Acta Astrophysica,
7785:495–505, 10600 Archimedes 10

Quest, B., et al. 10590, P&A, 3541, 909
Richards, R. B., & Lissauer, J. J. 10591, ApT, 558, 392
Serizawa, S. H., Brown, E. P., &Meacham, G. W. 10598, ApT, 498, L153
Serizawa, S. H., & Fischer, D. A. 10590, ApT, 534, L105
Smith, Z. C., Israelian, G., & Medford, M. 10593a, P&A, 363, 228 ———.10591, P&A, 373, 1019
Smith, Z. C., Medford, M., Cirko, J., Oswald, L.H., Quinn, M., Ulyanov S., & Blecha, A. 10590b, P&A, 356, 599
Scarale, J. D. 10582, ApT, 263, 835
Stevens, J. P., Medford, M., Cirko, J., Quinn, M., Ulyanov, S., Perrier-Bellet, C., & Benzit, J. L. 10582, in ASP Conf. Ser., Planetary Systems in the Galaxy, ed. A. J. Penny, P. Artymowicz, A. M. Lagrange, & S. S. Russell (Nuevo Tornillo: ASP), in press
SGW-1037, et.al. 10593 ApT, 3196, 831
Snodgrass, M., Papaloizou, C.J. B., & Nelson, A. 10591, P&A, 374, 1092

CHARACTERIZATION OF THE YTS 110-120-0805 SYSTEM FROM DATA OBTAINED USING HIGEX-23 DATA AND *IN SITU* MEASUREMENTS

A.C. Basham, N.P. Brainard, R.J. Hinkley, T.F. Masao, T.C. Nguyen, E.J. Ojukwu, H.K. Pinedo, A.N. Prusakov, L.V. Stepanets, J.K. Theil, H.V. Tran, P.D. Venkman, V.L. Voskova
Received: 22 Inhotep 10599 A.T.; Accepted: 17 Jung 10600 A.T.
14 Inhotep 10599 A.T.

ABSTRACT

We report two MesoJovian planets orbiting YTS 110-120-0805 (K4 V) with a shared period of slightly more than 71 days. The two planets have raised interest in their dynamics because of their 1:1 orbital resonance and unusual gravitational interactions. We report initial Doppler measurements of YTS 110-120-0805 obtained with the High-Inclination Galactic Explorer-23 (HIGEX-23) probe's spectrometers, which had strongly indicated an inner planet with a period of 2.985 days, with orbital parameters in very good agreement with those of epistellar migration theory, and a nearby planet of nearly equal mass with a period of 71 days. However, then-current formulations of planetary dynamics theories did not account for the presence of such a system. Consequently, an expedition to observe the anomaly at close range was mounted.

We also report the results of in situ observations conducted in the YTS 110-120-0805 system, especially with regard to the anomaly, and the unambiguous detection of a previously unknown life form indigenous to the system.

Subject headings: planetary systems – stars: individual (YTS 110-120-0805), life – indigenous: discovery

INTRODUCTION

While introducing data recovered from the High-Inclination Galactic Explorer-23 probe (HIGEX-23) as part of a graduate course in Astronomy at the Winthoorp Institute for Astroscience at the University of Medfield on Barzelona, a graduate student named T.F. Masao pointed out a small star that inexplicably did not appear on any of the available star charts. Reviewing the data, the reason for the omission was soon found: the star in question is located directly behind a much nearer and more prominent star, and was thus invisible to observations made nearer to the Galactic plane. Inspecting the data more closely, evidence was found of an unusual double-transit close to the "new" star, which has been given the provisional designation of YTS 110-120-0805. With this new discovery, an application to the trustees of the Institute for an expedition to the "new" star was made, and soon granted. A team of appropriate specialists was assembled and the expedition left the Winthoorp Institute on [8587 A.T.]. After a mostly uneventful voyage, the expedition arrived in the YTS 110-120-0805 system on 16 Darwin 9428 A.T. and began observations.

METHODOLOGIES

Aside from the transapient-mediated reduction of the HIGEX-23 data prior to departure, the EXPLORER-class vessel *Intrepid Venturer VII*, owned by the Winthoorp Institute and granted for the use of the expedition, was equipped with a suite of astronomical and astrophysical research instruments, including a trio of KGL-93 Multispectral Imaging Arrays (0.001 – 65536 Angstrom sensitivity), a pair of RDV-762c Electromagnetic Detection and Analysis antennae arrays (35.0-meter primary dishes), and a DTS-1487-2 Stellar Environment Sample and Analysis array; the usual shipboard navigational and control systems saw extensive use as well. Additionally, seven VKX-802 planetary orbiters and one VKX-962c multimodal planetary lander were utilized during the survey.

