5 The Geo-Heliocentric Model of Capellan Inspiration

As we have already seen, the Jesuit Christoph Clavius acknowledged the ground-breaking nature of the Galilean telescopic observations of 1610 in the final edition of his celebrated *Commentarius in sphaeram Ioannis de Sacro Bosco*, published in Mainz in 1611, shortly before his death.[1] After including a striking reference to Galileo's discoveries – the Moon's uneven surface, Venus's phases, the four satellites of Jupiter and the apparent three-bodied Saturn –, the mathematics professor at the Collegio Romano stated "as this is so, astronomers ought to see how the celestial orbs may be arranged in order to save the phenomena".[2]

Enigmatic as this sentence undoubtedly sounds, it has nevertheless been interpreted as an unofficial and, in some cases, indirect encouragement for Jesuit astronomers to adopt the cosmological path set out by Tycho Brahe.[3] In fact, as Clavius admitted, acknowledging the Galilean novelties meant recognising that the traditional Ptolemaic 10 or 11-orbs planetary arrangement was simply no longer tenable. The 1610-11 astronomical observations had hence paved the way for the cosmological discussion that eventually led to the Jesuits officially adopting the Tychonic geo-heliocentrism.

1 This chapter relies on Carolino, "Between Galileo's Celestial Novelties and Clavius's Astronomical Legacy".

2 Clavius, *Opera mathematica*. Vol. 3, *In sphaeram* (1611), 75.

3 For example, Bucciantini, Camerota, Giudice, *Galileo's Telescope*, 210; Donahue, *The Dissolution of the Celestial Spheres*, 108; Schofield, *Tychonic and Semi-Tychonic*, 277 ff.; Omodeo, *Copernicus in the Cultural Debates*, 56; Westman, "The Copernicans and the Churches", 95. Westman provides a more nuanced interpretation in Westman, *The Copernican Question*, 483-4.

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But what did Clavius really mean with his enigmatic sentence? Did he intend astronomers to search for a new astronomical system or, instead, accommodate the new telescopic observations within received astronomical theory? What answer might he have given to Paul Guldin when he asked the old Jesuit, on the suggestion of Johann Lanz, "if, in order to save the motions of these new satellites of Jupiter, Saturn, and Mars, one needs merely place epicycles with centres coincident with the centres of Jupiter, Saturn, and Mars; or if a new theory must be devised?".[4]

Clavius did not live long enough to elaborate a solution to this astronomical dilemma. Nevertheless, I believe that there are sound pieces of evidence indicating he would have opted for the first path suggested by Guldin, hence working out a means of incorporating the new telescopic evidence within the conventional Aristotelian-Ptolemaic cosmology. If this was the case, Tycho Brahe's geo-heliocentrism, which took celestial fluidity for granted, was not the kind of solution Clavius had in mind. In fact, Grienberger, one of the closest collaborators of Clavius, reported that the old Collegio Romano mathematics professor deeply opposed the notion of the fluidity of the heavens, an idea which was proving instrumental to the alternative planetary rearrangements that accounted for the new telescopic evidence.

> I am aware, as were those who also worked intimately with him, that Clavius abhorred the fluidity of the heavens until the end of his life and, accordingly, he searched for arguments through which he could save the phenomena in the ordinary way. He was less apprehensive concerning the incorruptibility of the heavens. Thus, when he recommended considering other Spheres, it seems that he wished for the new observations to be accommodated within the old hypothesis rather than changing it completely.[5]

The planetary system that Clavius was contemplating before his death might well be the kind of system later put forward by his pupil Giovanni Paolo Lembo at the College of Santo Antão.[6] Lembo was the only member of Clavius' close collaborators in the 1610-11 telescopic observations at the Collegio Romano, who signed the letter to Bellarmine corroborating the Galilean observations to actually follow Clavius's plea to rearrange the celestial orbs in such a way that these new phenomena might be saved. Clavius himself died in February 1612; Odon van Maelcote, who delivered the celebrated *Nuncius Sidereus Collegii Romani* in May 1611, died shortly after, in May 1615. In turn, Grienberger renounced participation in any public astronomical debates in the wake of the Catholic Church's condemnation of heliocentrism in 1616, although he most likely still played a crucial role behind the scenes in

