Chapter 20

# Solving the Flyby Anomaly by the General Relativity of CFLE Theory

## 20.1 The Flyby Anomaly

The flyby or swing-by is a method used in interplanetary space flight to alter the path and the speed of a space craft, using the gravity of a planet. This technique has many advantages, including higher velocities for reaching distant planets, resulting in related time, fuel, and cost savings, and easy access to orbits far from the ecliptic, as well as being repeatable.

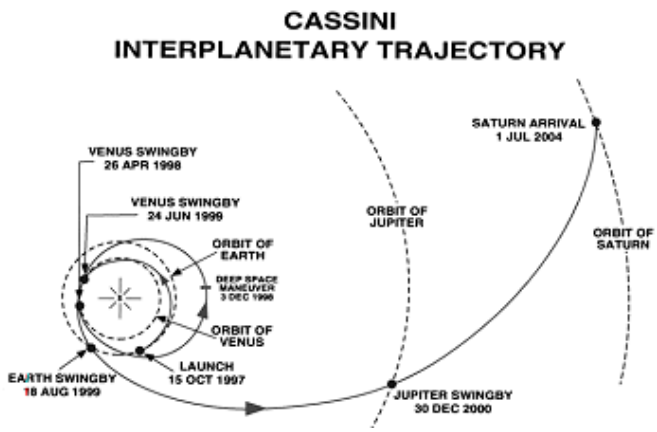



**Figure 20-1-1. Cassini interplanetary swing-bys**
**(Source: Courtesy NASA/JPL-Caltech)**

The flyby anomaly, which was first observed in the early 1990s, is an unexpected increase or decrease in energy experienced by a space craft executing Earth flybys. The anomaly was observed as shifts in the S-band and X-band Doppler and ranging telemetry by an international network of communication facilities for the support of interplanetary space craft missions and radar astronomy, called the Deep Space Network (DSN). This network has three facilities: the Goldstone DSN complex, Mohave Desert, California, USA; the Madrid DSN complex,

Robledo, Spain; and the Canberra DSN complex, Tidbinbilla, Australia (Figure 20-1-2).

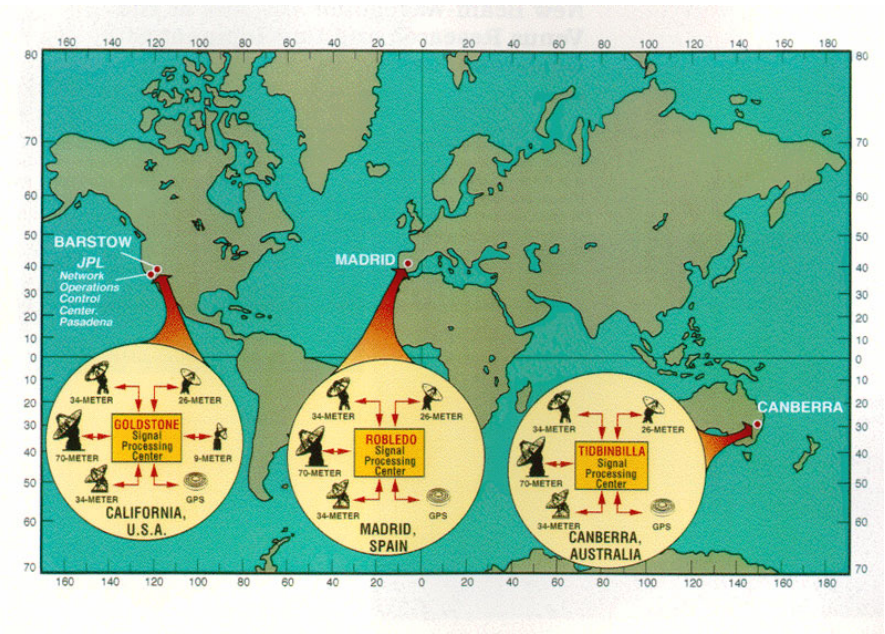



**Figure 20-1-2. Locations of the Deep Space Network (DSN)**
**(Source: Courtesy NASA/JPL-Caltech)**

The main method for measuring the velocity of a space craft is by observation of these two electromagnetic wave bands, where the designed accuracy of the DSN measurement is $\sim 0.01$ mm/s. The anomaly was picked up by J. D. Anderson and other engineers at the Jet Propulsion Laboratory (JPL) during an inspection of DSN Doppler data, shortly after the Earth flyby of Galileo 1 on 8th December 1992. The Doppler residual usually remains flat, but the analysis revealed an unexpected 66 mHz shift, which corresponds to a velocity increase of 3.92 mm/s at perigee.

An investigation of this anomalous increase at the JPL, the Goddard Space Flight Center (GSFC), and the University of Texas did not yield any satisfactory explanations. Then on 23rd January 1998, the Near Earth Asteroid Rendezvous (NEAR) space craft gained an anomalous velocity increase of 13.46 mm/s after its Earth encounter. This incident was followed by the Cassini space craft experiencing $-1.7$ mm/s at perigee on 18th August 1999.

Table 20-1-1 summarizes some important parameters related to these three anomalous flyby incidents.

**Table 20-1-1. Some important parameters related to anomalous space craft flyby incidents.**

| | Galileo I | NEAR | Cassini |
|---|---|---|---|
| **Date** | 12/8/1992 | 01/23/1998 | 08/18/1999 |
| **Speed at perigee km/s** | 13.738 km/s | 12.739 km/s | 19.03 km/s |
| **Trajectory inclination to equator** | 142.9° | 108.8° | 25.4° |
| **Spacecraft mass kg** | 2497kg | 730kg | 4612kg |
| **Minimal altitude** | 956 km | 532 km | 1172 km |
| **Power Watt** | Orbiter:570 watt<br>Probe:580 watt | S.Pannel:400watt<br>Total:1800 watt | BOL~660 $watt$<br>2010~670$watt$ |
| **Speed increment at perigee** | 2.56 ± 0.05 mm/s | 7.21 ± 0.07 mm/s | –1.7 ± 0.9 mm/s |

**(Source: Wikipedia at http://en.wikipedia.org/wiki/Flyby_anomaly; accessed December 10, 2012)**

### 20.1.1 Proposed equation

An empirical equation for the anomalous flyby velocity change was proposed by J. D. Anderson and his collaborator J. Jordan. That is,

$$\frac{dV}{V} = \frac{1}{2}\frac{\Delta E}{E} = K(\cos\varphi_i - \cos\varphi_0), \quad K = \frac{2\omega_e R_e}{C} = 3.1 \times 10^{-6} \qquad 20\text{-}1\text{-}1\text{-}1$$

where $\omega_e$ is the angular frequency of the Earth, $R_e$ is the Earth radius, and $\varphi_i$ and $\varphi_0$ are the inbound and out-bound equatorial angles of the space craft, respectively.

Based on this equation, Anderson and his colleagues predicted a speed increase of 1 mm/s for the Rosetta space craft flyby on 13th November 2007. The data analysis, however, revealed that Rosetta's flyby was complete, and absent of flyby anomalies.

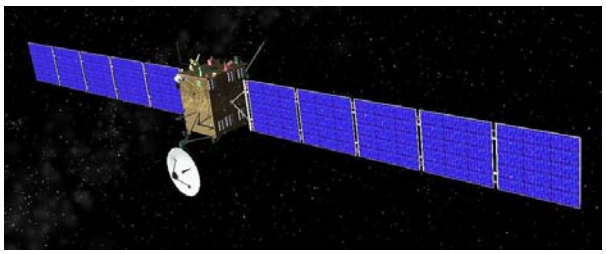


**Figure 20-1-1-1. Computer model of Rosetta**
**(Source: Wikipedia; http://en.wikipedia.org/wiki/File:Rosetta.jpg)**

## 20.1.2. Results

Many possible explanations about the flyby anomalies have been proposed, with fancy titles such as the Transversal Doppler Effect; Dark Matter Halo Around the Earth; The Casimir Effect; The Impact of General Relativity; and General Relativity Combined with a Rotating Universe. However, none of these explanations can be universally accepted. Therefore, this important problem remains listed as a mystery as to what causes the unexpected change in acceleration or deceleration for space craft planetary flybys.

