Agnosticism

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agnosticism

mission

fragment

- earth heat engine hypo
  high T Sun, low T background radiation
- 质子尺寸：s-wave的异常?
- cross section 在紫外趋于平稳一次函数

mystery

theoretical hypo without emperical evidence

- magnetic monopole
- proton decay
- SUSY
- electron size

emperical phenomenon without theoretical desctiption

- quantum collapse
- dark matter
- Baryon asymmetry
  matter-antimatter asymmetry
- neutrino oscillation
- chirality
  ElectroWeak theory is a chiral theory

other mysteries

- metallic hydrogen
  degenerate matter?
- quaser
- ball lightning

thought experiment

describing biosphere to aliens

- fundamental physical quantity

  temperature scale: water triple point

  length scale: spectrum wavelength

start with mountain height

- Xiao-Gang Wen
- discussion with Zhuo-Xiao Wang

  planet with too small size cannot grab water/oxygen and will lose them / become like Venus

  planet size and temperature
- invisibility

  submarine, optical invisibility and conductivity of water
- env for carbon-based lifeform

other

- a spoon of electron
- high-density air

  fundamental medium matter

  fundamental framework element

Mathematics

- Axiom of Choice

  Hausdorff ball
- indefinable real numbers
- Three crisis of mathematics

  proposed in Leninism society to demonstrate the evolution of science

  not necessarily three

Quantum Physics

- Non-unirarity of quantum collapse
- delayed eraser
- collapse 'is not an event' ?

ElectroDynamics

- action $L = V(\phi) + J\phi$ means J is source related to energy, and from Lagrangian equation $\partial\phi = J$ indicating J is also the field-generating source
- EM field in higher dimension

  E & M field no longer dual?

HydroDynamics

- Fluid Roche limit
- Waterball without gravity

  ossilation?

Astronomy

- Magnetic Field

  Solar wind dynamics in geomagnetic field is plasma dynamics rather than single particle one

  Solar wind + solar magnetic field also blocks space rays
- Atmospheric Optics

  absorption

  scattering

  Ionosphere Dynamics

Cosmology

- Scale invariance

  expression of space of light
- Penrose Conformal Cyclic Cosmology

Gravity

Gravitational Wave

- coupling of gravitational wave?

  with mass / gravitational waves / black holes
- curve of spacetime is nonlinear, ‘gravitational wave’ is just the linear asymptotic
- vaccum with nonzero cosmological constant is itself a momentum medium, it has E-P density
- it is not wierd that $(1 + \lambda(x + y)^2)^{\frac{1}{2}}$ has a $xy \times o(\lambda^2)$ term

mass myth

- ‘gravitational mass’ in classical equations is defined through energy/force

  then blocked by the fact that energy is not well defined in curved spacetime
- The only meaningful connection is through E-P tensor and Einstein equation $S = \sqrt{-h}S_{flat}$
- asymptotically mass could be treated as source of ‘gravity’ $(h - h_{flat})$

energy of gravity system

- how much energy is released in a collapsing celestial

  an extreme case is ‘black hole bomb’, which ‘release energy’ to an asymptotic flat spacetime

  then blocked by the fact that energy is not well defined in curved spacetime

Black Hole

Black Hole Geometry

- Black hole has no volume

  It has only area, just like the line on the tennis has no area but only length

  decuction: all mass of black hole is stored on surface — surface information hypo — holographic universe hypo

- Killing Vector

  how to comprehend the time/space Killing Vector?

Black Hole as a Celestial

- Dark region is larger than the horizon

Black Hole ThermoDynamics

- Hawking Radiation

  black hole evaporate V.S. Background Radiation

  mass-temp relation, critical mass/size

- Does black hole has a characteristic scale? Does the Penrose CCC hypo require all black holes vaporized?
- mass of a Schwarzmann black hole is proportional to area. But black hole thermodynamics is derived from energy extration in Penrose process of Kerr black hole. What' s meaningful in black hole thermodynamics $\delta M = \frac{\kappa}{8\pi G}\delta A + \Omega_H \delta J$ is surface gravity $\kappa = \frac{\partial M}{\partial A} \propto \frac{1}{M}$
- What is mass

  Irreducible mass is area sqrt $M_{irr}^2 = \frac{A}{16\pi G^2}$

  mass is E-P tensor, E-P is invariant of spacetime invariance, but black hole is curved spacetime

  is it related to 'gravity is entropy force'

  is Penrose process also related to entropy / free energy

Dynamics

fragment

- orbit stability

  Bertland Theorem

- sunshine duration
- effective gravity induced by rotation of facility

  Only second-order effect is present at a perturbative level

- epicycle model

  Fitting Kepler orbit of binary celestial system to epicycle system?