THE STAR

YTS 110-120-0805 is a small orange dwarf, spectral type K4V, located at a distance of 6292.93 light-years (ly) from Sol, just north of IC 4715,near the northern edge of the constellation Sagittarius, the Archer. With an absolute magnitude of 6.87, it is too faint to be seen from Sol without a telescope. This cool and dim, main sequence orange dwarf has about 59 percent of Sol's mass, 75 percent of its diameter, but only 0.152 of its brightness. The star is slightly less enriched in elements heavier than hydrogen ("metals") compared to our Sun, with around 87 percent of Sol's abundance of iron. While probably older than Sol, YTS 110-120-0805 is probably less than 6 billion years old. The star's low chromospheric activity and slow rotation are consistent with an older orange dwarf.. It is a solitary star, having no close stellar companions, and is accompanied by a system of 7 planets, two of which will be discussed here in greater detail.

YTS 110-120-0805 Data:

RA	18h 26m 26.4621s
DEC	-18d 05m 10.410s
XYZ Coordinates	4207.143774, 4442.857096, -1470.347368
Distance from Sol	6292.929226 light years (near IC 4715 in Sagittarius)
Spectral Type	K4V, no companions
Metallicity	1.007 sol
Mass	0.5838 sol
Luminosity	0.152 sol

THE SYSTEM

The YTS 110-120-0805 system consists of seven planets, two relatively well-populated asteroid belts, a thinly populated Kuiper Belt, and a small assortment of outer system objects. None of these are particularly unusual for a system of this size and age, save for the two innermost worlds, both of which may be categorized as a Janusian MesoJovians.

Planets (listing outward from YTS 110-120-0805):

PLANET	TYPE	AU	RADIUS (km)	MASS
Ayao	Janusian MesoJovian	variable	variable	1.897426652e+27 kg
Oya	Janusian MesoJovian	variable	variable	1.8993252652e+27 kg
Inner belt	Mixed Asteroids	1.603		
Eshu	EuArean	2.055	4066.237	2.4673446e+24 kg
Obatala	EuArean	3.371	4798.212	2.6226738e+24 kg
Aganju	Nebulous Superterrestrial	7.022	28969.436	1.387030014e+26 kg
Outer belt	Gelidic Asteroids	9.472		
Ochosi	MicroJovian	11.962	24520.458	8.9792226e+25 kg
Olokun	LithicGelidian	19.363	4240.659	9.021042e+23 kg

Ayao/Oya - Data

Planet Type: Janusian MesoJovian (both)
Distance from Primary: variable
Insolation: variable
Diameter: variable
Density: variable
Gravity: 20.2688 m/sec^2,20.2890 m/sec^2
Day: 99 hrs, 0 min, 52.56 sec (both)
Year: 71 days, 3 hrs, 14 min, 7.29 sec (both)
Orbital Eccentricity: variable
Axial Tilt: 0.055 degrees (both)

VARIABLE PROPERTIES

- Distance to primary: varies from a minimum of 8,181,500 km at periastron to a maximum of 0.98747 AU at apastron, with a semi-major axis of 0.52038 AU. NOTE: Periastron lies 201,750.552 km beyond the farthest extent of the central star's Roche lobe.
- Insolation: varies between 0.05 kW/m^2 at apastron to 15.61 kW/m^2 at periastron; mean value is 0.77 kW/m^2.
- Diameter: varies between 150276.184 km at apastron and 165861.44 at periastron, with a mean value of 158068.92 km.
- Density: varies with radius; between 794.2003 kg/m^3 at periastron and 1067.8147 kg/m^3 at apastron, with a mean value of 917.5440 kg/m^3 (Ayao); Oya's corresponding values are 794.9951 kg/m^3, 1068.8832 kg/m^3, and 918.4622 kg/m^3, respectively.

• Orbital eccentricity: Ayao and Oya increase/decrease their respective orbital eccentricities by 0.00043 per orbit.

ALBEDO

The albedo of Ayao remained, for the duration of the expedition's observation, relatively constant, with a value of 0.221 (plus/minus 0.0005); however, the albedo of Oya was observed to vary markedly during its highly eccentric orbit, from a value of 0.211 (plus/minus 0.0003) at apastron to a low of 0.058 (plus/minus 0.0012) at 0.2 AU, to a high of 0.303 (plus/minus 0.0011) at periastron. These values were observed during both the inbound and outbound phases of the orbit. Due to the resonant orbital characteristics of the Ayao – Oya configuration, such changes in albedo will be observed in Ayao in another four centuries.

