

# SnT 2023

CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

HOFBURG PALACE - Vienna and Online

**19 TO 23 JUNE**

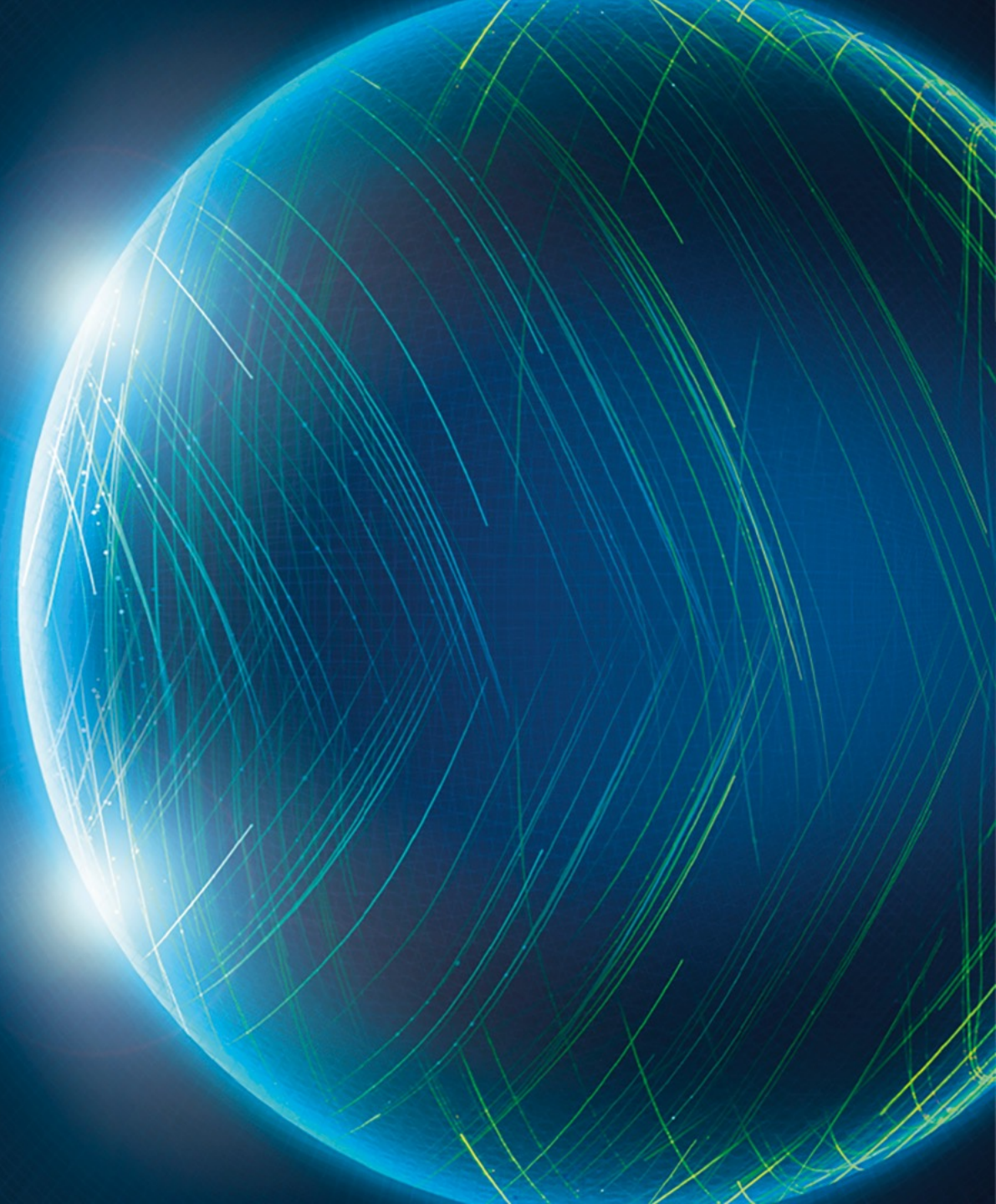
## **General Discussion of Analog Seismic Data, and (at last) an Origin Time for the First Nuclear Explosion (TRINITY)**

