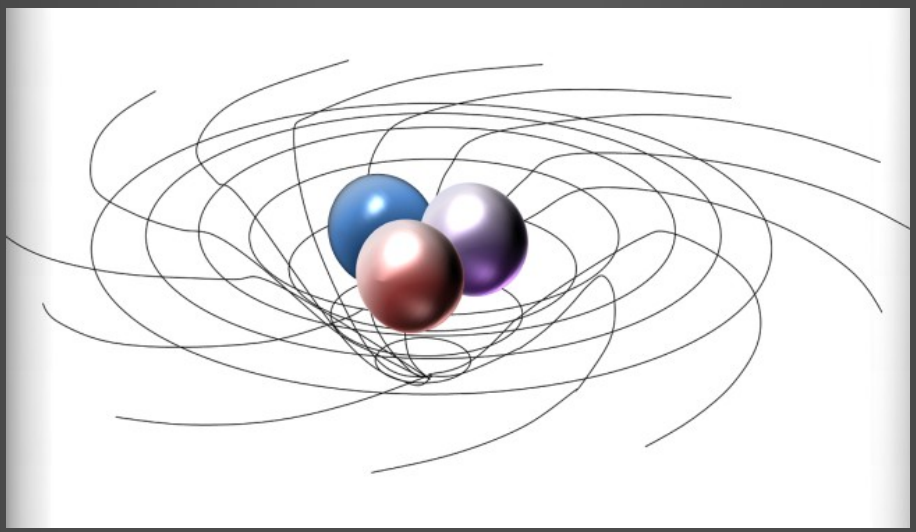
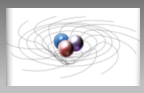
The Quantum Force



For background and rule information please enter at your own risk here….



Introduction

Black Holes, Wormholes, Time Dilation – Can you master the laws of nature? Explore the world of physics from the far reaches of space to the smallest reaches of atoms as you search for the coveted pulsar stones. But beware, the strange effects of each realm may engulf, contract, dilate, and even entangle you along the way. This game will test your skills and enlighten your mind as you discover the weird twists and turns of modern physics and strive to become the ultimate quantum force!

Note: Each realm represents a true physics principle and background for each realm is provided in the Quantum Force Cards section of this booklet. However, background information should be validated by the reader as scientific truth is constantly being discovered and modifications to theories and understanding are often updated. This game is intended to simply introduce players to these concepts and also encourage some fun along the way.

General Description of Game Play

Winning the Game

Each player works their way around the game board striving to uncover pulsar stones and gain points before time runs out. The player with the most points when all players have exhausted their time or when all pulsar stones have been uncovered, wins.

Points

Players receive four points for each pulsar stone, but minus two points for each charge stone in hand at the end of the game. The ultimate pulsar stone is worth ten points.

Enhanced Play (Option) – As an option, players may chose to log the number of spaces they've moved throughout the game. When points are tallied, players receive one point for each space moved towards their total.

Getting Started

Setting up the Board

If opening the game for the first time a 4"x4" square card contains the charge and pulsar indicator pieces. These squares should be cutout to create the individual pieces. Similarly, a 4"x4" square has the protection realm pieces. These should be cutout as well.

The game board is made up of 16 discrete realms. Refer to the back section for a background explanation of each of the realms.

Randomly place, face down, one blue pulsar indicator square on the black square in each of the non-Earth, non-Protection realms. No player is allowed to initially know the value of the indicator for each realm.

Randomly place, face up, one red, charge indicator square on the red square in each non-Earth, non-Protection realm.

Each player gets a tracking card and three clear crystals to track the number charge stones, pulsar stone, and time stones that they have. The red squares on the tracking mat are used to track charge stones, the blue squares are used to track pulsar stones, and the purple areas are used to track times stones. Players start out with three charge stones and eight time stones (i.e. place a crystal on the red square marked with a three and place another crystal on the purple area marked with an eight.

