Possibility to construct a gravitational wave detector by utilizing the electrogravitic property of dielectric materials

Takaaki Musha

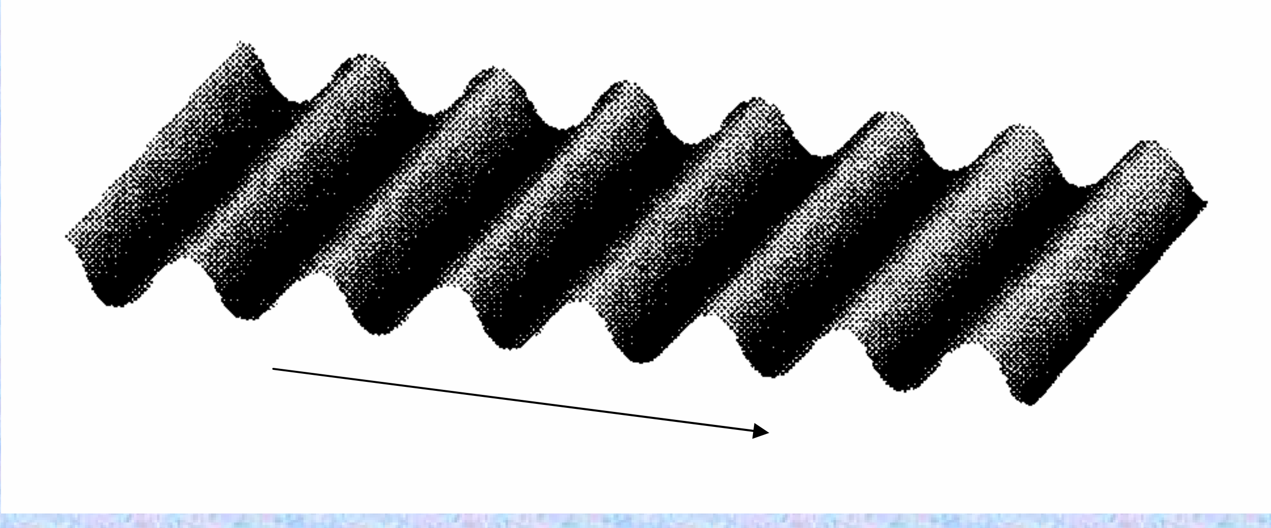
Presented at the STAIF II, March.13-15, 2012, Albuquerque, NM

Background of my research

T.T.Brown conducted the research on the rock electricity and he discovered that rocks possessed a property which he referred to as a natural electrical polarization. It is the phenomenon that electricity is generated from rocks, and he concluded that it was spontaneous, everlasting and affected only by diurnal cycles, which is based on observation taken for entire years in various parts of the United States. Brown concluded that the dielectric materials underwent changes influenced by the potion and orientation of the Earth with respect the Sun and Moon and the universe, which leads to the conclusion that the rocks can be charged by the gravitational waves arriving from the universe.

The author presents the theoretical analysis of the rock electricity discovered by T.T.Brown and an experimental result obtained by him to try to detect gravitational waves from the Crab nebula by using a piezoelectric transducer.

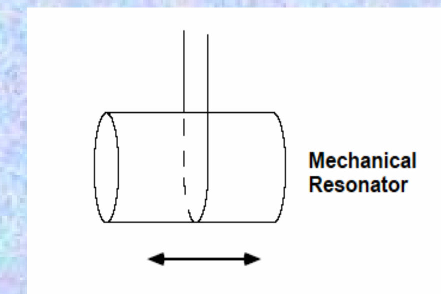
Gravitational wave propagating on the space-time manifold

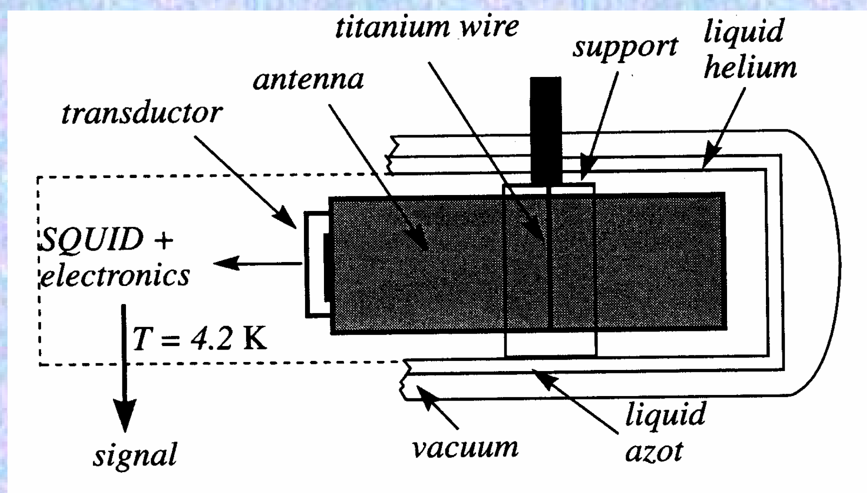


$$\bar{h}_{\mu\nu}(r,t) \approx \frac{4G}{r}\int \frac{T^{\mu\nu}(x',y',z',t-r/c)}{c^4}dx'dy'dz'$$

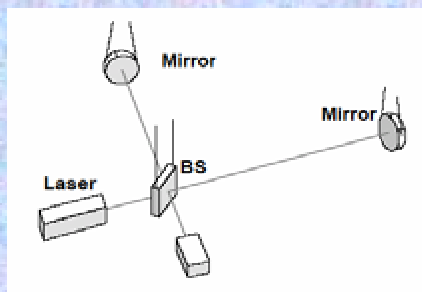
Conventional gravitational wave detecting methods