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**O2.5-518**

20 June 2023



Jocely Lopez Luna, Göran Ekström,  
Won-Young Kim, and David P. Schaff

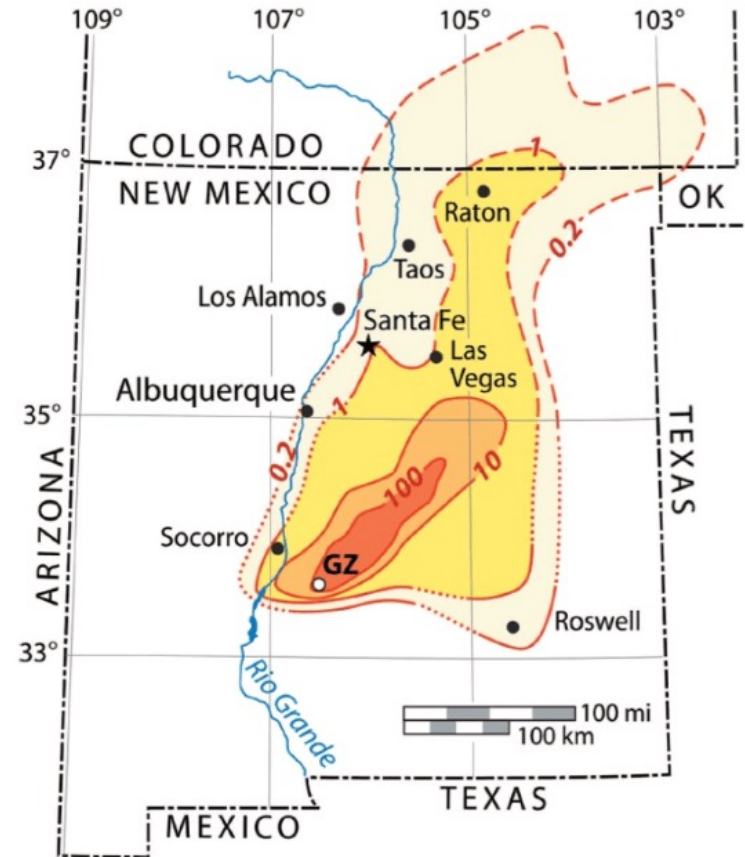
all of us at the  
Lamont-Doherty Earth Observatory of Columbia  
University in New York

Many people have studied the fallout from TRINITY, and its medical consequences.

In 2020, a set of papers (from US government agencies) was published in *Health Physics*.

An informative introduction is at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7497476/>

This Figure shows a map of exposure rates in milliroentgens per hour, 12 hours after the explosion.





