

Limits of imaging

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Imaging

Primitive

Direct inversion

Object → optical media
→ Identification



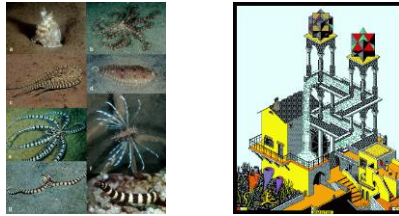
Advanced

Modeling

Model → mathematical
media → interpretation

Limitations of direct inversion

- **Mimicry**



Not sufficient information on the object

- **Illusion**

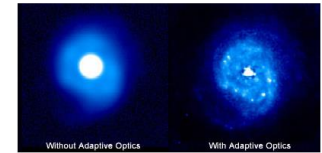
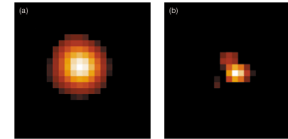
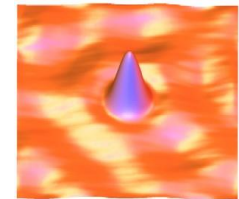
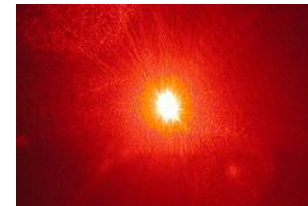


Figure 7. Images of FS Tau, a young star, (a) without adaptive optics and (b) with Lick laser guide star adaptive optics, in which a faint binary companion is seen.

Optical media is at fault

- **No identification (lack of reference object or limitations by physical laws)**



Advanced imaging

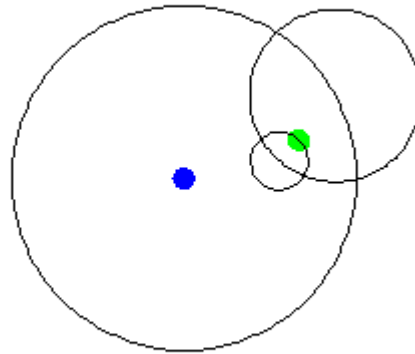
- Human invention
- Roots in organized societies (**prophets, soothsayers, priests**)
 - **Basic want:** to predict events
 - **Basic information:** model of Nature
 - **Basic intermediary:** supreme being
- Birth of science (**scientists**)
 - **Supreme being** is replaced by **mathematics**

