L'observation et la réduction des phénomènes mutuels

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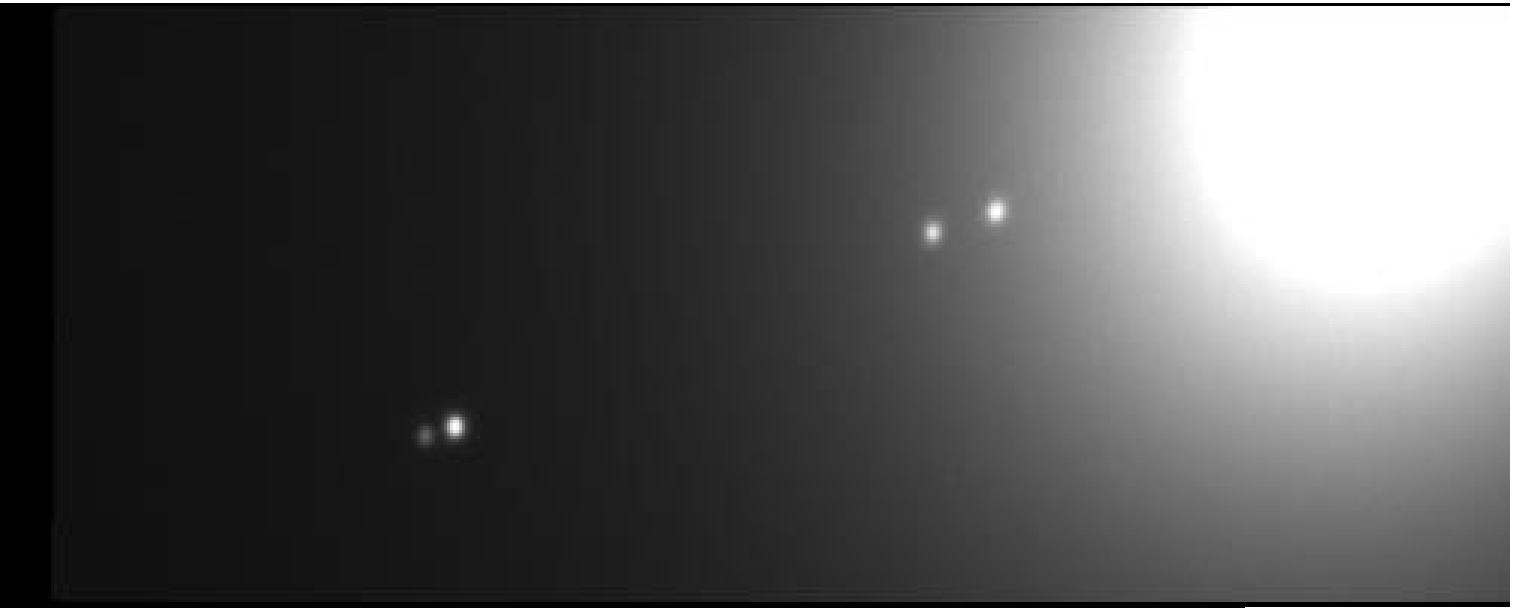
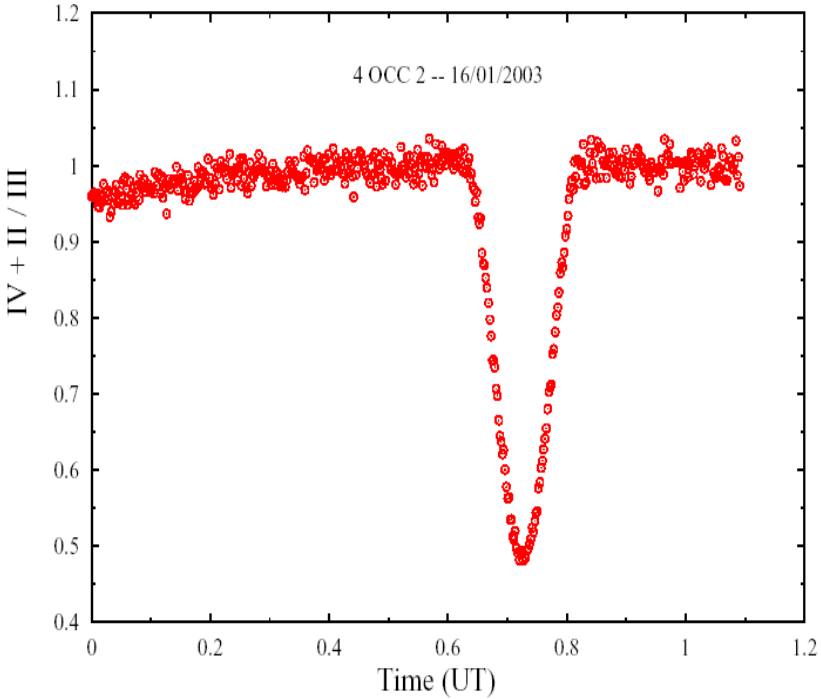
L’observation des phénomènes mutuels

