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THE SCIENTIFIC CUES STUDY OF “ZARRAH” IN AL-QUR’AN AS KNOWLEDGE CONTENT ON MODERN PHYSICS LEARNING BASED ON TPACK

*Kajian Isyarat Ilmiah “Zarrah” pada al-Qur’an sebagai Content Knowledge
dalam Pembelajaran Fisika Modern Berbasis TPACK*

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Abstract

This study discusses the scientific cues of “zarrah” in *al-Qur’an* that related to Modern Physics. This qualitative research study was the result of a descriptive analysis of *al-Qur’an* as primary data. While secondary data were the book of *Modern Physics Schaum’s outlines*, Tafseer of *al-Jami ‘li Ahkam al-Qur’an*, Tafseer of *al-Qur’anul Madjid an-Nur*, Tafseer of *al-Mishbah*, Tafseer of *al-Jami’ al-Bayan at-Ta’wil Ayi al-Qur’an*, *al-Qur’an Tafseer of al-Aisar*, Book of *Risale-i Nur*, *al-Jawahir fi Tafsir al-Qur’an al-Karim*, and other relevant references. The analytical method used was critical analysis with inductive thinking techniques. This study reports that Mufassirs interpret the word ذَرَّةٌ in QS. Al-Zalzalah verses 7-8 as the smallest thing. Currently, *zarrah* contextually in modern physics could be called a quark. Due to a phenomenon known as color confinement, quarks are never directly observed or found in isolation. In line with the word الأَبْصَار in QS. as-Sajdah verse 9. This plural word can contain the meaning of optical devices have limitations to be able to observe objects including *zarrah* and become scientific cues to find other optical instruments that are more sophisticated than previously discovered. Theoretical studies of atomic structure and optical devices that have been discovered at this time can be used as some scientific explanation of scientific cues in the Qur'an in accordance with the times.

Keywords: Human Eye, Optical Devices, *Zarrah*, Quarks.

Abstrak

Penelitian ini bertujuan untuk mengkaji isyarat ilmiah dalam al-Qur’an terkait Fisika Modern. Penelitian kualitatif ini merupakan hasil analisis deskriptif al-Qur’an sebagai data primer. Sedangkan data sekunder berupa buku Fisika Modern Seri Schaum’s outlines, tafsir al-Jami’ li Ahkam al-Qur’an, tafsir al-Qur’anul Madjid an-Nur, tafsir al-Mishbah, Tafsir al-Jami’ al-Bayan at-Ta’wil Ayi al-Qur’an, Tafsir al-Qur’an al-Aisar, buku Risale-i Nur, al-Jawahir fi Tafsir al-Qur’an al-Karim, dan artikel relevan lainnya. Metode analisis yang digunakan adalah kritis analisis dengan teknik berpikir induktif. Studi ini melaporkan bahwa para Mufassir menafsirkan kata kata ذَرَّةٌ di dalam QS. Az-Zalzalah ayat 7-8 sebagai benda yang sangat kecil. Saat ini, *zarrah* secara kontekstual dalam fisika modern dapat disebut quark. Karena fenomena yang dikenal sebagai kurungan warna, quark tidak pernah secara langsung diamati atau ditemukan dalam isolasi. Hal ini dapat berkaitan dengan isyarat ilmiah الأَبْصَار di dalam QS. as-Sajdah ayat 9. Kata jamak ini dapat bermakna bahwa alat optik memiliki keterbatasan dalam mengamati benda-benda termasuk *zarrah* dan menjadi isyarat ilmiah untuk menemukan alat optik yang lebih canggih. Kajian teori tentang struktur atom alat optik yang telah ditemukan oleh para ilmuan saat ini dapat digunakan sebagai penjelas saintifik isyarat ilmiah dalam al-Qur’an sesuai dengan perkembangan zaman.

Kata kunci: Mata Manusia, Alat Optik, Zarah, Quark.

INTRODUCTION

Islam is a religion that has been believed to be a reference of science in the study of various sciences. However, there is still a strong assumption in the wider community that religion and science are two things that cannot be met. Both have their respective study contexts, separate from one another in terms of formal material objects, research methods, truth criteria, and the role played by scientists (Sabarni, 2019).

