

### Introduction

Planet Earth is bombarded daily by dozens of tons of debris from space that enter its atmosphere and can be seen in the form of meteors. It is no different on the Moon, but since it has no atmosphere, the impact on its surface is direct, generating flashes that are commonly called TLP, or Transient Lunar Phenomena.

During a meteor shower, the likelihood of observing a TLP increases considerably, and it was during one such shower, the 2017 Geminids, that the National Lunar Impact Observing Campaign was launched in Brazil in order to monitor the Moon's surface on the day of the shower's peak and to detect possible meteoroid impacts on its surface.

The campaign was conceived when members of BRAMON realized that the Moon's altitude and phase during the shower's peak would place it in a privileged position for impact observation.

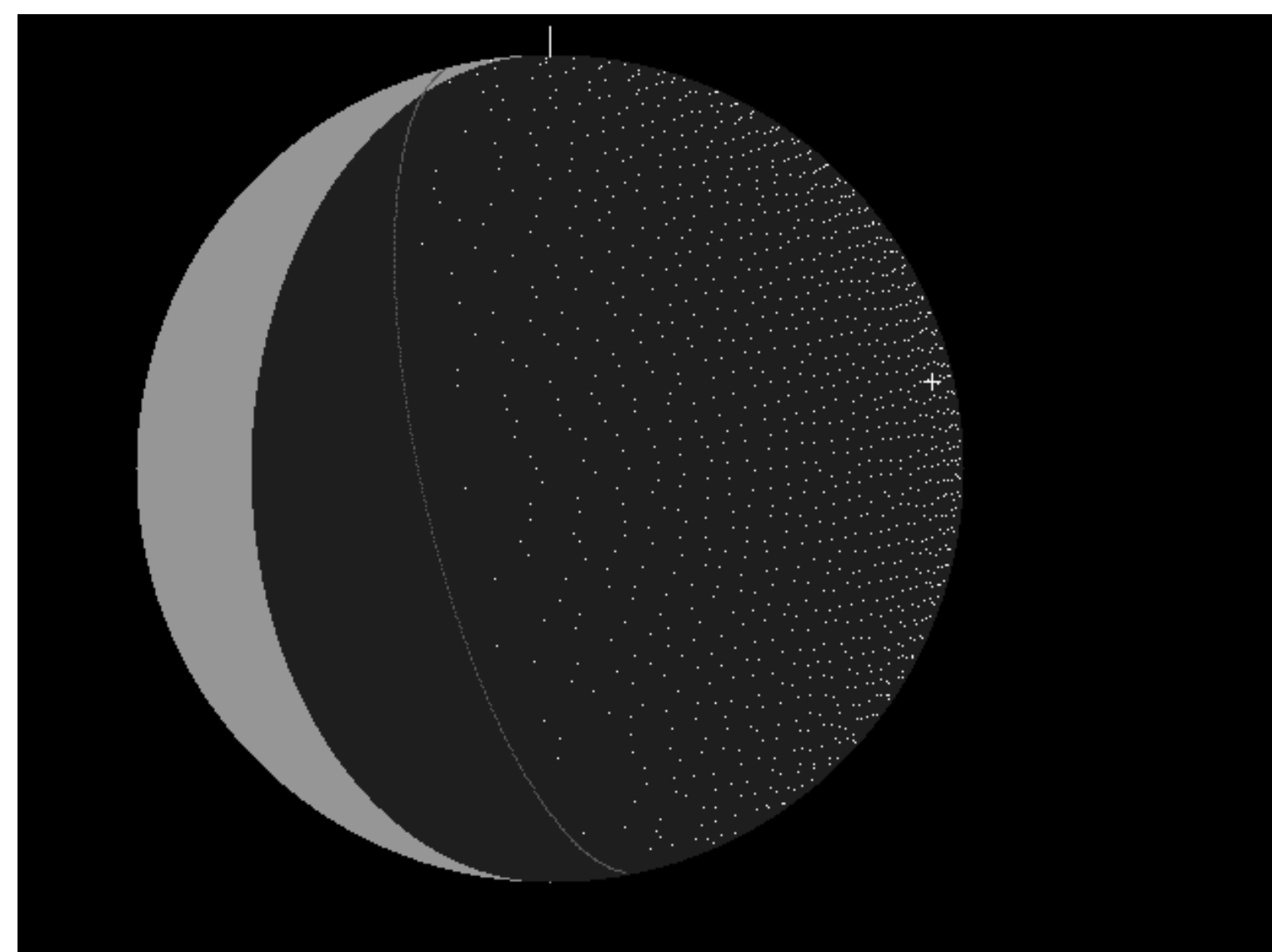


Figure 1: Prediction of impact geometry for december 14, 2017  
Lunar Scan 2.00

### Organizing the Campaign

Once it was established that the window of opportunity would be on December 14th 2017, the campaign's organization got started and Brazilian amateur astronomers were called upon to take part in the event.

Live broadcasts were held to address technical aspects and communicate the event, explanatory texts about the campaign were shared on social media to gather the highest number of participants, and supporting material was put together for those who were interested in participating.