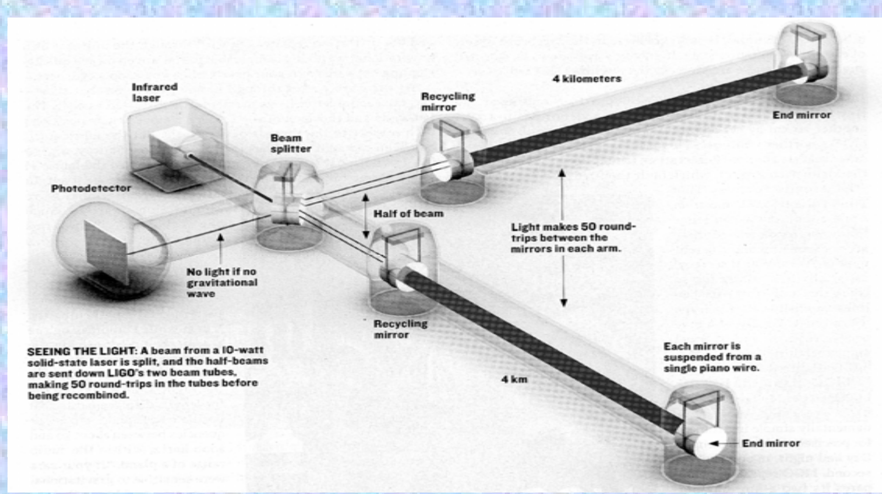
Weber Detector



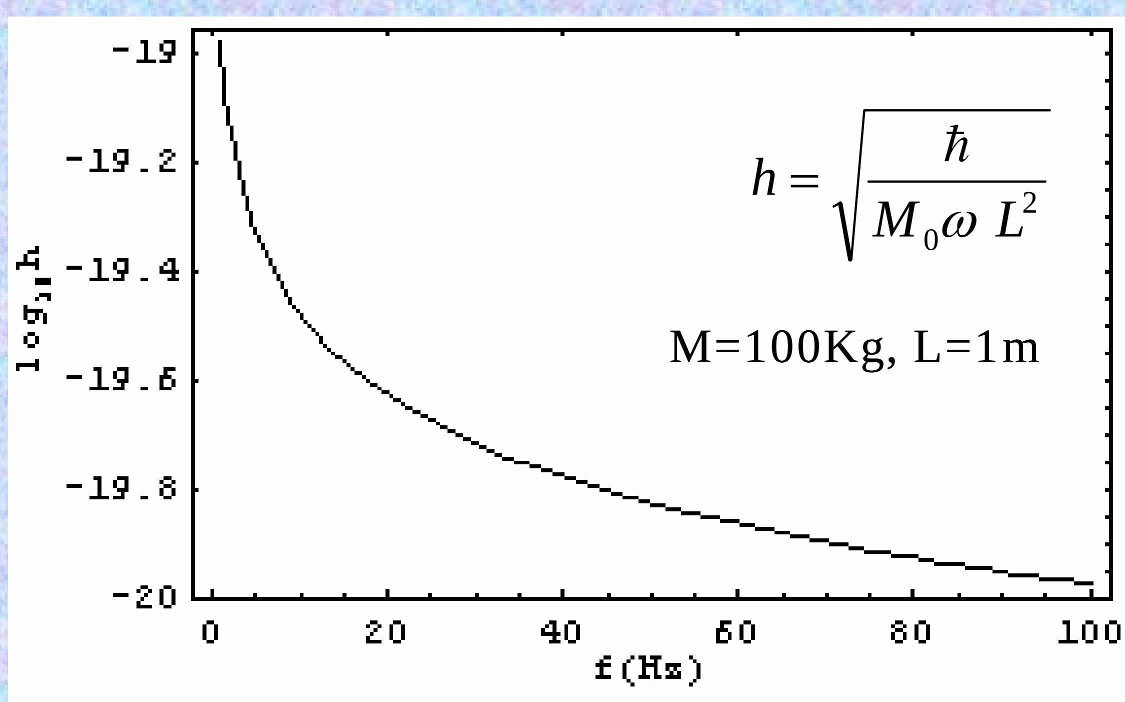


Interferometer

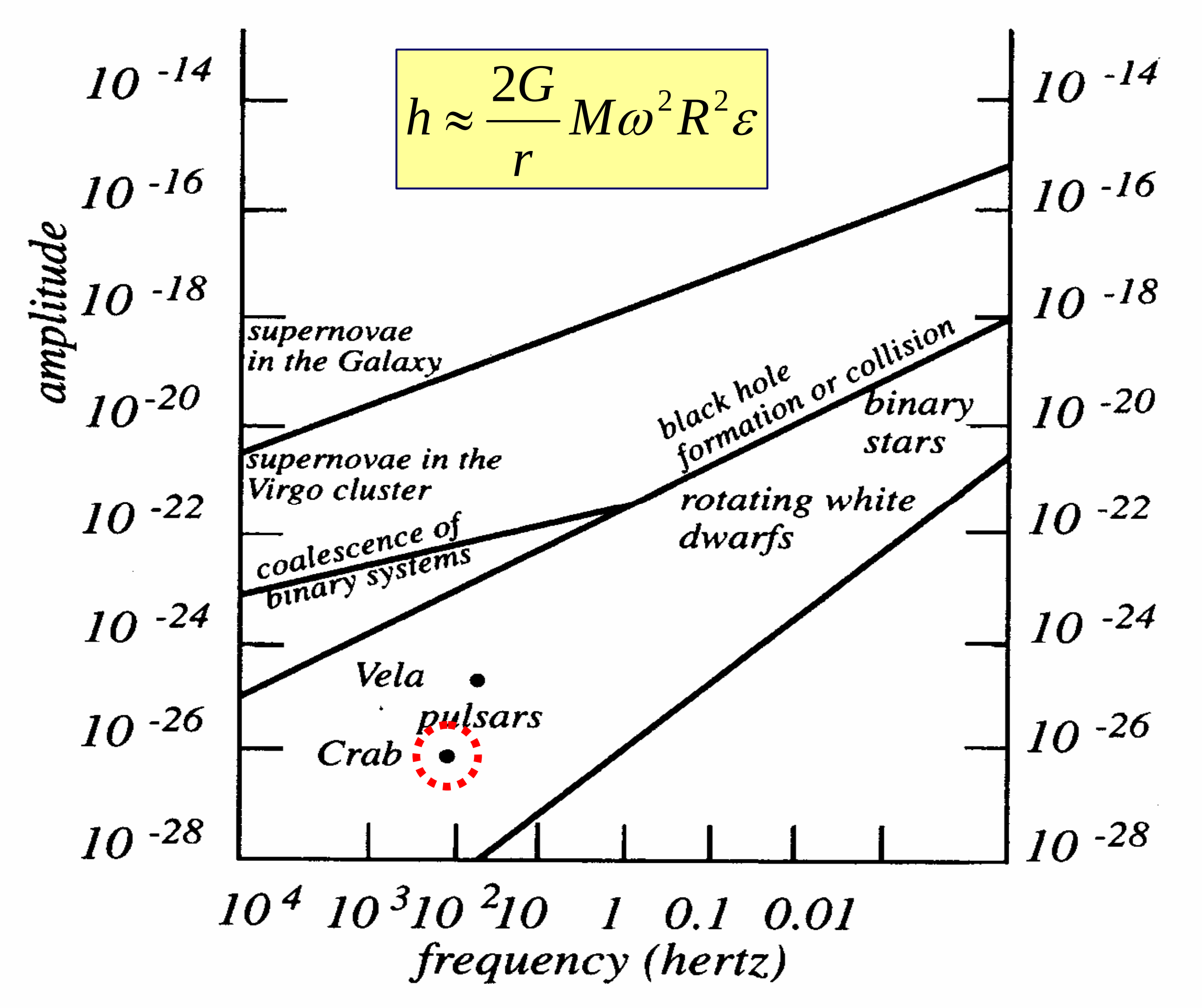




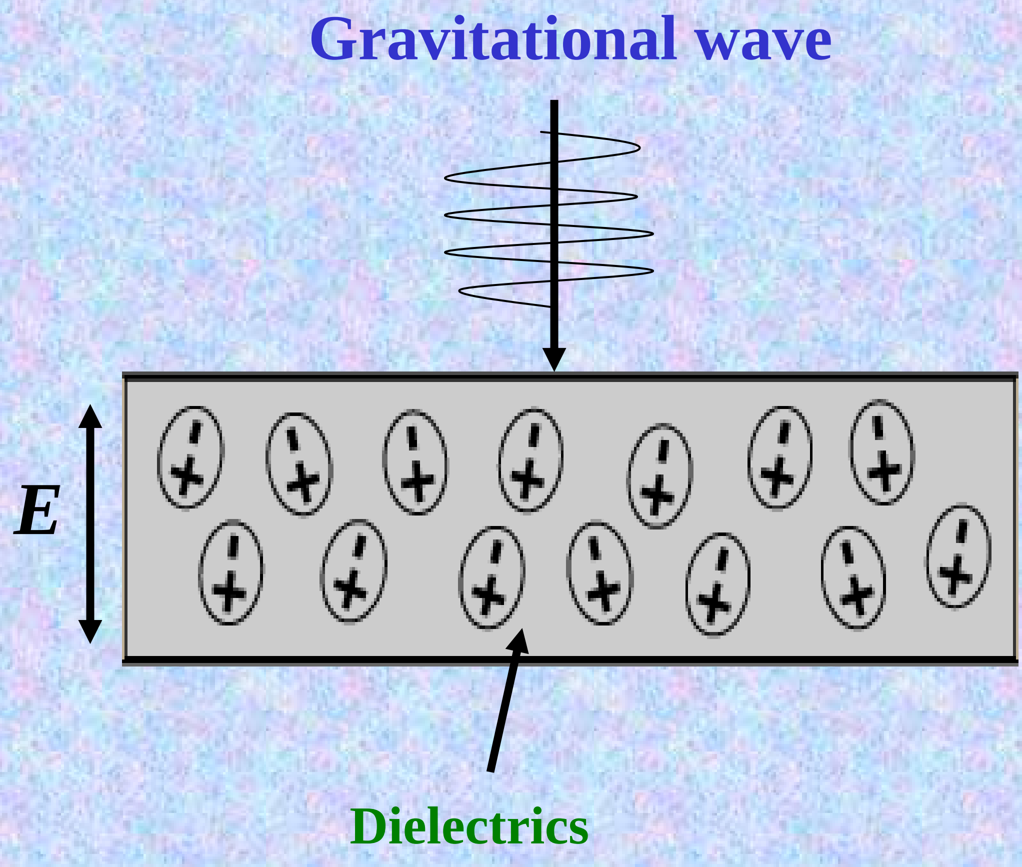
Quantum limit of the conventional gravitational detectors



Expected amplitude of the gravitational wave using currently accepted models



Electric field by gravitational waves



Derivation process of the formula

$$g_i = c^2 \hat{f}^{-1} \left(\frac{B'}{2} \sqrt{\frac{\kappa\varepsilon}{8\pi}} \bar{\phi}_i + \frac{\kappa\varepsilon}{8\pi} \bar{\phi} \bar{\phi}_i \right)$$

