

# Lunar Visibility and the Islamic Calendar

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## Abstract

### Introduction

Calendars are used to keep track of the motion of the earth, moon and sun. Lunar visibility determines when the Islamic month starts, and hence, when the Muslim festivals will fall on. There are two main Muslim festivals in Singapore, namely Hari Raya Puasa and Hari Raya Haji. Hari Raya Puasa falls on the first day of the 10<sup>th</sup> Islamic month, while Hari Raya Haji falls on the 10<sup>th</sup> day of the 12<sup>th</sup> Islamic month. To predict when these festivals will fall on, we need to know the astronomy behind the basis of the Islamic calendar. In this project, we will talk about some basic calendrical concepts, how the Islamic Calendar came about, the various practices adopted by different countries, and most importantly, the prediction criterions that are developed over the years ever since the Babylonians era. The project will further analyse the Islamic Calendar in Singapore, including the criterion that the Islamic Religious Council of Singapore (MUIS) uses.

### The Islamic Calendar

The Islamic calendar is a lunar calendar, because it follows the lunar phase cycle (lunation) and do not follow the seasons. A lunar year of the Islamic calendar consists of 12 months, with the start of each Muslim month determined by the first sighting of the crescent moon. Since the Islamic calendar does not follow the seasons, Islamic dates move back about 11 days each year. This is because each Muslim month consists of 29.5 days on average. Hence, in a year, there are about  $12 \times 29.5 = 354$  days, while the tropical year consists of about 365.2422 days a year. Although the traditional moon sighting practice still exists in many Muslim communities for religious purposes, astronomers from as early as 500 C.E. has already been researching into the possibilities predicting lunar visibility using different criterions.

### Prediction Criteria

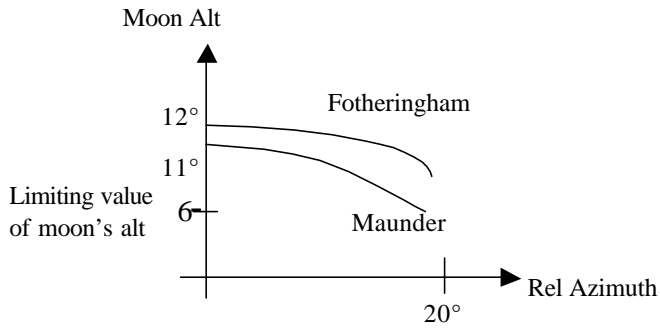
#### Babylonians (500 C.E.)

The moon is visible if, at local sunset, the

- (i) Age of the moon is  $>24$  hours from the time of conjunction
- (ii) Sunset to moonset interval is  $> 48$  minutes

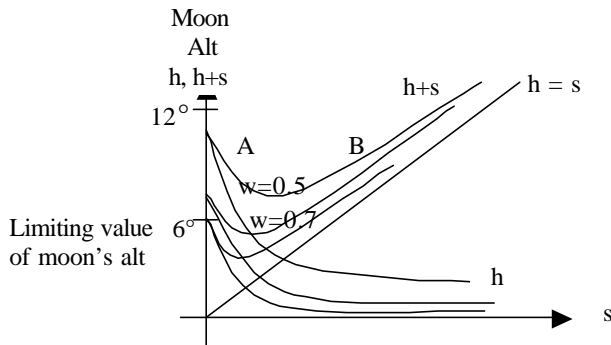
#### Fotheringham / Maunder (1910 / 1911)

The moon is visible if a set of data chosen lies above the curves.



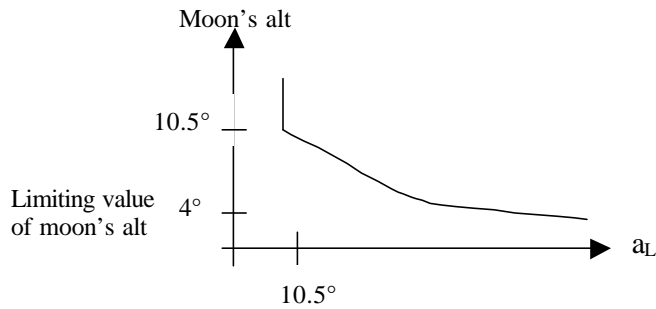
Bruin (1977)

The moon is visible if the data lies above the curves for a chosen width.