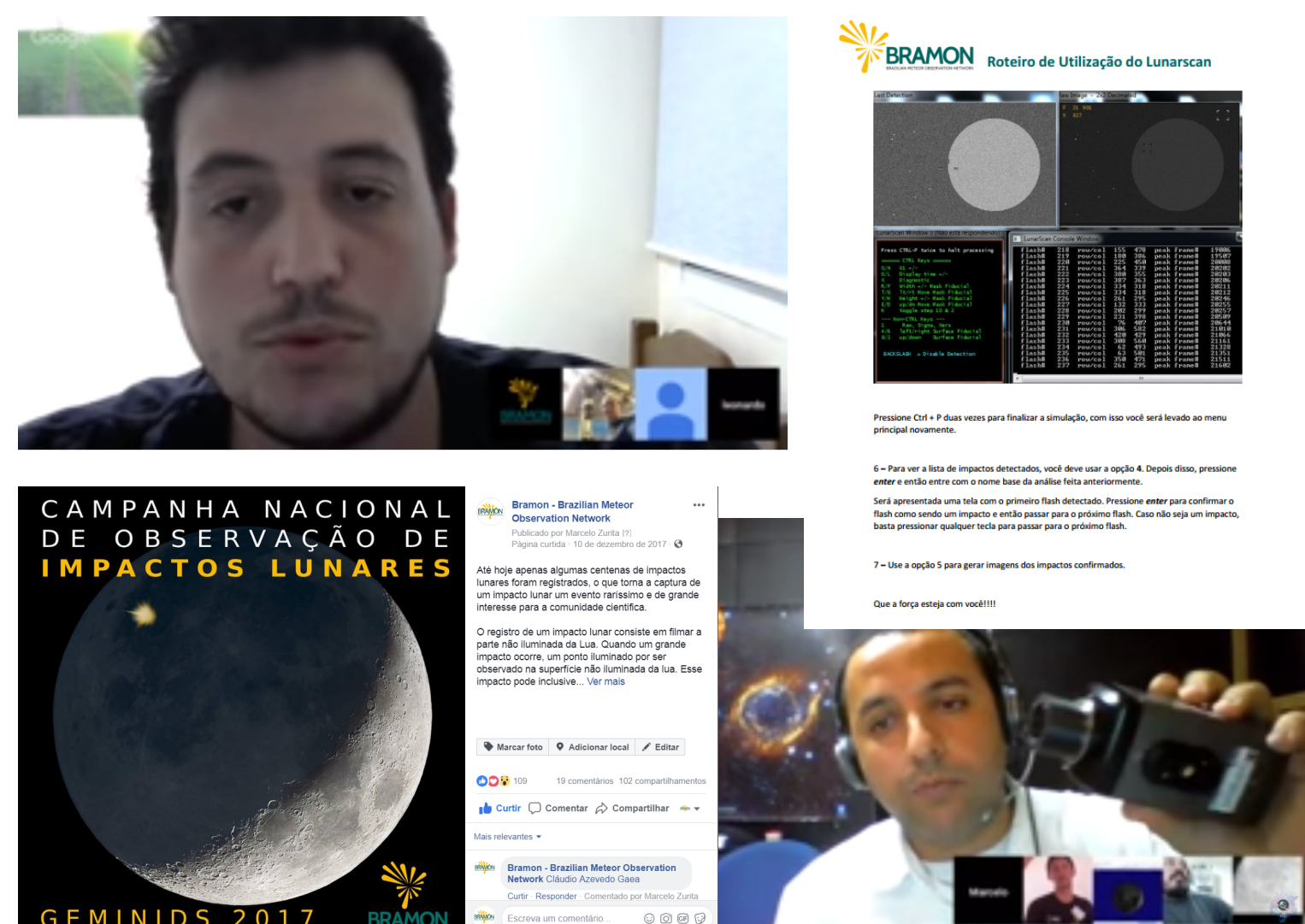


Figure 2: Live broadcasts, call to amateurs in social media and LunarScan Tutorial in Portuguese



### Methodology

To determine whether a lunar impact has actually occurred, the same phenomenon must be watched by two independent observers placed at different locations far from each other. This will eliminate the possibility of it not having occurred on the satellite's surface, but being otherwise caused by cosmic rays, satellite flares, meteors and other phenomena.

In order to confirm that the phenomenon seen by two different observers is really a TLP, both events must have:

- occurred at the same moment (requires time synchronization)
- occurred on the same region of the lunar surface.
- similar duration and magnitude.

Minimum equipment required to collect data is:

- A video camera or astronomical CCD with a framerate as high as possible.
- A telescope equipped with automatic tracking.
- A computer with a fair amount of disk space.

Software used:

- SharpCap (or equivalent) - Imaging.
- NTP - Time synchronization.
- LunarScan - TLP search (by Peter Gural).



Figure 4: Setups used in Moon footage.  
Left: Skywatcher 130mm F5 + Samsung SCB 2000 camera.  
Right: Meade LX80 8" + ASI 1600 CCD

### Results

Despite the unfavorable weather conditions, some observers managed to implement the TLP search with footage of the Moon recorded during much of the stipulated period. Among the observers, Marcelo Zurita (APA/BRAMON) as well as Romualdo Caldas (CEAAL/BRAMON) and David Duarte (CEAAL) succeeded in capturing a flash on the Moon's surface at 07:13:46 UT on Dec 14, 2017, caused by an impact at the selenographic coordinates of 9.9° N and 45.4° E.