Weyl-Majumdar-Papapetrou solutions of the Einstein equations

⇓

$$|e| = \sqrt{4\pi\varepsilon_0 G} m$$

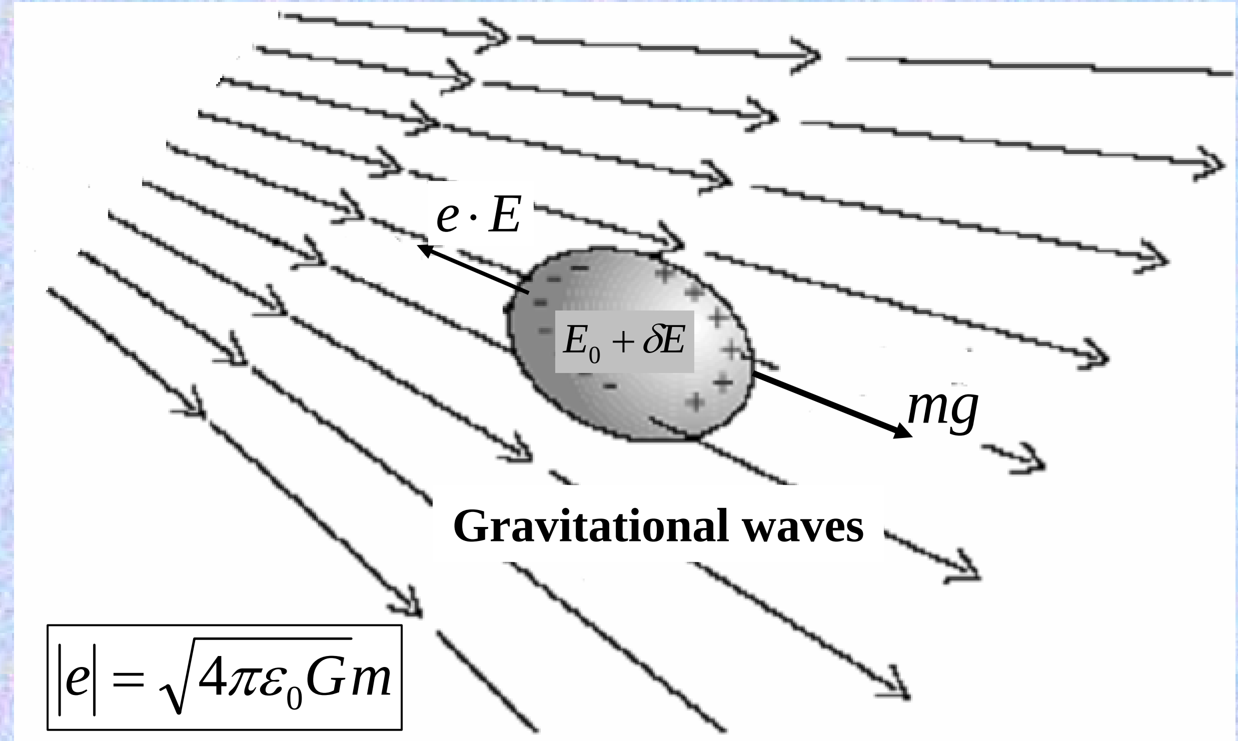
Equilibrium relation between the mass and the charge

⇓ $m \partial_k \phi \approx eE$

$$E = \frac{1}{\sqrt{4\pi\varepsilon_0 G}} g$$

Quasi-static equation for the generation of electric field by the gravitation

Charged particle which stays in equilibrium



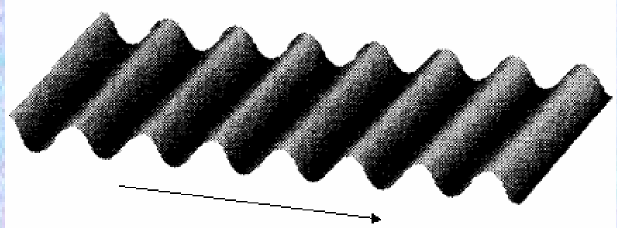
$$m\ddot{x}^k + m\partial_k \phi + m\omega_0^2 x^k = eE, \quad \omega_0 = \sqrt{4\pi N e^2 / m(\chi - 1)}$$

$$m\partial_k \phi \approx eE$$

Derivation process of the formula (continued)

(Propagating plane wave)

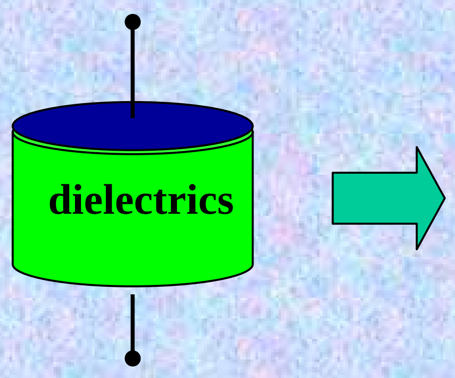
$$\phi = \phi_0 \exp[i(\omega t - k_z z)]$$



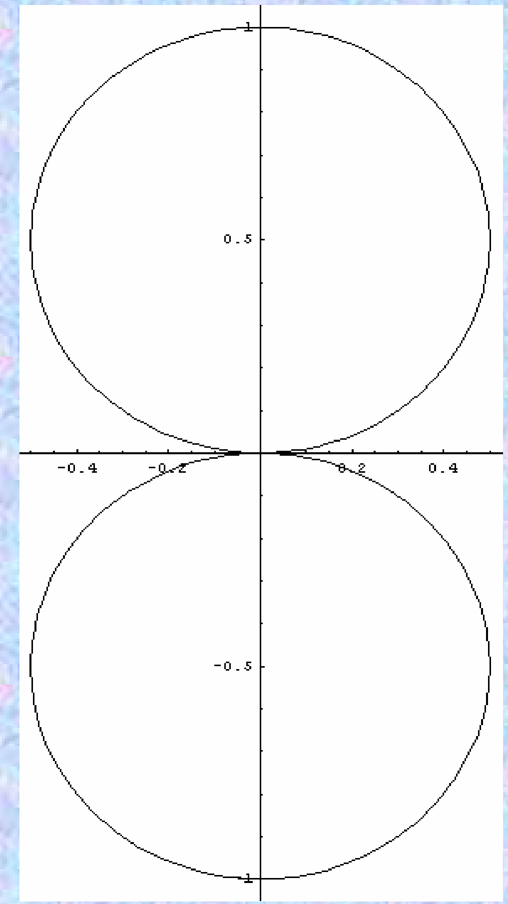
$$g = -\partial\phi / \partial z = k_z \phi_0$$

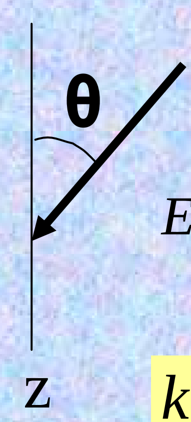
$$\phi_0 \approx \sqrt{4\pi\varepsilon_0 G} \cdot E / k_z = 8.6 \times 10^{-11} E / k_z$$