Mimicry

The nature of gravity

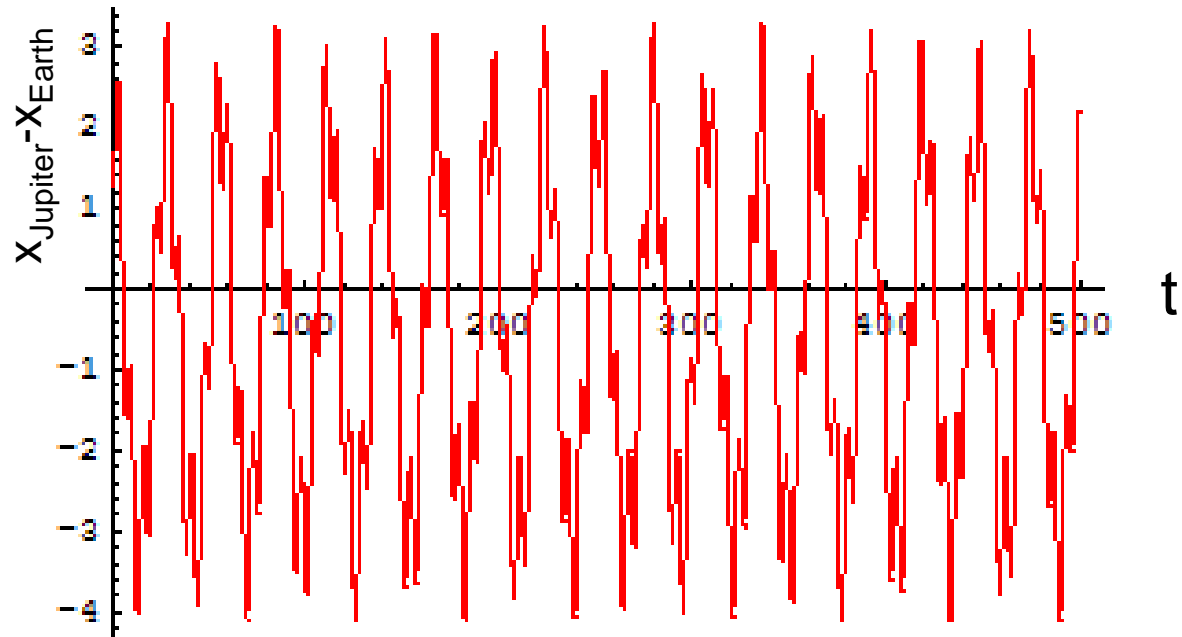


Ptolemy model

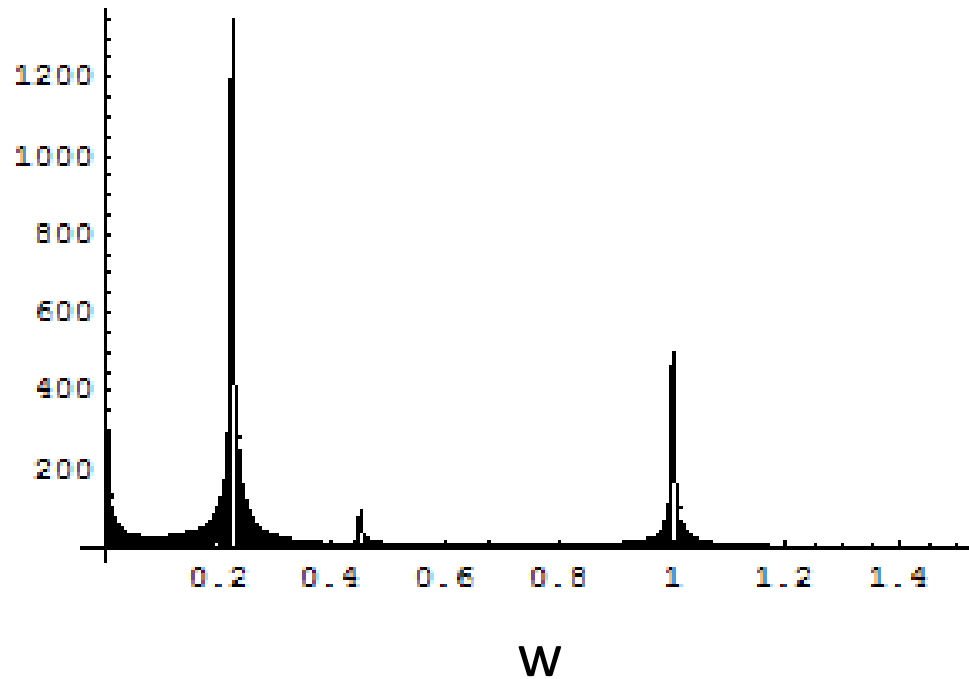


$$\begin{aligned} x_j - x_z &= r_1 \cos \varphi_1 t - r_2 \cos \varphi_2 t - r_3 \cos \varphi_3 t \\ y_j - y_z &= r_1 \sin \varphi_1 t - r_2 \sin \varphi_2 t - r_3 \sin \varphi_3 t \end{aligned}$$