**TRINITY**  
**First Test**

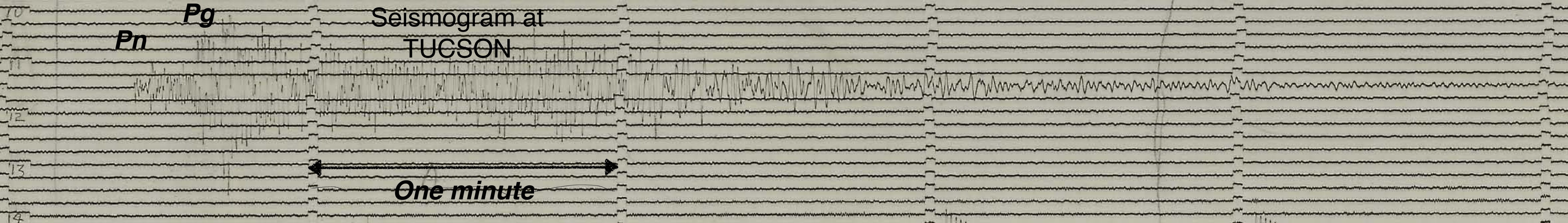
**Distance = 437 km**

**TUCSON**  
**Observatory**

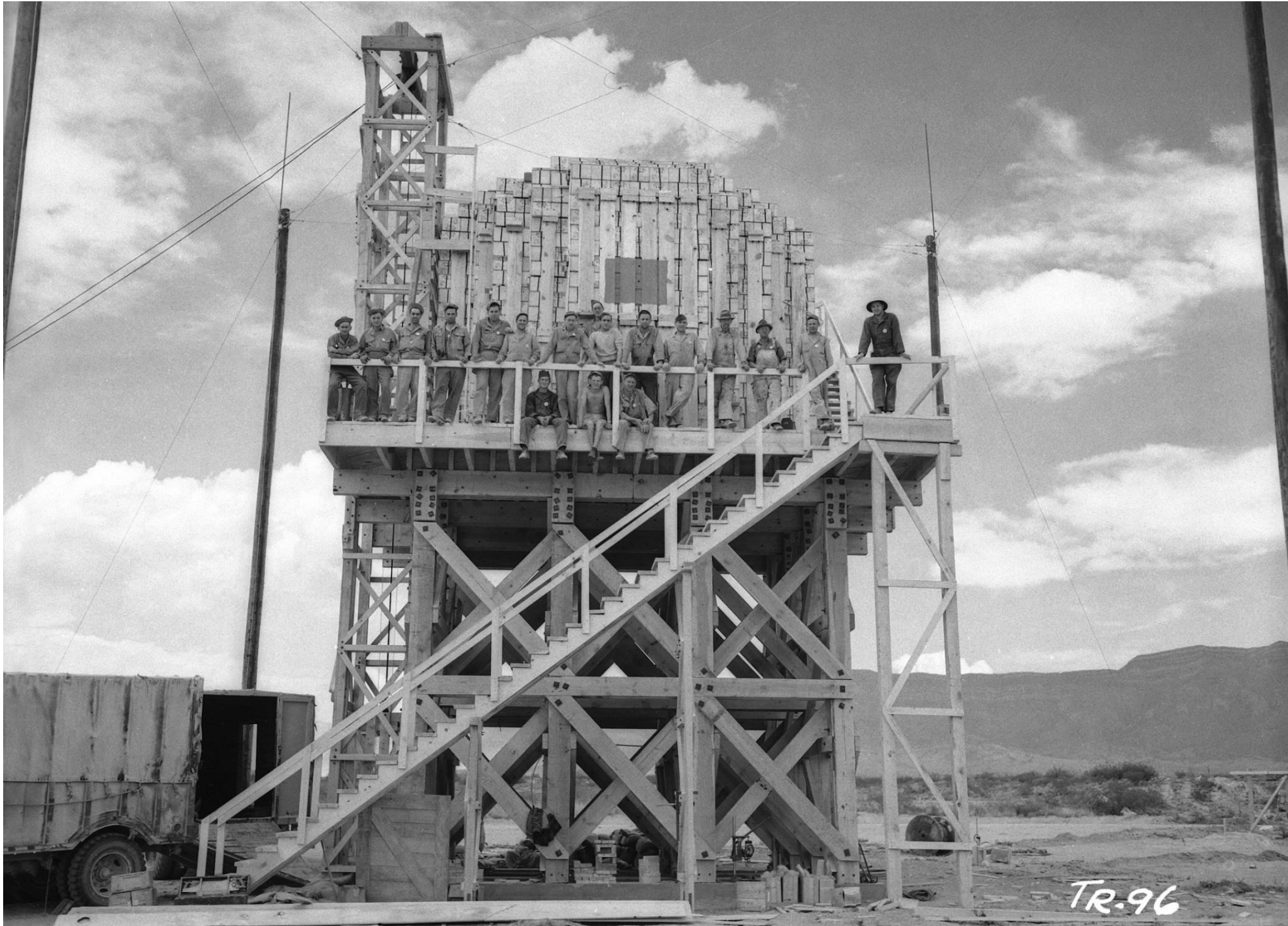


July 16 1945, 5:29:45 A.M. (Mountain War Time)  
Trinity Site Zero, Alamogordo Test Range,  
Jornada del Muerto desert.