Directivity of the voltage output from the transducer



Transducer





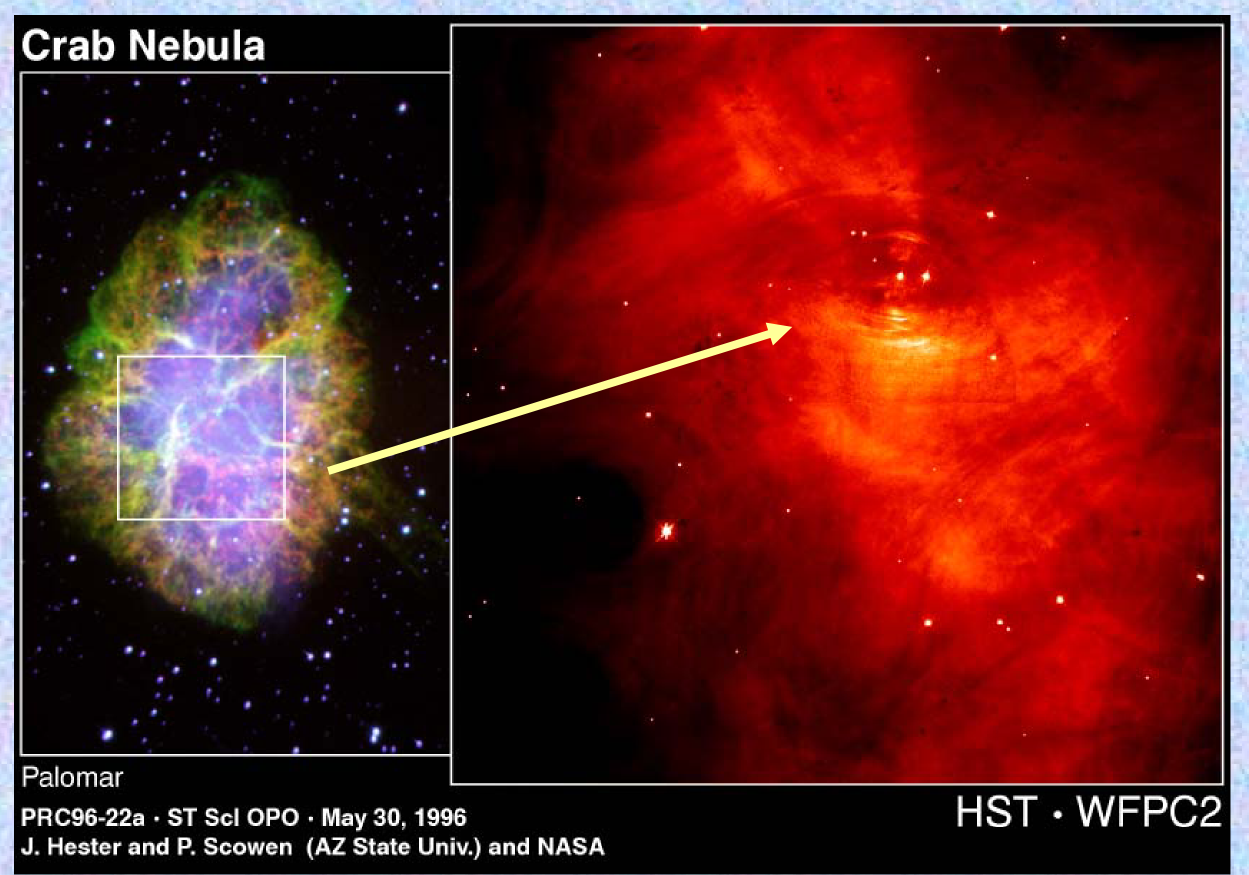
$$E = \frac{k_z}{\sqrt{4\pi\varepsilon_0 G}}\phi_0$$

$$k_z = \omega \cos\theta / c$$

Experimental Result for the Detection of Gravitational Waves

The experiment was conducted at the time 1700 on March 5, near the meridian passage of the constellation Taurus, in which the Crab nebula is located.

Pulsar in the Crab nebula



At the center of the Crab Nebula, there is a magnetized neutron star that spins very rapidly, completing one full revolution every 33 milliseconds (= 30.3Hz).

