Cross-Views on Unidentified Aerospace Phenomena Observed in Infrared and Radar

by **Luc Dini**, Chairman of the SIGMA 2 Technical Commission, **Jean-Marc André**, Air Brigade General, former pilot and air defence specialist, **Joël Deschamps, retired from ONERA, expert and former researcher on infrared signature measurements and observation**

Summary

The observation of Unidentified Aerospace Phenomena (Phénomènes Aérospatiaux Non-identifiés or PANs) is not new, although it remains mysterious in many ways. Since the 30s-40s (or even long before) many testimonies have been reported and investigations carried out in different countries by the air forces (Blue Book report of the US Air Force, Condigm UK program, work of GEIPAN in France since 1977, SETKA program in Russia), etc.) collecting visual, radar, photo or film observations. More recently, infrared cameras have been deployed, especially on surveillance aircraft or on fighter aircraft, providing new, sometimes very surprising, recordings. However the infrared very useful to detect an object, to identify it, requires other means to estimate distances and speeds in particular, such as radars. The purpose of this article is to describe three cases of NPA observations with crossed IR means coupled with radar observations, starting with the case of Cougar (2011, Chilean Marine), Aguadilla (2013, Puerto Rico, coastal surveillance aircraft), and Nimitz (IR observations by F18 from the US Navy and Nimitz and Princeton radars in 2004 and again in 2014-2015 by F-18s). This latest case is the most famous and has been in the news since December 2017, with the publication of articles in the New York Times, accompanied by the revelation of a secret research program AATIP [1] of the Pentagon on UFOs (Unidentified Flying Objects). These IR videos (recognized as authentic by the Pentagon in April 2020) provide 2D data. They also need to know the position of the observation platform, its attitude and the context data, including radar, to reconstruct the distances and deduce a 3D kinematics.

COUGAR CASE: 2011 - CHILE

The Cougar case dates from November 11, 2011 and was sent to us by CEFAA [2] in 2014. The study we conducted is described in letter 3AF N°27 and will be detailed in the forthcoming report of the SIGMA2 Technical Commission. To summarize, a Chilean helicopter observes for about two minutes an unknown phenomenon with its IR camera. The infrared video, of medium quality, presents saturation effects and nevertheless allows an exploitation of the images. It brings out two or three hot spots [3], and then issuing a plume. The radar data provided by the Brazilian CEFAA could be used, allowing to know the regional air traffic, to be cross-checked and to allow the identification and the estimation of distances (see Figure 1). This case is exemplary from the point of view of the restitution of the observation, putting in default the conclusion to a UFO made by the Chileans.

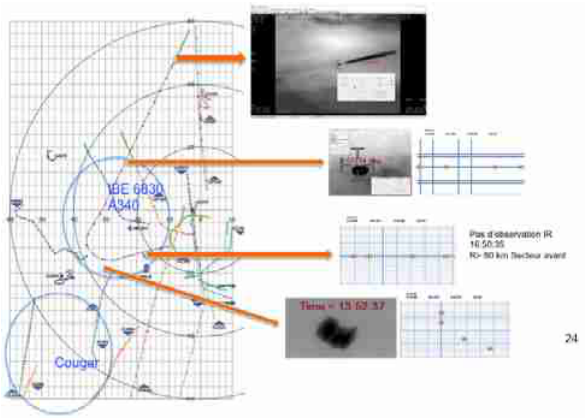

Figure 1 - Reconstructed trajectories of Cougar and IBE 6830 (Airbus A340)- specific observation points and associated images- geometry of hot spots in the image plane

[1] *AATIP: Advanced Air THreat Investigation Program*

[2] *CEFAA: Chilean civil aviation agency in charge of PANx studies*

[3] *The IPACO group had exploited the video is identified two to three hot spots reminiscent of a medium-haul jet. However the emission of the plume by an airplane flying at 4000 m remained without explanation.*

THE AGUADILLA CASE

The report “2013 Aguadilla Puerto Rico UAP” was submitted to the 3AF/SIGMA2 Commission in May 2015, along with its data (radar data and infrared video) by a scientific group entitled Scientific Coalition For UFO (SCU). It can be accessed at the following link: *https://24d63f27-e686-40c4-adce-0870e805ceec.filesusr.com/ugd/299316_9a12b53f67554a008c32d48eff9be5cd.pdf*

This report reflects the in-depth study of a case of NAP observed at the Rafael Hernandez Airport site
à Aguadilla, Puerto Rico, 25 April 2013 at 21:20 (local time) based on testimonies, an IR video recording by a coastal surveillance aircraft and civilian air traffic control radar data.