Al-Qur’an is a source of science and scientific facts. Some scientific facts of science have been revealed by the verses of al-Qur’an and have been recognized for their truth by scientists. Al-Qur’an as a guide to human life that is believed to have the truth has made a major contribution for humans to learn and explore knowledge. Modern science that has been found in accordance with the contents of the verses of al-Qur’an. Of the several phenomena that occur, science cannot be separated from religion in seeking the true nature of truth. Indeed, science and religion (Islam) are two words that go together to accompany human life.

Science is a very important component in human life, in everyday life we cannot escape from the problems of science. Science is the study of intelligent life. Someone who has knowledge because he was given understanding by God in science has a higher position than someone who is not skilled. Islam is a religion that upholds

science and people who try to study and develop it. The study and development of knowledge which is based on and/or related to Islam is often referred to as an integration effort, one of which is with physical theories. One of the material studies of modern physics has been revealed by as-Sajdah verse 9 and al-Zalzalah verses 7 and 8.

Apart from the integration of al-Qur’an with Natural Sciences, we need to know that we have entered the 21st century, which has different characteristics from the 19th or 20th century. The fundamental difference lies in the conditions of information, communication, and technology (ICT). All three have greatly influenced how we live, work or act, and in learning and teaching (Niess, 2005). Progress in the field of ICT has led us to the digital era globally, which is an era where digital has become the basis of global life. Optimization of Islamic integrated science learning can be done using simple software such as Ms. Excel, Ms. PowerPoint, Macromedia Flash, Phet, and Modellus (Susilayati, 2017; 2019).

Technological Pedagogical Content Knowledge abbreviated as TPACK (previously abbreviated as TPCK) is the knowledge needed to integrate technology in learning. This knowledge framework comes from the construct of Shulman (1986) about Pedagogical Content Knowledge (PCK). Shulman (1987) argues that preparing teachers or prospective teachers with general pedagogical skills and subject matter knowledge, such as science separately is inadequate. Instead it is necessary to base the teaching that is at the intersection between the content of subject matter and pedagogy.

In the TPACK framework model, there are three components of teacher knowledge, namely subject matter, pedagogy, and technology. This model has three equally important intersections, namely intersection between bodies of knowledge expressed as PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK (technology, pedagogy, and content knowledge). Based on the above background, this study aims to discuss the scientific cues contained in al-Qur’an relating to Modern Physics.

DISCUSSION

The Meaning of *Zarrah* in al-Qur'an

The interpretation of the verses of al-Qur’an related to *zarrah* in this study are examined, among others, from al-Qur’an’s letter: Yunus verse 61; an-Nissa’ verse 40; Saba’ verse 3; and az-Zalzalah verses 7-8. Al-Qur’an in the verse Yunus verse 61 reads:

وَمَا تَكُونُ فِي شَأْنٍ وَمَا تَتْلُو مِنْهُ مِنْ قُرْآنٍ وَلَا تَعْمَلُونَ مِنْ عَمَلٍ إِلَّا كُنَّا عَلَيْكُمْ شُهُودًا إِذْ تُفِيضُونَ فِيهِ ۗ
وَمَا يَعْزُبُ عَنْ رَبِّكَ مِنْ مِثْقَالِ ذَرَّةٍ فِي الْأَرْضِ وَلَا فِي السَّمَاءِ وَلَا أَصْغَرَ مِنْ ذَلِكَ وَلَا أَكْبَرَ إِلَّا فِي كِتَابٍ مُبِينٍ

It means: “You are not in a situation and do not read a verse from the al-Qur’an and you do not do any work, but We bear witness to you when you do it, not escape from your Lord’s knowledge even as large as Zarrah (atoms) on earth or in the sky. nothing is smaller and not (also) greater than that, but all are recorded in the real book (Lauhul Mahfuz)” (al-Mizan, 2015).