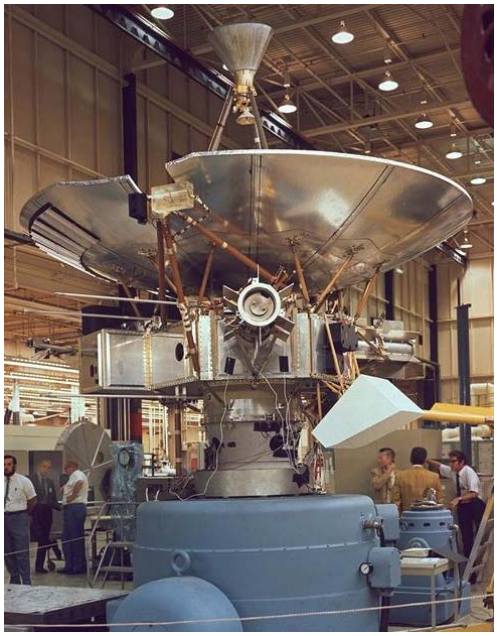


**Figure 20-1-2-1. Pioneer 10 final construction phase; launched March 2, 1972.**
**Anomaly observed, $\alpha_{\text{Pioneer}} = -(8.74 \pm 1.33) \cdot 10^{-10}$ m/s$^2$**
**(Source: Courtesy NASA Ames Research Center)**

## 20.2. Solving the Flyby Anomaly by the General Relativity of CFLE Theory

### 20.2.1. Galileo 1

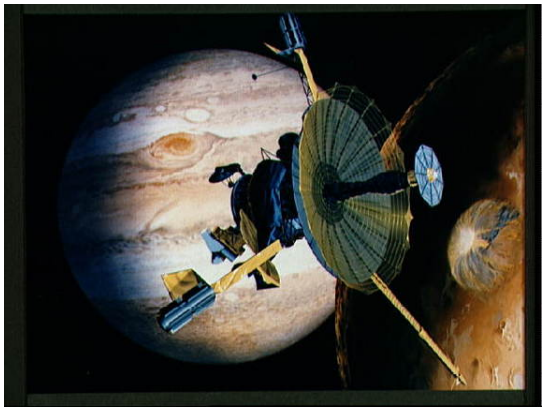


**Figure 20-2-1-1. Artist's conception of Galileo 1 near Jupiter**
**(Source: Courtesy NASA)**

According to special relativity, the additional classical electric force appears as a magnetic force. That is

$$F = Q\,(E + V \times B) \qquad 20\text{-}2\text{-}1\text{-}1$$

$$B = \frac{V}{C^2} \times E \qquad 20\text{-}2\text{-}1\text{-}2$$

Therefore, qualitatively, the additional field is expressed as

$$E_s = V \times \frac{V}{C^2} \times E$$

Quantitatively, the additional field is expressed as

$$E_{ss} = \frac{q}{4\pi\varepsilon_0 r^2} \cdot \frac{(1-\frac{V^2}{C^2})}{(1-\frac{V^2\sin^2\theta'}{C^2})^{3/2}}$$

$$= E(1 - \frac{V^2}{C^2}\sin^2\theta')^{-1/2}$$

$$\approx E + \left(\frac{1}{2}\frac{V^2}{C^2}\sin^2\theta'\right)E \qquad 20\text{-}2\text{-}1\text{-}3$$

However, the approximate additional field can also be expressed quantitatively as

$$E_s \approx \frac{1}{2}\frac{V^2}{C^2}\sin^2\theta' \mathrm{E} \qquad 20\text{-}2\text{-}1\text{-}4$$

This is none other than the relativistic effect by the *K* factor from special relativity:

$$K = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}} E \qquad 20\text{-}2\text{-}1\text{-}5$$

Because of special relativity, the factors of gravitational force should be changed (function of velocity) when the mass change is very small. That is

$$F = ma \rightarrow \ F = \frac{m}{\sqrt{1-\frac{u^2}{C^2}}}\left[a + \frac{u(u\cdot a)}{(c^2-u^2)}\right] \qquad 20\text{-}2\text{-}1\text{-}6$$

However, according to CFLE theory (cf. §5), the gravitational force can be described as

$$F = m(\mathbb{E} + v \times \mathbb{B}) \qquad 20\text{-}2\text{-}1\text{-}7$$

$$\mathbb{B} = \frac{V}{C^2} \times \mathbb{E} \qquad 20\text{-}2\text{-}1\text{-}8$$

where $\mathbb{E}$ is the gravitational field and $\mathbb{B}$ is the gravitomagnetic field.

Therefore, qualitatively, the additional field is

$$\mathbb{E}_s = V \times \frac{V}{C^2} \times \mathbb{E} \qquad 20\text{-}2\text{-}1\text{-}9$$

However, quantitatively, the approximate additional field can be by

$$\mathbb{E}_s \approx \frac{1}{2}\frac{V^2}{C^2}\sin^2\theta' \mathbb{E} \qquad 20\text{-}2\text{-}1\text{-}10$$

Again, this is the relativistic effect by the *K* factor from special relativity:

$$K = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}} \mathbb{E} \qquad 20\text{-}2\text{-}1\text{-}11$$

Now we can apply Eq. 20-2-1-10 to flyby anomalies, when $\frac{V^2}{C^2}$ is much smaller than 1.

| Space craft | date | Speed at perigee Km/s | Minimal altitude km | Space craft Mass kg | Trajectory inclination to equator | Speed increment at perigee mm/s |
|---|---|---|---|---|---|---|
| Galileo 1 | 1990-12-08 | 13.783 km/s | 956 km | 2497 kg | 142.9° | 2.56±0.05 |

**Table 20-2-1-1**

Because the speed of Galileo 1 at perigee was $V = 1.378\times 10^4$ m/s, the additional effect by special relativity is

$$E_A \approx \frac{1}{2}\left(\frac{1.378\times10^4 m/s}{2.998\times10^8\, m/s}\right)^2 \approx \frac{1}{2}\left(\frac{18.98\times10^7 m/s}{8.988\times10^{16} m/s}\right) \approx 1.056\times10^{-9} \quad \text{20-2-1-12}$$

However, two radioisotope thermoelectric generators (RTGs) which powered the spacecraft through the radioactive decay of plutonium-238. The heat emitted by this decay was converted into electricity through the solid-state Seebeck effect. This provided a reliable and long-lasting source of electricity unaffected by the cold environment and high-radiation fields in the Jovian system.

Each GPHS-RTG, mounted on a 5-meter long boom, carried 7.8 kilograms (17 pounds) of $^{238}$Pu. Each RTG contained 18 separate heat source modules, and each module encased four pellets of plutonium dioxide, a ceramic material resistant to fracturing. The modules were designed to survive a range of hypothetical accidents: launch vehicle explosion or fire, re-entry into the atmosphere followed by land or water impact, and post-impact situations. An outer covering of graphite provided protection against the structural, thermal, and eroding environments of a potential re-entry. Additional graphite components provided impact protection, while iridium cladding of the fuel cells provided post-impact containment. The RTGs produced about 570 watts at launch. The power output initially decreased at the rate of 0.6 watts per month and was 493 watts when *Galileo* arrived at Jupiter.

By such 570 ~ 580watt electrical power of GPHS-RTG battery in satellite is changed to gravitational power that interacts with Earth magnetic field.

According to CFLE theory maximum change of gravitational force line curve by electricity is $g = 8$

Therefore, total change of force line curve is

$d_{total} = 1.5 \times 8$ 20-2-1-13

where factor of 1.5 is correspondence number between electricity and gravity(cf.§24).

$c_c = 1.5$

Because force is $F = \frac{Gm^2}{r^2}$ or $\frac{e^2}{4\pi\varepsilon_o r^2}$ and is also given by $F = \frac{d}{dt}(mv) = m\frac{dv}{dt} + v\frac{dm}{dt} = ma + vi$ according to relativity theory, the total additional force effect by change of curve of force line is

$E_{\text{electricity}} = g^2_{\text{mass}}$

$= (8\times 1.5)^2$

$=144$ 20-2-1-14

Therefore, all of the additional interacting strength between Earth's magnetic field and the space craft's gravitational force is

$E_{Agt} \approx (1.056 \times 10^{-9})\,(1.44 \times 10^2) \approx 1.521 \times 10^{-7}$ 20-2-1-15

With Galileo 1's speed in mm/s being $V = 1.378 \times 10^7$ mm/s, the possible maximum additional speed from the craft interacting with Earth's magnetic field is

$V_{\text{add}} \approx (1.521 \times 10^{-7})\,(1.378 \times 10^7 \text{ mm/s})$

$\approx 2.095$ mm/s 20-2-1-16

However, because the Earth's force line curve $g = 1.202$ the real additional speed is

$V_{\text{add}} \approx 2.095 \times 1.202 = 2.52$

$\approx 2.52$ mm/s 20-2-1-17

That is the speed increment of Galileo 1 at perigee.

The observed speed increment of Galileo 1 at perigee by J. D. Anderson and colleagues was

$V_{\text{add}} = 2.56 \pm 0.08$ mm/s 20-2-1-18

We find here that the theoretical value calculated by CFLE theory agrees quite well with the observed value.