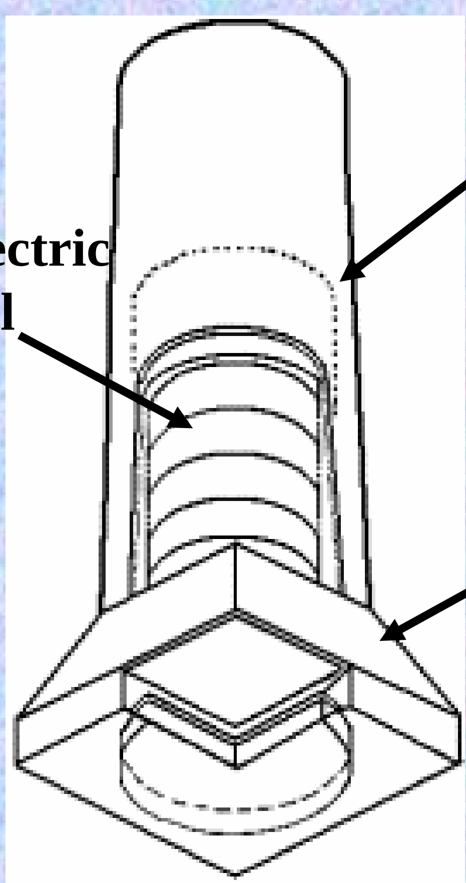
Facility used for the experiment

5th Research Center, TRDI in Yokosuka, Japan

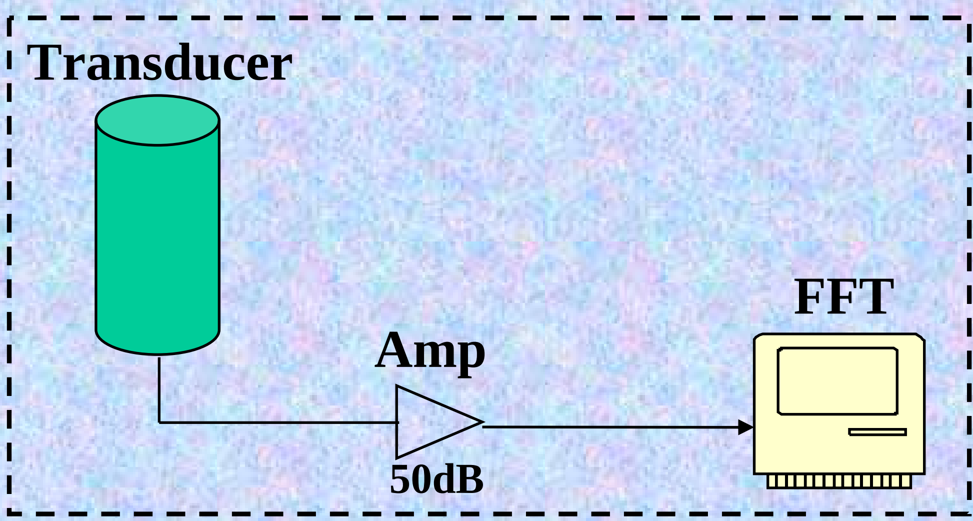
(35.224494N, 139.728096E, 1700, March 5,2006)

Experimental Set-up

Structure of the transducer used for the experiment



Gravitational waves measurement set-up



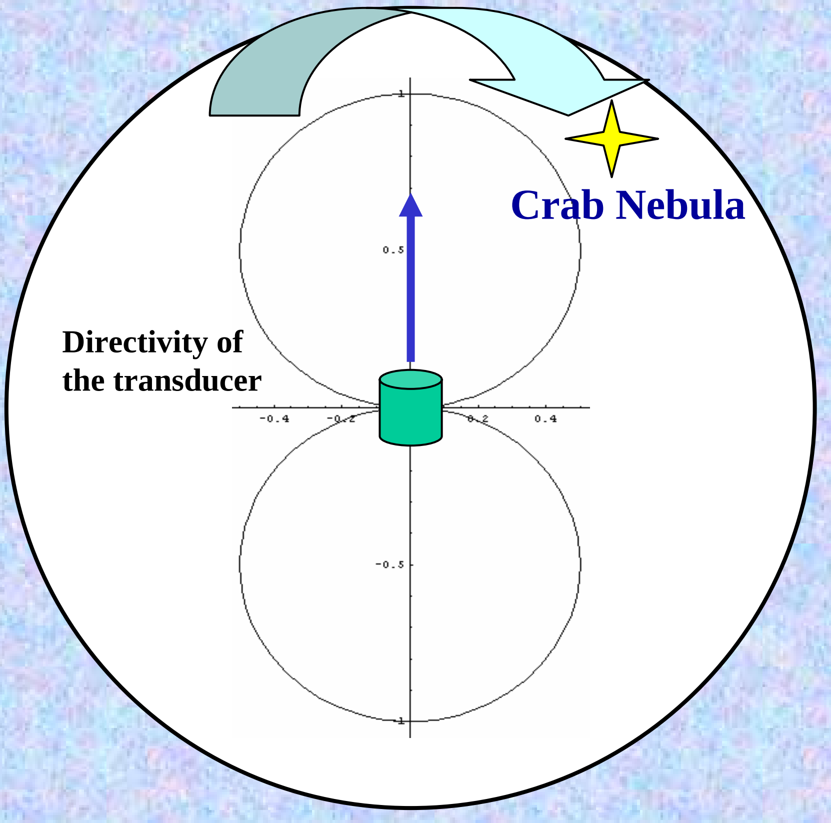
Multi-purpose
FFT Analyzer
CF-5220
(ONO SOKKI)