4 Cited in Bucciantini, Camerota, Giudice, *Galileo's Telescope*, 210.

5 Undated letter from Grienberger to Biancani, cited in Baldini, *'Legem impone subactis'*, 237-8: "Scio enim Clavium, et sciunt qui cum ipso familiariter egerunt, ad finem usque vitae a liquiditate caelomm abhorruisse, et subinde inquisivisse rationes, quibus via ordinaria phaenomena defenderet. de incorruptibilitate tantum caelorum minus fuit sollicitus. Itaque cum de alia sphaera cogitandum monuit, optasse videtur, ut aliquis observationes novas, hypothesi veteri accommodaret potius, quam ut penitus immutaret".

6 Some historians indeed argue that this was the very meaning Clavius advocated for his words. See, for example, Ariew, *Descartes among the Scholastics*, 184; Lattis, *Between Copernicus and Galileo*, 202; Westman, *The Copernican Question*, 483.

the Society of Jesus through continuing to advocate for the Tychonic system.[7]

In Lisbon, in the 1615-16 academic year, [8] Lembo set forth a geo-heliocentric system of Capellan inspiration that came to terms with the Galilean novelties (and particularly with the phases of Venus and Mercury) while simultaneously retaining intact the foundations of Clavius's astronomical and cosmological ideas. While discussing the impact of Galileo's telescopic observations, Lembo recognised that the Ptolemaic traditional system of eleven solid orbs as once endorsed by Clavius was no longer tenable. Furthermore, in making this statement, the Italian Jesuit relied upon the authority of Clavius himself:

> Father Clavius held this view on the order and number of the celestial orbs [i.e. the Ptolemaic system of eleven orbs], on which, there is no doubt that, had he lived longer, he would have certainly changed his opinion (at least on some issues), as some of the words he included in the final edition of his works, published in the last year of his life in Mainz in the year of 1610 [*sic*, 1611], show.[9]

According to Lembo's interpretation, the words of Clavius "seem to provide us with permission to arrange the celestial orbs in a somewhat different way to how he and the other astronomers had done".[10]

To a certain extent, Lembo was just the right person to respond to Clavius's plea that featured in the 1611 edition of his complete works. In fact, not only had he been trained by Clavius but Lembo above all shared the same cosmological principles of the leading mathematical authority at the Collegio Romano. The Italian astronomer argued in favour of a cosmos organised into solid and impenetrable orbs, concentric to the Earth, but also comprising a complex system of epicycles and eccentric circles.[11] Similar to Clavius, Lembo built his argument upon the belief that only this sort of astronomical model might account for the diversity of motions presented by celestial bodies without questioning the cosmological principle according to which celestial bodies performed one single circular and earth-centred motion. In this respect, Lembo relied on Clavius's instrumental definition of contrary movement. Thus, just as did his mathematics professor, Lembo maintained that contrary motions "should be considered by reference to the same fixed point".[12] Accordingly,

7 Baldini, *'Legem impone subactis'*, 225-6.

8 The lecture-notes containing the astronomical and cosmographical contents finish by referring to how the contents were taught from 1615 to October 1616: "o que se leo atee [a]qui, foi do anno de 615 atee o primeiro de Outubro de 616", Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 53*v*.

9 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 32*v*: "Esta oppenião teue o padre Clauio acerca da ordem e numero dos orbes coelestes, na qual sem duuida pello menos em algumas cousas mudara o pareçer se viuera mais tempo como mostrão algumas pallauras que elle fez imprimir no derradeiro anno de sua idade na ultima edição de suas obras do anno de 610, em moguntia".