Galileo 1's angle between the trajectory of the ground track and the equator was

$\theta = 142.9°$ 20-2-1-19

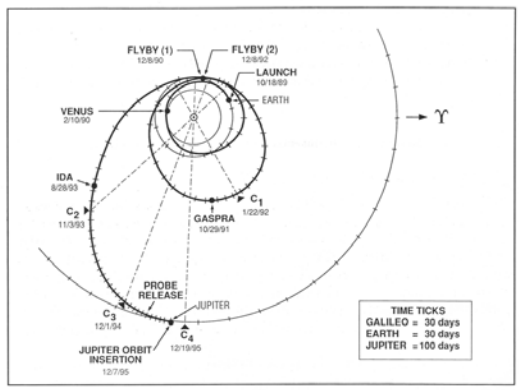



**Figure 20-2-1-2. Galileo's trajectory**
**(Source: Courtesy NASA)**

At this angle ($\theta$ =142.9°) of Galileo 1, the mass magnet of the space craft cannot interact with Earth's magnetic field, because the angle of the gravito magnetic field for Galileo 1, called the rest angle, is

$\theta_{\text{rest}} = 142.9° - 90°$

$= 52.90°$ 20-2-1-20

The angle between magnetic north and the rotational axis of Earth or the space craft, called the north magnet angle, is

$\theta_{\text{north magnet}} = 10.54°$ 20-2-1-21

Likewise, the angle between magnetic south and the rotational axis of Earth's or the space craft's magnetic south, called the magnetic south angle, is

$\theta_{\text{south magnet}} = 27.14°$ 20-2-1-22

The total angle ($\sin^2\theta'$) between the space craft and Earth is called the action angle, and is

$\theta'_{\text{action}}$ = [(52.90°) + (10.54°) + (27.14°)] (1)

= 90.58° ≈ 90° 20-2-1-23

Because $\sin(90^o) = 1$, in the case of Galileo 1, there cannot exist the effect from the action angle by the process between

$$\mathbb{E}_s = V \times \frac{V}{C^2} \times \mathbb{E} \text{ (Vector)} \leftrightarrow \mathbb{E}_s \approx \frac{1}{2}\frac{V^2}{C^2}\sin^2\theta'\mathbb{E} \text{ (Scalar)} \qquad 20\text{-}2\text{-}1\text{-}24$$

This good agreement gives encourages us to investigate other flyby anomalies using the general relativity of CFLE Theory.

## 20.2.2. NEAR


**Figure 20-2-2-1. NEAR: the Near Earth Asteroid Rendevous space craft (Source: Courtesy NASA)**

The calculations of CFLE theory parameters for NEAR and Cassini (cf. §20.2.3) are exactly the same as those used for Galileo 1 above (cf. §20.2.1), the only variables being the speeds and angles of the respective space craft. Therefore, only calculations pertinent to the space craft under discussion are presented below.

| Space craft | date | Speed at perigee km/s | Minimal altitude km | Space craft mass kg | Trajectory inclination to equator degrees | Speed increment at perigee mm/s |
|---|---|---|---|---|---|---|
| NEAR | 1998-01-23 | 12.739km/s | 532 km | 730 kg | $108.8^o$ | 7.21±0.07 |

**Table 20-2-2-1**

The speed at infinity of the space craft NEAR is $V = 1.274 \times 10^4$ m/s, giving the additional effect by special relativity as

$$E_A \approx \frac{1}{2}\left(\frac{1.274\times10^4}{2.998\times10^8}\right)^2 \approx \frac{1}{2}\left(\frac{162.31\times10^6}{8.988\times10^{16}}\right) \approx 9.029 \times 10^{-10} \qquad \text{20- 2-2-1}$$

However, Power was provided by four 1.8 by 1.2 meter gallium arsenide solar panels which could produce 400 watts at 2.2 AU (329,000,000 km), NEAR's maximum distance from the Sun, and 1800 W at one AU (150,000,000 km). Power was stored in a nine ampere-hour, 22-cell rechargeable super nickel-cadmium battery. Such 400watt electrical power of battery in satellite changed to gravito magnetic field that interacts with Earth.

$$E_{Ag} \approx 144$$

Therefore all of the additional interacting strength between Earth's magnetic field and the satellite's gravitational force is

$$E_{Agt} \approx (9.029 \times 10^{-10})\,(1.44 \times 10^2) \approx 1.300 \times 10^{-7} \qquad \text{20-2-2-2}$$

Thus, the possible maximum additional speed of NEAR by interacting with Earth's magnetic field is

$$V_{\text{add}} \approx (1.300 \times 10^{-7})\,(1.274 \times 10^7 \text{ mm/s})$$

$$\approx 1.656 \text{ mm/s} \qquad \text{20-2-2-3}$$

$$V_{\text{add}} \approx (1.656 \text{ mm/s})(1.202)=1.991\text{mm/s}$$

| Space craft | speed | mass | Altitude |
|---|---|---|---|
| Galileo 1 | 13.783 km/s | 2497 kg | 956km |
| NEAR | 12.739km/s | 730 kg | 532km |
| Cassini | 19.03km/s | 4612 kg | 1172km |

**Table 20-2-2-2**

Because of earth gravito magnetic factor $f_{EGM} = 1.5$ between gravitational charge and gravito magnet appear difference of force line curve. That is

$$\Delta g = 1.463\,, \frac{1.463}{8} = 0.183 \qquad \text{5-3-8-7}$$

Therefore, correspond mass difference should be

$m_{cor}$ =(500$w$)($\frac{1}{0.183}$) $= 2732w \rightarrow 2732kg$ 20-2-2-4

Because earth gravitational permittivity effective correspond mass is

$m_{cor} = \frac{2732kg}{1.073176} = 2546kg \approx 2500kg$ 20-2-2-5

Therefore, mass of Galileo 1 space craft can be standard mass for another space craft.

Ratio of mass difference between Galileo1 and NEAR is

$d_m = \frac{2497kg}{730kg} = 3.42$ 20-2-2-6

Under same force NEAR space craft accelerated faster than Galieo1

As much as factor of 3.42

Ratio of speed difference between Galileo1 and NEAR is

$d_v = \frac{13.783km/s}{12.739km/s} = 1.082$ 20-2-2-7

Total different ratio is

$R_d = (3.42)(1.082) = 3.700$ 20-2-2-8

Therefore, predicted total speed increment of NEAR is

$V_{add}$ =1.991mm/s $\times$ 3.700 $= 7.37mm/s$ 20-2-2-9

the observed additional speed by J. D. Anderson and colleagues is

$V_{add}$ =7.21 ± 0.07 mm/s/

**Figure 20-2-2-2. Goldstone NASA Deep Space Network**
**(Source: Courtesy NASA)**

## 20.2.3. Cassini

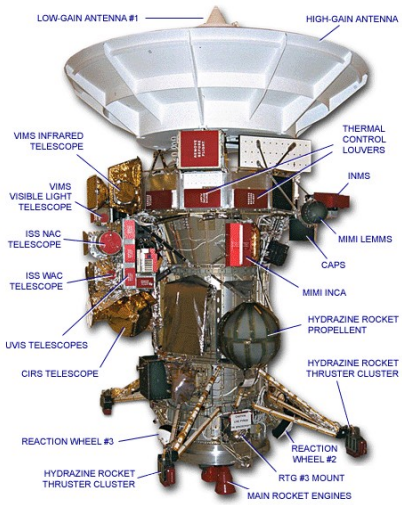



**Figure 20-2-3-1. CASSINI space craft payload.**
**(Source: Courtesy PDS Imaging Node)**

In this section, only the results of all the parameters calculated as they pertain to Cassini are presented. To review the steps in the calculations with explanations, please refer to §20.2.1.

| Space craft | date | Speed at perigee km/s | Minimal altitude km | Space craft mass kg | Trajectory inclination to equator degrees | Speed increment at perigee mm/s |
|---|---|---|---|---|---|---|
| Cassini | 1999-08-18 | 19.03km/s | 1172 km | 4612 kg | $25.4^o$ | $-1.7\pm0.9$ |

**Table 20-2-3-1**

*Cassini* is powered by 32.7 kg of plutonium-238—the heat from the material's radioactive decay is turned into electricity.

Cassini's speed at infinity is $1.903 \times 10^4$ m/s; therefore,

$$E_A \approx \frac{1}{2}\left(\frac{1.903\times10^4}{2.998\times10^8}\right)^2 \approx \frac{1}{2}\left(\frac{36.21\times10^7}{8.988\times10^{16}}\right) \approx 2.015\times 10^{-9} \qquad \text{20-2-3-1}$$

$$E_{Agt} \approx (1.015 \times 10^{-9})\,(1.44\times 10^2) \approx 1.462 \times 10^{-7} \qquad \text{20-2-3-2}$$

$$V_{\text{add}} \approx (1.462 \times 10^{-7})\,(1.903 \times 10^7 \text{ mm/s})$$

$$\approx 2.782 \text{ mm/s}$$

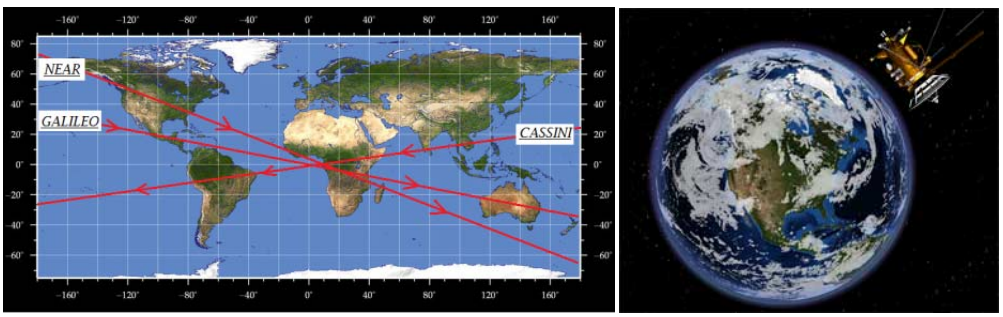



**Figure 20-2-3-2. Cassini above Earth, 10 years ago**
**(Source: Courtesy NASA)**

However,$25.4^o$ is anti rotations direction of Earth. Therefore effect becomes negative

$$V_{\text{add}} \approx \frac{-2.782\text{mm/s}}{1.202} = -2.314 \text{ mm/s} \qquad \text{20-2-3-3}$$

| Space craft | speed | mass | Altitude |
|---|---|---|---|
| Galileo 1 | 13.783 km/s | 2497 kg | 956km |
| NEAR | 12.739km/s | 730 kg | 532km |
| Cassini | 19.03km/s | 4612 kg | 1172km |