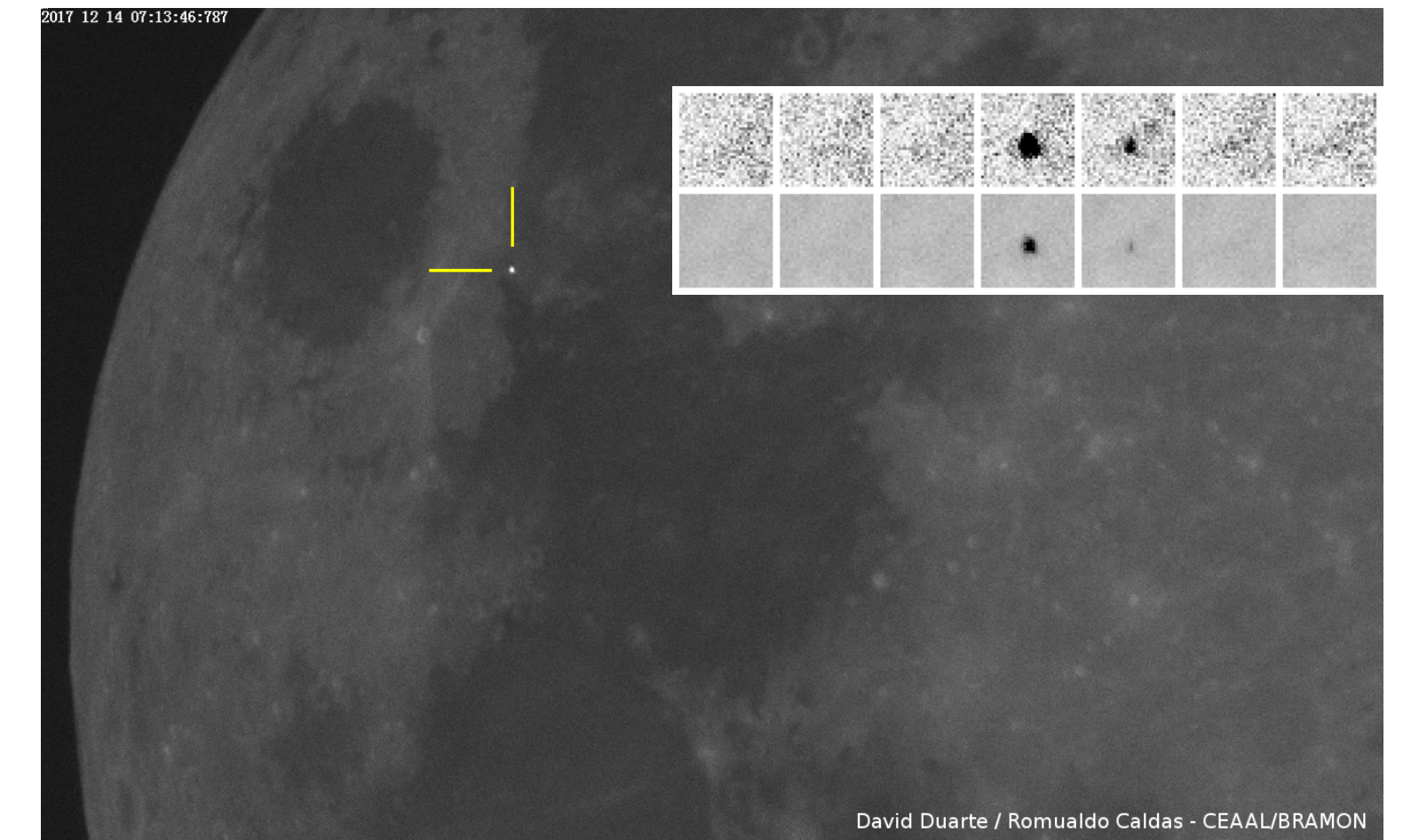


Figure 5: Observer A: David Duarte (CEAAL) & Romualdo Caldas (CEAAL/BRAMON)  
Observer's Site: Maceio, AL, Brazil / Lat: -9.6205, Long: -35.7200  
Instruments: Smidt Cassegrain MEADE 8" + ASI 1600 Mono Cooled Camera