$$X_{\text{Jupiter}} - X_{\text{Earth}}$$



Spectrum of $X_{\text{Jupiter}} - X_{\text{Earth}}$



Epicycles for Jupiter



$w_1 \square 0; w_2 \square 0.2247; w_3 \square 0.4492; w_4 \square 1$

$r_1 \square 0.6089; r_2 \square 2.6828; r_3 \square 0.2; r_4 \square 1$

Mimicry

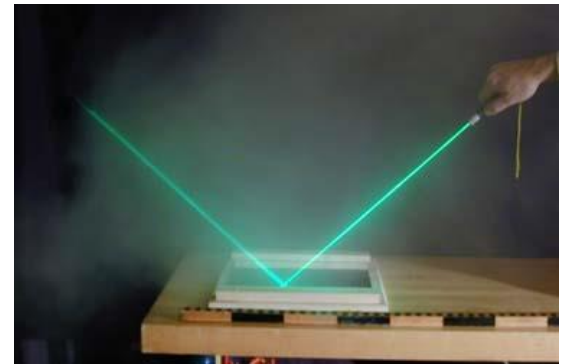
The nature of electromagnetic field

Newton conjecture

Light is a stream of particles

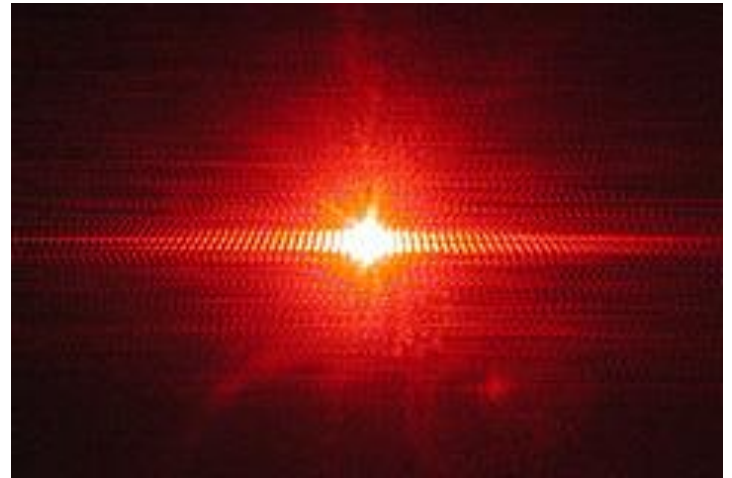
- Supporting argument:
Particles go in straight lines and obey simple laws of reflections.
Beam of light behaves likewise.

Light is a stream of particles



Wave nature of light

- **Experiment:** beam of light cannot have a sharp edge (Fresnel diffraction).
- **Theory:** the wave that has the wavelength much shorter than the width of the beam obeys the rules of geometric optics.



The argument for the particle nature of light is invalidated.

Particle nature resurrected

- Lewis argument
 - Charge-EM wave energy/momentum transfer is the same as for particles
- Argument against
 - Interference, diffraction
- Proof against particle nature
 - Frequency dependent energy/momentum transfer is derived from quantum dynamics

Compromise

- Instead of rejecting particle nature of the electromagnetic field a new idea in science is introduced

dualism

Essence of particle manifestation of the electromagnetic field

$$\begin{aligned}
 & i \left[\frac{1}{2m} \left(\mathbf{f} \cdot \nabla - \nabla \cdot \mathbf{f} \right) - \mathbf{f} \cdot \mathbf{v} \right] \mathbf{A} \cdot \mathbf{f} \\
 & \mathbf{A} = \mathbf{A}_0 e^{i\mathbf{k} \cdot \mathbf{r} - i\omega t} \quad \mathbf{A}_0 e^{i\mathbf{k} \cdot \mathbf{r} - i\omega t} \\
 & \mathbf{f} = \mathbf{f}_0 e^{i\mathbf{k} \cdot \mathbf{r} - i\omega t} \quad \mathbf{f}_0
 \end{aligned}$$

Photon counter

- Based on the effect of ejecting electrons from atoms by the electromagnetic plane wave.
- Probability of ejecting is proportional to:
amplitude squared of the field - **modulus of the Poyting vector** - **number of photons**