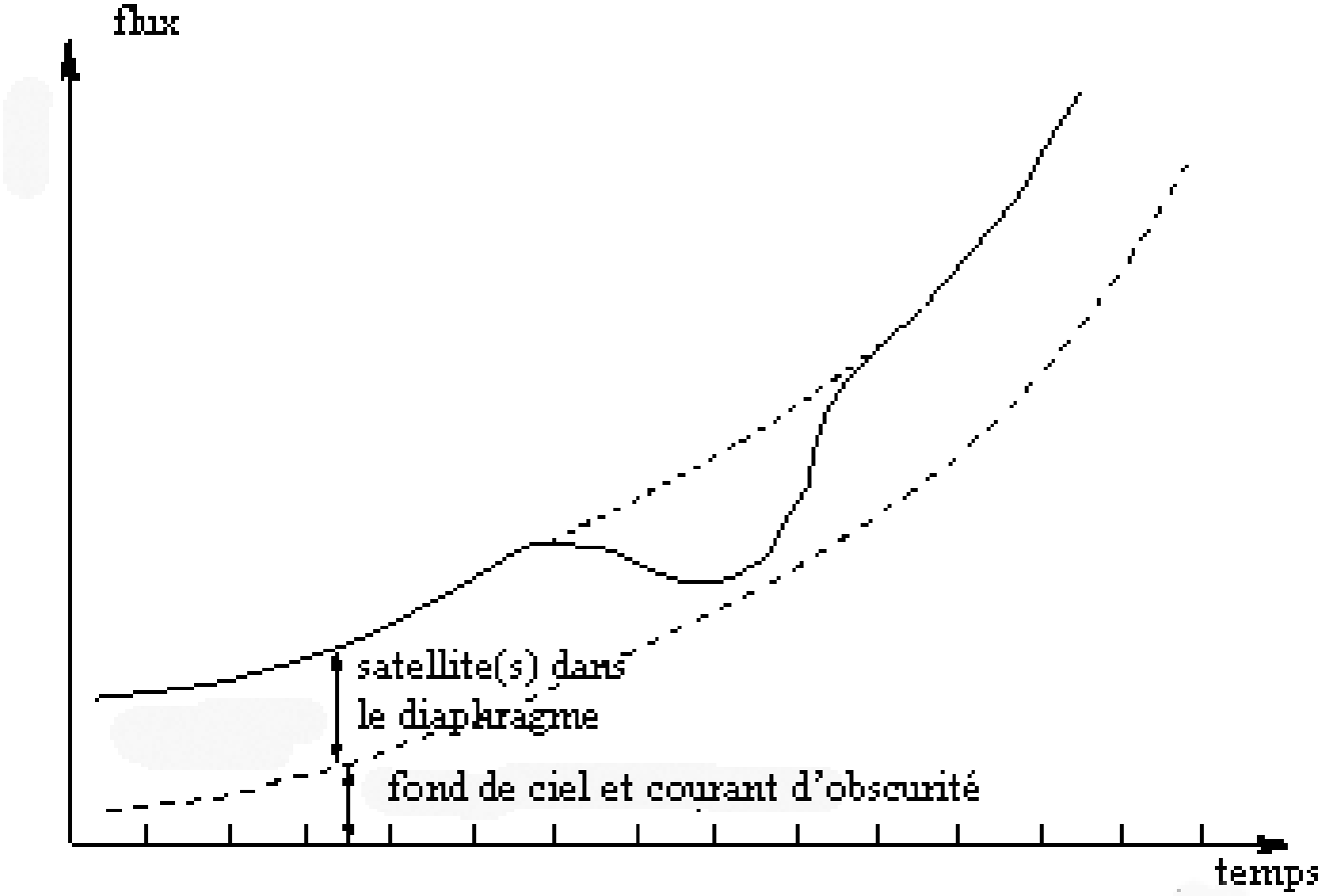




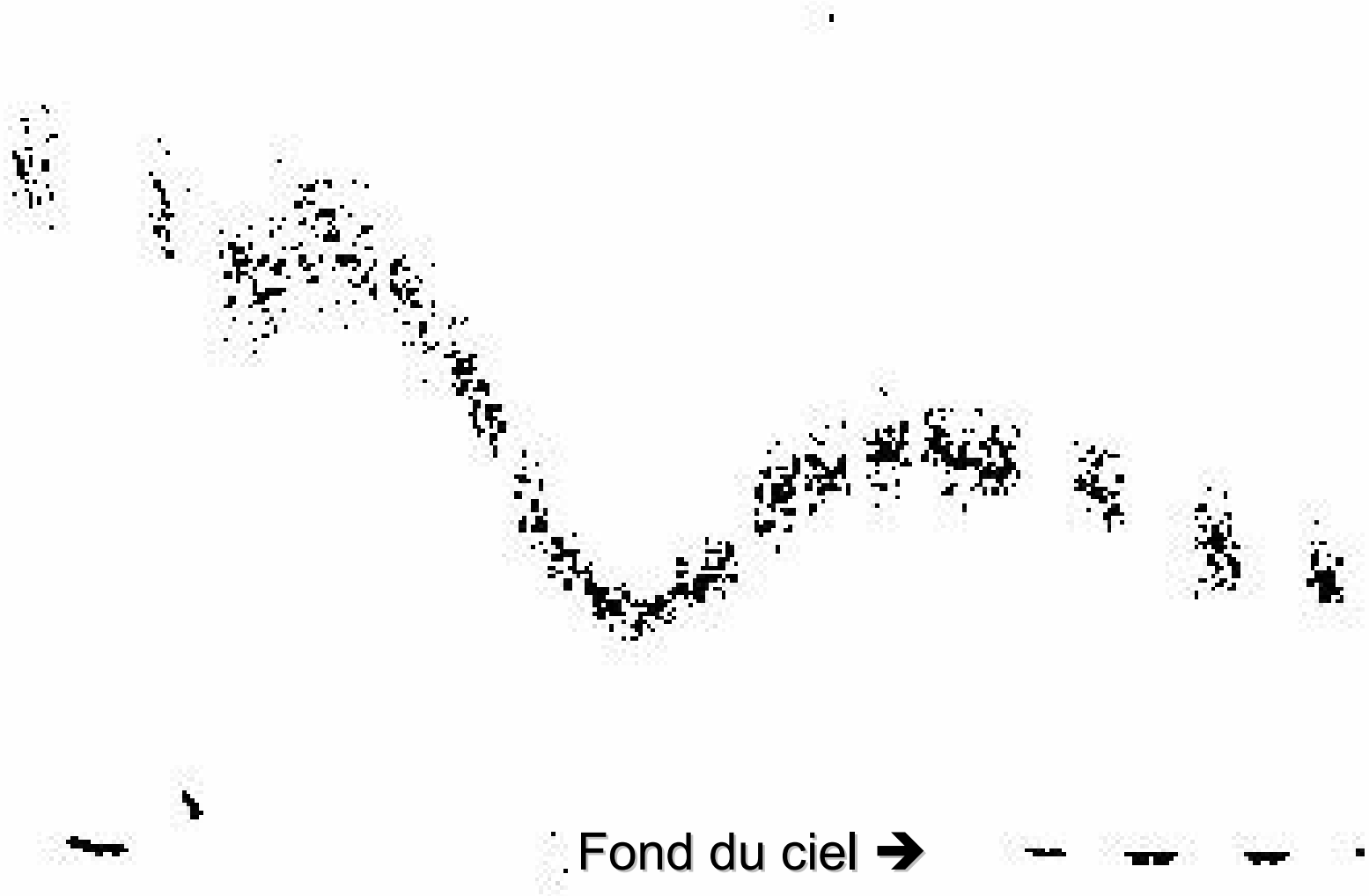
Les satellites galiléens

Un timing photométrique:
0,1 sec = 1 km
Une mesure astrométrique:
0.1 arcsec = 300 km

Les problèmes photométriques: le fond du ciel

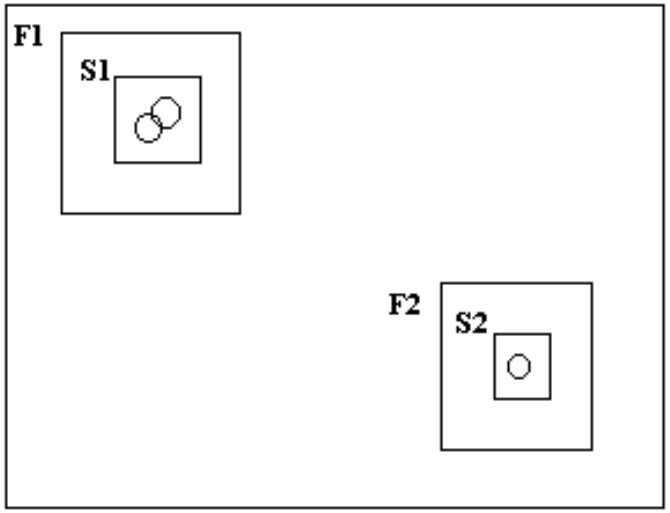


Les problèmes photométriques: l'absorption

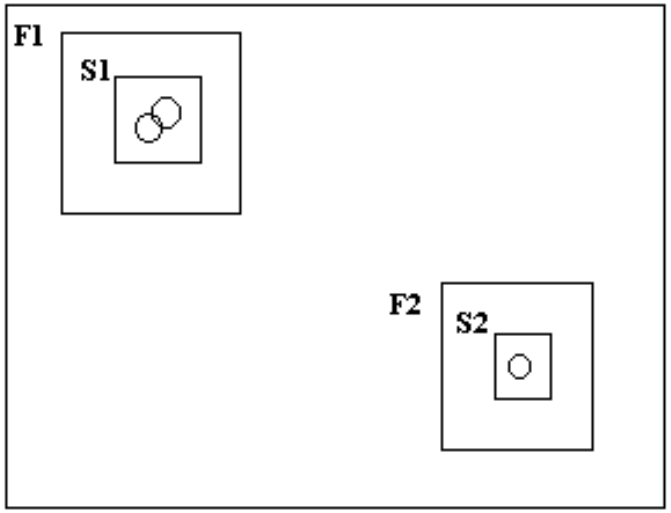


Corriger les problèmes de photométrie

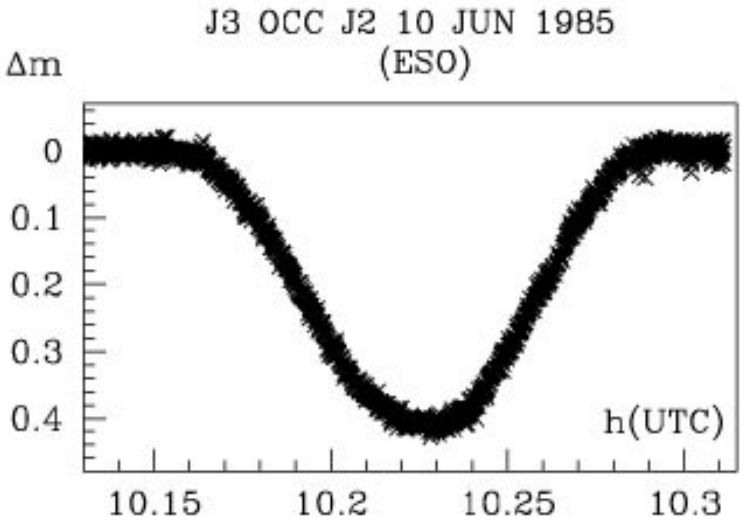
Intérêt de l'observation d'images CCD:
enregistrer un objet de référence constant avec les satellites occulté ou éclipsé