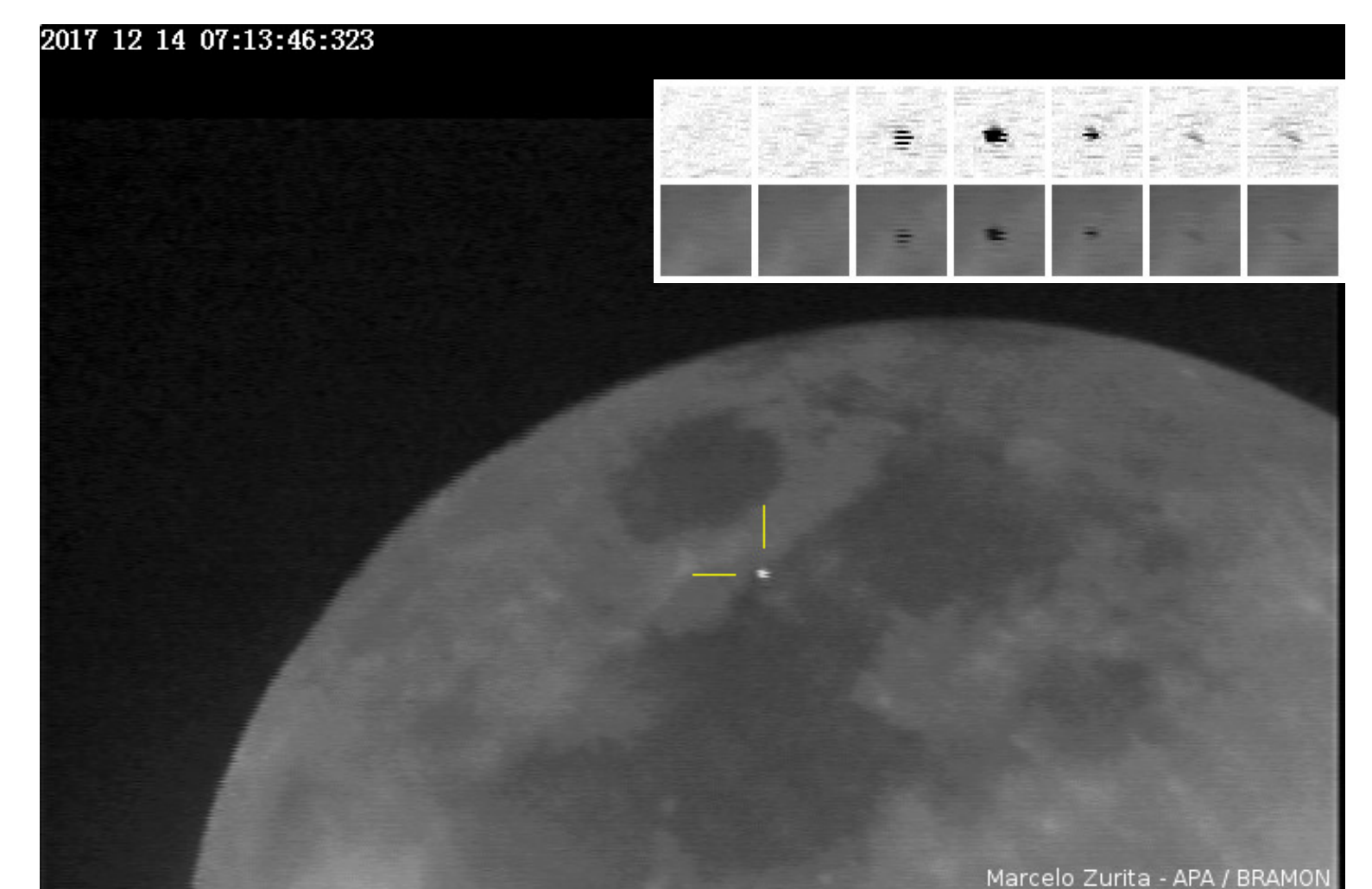


Figure 6: Observer B: Marcelo Zurita (APA/BRAMON)  
Observer's Site: Araruna, PB, Brazil / Lat: -6.4523°, Long: -35.6732°  
Instruments: 130mm f/5 newtonian + SCB 2000 Camera