Al-Qur’an an-Nissa’ verse 40 is written:

إِنَّ اللَّهَ لَا يَظْلِمُ مِثْقَالَ ذَرَّةٍ وَإِنْ تَكَ حَسَنَةً يضاعِفْهَا وَيُؤْتِ مِنْ لَدُنْهُ أَجْرًا عَظِيمًا

It means: “Indeed, Allah does not persecute someone even as big as zarrah, and if there is a virtue as big as zarrah, surely Allah will multiply it and give from His side a great reward” (al-Mizan, 2015).

Al-Qur’an’s Saba’ verse 3 written:

وَقَالَ الَّذِينَ كَفَرُوا لَا تَأْتِينَا السَّاعَةُ قُلْ بَلَىٰ وَرَبِّي لَتَأْتِيَنَّكُمْ عَالِمِ الْغَيْبِ ۗ لَا يَعْزُبُ عَنْهُ مِثْقَالُ ذَرَّةٍ فِي السَّمَاوَاتِ
وَلَا فِي الْأَرْضِ وَلَا أَصْغَرَ مِنْ ذَلِكَ وَلَا أَكْبَرَ إِلَّا فِي كِتَابٍ مُبِينٍ

It means: “And those who disbelieve say: “The day of awakening will not come to us”. Say: “Certainly come, for the sake of my Lord who knows the unseen, Truly the end will come to you. there is nothing hidden than Him as big as zarrah that is in heaven and that is on earth and there is no (also) smaller than that and greater, but it is in the real book (Lauh Mahfuzh)” (al-Mizan, 2015).

Al-Qur’an at surah az-Zalzalah verses 7-8 are written:

فَمَنْ يَعْمَلْ مِثْقَالَ ذَرَّةٍ خَيْرًا يَرَهُ ۗ
وَمَنْ يَعْمَلْ مِثْقَالَ ذَرَّةٍ شَرًّا يَرَهُ ۗ

It means: “Whoever does good deeds as heavy as zarrah, surely He will see (in return). And whoever commits a crime as big as zarrah, surely He will see (his reply) too” (al-Mizan, 2015).

Interpretation of Zarrah by Mufasssirs

According to al-Qurthubi (2009) in his book the interpretation of al-Jami’ li ahkam al-Qur’an, said that lafaz *ذَرَّةٌ مِثْقَالٌ* “Even if it is as big as zarrah (atom)”. The word *ذَرَّةٌ* means the weight of an atomic scale or is also interpreted as a small red ant. Meanwhile, according to ath-Tabari (2008) in his book Tafsir al-Jami’ al-Bayan at-Ta’wil Ayi al-Qur’an, said that the lafaz *ذَرَّةٌ مِثْقَالٌ* even as big as zarrah (atom), the

meaning is from weight the smallest ant. Arabs used to say, “*Take this, because it is lighter than that*”. The point is that the scales are lighter.

According to al-Jazairi (2013) in his book Tafsir al-Qur’an al-Aisar, lafaz Mitsqaala Zarrah means the weight of a small ant. The meaning of the meaning of Surah al-Zalzalah verses 7 and 8 about “anyone who does good deeds as heavy as Zarrah, surely he will see (reply). The goodness of zarrah as heavy as in the world will be rewarded in the hereafter and whoever does the ugliness as heavy as zarrah during the world, then he will be rewarded in the afterlife. Except when Allah Ta’ala forgives his mistakes.

According to ash-Shiddieqy (2011) in his book Tafsir al-Qur’anul Madjid an-Nur, said that every believer who works a charity, whether small or large, good or evil even as big as zarrah (lightest object, atomic) then Allah will reward you for your deeds. Nothing is smaller than the smallest thing (zarrah) and nothing is bigger than the biggest object like Arsy (ash-Shiddieqy, 2011: 363).