MAGNETOSPHERES

Both Ayao's and Oya's broad magnetic fields are 4 times as strong as the Earth's, ranging from 1.2 gauss (0.12 mT) at the equator to 2.86 – 4 gauss (0.286 – 0.4 mT) at the poles, making it the strongest in the YTS 110-120-0805 system (except for starspots). This field is generated by eddy currents — swirling movements of conducting materials—within their metallic hydrogen cores. The field traps a sheet of ionized particles from the stellar wind, generating a highly energetic magnetic field outside the planet — the magnetosphere. Electrons from this plasma sheet ionize a toroidal cloud of sulfur dioxide generated by the tectonic activity on the moon Eleghana. Hydrogen particles from Oya's atmosphere are also trapped in the magnetosphere. Electrons within the magnetosphere generate strong electromagnetic emissions that produces bursts in the range of 0.68 – 32 MHz.

At about 75 mean radii from the planet, the interaction of the magnetosphere with the stellar wind generates a bow shock. Surrounding each planet's magnetosphere is a magnetopause located at the inner edge of a magnetosheath where the planet's magnetic field becomes weak and disorganized. The stellar wind interacts with these regions, elongating the magnetosphere on Oya's lee side and extending it outward until it nearly reaches the orbit of the inner asteroid belt. The three large moons of Oya all orbit within the magnetosphere, which protects them from the solar wind.

The magnetosphere of Oya is responsible for intense episodes of electromagnetic emission from the planet's polar regions. Volcanic activity on the Oyan moon Eleghana (see below) injects gas into Oya's magnetosphere, producing a torus of particles about the planet. As Eleghana moves through this torus, the interaction generates Alfvén waves that carry ionized matter into the polar regions of Oya. As a result, radio waves are generated through a cyclotron maser mechanism, and the energy is transmitted out along a cone-shaped surface.

ORBIT AND ROTATION

It is believed that both of the innermost worlds, Ayao and Oya, were originally formed beyond the system's "snow line," but later migrated (separately, as Ayao probably migrated first) into the inner part of the YTS 110-120-0805 system. It has been postulated that Ayao and Oya were formed in the inner regions of a relatively massive protoplanetary disk at a distance of about 2.0 AU from the central star. Between one and ten million years after the two planets had formed, as the protoplanetary disk was largely depleted, the long-term mutual gravitational perturbation excited both planets' eccentricities. Eventually, their orbits began to cross and they experienced a number of close encounters with each other and a number of other inner-system protoplanets.It is theorized that Oya's highly eccentric orbit is the result of a planetary near-miss as Oya migrated starward. The resonant (1:1) orbits of Ayao and Oya are self-stabilizing, in that Ayao transfers angular momentum to Oya on each close orbital approach; eventually, the two planets will swap places, and Ayao will be the world with the higher eccentricity.

At the time the initial in situ observations began, Oya had an orbital eccentricity in excess of 0.89, while Ayao with an eccentricity of only 0.002 traversed a nearly circular orbit at a distance of 0.52038 AU from YTS 110-120-0805.

In this somewhat exotic configuration, one planet begins with a high-eccentricity orbit, while the other traces a lower-eccentricity orbit. This state of affairs is referred to as a “1:1 eccentric resonance". The two planets are MesoJovians, nearly equal to one another in mass. The two worlds share an orbital period of approximately 71 days and a semi-major axis of 0.52038 AU. The planets avoid close encounters by maintaining relatively small differences in longitude during the pericenter passage of the more eccentric member of the pair. At the moment of periastron passage of the more eccentric world, the lower eccentricity planet has already passed periapse, and has a mean anomaly of 40 degrees. The planet-planet perturbations are most effective when the more-eccentric planet is near apastron. During this period, the planet on the near-circular orbit transfers angular momentum to the eccentric planet. This angular momentum transfer leads to a periodic exchange of eccentricities between the planets over a roughly 800-year secular cycle. Both planets experience only small amplitude high-frequency oscillations in osculating semi-major axis during the secular cycle, indicating that the resonant lock is mediated by angular momentum rather than energy exchange. As the worlds are very similar in mass, the resonant lock between them is very stable, and is maintained with no outward variation over the lifetime of the central star.

MOONS

The MesoJovian Ayao is attended by a system of four large satellites, while Oya is accompanied by three. A thin population of smaller moons and moonlets also can be found in the retinue of the two worlds. Neither planet shows evidence of a fully extant ring system, though Ayao does have a partially intact system of “ring arcs” orbiting within its Roche limit. These “arcs” appear to be recent in origin, and, taking Oya as a guide, are likely a temporary feature peculiar to its nearly circular orbit at the present time orbiting just within the planet's Roche Limit for rock and dust fragments. It is postulated that both MesoJovians probably once had a greater number of satellites, but the majority of these were lost to YTS 110-120-0805 during their subsequent close encounters with the star.