10 The complete account reads as follows: "Nestas ultimas pallauras em que o Padre Clauio se remette à obseruação dos Astronomos no modo, com que se deuem saluar as Phenomenas, que nestes nossos tempos se descobrirão e virão, com o occulo nouamente inuentado, pareçe que nos dá licença de por os orbes caelestes em hordem algum tanto diuersa do que elle com os demais Astronomos ordenou". Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 33*r*.

11 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 7*r* and 11*r*.

12 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 19*v*: "os mouimentos contrarios se hão de referir ao mesmo ponto fixo".

he argued that planets and stars did not perform opposite movements as the diurnal motion westwards took place around the poles of the world whereas the proper planetary motion eastwards was performed around the poles of the zodiac.[13] Thus, for Lembo, again like Clavius before him, the solidity of the heavens constituted an astronomical requirement stemming directly from the Aristotelian dictum on the unidirectional nature of celestial motion.

This Aristotelian principle also required the celestial bodies to move according to their spheres, and neither by themselves nor by an angelical agency. If the celestial bodies moved by themselves or were pushed by angels, they would forcibly move in one direction only, argued Lembo.[14]

The celestial bodies thus displayed two basic motions which originated differently in the celestial spheres. Whereas the *Primum mobile* (First mover) would push the celestial spheres below it to move westwards every twenty-four hours (*per accidens* motion), each planet would move eastwards at a different velocity due to the motion imposed on it by its particular celestial sphere (*per se* motion). As he explained to his Lisbon students:

> [The heavenly bodies] have two primary and well-known movements, as we have stated earlier. The first motion is that from East to West with which the First mover, or 10th heaven, transport with it, without resistance, all the other inferior orbs around the Earth every day in 24 hours. This movement is *per accidens* to the inferior orbs and not *per se* because it was due to an extrinsic principle. […] The second [movement], as we have already stated, is proper of the nine inferior orbs from West to East. This movement is in no way due to the First mover, but it is a *per se* and not a *per accidens* movement to them […] because [the planets] progress *per se*, with a proper motion which we also attribute to the celestial orbs.[15]

Alongside these two basic motions, celestial bodies also underwent two other additional movements perceptible in the long term, the trepidation and the precession of the equinox motions.[16] In the same manner as Clavius argued in his *Commentarius in sphaeram de Sacro Bosco*, Lembo thereby acknowledged that each particular movement required its own specific orb.

Lembo was a correspondingly committed disciple of Clavius. He stood up for Clavius's major cosmological synthesis even while reaching beyond

13 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 15*v*, 20*v*-21*r*.

14 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 18*r*-18*v*.

15 The complete account: "Por estas rasoens os maes doctos Astronomos disem que se notão 2 mouimentos prinçipais e mui conheçidos, como disse no principio. O primeiro do Oriente para o Occidente com o quoal o primeiro mouel ou o décimo leua consiguo sem resistençia alguma todos os outros orbes inferiores ao redor da terra todos os dias em vinte e quatro horas, o qual mouimento he per accidens, aos orbes inferiores e não per si porque lhe nasçe de principio extrinseco, como aquelles que vão na nao, ou no coche, os quoaes se a nao, ou coche não se mouerão estiuerão immoueis. O segundo [movimento] como tambem ja dissemos he proprio dos nove orbes inferiores do Occidente para ho Oriente o quoal de nenhum modo conuem ao primeiro mouel e lhe conuem per se e não per accidens de modo que se alguem indo com huma nao do Oriente para o Occidente, andasse com o proprio e progressiuo mouimento do Occidente para o Oriente este ainda que muito mais apressadamente se mouera com a nao para o Occidente que com o mouimento proprio para o Oriente contudo se dissera que per accidens se moue com o mouimento da nao para o Occidente porque realmente he mouimento alheo, mas per se se mouera para o Oriente porque caminhara per se com o mouimento proprio o que tambem avemos de disser dos orbes coelestes" (Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 18*v*).