According to Hamka (2015) in Tafsir al-Azhar, this verse explains about important issues and matters faced by Rasul SAW as well as Allah’s warning that our respective attention is drawn to the call of religion and to carry out divine commands. “*And nothing escapes Allah.*” That is, there is nothing far away from Him and there is nothing unseen hidden from Him. “*Even from the one that weighs zarrah.*”

According to Shihab (2002) in Tafsir al-Mishbah, *zarrah* is understood by several commentators in various meanings, including very small ants, ant heads, and flying dust that is only seen in the sun’s gaps. While adults today understand it in the sense of an atom. Indeed, the word is now used to designate atoms, although during the descent of al-Qur’an the atom is not yet known. In the past, language users used the word to designate the smallest things. The ignorant society interprets this meaning by the meaning of the head of an ant or dust that is seen flying in the sunlight or ant eggs. His words which are smaller than *zarrah* are protons and neutrons which are two atomic elements (Shihab, 2002: 566). Hamka in Tafsir al-Azhar explains that *zarrah* in modern science is meant by atoms. Now humans have investigated the atomic substances as far as possible, so humans have concluded that the atom has power.

Allah explains His word in surah Saba’ verse 3, that there is nothing in the sky nor on earth, there is nothing hidden from Him, even as big as *zarrah*. Do not let a servant think that the very small acts that have been hidden in the world will not be rewarded by God. Verily, Allah knows and will reward or reward his servants in the world or in the hereafter, who have done good and good deeds, according to His wisdom and justice.

When the atom was discovered, Arabic experts named it *zarrah*, because at that time it was considered as the smallest chemical element (after nuclear). Of course, after the atom can be broken or separated, then the smallest parts are more accurately named *zarrah*. *Zarrah* in al-Qur’an and its revised interpretation by the Ministry of Religion of the Republic of Indonesia means very small seeds or small black ants.

According to Nursi (2010), an atom is a tool used by the Creator to display His Existence and Being. The arguments are that no atom can decide when and where it should move away or join other atoms. The only alternative is that God directs each atom to achieve certain goals. Each atom contains two further concrete witnesses for the existence and unity that the Creator needs. Despite its absolute powerlessness, each atom carries out many important tasks; although lifeless, each atom acts according to the universal order, which displays universal consciousness. Thus each atom testifies to the Existence of the Almighty through its impotence and Unity by acting in the order of the universe.

In addition, Jauhari (1350 H) also mentioned the atom when interpreting QS. al-Zalzalah. On the day that people are resurrected, there are those who accept a book with their right/left hand (to show their deeds), in return for their deeds. Whoever does the smallest act of *zarrah*, that is, a small atom or dust, for example, a good deed, a good reward will be shown. And whoever does bad deeds as small as an atom will be shown.

Based on the description above, the Mufassirs interpret the word *zarrah* as something very small. There is the refinement of interpretations about the example of something very small, ranging from as small as ants, mustard seeds/figs, atoms, to protons, neutrons, and electrons. In fact, the refinement of this example is in line with the refinement of natural science in the form of the development of atomic theory and the discovery of increasingly sophisticated optical devices so that humans can know objects of increasingly smaller sizes. Starting from the example of ants and figs/mustard seeds that can be seen with the ordinary eye to the example of atoms, protons, neutrons and electrons that can be seen with an electron microscope.

This can also be in line with scientific cues الأَبْصَار in QS. as-Sajdah verse 9 which means “eyesight” in the plural. If eyesights are interpreted as optical instruments which are the tool used to see, many types have been found. The natural optical instrument is the eyes. However, human eyes have limitations to see objects that are so far and small because all creatures must have limitations (Susilayati, 2016). Therefore, the eyes require the addition of artificial optical devices, such as a microscope to see very small objects. Through the discovery of this microscope,

scientists can see the objects smaller than atoms, namely electrons. Knowledge of eyesight physically can be useful for understanding scientific cues in the true sense, with the eyes of the heart.

Interpretation of *Zarrah* in Physics: From Atom to Quark.

First definition of *zarrah* in physics is atom. The atom was sparked by Democritus, according to him all objects can be broken into the smallest particles, where the particles cannot be subdivided or called atoms. Atom comes from the word *atomos* (‘*a*’ which means no, and ‘*tomos*’ which means to cut), so it has a meaning that cannot be cut or cannot be divided (Petrucci, 1996). Every material in the universe is composed of particles that are very small and cannot even be seen by human vision. The concept of atoms put forward by democracy is based on the results of thought rather than experimental results. The concept of the atom was further developed by Leokipus (student of democracy) and its truth is still recognized until now. Leukipus concluded that the universe only contains atoms (Yusman, 2008: 5). In 1897 J.J Thomson discovered the electrons which was likened to raisin in plum pudding which was known as the classical atomic model. The small size of the atoms made it impossible to see directly their internal structure.

