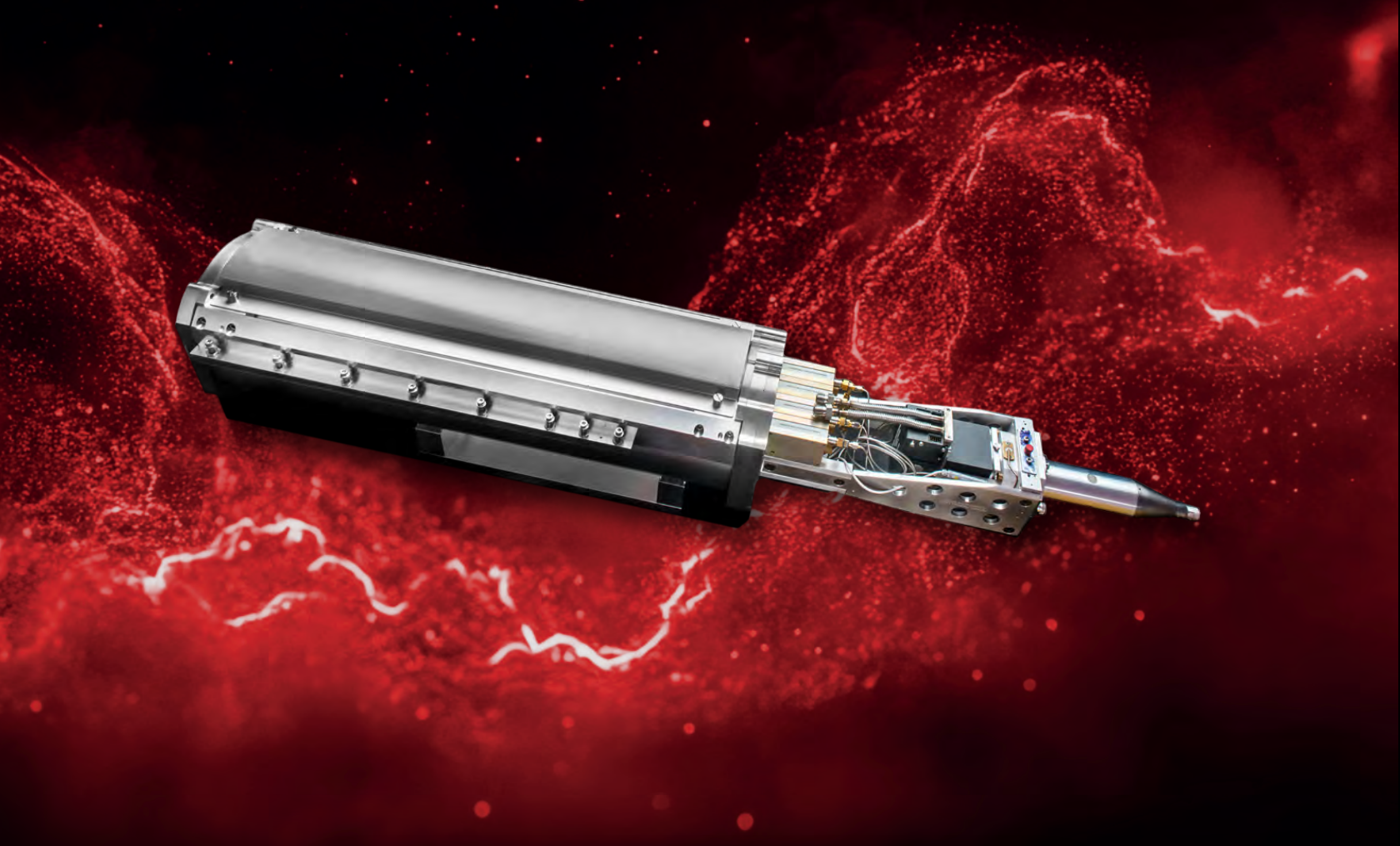
SYDOR TECHNOLOGIES



X-RAY FRAMING CAMERA

COMPLEX MEASUREMENTS—CRITICAL RESULTS

FEATURES

- Easy to control number of frames, frame rates, and frame size
- Digital readout with Sydor Vacuum CCD eliminates the need for film packs
- Electronics housed in their own airbox
- Remote operation and monitoring allows for use in harsh environments