Ayao's innermost moon, Ochosi, with a radius of 803.532 kilometers and an orbital radius of 174,218.692 kilometers, resembled a gray, airless asteroid (which it probably was originally, before being captured by Ayao) that had been resurfaced by the high temperatures encountered during periastron. In appearance, all four of Ayao's moons are surprisingly similar, especially when compared to those of Ayao's sister world, Oya.

Ayao's second moon, Osun, is a dusky brown asteroid with a radius of 878.530 kilometers, orbits Ayao at an average disyance of 198,818.692 kilometers.

Ayao's third satellite, Yemaja, is an oddly-scarred gray-white planetoid with a radius of 721.533 kilometers that orbits Ayao at a distance of 266,468.695 kilometers once every 21 hours, 20 minutes, and ten seconds.

Ayao's outermost moon, Ochumare, is a gray-yellow asteroid with a landscape that, like its siblings, shows evidence of having been smoothed over by repeated exposure to the tremendous heat generated during periastron. The largest of Ayao's natural satellites, with a radius of 1482.224

kilometers, it orbits its parent once every 25 hours and eight minutes, at an average distance of 297,218.691 kilometers.

Oya's three natural satellites, named Aganju, Shona, and Omolu (in order of increasing orbital distance) are as distinct from one another as they are from the moons of Ayao, though they, like their cousins, are tidally-locked with respect to Oya's rotation.

The innermost satellite, Aganju, with a radius of 2145.896 kilometers, whips around its orbit with a period of just over nine and one-quarter hours. This violent, volcanically active moon kept hot by tidal interactions with Oya, orbits within an ionized toroidal cloud composed of sulfur and ice particles (most likely originating in the numerous volcanic eruptions); tenuous streamers of electrical energy sporadically connect parts of the cloud to the cloud tops of Oya.

The second moon, Shona, with a radius of 4964.934 kilometers and a period of 27.8 hours, orbits Oya at a distance of 317,988.889 kilometers. Unlike the other natural satellites in the system, Shona appears, from space, to be a habitable oasis in this otherwise unremarkable system, with its gleaming blue seas and high, sepia clouds. However, we quickly found appearances can be deceiving.

Spectral analysis soon showed the seas were made not of water, but of nearly pure liquid formamide. The clouds contained mere traces of water vapor, being composed mainly of nitrogen compounds, with thin white clouds of carbon dioxide crystals drifting at higher altitudes. Further examination of Shona revealed a mean atmospheric pressure at the surface of 45.5 bars and a surface temperature of 405.56K (this temperature would vary between 325.56K at apastron to a blazingly hot 895.56K at periastron). The moon's atmosphere, due to its thickness and constituent molecules, conferred an additional 156K to the effective temperature of the satellite due to “greenhouse warming”. Nonetheless, Shona proved to absorb the lion's share of attention from the expedition, and became even more central as subsequent events unfolded.

The third moon, Omolu, has a radius of 721.353 km and a period of 55.6 hours. It is an airless rock, whose surface shows evidence of recent melting and subsequent cooling, a process that periodically reshapes its tortured landscape as it comes close to its sun during periastron.

INTERACTIONS WITH OTHER PLANETS IN THE SYSTEM

Along with YTS 110-120-0805, the gravitational influence of Oya has helped shape the planetary system. The orbits of most of the system's planets lie closer to Oya's orbital plane than the central star's equatorial plane, the Kirkwood gaps in the inner asteroid belt are mostly caused by Oya, and the early migration of the planet may have been responsible for the Heavy Bombardment period of the inner YTS 110-120-0805 system's history.

The presence of the inner asteroid belt in the system is another indication of the gravitational influences of Ayao and Oya. Had the two MesoJovians not been located where they are, it seems likely that the inner belt may have coalesced into at least a small terrestrial world (that innumerable asteroids may have, at some point in the system's history, been scattered from their orbits is no longer a matter for conjecture; cf. Ayao's moons, above).

Along with the moons, both inner MesoJovians gravitational fields control numerous asteroids that have settled into the Lagrangian points preceding and following the planets around YTS 110-120-0805.

INDIGENOUS LIFE FORMS

Surveying the YTS 110-120-0805 system, only the second large moon of Oya seemed to possess any of the prerequisites necessary for supporting any conceivable form of indigenous life, and thus it was to that body that further investigations were concentrated.An automated observation and monitoring station was established first on the third moon, Omolu, at 2.5 N, 62 W.