**Table 20-2-3-2**

Ratio of mass difference between Galileo1 and NEAR is

$$d_m = \frac{4612kg}{2497kg} = 1.847 \qquad 20\text{-}2\text{-}3\text{-}4$$

Under same force Cassini space craft accelerated slower than Galieo1

As much as factor of 1.847

Ratio of speed difference between Galileo1 and NEAR is

$$d_v = \frac{19.03km/s}{13.78km/s} = 1.381 \qquad 20\text{-}2\text{-}3\text{-}5$$

Total Ratio different is

$$R_d = \frac{1.847}{1.381} = 1.337 \qquad 20\text{-}2\text{-}3\text{-}6$$

Therefore, predicted total speed increment of Cassini is

$$V_{\text{add}} \approx \frac{-2.314\text{mm/s}}{1.337} = -1.731 \text{ mm/s} \qquad 20\text{-}2\text{-}3\text{-}7$$

The observed speed decrement of Cassini at perigee by J. D. Anderson's team was

$$V_{\text{add}} \approx -1.7 \pm 0.9 \text{ mm/s} \qquad 20\text{-}2\text{-}3\text{-}8$$

In conclusion, this good agreement between CFLE theory and the experiments proves that the work of the DSN is successful and correct. Earth's magnetic field interacts with space craft via force lines, causing the craft to gain or loss energy and speed. Therefore, we can say that the gravitational force is transported by gravitational force lines, in the same way that electrical force is transported by electrical force lines, a concept that M. Faraday (1791–1867) introduced and J.Maxwell(1831-1879) formulate four equations.

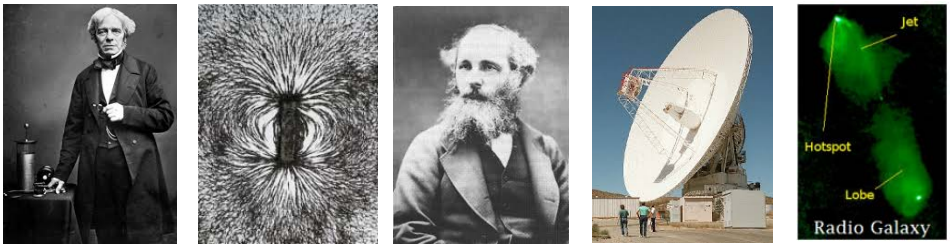
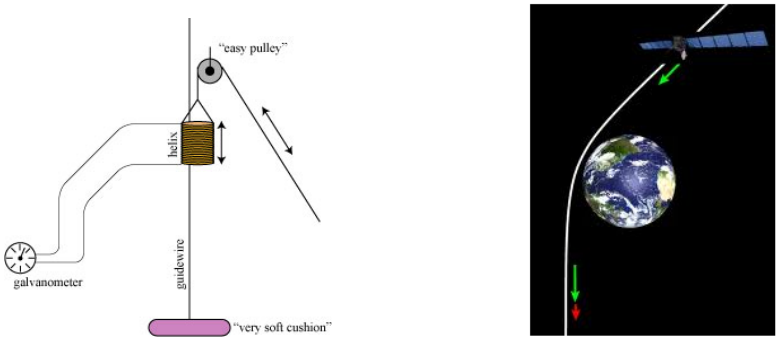



**Figure 20-2-3-3**

Furthemore Faraday's report on his experimental findings was presented to the Royal Society on August 1, 1850. Titled, "On the possible relation of gravity to electricity," it appeared in print in vol. 141 of the Philosophical Transactions (1851), pp. 1-6. He begins the paper by stating yet again his belief in a unifying principle:

The long and constant persuasion that all the forces of nature are mutually dependent, having one common origin, or rather being different manifestations of one fundamental power, has made me often think upon the possibility of establishing, by experiment, a connection between gravity and electricity, and so introducing the former into the group, the chain of which, including also magnetism, chemical force and heat, binds so many and such varied exhibitions of force together by common relations.

For the first experiment, Faraday twisted 350 feet of copper wire into a hollow cylindrical helix 4 inches long, with an internal diameter of 1 inch and an external diameter of 2 inches. This helix was attached to a line running along a pulley, allowing it to be raised 36 feet and dropped onto a "very soft cushion". Long wires connected the ends of the helix to a sensitive galvanometer, placed 50 feet away and level midway with the path of the helix. This is illustrated figure 20-2-3-3




**Faraday experiment** **DSN Experiment**

**Figure 20-2-3-4**

Unexpected historical meaning of DSN experiment of Earth flyby is space craft version of Faraday experiment. Here, we can compare scale of two experiments as figure 20-2-3-4. However, we can find surprisingly Michael Faraday was right who didn't have space craft, radar, computer and theory of relativity.

Consequently, curved space cannot exist as Einstein asserted (Figure 20-2-3-4), and we should be considering where and how to fix Einstein's mistake?

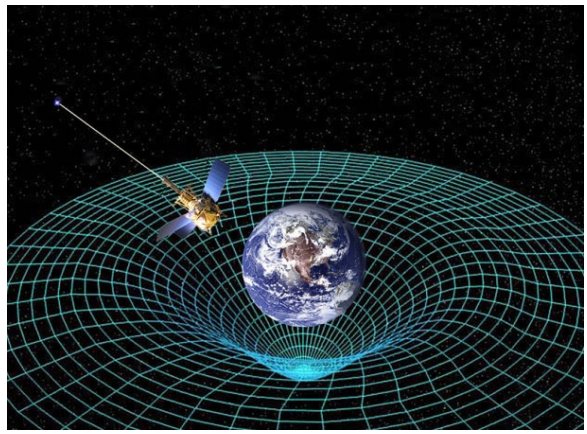


**Figure 20-2-3-5. Artist's rendition of Einsteinian space–time and gravity (Source: Courtesy NASA)**

## 20.2.4. Establishing the theoretical angle between Earth's rotational axis and Earth's magnetic South Pole

The ratio between the strong force and the electromagnetic force is

$$R_F = 92:238.03$$

$$= 1:2.587 \qquad 20\text{-}2\text{-}4\text{-}1$$

where 238.03 is the maximum number of neutrons and protons in uranium as permitted by nature, and 92 is the maximum number of electrons or protons.

Therefore, the maximum allowed strong force strength in the uranium nucleus is

$$F_{\text{strong}} = 2.587\ F_{\text{electric}} \qquad 20\text{-}2\text{-}4\text{-}2$$

Because the strong force is the primary reason for Earth' mass (cf. §5) and its related gravitomagnetic force, the maximum excited-state energy level for a neutron in the nucleus is

$$E_{\text{excite}} = 2.587\ E_{\text{bound}} \qquad 20\text{-}2\text{-}4\text{-}3$$

However, Earth's magnetic South Pole is a force line donator (cf. §5), much like the charge and mass of a positively charged particle are 1836 times bigger than that of a negatively charged particle.

Therefore, the theoretical maximum South Pole angle is

$$\theta_{\text{south}} = 2.587\ \theta_{\text{north}}$$

$$= (2.587)\ (10.54°)$$

$$= 27.27° \qquad \text{20-2-4-4}$$

However, upon changing from the electrical force strength to the strong force strength, with the change of the force line curve going from $g = 1$ to $g = 8$, the related electrical permittivity change of the particle is

$$Q = (0.000579)(8) = 0.004632, \qquad x = 1.004632 \qquad \text{20-2-4-5}$$

The effective maximum angle becomes

$$\theta_{\text{south}} = \frac{27.27°}{1.004632} = 27.14° \qquad \text{20-2-4-6}$$

Because of the gravitational permittivity of Earth (cf. §10), the theoretical South Pole angle is

$$\theta_{\text{theoretical}} = \frac{27.27°}{1.073176} = 25.29° \qquad \text{20-2-4-7}$$

The observed angle between the magnetic South Pole and the rotational axis by the Geological Survey of Canada on 2001 (cf. §5.3) was

$$\theta_{\text{observed}} = 25.30° \qquad \text{20-2-4-8}$$

giving the observed position of the magnetic South Pole in 2001 as

$$P_{\text{observed}} = [64.70°\ \text{S}, 138.00°\ \text{E}] \qquad \text{20-2-4-9}$$

