Apparent colours as manufacturing markers for GEO satellites

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Introduction

- **Optical telescopes**

  Large FoV:

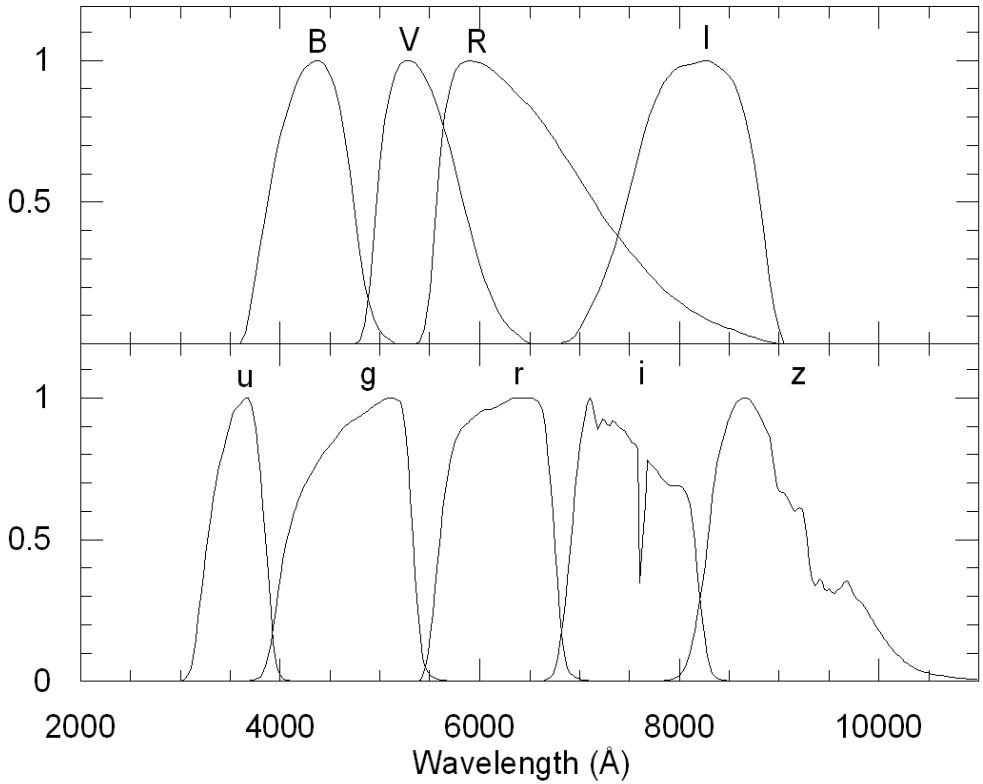
  - Detection
  - Characterization (lightcurve, etc.)

  Small FoV:

  - Characterization

- **Multiband photometry** (Johnson-Cousins, Sloan)

- Information about **surface materials, tumbling/rotation, peculiar features**



(Bilir et al. 2007)

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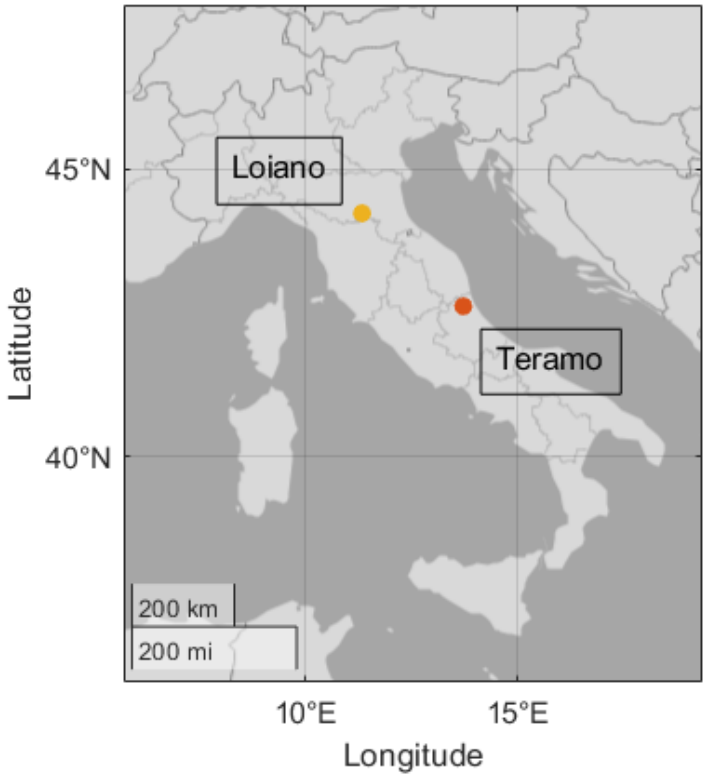
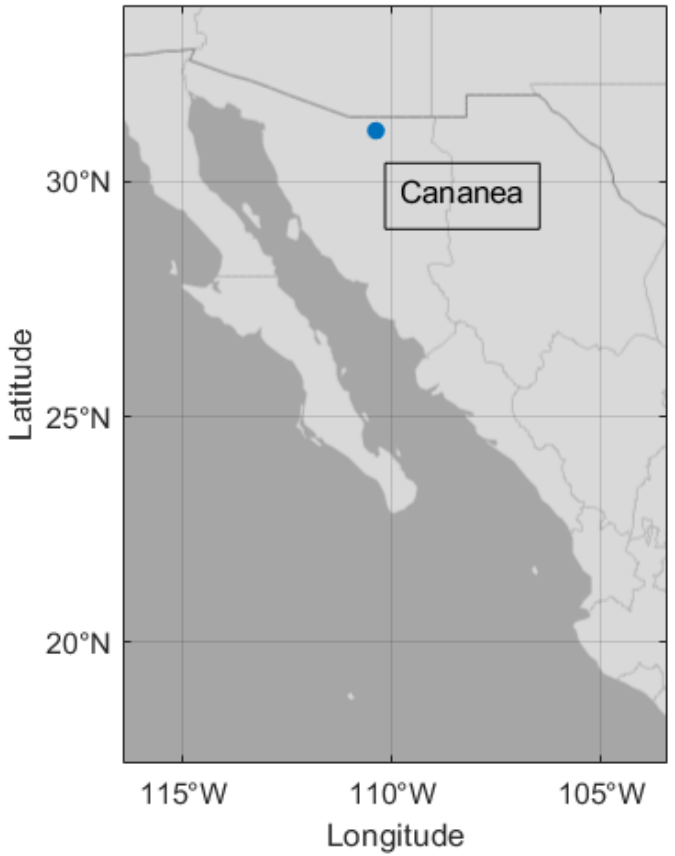
Observational sites