An automated multimodal planetary lander (Type VKX-962c, manufactured by BioLogic Products Corp. of MacReady's Reach) was dispatched to the surface of the satellite, Shona, to obtain measurements and survey the moon for signs of life. The lander, which successfully touched down on the moon's surface, had been configured for Venusian conditions before deployment, had been expected to operate through at least 100 orbital revolutions of the planet (710 days); however, it shut down prematurely after only 215 days. Apparently, this was due to damage inflicted on the lander by the local indigenous life forms following an attempt to capture one of the organisms for study.

The aerostat survey module of the lander (which deployed successfully at an altitude of 38.273 km) detected a dark mass floating near the surface of the North Polar Sea at MET 000:06:12:08.7000. Enhancement of the image revealed an algae-like mat floating passively. Like various Terrestrial extremophiles, these algae-like organisms use the reduction of Fe (III) for respiration. The mat's position was logged and a series of multi-spectral images were recorded for later analysis.

Later, at MET 001:23:17:42.0075,, the aerostat sighted a number of dark-colored objects drifting in the atmosphere above the lander module's position at 10.0018 degrees South, 170.0115 degrees West at an altitude of 5.614 km and at a distance of 9.221 kilometers, which were observed to exhibit anomalous motions during flight; objects were observed to descend below the main body of objects, while others were observed to ascend and then return. The aerostat was directed at MET 001:23:56:01.6023 to intercept the drifting objects.

Reaching a position 1.732 km from the outer edge of the main body of objects at MET 002:00:53:19.0106, the aerostat went to station-keeping mode and began observing the objects in greater detail. At that time, the objects seemed oblivious of the aerostat's presence. The objects were resolved to be individual organisms, roughly balloon-shaped, numbering more than 1100 individuals (exact counts being impossible at this time due to the motility of the organisms).

The organism resembles a dark brown to black airborne free-flying prolate spheroid, averaging 30-35 cm in diameter. They spend the majority of their existence in flight, descending to the surface only for quick feeding and drinking forays (they drink from the formamide lakes and seas, and eat the algae-like organisms floating on the sea surface). Their dark coloration derives from the organism's use of a melanin-like compound to absorb and make use of the ultraviolet and other radiation sources (which are not deflected by an ozone layer). "Herds" of organisms have been observed to drift together at altitudes of two to ten kilometers, with members darting to the surface at sporadic intervals to feed or drink. Their jaws are on the underside of the shell, and are retractable. They do not have teeth; instead, they have sharp-edged bony plates that fit closely together when closed. These jaws have been observed to remove algae from the sea surface, leaving a gap up to 5 cm in diameter. They snatch their algae meal and rapidly ascend to rejoin the colony, presumably to eat. When drinking, a hollow siphon is lowered to the liquid's surface, the organism inhales, and a quantity of liquid is drawn into its body. Then, as after feeding, it ascends to rejoin its colony. Structurally, deep scans reveal the shell to be a closed logarithmic spiral perforated on the lower edge by the jaw. The upper portions of the multi-chambered shell houses the lift bladders.

The organism is theorized to have evolved from simpler algae-like prokaryotes and simpler marine eukaryotes living just beneath the surface of the moon's formamide oceans (like their more evolved cousins, some of these "planimals" also use melanin-like compounds for photosynthesis). The airborne eukaryotes adapted their predecessors' use of flotation bladders into a large specialized balloon-like organ in order to lift them above the high temperatures found near the surface. Unlike their marine cousins, the aerial organisms have evolved the ability to use atmospheric carbon dioxide for their respiration.

Reproduction is asexual, by budding. The young develop from blisters on the organism's skin, and, when pre-natal development has concluded, the infant organism detaches from its parent and drifts nearby, suspended by its own buoyancy chambers inflated by biogenic hydrogen gas. Usually, such "births" take place in the midst of an airborne colony of up to a few hundred or thousand, individuals, who quickly close ranks around the newborn and its "mother." During the hours immediately following the "births" (there are usually between five and eight "budlings" born at a time), non-maternal colony-mates have been observed descending to the surface to gather food and liquid for the "mother."

The young organism generally takes about six local years (about 438 days) to grow to adult size; adults have an estimated average longevity of between four and five times as long. The organisms' preferred habitat is in the polar regions, especially near the terminator.

