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Modern hard SF: Simulating Physics in Virtual Reality in Cixin Liu's *The Three-Body Problem*

ABSTRACT

In Cixin Liu's *The Three-Body Problem*, the reader follows the protagonist Wang Miao into the digital depths of the virtual reality of *Three Body*. As I will demonstrate in this paper, the virtual reality *Three Body* constitutes a purposeful combination of literary simulation of modern physics and intermedial virtual reality (VR) game representation. I will show that this combination is utilized for several interesting narrative purposes, for example, as a powerful foreshadowing instrument and as an almost didactic explanatory device for the theoretical physics problem upon which the novel is based.

Keywords: virtual reality, Chinese SF, hard SF, Cixin Liu, intermediality

In recent years Cixin Liu has become the posterboy of the new wave of Chinese science fiction as his *Remembrance of Earth's Past* trilogy was a major success, both in his home country and all over the world. According to Wu (2013, p. 4), Chinese SF currently enjoys a high level of popularity due to bestsellers written by Cixin Liu and Han Song and the works of other leading sci-fi authors like Wang Jinkang and He Xi. This current popularity of Chinese science fiction is also commented upon by Chau (2018, p. 112), who argues that it is especially due to the considerable international impact of Cixin Liu's *The Three-Body Problem* and the two Hugo awards that Cixin Liu and Hao Jingfang were awarded in 2015 and 2016.

The narrative of *The Three-Body Problem* (2008/2016) begins during China's Cultural Revolution. In the wake of these political events, the imprisoned young astrophysicist Ye Wenije decides to forego punishment as a political prisoner by aiding the Red Coast Base's search for extraterrestrial signals. Yet, over the years a terrible hatred for humanity remains in her heart, fostered by the unspeakable crimes she witnessed during the Cultural Revolution. When finally she receives a message from the planet of Trisolaris, she responds, asking the extraterrestrial beings to conquer earth. Decades later, the nanomaterials researcher Wang Miao

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(the protagonist) is hired by a secret international organization of political, military, and scientific members to investigate a current series of scientist deaths. The traces lead him to the online game *Three Body*, a simulation of the harsh environment of Trisolaris dominated by its three suns. As Wang plays, he quickly finds out that an organization led by Ye Wenije is behind the game. He reports his findings, and the global organization decides to put an end to Wenije's group. As they do so, Wang and the Battle Command find out that the Trisolarians will arrive on earth in four centuries. Time is ticking for humanity.

Cixin Liu is very much a writer of hard SF in the tradition of authors like Isaac Asimov and Arthur C. Clark, and so his approach to the medium of VR is significantly more factual and science-centered¹. However, one should not make the mistake of inferring from this fact that hence his vision would be less artistic. Instead, the virtual reality of *Three Body* constitutes a rich hybrid of intermedial video game representation and physics simulation serving as a multifaceted narrative tool. Consequently, this paper will focus on the virtual reality *Three Body* as a purposefully employed combination of literary simulation of modern physics and as an intermedial representation of VR video games. I will demonstrate in this paper that this combination is utilized for several interesting narrative purposes, for example, as a powerful foreshadowing instrument and as an almost didactic explanatory tool for the theoretical physics problem upon which the novel is based.

1. The Origin of *Three Body*

One of the central concepts within Cixin Liu's novel *The Three-Body Problem* is the virtual reality video game *Three Body*. It is a bizarre game filled with quirky characters, diverse cultural references, anachronistic instances of Chinese history, and a focus on the three-body problem in physics, all instilled with a dash of intermediality. Essential intermedial elements, that are featured in the novel are: explicit intermedial reference², implicit intermedial reference³, and transposition⁴.

¹ This is a fact that is also frequently addressed by the author himself. For example in his essay "Beyond Narcissism: What Science Fiction Can Offer Literature". Here (Cixin, 2013, p. 29) he argues: "science fiction world-building must follow the way of science". He also adds that Asimov's work showcases that science fiction is a genre that is primarily focused on content and not on form and that his own novels clearly abide by this credo, especially concerning their world-building.

² Explicit intermedial reference (also termed intermedial thematization) is according to Wolf (2002, p. 24) an overt representation of a different medium.

³ In contrast to its explicit counterpart, implicit intermedial reference (also referred to as intermedial imitation) is described by Wolf (2002, p. 25) as an imitative embedding of another medium in an iconic manner.

⁴ Transposition is defined by Wolf (2002, p. 19) as a discernible transfer of content or formal elements from one medium to another.

