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# THE CROSSOVER AMONG THE INCAS IN THE COLLASUYU

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## ABSTRACT

We present archaeoastronomical and ethnohistorical evidence related to the *ushnu* and the spring equinox full Moon on Inca contexts, in central-northern Chile and northwestern Argentina (1470-1536 AD). From the perspective of the landscape archaeology and the astronomy in culture we analyze the lunar cycles of 18.03, 18.61, and 19 years, including synodic and intercalary months. As hypothesis we assume the use of the *Citua* ceremony, in the lunar month of September, to determinate the solar year of 365 days and the 354 days lunar cycle, useful to predict eclipses (1 Metonic - 12 lunar months = 1 Saros). The analysis of twelve Incan sites in the *Collasuyu*, between the 18.5° and 34° south latitude, show us the importance of architecture, rock art, the gnomon, and horizon landmarks, to determinate not only solstices and equinoxes, but also major and minor lunar standstills, and the crossover related to the full Moon. We conclude that the Incas were able to predict lunar eclipses, with political and ideological purposes, thanks the use of these astronomical cycles in ritual contexts. In other words, a mnemonic system that allowed coordinates the main ceremonial activities with lunar and solar cycles within the Inca *ceque* calendar.

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**KEYWORDS:** lunar cycles, crossover, Citua ceremony, ushnu, Collasuyu.

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## 1. INTRODUCTION

The Inca Empire or *Tawantinsuyu* (world of four *suyus*: *Chinchaysuyu*, *Collasuyu*, *Antisuyu* and *Cuntisuyu*) had control over diverse territories and populations between the south of Colombia, the mountain and coastal areas of Ecuador and Peru, the Bolivian highlands, north-western Argentina and the north of Chile, between 1470 and 1532 AD. It was one of the most famous Pre-Columbian civilizations, until the arrival of Spanish conquistadors, with a population of about 14 million people. Its political capital was located in the city of Cuzco, south-eastern Peru (D'Altroy, 2003; Pärssinen, 2003[1992]; among others).

Like in any pre-Hispanic state, among the Incas, politics and religion were connected, justifying themselves by a dialectical relationship, from the myth of creation and cosmologies linked to natural forms, such as hills, rocks, caves, water bodies, in addition to celestial phenomena as solstices, equinoxes and passes through the zenith, heliacal risings and settings of stars and constellations, phases and cycles of the Moon, and even weather phenomena as lightning, hail, rain and rainbows, among others, known as sacred entities or *huacas*, as testified by the drawing of Pachacuti (1993 [1613]:208). In this sense, the Moon or *Quilla* was recognized as the sister of the goddess *Wiracocha*, wife and sister the Sun god or *Inti*. *Quilla* was the deity responsible for the seasons, agricultural cycles, telluric forces, and fertility cycles of females, and the word for Month (*Quilla*) (Bauer & Dearborn, 1998; Ziolkowski & Lebeuf, 1993; Ziolkowski *et al.* 2015).

The following paper presents archaeological and ethno-historical evidence referring to the observation of the Moon in Inca sites where an *ushnu* is present, related to the concepts of calendar and landscape in the southern Andes region (1470-1536 AD) (Moyano, 2013, 2014, 2015) (Fig. 1). We assume that the Incas or their representatives had used the sky for social and political purposes, that is to say, that the stellar objects were agents inside of the Inca ideology and politics in the conquered provinces.

In our point of view, calendar (from Latin *calendarium*) is defined like any human product as a social instrument, useful to organize time and activities (Prem, 2008)<sup>1</sup>. However, rather than a periodic system, it is reflecting the structure and social organization, a result of the physical environment, human

activities and symbolic relationships, intended to synchronize categories of space and time, which are part of the worldview or "dwelling or living in the world" (DLW) (Moyano, 2011, 2013; following ideas of Heidegger 1999). According to Iwaniszewski (2007, 2011) DLW would be the result of "being there" (*Dasein*); a mutually relationship between people and the world around them or cosmovision<sup>2</sup>.