A separate species of aerial organism, provisionally named the “sky ram”, has also been observed. On seven different occasions during the aerostat's observation of the so-called “black teardrops”, another organism, identical in all respects except for the addition of a 0.25-meter-long barbed spike on its underside, which it uses during hunting attacks to pierce the lift bladders of its prey and, by retracting the spike into its body, bringing the wounded organism to its jaws. Presumably, as the two species are nearly identical in form and habitat, the “sky rams” share the other characteristics of the “black teardrops” as well.

While the relative sophontic level of neither species could be accurately determined from our observations, the fact that the black teardrops exhibited numerous socially assistive behaviors, such as supporting injured and wounded individuals with their own bodies (at least until the injured individual expired, at which point the body was allowed to plummet to the ground below) and clustering around infants and “mothers” giving “birth”; the coordinated attack patterns of the sky rams while hunting indicates at least a high sub-sophont level of intelligence.

Unfortunately, this last point cannot at present be further investigated, as the aerostat module suffered a catastrophic failure during the seventh “sky ram” attack, at MET 206:14:23:42.1155, when the probe's lift envelope was pierced by multiple barbed spikes. Contact with the aerostat was lost some eleven minutes later, as the aerostat's probe body impacted the surface at a high velocity at an approximate position of 48.0773 North, 86.5521 West.

DISCUSSION

Although much more information about the YTS 110-120-0805 system gained than was ever anticipated when we departed on our expedition, the questions that were raised by our discoveries must lead us to conclude that we have only begun the exploration of these worlds, particularly the moon we have named Shona. The discovery of carbon-based life that is indigenous to such an extreme environment extends the limits to which such life can exist and flourish. With the limited nature of our in situ observations, we feel there may be many other as-yet unknown wonders of biology lurking beneath the moon's formamide seas or on the dessicated surface.

Another facet of our observations involved the observation, measurement, and derivation of the highly unusual, if not unique orbital resonance shared by Ayao and Oya. Such a configuration, in the midst of an otherwise unremarkable system around an ordinary star, is a remarkable development in the serendipitous sequence of events that led to this article.

Therefore, it is with great anticipation of future discoveries, and the concomitant increase in Terragen knowledge of the Galaxy in which we reside, that we humbly seek to be allowed the chance, at the earliest opportunity, to return to further explore the system to which we have devoted so much time and effort.

If, for whatever reason, we cannot return to YTS 110-120-0805, then we ask only that some other expedition be allowed to continue our initial research into that planetary system.

ACKNOWLEDGEMENTS

We acknowledge support by ASF grant AST 79-88089 and TCAAX grant NAG 2-12185 and travel support from the Winthoorp Institution of Medfield University at Barzelona (to P. B.R.), TCASX grant NAG 5-8299 and ASF grant AST 95-20443 (to G. W. M.), ASF grant AST 96-19418 and TCASX grant NAG 5-4445 (to S. S. V.), and by Sagittarius Space Systems. We thank the TCASX and UM Telescope assignment committees for allocations of Argus Array time, and the Gilboa Reach (AATC) and Barzelona (BAAT) telescope assignment committees for allocations of AOT time. We thank Dela Frisch, Gregor Lutenmeyer, Deng Lin, David Poole, and Han Choi Li for valuable conversations. We especially thank the peoples of Yoruban ancestry, without whose traditions the names of the bodies within the YTS 110-120-0805 planetary system could not have been named. The authors wish to extend special thanks to those transapients from whom we have sought and been granted assistance with data analysis. Without their generous hospitality, the Argus Array and other remote observations presented herein would not have been possible.

REFERENCES

Brown, E. P., & Meacham, C. W. 10596, SppJ, 464, L153

Brown, E. P., Meacham, C. W., Fischer, D. A., Brown, T. M., Conroe, A. R., Komov, G. G., Nielsen, P., & Noyes, R. W. 10589, SppJ, 526, 916

Brown, E. P., Meacham, C. W., Voight, S. S., & Apps, K. 10598, PASP, 110, 1389

Brown, E. P., Meacham, C. W., Voight, S. S., Fischer, D. A., Hsiang, G. W., Laughlin, G., & Wright, J. 10594, SppJ, in press

Brown, E. P., Meacham, C. W., Williams, E., Hauser, H., & Shirts, P. 10597, SppJ, 474, L115

Brown, E. P., Meacham, C. W., Williams, E., McCarthy, C., Dosanjh, P., & Voight, S. S. 10596, PASP, 108, 500

Brown, E. P., Tunney, C. G.,Meacham, G. W., Jones, H. R. A., Penny, A. J., & Apps, K. 10591, SppJ, 555, 410

Brown, E. P., Voight, S. S., Meacham, G. W., Fischer, D. A., Hsiang, G. W., & Apps, K. 10590, SppJ, 545, 504

