

# List of artificial radiation belts

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**Artificial radiation belts** are radiation belts that have been created by high altitude nuclear explosions.  
[1][2][3][4]

**List of Artificial Radiation Belts**

Explosion	Location	Date	Yield (approximate)	Altitude (km)	Nation of Origin
Hardtack Teak	Johnston Island (Pacific)	1958-08-01	3.8 megatons	76.8	United States
Hardtack Orange	Johnston Island (Pacific)	1958-08-12	3.8 megatons	43	United States
Argus I	South Atlantic	1958-08-27	1-2 kilotons	200	United States
Argus II	South Atlantic	1958-08-30	1-2 kilotons	256	United States
Argus III	South Atlantic	1958-09-06	1-2 kilotons	539	United States
Starfish Prime	Johnston Island (Pacific)	1962-07-09	1.4 megatons	400	United States
K-3	Kazakhstan	1962-10-22	300 kilotons	290	USSR
K-4	Kazakhstan	1962-10-28	300 kilotons	150	USSR
K-5	Kazakhstan	1962-11-01	300 kilotons	59	USSR

The table above only lists those high-altitude nuclear explosions for which a reference exists in the open (unclassified) English-language scientific literature to persistent artificial radiation belts resulting from the explosion.

The Starfish Prime radiation belt had, by far, the greatest intensity and duration of any of the artificial radiation belts.<sup>[1]</sup>

The Starfish Prime radiation belt damaged the United States satellites Ariel 1, Traac, Transit 4B, Injun I and Telstar I. It also damaged the Soviet satellite Cosmos V. All of these satellites failed completely within several months of the Starfish detonation.<sup>[1]</sup>

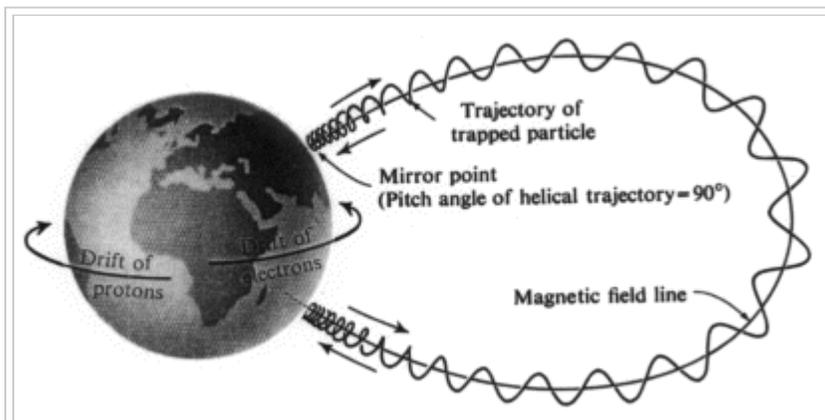
Telstar I lasted the longest of the satellites damaged by the Starfish Prime radiation, with its complete failure occurring on February 21, 1963.<sup>[5]</sup>

In Los Alamos Scientific Laboratory report LA-6405, Herman Hoerlin gave the following explanation of the history of the original Argus experiment and of how the nuclear detonations lead to the

development of artificial radiation belts.<sup>[1]</sup>

"Before the discovery of the natural Van Allen belts in 1958, N. C. Christofilos had suggested in October 1957 that many observable geophysical effects could be produced by a nuclear explosion at high altitude in the upper atmosphere. This suggestion was reduced to practice with the sponsorship of the Advanced Research Project Agency (ARPA) of the Department of Defense and under the overall direction of Herbert York, who was then Chief Scientist of ARPA. It required only four months from the time it was decided to proceed with the tests until the first bomb was exploded. The code name of the project was Argus. Three events took place in the South Atlantic. . . . Following these events, artificial belts of trapped radiation were observed.

"A general description of trapped radiation is as follows. Charged particles move in spirals around magnetic-field lines. The pitch angle (the angle between the direction of the motion of the particle and direction of the field line) has a low value at the equator and increases while the particle moves down a field line in the direction where the magnetic field strength increases. When the pitch angle becomes 90 degrees, the particle must move in the other direction, up the field lines, until the process repeats itself at the other end. The particle is continuously reflected at the two *mirror* points — it is trapped in the field. Because of asymmetries in the field, the particles also drift around the earth, electrons towards the east. Thus, they form a shell around the earth similar in shape to the surface formed by a field line rotated around the magnetic dipole axis."



**Illustration of the motion of a charged particle trapped in the Earth's magnetic field.**

## See also

- Operation Argus
- The K Project
- Starfish Prime
- Operation Fishbowl
- Van Allen radiation belt
- High-altitude nuclear explosions
- Lawrence Berkeley National Laboratory
- Lists of environmental topics
- Nicholas Christofilos

## References

1. <sup>^</sup> *a b c d* Hoerlin, Herman "United States High-Altitude Test Experiences: A Review Emphasizing the Impact on the Environment" Report LA-6405, Los Alamos Scientific Laboratory. October 1976 [1] Retrieved 2009-10-25
2. <sup>^</sup> Hess, Wilmot N. (September 1964) (PDF). *The Effects of High Altitude Explosions*. National Aeronautics and Space Administration. NASA TN D-2402. [http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19640018807\\_1964018807.pdf](http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19640018807_1964018807.pdf). Retrieved 2009-10-24.
3. <sup>^</sup> Zak, Anatoly "The K Project: Soviet Nuclear Tests in Space," *The Nonproliferation Review*, Volume 13, Issue 1 March 2006 , pages 143 - 150 [2]
4. <sup>^</sup> U.S. Defense Threat Reduction Agency. "Operation ARGUS." *DTRA Fact Sheets*, July 2007.
5. <sup>^</sup> National Space Science Data Center: Telstar 1 [3] Retrieved 2009-10-25

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