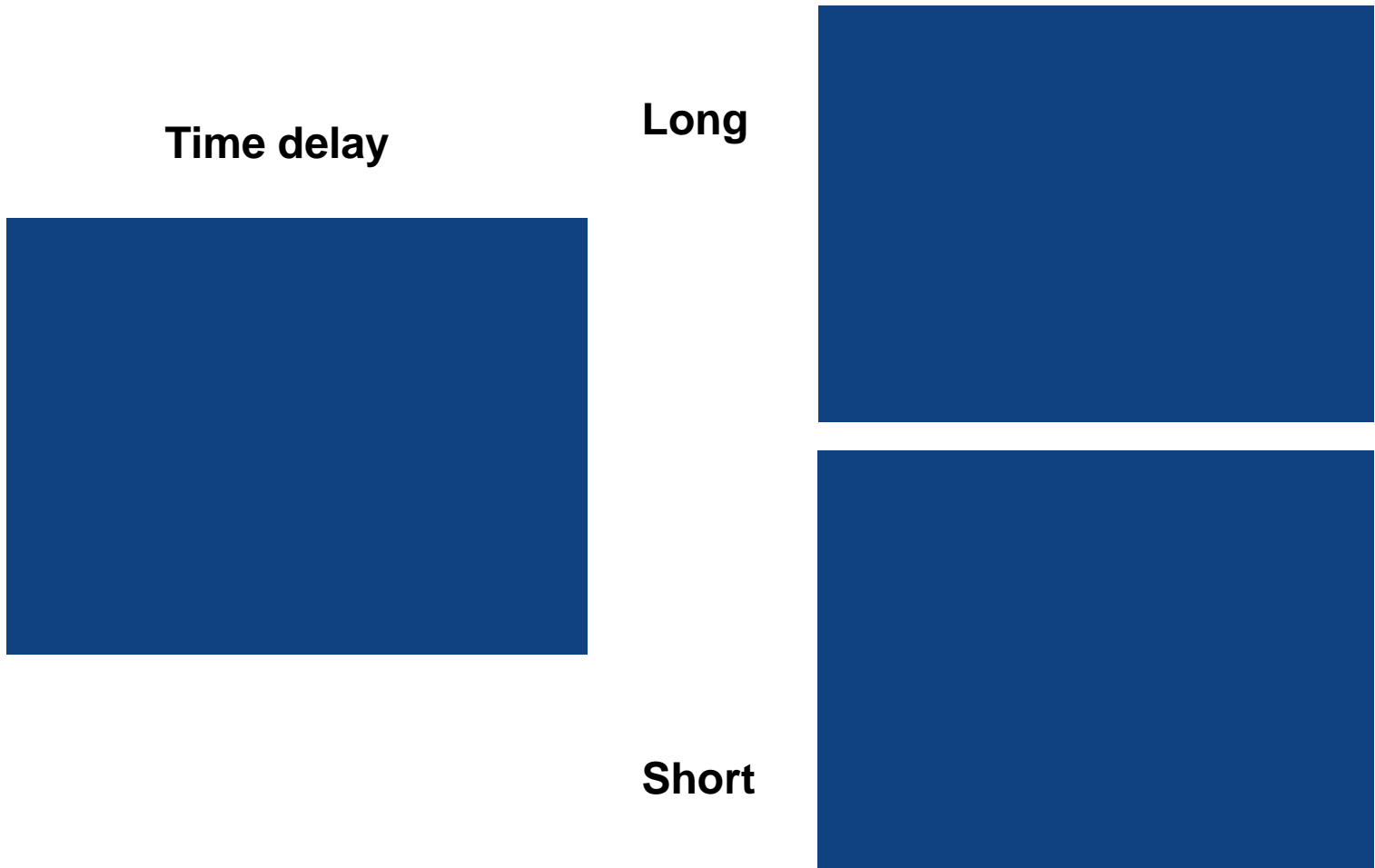
Weaknesses of the photon model

- Compton effect must assume a bound charge
- Rabi oscillations not explainable
- Drift velocity not explainable

Illusion Resonances

- Typical quantum phenomenon in dynamics of particles:
 - Decay
 - Nuclei, elementary particles, dissociation of molecules
 - Collisions
 - Elementary particles, long lived transition states, quantum gas

Time delay and resonance scattering



Illusion

Klein paradox

- Great impact on merging relativity and quantum mechanics
- Based on its predictions it is accepted that merger is not possible without quantizing field of particles
- Its predictions are:
 - Creation of particle-antiparticle pairs
 - Particles cannot be bound

Scattering on infinite potential wall

non relativistic dynamics



Errors in derivation

there are many

- Plane wave in $z > 0$ does not represent outgoing wave

$$e^{iPz} \quad \text{or} \quad e^{i v z - i p z}$$

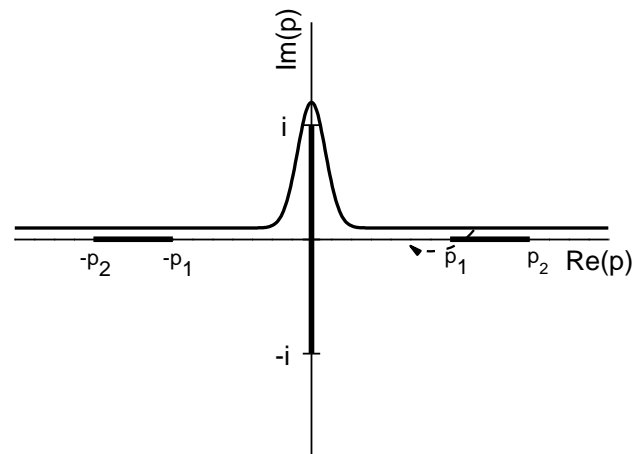
- Equation for wave function has singularity

$$\psi_{z,z} f = \frac{1}{e^{-v} - 1} \psi_z v \psi_z f \quad \left| e^{-v} \right| \approx 1 \quad \left| f \right|$$