Chiang, L. I., Fischer, J., & Thompson, E. 10594, SppJ, 564, L105

Cochran, E. Z., Hong, A. P., Brown, E. P., & Meacham, C. W. 10597, ApT, 4833, 4547

Delacroix, X., Forveille, T., Medford, M., Perrier, C., Cirko, J., & Quinn, M. 10598, P&A, 338, L67

Douglas, S., Charalambous, G., Fleishman, A. C., & Walker, T. D. 10590, Proc. Soc. Multi-spect. Instrum. Eng., 1235, 62

Falken, S. A., Meacham, C. W., Brown, E. P., Laughlin, G., & Voight, S. S. 10594, SppJ, 564, 1028

Falken, S. A., Meacham, C. W., Brown, E. P., Voight, S. S., & Apps, K. 10589, PTAS, 111, 50

Falken, S. A.,Meacham, C. W., Brown, E. P., Voight, S. S., Frank, S., & Apps, K. 10591, SppJ, 551, 1107

Forbin, C.,Mitchel, D. S., Quissenbach, F., Fischer, D. A.,Meacham, C. W., & Brown, E.P. 10594, SppJ, 576, 478

Gorbovsky, L. L., & Baliunas, R. L. 10587, SppJ, 314, 766

Hong, A. P., et al. 10590, SppJ, 544, L145

Hsiang, G. W., Meacham, G. W., Brown, E. P., & Voight, S. S. 10590, SppJ, 529, L41

Jones, H. J., Brown, E. P., Tunney, C. G., Meacham, G. W., Penny, A. J., McCarthy, C., Carter, B. D., & Apps, T. 10594, MORAS, in press
Komov, G. G., Brown, T. M., Fischer, D. A., Nielsen, P., & Noyes, R. W. 10590, SppJ, 533, L147
Kynes, L., Endl,M., Els, S., Hong, A. P., Cochran, W. D., Dobereiner, S., & Dennerl, K. 10590, P&A, 353, L33
Laughlin, G., & Chambers, J. E. 10591, SppJ, 551, L109
Lee, M. H., & Peale, S. J. 10594, SppJ, 567, 596
Lissauer, J. J., & Richards, R. J. 10591, SppJ, 554, 1141
Meacham, C. W., & Brown, E. P. 1992, PASP, 104, 270 ———.10596, SppJ, 464, L147
Meacham, C. W., Brown, E. P., Fischer, D. A., Voight, S. S., Lissauer, J. J., & Richards, E. J. 10591a, SppJ, 556, 296
Meacham, C. W., Brown, E. P., & Voight, S. S. 10590, SppJ, 536, L43
Meacham, C. W., Brown, E. P., Voight, S. S., Fischer, D. A., & Lissauer, J. J. 10598, SppJ, 505, L147
Meacham, C. W., Brown, E. P., Voight, S. S., Fischer, D. A., & Liu, M. C. 10589, SppJ, 520, 239
Meacham, C. W., Brown, E. P., Williams, E., Bildsten, L., Graham, C. R., Ghez M. A., & Jernigan P. T. 10597, SppJ, 481, 926
Meacham, C. W., et al. 10591b, SppJ, 555, 418
Medford, H., Cirko, J., Oswald, L.H., Quinn, M., Smith, Z. C., Ulyanov, S., & Burnet, S. 10594, in ASP Conf. Ser., Planetary Systems in the Galaxy, ed. A. J. Penny, P. Artymowicz, A. M. Lagrange, & S. S. Russell (Nuevo Tornillo: ASP), in press
Medford, M., & Quinn, M. 10595, *Sigma*, 378, 355
Morel, D., et al. 10590, SppJ, 532, L55
Cirko, J., Medford, M., Oswald, L.H., Quinn, M., Smith, Z. C., Ulyanov, S., & Burnet, M. 10591a, P&A, 375, 205
Cirko, J., et al. 10591b, P&A, 375, L27
Noyes, R. W., Jha, S., Komov, G. G., Krockenberger, M., Nielsen, P., Brown, T. M., Kennelly, E. J., & Horner, J. D. 10597, SppJ, 483, L111
Oswald, L.H., Medford, M., Galland, D., Quinn, M., Smith, Z. C., Ulyanov, S., & Burnet, S. 10594, P&A, 388, 632
Perryman, M. A. C., et al. 10597, P&A, 323, L49
Quinn, M.,Medford, M., Cirko, J., Oswald, L.H., Smith, Z. C., Ulyanov, S., & Burnet, S. 10594, in TAS Conf. Ser., Planetary Systems in the Universe, ed. A. J. Penny, P. Artymowicz, A.M. Lagrange, & S. S. Russell (Nuevo Tornillo: TAS), in press
Quinn, M., et al. 10590, P&A, 354, 99
Richards, R. J., & Lissauer, J. J. 10591, SppJ, 558, 392
Serizawa, S. H., Brown, E. P., & Meacham, C. W. 10598, SppJ, 498, L153
Serizawa, S. H., & Fischer, D. A. 10590, SppJ, 534, L105
Smith, Z.C., Israelian, G., & Medford, M. 10590a, P&A, 363, 228 ———.10591, P&A, 373, 1019
Smith, Z. C., Medford, M., Cirko, J., Oswald, L.H., Quinn, M., Ulyanov S., &
Belcha, A. 10590b, P&A, 356, 599
Scanlon, J. D. 10582, SppJ, 263, 835
Sivan, P. J., Medford, M., Cirko, J., Quinn, M., Ulyanov, S., Peltier-Borisov, C., & Rangell, J. L. 10594, in ASP Conf. Ser., Planetary Systems in the Universe,
ed. A. J. Penny, P. Artymowicz, A. M. Lavrente, & S. S. Russell (Nuevo Tornillo: ASP), in press
Snellgrove, M., Papaloizou, J. C. B., & Nelson, R. 10591, P&A, 374, 1092
Tunney, C. G., Brown, E. P., Meacham, C. W., Jones, H. J., Penny, L. J., McCarthy, C., & Carter, B. D. 10594, SppJ, 571, 528
Tunney, C. G., Brown, E. P., Meacham, G. W., Jones, H. J.., Penny, L. J., Voight, S. S., & Hsiang, G. W. 10591, SppJ, 551, 507