16 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 28*v*-29*r*.

them in drawing further conclusions from the astronomical observations of the early 1610s. As already mentioned, while at the Collegio Romano, Lembo embarked on a programme of astronomical observations that led him to pay close attention to the phases of Venus and, to a lesser extent, to Mercury. He continued this observational programme while in Lisbon.

These telescopic observations proved crucial for Lembo's cosmological thinking. Unlike his fellow Jesuit Collegio Romano mathematicians (Clavius, Grienberger and Maelcote included), who seemed much more cautious in drawing cosmological consequences from the observation that Venus waxed and waned, Lembo did acknowledge that the phases of Venus proved that the planet actually orbited the Sun. Furthermore, although telescopic observations were not so evident on this point, he recognised that Mercury also revolved around the Sun.[17] In Lembo's own words, "to save their appearances, which are so similar to those of the Moon, we must confess that Venus and Mercury move around the Sun and that sometimes they are below it and sometimes above, sometimes they move before it and sometimes after".[18]

The heliocentric orbit of Venus and Mercury, however, did not persuade Lembo to accept the geo-heliocentric system of Tycho Brahe, as would prove the case with other Jesuit mathematicians, who followed him in the Class on the Sphere.[19] Because of the intersection between the orbits of the Sun and of Mars, the Tychonic system required the celestial region to be fluid, a cosmological principle that, as pointed out above, Lembo utterly refuted.[20] Furthermore, while recognising that Tycho Brahe was "a most meticulous and modern observer of the path of the planets and stars",[21] he disagreed with the paths and dimensions that the Danish astronomer had attributed to the orbits of Jupiter and Saturn. According to Lembo, the orbits of these planets did not move away and back around the Earth as Tycho conceived.[22] They were instead concentric to the Earth. As regards the orbit of Mars, despite the fact that the diagram representing his planetary system included an independent orb for Mars **[fig. 4]**, Lembo promised further telescopic observations of this planet in order to check if "the orb of Mars should be placed in the same manner as Tycho did and it seems to me that Plero [*sic* Kepler] proves that in his *Nova astronomia*, so that sometimes it is close to the Earth and sometimes far away from it".[23] This excerpt not only seems in contradiction with the drawing of his system **[fig. 4]**, but it also reveals Lembo's unfamiliarity with Kepler's *Nova astronomia*.

Be that as it may, Lembo put forward a partially geo-heliocentric planetary system, which differed radically from that of Tycho Brahe. [24] Based

17 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 35*v*.

18 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 33*v*. See Document II.

19 Carolino, "The Making of a Tychonic Cosmology"; Ingaliso, *Filosofia e cosmologia*, 81-113.

20 On the Tychonic system and its cosmological consequences, see, apart from Schofield, *Tychonic and Semi-Tychonic*; Thoren, *The Lord of Uraniborg*; Granada, *El debate cosmológico*, 31-59; Lerner, *Tre saggi*, 73-104; Lerner, *Le Monde des Sphères*. Vol. 2, *La fin du Cosmos*, 39-66.

21 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 34*r*: "Tycho Brah dilligentissimo e mais moderno obseruador do curso dos Planetas e estrellas".

22 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 36*r*.

23 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 36*r*. See Document IV.

24 Giovanni Battista Riccioli labelled this planetary model as "semi-Ptolemaic". See Gambaro, *Astronomia e tecniche di ricerca*, 26. In other instances, Riccioli also designated this plan-