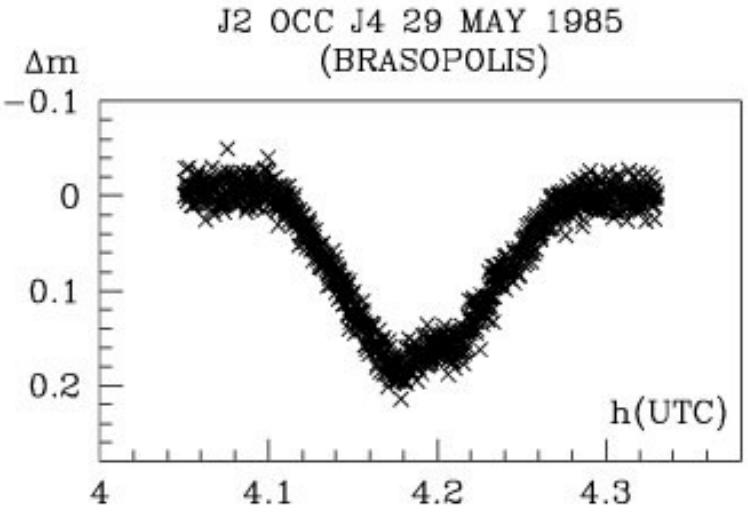
- If a reference object is present in the field (generally another Galilean satellites, rarely a bright solar-type reference), we will calculate its light flux for each image. This flux is supposed to be a constant. If Flux2 is the light flux of the reference object S2, the light flux of the occulted or eclipsed satellite S1 will be:
- **Flux of satellite S1 = (Flux1 / Flux2) * FM2**
- where FM2 is the average flux of reference S2 , used in order to normalized the calculated flux of S1.
- Then we obtain:
- **Flux of satellite S1 = ((S1/N1 - Fond1) / (S2/N2) - Fond2)) * FM2**
- This technique allows to observe events in difficult conditions: proximity of Jupiter (the background
- Fond1 and Fond2 may be very different), variation of the absorption or transit of light clouds
- (Flux1/Flux2 remains a constant), twilight (the sky background varies exponentially but is removed from each image).



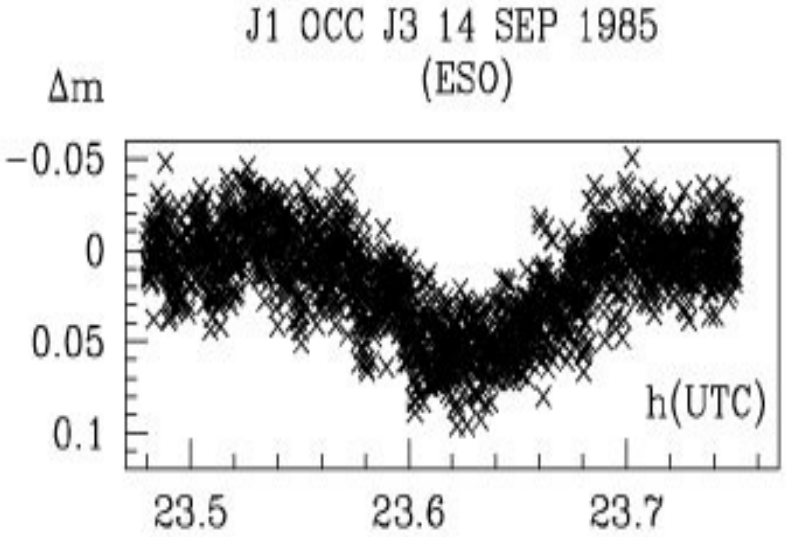
Exemples de courbes de lumière en V ou R