- Cassini-Loiano Telescope
- Teramo Normale Telescope (TNT)

- Guillermo Haro Astrophysical Observatory (OAGH)



National campaigns

	Loiano	TNT
Organization	INAF	INAF
Primary mirror (cm)	152	72
f (cm)	1200	980
FoV (arcmin)	13×12.6	5×5
CCD area (px)	1300×1340	1024×1024
CCD resolution	0.6	$\sim$0.3
Observed Objects	11	8
Epoch	2010 - 2011	2017

- The telescopes are equipped with Johnson-Cousins filter sets

Observed sample

Name	Bus	Model	Launch date
Astra 2E	Eurostar	3000	30/09/13
Astra 2F	Eurostar	3000	28/09/12
Astra 2G	Eurostar	3000	27/12/14
Eutelsat 21B	Spacebus	4000C3	10/11/12
Ekspress AM7	Eurostar	3000	18/03/15
Ekspress AM8	Ekspress	1000HTB	14/09/15
Turksat 4A	Mitsubishi Melco	DS-2000	14/02/14
Turksat 4B	Mitsubishi Melco	DS-2000	16/10/15
Anik F1R	Eurostar	3000S	08/09/05
Anik F1	Hughes	HS-702	21/11/00
Anik G1	Loral	SSL-1300	15/04/13
Mexsat 3	GeoStar	2.4	19/12/12
Astra 1H	Hughes	HS-601HP	18/06/99
Astra 1KR	Lockheed Martin	A2100AXS	20/04/06
Astra 1L	Lockheed Martin	A2100AXS	04/05/07
Astra 1M	Eurostar	3000	05/11/08
Hispasat 1C	Spacebus	3000B2	03/02/00
Hispasat 1D	Spacebus	3000B2	18/09/02
Spainsat	Loral	SSL-1300	11/03/06
Eutelsat 13A	Spacebus	3000B3	21/08/02
Eutelsat 13B	Eurostar	3000	04/08/06
Eutelsat 13C	Eurostar	3000	20/12/08
Meteosat 8	Alcatel	spin stabilized	28/08/02

- 23 GEO satellites
- Mostly telecommunication satellites
- Active at the time of observations

Observation strategy

Alternating the filter sequence (VRI) we obtained consecutive multi-band images.

- 60 seconds exposure
- 30 to 60 images per GEO object were acquired
- Resulting database of more than 1,200 scientific images
- Acquisition of instrumental calibration frames (dark current, bias, flat-field)
- Acquisition of Landolt (1982) stellar fields for standard calibration

We performed **aperture photometry** with IRAF and DAOPHOT software *(Tody 1986, Stetson 1987)*