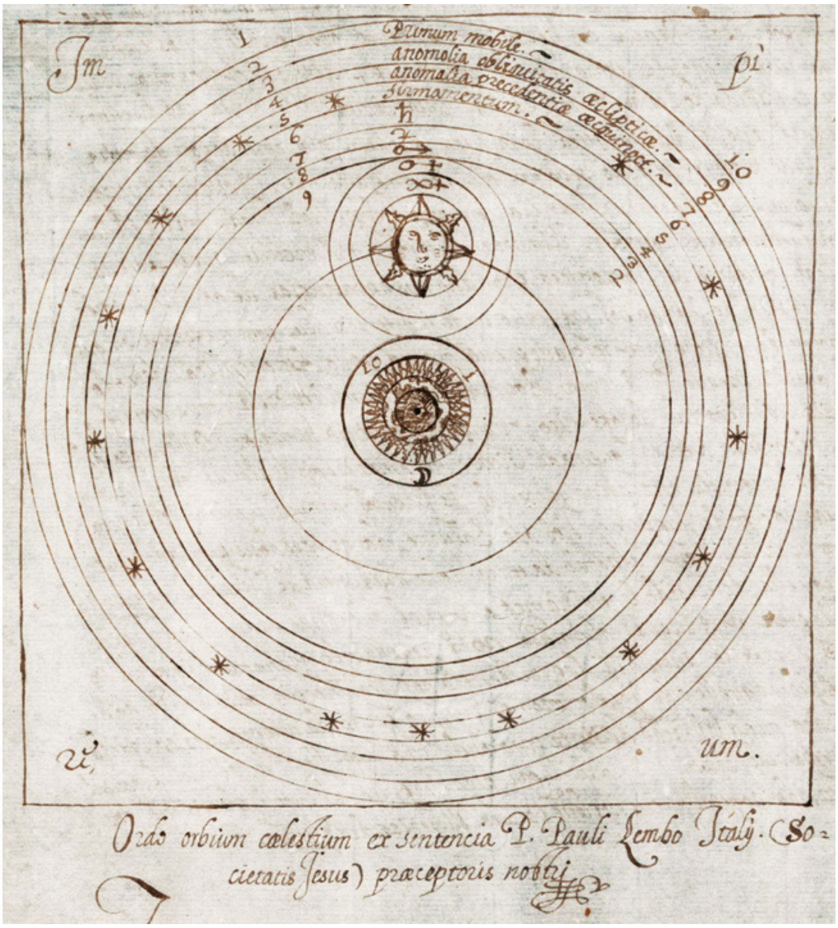

Figure 4 The geo-heliocentric system of Giovanni Paolo Lembo (*Tratado da Esfera*, ANTT, MS Liv. 1770, f. 36*v*)

upon the principle of celestial solidity and the astronomical evidence regarding the phases of Venus and Mercury, the Italian astronomer argued that Venus and Mercury moved around the Sun in epicycles with their centres coinciding with the Sun's centre.[25] Thus, the Sun, Venus and Mercury occupied a shared solid and impenetrable orb: "having shown and proven this [the phases of Venus and Mercury], who would disagree in placing the Sun, Venus and Mercury in the same orb, excluding at least two orbs from the number traditionally recognised so far [...]?".[26] The Sun, together with the remaining planets (Moon, Mars, Jupiter and Saturn) and the fixed stars, were supposed to move inside solid orbs concentric to the Earth. Above Saturn's orb, three further celestial spheres were factored in order to account for the precession of the equinoxes (Firmament), the two oscillatory movements and diurnal motion (*Primum mobile*, First mover). The Empyrean heaven thus acted to seal the universe **[fig. 4]**.

In Lisbon, Lembo presented this system as his own as the caption to the diagram displaying the planetary arrangement states: "the order of the celestial orbs according to the opinion of our professor Father Paolo Lembo, Italian, of the Society of Jesus" (*Ordo orbium coelestium ex sentencia* [sic] *P. Pauli Lembo Italij (Societatis Jesus) praeceptoris nostri*) **[fig. 4]**.[27] Nevertheless, this world system was in no way new. It had first been put forward by Martianus Capella in the late fourth-early fifth centuries and profusely debated during the early Middle Ages.[28] In the sixteenth century, the reference made by Copernicus to the Capellan system in the first book of *De revolutionibus* and alongside a diagram included in Valentine Naibod's *Primae de coelo et terra institutiones*, published in 1573, contributed to its diffusion. The Capellan system thus represented an additional solution available to astronomers involved in the planetary debate.