APPLICATIONS

- X-Ray Radiography
- Inertial Confinement Fusion

ABOUT THE X-RAY FRAMING CAMERA (XRFC)

The Sydor X-ray Framing Camera (XRFC) comes paired with Sydor's Vacuum CCD for a completely integrated solution useful for acquiring sequential image frames for x-rays spanning 0.2-15 keV.

The XRFC is designed for use in vacuum to provide 2D spatially time-resolved frames or 1D spectrally resolved images of target features. This framing camera can be configured with fast or slow detection heads for frames ranging from 40 ps to 1000 ps. The system uses a strip-line activated micro-channel plate and phosphor screen. Captured images are recorded using Sydor's Vacuum CCD—a compact 16 MP sensor with 9 micron pixels.

The XRFC System is provided with high-performance electronics that include trigger units, delay units, pulse forming modules (PFMs), bias supplies, the phosphor pulser, the pulse monitor, and the main control unit. The complete system is enclosed within an air bubble mounting structure that is hermetically sealed, protects the system's electronics, supports the head, and provides system mounting provisions.

PRODUCT SPECIFICATIONS

Detector

- Micro-Channel Plate: 1, 2, or 4 strip
- Active Area: 30 x 30 mm
- Sensor: 4,096 x 4,096 pixels
- Spectral Sensitivity: 200 nm to 10 keV

Electronics

- Fast Design Frame Speed: < 100 ps
- Slow Design Frame Speed: 200 ps-1 ns
- Trigger Input: Optical or electrical
- Power: 28 VDC at <1.2 A

Mechanical

- Weight: 48 lbs
- Dimensions (without rails or lifting yoke): 38.5" (L) x 7.125" (W) x 8.5" (H)
- Lifting: Removeable lifting handles and rigging yoke

Readout

- Sydor Vacuum X-Ray CCD: Compatible vacuum-compatible digital detector
- Thermoelectric Cooler: 0°C in vacuum
- Communication: Fiber communication through vacuum
- Controller: 19" rack mount with Ethernet communication, others available
- Controls: Readout rate, arming/triggering, binning, and CCD temperature