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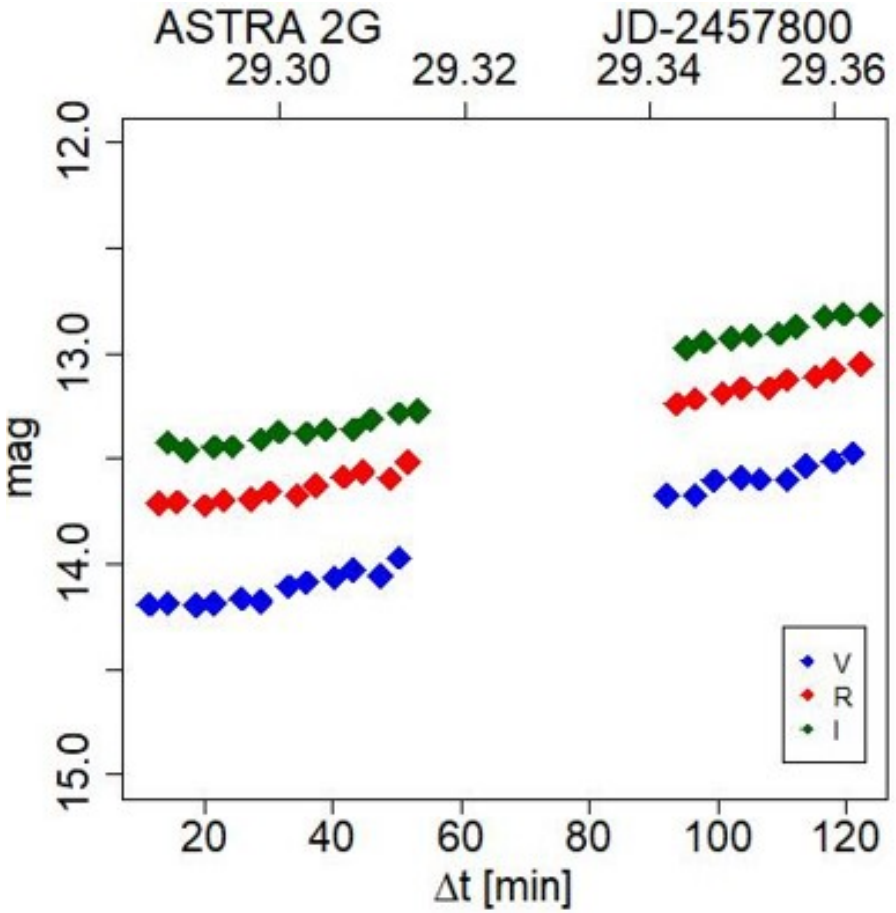
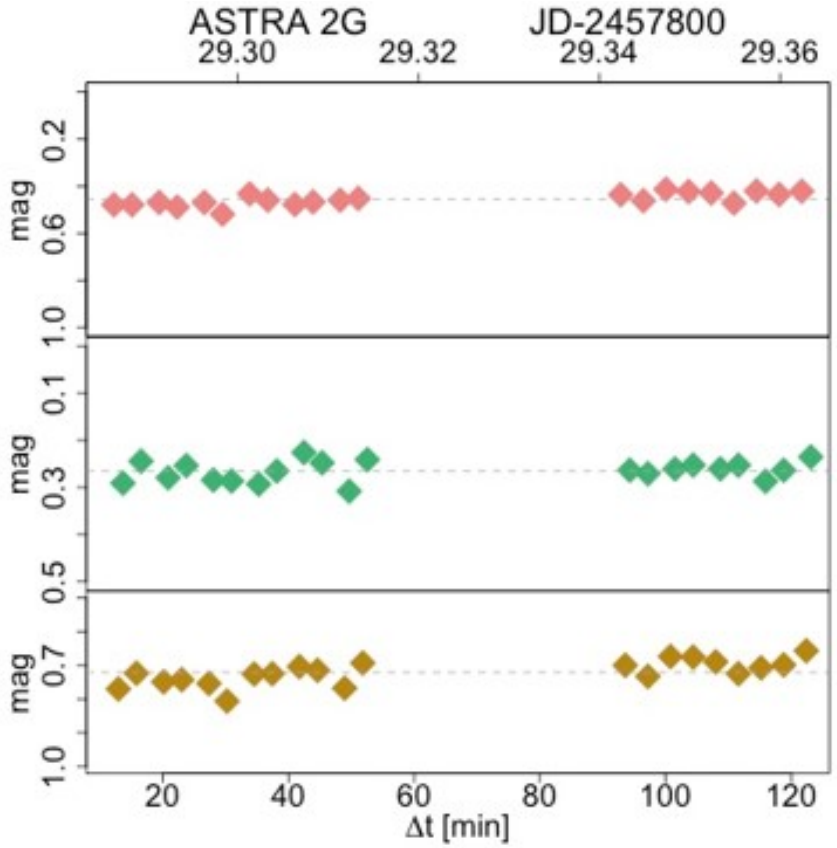
Lightcurves reconstruction



Lightcurves in V, R, I filters.



Color lightcurves.
From top to bottom: V-R, R-I, V-I

Color-color planes

We investigated a possible correlation among color indexes and bus/model (see Schmitt 2021)

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Conclusions

- GEO satellites analysed up to now show a mild tendency to clusterize in the color-color planes according to their bus

- However several exceptions result from the preliminary analysis: we are investigating the influence of structural features (i.e. dry mass, wingspan, etc...)

Further analysis and observations are required.