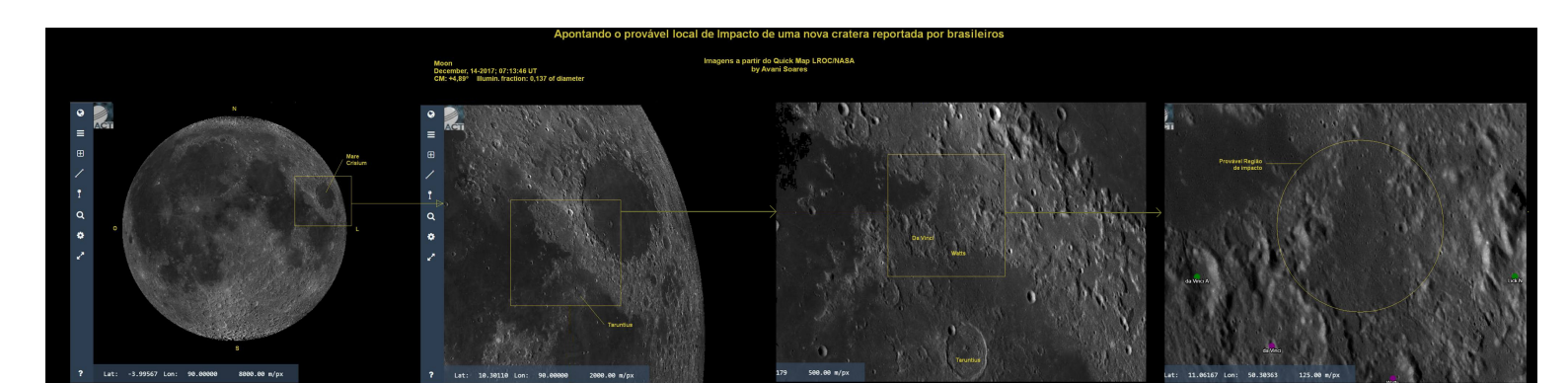


Figure 7: Pointing the probable impact location  
Produced by Avani Soares, a brazilian amateur astronomer from LRO images