Ilyas A (1981)

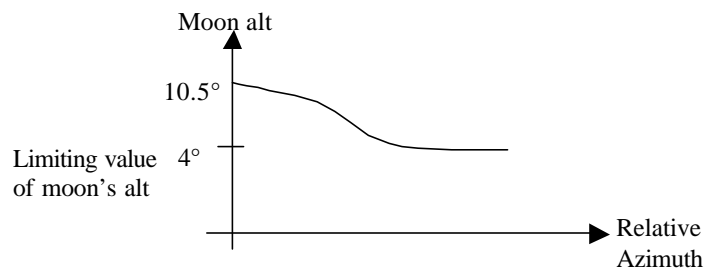
Again, the moon is visible if a set of data chosen lies above the curves.



This criterion combines both the criteria Fotheringham / Maunder and Bruin and improve on them. The graph is extended to higher latitude.

Ilyas C (1988)

This is an improved criterion of Ilyas A. The moon is visible if the chosen set of data lies above the curve.



## RGO 67 (by the Royal Greenwich Observatory)

The moon is visible when

- (i)  $Z > 5^\circ$  when  $s$  (solar depression)  $> 3^\circ$
- (ii)  $a_L > 10^\circ$

## Shaukat

The moon is visible if, at local sunset, the

- (i) moon's altitude  $> 3.4^\circ$
- (ii)  $(\text{alt}/12.7) + (\text{crescent width in arcmin}/1.2) > 1$

## **The Islamic Calendar in Singapore**

In the analysis of the Islamic calendar in Singapore, "MoonCalc" is used. "MoonCalc" is a computer programme used to find out the various important quantities like the moon's age, the altitudes and azimuths of the sun and the moon, the sun-moon elongation, the moonset lag, the width of crescent, etc., when a given location, date, time and the preferred criterion is keyed in.

The Islamic calendars of Singapore are released by MUIS, the Islamic Religious Council of Singapore. In the 50s and 60s, the Muslim calendar in Singapore was based on sightings of the moon from Sultan Shoal, the southernmost part of Singapore. In the 70s, MUIS made use of predictions. If the moon is above horizon during sunset of the 29<sup>th</sup> day of the month, even if the moon is just  $1^\circ$ , the new month would start. In the 80s they decided to follow a variation of the 1978 Istanbul criterion where the altitude of the Moon should be more than  $7^\circ$  at sunset. In 1992, they switched to the

## Mabims criteria\*:

- (i) Moon's altitude of  $2^\circ$
- (ii) Sun-moon elongation  $3^\circ$
- (iii) Age of moon 8 hrs old

The Mabims criteria came into use because religious officials in Singapore, Malaysia, Indonesia and Brunei decided to coordinate major Muslim holidays in 1992 together based on an agreed set of criteria. However, each country is not bound to follow due to religious or political reasons.

In the analysis of the past years Muslim calendar, for example, for the year 2000, it was found that there are some discrepancies.

## **Calendar 2000**

Month	Muslim	Mabims	Age of Moon on			Mabims	Agreement Ratio
			Ilyas_C	RGO 67	Shaukat		
Jan	8/1(P)	7/1	8	8	8	16.97 hr	
Feb	7/2	6/2		7	7	22.29 hr	
Mar	7/3	7/3 (6/3)	7	7	7	30.03 hr	

Apr	6/4	5/4	6	6	6	16.99 hr	3/12
May	5/5	5/5 (4/5)	5	5	5	30.91 hr	
Jun	4/6	3/6				22.91 hr	
Jul	3/7	2/7	3	3	3	19.91 hr	
Aug	1/8	31/7	1	1	1	8.86 hr	
	31/8	30/8				24.84 hr	
Sep	29/9	28/9	29	29	29	15.09 hr	
Oct	29/10	28/10				26.88 hr	
Nov	27/11	26/11	27	27	27	11.70 hr	
Dec	27/12(P)	26/12	27	27	27	17.75 hr	

From the data of MoonCalc, on 4/5/2000,  
 Altitude of the moon =  $3.396^\circ - 2^\circ$   
 Elongation =  $5.329^\circ - 3^\circ$   
 Moon Age = 6.91hr < 8hr

This analysis has shown that the actual deciding criteria is only the one where the moon's altitude  $2^\circ$ . Further corresponding with MUIS shows that,

The "actual" **Mabims criteria\*** is:

***Deciding Criteria for Visibility***

(i) ***Moon's altitude  $2^\circ$***

***Factors which determine the Degree of Visibility***

(ii) ***Sun-moon elongation  $3^\circ$***

(iii) ***Age of moon 8 hrs old***

**References**

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