- space channel in gravitational fields

  More fictional rather than a realistic one. Few materials are found

- Hydrogen and $SO(4)$ symmetry

  Laplace-Runge-Lenz vector does not necessarily commute with angular momentum L in the $\mathcal{L}$ notion. It is conserved given that $\mathcal{H}$ is time-independent. In other words, it is invariant under a different (more strict) variational condition.

- action / time evolution

  Time evolution operators classically (failed)

Tidal Force

$$
\begin{aligned}
(1+x)^{-\frac{1}{2}} &= 1 + (-\frac{1}{2})x + (\frac{3}{8})x^2 + o(x^3) \\
(1+x)^{-\frac{3}{2}} &= 1 + (-\frac{3}{2})x + (\frac{15}{8})x^2 + o(x^3)
\end{aligned}
\tag{taylorM}
$$

$$
\begin{aligned}
\vec{a}_g &= -\frac{k}{|\vec{r}|^3}\vec{r} \\
&= -k(\vec{r}^2)^{-\frac{3}{2}}\vec{r} \\
&= -\frac{k}{r_0^3}(1 + \frac{(\vec{r_0} + \vec{\Delta} r)^2 - \vec{r_0}^2}{\vec{r_0}^2})^{-\frac{3}{2}}(\vec{r_0} + \vec{\Delta} r) \\
&= -\frac{k}{r_0^3}(1 + \frac{2\vec{r_0}\cdot\vec{\Delta} r + (\vec{\Delta} r)^2}{\vec{r_0}^2})^{-\frac{3}{2}}(\vec{r_0} + \vec{\Delta} r) \\
&= -\frac{k}{r_0^3}(1 - \frac{3\vec{r_0}\cdot\vec{\Delta} r}{\vec{r_0}^2} + \frac{15(\vec{r_0}\cdot\vec{\Delta} r)^2}{2\vec{r_0}^4} - \frac{3(\vec{\Delta} r)^2}{2(\vec{r_0})^2})(\vec{r_0} + \vec{\Delta} r)
\end{aligned}
\tag{taylorG}
$$

$$
\begin{aligned}
\vec{a}_c &= -\frac{k}{r_0^3}\vec{r_0} \\
\vec{a}_{Tide} &= \vec{a}_g - \vec{a}_c \\
&= o((\vec{\Delta r})^3) - \frac{k}{r_0^3}(\vec{\Delta r} - \frac{3\vec{r_0}\cdot\vec{\Delta r}}{\vec{r_0}^2}\vec{r_0}) \\
&- \frac{k}{r_0^3}(\frac{15(\vec{r_0}\cdot\vec{\Delta r})^2}{2\vec{r_0}^4} - \frac{3(\vec{\Delta r})^2}{2(\vec{r_0})^2})\vec{r_0} - \frac{k}{r_0^3}(-\frac{3\vec{r_0}\cdot\vec{\Delta r}}{\vec{r_0}^2})\vec{\Delta r} \\
&= \vec{a}^1_{Tide} + \vec{a}^2_{Tide} + o((\vec{\Delta r})^3) \\
\vec{a}^1_{Tide} &= -\frac{k}{r_0^3}(\vec{\Delta r}_\perp - 2\vec{\Delta r}_\parallel)
\end{aligned}
\tag{taylorTide}
$$

$$
\begin{aligned}
V_g &= -\frac{k}{|\vec{r}|} \\
&= -k(\vec{r}^2)^{-\frac{1}{2}} \\
&= -\frac{k}{r_0}(1 + \frac{(\vec{r_0}+\vec{\Delta r})^2 - \vec{r_0}^2}{\vec{r_0}^2})^{-\frac{1}{2}} \\
&= -\frac{k}{r_0}(1 + \frac{2\vec{r_0}\cdot\vec{\Delta r} + (\vec{\Delta r})^2}{\vec{r_0}^2})^{-\frac{1}{2}} \\
&= -\frac{k}{r_0}(1 - \frac{\vec{r_0}\cdot\vec{\Delta r}}{\vec{r_0}^2} + \frac{3(\vec{r_0}\cdot\vec{\Delta r})^2}{2\vec{r_0}^4} - \frac{(\vec{\Delta r})^2}{2(\vec{r_0})^2}) + o((\vec{\Delta r})^3) \\
&= V_0 + V_1 + V_2 + o((\vec{\Delta r})^3)
\end{aligned}
\tag{taylorV}
$$

Coriolis Force

In system with rotation $(\vec{\omega}, \vec{\beta})$ around point O, Non-inertial forces are

$$
\begin{aligned}
\vec{a}_c &= -2(\vec{\omega}\times\vec{\delta v}) \\
\vec{a}_\beta &= -\beta \times \vec{\delta r}
\end{aligned}
\tag{aRot}
$$

Space Colony

Space station O is orbiting $\vec{r} : (r, \theta)$ around the earth and an astronaut is wandering around O with displacement $\vec{\Delta r}$ in non-rotating system and $\vec{\delta r}$ in rorating system.