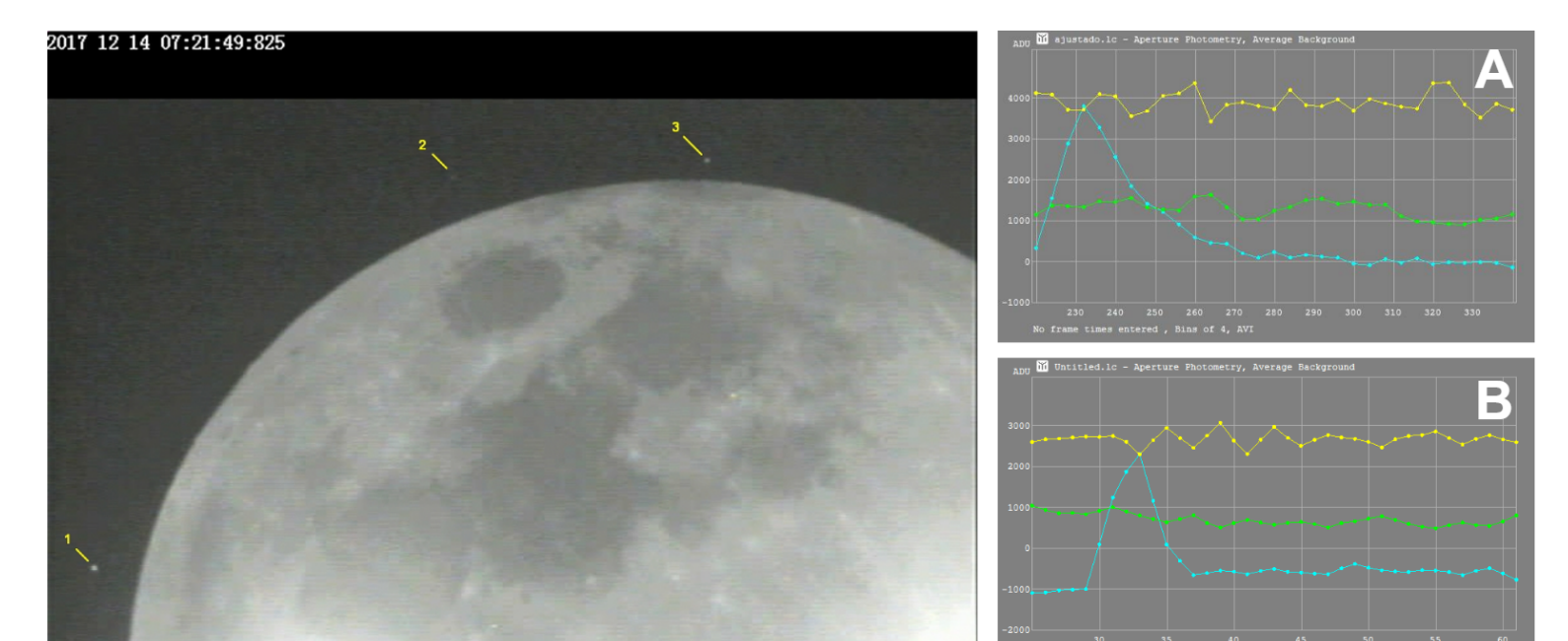


Figure 8: Left: Reference Stars used to determination of impact flash magnitude.  
Right: Photometric analysis showing typical light curve of a lunar impact for both observers (A: David Duarte & Romualdo Caldas; B: Marcelo Zurita)

### Next Steps

Based on the success of the first campaign, another 3 efforts were scheduled for 2018, for Lyrids on April 21 and 22, Perseids on August 13 and 14 and for the Geminids on December 14. This comes enhancing the technique, gather more observers and encourage lunar observation and TLP searching.