Players begin play in a protection realm of their choice and each player initially starts out with three red charge stones and eight purple time stones.

Play always begins with the youngest player and moves clockwise.

Playing the Game

Player Movement

Each player rolls the dice to determine how many spaces they may move. A player may move any number of spaces up to the number indicated by the dice.

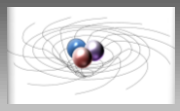
Movement around the game board is circular. So, if a player is in the upper left most realm they may move left off the board and end up in the realm in the upper right most position. This type of circular movement is allowed for all realms along the edges of the board.

Players may make a move and explore a realm during the same turn.

Time Stones

Each player starts out with eight time stones. These stones represent the ability for a player to take a turn exploring or moving. After each turn, the players must reduce the number of times stones they have by one. Once a player has relinquished all their time stones they have run out of turns to play. There are ways, however, for a player to obtain additional time stones even once they've run out, so don't go far!

If desired, players may choose to skip their turn and therefore not have to relinquish a time stone for their turn.



Charge Stones

Charge stones are acquired by visiting the Earth Realm and are needed for exploring non-Earth and non-Protection realms. To obtain charge stones, a player rolls the dice while on the center location of the Earth realm. The player then receives the number of charge stones indicated by the dice.

The charge stones allow the spaceship to enter and exit the realms atmosphere. The number of charge stones required to explore a realm is indicated by the value on the charge stone indicator placed in each realm. Once a player is on the center point of a realm and decides they want to explore, they must relinquish the number of charge stones shown on the indicator.

On a player's turn, the player may choose to remain in their current location and re-explore that realm. In this case, a player need not relinquish additional charge stones. However, if the player leaves the realm, returns, and wishes to explore the realm again, they need to repay the number of charge stones required to explore the realm.

Obtaining Pulsar Stones

Players obtain Pulsar Stones by exploring the various realms and subsequently drawing a Pulsar Stone card from the Quantum Force Card pile. To explore a realm, a player must be located on the center position within the realm. The player may then choose to explore the realm by relinquishing the number of Charge Stones required (see section on Charge Stones).

Once the Charge Stones are given up, the player rolls the dice. The difference (larger number minus lower number) between the two die indicates the number of Quantum Force Cards (Refer to Cards Section) that the player must draw. If the numbers on the two dice are equal, no cards are drawn. The player then plays the cards in the order drawn and the effects of the cards are implemented - each card, one at a time (this is where all fun lies, so beware). If a pulsar card is among the cards drawn and the player happens to still be in the realm they intended on exploring, then the player turns over the pulsar indicator piece and receives the number of pulsar stones as indicated. If another pulsar card is within the same player's hand, during that turn the player receives, again, the number of pulsar stones as indicated.

Once a realm's pulsar stones have been uncovered that realm is no longer open for exploration.

Winning the Game

Once all players have run out of time stones or all pulsar stones are uncovered the game is over, points are tallied, and the player with the most points wins.

Special Play for Entanglement Realms

The two Entanglement Realms are linked together in spacetime! Once a pulsar stone indicator is turned over in one entanglement realm the other entanglement realm's pulsar indicator must be turned over and is now also known., although the player only receives the pulsar stones for the entanglement realm they are currently in.

Protection Realm

A player may seek refuge from the havoc of physics by visiting the Protection Realm. No direct effects from the Quantum Force Cards can influence players although the Protection Realms can appear and disappear suddenly.

Quantum Force Cards

Each realm has three associated quantum force cards. The explanation of how each card is implemented is provided on the cards themselves. Quantum force cards provide the twist, turns, and unexpected events that will leave you wondering if you ever knew reality. Careful what you uncover….