Then, Ernest Rutherford with Hans Geiger as asisten projected very small particles onto thin material, some of which collided with atoms and eventually exited at various angles, as the beginning of the modern atomic theory. In 1913 Rutherford discovered nucleus for the central charged core and definitely decided that the core (containing most of the mass) was positively charge, surrounded by the negative electron. After that quantum theory might affect atomic stucture. Niels Bohr assumed that electrons moved around a massive, positively charged nucleus. The electron orbits are circular rather than elliptical and that the nuclear mass is co much greater than the electron’s mass that it may be taken to be infinite. The electron has sharge $-e$ and mass m and resolves a nucleus of charge $+e$ in a circle of radius a . The size of the nucleus is small compared with the atomic radius a . Bohr had demonstrated the necessity of Planck’s quantum and Einstein’s conception of the photoelectric effect as well. The assumption of the angular momentum led to the quantization of orbital radius, velocity, and energy of particle (Thornton, 2013).

In 1964, Murray Gell-mann dan George Zweig predicted the existence of one of the elementary particles and constituent substances, namely quarks. The existence of a quark was first discovered in 1968 at Stanford Linear Accelerator Center, Stanford University. Quarks combine to form particles called hadrons, the most stable of which are protons and neutrons, which are components of the nucleus. Due to a phenomenon known as color confinement, quarks are never directly observed or found in isolation.

Quarks can only be found in hadrons, such as baryons (for example protons and neutrons) and mesons.

Quark also has various intrinsic properties namely electric charge, mass, color charge and spin. Quarks are the only elementary particles in the Standard Model of particle physics that experience the four fundamental interactions, also known as fundamental forces (electromagnetic, gravitational, strong interactions and weak interactions) and the only known particles whose electrical charges are not multiples of integers from basic charge.

At present six quarks types have been discovered through various high energy experiments, namely: up (u), down (d), charm (c), third generation strange, top, and bottom third generation. Up and down has the lowest mass of all quarks. Heavier quarks quickly turn into up and down quarks following the process of particle decay (transformation from a state of higher mass to a state of lower mass). Therefore, quarks up and down are generally stable and most common in the universe, whereas charm, strange, top and bottom can only be produced in high-energy collisions (such as those involving cosmic rays and particle accelerators). For each quark taste there is an appropriate type of antiparticle, known as an antiquark, which differs from a quark simply because some of its properties have the same size but opposite charge as shown in table 1.0 bellow.

Table 1. Fundamental in the Standard Model (Griffiths, 2008)

Generation	Quark	Charge	Lepton	Charge
1	u (up)	$2/3$	V_e	0
	d (down)	$-1/3$	e^-	-1
2	c (charm)	$2/3$	V_μ	0
	s (strange)	$-1/3$	μ^-	-1
3	t (top)	$2/3$	V_τ	0
	b (bottom)	$-1/3$	τ^-	-1

Quarks have $1/2$ spin particles, stating that quarks are fermions according to the spin-statistical theorem. Quarks fulfil the Pauli prohibition principle which states that no two identical fermions can simultaneously occupy the same quantum state. This is different from bosons (particles with round integers) whose numbers can be in the same state. Quarks which determine the quantum number of hadrons are called valence quarks. Any hadron is possible to contain quarks, antiquarks, and gluons which do not affect their quantum numbers.

There are two hadron families, Baryon with three valence quarks and meson with a quark and a valence antiquark. Most hadrons are distinguished by their quark content and the quark nature of their constituents. The existence of exotic hadrons with more valence quarks, such as tetraquarks $qqqq$ and pentaquarks $qqqqq$, have been predicted but not proven. However, on July 13, 2015, the LHCb collaboration at CERN reported results that were consistent with the state of the pentaquark.