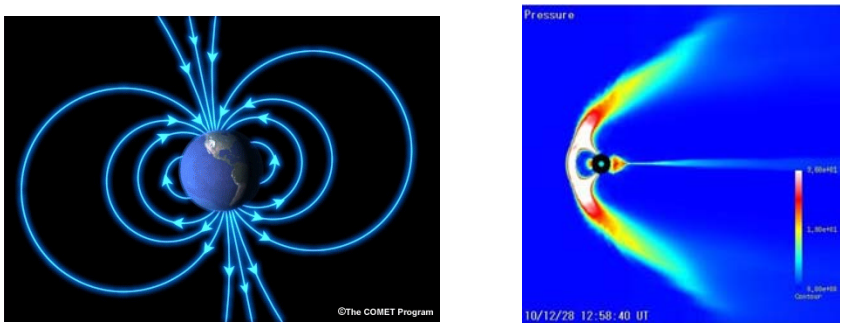



**Figure 20-2-4-1. Earth's magnetic field and the unusual activity of Earth's magnetosphere**
**(Source: Courtesy Windows to The Universe)**

## 20.3. Wrong Relation Between Einstein's Equivalence Principle and Curved Space-time

Albert Einstein observed that bodies accelerated toward the center of Earth at a rate of $1g$ (or 9.81 m/s$^2$), the standard gravitational acceleration equivalent to that of an inertially moving body observed on a rocket in free space. In 1907, Einstein established the assumption of "complete physical equivalence" between the gravitational field and a corresponding acceleration of a reference system. This became known as the equivalence principle.

In 1911, Einstein developed the idea of two frames of references: one was a uniform gravitational field, named$K$; the other, named$K'$, had no gravitational field but was uniformly accelerated such that objects in the two reference frames would experience the identical force. Again, Einstein assumed both reference systems to be "physically exactly equivalent," whereby $K$ in a space free from gravitational fields would also be uniformly accelerated. In his own words

> "This assumption of exact physical equivalence makes it impossible for us to speak of the absolute acceleration of the system of reference, just as the usual theory of relativity forbids us to talk of the absolute velocity of a system; and it makes the equal falling of all bodies in a gravitational field seem a matter of course." [1]

1. Excerpt from Einstein, Albert. 1911. "Über den Einfluß der Schwerkraft auf die Ausbreitung des Lichtes," *Annalen der Physik* **35**.

Einstein went further to suggest that the total physical equivalence of systems $K$ and $K'$, where the laws of nature with respect to $K$ are in complete agreement with those with respect to $K'$, would not be significant if restricted only to Newtonian mechanics. Instead, this principle had to apply also to optics and all electromagnetic and other universal phenomena.

This idea sowed the seeds for Einstein's theory of general relativity.

Figure 20-3-1 shows this situation clearly.

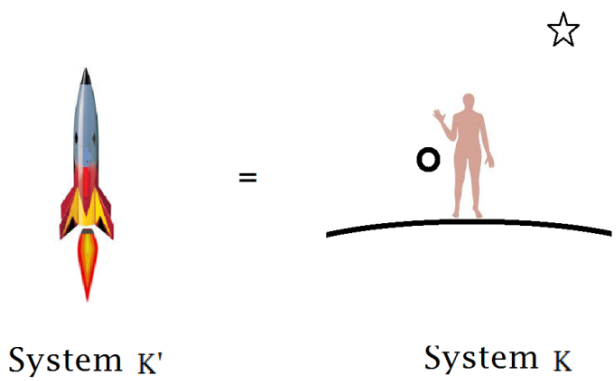



**Figure 20-3-1**

Einstein combined the equivalence principle with his special relativity theory to predict the bending of light rays in a Sun's gravitational field and the precession of Mercury's orbit. After the success of these predictions (cf. §1), he concluded that space–time is curved by gravity. This means that Einstein blew away, all at once, the classical electromagnetic theories of Oersted, Ampere, Coulomb, Faraday, and Maxwell into empty space.

However, the original equivalence principle as described by Einstein, without any input of special relativity or consideration for an observable object $O_{K''}$ in a system $K''$, concluded that free-fall and inertial motion were physically equivalent. This would mean that the gravitational force for observer $O_K$ in system $K$, observer $O_{K'}$ in system $K'$, and object $O_{K''}$ in system $K''$ is $F = mg$.

Figure 20-3-2 shows a simple schematic of Einstein's his principle and the successful prediction of the bending of light rays.

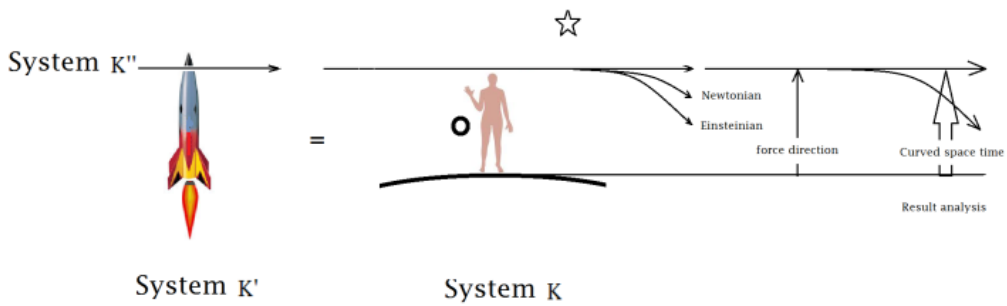



**Figure 20-3-2**

In this situation, the relative movement of the Y component for observer $O_{K"}$ in system $K''$ (Eqs. 2-1-19 and 2-1-20 cited below are from §2.1) is

$$U_{K"y} = dv\sqrt{1-\frac{V^2}{C^2}} = dv \cdot 0 = 0 \qquad \text{2-1-19}$$

The relative movement for observer $O_{K'}$ in system $K'$ is

$$U_{K'y} = -dv \qquad \text{2-1-20}$$

By combining his equivalence principle with special relativity, Einstein rendered his principle inconsistent, because he had not considered the relation with object $O_{K"}$ in system$K''$ under the condition of special relativity. That is, for object $O_{K"}$ in system $K''$, the gravitational force of system $K'$is very different. Under the new special relativity concept, a rocket of system $K'$ now moves with an acceleration of $a = K_{K'}$ and the moment velocity for object $O_{K"}$ in system $K''$ is $v = v_{\text{moment}}$. According to special relativity, for object $O_{K"}$ in system $K''$, the inertial force of $K'$ is observed when the mass change is very small:

$$F = \frac{m}{\sqrt{1-\frac{u^2}{c^2}}}\left[a + \frac{u(u\cdot a)}{(c^2-u^2)}\right] \qquad \text{20-3-1}$$

$$= m\,(\mathbb{E} + u\mathbb{B}) \qquad \text{20-3-2}$$

where $a = \frac{du}{dt}$. This force is none other than the gravitational Lorentz force $F = Q\,(E + vB)$ according to CFLE theory. If the mass change of system $K'$ is large, the final force change will be $F = ma + \frac{dm}{dt}v$ and the gravitational force for observer $K'$ is now only

$F = mg$ 20-3-3

where $a = \frac{GM}{r^2}$ , and $G$ is the Newtonian constant. Because a mass magnet or gravito magnet ($\nabla \times \mathbb{B}$) is now produced by special relativity, the inertial mass and gravitational mass are equivalent for object $K''$ in system $K''$, or the gravitational field is equivalent to the corresponding acceleration of the reference system. This means Einstein's equivalence principle is correct and can be allowed to be a general principle yet. That is

$m = m(1 + \frac{d}{dt}) \Longrightarrow$ gravitational mass and inertial mass are the same 20-3-4

$g = [a + \frac{u(u \cdot a)}{(c^2 - u^2)}]/[\sqrt{1 - \frac{u^2}{c^2}}] \Longrightarrow$ Gravitational field and acceleration of the reference system are the same 20-3-5

Figure 20-3-3 is a simple schematic of this situation.

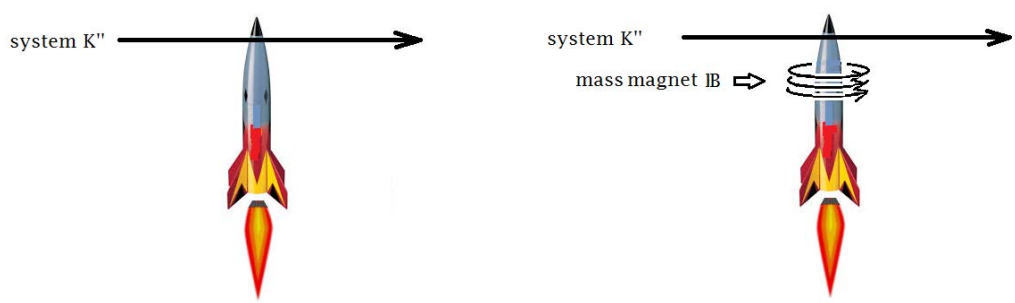



**Figure 20-3-3**

But this result is not all. Because system $K'$ is now accelerated for observer $K''$, the curl of the mass magnet ($\nabla \times \mathbb{B}$) must be one more curl according to the corresponding Maxwell electrodynamics for electromagnetic wave radiation.

$$\nabla \times (\nabla \times B) = \nabla(\nabla \cdot B) - \nabla^2 B = -\mu_o \varepsilon_o \frac{\partial^2 B}{\partial t^2} \quad 20\text{-}3\text{-}6$$

The corresponding gravito magnetic wave radiation situation of Figure 20-3-3 is changed as

$$\nabla \times (\nabla \times \mathbb{B}) = \nabla(\nabla \cdot \mathbb{B}) - \nabla^2 \mathbb{B} = -\frac{1}{G_o I_o}\frac{\partial^2 \mathbb{B}}{\partial t^2} \qquad 20\text{-}3\text{-}7$$

Because of this curl $\nabla \times (\nabla \times \mathbb{B})$, the rocket in system $K'$ is curved as shown in Figure 20-3-4.