Total length	78 mm
d_{33}	302×10^{-12} m/V
ε_r	1400

$$h = 9.13\times10^{-20}\,\frac{\overline{\psi}_0}{f\cdot d}$$

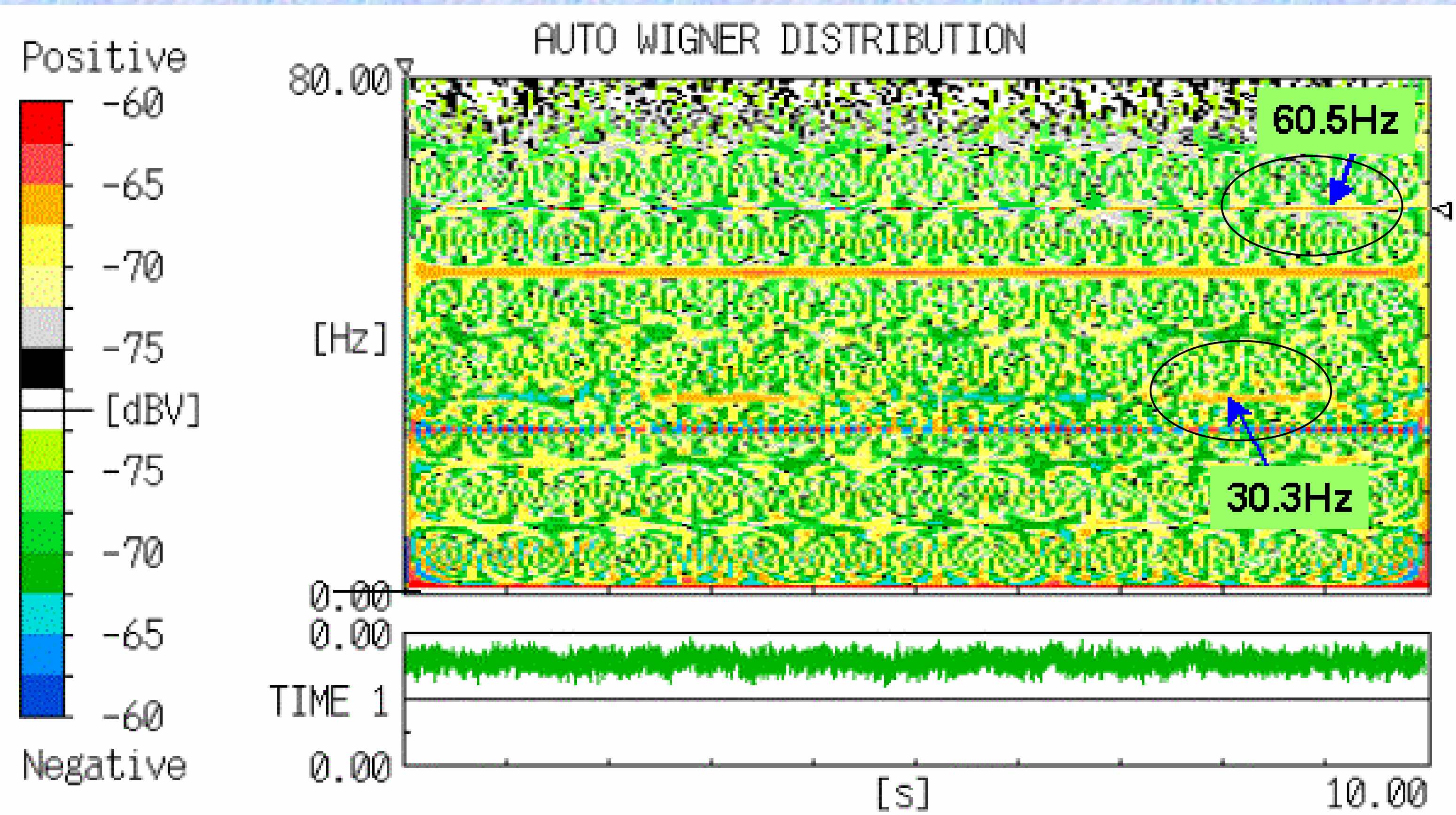
Time of the Experiment

1700, March 5, 2006 is near the meridian passage of the constellation, in which the Crab Nebula is located ⇒ Maximum directivity of the transducer



Location of the Experiment:
35.224494N, 139.728096E

Analyzed result by the Wigner distribution



$$W_s(f,t)=\int_{-\infty}^{+\infty} s(t+\tau/2)s^*(t-\tau/2)e^{-i2\pi f\tau}d\tau$$

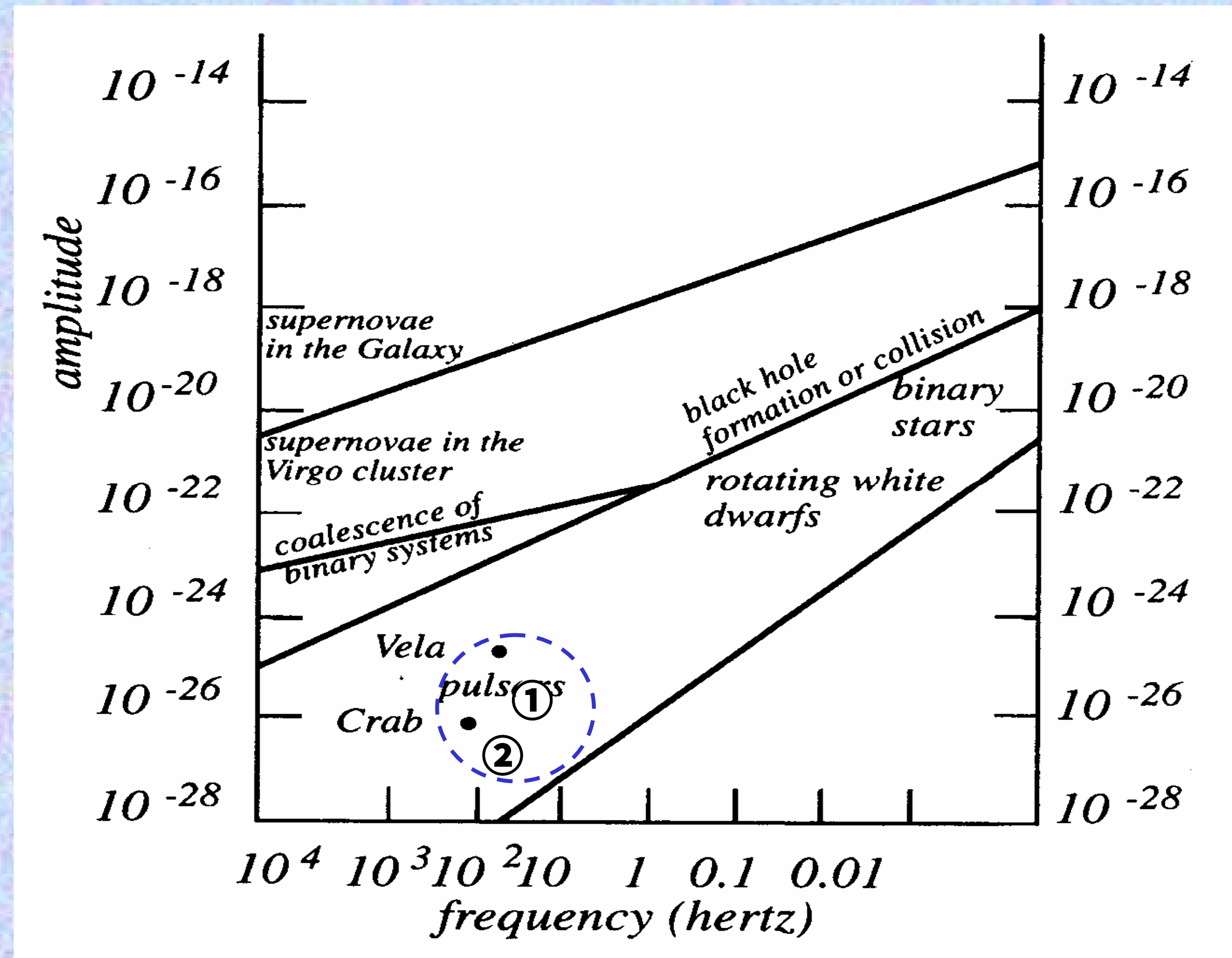
Frequencies of the signal detected, electric potentials measured at the output of the transducer and estimated amplitudes of gravitational waves from the Crab pulsar

No	Frequency	$\overline{\psi}_0$	h
1	**30.3Hz**	**-80.2dBV**	1.19×10^{-26}
2	**60.5Hz**	**-89.2dBV**	2.12×10^{-27}

$$h_{00} = 1.17\times10^{-18}\overline{\psi}_0 / f$$

One full revolution of the neutron stat be every 33 milliseconds (= 30.3Hz).