Dynamic in the rotating system is described as

$$\begin{aligned} \vec{a}_\delta &= \vec{a}_{Tide} + \vec{a}_c + \vec{a}_\beta \\ \vec{a}_{Tide} &= -\frac{k}{r_0^3}(-2\delta r_r \hat{r} + \delta r_\theta \hat{\theta}) \\ \vec{a}_c &= 2\dot{\theta}(\delta \dot{r}_\theta \hat{r} - \delta \dot{r}_r \hat{\theta}) \\ \vec{a}_\beta &= \ddot{\theta}(\delta r_\theta \hat{r} - \delta r_r \hat{\theta}) \end{aligned} \tag{aDelta}$$

Assume O is orbiting on a circle $(\dot{\theta}, \ddot{\theta}) = (\omega, 0)$, we have $\omega = \frac{k}{r_0^3}$,

then the above equations are simplified as

$$\begin{aligned} \frac{d^2}{dt^2}\vec{\delta r} &= \vec{a}_{Tide} + \vec{a}_c \\ &= -\omega^2(-2\delta r_r \hat{r} + \delta r_\theta \hat{\theta}) + 2\omega(\delta \dot{r}_\theta \hat{r} - \delta \dot{r}_r \hat{\theta}) \end{aligned} \tag{aCircle}$$

Qualitative analysis of the dynamics: Assume the astronaut orbits around the space station with $\dot{\delta\theta} < 0$ and a period same as the space station orbit T_0

- Averagely, orbit of $\vec{\delta r}$ operates with $-\vec{\omega}$;
- At vertex along the $\hat{r}$ direction, $\vec{a}_{Tide}$ points outwards, so velocity should be large to generate massive $\vec{a}_c$;
- At vertex along the $\hat{\theta}$ direction, $\vec{a}_{Tide}$ points inwards, enough to keep the orbit bound, so velocity should be small;
- Quantitave description of the orbit dynamic remains mystery;

Lagrangian Points

We consider the effective dynamics in a Non-inertial system of two-body gravity system.

Consider a two-body system consists of two celestial bodies M_1 and M_2 with distance of D. The two-body effective mass and orbiting angular velocity are

$$
\begin{aligned}
M &= \frac{M_1 M_2}{M_1 + M_2} \\
\frac{GM_1M_2}{D^2} &= \frac{M_1M_2}{\omega}^2 D \\
\omega^2 &= \frac{G(M_1+M_2)}{D^3}
\end{aligned} \tag{motionBin}
$$

The two celestial bodies are orbiting around the centroid O. Now we consider the Lagrangian point L_4 locating at the vertex of an equilateral triangle connecting M_1 and M_2, thus we have $\vec{r} = \frac{M_1\vec{r_1}+M_2\vec{r_2}}{M_1+M_2}$

In the rotating celestial system, the effective potential around L_4 is

$$
\begin{aligned}
V_{eff} &= V_0(\vec{r_1}) + V_1(\vec{r_1}) + V_2(\vec{r_1}) + V_0(\vec{r_2}) + V_1(\vec{r_2}) + V_2(\vec{r_2}) + o((\vec{\Delta} r)^3) + V_\omega \\
&= V_{eff}^0 + V_{eff}^1 + V_{eff}^2 + o((\vec{\Delta} r)^3) \\
V_\omega &= -\frac{1}{2}\omega^2(\vec{r} + \vec{\Delta} r)^2 \\
V_{eff}^1 &= -\frac{GM_1}{D}\left(-\frac{\vec{r_1}\cdot\vec{\Delta} r}{|\vec{r_1}|^2}\right) - \frac{GM_2}{D}\left(-\frac{\vec{r_2}\cdot\vec{\Delta} r}{|\vec{r_2}|^2}\right) - \omega^2\vec{r}\cdot\vec{\Delta} r \\
&= \frac{G}{D^3}(M_1\vec{r_1} + M_2\vec{r_2})\cdot\vec{\Delta} r - \frac{G}{D^3}(M_1\vec{r_1} + M_2\vec{r_2})\cdot\vec{\Delta} r \\
&= 0 \\
V_{eff} &= V_{eff}^0 + V_{eff}^2 + o((\vec{\Delta} r)^3)
\end{aligned} \tag{taylorBin}
$$

In fact V_{eff}^2 is convex around L_4, thus L_4 is a smooth maximum in the rotating system. Celestial bodies around L_4 are bounded by Coriolis force under certain condition (the mass ratio boundary $\frac{M_1}{M_2}$ actually)