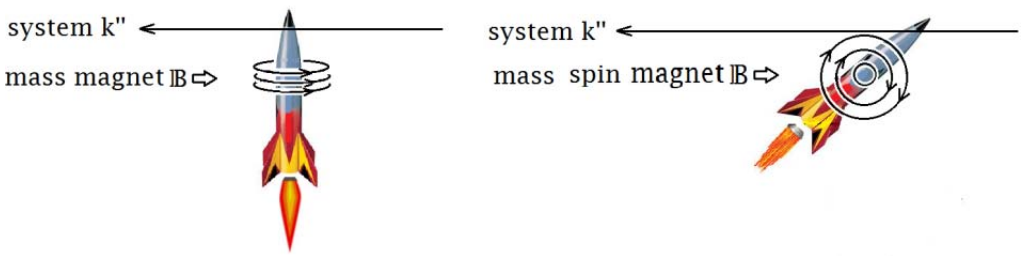



**Figure 20-3-4**

Simply speaking, Newtonian gravity is only

$$F_{New} = \frac{mGM}{r^2} = ma \qquad 20\text{-}3\text{-}8$$

Now, Einsteinian gravity is too $ma$

$$F_{Ein} = \frac{dp}{dt} = \frac{d}{dt}(mv) = m(\frac{dv}{dt}) + v\left(\frac{dm}{dt}\right) = ma + vi \qquad 20\text{-}3\text{-}9$$

However, because mechanical balance between seed and excessive force line and its elements by relativistic effect in center of particle is broken, arrangement of force line and its elements is changed as figure 20-3-4 as

$$F_{cfle} = ma + vi + \int \frac{d}{dt}(\, ma + vi)\ dt$$

$$= ma + vi + \int (m\frac{da}{dt} + a\frac{dm}{dt} + v\frac{di}{dt} + i\frac{dv}{dt})dt \qquad 20\text{-}3\text{-}10$$

Because mechanical balance between seed and excessive force line and its elements by relativistic effect in center of particle is broken, charge screening degree and related force strength is changed by curve of force line with acceleration as

$$F_{cfle} = \ ma + vi + \int (m\frac{da}{dt} + a\frac{dm}{dt} + v\frac{di}{dt} + i\frac{dv}{dt})dt \rightarrow\rightarrow\rightarrow$$

$$F_{cfle} = \ ma + vi + \int \frac{d}{dt}\{F + (\ m\frac{da}{dt} + a\frac{dm}{dt} + v\frac{di}{dt} + i\frac{dv}{dt})\}dt \ \rightarrow\rightarrow\rightarrow$$

$$F_{cfle} = ma + vi + \int \frac{dF}{dt} dt + \int ( m \frac{d^2a}{dt^2} + \frac{da}{dt}\frac{dm}{dt} + a\frac{d^2m}{dt^2} + \frac{dm}{dt}\frac{da}{dt} + v\frac{d^2i}{dt^2} + \frac{di}{dt}\frac{dv}{dt} + i\frac{d^2v}{dt^2} + \frac{dv}{dt}\frac{di}{dt})dt \qquad 20\text{-}3\text{-}11$$

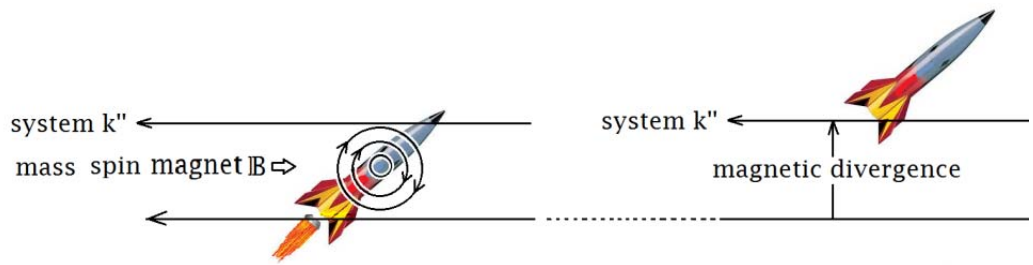



**Figure 20-3-5**

Because existence of inertia and equivalence between inertia and gravity, total force should be changed by anti-magnet, anti-spin magnet, anti- acceleration and radiation (cf.§15)as

$$F_{\text{total}} = [\, ma + vi]_{Einstein} \qquad 20\text{-}3\text{-}12$$

Therefore, gravity remains same before as much as $F = ma$.

However, component of magnetic divergence with $g = 2$ by special relativity that has same quantity of gravity in figure 20-3-5, is added with remains gravity. Now, total effect of gravity is double.

In this situation, the relative movement of the Y component for observer $O_{K''}$ in system $K''$ (the equations cited below are from §3.2) is

$$U_{K''y} = dv\sqrt{1 - \frac{V^2}{C^2}}\alpha = dv \cdot \sqrt{\left|\frac{\hbar}{C}\right|} \neq 0 \qquad 3\text{-}2\text{-}18$$

The relative movement for observer $O_{K'}$ in system $K'$ is

$$U_{K'y} = -dv \qquad 3\text{-}2\text{-}17$$

Because of this last magnetic divergence of system $K'$, object $K''$ is observed by $K'$ as being more curved. According to the last magnetic divergence of system $K'$ and Eq. 3-2-18, the essence of further falling cannot be by curved space, but instead it must be by a curved rocket or a curved force line.

When such relative movement observe from view point of frame $K''$ (or photon's frame), we can understand more clearly Einstein's additional falling. Now rocket move into frame of $K''$(or photon's frame) with$v = c$, observer in photon's coordination system observe motion of rocket as figure 20-3-6.

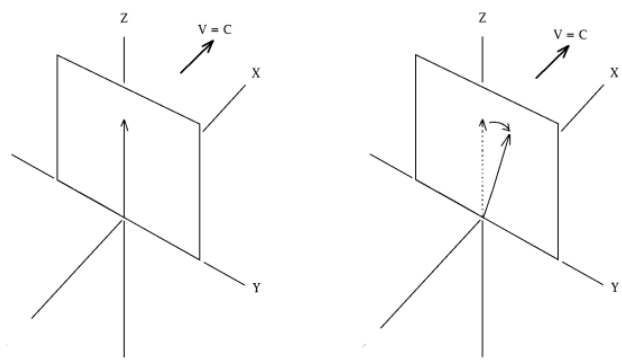



**Figure 20-3-6**

Left of Figure 20-3-6 is mass magnet $\mathbb{B}$ for observer in photons system$K''$. Rocket version of figure 20-3-6 is

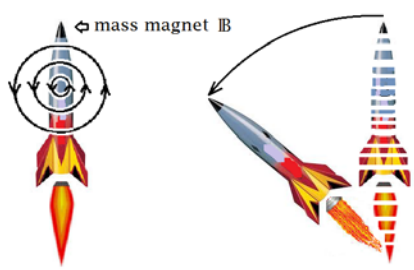



**Figure 20-3-7**

This result is rotation by regular mass magnet $\mathbb{B}$. Because reaction between force line elements and seed of particle, force line elements starts spin magnetic arrangement as figure 20-3-8.

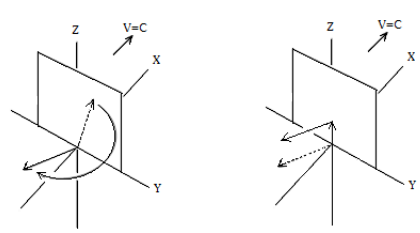



**Figure 20-3-8**

Figure 20-3-9 shows motion of force line elements by mass magnet$\mathbb{B}$, spin magnet$\mathbb{B}_s$ and magnetic divergence by mass from broken gauge symmetry of spin magnet force line elements .