Figure 1. Map of general location

In the context of "cultural astronomy" or "astronomy in culture" (Carlson *et al.* 1999; Iwaniszewski, 1991, 1995; among others), we assume the sky from the social perspective. This means, understand it, not as an abstract entity, but as the result of a cultural construction that participates actively in the social life, in terms of projection of values, norms and socio-cultural categories. It appears that notions of agency and animism become important issues to be introduced. When celestial bodies, meteorological phenomena, mountains and others topographical elements are conceived of as vivified and animated beings, then they can be regarded as agents or social actors who by the producing signs, marks, messages can negotiate their status, rank, class, age, and gender with the population of humans (Iwaniszewski, 2009, 2011).

In this sense, the sky like as part of the landscape is not only result of processes of perception and representation with humans, but also it turn give form and content to the world that interacted with people. Following authors like Bourdieu (1998, 2007) and Giddens (1995), we assume that humans are not fully determined by social structures, by way of rules, laws and regulations. But, them to act under the practical sense (practical consciousness) and the con-

<sup>1</sup> In Western tradition is defined as system used to measure and arrange the days, weeks, months, and special events of the year (<http://dictionary.cambridge.org/dictionary/english/calendar>) (accessed on January 19, 2016).

<sup>2</sup> In other sense "the structured view by which... [people] combined their notions of cosmology into a coherent whole. This view implied the observation of nature, but also related the cosmos to society and to the political order" (Broda, 2015:220).

cept of *habitus* (a system of structure, structuring dispositions), understood as those practices linked to schemes, ways of thinking, feeling and social construction of the sky (Moyano, 2013).

The working methodology included the observation and recording of astronomical phenomena, between 2009 and 2015, in order to identify - using the theodolite, geodetic calculation and panoramic photography - astronomical points as solstices, equinoxes, lunar standstills and dates of mid-season<sup>3</sup>. The astronomical analysis (azimuth, declination and dates), was performed using a reference horizon system (Martz de la Vega et al. 2013), based on the "Instytut Geodezji i Kartografii" (IGiK) data<sup>4</sup>, accompanied by the use of StarCalc 5.72 and 5.1 Moshier's Ephemeris, and the NASA eclipse website<sup>5</sup>, always taking into account the parallax factor (Moyano, 2013:169-189).

The fieldwork data finally show us the importance of architecture, rock art, the gnomon, and horizon landmarks, to determinate not only solstices and equinoxes, but also major and minor lunar standstills, and the crossover phenomena linked to the full Moon. These, are related to the *Citua* ceremony and the lunar month of September, useful to determinate the length of solar year, the lunar cycle of 354 days, and seasons of eclipses in pre-Hispanic times.

## 2. INCA LUNAR ASTRONOMY

From the point of view of calendrical studies, the Moon apparently not only was related to agricultural production and main festivities in the Inca World, but also to the ritual organization of the *ceque* system or 41 imaginary lines projected from the Temple of Sun or *Koricancha*, and the *ushnu* of *Haukaypata* (main plaza), out to sacred places or *huacas* in the surroundings of Cuzco (Bauer, 1998; Zuidema, 2011, 2014, 2015). In this context Zuidema (2011), suggests a possible relation between the numbers of *huacas*, equal to 328, and the extension of 12 lunar sidereal

months, along with the use of an intercalary period of 37 days, between the 3 of May and 9 of June, then the Pleiades are not visible in the latitude of Cuzco, that according to Zuidema the dates are rendered in the Gregorian calendar (Zuidema, 2011:3-99).

*Ushnus* (*usno* or *usnu*) have been defined in many different ways, as locis for military parades, justice tribunals, places where military leaders swore obedience to the Inca, places for *capac hucha* ceremonies<sup>6</sup>, places where the *Sapa Inca* or his representatives spoke about politics and justice, podiums where local authorities carried out their responsibilities, places -at least in Cuzco- where the *Citua* ceremony took place<sup>7</sup>, platforms for ceremonies for fertility worship, places for astronomical observations and centre for architectural planning. Architecturally, *ushnus* were platforms made of rock and mud with different dimensions, cardinal and angle orientations; characterized by rectangular, quadrangular or truncated pyramidal forms. In most cases they have stairs and seats as well as *cochas* (water containers) related to drainage systems that enable the evacuation of liquids, probably *chicha* (corn based alcohol) (Farrington, 2013, 2014; Gasparini & Margolies, 1977; Meddens 1997; Meddens et al. 2008; Hyslop, 1990; Pino 2005; Zuidema, 1980, 1989, 1995, 2011, 2014, 2015; among others).