Throughout most of the novel, the world of *Three Body* is a rather mysterious place. The protagonist Wang Miao is shown to be initially simply enticed by the game's obscure appeal and hidden secrets (e.g. p. 120). It is only later in the novel that the real reasoning behind the VR game is revealed (pp. 346–348). Here it is explained that Ye Wenije's Earth-Trisolaris Movement (also called ETO) has created it. This organization consists of three factions. The Adventists, who hope that Trisolaris will eradicate the human race (p. 345), the Redemptionists, a religious group fueled by the belief that a higher developed intelligent species could enlighten humanity (p. 346), and the Survivors, who simply want to secure the future of their descendants by taking part in the movement (p. 349). *Three Body* is essentially a project created by the Redemptionists to find new members of all social strata, to spread their religion, and, most importantly, to find a solution to the three-body problem in order to save the Trisolarans (p. 347–348).

2. The Virtual Lay of the Land

Now that the origin of the video game *Three Body* has been explained, the next important aspect are its key features. Already in terms of the visual construction of the world, there are several essential points. The game world at first consists primarily of a grand desolate plain (p. 101), stone buildings, tunnels, large Pendulums, and a gigantic pyramid (p. 110). However, every time Wang Miao is depicted to log in, this world changes significantly. The world always appears to be a lifeless plain, however, the pyramid changes from an Egyptian to an Aztec pyramid (p. 150), to a Gothic-style cathedral (p. 193), and eventually into a representation of the UN Headquarters (p. 251), and with it the buildings are also altered several times, incorporating Gothic architecture (p. 193), and ancient Greek monuments (p. 193). The diverse cultural appeal is also upheld regarding the players' identities, who are shown to impersonate historical figures like Mozi (p. 150), Confucius (p. 151), Copernicus (p. 192), Aristotle (p. 194), Newton (p. 224), Von Neumann (p. 225), and Einstein (p. 251) and ancient rulers, such as the Chinese Kings Wen of Zhou (p. 102) and King Zhou of Shang (p. 111), Chinese emperor Qin Shi Huang (p. 233), and Pope Gregory (p. 193). This mixture of Western architecture and Eastern and Western thinkers and rulers is a highly significant aspect of the virtual world of *Three Body*.

According to Wu (2013, p. 4), three essential aspects render Chinese SF unique. Firstly, its frequent thematic exploration of liberty and the abandonment of old cultural, political, and institutional systems. Secondly, discourse revolving around Western science and culture embedded in the themes of liberation. Thirdly, concern for the future of China. I would argue that the concept of *Three Body* in Cixin's novel aligns itself quite well with these key features. As has been explained, there are three goals behind the simulation. Namely, saving the Trisolarans, recruiting new members, and spreading their religion. All of these aspects

are inherently infused with themes of liberation. The first goal is about liberating Trisolaria from the oppression of the three suns. Goals two and three are essentially about leaving behind established cultural and political systems. Furthermore, *Three Body* contains multiple scenes in which historical thinkers from different cultures work together and explore different theories to solve the three-body problem. The foundation of this scientific collaboration is one of merging Western and Eastern attitudes towards science to reach a shared goal. Lastly, the implied worldview raises at least in an allegorical manner concerns for the future of China. The shared intercultural efforts in the virtual world of *Three Body* to solve the three-body problem and the novel's focus on international organizations are both indications that the implied worldview is in favor of the idea that the future of China lies in international cooperation rather than nationalism. This international core of the novel is also highlighted by Kile (2017, p.112) who states that: "*The Three-Body Problem* conceives of the world as united by modern technology, international physics research, and a shared planet under intergalactic threat".

Another essential visual aspect of *Three Body* is that the number of suns in the sky alternates continuously between zero and three suns. Sometimes there is no sun at all (p. 117) and the game world freezes to death (p. 118), other times there is one (p. 156) or two suns (p. 107), and in the worst case there are three suns in the sky (p. 200) and the world goes down in flames (p. 201). These constellations of the three suns decide if the virtual world is currently in a chaotic or stable era, or if it is annihilated (p. 103–104). A final essential element of the world of *Three Body* is the concept of dehydration and rehydration. Throughout the virtual episodes, it is shown that during the chaotic eras the population is dehydrated (e.g. pp. 106, 108, 110), transforming the people into strange, leathery things which are later rehydrated during a stable era (e.g. pp. 107, 114). This strange process and the obscure image of these dehydrated bodies stored as rolls on top of each other in storehouses (p. 114) are an integral part of the game.