- Cards marked with X apply to the player that drew the card, or group of players as indicated by the explanation section associated with the card
- Cards marked with O only apply to players within the realm indicated on the card.
- Cards marked with Δ apply to realms.
- Cards take immediate effect in the order they are drawn and implemented

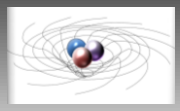
Space Challenge Cards

When a seven is rolled on a player's turn a space challenge card is issued and the player chooses another player as a competitor. Each player rolls the dice, and the person who rolls closest to the number on the card wins. A tie is permissible. After the challenge, the card is returned to the pile.

The winner receives one pulsar stone and one time stone, but the loser loses two pulsar stones. In the case of a tie both players lose one pulsar stone.

Final Note

As always have fun! If you come across a situation in the game that is not directly addressed by the rule book, or a specific rule is not clear to you – make it your own and decide how you would fairly handle the rules under the circumstances. Also, we are always interested in feedback so please let us know what you think. Refer to the back cover for our contact information.



Game Pieces and Realm Number Tables

Games Pieces	Description
Bags	Various bag sizes to hold parts
Dice	Two dice for game play
Pulsar Indicators	12 blue, square pieces with values (1 – x3, 2 – x3, 3 – x3, 4 – x3)
Charge Indicators	12 red, square pieces with values (2 – x4, 3 – x4, 4 – x4)
Spaceships	6 various colored spaceships act as the players pawns
Crystals	Each player uses the crystal to mark the numbers on their tracking cards.
Ultimate Pulsar Stone	Orange crystal piece - The Ultimate Pulsar Stone is worth 10 points towards a players total
Tracking Cards	Tracking cards are used to tally the number of charge stones, pulsar stones, and time stones that each player has
Booklet	One instruction booklet
Quantum Force Cards	These cards are played during realm exploration
Space Challenge Cards	These cards are played during a space challenge
Game Board	-
Protection Realm Squares	2 squares indicate Protection Realms are taken out of play. 1 square to indicate to conversion to a Protection realm
Discs	One white disc and two red discs are use during game play.
Earth Realm Square	1 square to indicate Earth Realm is taken out of play.

Realm Number Table	
Realm	**Number as Rolled on Dice**
Black Hole	**2**
Worm Hole	**3**
Tunneling	**4**
Frame-Dragging	**5**
String Theory	**6**
Quantum State	**7**
Entanglement(Red or Blue, Player's Choice)	**8**
Time Dilation	**9**
Force Carriers	**10**
Uncertainty Principle	**11**
Length Contraction	**12**

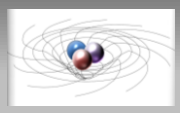
Background Information
The following section provides a brief background for each of the concepts represented by the games' realms.

Black Holes
A black hole is a region of space where the gravitation force is so extreme that nothing can escape its pull. There is as area around a black hole that is called the event horizon which, once crossed, an object will not be not be able to overcome the gravitational force. The theory of relativity predicts that an object of adequately condensed mass can produce a black hole.

Entanglement
Einstein described this phenomenon of quantum physics as "spooky action at a distance". Entanglement is described by two particles initially interacting and whose properties become "entangled". Once entangled, the two particles may be separated, but their properties are still related and can be properly described even with a far physical distance between them. Their shared state, however, remains indefinite until measured.

For example, assume two pennies have become entangled, and that the state of each penny can either be heads up or tails up, but they both can't be heads or tails at the same time. Now imagine that one of the pennies is on Earth while other is on the Moon. If the penny on Earth is flipped and lands heads up, the penny on the Moon will always be predicted as tails up. Likewise if the penny on Earth would land tails up, the penny on the Moon would always land heads up. Until the state of one of the pennies is measured however, the state of each penny is indefinite.

Background Information



Force Carrier Particles
In particle physics, the forces among particles occur as a result of the exchange of other "force" carrier particles. Electrical forces, magnetic forces, nuclear forces, gravity – each of these forces are thought to be the result of the exchange of specific types of force carrier particles. W Particles, Z Particles, and the Higgs Particles are each examples of force carrier particles. The Higgs Particles, for example, are thought to give mass to particles.