The observations

The coastal surveillance aircraft was alerted by the control tower to the presence of an unknown red light inbound to the airport. The aircraft makes two loops and records with its infrared camera (and laser range finder) an object for about two minutes. The IR video (see Figure 2) is of poor quality due to image processing (saturation, contrast inversions) and does not allow to precisely exploit the images, the shapes or find overlapping points in the image and on the map to estimate the distance and reconstruct the trajectory of the phenomenon in 3D. In addition, the laser rangefinder actually measures the plane-point of impact distance of the laser on the ground, which allows to restore the envelope of the lines of sight Camera and laser on which the object moves. This restitution is consistent with the terrain, but the position of the phenomenon and its altitude remain unknown?

We also attempted to cross-reference IR observations and radar data (see Figures 3 and 4) to obtain the position of the object. Unfortunately, radar data show a series of plots moving from east to west, mainly corresponding to wind-driven drifts of nebulae. Some may be consistent with the position of the object, but punctually and without certainty, given the position of the aircraft whose radar returns to the west. On the other hand, the position of the aircraft on the radar and that recorded on the video, as well as the scrolling of the landscape, coincide, which confirms the authenticity of the video and the obeservation.

The absence of a radar trace could be explained either by the low radar signature of the phenomenon, or by the lack of measures to identify the distance or altitude of the phenomenon. This will lead us to make a restitution based this time on three assumptions of flight altitude to simplify:

- Case of a low-level flight path with a low-level flight at about 100 ft, which could correspond to a skiff over the water in the end. The object is not visible on radar, which could attest to the hypothesis of shaving flight, even if the weak signature could justify it.

- The case of a local flight at medium altitude (approximately 600 ft), corresponding to a local slow descent path around the crossover point of the aircraft’s sightlines. The object may be visible on radar, but it is not.

- High-altitude trajectory in the vicinity of the aircraft, where the aircraft and the object would operate on two concentric and close trajectories. The high flying object may be visible on radar; it is not, while the aircraft is visible on radar.

Figure 2 – IR image of the object with contrast inversion effect of the IR landscape background (local image processing effect). The object is to the right and at the base of the cross of sight

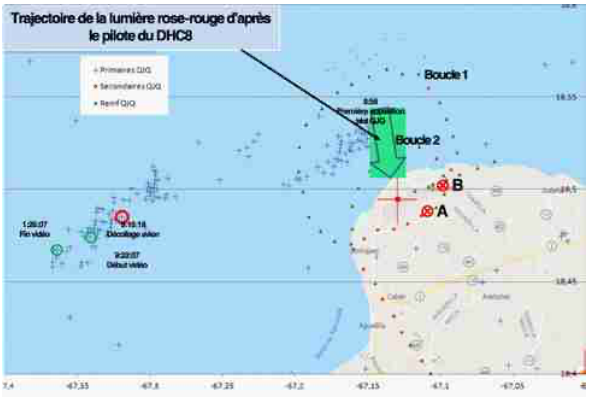

Figure 3 – Track of the DHC-8 retrieved from the video (in green) overlaid on the radar echo map

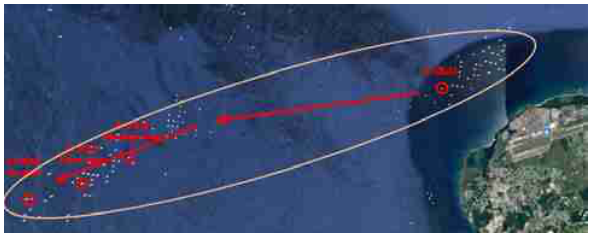

Figure 4 – Successive Positions of Echo Alerting Controllers with Spike Drift Westward

Strange phenomena have been observed on some sequences of the IR observation:

- Contrast inversion (see Figure 2) when hovering over the water body (related to local image processing gain).
- Temporary occultation or strong attenuation of the thermal signature of the phenomenon observed on the seabed (see Figure 5). Several interactions are possible depending on the proposed trajectories and altitudes. For a slow object moving around 600 ft, the occultation would be linked to clouds, but these would also have to hide the landscape background and not just the object… However, this is not the case, which does not support the hypothesis of a final medium altitude trajectory (case of a slow local trajectory). The SCU gave us its report hypothesizing a very low trajectory over the water, with a "no splatch" dive, while showing a residual, colder, thermal trace of the object. It would be temporarily submerged, moving underwater (see Figure 6). We do not accept this extraordinary hypothesis which is not physical (water is opaque to the infrared and should completely erase the thermal signature). Finally, if we consider the hypothesis of the flight razing above the earth and then the water, it seems conceivable that the object could then «surf» at the level of the waves, raise spray and see its thermal signature temporarily hidden by this effect of fogging (see Figures 5 and 6). This hypothesis would support the solution of shaving flight, which however raises other questions.
- The phenomenon becomes visible again after the passage on the seabed (overflight, skipping flight or immersion according to some) and seems to divide into two similar thermal spots. Is it a physical separation of two hot spots while only one was observed? Or

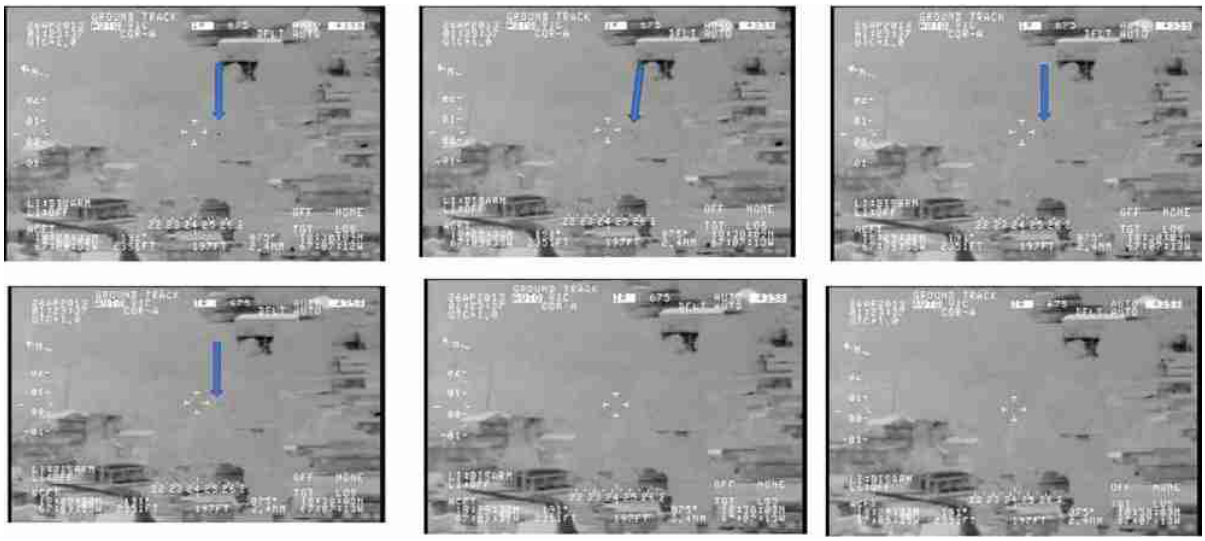

Figure 5 – Sequence of Images Showing Temporary Occultation of Object During Seabed Overflight

a parasitic reflection in the objective; normally the reflection is generally less intense than the source? Or well is it a Thai lantern with two parts hot as some have thought. The mystery remains whole... We could also imagine a scenario of James Bond film with a reconnaissance drone, returning from mission and collected by a team of SEALs equipped with two jet skis (two hot spots), but this scenario is quite fanciful, though less extraor- that of a submerged UFO, emerging from the ocean to divide into two objects. This is not our hypothesis here.

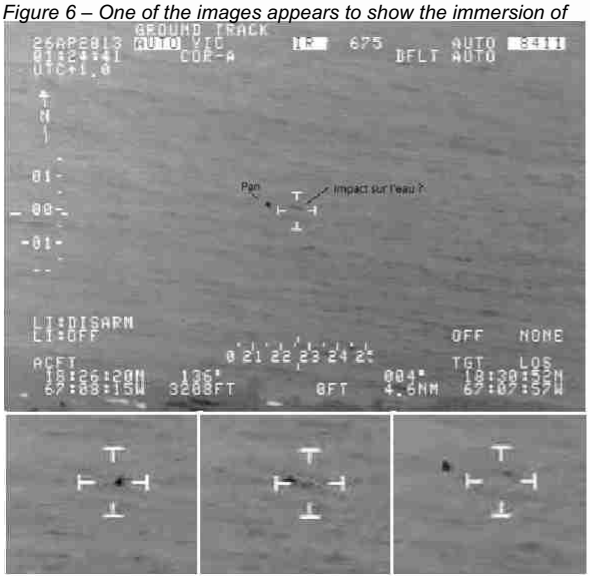

Figure 6 – One of the images appears to show the immersion of the object (according to the SCU), without splatch while leaving an attenuated thermal trace