- Exact solution is

$$\int \left[A f e^{iet} + A f e^{iet} \right] dp$$

- where integration path should be defined in Riemann p -plane



Scattering on hard wall

standard boundary condition



Scattering on hard wall

“physical” boundary condition



No reference object spin-statistics connection

- Fundamental empirical postulate
 - Spin dependent symmetry of the probability amplitude for a system of identical particles
- Problem
 - Symmetry has origin in dynamics, what is it for this postulate?

Example

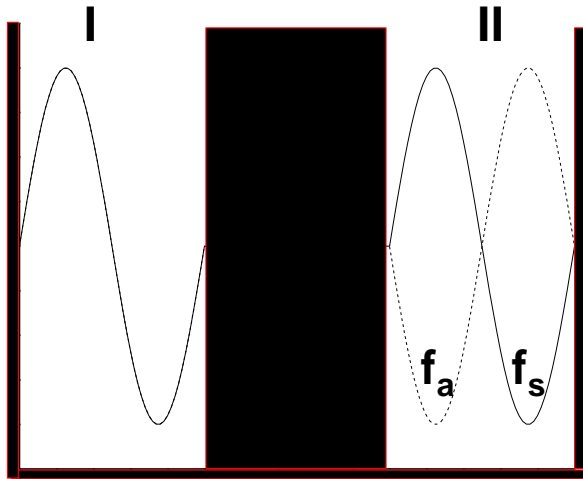
super fluidity

- He⁴ and He³ have different super fluid properties.
- Dynamic parameters that determine fundamental difference
 - Mass and magnetic dipole moment
- Mass determines the smallest stable cluster
- Potential energy of two magnetic dipole moments for protons at $r=10^{-10}$ m
 - $V \sim 10^{-10}$ eV

Claim

- Fundamental difference of two liquids is the consequence of the nuclear spins of the two He isotopes, resulting in:
 - different symmetry of the probability amplitude for the two systems of He atoms**
- Question:
 - What is the interaction that causes the difference in symmetry?**

Role of symmetry



Particle is localized in

well I $\square f \square f_s \square f_a$

well II $\square f \square f_s \square f_a$

For 2 particles one defines

$f_1 \square f_s \square 1 \quad f_s \square 2 \quad f_2 \square f_a \square 1 \quad f_a \square 2$

$f_3 \square f_s \square 1 \quad f_a \square 2 \quad f_s \square 2 \quad f_a \square 1$

$f_4 \square f_s \square 1 \quad f_a \square 2 \quad f_s \square 2 \quad f_a \square 1$

Particle 1 in well I and particle 2 in well II

$f \square f_1 \square f_2 \square f_4$

Two identical particles in harmonic field

Model for connecting interaction with permutation symmetry

$$\begin{aligned}
 & \frac{1}{2} \psi_1 + \frac{1}{2} \psi_2 + \frac{1}{2} \psi^2_{r_1} + \frac{1}{2} \psi^2_{r_2} + V \left[\psi_{r_2} \psi_{r_1} \right] \\
 & \left[\psi_r \right] + \frac{1}{4} \left[\psi_R \right] + \frac{1}{4} \left[\psi^2_{r^2} \right] + \frac{1}{4} \left[\psi^2_{R^2} \right] + V \left[\psi_r \right] \\
 & r \left[r_2 \right] \psi_{r_1} \quad R \left[\frac{1}{2} \right] \left[r_2 \right] \psi_{r_1}
 \end{aligned}$$

Solution

$$\psi(r_1, r_2) = f(r) g(R)$$

For repulsive $V(r) > 0$ boundary condition is $\psi(r) = 0$

In terms of unperturbed solutions

$$\psi(r_1, r_2) = \psi_n(r_1) \psi_m(r_2) + \psi_n(r_2) \psi_m(r_1)$$

No reference object

- What is a reference object?
 - Built from classical experience
 - Force plays the central role**
- Limits of classical experience
 - Quantum effects
 - Relativistic effects
 - Field reaction

Imaging without reference object

Mathematical modeling

- **Examples**