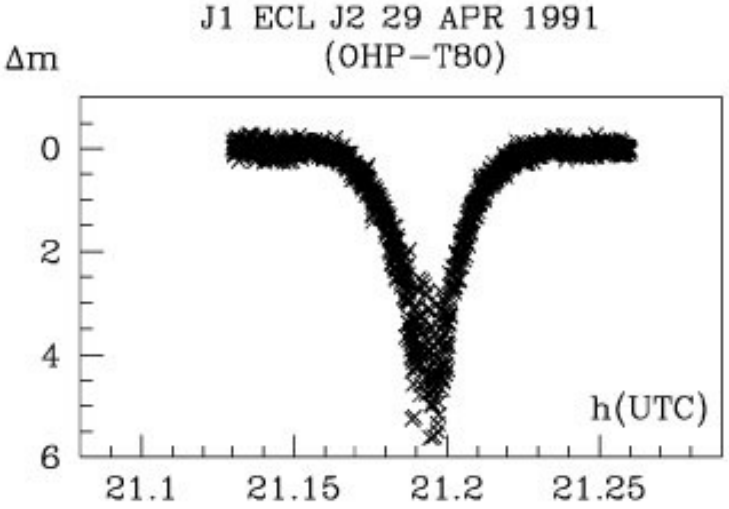
Courbe symétrique



Coube asymétrique

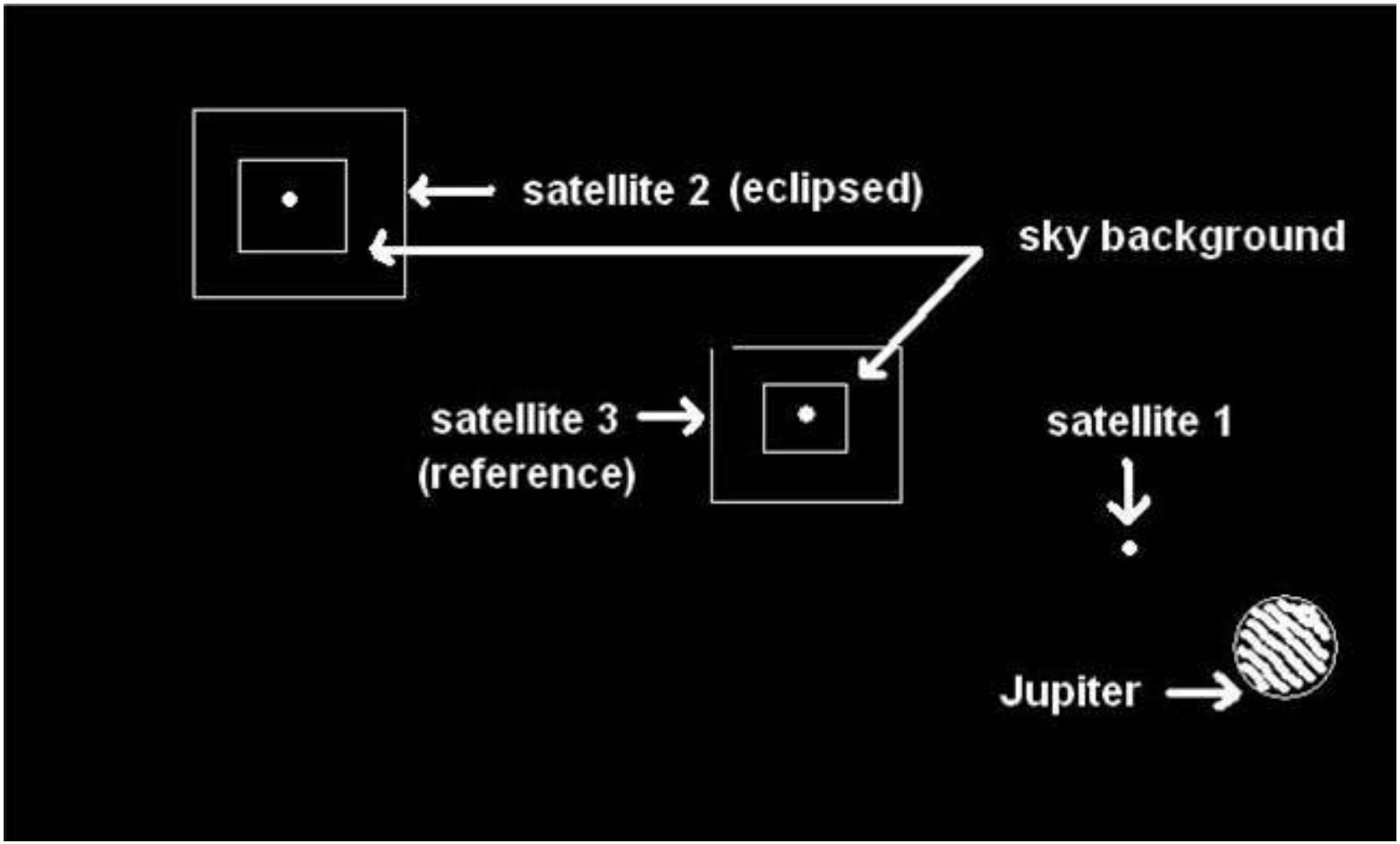


Phénomène rasant

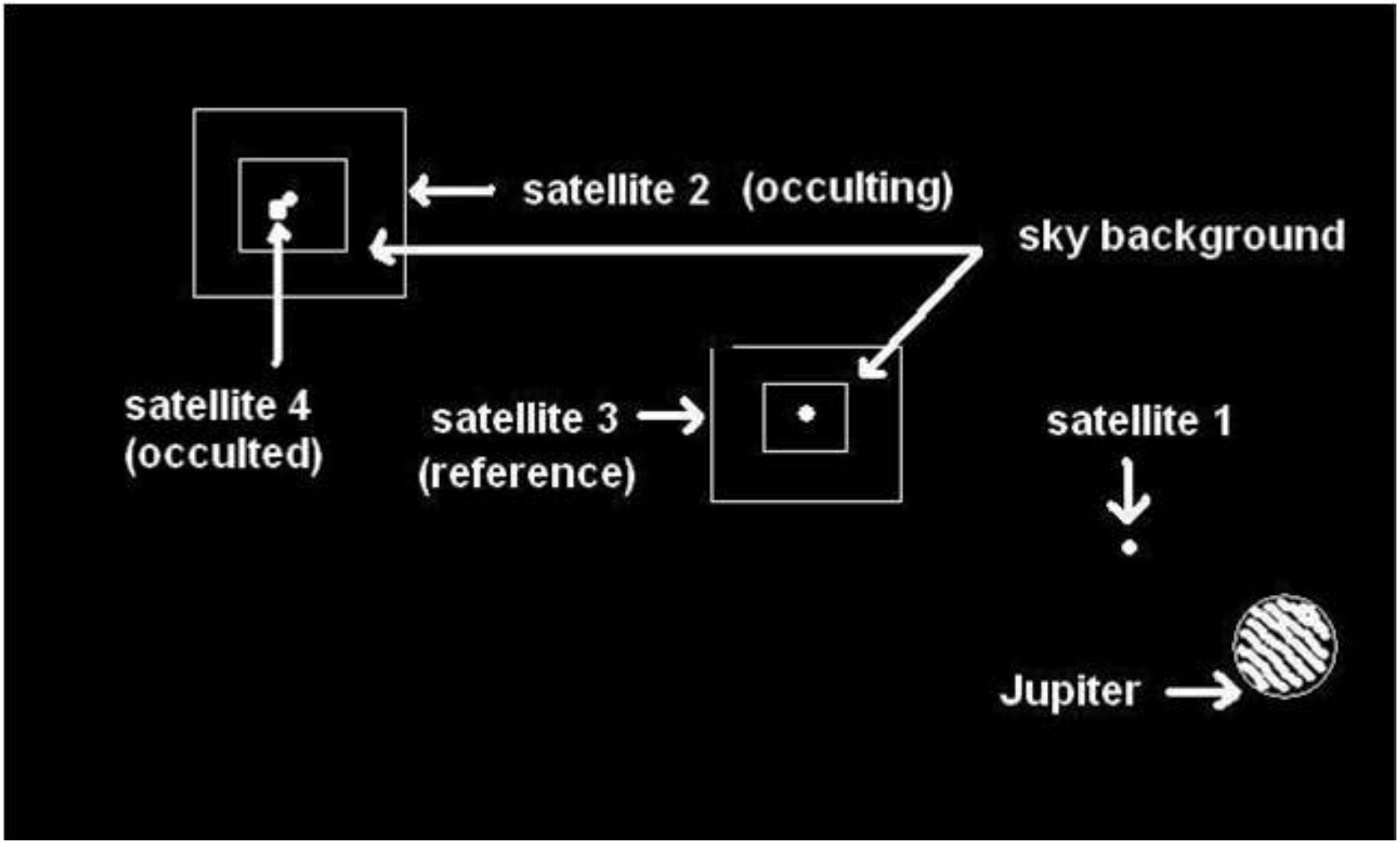


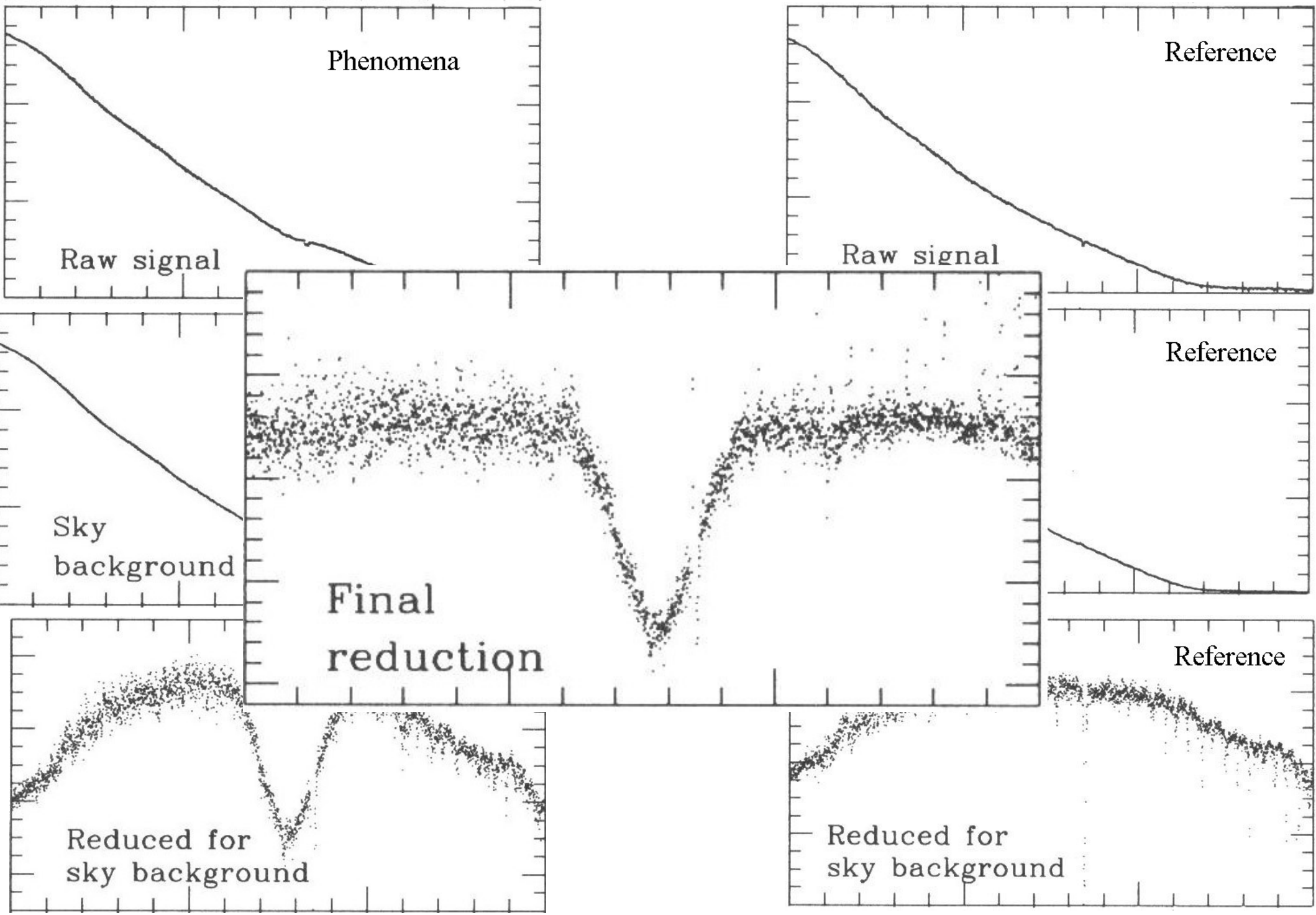
Phénomène total

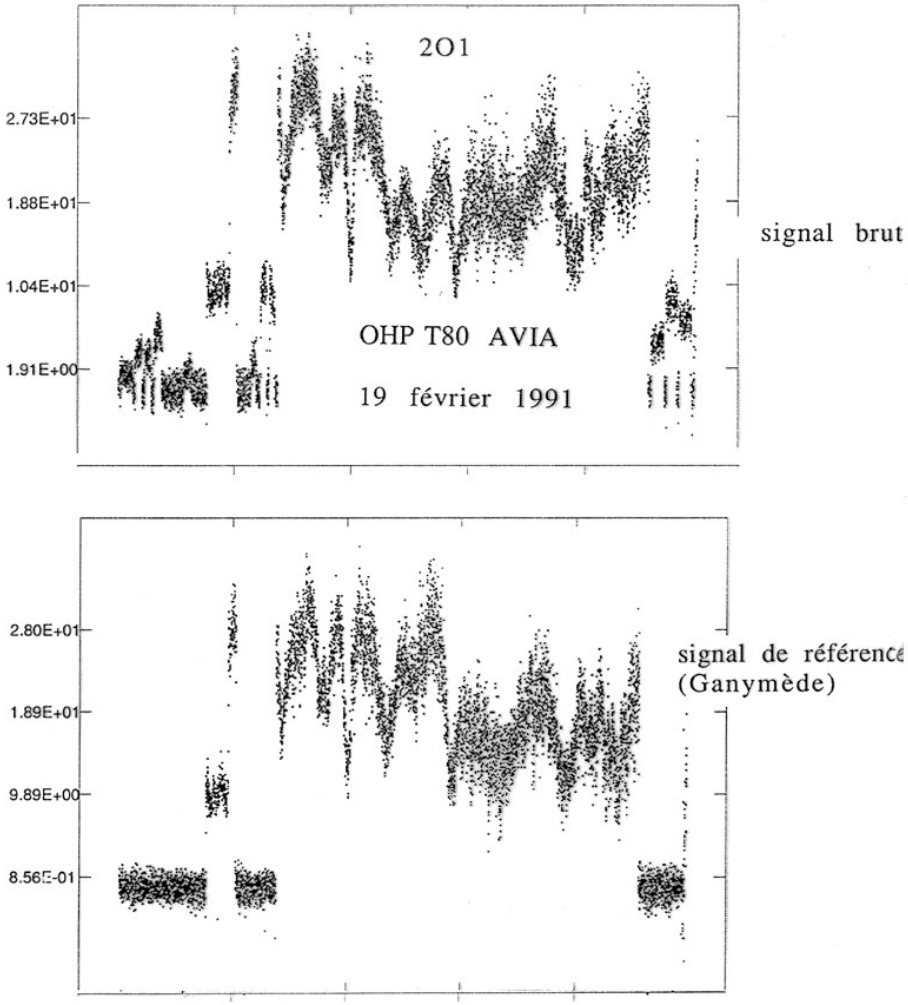
Une observation photométrique bi-dimensionnelle