3. The Immersive Portrayal of the Three-Body Problem

This also brings us to the foundational issue within *Three Body*, the three-body problem⁵. Already during the protagonist's first round of VR gaming, the main premise of the game is highlighted, namely to be able to understand and calculate the pattern of the three suns to be able to predict the occurrence of chaotic and stable eras. Wang Miao is shown to travel five times into the virtual realm of "Three-Body", and each time there are players who try to solve the problem. For example, there is King Wen, who is depicted as trying to calculate the movements of the

⁵ The three-body problem, in astronomy, is defined as: "The problem of determining the motion of three celestial bodies moving under no influence other than that of their mutual gravitation" (quoted from *Encyclopedia Britannica*). It is till date an unsolved problem.

three suns by hand (p. 112). Then, there is Mozi, who establishes an intricate model of the universe in which it is a sphere with holes in its outer layer surrounded by a sea of flames, the holes being the spots where the fire can shine through and take the form of the suns or stars (p. 153). Mozi's model also proves to be completely insufficient to calculate the patterns of the three suns. Lastly, the most elaborate in-game attempt to solve the three-body problem is conducted by Von Neumann and Newton who create a massive human-computer by instrumentalizing millions of soldiers of King (pp. 227–228). These soldiers take the role of signal input and signal output and are instructed to perform different logical circuits, like an AND gate and an OR gate (pp. 229–230)⁶. Eventually, a massive army of 30 million soldiers is shown to perform these logical circuits, acting like a computer formed out of human beings (pp. 234–235). In terms of the visual representation of a solution to the three-body problem in physics, this section is especially significant as the vocabulary suddenly shifts towards typical computer jargon. Now there is a “central CPU”, a “motherboard” with “flashing components” (p. 235), a “differential calculus module” and a long “computation”. Therefore, the image of a gigantic army is suddenly mixed with typical computer imagery and so it becomes an in-between for the reader. This can be described as an ekphrasis⁷ of computer hardware that is placed above the actual narrative image of the gigantic army and combines them. In terms of the literary simulation of physics, this calculatory experiment is then brought to its end in a truly terrifying manner as suddenly the three suns appear in one straight line and their gravitational force is displayed to destroy the atmosphere, leaving the people with boiling blood and disintegrating organs in the vacuum of space (p. 242).

Aside from being an ekphrasis this example of Neumann and Newton's human-computer can be categorized as partly both explicit and implicit intermedial reference. On the one hand, it constitutes an explicit simulation of a computer filled with vocabulary that belongs to the domain of computers and video games. On the other hand, there is also an implicit intermedial aspect to it as the workings of the calculatory processes of a computer are imitated.

The *Three Body* chapters are filled with several such intermedial elements, most of which are explicit references, that serve various purposes. Firstly, multiple times the technology needed to access the virtual reality is mentioned. These

⁶ The interactive representation of *Three Body* aligns itself well with typical characteristic of massive multiplayer online games. As Downey (2014) outlines, since the late 90s extremely large sums are being invested by gaming companies “to produce vibrant visual worlds that draw users into the game and feed their desire to explore and play” (p. 59). Downey argues that games such as World of Warcraft and Second Life are offering virtual environments that players can truly interact with in a great number of ways (pp. 59–60).

⁷ In the sense of Heffernan's definition of ekphrasis as “the verbal representation of visual representation” (Heffernan, 1993, p. 3).

technological tools are a VR suit, which is also described as a haptic feedback suit, and a panoramic viewing helmet (p. 85).⁸ As this gear is introduced, it is also stated in the same breath that the suit allows players to experience both physical sensations, such as a punch, and temperature changes (ibid.). That this gear is mentioned is especially important as it contextualizes the VR experience of the protagonist in an intermedial manner by serving as a reminder for when he logs in (e.g. pp. 101, 149, 192), logs out (pp. 119, 160), or for certain virtual sensations that it allows him to feel (e.g. p. 104). Interestingly, these examples of VR gear are only present during the first three virtual adventures. In the last two runs, these mentions of Wang putting on the VR-Suit when he logs in or out, or of the VR-Suit allowing him to experience physical and temperamental sensations in the game world, are omitted. I would argue that Cixin accentuates these technological matters during the first half of the VR chapters, to create a distinct image of the process within the reader's minds, by clearly separating the virtual and the non-virtual world in their imagination.