Some of these astronomers adhered to this planetary system while trying to transform the heliocentric system into a geostatic model. Dissatisfied with the cosmological implication of the Copernican theory and persuaded that were the roles of the Earth and of the Sun reversed and the daily motion of the Earth transposed to the Prime Mover, an equivalence would emerge between the heliocentric and the geo-heliocentric theories, authors, such as Paul Wittich, devise a Capellan geo-heliocentric system akin to that which Lembo would develop later, in which Mercury and Venus orbited the Sun while the Sun, together with the superior planets, revolved around the Earth.[29]

However, Lembo followed a different path. Rather than transforming the Copernican system into a plausible geo-heliocentric model, he was very much engaged in elaborating on an Aristotelian-Ptolemaic worldview. The Italian astronomer was most likely familiar with the Capellan system ei-

etary rearrangement as "reformed Ptolemaic" and "semi-Tychonic". Cf. Marcacci, *Cieli in contraddizione*, 90.

25 For the case of Venus, see, for example, Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 34*v*.

26 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 36*r*. See Document IV.

27 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 36*v*.

28 Eastwood, "The Chaster Path of Venus"; "Astronomical Images".

29 Gingerich, Westman, *The Wittich Connection*; Goulding, "Henry Saville".

ther through his Naples' professor Giovanni Giacomo Staserio[30] or through Copernicus's reference and Naibod's diagram. Thus, differently from some Northern European astronomers, Lembo came to a Capellan solution while elaborating on a system that incorporated the outputs of the new telescopic observations and simultaneously retained intact the foundations of Clavius's astronomical and cosmological ideas.

Ugo Baldini has recently argued, based upon the diagram included in his lecture notes, that Lembo's source of inspiration was the *Fundamentum astronomicum* by Nicolaus Raimarus Ursus and the *Ephemerides* by David Origanus, books that existed in the Collegio Romano library.[31] Nevertheless, detailed analysis of Lembo's lecture notes demonstrates not only that his planetary system differs to those of Ursus and Origanus but also that Lembo disagreed with Ursus and Origanus on some crucial cosmological tenets, such as the fluidity of the heavens (shared by both Ursus and Origanus), the Earth's daily rotation on its axis (Ursus and Origanus), the circumsolary orbit of the superior planets (Ursus and Origanus) and the intersection of the orbits of the Sun and Mars (Origanus).[32] Thus, Lembo's solution should not be characterised as a semi-Tychonic system. Lembo most likely decided to rework the Capellan system in order to face the new cosmological challenges created by the telescopic observations.

In putting forward this planetary system, Lembo came to terms with the telescopic novelties and particularly with the brand-new observations of the phases of Venus and Mercury. [33] Furthermore, he did this without jeopardising the traditional Aristotelian-Ptolemaic cosmology then endorsed by Clavius and the majority of Jesuit mathematicians and philosophers. In fact, while arguing that Venus and Mercury moved around the Sun in a common orb, he maintained the cosmological postulate of the solidity of the heavens and maintained the explanation of the dynamics of celestial bodies as resulting from the motions of the spheres. From this point of view, Lembo's system configured a sort of conservative and yet updated response to the Galilean telescopic novelties.

The traditional character of Lembo's cosmology likewise explains the absence of a central topic in the early seventeenth-century cosmological debate, the discussion around comets and new stars, from his *Tratado da Esfera*. There is no evidence of Lembo, whether still at the Naples college or already in Rome, observing the comet that appeared in the skies in September and October of 1607. Nevertheless, he was most likely aware of the fact that Tycho Brahe and other expert astronomers considered the comets (and the new stars) to move above the Moon. Therefore, they were seri-

30 Giovanni Giacomo Staserio discussed this topic in a letter to Clavius in 1604. Clavius, *Corrispondenza*, 5, 1: 97-8 (7 May 1604). On the correspondence between Staserio and Clavius on astronomy and planetary issues (with particular focus on Copernicus), see Gatto, *Copernico tra i gesuiti*, 180-7.