Figure 7 – Red: DHC-8 trajectory; in green: positions of the target

Figure 8 – The projection of the NAP trajectory is in the yellow area

The hypotheses of kinematics of the object

In the absence of cross-checking of the altitude and distance observations, we reconstructed the envelope of the lines of sight (see Figure 7) from the aircraft to the "target" (point of impact of the laser spot on the ground), then made assumptions of flight profile, and in particular of altitude. We then plotted the supposed trajectory of the object responding to these kinematic hypotheses while crossing them with the lines of sight, revealing a possible trajectory on this envelope (see Figures 8 to 12).

Three types of flight profiles were studied based on descent rate and altitude assumptions:

- **Flight profile very close to that of the aircraft.** This school hypothesis consists of assuming the plane and object paths (aircraft altitude less than 100 ft) close and parallel while circling the airport. They do not correspond to a credible scenario, the distance plane object is then very small. Neither the trajectory nor the scenario is explained, let alone the poor image quality, whereas the object would be observed at a short distance and should benefit from better image quality.

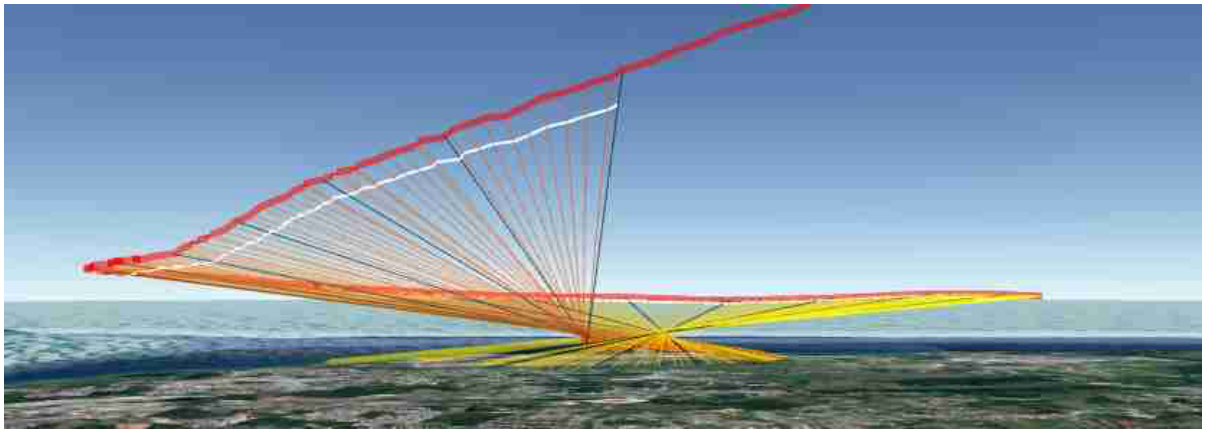

Figure 9 – Observation Aircraft "Escort" PAN Profile (arbitrarily set an altitude differential of -100 feet from the DHC-8 altitude).

- **A very low ground-following flight profile** (around 100 ft AGL), which may correspond to an overflight of land and sea during the last phase of flight. The profile could be a micro-drone. Its speed would vary from 300 km/h at the beginning to 100-120 km/h in the final phase above the water, which shows a somewhat extreme speed dynamics in high speed limit (micro drones reach in general

  150 km/h) but some special drones (equipped with gas propulsion or micro turbo reactor) can reach speeds of 300 to 400 km/h or more, with very low take-off and landing speeds. Moreover, nothing says that the object could not start from a higher altitude and a closer distance, so with a lower initial speed at the beginning of the observation, and a higher rate of descent to reach the altitude of field follow? This is not

  studied or demonstrated. In addition, the thermal signature with a sufficiently high hot spot could confirm the hypothesis of thermal propulsion or with hot gas nozzles. However, it remains to understand the presence of a rapid micro-drone in the vicinity of the airport? Is the hypothesis wrong?
  Is it a test with a special micro-drone (special forces). The question is open and is not within our jurisdiction.