In the southern Andes (*Collasuyu*), *ushnus* have been defined as an Incan architectural feature, related to the existence a main plaza or *Haukaypata*, secondary plazas or *kanchas*, administrative buildings as the *kallanka*, and performed political, administrative, religious and calendrical functions (Raffino, 1981). According to recent archaeological research, all related to the existence of mineral resources of silver and copper, lines of *ceques* oriented to sacred mountains, water bodies, astronomical observation, and the connection to the Main Inca trail or *Qhapaq Ñan* (Bustamante & Moyano, 2013; Farrington et al. 2015; Jacob et al. 2013; Moyano, 2013, 2014, 2015; Moyano & Díaz, 2015).

Due to the Moon's orbit inclination on the ecliptic, equal to 5°09', it can reach points on the horizon further north and south than the Sun in the solstices. A slight wobble with a period of 173.31 days has as a consequence that the line of intersection of both

<sup>3</sup> pre-December Solstices Sunrise (P-DSSR), December Solstice Sunrise (DSSR), pre-December Solstice Sunset (P-DSSS), December Solstice Sunset (DSSS), pre-June Solstice Sunrise (P-JSSR), June Solstice Sunrise (JSSR), pre-June Solstice Sunset (P-JSSS), June Solstice Sunset (JSSS), pre-Equinox Sunrise (P-EQSR), Equinox Sunrise (EQSR), pre-Equinox Sunset (P-EQSS), Equinox Sunset (EQSS), North Maximum Moonrise (NMMR), North Maximum Moonset (NMMS), South Maximum Moonrise (SMMR), South Maximum Moonset (SMMS), North Minimum Moonrise (NmMR), North Minimum Moonset (NmMS), South Minimum Moonrise (SmMR), South Minimum Moonset (SmMS).

<sup>4</sup> <http://www.igik.edu.pl/>

<sup>5</sup> <http://eclipse.gsfc.nasa.gov/eclipse.html>

<sup>6</sup> State-managed child sacrifice (the term translated as royal sin/message) (Meddens et al. 2014:277).

<sup>7</sup> The *Citua* (*Situa*) is defined as an Inca ceremony - with an earlier tradition dedicated to the Thunder and Wiracocha gods - in an open space as the *Huacaypata* in Cusco, during the months of August or September, but always before the sowing and rainfall, with the goal to expel diseases thanks to ceremonies in a hole of the *ushnu*: racing of warrior and offerings of *chicha* (Monteverde, 2011).

planes or "lines of nodes" is not fixed but has a precession of 18.61 years (nodal cycle). As a result, within a synodic month, the Moon runs a movement on the horizon, similar to that of the Sun during the year, but with the difference that its ends are not fixed and vary not only every month, but also within the nodal cycle. The extreme declinations will be equal to the ecliptic value ( $23.5^\circ$ ) +  $5^\circ 09'$  north and south, for example: +  $28.5^\circ$  and -  $28.5^\circ$  or major lunar standstills (Aveni, 2005:104-105). This movement could be useful in predicting eclipses (Moyano, 2014, 2015), and according to some researchers could be determinate the location of some Inca sites near to the latitude  $28.5^\circ$  south, and the major lunar standstill any 18/19 years (Ianiszewski, 2010:145-147; Far- rington, 2010-2013 personal communication).