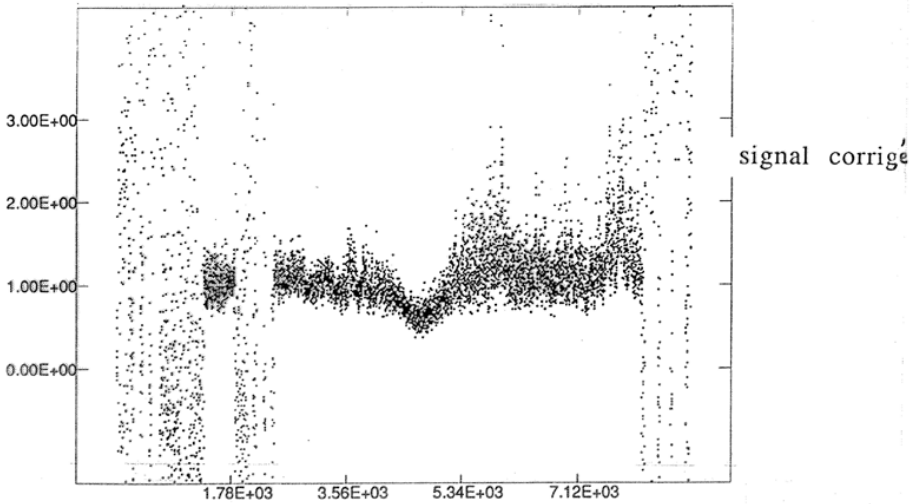


Une observation photométrique bi-dimensionnellle



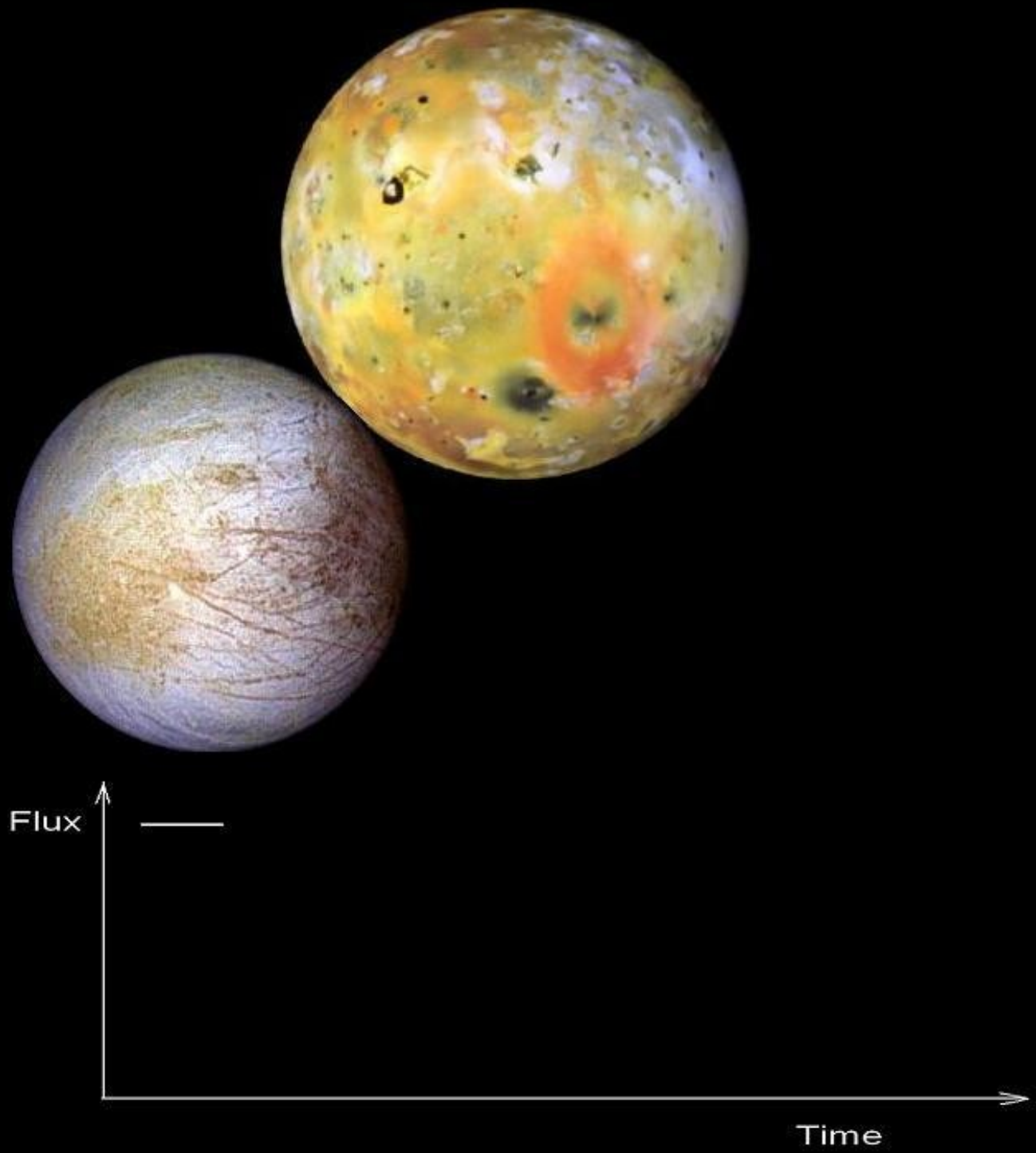

Phenomena
Raw signal
Reference
Raw signal
Sky
background
Final
reduction
Reference
Reference
Reduced for
sky background
Reduced for
sky background