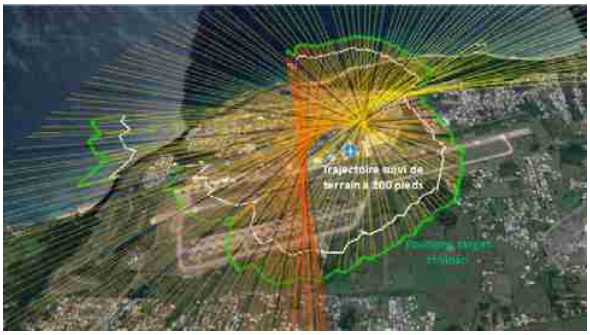

Figure 10 – In White: PAN Track in Field Tracking à 100 feet

- **Slow descent intermediate altitude flight profile (2 ft/s) between 800 and 1000 ft. The object follows a trajectory in the vicinity of the airport, at very low speed (18 to** 40 km/h), at the crossroads of the lines of sight, the aircraft rotates around the trajectory of the object. The compatible low speed of a balloon, drone or ULM type object is consistent with the local wind (direction and speed overlap), the object can drift slowly downhill. On the other hand, if the kinematics is credible, there is a very weak overlap with the IR data: the thermal signature of a Chinese lantern is very weak compared to the observed hot spots. Moreover, the signature occultation (at the end of the trajectory on the seabed) is not explained. At the considered altitude (about 600 ft) only nebulous clouds could explain the occultation of the object, but they also hide the landscape background (sea), which remains visible.

Figure 11 – PAN track for torque 1000 feet/-2 feet/s

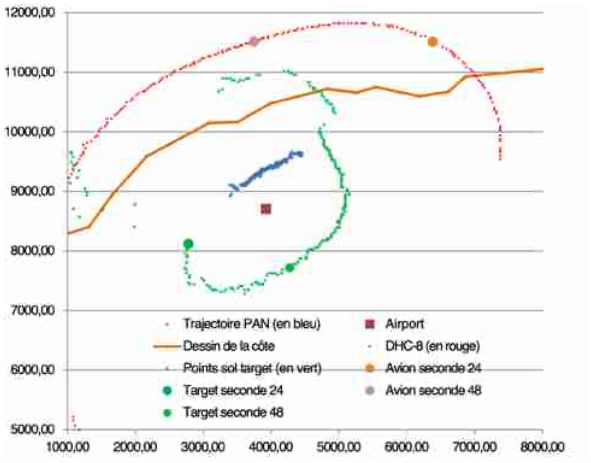

Figure 12 – Track (in blue) for initial altitude of 1000 feet and vertical speed of -2 feet/s

In conclusion, we can say that an infrared observation of a PAN has been made, and that it intersects the trajectory of the aircraft whose radar trace is also confirmed. The radar track of the PAN is not visible (invisible or flying too low, which in this case could possibly confirm a very low trajectory).

Infrared images confirm a hot spot that could be compatible with electric or thermal propulsion and a size less than 2 m. However, because of their poor quality, no cross-checking can be done between the lines of sight, the image and characteristic points of the landscape; This would have allowed a distance and altitude recalculation of a possible track. Phenomena of occultation of the object at the end of the observation are remarkable. An explanation for the cloud cover is not demonstrated (the background is not masked). On the other hand, a flight profile in field monitoring could be compatible with a fog effect during the final flight of a drone near the sea. Finally, a sort of final duplication of points hot appears in the final; no convincing explanation (separation by rupture, parasitic reflection,...) is obtained.

From a kinematic point of view two hypotheses emerge. One corresponds to a local path in the vicinity of the airport in slow descent (2 ft/s) between 1000 and 800 ft, compatible with that of a balloon or a Chinese lantern, or even a micro-drone, drifting at low speed while being carried by the wind. But this hypothesis, which would have the merit of corresponding to a simple scenario and a classical kinematics, is not consistent with radiometric data (hot spot, occultation). The other hypothesis could be 100 ft field monitoring, at least in the second part of the trajectory; which could explain some observed phenomena (hot spot, temporary occultation of the signature in flight grazing over the sea). It could be a micro-drone with extreme high-speed capabilities (nearly 300 km/h) at the beginning of the trajectory, as there are some prototypes. However, the use scenario of such a drone seems very atypical. A flight level change hypothesis with rapid descent could potentially change the initial speed peak but does not resolve issues such as duplication.