The eclipse (derived from the Greek word *Ekleipsis*), means "disappearance or abandonment" (Green, 1999:439-463), in Quechua "Quillamhuañun or Quillatutayan" (Arriaga 1968: 218 [1621: Cap 6], in Bauer & Dearborn, 1998:179), that explicitly refers to the symbolic death of the Moon "to die, to breath out, to faint". From the point of view of the theory of "rites of passage" (following ideas of Van Gennep, 1982), possibly interpreted as a liminal and fateful moment in the life of Andean people, associated (according to Spaniards chronicles of XVI century), with the representation of mythical animals as "lion or serpent" that literally "lunged" the Moon, creating fear and terror among the natives (Ziólkowski & Lebeuf, 1993; Ziolkowski *et al.* 2015). Ziólkowski and Lebeuf restate the Anonymous Chronicler, propose a model for predicting eclipses based on the geometry of the pillars of hill Picchu in Cuzco<sup>8</sup>. In this case, thanks to these pillars the variation of the inclination of the Moon can be determined. This phenomenon can be observed around the time of February 13 and October 30, when the Sun is in the zenith, and the Moon near to the nadir (Ziólkowski & Lebeuf, 1993).

The configuration Sun-Moon and the eclipses are repeated, in the same order after 223 synodic months in a cycle known as Saros (equal to 18.03 years). However, due to the rotation of the Earth, the eclipse will not be visible from the same point, but also in a period of 54 years and 33 days, in a cycle known as "Exeligmos". Another cycle is the Metonic (equal to 19 tropical years or 235 synodic months), equal to

the period it takes the Moon to return to the same stage, in the same date of year, and with the same background of stars (Moesgaard 1980). One consequence of the Metonic cycle is that we can watch the full Moon close to equinox dates in parcels of heaven more or less known. At this time, the Moon (to the east) is located at  $180^\circ$  from the Sun, moving from one quadrant of the sky to the other, in reverse movement from the Sun (to the west). This phenomenon is known as crossover or megalithic equinox, relating (in the northern hemisphere) to the appearance of the full Moon nearest to the equinox and the beginning of spring, about  $7^\circ$  to  $9^\circ$  south of EW line. Today we know that this phenomena (the crossover) may well occur at other stages of the phase of the Moon, i.e. first or third quarter. Nevertheless, when the Moon is full, it is possible to calibrate the division of year in periods of 12 or 13 lunations, when the full Moon has a distribution of  $\pm 4^\circ$  of decline from the celestial equator (Da Silva, 2010; Silva & Pimienta, 2012).

### 3. FIELDWORK DATA

The sites investigated that feature an *ushnu* are consistent with ethnohistoric evidence; e.g. the existence of platforms (in most cases), gnomons, holes (*cochas* type) and channels (to evacuate liquids) are registered. In all the cases studied, between northern Chile and northwestern Argentina (N=12) (Fig. 1) we verified the existence of visual and astronomical relations between mountains recognized as *huacas* and important dates within the Inca calendar, such as summer and winter solstices, minor and major lunar standstills, harvest and planting festivities, but specifically for moments near to the equinox (Moyano, 2013, 2014, 2015). For example, the use of a gnomon in La Ciudadcita, an Inca site located 4400 masl in the "Cumbres del Aconquija" (Aconquija Mountains), northwestern Argentina, particularly stands out. Here exists an *ushnu* and a Plaza with astronomical orientation in addition to a vertical one-metre-high rock or "gnomon" (600 m away), installed in the centre of a ceremonial square, apparently used to mark the sunrise during the equinoxes (March 21 and September 22) and other dates, 20 days after and before the event (April 11 and September 2), thanks to a face oriented to the flat horizon in the Tucuman Yunga (Moyano & Diaz, 2015) (Fig. 2).

<sup>8</sup> 1) The difference ( $\delta$ ) between the pillars of August 18 and September 2, equals  $5^\circ 10'$ , is a value close to the inclination of the orbit with respect to the ecliptic, equal to  $5^\circ 09'$ . 2) The difference - in values of declination - of external pillars ( $18^\circ 10'$  and  $7^\circ 38'$ ) is  $10^\circ 32'$ . Twice the distance between the orbits of the Moon with respect to the ecliptic (Ziólkowski & Lebeuf, 1993: 301-303.)