There are further such elements utilized to the effect of creating a clear transition from the real world to the virtual reality of *Three Body* and back. For instance, terms like "log in/logged into" (e.g. pp. 101, 149), "logged on/ log on" (e.g. pp. 192, 201, 243, 251), "exit" (e.g. pp. 117, 118), and "logged out" (e.g. pp. 202, 243) are repeatedly employed throughout the novel as linguistic signaling devices showing when the protagonist leaves and enters the virtual world of *Three Body*. Naturally, it can be claimed that these terms have simply become commonplace by now when we talk about VR and online gaming. Nonetheless, I would argue that as they cannot be separated from the medial field they belong to, they establish per se an explicit intermedial connection, especially if they are combined with other such terms.

One significantly different intermedial element that draws attention to the videogame-esque nature of *Three Body* is its online address www.3body.net (p. 86). This web address is actually of specific interest to us because Cixin Liu and his team have established a website with exactly this address that was filled with information and extra content on the novel to foster an intermedial connection between the book and the internet, – a connection that sadly does not exist anymore as the website was deactivated a few years ago. Nonetheless, intermedial transposition of content from one medium to another is again an aspect that purposefully links this fictional video game to the actual realm of VR technology and the internet.

There are several other moments during which the game nature of *Three Body* is explicitly drawn attention to. For example, the process of launching the game is described in detail (p. 101). During this sequence there is an explosion, mountains

⁸ The VR gear in Cixin's novel seems akin to the technology produced by companies like teslasuit, HTC und Oculus VR.

come crashing down in the far distance and everything is bathed in the dust. Then, as the dust settles down Wang Miao is confronted with the registration screen and has to create an ID. Furthermore, there is the continuous highlighting of the game's option to speed up or slow down time (e.g. pp. 105, 113, 156, 231, 236), an aspect that is essential as game time always passes much faster than the play-time (discourse time). Thus, the presentation of the game world is considerably transformed as the reader is made to envision the changes which are described in these scenes as happening at an extremely fast pace and then suddenly being slowed down. Further, slightly more minor examples of the novel's foregrounding of the videogame nature of *Three Body* are comments on the game designers (p. 157), the game interface (pp. 120, 156), the game being over (p. 156), and the epilogue that appears at the end of each of Wang Miao's plays and re-narrates the story of the virtual civilizations that have just vanished (pp. 118, 160, 201, 242, pp. 262–263).

Via these explicit intermedial references, the fact that *Three Body* is a virtual reality game is emphasized repeatedly. I would argue that there is something quite essential to this overemphasis. In a way, all these intermedial aspects can be viewed as instances of self-reference drawing attention to the virtuality of the world. Hence, one could claim that *The Three-Body Problem* presents the reader with a VR game that constantly draws attention to its being a game. Now, what is interesting about this is that after all such a repeated act of self-reference tends to have the potential to break the aesthetic illusion of a text, a movie, or a game, and, indeed, the characters are shown to be somewhat unimmersed in the sense that they are shown to be aware of *Three Body* being a game. However, and here comes the catch, the effect on the reader can also be decisively different. Since the virtual reality chapters include so many overt mentions of VR and video gaming, the reader is likely immersed to a greater degree as the virtual world is rendered more distinct and believable⁹. After all, by repeatedly drawing attention to the idea that *Three Body* is a video game with typical video game visuals, features, and rules, the novel fosters a distinct intermedial vision of the narrative world within the reader's mind. Consequently, the effect on the reader can be quite opposite of what such instances of self-reference commonly provoke. This effect is also strengthened by the repeated emphasis of the text on the immersive qualities of *Three Body*. For instance, the main character is shown to be exceedingly intrigued

⁹ Møller-Olsen (2020, p. 135) also comments on the duality of *Three Body's* self-referentiality in terms of both being an immersive tool and being potentially illusion breaking: "The computer game becomes a chronotope that blurs the boundary between reality and imagination, as well as a metafictional gesture pointing out that the two realities (virtual and physical) are both fictional, existing side-by-side on the pages of Liu's book".

by the experiences he has in the virtual world to the point where it becomes almost more fascinating to him than the real world (p. 160):

After his mind had calmed down a bit, he again had the thought that *Three Body* was deliberately pretending to be merely illusory, while in fact possessing some deep reality. The real world in front of him, on the other hand, had begun to feel like the superficially complex, but in truth rather simple, *Along The River During the Qingming Festival* (Cixin L., 2016, p. 160).