There is nothing to confirm a case of extraordinary PAN, even if we are faced with indeterminations on the restitution of trajectories and therefore of the type of flying object, or even with questions on certain IR phenomena (occultations, duplication).

Both assumptions have advantages and disadvantages.

THE IR OBSERVATION CASE FROM F18 IN THE US NAVY

As already explained, we were aware of these cases through the IR videos that were collected by the Nimitz F18 in 2004 and disseminated to the American media by the company TTSA (having worked for the Pentagon on the AATIP research program on advanced air threats). In addition, the Scientific Coalition for UFO (SCU) provided us with an analysis report of these observations entitled A Forensic Analysis of Navy Carrier Strike Group Eleven's Encounter with an Anomalous Aerial Vehicle.

No US Navy report has been released since, reporting facts and observations not only visual, or infrared, but also radar. We were able to listen to the testimony of the pilots or radar operators of the Nimitz or the Princeton, but no detailed report is available. Nevertheless, the Pentagon and the US Navy have recognized the existence of a research program on advanced air threats (including UAPs?) and also incursions into US airspace of unknown objects (confirmed recently by the North Command US) which are now being reported. The Pentagon formed a Task Force on UAPs (PANs in English) in August 2020 4 under the leadership of the US Navy. At the same time, Japan also launched a similar organisation and concluded a cooperation agreement with the USA.

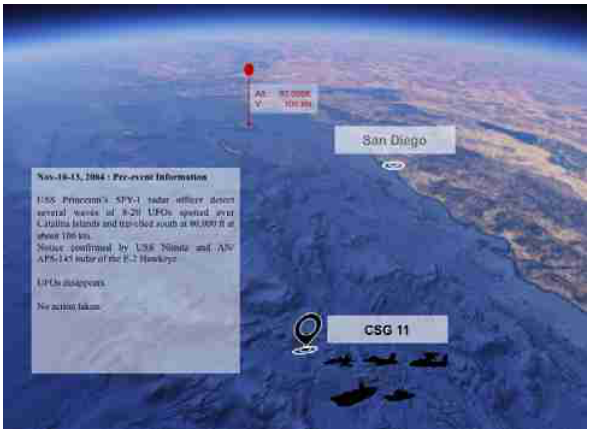

Figure 14 – Radar Observation (Nimitz Aircraft Carrier-Aegis Princeton Cruiser)

At this stage, we will simply provide simple comments on the facts reported in the SCU report, as well as on the IR videos we have viewed.

It is easy to understand after the illustration of the two previous cases, where we have crossed IR and radar data with varying success, that the data provided by the three IR videos without accurate radar data, nor restitution, nor trajectories and kinematics, are largely insufficient to draw the slightest conclusion. Indeed, how to reconstruct 3D images to evaluate the kinematics, the signature (radiated energy), or even the shape or size, without information on the position of the camera, the F18 and the object?

Only the "GO Fast" video is of sufficient quality to carry out an analysis of the image in an attempt to identify the NAP, provided that the background information already mentioned is not available to date. The radar-IR cross-view is required.

Analysis of the report and related facts

For several days (10 to 13 November 2004), during a naval exercise off San Diego, waves of 8 to 20 PAN were observed on SPY-1 radar (see Figure 13).

The details of the events that occur until November 14 (date of the infrared recording by an F18) are described below. On 14 November, following multiple radar observations, the Nimitz sent several F18 patrols to intercept the area. One of them makes eye contact with an oblong object (tictac) observed above the water and then moves rapidly (see Figure 14). One of these patrols will obtain radar contact and make an infrared recording broadcast from (FLIR 1 and Gimbal video).

It is troubling to note that these observations were not officially corroborated by the US Air Force or NORAD, when they corresponded to an intrusion into American airspace three years after September 11. However, the revealed existence of the AATIP program, but also the recent statements of the Pentagon (April 2020), the US Navy and finally the North Command, attest to regular observations of the presence of unknown objects, Chinese drones, Russian or other origins, according to the assumptions made. The observations of 2004 and 2014 and 2015, by radars and IR means are therefore a priori real and not faults of sensors or false alarms.