Quarks have three states of color, which are labelled as $I = 1, 2, 3$ or red, green and blue according to the three basic colors. Three color states form the basis in 3-dimensional complex vector spaces. The state of color can be rotated by a 3×3 unitary matrix. All of these one-unit transformations with determinant units form Lie SU groups. The 3-dimensional color space is a fundamental representation of SU. The rule of using colors together follows the space of a SU group, as well as adding angular momentum in quantum mechanics.

The discovery of leptons (τ) and neutrino, ν_τ change (add) the total number of leptons to number six. Experiments on the six leptons are present to show that the leptons have a point-like structure so that the leptons can be viewed as true elementary particles which are not composed of the smallest entities.

Although there are currently only six known leptons, there are many more hadrons (meson and baryon). Table 2 shows that only the hadrons were stable in dealing with decay through strong interactions, but there were also hundreds of hadron resonances. With hadron breeding, scientists began to conduct research to get a simple explanation of the growth rate. Gell-Mann (1964) and Zweig (1964) stated that the hadron is composed of three elementary particles called quarks. (The name “quark” was copied by Gell-Mann of James Joyce’s *Finnegans Wake*).

Later it was revealed that, instead of three quarks, the hadron was composed of six quarks and six antiquarks. A list of quarks and their properties is given in Table 2. Meson is composed of a quark and an antiquark. For example, meson π^+ has a quark structure ($u\bar{d}$) while the antiparticle meson π^- has a quark structure ($\bar{u}d$). Baryon is composed of three quarks, and antibaryons are composed of three antiquarks. For example, baryon p has a quark (uud) structure. Short-lived Baryon Δ^+ is an excited state of p , and composed of the same quark structure (uud). The p Baryon and its excited state, Δ^+ , considered to be two different particles. The ground state p has spin $1/2$ and the rest energy 938 MeV, while the excited state Δ^+ has spin $3/2$ and the rest energy 1232 MeV.

All quarks have a $1/2$ spin, and so do fermions. The Pauli Principle excludes the use of two identical quarks to arrange the hadron. At first it appears that the quark (uud)

structure of Δ^+ violates the Pauli principle, because to produce a total spin of $3/2$ for Δ^+ , both quarks must have the same spin. To avoid violating Pauli's principle, another quantum number called color is pinned to a quark. In analogy with the visualization of the main colors, the colors of the quarks are named red, green and blue. The two u quarks in Δ^+ do not violate Pauli's principle, because they have different colors. The quark color combination always produces colorless hadrons.

The forces between elementary particles are described as the result of exchanging field particles or quantum virtual fields. The picture is something that resembles elementary particles that use quantum fields in a catch capture game. A particle emits a quantum field that is absorbed by the second particle and after that the second particle sends the quantum field back to the first particle. This continuous capture game produces forces between the two particles. In this picture, the quantum field is said to mediate this interaction.

Table 2. List of Quarks and Their Properties

Name	Symbo l	Spin (S)	Charg e numbe r	Barion numbe r	Alienati on	Char m	Bas e	Pea k
Up	u	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{3}$	0	0	0	0
Anti-up	\bar{u}	$\frac{1}{2}$	$-\frac{2}{3}$	$-\frac{1}{3}$	0	0	0	0
Down	d	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{3}$	0	0	0	0
Anti- down	\bar{d}	$\frac{1}{2}$	$-\frac{1}{3}$	$-\frac{1}{3}$	0	0	0	0
Charm	c	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{3}$	0	1	0	0
Anti- Charm	\bar{c}	$\frac{1}{2}$	$-\frac{2}{3}$	$-\frac{1}{3}$	0	-1	0	0
Alienati on	s	$\frac{1}{2}$	$-\frac{1}{3}$	$\frac{1}{3}$	-1	0	0	0
Anti- Alienati on	\bar{s}	$\frac{1}{2}$	$\frac{1}{3}$	$-\frac{1}{3}$	1	0	0	0
Top	t	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{3}$	0	0	0	1

Name	Symbo l	Spin (S)	Charg e numbe r	Barion numbe r	Alienati on	Char m	Bas e	Pea k
Anti-top	\bar{t}	$\frac{1}{2}$	$-\frac{2}{3}$	$-\frac{1}{3}$	0	0	0	-1
Bottom	b	$\frac{1}{2}$	$-\frac{1}{3}$	$\frac{1}{3}$	0	0	1	0
Anti- bottom	\bar{b}	$\frac{1}{2}$	$\frac{1}{3}$	$-\frac{1}{3}$	0	0	-1	0