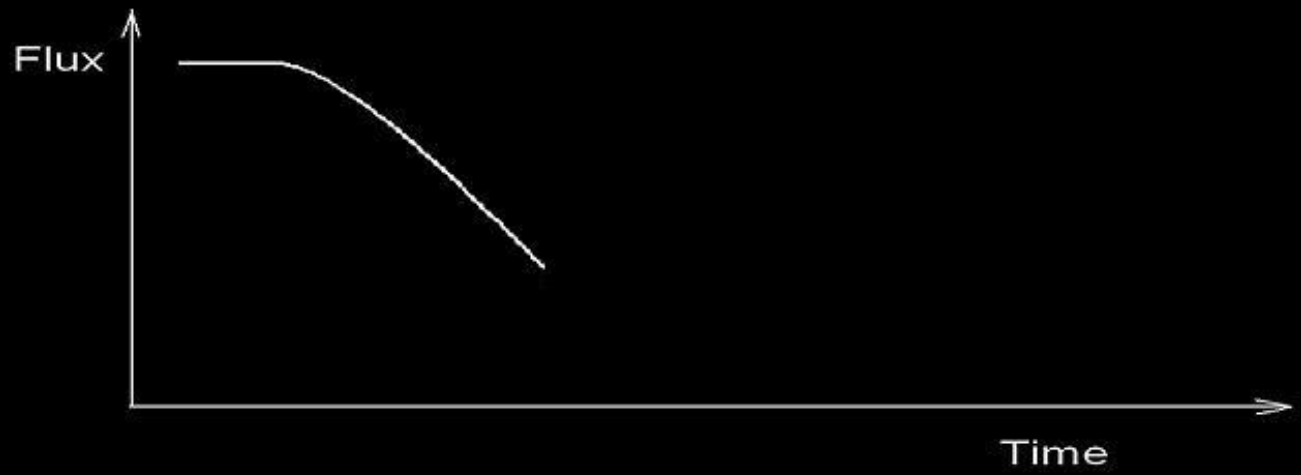


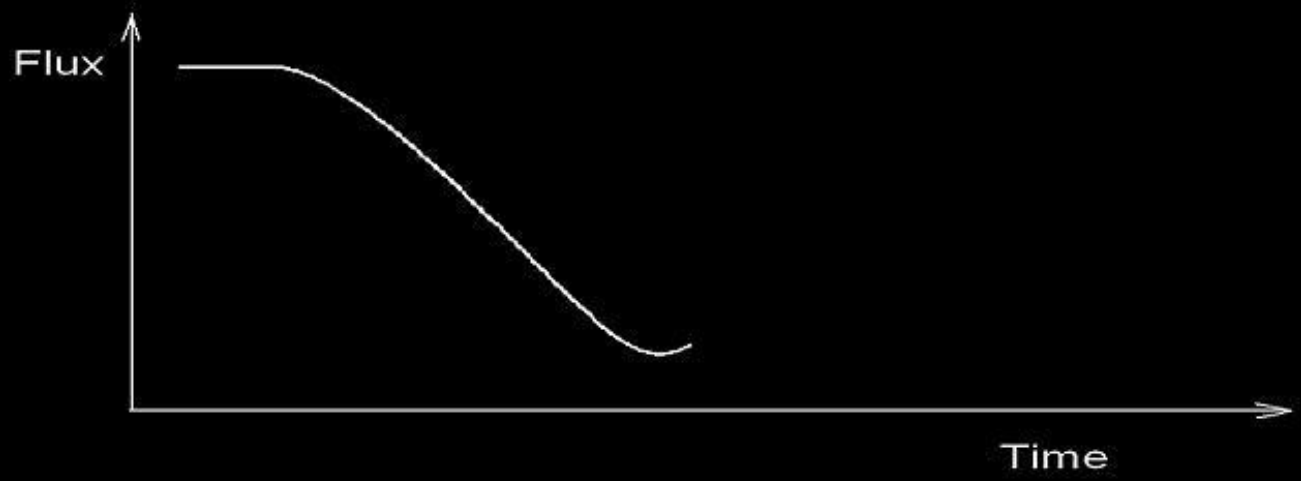


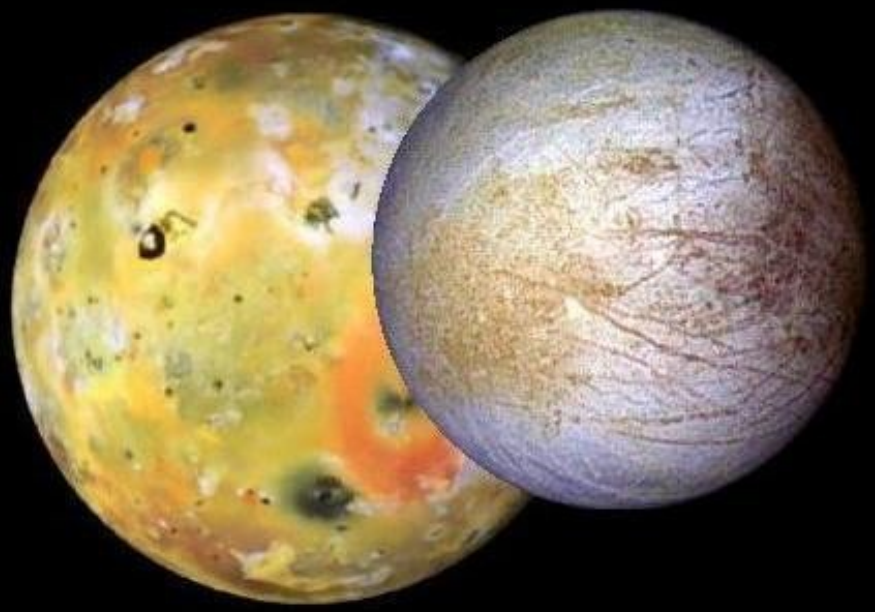
Un phénomène observé
à travers des nuages