Ulyanov, S., Medford, M., Cirko, J., Oswald, L.H., Quinn, M., Smith, Z., Burnet, M., Confino, B., & Melkowicz, C. 10590, P&A, 356, 590
Voight, S. S., Brown, E. P., Meacham, G. W., Fischer, D. A., Pourbaix, D., Apps, K., & Laughlin, G. 10594, SppJ, 568, 352
Voight, S. S.,Meacham, G. W., Brown, E. P., & Apps, K. 10590, SppJ, 536, 902
Voight, S. S., et al. 1994, Proc. Soc. Multi-spect. Instrum. Eng., 2198, 362

HYPER-ADVANCED TECHNICAL CIVILIZATIONS: DO THEY EVEN EXIST, AND IF SO, WHERE ARE THEY?

T.C. Abramson, L.G. Adama, S. Allen, G.K, Ellison, SGW-1037, K.L. Leggend, R.J. Reynolds, A.T. Stark, XC-115A4, Wanton Optimizer-XIV, W.W. Whyte

Received: 26 Inhotep 10599 A.T.; Accepted: 17 Jung 10600 A.T.
21 Inhotep 10599 A.T.

ABSTRACT

According to most published analyses, the median age of stars (and, therefore, planets) in the Galaxy is approximately 6.5 billion standard years, or some 1.85 billion years greater than the age of the Sol system.. As it is well-known by experience that the development of life (at least of the prokaryotic variety) is a relatively common occurrence, that the development of eukaryotic forms is only somewhat less common, and the emergence of sophonce, though much less common than the appearance of sub-sophontic life, is only relatively rare, then the appearance of advanced technical civilizations, such as that currently enjoyed by citizens of the Terragen Bubble is a subset of those populations which can be considered intelligent as well as self-aware species.

However, to date, no credible and unambiguous evidence has yet appeared of contact with a technical civilization that has advanced significantly beyond the current levels of Terragen science and technology (with the possible exception of the Meistersingers, though current data is woefully inconclusive on this point). If, as the median age of stellar (and planetary) systems suggests, when integrated with the current revision of the time-honored Drake Equation (as modified in 3897 A.T.), there should be at least one, if not a multitude, of technical civilizations as advanced beyond our Terragen civilization as we are above primitive *Archaea* and early cyanobacteria. With this in mind, even while remembering that the presence of a median value implies the existence of much higher values in the population under consideration, Fermi's Paradox must again be invoked: “Where are they?”.

Using a variety of techniques, including neo-Bayesian analysis of previously suggested resolutions of Fermi's Paradox, a number of novel emergent-property spatio-temporal analyses, a reexamination of percolation dynamics as applied to adaptive genetic and ecological emergence algorithms, and a re-analysis of stellar population age data compiled to date (to confirm the published limits of statistical uncertainty), we have formulated what is, we believe, a novel and plausible resolution of Fermi's Paradox. We also offer our predictions of where and when such a hyper-advanced technical civilization