### SUPPORTERS

- |                            |                                  |                            |                                   |   |                                      |                                |                                  |   |                             |
|----------------------------|----------------------------------|----------------------------|-----------------------------------|---|--------------------------------------|--------------------------------|----------------------------------|---|-----------------------------|
| ALCIENE SEVERO DE OLIVEIRA | ANTONIO CARLOS SEVERO WIEDERMANN | CRIS RIBEIRO               | ERICK DE BRITO COUTO              | HELDER ASSIS RAASCH                     | JOÃO FIDÉLIS SALLES                  | LEONARDO SCANFERLA AMARAL      | MARLENE JOAQUIM DE SOUZA         | RAFAEL NARDE DE REZENDE                 | RUBENS FRAGA JUNIOR         |
| ALEXANDRE ALVES NETO       | ANTONIO RAFAEL DA SILVA SOUSA    | CRISTOVÃO JACQUES          | EVERTON LIMA SALAZAR              | HELIO MARZIO RODRIGUES MOREIRA          | JOCIMAR JUSTINO SOUZA                | LILIAN MARIN                   | RAFAEL LOPES GRANJEIRO           | RAFAEL VENANCIO LEMOS SANTOS            | RUBENS GHIGONETTO           |
| ALEXANDRE VIEIRA PIECZUR   | ARTHUR SVOZINSKI                 | DANIEL FREIRE ALMEIDA      | FELIPE HIME                       | HERACLIDES JOSE CORDEIRO                | JONATHAS FONTELE DOURADO             | LUCAS DE MORAIS TEIXEIRA       | MICHEL TORRES                    | RAFAELA DE MARSLIAC                     | SAMARA DA SILVEIRA LOURENÇO |
| ALFREDO DAL AVA JUNIOR     | AUGUSTO DE ORNELLAS ABREU        | DANIELA CARDOZO MOURÃO     | FELIPE SERVULO                    | HERITON ROCHA                           | JONATHAN DE ALMEIDA VIEIRA           | LUCIMEIA IVIZI                 | MICHELE COSTA                    | REGIANE SOUZA                           | SANDRO ROSA                 |
| ALMIR AMORIM ANDRADE       | BONIFACIO DE OLIVEIRA            | DAVI SOUZA                 | FERNANDO MARTINS DE PAIVA         | HILBERNON ALMEIDA FILHO                 | JONATHAN PEREIRA DE PAULA            | MACIEL SPARENBERGER            | MIGUELBORGES                     | REGINALDO DE SOUZA SILVA                | SCHWARZA                    |
| ALLISIO AMORIM ANDRADE     | BRUNO BONICONTRO                 | DAVID MARQUES              | FERNANDO SCHMIDT                  | HUMBERTO ORCY DA SILVA                  | JONATHAN TITTON                      | MAICON GERMINIANI              | MÓNICA ÂNGELA MAZZONI            | RENATO CASSIO POLTRONERI                | SERGIO LARRUSCAIM MATHIAS   |