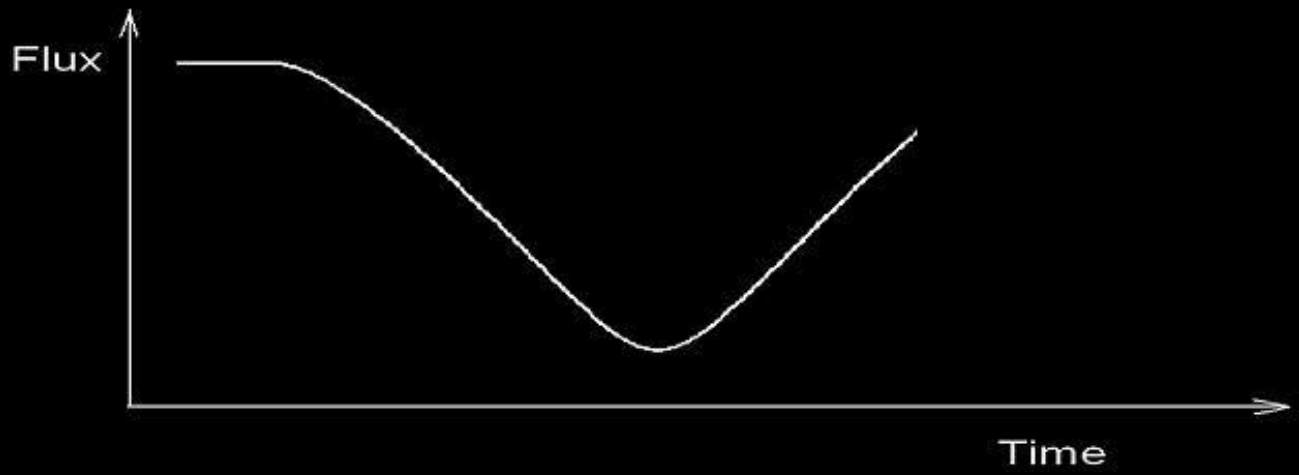
L’inversion de la courbe de lumière

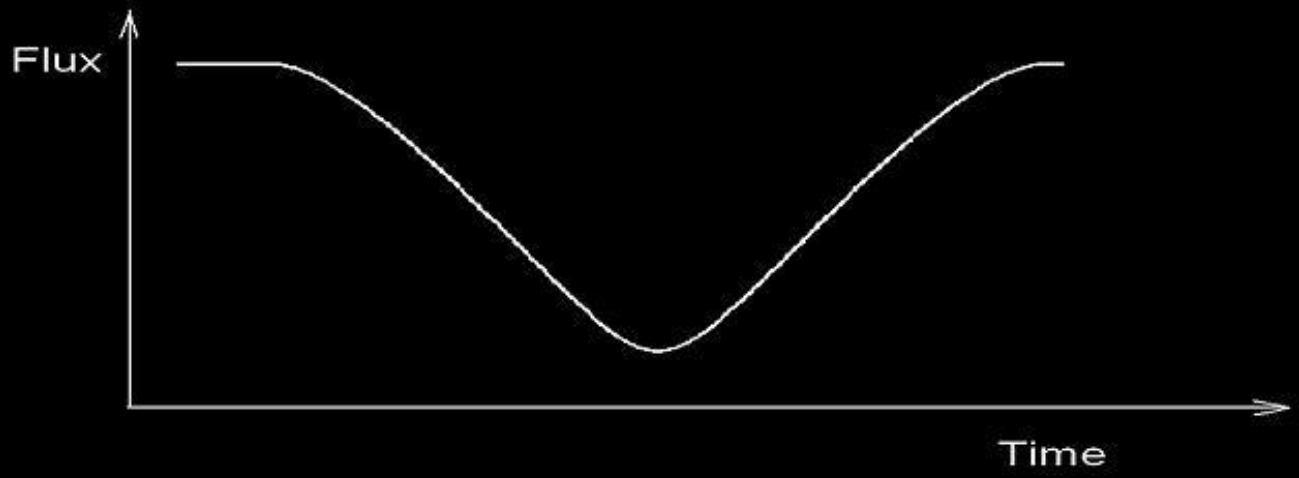

Flux
Time

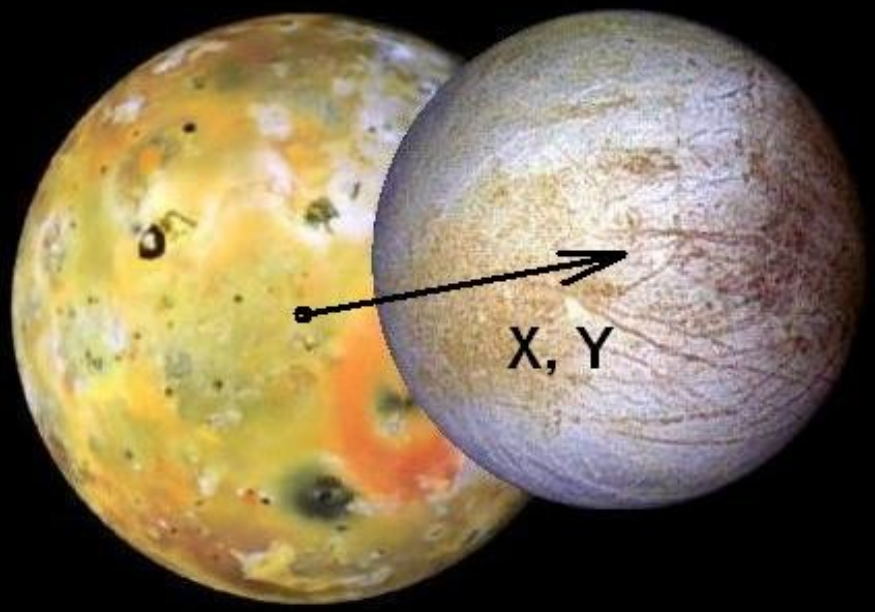

Flux
Time

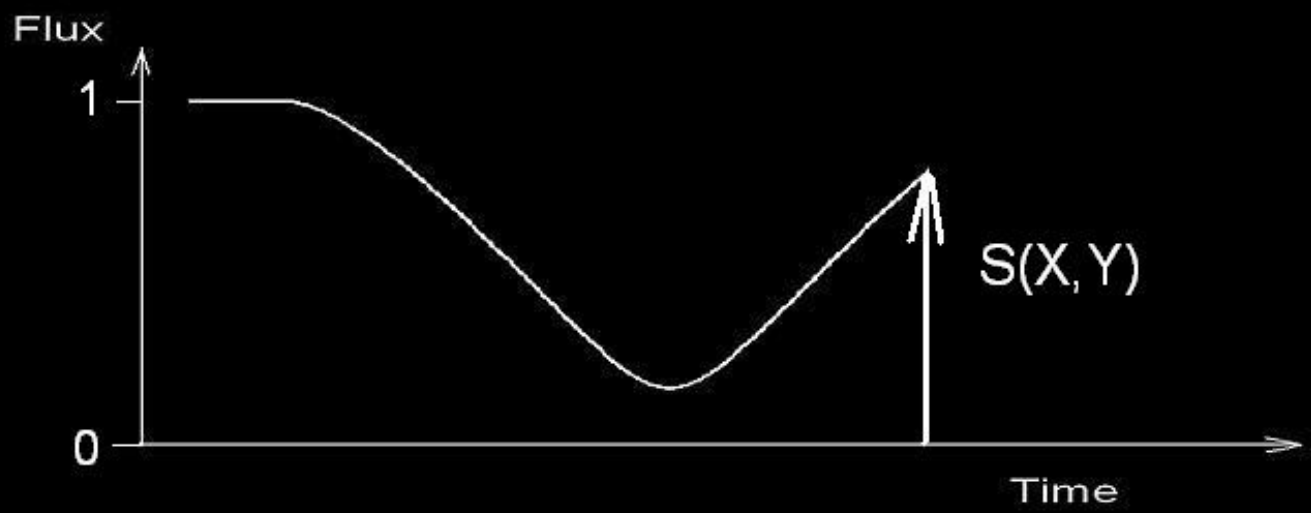

Flux
Time




Flux
Time


Flux
Time


X, Y


Flux
1
0
S(X,Y)
Time

Le modèle photométrique

L’extraction des paramètres astrométriques du flux observé

La fonction S(X,Y)