Consider two people playing catch with a baseball, and the baseball represents the force carrier particle. As one person throws the ball to the other, the ball carries energy and momentum, and when caught by the other person, transfers this energy and momentum to that person. Force carrier particles can be thought to act in a similar way.

Frame Dragging
General relativity explains that not only does mass warp spacetime but also does the rotation of a mass. If another object comes into orbit of the rotating mass, that object will be acted upon by the warped spacetime field and tend to rotate itself. This phenomenon is called frame-dragging. As an analogy, picture an apple placed on a plate full of syrup and that small poppy seeds are in the syrup. If you twist the apple, the syrup will warp and the poppy seeds will be dragged along following the rotation of the syrup.

Length Contraction
If an object is traveling at a faster speed relative to another object the faster object will appear contracted lengthwise. This is explained by the theory of relativity and is similar to time dilation, but for physical length of an object.

Therefore that same person that is running by you on the sidewalk whose time appears slower actually is shorter and skinner than if they were simply standing right next to you. Of course, though, one would have to be traveling quite fast in order to notice any difference.

Quantum State
In quantum mechanics, particles bound within a system must each occupy one, discrete energy level. That is, no two particles may occupy the same energy state. For example, electrons within an atom will each occupy a separate energy level. Particles may transfer from one state to another, but conservation of energy will be maintained through the absorption or emission of a photon. Light scattered through a diamond exposes the different energy levels of the photons whose wavelengths (or energy) become visible as different colored pigments.

String Theory
String Theory is a modern attempt to combine all the theories of relativity, quantum physics, and classical physics into one universal set of equations. As the name suggests, String Theory proposes that the small particles that make up the universe are actually oscillating lines or "strings". The theory has diverged and evolved over the past few years, but mathematical models have included as many as 26 spacetime dimensions.

Time Dilation
There are two types of time dilation – velocity time dilation and gravitational time dilation. Both are explained by the theory of relativity. Velocity time dilation suggests that for object that is traveling at a faster speed relative to another object, time will actually appear slower for the faster traveling object. Likewise for an object that is an area of extreme gravity, for example a black hole, time will appear slower relative to and object in a less extreme gravitational area. This is gravitational time dilation.

For example for a person running on the sidewalk, time is actually passing more slowly than that relative to a person walking on the sidewalk. And for a person standing on top of a mountain time is passing more slowly than that relative to a person as sea level. At those speeds and gravitational forces, however, the differences are so small that it is unnoticeable.

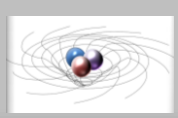
Tunneling
Background: Tunneling is an aspect of quantum mechanics where a particle is able to traverse a potential barrier even though classically it shouldn't be able to. This phenomenon, albeit having low probability, is explained by the wave-particle equations of quantum mechanics. An analogy would be a person pushing up against a wall theoretically should not be able to pass through the wall because that person does not have enough "energy" to overcome the wall barrier. However, because of the properties of the wave-particle equations, a person could pass through the wall. That person, though, could be pushing for a very, very long time before the phenomenon would be observed.

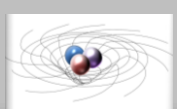
Uncertainty Principle
In quantum mechanics particles follow the uncertainty principle. This equation is often represented as:

$$\sigma_x \sigma_p \geq \frac{\hbar}{2}$$

Where the left side of the equation represents the location and momentum of a particle and the right side contains the Planck constant. What this equation suggests is that the exact location and momentum of a particle cannot be known simultaneously. Therefore, the more precisely the location of the particle is known, the less precisely the momentum is known and vise versa.

Wormhole
A wormhole is a theoretical shortcut in spacetime. Although there has not been any observational evidence of wormholes, solutions to the equations from general relativity suggest that they could exist. Worm holes have been described as both unidirectional and bidirectional, where bidirectional holes require a negative energy within the hole to remain stable.





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