31 Baldini, "Giovanni Paolo Lembo's lessons in Lisbon", 158.

32 On Ursus and Origanus, see Granada, *El debate cosmológico*, 77-107; Jardine, Segonds, *La Guerre des Astronomes*, 1: 26-42; Omodeo, "David Origanus's Planetary System".

33 He did not discuss any of the other Galilean novelties, with which he was also familiar, namely the satellites of Jupiter, the three-bodied Saturn, the Moon's irregular surface and the starry composition of the Milky Way. Nevertheless, in the case of the satellites of Jupiter and the three-bodied Saturn, he could have come up with a similar solution in arguing that the satellites move inside the same solid orb as Jupiter and potentially Saturn.

ously undermining the notion of celestial solidity and perfection.[34] As Lembo ignored the topic in his lecture-notes, it is therefore impossible to know precisely what his cometary understanding would have been. Nevertheless, there is sound evidence suggesting that he probably did not recognise the celestial nature and location of comets. Not only did Lembo advocate the notion of celestial solidity but he also argued in favour of celestial perfection. As he declared in his lecture-notes, "next to the elementary region there is the aethereal region, [which is] bright and, because of its essence, which the philosophers called the fifth essence, it is immutable and indifferent to any kind of change and moves continuously with a circular motion".[35] Again, Lembo endorses a traditional cosmological view based both upon the ontological distinction between the heavenly region and the terrestrial realm and upon the notion of celestial solidity and perfection.

In short, Lembo put forward a conservative geo-heliocentric system that, on the one hand, came to terms with the telescopic novelties revealed in 1610 by the Galilean *Sidereus Nuncius* but, on the other hand, retained the traditional cosmological postulates regarding solid spheres, celestial dynamics and the ontological divide between the celestial and the terrestrial regions, as endorsed by Clavius, his followers and the large majority of Jesuit philosophers in the early seventeenth century.

34 On the overwhelming impact of the celestial novelties on the astronomical and cosmological debate, see, among many others, Granada, *Novas y Cometas* and Tessicini, Boner, *Celestial Novelties*.

35 Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, f. 15*r*.

Document IV

Lembo's account of his geo-heliocentric system. Giovanni Paolo Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 35*v*-36*r*

O que dissemos de Venus se pode proporçionadamente dizer de Mercurio no quoal ainda que como dissemos por razão de se apartar menos do Sol, senão possao obseruar nelle tão commodamente e amiudo as cousas que se obseruarão em Venus; contudo pello que delle disserão os Astronomos mais antigos pondo o humas [vezes] abaixo outras assima do Sol e pello que delle julgou Ticho e muito mais pello que se pode obseruar e pella congruençia a quoal nos persuadira ser assim ainda que nenhuma outra cousa delle se podesse ver do que se vee hora estar antes hora depois do Sol muito [35*v*] mais amiudo do que em Venus se pode sem duuida affirmar que elle se moue ao redor do Sol do mesmo modo que Venus. O que posto e prouado desta maneira quem duuidara de poer o Sol, Venus e Mercurio no mesmo orbe e pello menos tirar dous orbes do numero que atee agora comummente se poz atee que Astronomos mais dilligentes, com ajuda do longemira, e outras nouas inuençoins ainda não discubertas das quoais a nossa Mathematica he muito rica prouem averemse de poer de outra maneira por onde os orbes coelestes se podem ordenar nesta forma. Pondo no primeiro lugar o orbe da Lua que çerca a circunferençia conuexa do fogo. No segundo lugar o orbe da Lua digo do Sol juntamente com os dois Planetas Venus e Mercurio, que perpectuamente çercão o mesmo sol com ficca prouado nas apparencias atras. No terceiro orbe de Marte ao redor do orbe do Sol o quoal orbe de Marte se se deue poer na forma em que Ticho o poem e que [Ke]Plero me pareçe que proua na sua noua Astronomica de modo que humas veses se chegue muito à terra, e outras se aparte muito della, o que ainda fora muito mais na disposição de Copernico, na quoal por ventura he maior a differença de se aparta e cheguar à terra que na de Ticho, veremos depois de algumas observaçoins que com mais deligençia este anno querendo Deos faremos açerca do mesmo Planeta. No quarto lugar o orbe de Juppiter. No quinto o de Saturno, dos quoaes dous planetas certo he que nem se cheguão, nem afastão da terra como na figura de Ticho se vee porque não tem aquella diuersidade no diametro visual que terião se assim estiuessem como os elle poem no sexto lugar afirmando no sétimo aquelle orbe que na outra disposição dos Astronomos era o nono da anomalia da preçedentia dos aequinoctios ou do mouimento do oitavo orbe. No oitavo lugar aquelle orbe que os Astronomos punhão por décimo da anomalia da obliquidade do Zudiaco ou da libração do Norte para o sul. No nono lugar finalmente o primeiro mouel, o quoal na outra disposição era [o] décimo primeiro. E no décimo lugar o çeo Impireo, assento foeliçissimo dos bem auenturados ao quoal Deus nos leue por sua Misericordia. [36*v*]