Yield: 20-22 Kilotons



Seventy days earlier (May 7), 108 tons TNT





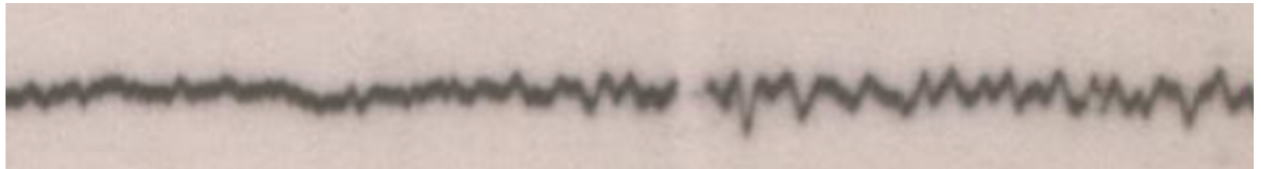
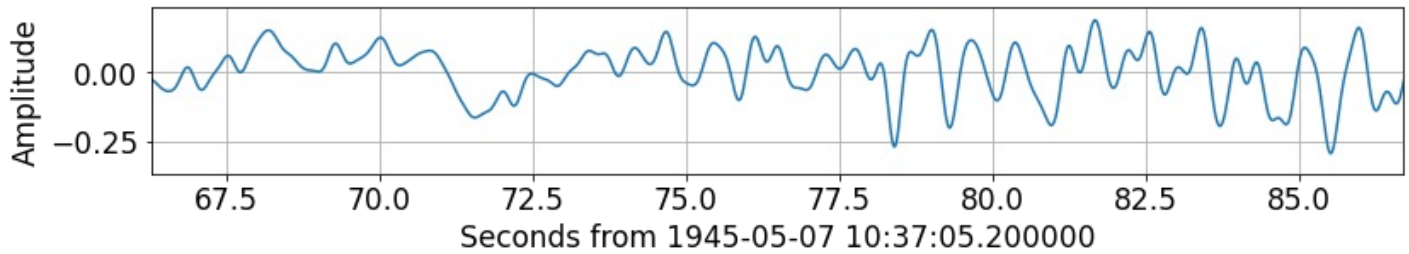
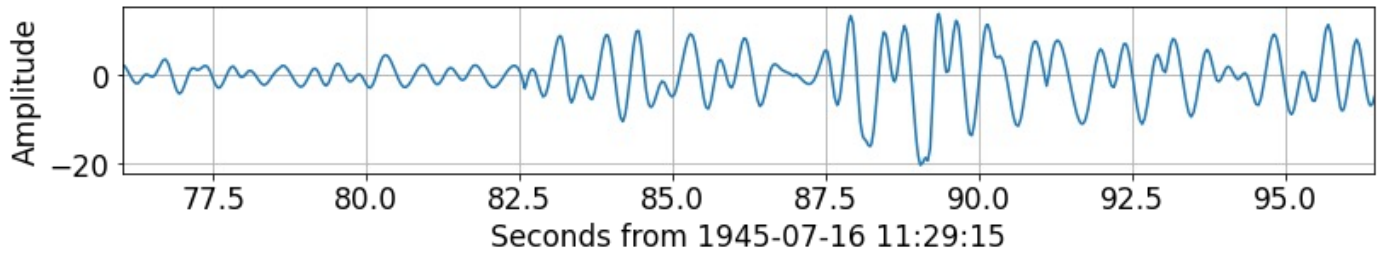
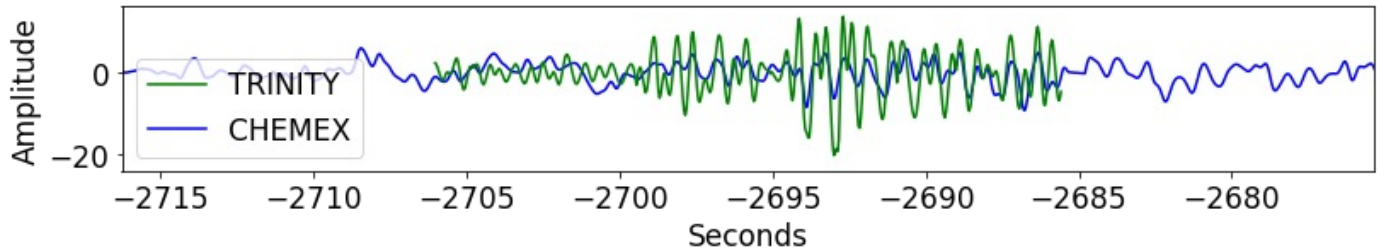
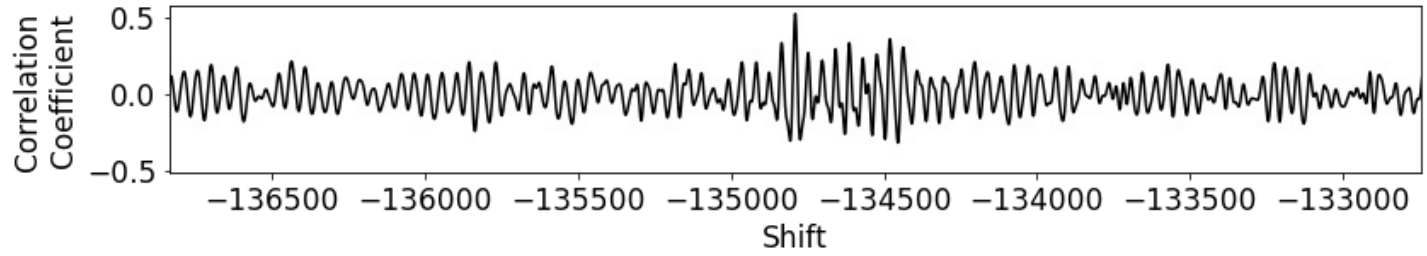