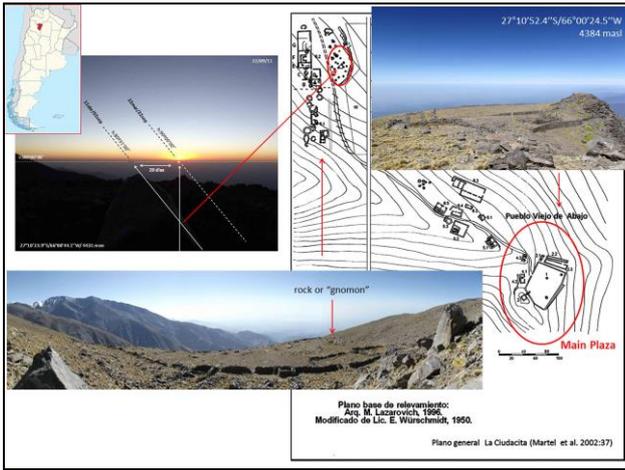


Figure 2. Ushnu and gnomon La Ciudadcita

The same phenomenon also is present in the urban planning of the city of Santiago de Chile (latitude 33°26'S), which, according to a previous research (Stehberg & Sotomayor, 2012), was placed over an ancient Inca administrative centre, with a political core in the actual Plaza de Armas, ancient *Haukaypata*, that included an *ushnu*, a *kallanka*, its very own *ceques* system, and a horizon calendar related to solstices and equinoxes. In the words of Ian Farrington (personal communication, 2013), Santiago may well be a “New Cuzco”. In this context the current orientation of Cathedral Street and the Plaza de Armas of Santiago de Chile, close to 83° of azimuth, could mark the Sunrises on September 15 and March 28/29, days before and after the equinoxes (Bustamante & Moyano, 2013; Moyano, 2015). It could also mark the average position of the Moon during the crossover phenomenon, right before the arrival of spring in the southern hemisphere (September), in relation to the lunar month of the *Coia Raimi Quilla* (Guama Poma de Ayala, 1980:227) among the Incas (Fig. 3).

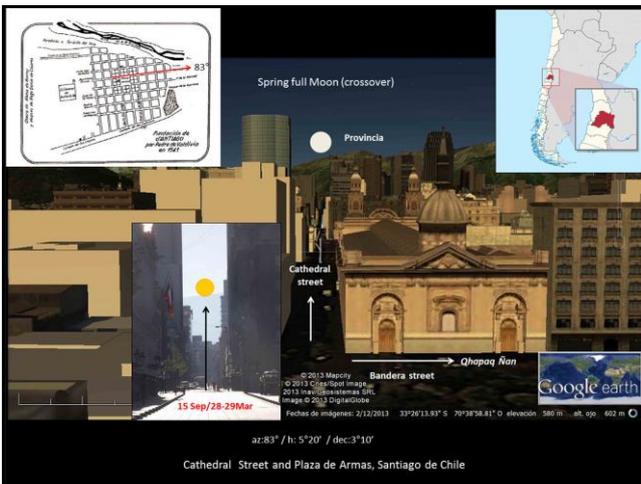


Figure 3. Orientation of Cathedral Street, Santiago de Chile

This logic behind the symbolic appropriation of landscape was even embodied by visual means, such as rock art. This is the case of El Apunao, located in the “Nevados de Cachi” (Cachi Mountains), in Salta, Argentina (Jacob *et al.* 2013; Moyano, 2014). Here as complementing observation from an *ushnu*, we suggest the possibility of an integrated system based on a petroglyphic (a possible *quipu*)<sup>9</sup> (Fig. 4).

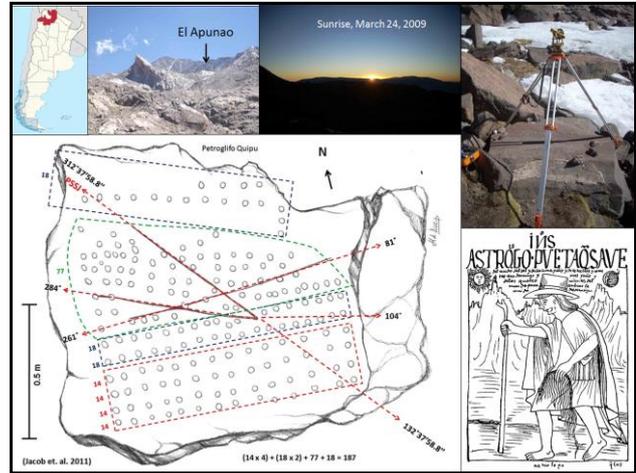


Figure 4. Rock art El Apunao

This is located 20 m downhill from the *ushnu* platform and corresponds to a flat rock (SW-NE axis) featuring 187 circles, marked on the skirts and grouped in sets (14 x 4), (18 x 2), 77 and 18 (Tab. 1):