This passage sums up two central aspects of the virtual reality. Firstly, here the self-referential illusion breaking of *Three Body* and its effect on the recipient are directly addressed, as it is commented that the world appears to be unreal yet also seems to contain a hidden reality. This foregrounding of the game world's fictionality whilst also implying that it hides something important renders the intermedial effect of these passages much more tangible. Furthermore, together with other such instances that affirm the immersive quality and captivating nature of *Three Body* (e.g. pp. 119, 246) it also foreshadows what is shown to be the real nature of the game. As has been mentioned before, it is revealed later on in the novel (pp. 346–348) that *Three Body* is a sort of recruiting software disguised as a game to find new members for the ETO as well as to find a solution to the three-body problem to save the people of Trisolaris. However, even earlier it is put forth that, indeed, *Three Body* is a game-like simulation of Trisolaris and that its primary features (three suns, chaotic and stable eras, dehydration/rehydration, and the Trisolaran-formation computer) exist on the planet of the Trisolarans. This foreshadowing of the existence of Trisolaris and its obscure features is one of the primary narrative functions of the *Three Body* chapters. Secondly, this passage exhibits the immersive qualities of *Three Body* in an intermedial manner as it is stated here that for the protagonist Wang Miao playing *Three Body* has become an experience that suddenly feels more exciting and deeper than reality. This is also exemplified via the explicit intermedial reference to a famous Chinese painting, – a reference point that is already established earlier (p. 120). By thus comparing reality to a painting and placing the virtual reality of *Three Body* in a sense above both as something more immersive and intriguing, an interesting assessment is created that once again strengthens the intermedial vision of the virtual reality whilst also creating a mysterious flair around the topic. In general, I would argue that one of the most outstanding aspects of the concept behind the virtual reality *Three Body* is its high narrative functionality regarding the novel's key aspects. As has been exhibited in this paper, *Three Body* is firstly, a virtual representation of the planet Trisolaris, its unique planetary situation, its people, and its culture (pp. 246–247). Secondly, it is shown to serve three practical purposes for the ETO (p. 347). Regarding these purposes, it is also underlined that *Three Body* was designed to present the Trisolaran culture by utilizing well-known elements of human culture in order

not to alienate new players (p. 347). Now, one other essential aspect of these clear-cut functions of *Three Body* within the context of the novel's story is that it can be argued that the virtual reality serves the very same purposes regarding the reader's reception of the text.

Firstly, the reader slowly but steadily gets to know the world of Trisolaris in a simulation environment and acquires knowledge about the planet and its people in a game-like world. Secondly, the alien inhabitants of Trisolaris are represented in a bizarre, humorous yet also exceedingly familiar manner that renders the whole world and its specific issues, like the three suns, the dehydration and rehydration of the people, and chaotic and stable eras more tangible and interesting. This is important because thus the extraterrestrial world and its civilization are in a sense built up from the ground in a logical and comprehensible manner. Thirdly, and probably most importantly, the same applies to the three-body problem in physics. If the novel started with theoretical expositions on the problem, then it could have been perceived as dry by many readers and might have had an alienating effect. Yet its playful presentation via *Three Body* and the whole backstory of intelligent beings on a distant planet who have been facing this problem for millennia renders the solving of this theoretical problem a highly sensible and intriguing task and creates a sense of investment within the reader, similar to the effect it is shown to have on characters who play *Three Body*. Subsequently, the more expositional passages in the middle of the novel (pp. 208–216), in which the three-body problem is explained, are framed in a way that makes them appear much more necessary and purposeful. As Bould and Vint (2011, p. 76) outline, the genre of hard SF that marked the so-called golden age of science fiction was primarily defined by its focus on extrapolations founded upon scientific plausibility and narratives that followed a concise logic. I would argue that Cixin's focus on physics and his implementation of a scientifically sound explanation and discussion of the three-body problem renders it a modern example of this kind of SF.

4. Conclusion

As I have demonstrated in this paper, Cixin Liu's portrayal of VR in *The Three-Body Problem* renders it a prime example of modern hard-SF. This is because the concept of *Three-Body* is utilized in a straightforward and functional manner. Every aspect from its intermedial presentation as virtual reality game to its intratextual functions as both a political tool and a sandbox simulation allowing players to attempt one of the most complex problems in modern physics serves distinct narrative purposes. In almost every case, these aims concern both the plot and the text's effect on the reader. Given its more traditional hard-SF approach, I would argue that the combination of simulating and rendering accessible a complicated theoretical problem whilst also firmly embedding it into its narrative can be viewed as one of the most stunning achievements of the novel.

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