26 HOURS  
VERTICAL

NORTH

100 METERS

$CC_{max} = 0.522$   
Shift = -134790



**Pg**

Passband: 1-10 Hz

Wlen: 20.4 seconds

TRINITY  $T_0$  ESTIMATE:

1945-07-16 11:29:24.540000

# Summary

- Radio timing services failed for the TRINITY event (July 16, 1945), but we were available to use the origin time of an earlier 108 ton TNT explosion, conducted near the TRINITY site on May 7, 1945.
- We have scanned and digitized the vertical-component analog seismograms recorded at Tucson Observatory (TUCO, at a distance of 437 km) for both events.....
- We applied cross-correlation methods of analysis to the regional seismic window, and found that the very faint signals on May 7 provide a satisfactory cross-correlation peak when compared with the TRINITY signals, enabling us to provide a preliminary estimate of its origin time on July 16, 1945.
- It was 11:29:24.5 (GMT) correct to a few tenths of a second.

# Conclusion

The ability to obtain this very specific result was a surprise to us, in view of the very small size of a key reference signal, with accurate timing, recorded 70 days earlier than the TRINITY nuclear explosion. We conclude that:

- Analog records are necessary to document a wide range of features of nuclear explosion seismograms;
- There is merit in developing a complete list of basic parameters of historic nuclear test explosions. And
- **Modern methods of cross-correlation analysis can be effective in application to scanned/digitized old records**