In electromagnetic interactions, the quantum field is photons. In weak interactions, there are three quantum fields, W^+ , W^- , and Z^0 called boson vectors. In strong interactions, the quantum field is gluons, which produce a strong force between quarks. Until now, gluons have not been observed experimentally. It was postulated that in gravitational interactions there is a quantum field called graviton, but this has not been observed experimentally. The properties of several quantum fields are shown in Table 3.

Table 3.0: The Properties of Several Quantum Fields

Boson	Symbol	Interaction	Spin	Electric Charge	Mass (GeV)
Gluon	g	strong	1	0	0
Intermediat Boson	W^+	weak, electromagnetic	1	+e	80,2
	W^-	weak, electromagnetic	1	-e	80,2
	Z^0	weak, electromagnetic	1	0	91,2
Foton	γ	electromagnetic	1	0	0

Experiments carried out in experiments all failed to observe isolated quarks. To overcome this, particle physicists develop theoretical arguments called quark restrictions, which say that it is not possible to observe isolated quarks. When the quarks move away from each other, the forces between them will be stronger, analogous to the forces between the masses at the ends of an unbroken stretch of rubber bands. Instead of breaking up like a rubber band after a sufficient amount of energy is applied to the range, the energy of the restoring force between quarks becomes infinite as the distance between the two increases, and that energy will limit the quarks to remain in their hadron bonds. The notation for limiting quarks gives rise

to the idea that the basic building blocks of all quark hadrons are impossible to observe.

Before the scientists expressed their opinions, Allah first included the verse in al-Qur’an about *zarrah* or currently known as the quark, namely in the az-Zalzalah verses 7-8 which read:

فَمَنْ يَعْمَلْ مِثْقَالَ ذَرَّةٍ خَيْرًا يَرَهُ (٧)
وَمَنْ يَعْمَلْ مِثْقَالَ ذَرَّةٍ شَرًّا يَرَهُ (٨)

Meaning: “(7) Whoever does good deeds weighing zarrah, surely He will see (in return); (8) And whoever commits a crime as big as zarrah, surely He will see it (in return) as well” (al-Mizan, 2015).

In the two verses above, there is the word *zarrah* which is finer than dust. The term *zarrah* has also been used by physicists to refer to the word quark. In addition to the word *zarrah*, quarks are also called al-Jauharulfard which means objects that are very delicate and cannot be subdivided. In this verse it also appears that the quark has a weight (mass) and magnitude. Because from this verse it says “as heavy as *zarrah*” then the atom / quark (*zarrah*) has mass. Then Allah also says in al-Qur’an surah an-Nisa’ verse 40 which reads:

إِنَّ اللَّهَ لَا يَظْلِمُ مِثْقَالَ ذَرَّةٍ وَإِنْ تَكَ حَسَنَةً يُّضَاعِفْهَا وَيُؤْتِ مِنْ لَدُنْهُ أَجْرًا عَظِيمًا

It means: “Verily, Allah does not persecute someone even as big as zarrah, and if there is a virtue as big as zarrah, surely Allah will multiply it and give from His side a great reward” (al-Mizan, 2015).

CONCLUSION

Based on the results of the study it can be concluded that the study of scientific cues on al-Qur’an as content knowledge in learning TPACK-based Modern Physics is carried out by looking at the translation of the verses of al-Qur’an and the interpretations of experts discussing quark / atomic material based on their scientific characteristics. Content Knowledge has answered the discussion of quarks in al-Qur’an which is abstract in nature that is easily understood. Mufassirs interpret *zarrah* is the smallest object. Previous Mufassir interpret *zarrah* with the mustard seeds and dust. In the contemporary era, modern Mufassir interpret *zarrah* with an atom to quark. Theoretical studies of atomic structure and optical devices that have been discovered at this time can be used as some scientific explanation of scientific cues in the Qur'an in accordance with the times.

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