| ANA RAMALHO ALKIM          | BRUNO FORTI                      | DENIS AUGUSTO DE ARAUJO    | FRANCISCO DANIEL                  | ISAAC SILVA                             | JOSE HENRIQUE ROSSI OLIVEIRI         | MARCELO MEDITEROS SANCHEZ      | MUCIO MACEDO                     | RENATO RIBEIRO                          | SERGIO LUIZ                 |
| ANDERSON SANTIAGO DA SILVA | CAMILA RENATA DE TOLEDO          | EDNEY SARI                 | FRANCISCO DE ASSIS ROCHA DA SILVA | ISABEL ALVES                            | JOSE PAULO DE CARVALHO               | MARCELO WAGNER SILVA DOMINGUES | NATALIA PALIVANAS                | RICARDO JOSE CAVALLINI                  | SERGIO SACANI               |
| ANDRE A C R COUTO          | CARLOS DI PIETRO                 | EDUARDO ALDAVIS PARLAMENTO | GABRIEL CARNEIRO DE PAIVA         | IVAN DONIZETE SOARES                    | JOSE ROBSON LEITE NOGUEIRA           | MARCO DOMENEGHETTI             | NEFTALI JUNIOR                   | ROBERTO GUIMARAES DE OLIVEIRA           | SOCORRO AILA COSTA          |
| ANDRE LUIZ ZANI            | CARLOS FERNANDO JUNG             | EDUARDO CIOELHO            | GABRIEL G                         | JOVEM EXPLORADOR E O ECOMUSEU DE PACOTI | JULIO BESSA                          | MARCOS JERONIMO ROQUE BARRETO  | PAULO CARLOS SALDANHA FILHO      | ROBERTO SOUZA                           | VÂNIA DE GODOY              |
| ANDRE MOUTINHO             | CARLOS KIKO FAIRBÁIRN            | EDUARDO FERNANDO BECKER    | GRECYA                            | JEFFERSON LUAN DO NASCIMENTO            | JULIANO ZAKIEVICZ                    | MARIA DAS GRAÇAS SILVA         | PAULO GUILHERME MONTEIRO ANDRADE | ROBSON DA SILVA SIQUEIRA PROF. SIQUEIRA | VIVIANE MELO                |
| ANDRE O ZANI NAS ALTURAS   | CHRISTINE LEÃO                   | EDUARDO MAIDA              | GUIDO GARCIA D ANGELO             | JESSICA                                 | KLEPER CARVALHO DE FIGUEIREDO LEITÃO | MARINA OUTRA                   | PAULO HERCÍDIO DE SOUZA          | RODRIGO NOBREGA ROCHA XAVIER            | WENDEL DOS SANTOS MONTEIRO  |
| ANDRÉ PEIXOTO              | CLAUDIO MÁX                      | EDUARDO TREVISAN           | GUNTER MORAES                     | JOÃO ANTONIO MATTEI                     |                                      | MARIO FELISBINO DA SILVA       | PAULO VITOR DE SOUSA LUCENA      | RONALDO DE SOUZA                        | WILSON BONFIM ABREU FILHO   |
| ANTONIO CARLOS DUARTE      | CLÁUDIO QUEIROZ                  | EFRAIM MELO DOS SANTOS     |                                   |   |                                      |                                | PEDRO JOSE DE SOUZA MATTOS       | RUBENS DAMIGLE ALVES MARREIRA           | WILTON FERREIRA DA COSTA    |