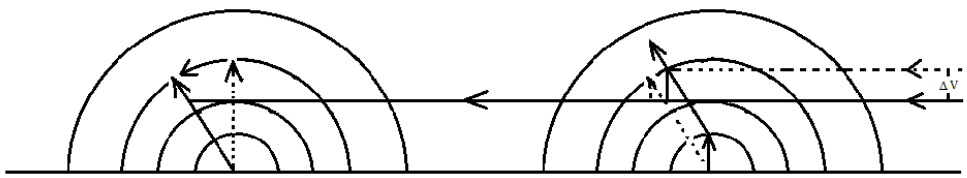



**Figure 20-3-9**

However, because of broken balance between seed and force lines by acceleration, rocket should be show related rocket motion by magnetic divergence with neutro-lateral mass as Figure 20-3-10

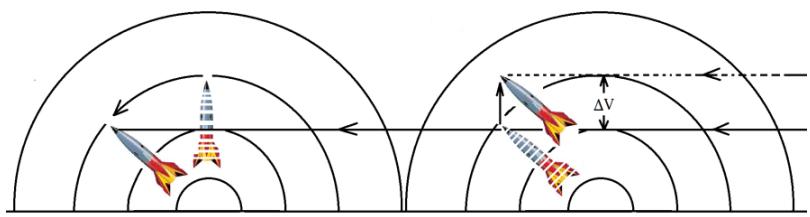



**Figure 20-3-10**

Because of existence of magnetic divergence should be force line curved as spin-magnetic field for observer of other coordination system.

According to magnetic divergence into direction of extra gauge freedom and normal gravity object $k''$ move as right of figure 20-3-11

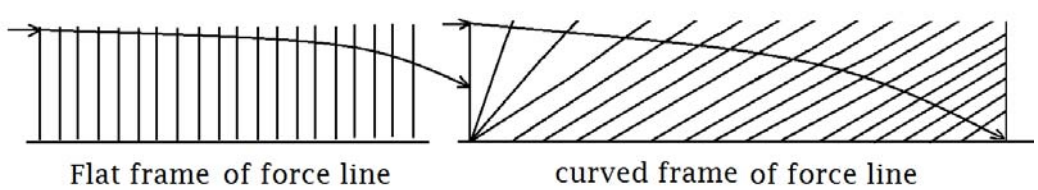



**Figure 20-3-11**

Therefore, because this motion of force line elements this theory is called curved force line elements theory

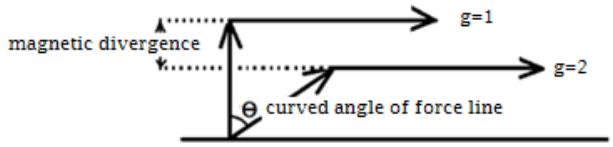



**Figure 20-3-12**

Because vacuum expectation value near the Sun's space is broken by strong sun's field as much as potential difference $\Delta V(\varphi)$as space in superconductor, this potential difference is influenced monopole force line elements by goldstone boson as magnetic divergence.

$$\Delta V_{Higgs} = \Delta g_{force\ line} = \Delta F(ma_{Newton}) \qquad 20\text{-}3\text{-}13$$

By broken balance between seed and force line elements for degree of charge screening, result is figure 20-3-13 so-called magnetic divergence as effect of special relativity. Therefore, relative gravity of Object (photon) in system $K''$should be experienced double stronger than expected by degree of curve of force line at $g = 2$ .

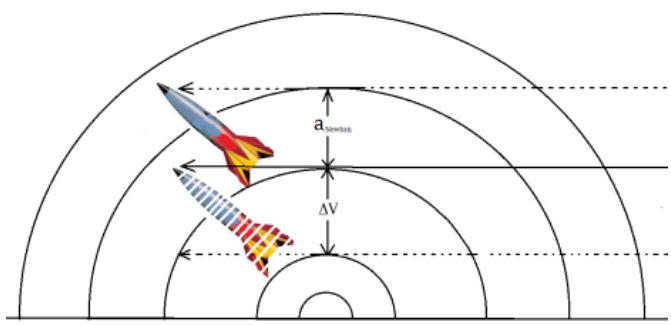



**Figure 20-3-13**

Because degree of double curve of force line elements by factor of $g = 2$(cf.§15.6), total effect of gravity for object $K''$(photon) is

$$g.a_{Newton} = 2.a_{Newton} \qquad 20\text{-}3\text{-}14$$

$$\theta_f = d\theta + \theta_n \cong \frac{dv_\odot}{c} + \frac{dv_\odot}{c} \cong \frac{2Gm_\odot}{c^2R_\odot} + \frac{2Gm_\odot}{c^2R_\odot} \cong \frac{4Gm_\odot}{c^2R_\odot} \qquad 3\text{-}2\text{-}21$$

Change of real gravito- spin magnetic force line for observer on photon's coordination system is

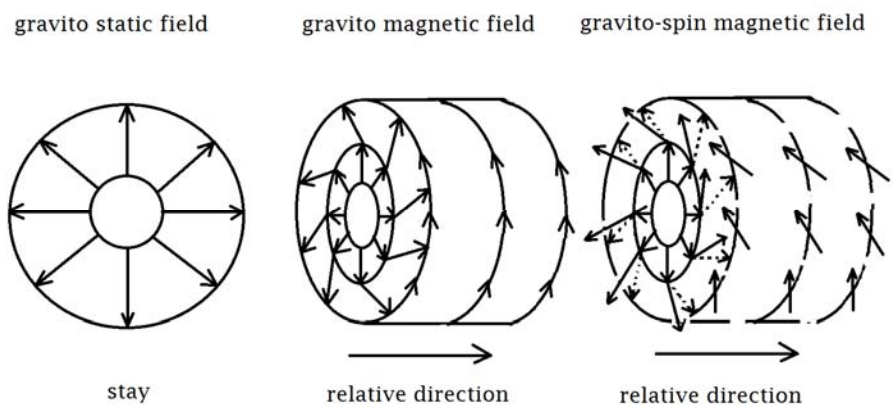



**Figure 20-3-14**

Finally this gravito-spin magnetic field for observer on photon's coordination system is

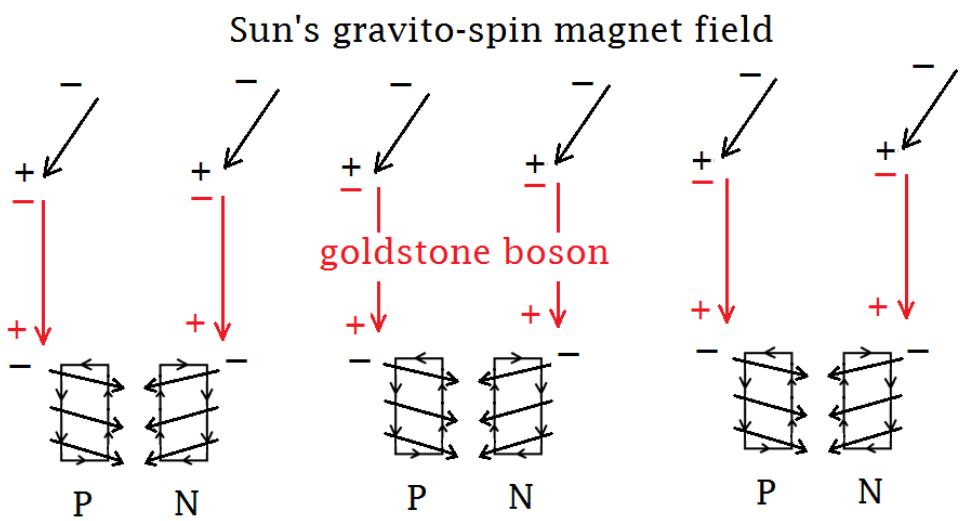



**Figure 18-8-7**

Therefore, because the equivalence principle is incorrect, the related space–time is not curved. Because Einstein's theory don't have gravitational force line and its element without mass magnet and magnetic divergence from force of magnetic monopole, unphysical

mathematical way especially geometrical way was employed as figure 20-3-15.

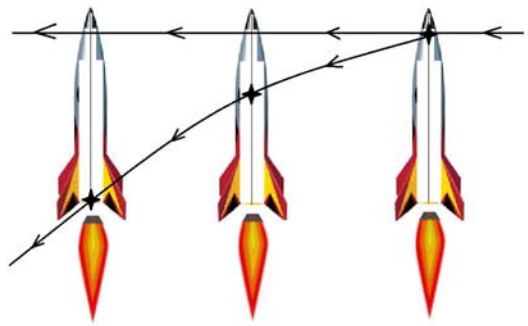


**Figure 20-3-15**

Gravitational lens, Black hole, light bending by the Sun is not evidence of curved space –time, but evidence for curved force line by double rest mass interacting of photon with field of astronomical objects.

Singularity problem is solved automatically, because curved space-time does not exist.

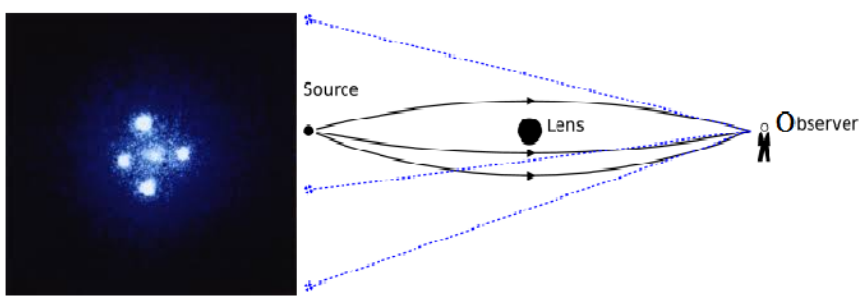



**Figure 20-3-16**

The flyby anomaly that J. D Anderson and colleagues observed, this fact tells us that gravitational force is transported by curved gravitational force lines and their elements. Because gravitational force is transported by gravitational force lines, extra dimensions cannot be used to describe any kind of force (gravitational force, weak force, electromagnetic force, and strong force). In conclusion, Einstein's equivalence principle is incorrect.