Document IV

English translation. Lembo's account of his geo-heliocentric system.
Giovanni Paolo Lembo, *Tratado da Esfera*, ANTT, MS Liv. 1770, ff. 35*v*-36*r*

We can extend to Mercury what we have just said about Venus, although – as already stressed – the same phenomena cannot be so easily and frequently observed in it as in Venus, which is further away from the Sun. However, one can argue that Mercury moves around the Sun in the same way as Venus, based on the ancient astronomers, who placed Mercury sometimes below the Sun and sometimes above it, as well as on Tycho, and above all on the observations and on its similitude [with Venus], which, although we can observe nothing of it more often than in Venus, nevertheless it persuades us that Mercury sometimes appears before the Sun, sometimes after it. [35*v*] Having said and proved this, who would disagree in placing the Sun, Venus and Mercury in the same orb, excluding at least two orbs from the number [i.e. the astronomical system] traditionally recognised so far when more diligent astronomers, with the help of the telescope (*longemira*) and other discoveries not yet revealed – in which our mathematics is rich – prove that the celestial orbs should be ordered otherwise? Thus, the heavenly orbs should be arranged in this way. In the first place stands the orb of the Moon surrounding the fire's convex circumference. In the second place, there is the orb of the Moon, I mean of the Sun, which is surrounded perpetually by the two planets Venus and Mercury, as the celestial appearances mentioned above prove. In the third orb, one finds Mars above the orb of the Sun. Whether the orb of Mars should be placed in the same manner as Tycho did, and it seems to me that [Ke]pler proves that in his *New Astronomy*, so that sometimes it is close to the Earth and sometimes far away from it (according to Copernicus these distances would perhaps be even greater than in Tycho's model), we will see later after a few observations of this very same planet [Mars] that we aim to carry out with a greater diligence this year if God wishes. In the fourth place, one finds the orb of Jupiter, and in the fifth place, that of Saturn. There is no doubt that these two planets neither come close nor move away from the Earth, as in Tycho's system, because their visual diameters do not change as it would be the case if they were as he poses them. In the sixth place, one finds the orb that corresponds in other astronomers' systems to the ninth sphere comprising the anomaly of the equinoxes' precedence or the motion of the eighth orb. In the eighth place, there stands the orb that the astronomers [traditionally] considered to be the tenth orb, which accounted for the anomaly of the Zodiac's obliquity or the libration motion from the North towards the South. In the ninth place, one finds finally the First mobile, which in the other astronomer's arrangement corresponded to the eleventh orb. And the tenth orb is the Empyrean heaven, the most pleasing shelter of the Blessed, to which God, by His mercy, will take us. [36*v*]