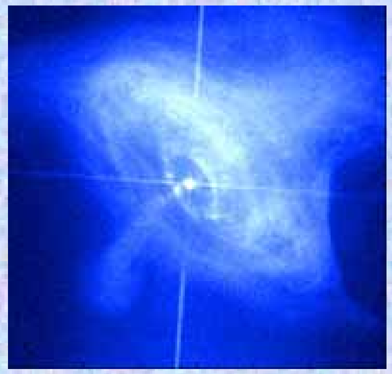
Experimental data compared with the theoretical analysis



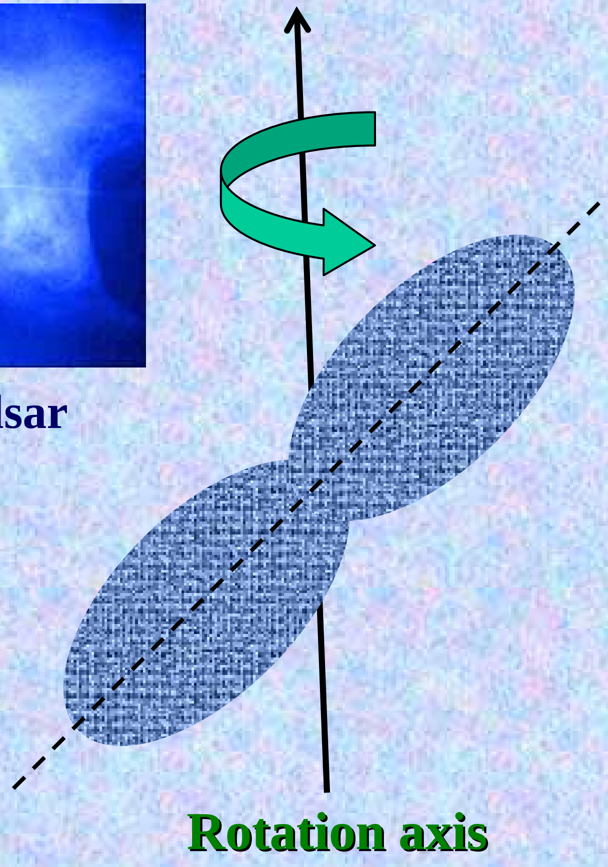
Shape of the Crab pulsar estimated from the Experiment data

30Hz and 60Hz spectrums detected

- Not a spherical but rather an oval shape.
- Rotation axis is shifted from the symmetrical axis.



Crab pulsar

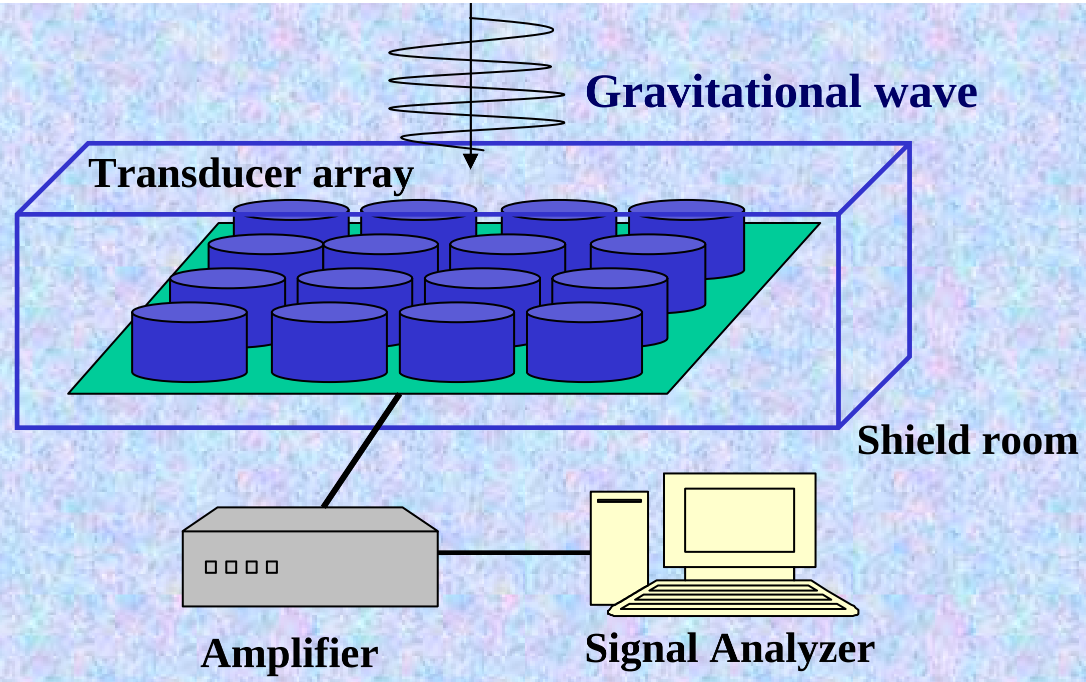


Conclusion

From the theoretical analysis, it is seen that the electric field can be induced by the gravitational field for the dielectric material and the relatively small gravitational detector with higher sensitivity compared with the conventional gravitational wave detector can be constructed.

Proposals for further experiments

- Higher dielectric constant ⇒ The detector must have the length more than ten times longer the original device to increase the sensitivity up to 20dB.
- Higher directivity ⇒Multiple transducer array must be used instead of a single element to sharpen its directivity.
- Low interference noise ⇒The experimental site must be located from the city, where there is a little influence of the electromagnetic noise to the experimental device.



The End