Table 1. Numerical analysis of petroglyph

14	14	18			
		+		+	77 + 18 = 187
14	14	18			
—		—		—	
56	+	36	+	95	= 187
—		—		—	
92 <sup>1</sup>	+		+	95 <sup>1</sup>	= 187

The set includes a V-shaped motif (open to the NW) crossed by a single line in NE-SW direction. It is possible that this system represents the part of the year between March 19 (feast of St. Joseph, Patron of Cachi) and September 23 (Spring Equinox) including the *ushnu*'s west horizon (+/- 1 day). Also, this system will help us understand the lunar extension of six synodic months, equal to 178 days, through the remainder of the total days of the solar year (365) and the extension of the account system (187). With

<sup>9</sup> Cords with knots suspended from primary cord; a mnemonic device/system of record keeping a kin to writing (Meddens *et al.* 2014:278).

four hypothetical months of 30 days, plus 2 months of 29 days, by means of the following operations:

a)  $4 \times 30 = 120$

$2 \times 29 = 58$

$120 + 58 = 178$

b)  $30 + 29 + 30 + 29 + 30 + (30) = 178$

#### 4. FINAL REMARKS

The background indicates a close relationship between the observation of the Moon cycles, fertility ritual and female aspect of the Incan Cosmos. Early chronicles from the XVI and XVII centuries, along with archaeoastronomical information in central and southern Andes, support the hypothesis that the Incas had great reverence for the Moon (*Quilla*), in parallel to the cult of the Sun (*Inti*), as the responsible for agricultural production, the main economical activity in pre-Hispanic times. The Moon for the Incas represent a type of oracle, an agent entity, which enables the management of uncertainty, through mnemonic of Saros or eclipse cycle (18.03 years), a possible rite of passage, from the observation of moons every Metonic cycle (19 years). The difference between two cycles, equal to 12 lunar months (354 days), was observed in the records of the orientations of certain urban settlements and architectural pieces, along with lunar standstills in the horizons, close to equinoxes or crossover instances. In our view, this phenomenon could be related to the celebration of the *Citua* in the lunar month of September, such as: La Ciudadita, Santiago de Chile and El Apunao, among others<sup>10</sup> (table 2).

Table 2. Presence of crossover (X)

Site	Crossover (P-EQSR/P-EQSS)
El Apunao	X
Uña Tambo	X
Cortaderas	X
Guitian	-
Viña del Cerro	-
La Ciudadita	X
El Shincal	X
Incaullo	X
Pucara de Chena	X
Ruinas de Chada	-
C. Santa Lucia	X
Catedral/Pza. de Armas	X

This festivity followed directly after August, including ceremonies centred in the *ushnu* of *Huacaypata* to expel disease from the city of Cuzco, after the start of planting and the passing of the Sun through the anti-zenith (nadir), nearing the months of April and August. This can help to understand the equinox in cultural terms, outside of Cuzco, not only as the quadripartite projection, along with the solstices in the annual movement of Sun in the horizon, but also as the possibility to connect the Sun and Moon's movements, through the mythical crossing in the crossover. A mnemonic system, which allows synchronising the main political, administrative, and ceremonial activities (in the conquered territories), with the Moon and the Sun, within the Inca *ceque* calendar and the regularity of eclipse phenomena, thanks to the mutual relationship between people and the world, in order to synchronize ideas of space and time, with ontological categories of "dwelling or living in the world".

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<sup>10</sup> On other hand, there are possibilities to observe the Moon during the period of March-April (*Ayriuaquilla*, according to Anonymous) (Ziolkowski, 2015:285-288), not discussed here because of it isn't related to with the beginning of agricultural activities in the southern part of the Andes.

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