Written for the Wind Crest Writers' Group, March 1, 2021.

T minus ten.

Nine.

Eight.

Seven.

Main engine start.

The date is July 23, 1999. It is 12:31AM, Eastern Daylight Time. The Space Shuttle Columbia, mission STS-93, is on the pad at launch complex 39B at the Kennedy Space Center in Florida. Commanding is Colonel Eileen Collins, USAF. The payload is the Chandra X-ray Observatory, decades in the making, a 2-billion-dollar sister ship to the Hubble Space Telescope, at twenty tons with its booster rocket, the heaviest payload launched with the space shuttle up to that time.

The shuttle has 3 main engines, which burn liquid hydrogen and liquid oxygen. Each is supervised by a computer, with a backup computer powered by a different power bus. Redundancy is important. The computers have about six seconds to get their engines up and running before the solid rocket motors are lit and the vehicle lifts off. They report all is well.

They are mistaken. During the last overhaul of Space Shuttle Main Engine #3, a pin was put into a shower-head like assembly to plug one of the holes used for spraying liquid oxygen into the combustion chamber. This is normal. What was not normal is that the vibration of the engine running cut it loose, spraying a golden bullet out through the nozzle where it dinged the engine bell slightly on the way out.

The vehicle lifted off the launch pad. Somewhere in the wiring harness a worn bit of insulation rubbing on a rough screw head finally gave up, shorting one of three power buses that supplied electricity to the computers which controlled the engines. So two of the six computers went offline, and the backup computer took over supervising engine #2. The backup program is slightly less informative, and the sensors it relies on are slightly less well calibrated. Loss of a second power bus would shut down an engine, requiring one of various abort scenarios (depending on when the engine fails). Nobody wanted to try landing a fully-laden shuttle on a runway, either at the Cape, or in Africa.

The engineer in charge of the hydraulics reported that the system that swiveled the right solid rocket motor's nozzle had been lost. This was a sensor glitch, and other indicators convinced him it was not a problem.

The space shuttle main engine nozzles are made of tubing which circulates liquid hydrogen around the flaming exhaust. This cools the nozzle, and pre-heats the liquid hydrogen fuel before it gets to the combustion chamber. The ding in engine #3 caused a slow leak of fuel. This can be seen as a small jet of flame in the post-flight examination of video taken up the tail pipes of the shuttle as it left the launch pad. To keep the pressure up, the computer boosted the oxygen level, making the engine burn hotter, about halfway to the high temperature limit.

Ascent continued more or less as normal. Houston called the crew with various abort scenarios, so they could immediately pick the right one in the event of an engine failure. As it happens, the slow leak of hydrogen in engine #3 was cancelled by the crude calibration of the backup liquid oxygen sensor, so the computer shut down the engine a few milliseconds early, thinking it was nearly out of oxidizer. In fact, it was nearly out of fuel.

MECO, came the call on the voice loop. Main Engine Cut-Off. The external tank was cut loose, and the shuttle orbiter was rolled so they can photograph it as it drifts away. The Flight Dynamics Officer calculated the orbit,

and it's good within errors, so we have a mission.

In Houston, on the Flight Director's voice loop, which is recorded for posterity, came the following exchange:

Yikes.

You bet.

Concur.

We don't need any more of these.

All delivered in the matter-of-fact tone of voice aviators reserve for their worst nightmares.

And so began the mission of the Chandra X-ray Observatory, still in orbit doing good science, twenty one and a half years later.