Some involve testing machines with advanced technologies or very advanced jamming technologies (from drones, NEMESIS project or from decoy/jamming by filamentary plasmas). These topics are covered in our upcoming SIGMA2 report.

4 *https://www.defense.gov/Newsroom/Releases/Release/Article/2314065/establishment-of-unidentified-aerial-phenomena-task-force/*

5 *https://www.the-unidentified.net/japan-and-the-united-states-have-an-alliance-over-unidentified-aerial-phenomenon-uap/*

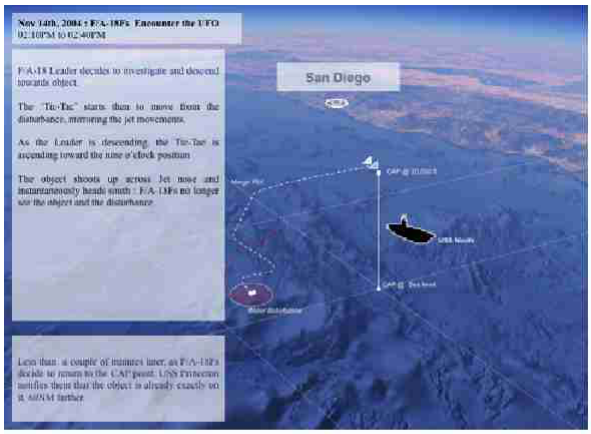

Figure 14 – Between 14:10 and 14:40 LT, the F18 crews observe a PAN shaped like a "Tic-Tac".

Analysis of IR videos

We are in possession of 3 videos named respectively FLIR 1, gimbal and Go Fast. They are published by the “To the stars academy of arts and science”. These videos were acquired by Raytheon’s AN/ASQ 228 pod which was commissioned in 2003 and installed on F18. Only the first video is dated 2004 and given as associated with the Nimitz case; the other two are presented as UAP observations by the US Navy without further details. The US Navy has since recognized the authenticity of the videos and mentioned the existence of other videos, of better quality.

FLIR 1 video

The video (see Figure 15) lasts 1min 14 s during which an object is observed in IR and then visible. The site and the line of sight deposit are very stable, except for an increase in the deposit at the end of the video. In IR, the object seems to be a saturated point without apparent structure, but in visible it clearly has an elongated shape.

The video, generally of poor quality, makes it difficult to identify the object.

We note however that the object appears much larger in visible than in IR. Yet in both cases, the field of the sensors seems the same (NAR) according to the inlays?

An image defect in the pod is not to be excluded since we can read that the first pods of this family installed on F115 have experienced some problems of focus.

Figure 15 – FLIR 1 Video

Gimbal Video

This video lasts 35 seconds, it is neither localized nor dated. It is of better quality (see Figure 16) than the previous one. On a cloud sea, we observe an oblong object while the F18 is turning left. The line of sight site remains constant at -2° and the deposit varies from 54° left to 5° right.

The most surprising thing is that the object changes its inclination when the deposit is between -5 and +5°, as if its position was related to the angle of the pod head mirror. The comments of the pilots attest to their surprise in the face of a change of attitude that defies the laws of flight mechanics, since placing the object orthogonally to the aerodynamic environment.

A defect in the intermediate focal plane of the optical system of the pod seems plausible to us. It may not be a coincidence that this video is called Gimbal.

Figure 16 – Gimbal video

Go Fast Video

Certainly the most interesting video because the sharpest of the 3 (see Figure 17). It is probably more recent (2014 observations).

It lasts 30 s. The aircraft is 25,000 feet flat and then in the last part of the video in a left turn. The line of sight begins at -22° site and 35° left deposit at the beginning of the video, to reach regularly -34° site and 55° left deposit.

The object is a punctual hot spot moving rapidly on the seabed. The operator misses the pursuit addict 3 times then succeeds the addict and activates the automatic pursuit.

The angular resolution is too low to identify the PAN, but it can be said to be a small hot object. When the automatic pursuit is engaged, it appears an inlay 4.0 RNG. If we consider that it is a measure of distance on the object, it is 7.4 km away from the plane while the flight altitude is 7.7 km. So we would have an object flying quickly at an intermediate altitude. Under these conditions, a geometric analysis of the NAP is possible.

Figure 17 – GO FAST Video

In conclusion, only the third video can provide relevant information; the first two are of too poor quality to expect to extract information from

mations. ■