## 20.4. Relation Between the Theory of Curved Space and Renormalization

Because curved space theory does not consider the gravitational massballization by mass monopoles (gravitational dipole), this theory cannot use the charge screening technique for renormalization as quantum electrodynamics and quantum chromo dynamics. Thus, such renormalization is called dipolar renormalization. Without dipolar renormalization, no theory can be truly compatible with quantum theory. Therefore, at present, any extra-dimensional connection to curved space theory from Einstein's general relativity cannot achieve dipolar renormalization. This means that infinity from curved space will have to be a constant presence during the quantization of gravity; therefore, it is impossible to have a gravitational quantum theory.

## 20.5. Relation Between Charge Screening Theory and String Theory

In extra-dimensional theory, the so-called String theory is applied to overcome the unavoidable effect of infinity. But the essence of infinity is caused only by the $K$ factor of special relativity. When this inconsistency is corrected, we need no longer worry about infinity arising from point-like particles in charge screening theory (cf. §3). According to the special relativity of CFLE theory, there are no point-like particles and string-like particles in nature (cf. §3, §18). Therefore, both physically and mathematically, the String as a particle is not needed in any field of physics (cf. §4, §18).

> "Maybe there's a way of wrapping up six of the dimensions. Yes, that's possible mathematically, but why not seven?[…] There's no reason whatsoever in superstring theory that it isn't eight of the ten dimensions that get wrapped up and that the result is only two dimensions, which would be completely in disagreement with experience."
>
> Richard Feynman (1918–1988)

## 20.6. Relation Between the Accelerating Expansion of the Universe and Gravitational Monopoles

The fact that the Universe is undergoing accelerating expansion, as proven by Saul Perlmutter (2011 Nobel laureate in Physics), is proof that gravitational monopoles can exist (cf. §13). According to CFLE theory, the accelerating expansion of the Universe can occur with gravitational monopoles by related decreasing of big bang protons(cf.§24), which go on to support the existence of the related gravitational charge and antigravity. The further existence of mass monopoles, mass conservation laws, pair annihilation (creation) and related gravitational energy conservation laws as simple electric charge conservation laws, pair annihilation (creation) and related electric energy conservation laws can exist naturally without serious logical defects.

Because many scientists believe Einstein's equivalence principle and general relativity, they expect a decelerating expansion of the Universe. However, that is only the motion of tossed objects and freefall by positive gravitational mass. The accelerating expansion of the Universe should only involve the motion of tossed objects and anti-freefall by negative gravitational mass by related negative electrical charge of the cosmic nucleus (cf.§24), as predicted by George Gamow (1904–1968) predicted:

> "One can say, however, that if a future experiment should show that antiparticles have a negative gravitational mass, it would deliver a painful blow to the entire theory of gravity by disproving the principle of equivalence. In fact, if an observer inside an accelerated Einstein chamber released an apple having a negative gravitational mass, the apple would 'fall upward' (in respect to the space ship), and, as observer from outside, would move with an acceleration twice that of the space ship without being subject any outside forces."

Here "the apple" that would "fall upward" is none other than the corresponding accelerating expansion of the Universe, and the "future experiment" was none other than the $I_a$ supernova observed by Saul Perlmutter.

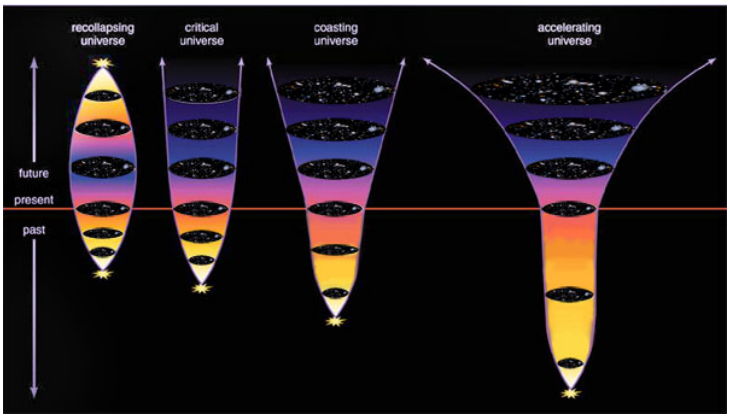
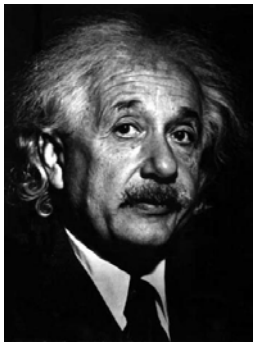



**Figure 20-6-1. The Universe is accelerating.**
**(Source: scienceblogs.com)**

## 20.7. The Historical Road to Extra-dimensional Theory

**L. Boltzmann**

**E. Mach**



**A. Einstein**

**Figure 20-7-1**

After blowing all of classical electrodynamics at once into empty space, Einstein expected a new start of a more revolutionary physics from his concept of curved space that was established under strong influence of Machian physics what is now called "Machian physics":

1. It should be based entirely on directly observable phenomena (Ludwig E. Boltzmann was attacked by this idea. On September 5, 1906, while on a summer vacation in Duino, near Trieste, Boltzmann hanged himself during an attack of depression)
2. It should completely eschew absolute space and time in favor of relative motion

3. Any phenomena that would seem attributable to absolute space and time (e.g. inertia, and centrifugal force) should instead be seen as emerging from the large scale distribution of matter in the universe.(Albert Einstein accepted this Idea. He received the 1921 Nobel Prize in Physics for his "services to theoretical physics".)

However, instead, classical electrodynamics fused into the quantum mechanics and quantum electrodynamics formulated by P.A.M Dirac in 1928, some claims of which (e.g., causality) Einstein clearly rejected, leading to his infamous quotation "My God does not play dice." By 1939, Einstein was such a powerfully influential figure that his signature on the Einstein-Szilárd letter was enough to convince President Franklin D. Roosevelt to initiate the Manhattan Project. His scientific assertions claimed absolute authority and many dared not question his brilliance, rendering him to be hailed as *the* greatest scientist in modern history. The many defenders of quantum mechanics could only be vindicated if Einstein himself finally conceded the logical consistency of the quantum theory and its agreement with experimental facts. Even if he privately had to accept that Bohr's quantum mechanics was correct, publically Einstein held stubbornly fast to his own ideas, up until his death in 1955. And yet, ironically, he also had to face the realization that he could not unify gravity and electricity with curved space theory.

In spite of that significant flaw, physicists could not even imagine to criticize Einstein's general relativity. After all, in the early 1960s, general relativity had so little connection with the rest of physics and astronomy that any skeptics of his theory were quite sparsely spread in the physics community. But any skeptical idea at that time would not be given the chance to be fully fleshed out, because the discovery of quasars in 1960 by Thomas Matthews and Allan Sandage thrust general relativity immediately to the forefront of astronomy. The high-energy quasar phenomenon represented a new collapsed state of matter that, at that time, was believed could be described only by the Einstein's general theory of relativity. Therefore, Einstein's relativity was fixed as being "beyond a shadow of a doubt." By such absolute authority and imminent situation were scientist driven to sophistry (cf. §17, §18), sowing the seeds of so-called extra-dimensional theory as being the "theory of everything." But the results of this denial would be the long lists of unsolved problems in physics.

**Figure 20-7-2. Solvay Conference on Quantum Mechanics, 1927.** Einstein is seated front and center, a reveal of his high stature and authority among his peers. Directly behind him, to the left, is Paul Dirac. (Source: http://w3.pppl.gov/~hammett/courses/gpp1/intro/solvay1927.html)

## 20.8. Conclusion

> "I'm particularly annoyed with my friends, the string theorists, because they cannot say anything about the physical world.[…] I don't know what these string people believe. I don't think they know what to believe since they cannot make contact with low energy …"
>
> Sheldon L. Glashow (1932– )

To solve the long list of unsolved problems in physics, it is clear now that we need a new theory of relativity (cf. §7~§23), one that obviates Einstein's equivalence principle and related curved space theory. Because gravitational force lines and mass monopoles with mass magnets exist, validation of the curved force line theory of CFLE general relativity is a matter of course. The Earth flyby anomaly brings us the important evidence of the existence of gravitational force lines and their force line elements, and the CFLE calculations are able to fully and accurately predict the anomalous events. This subsequently means that other forces must be have force lines and force line elements as well, to satisfy gauge symmetry (cf. §5) and complete cosmic consistency.

Therefore, it should be concluded that the extra-dimensional theory, the so-called theory of mathematical metaphysics, is incalculable and unextendable experimentally to the high energy of $10^{27}$ eV, and is not applicable to any fields of physic and mathematics. Instead, nature has given us force lines and force line elements for each conceivable force, which is applicable to all fields of science.