FIG. 2

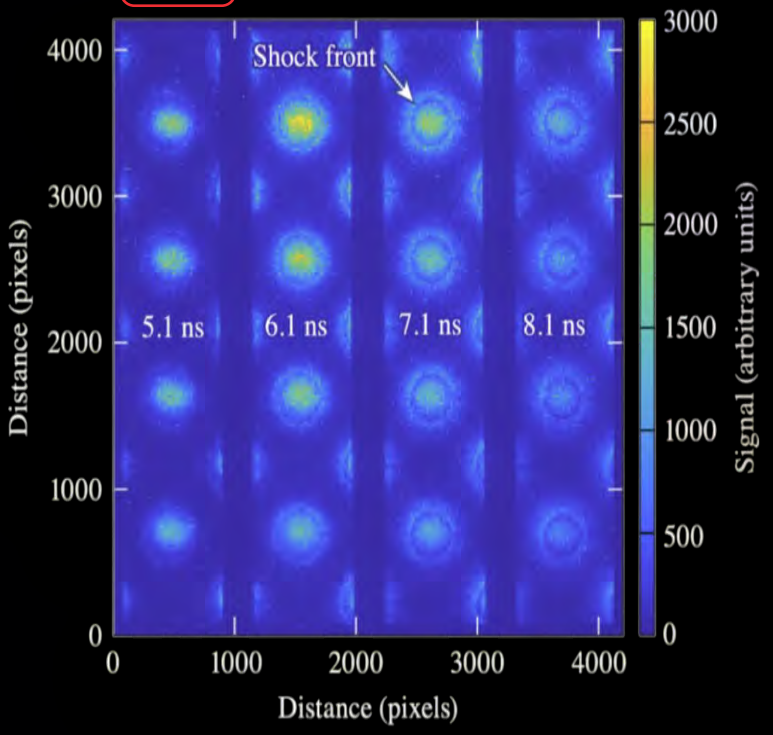


FIG. 4

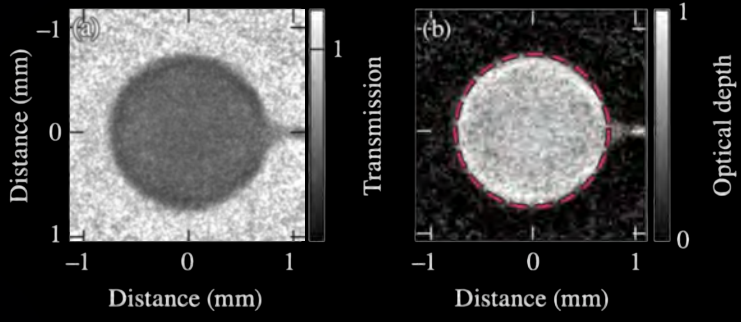
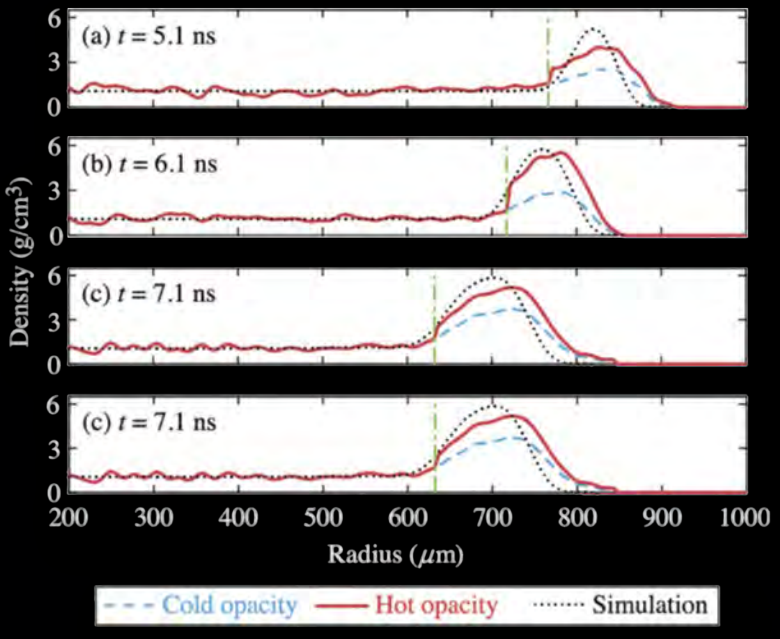


FIG. 5



Excerpt from L. Ceurvorst, et al. (2022):

This publication highlights the applications of x-ray framing cameras for inertial confinement fusion experiments. The images on the right show backlit spherical capsules compressed by the NIF laser. The x-ray framing camera can gate the collection of signal to obtain multiple time resolved profiles of x-ray transmission; Fig. 2 shows snapshots of x-ray intensity over roughly 400 picoseconds at four different times in the implosion. In Figure 4, we observe the cleaned intensity of x-ray transmission (a), then the transmission is converted into optical depth on the right (b). These images also have enough resolution to distinguish the stalk holding the capsule, which is the horizontal feature on the right of both images.

In Fig. 5, the optical depth from Figs. 2 and 4 has been radially averaged and analyzed using the calculated opacity of the material to obtain the density of the capsule at four different times. The experimental measurement of density of an imploding capsule is a critical function of x-ray framing cameras for inertial confinement fusion studies.

Excerpt from L. Ceurvorst, et al.; Development of an x-ray radiography platform to study laser-direct-drive energy coupling at the National Ignition Facility. Rev. Sci. Instrum. 1 October 2022; 93 (10) 105102. https://doi.org/10.1063/5.0098982