Une géométrie simple

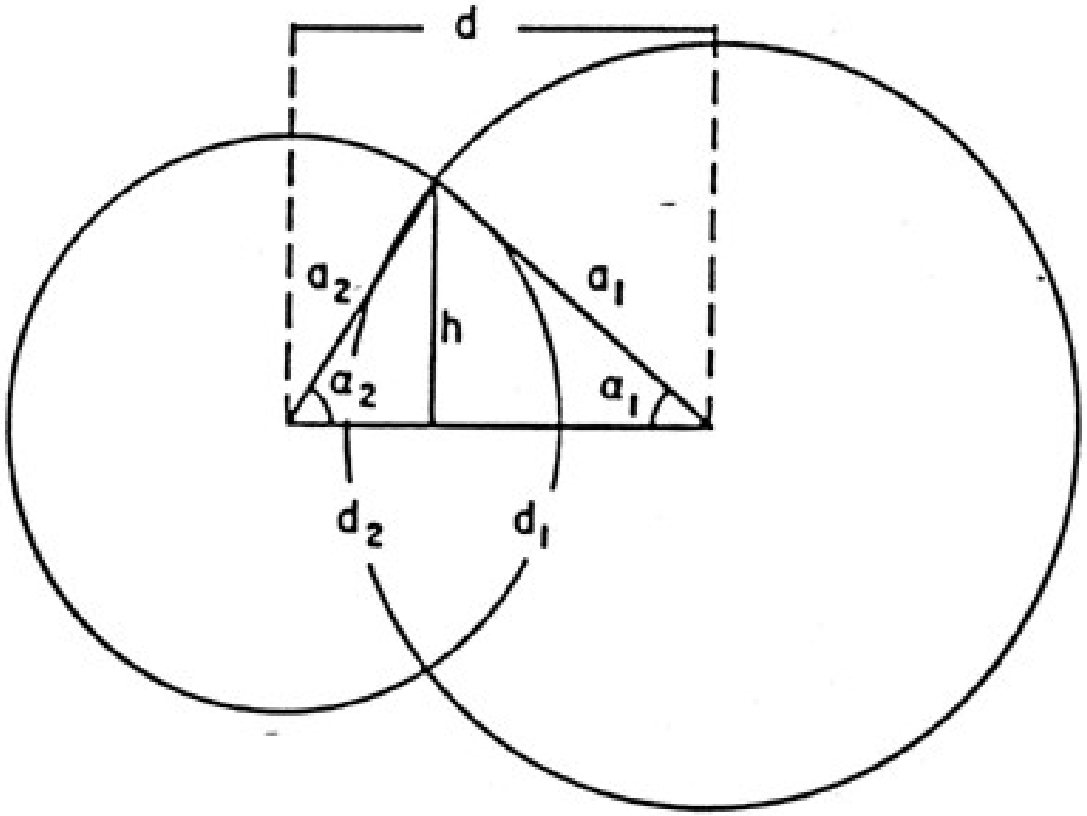
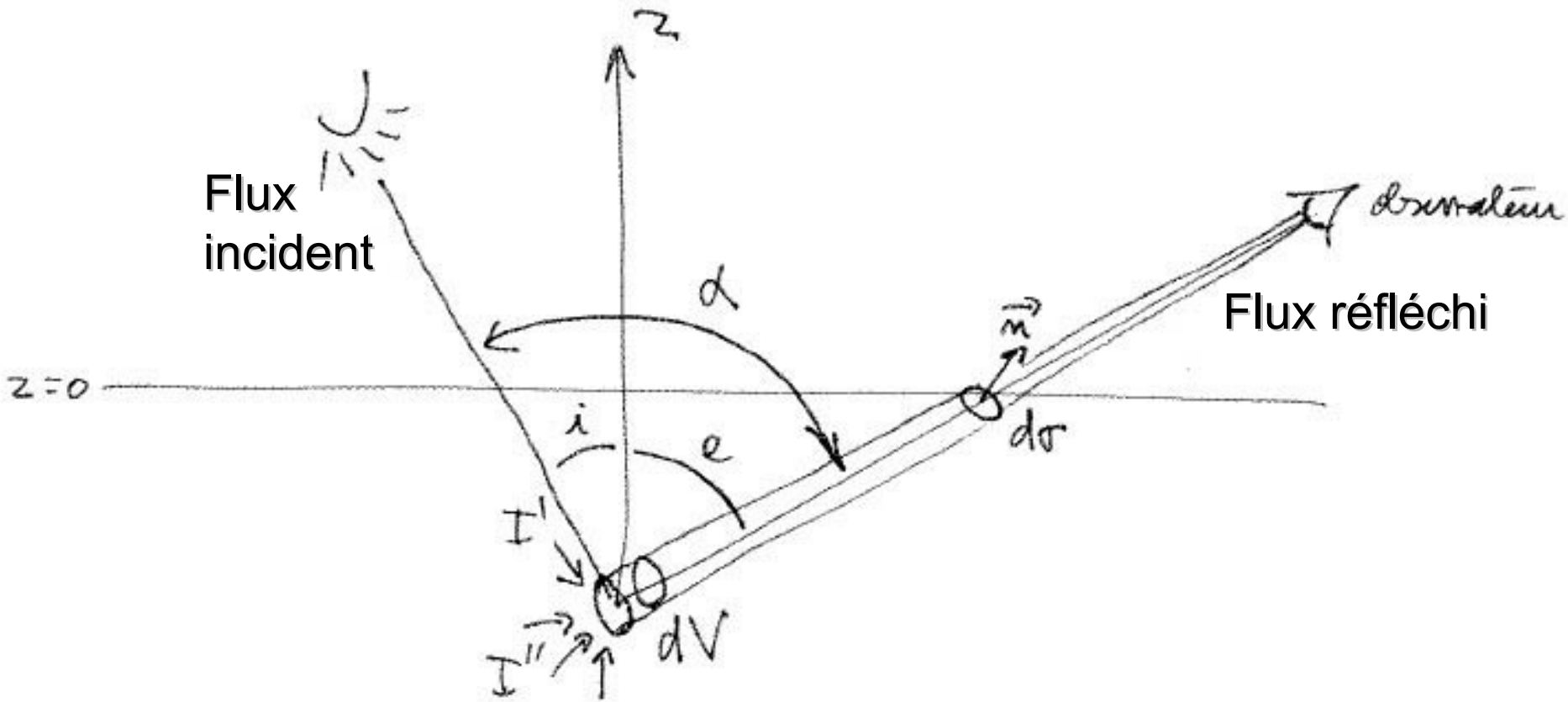


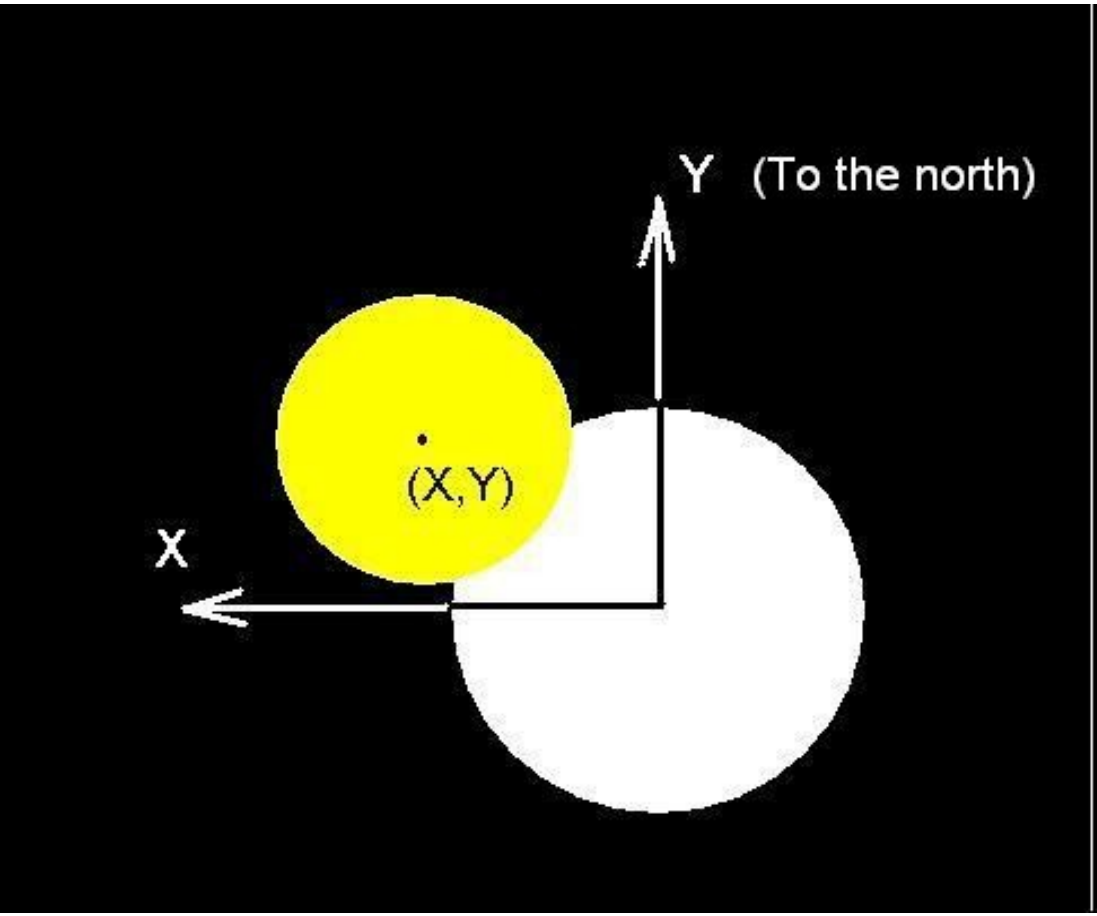
FIG. 1. Geometry of an occultation. Occulted area $= \alpha_1 a_1^2 + \alpha_2 a_2^2 - hd$.

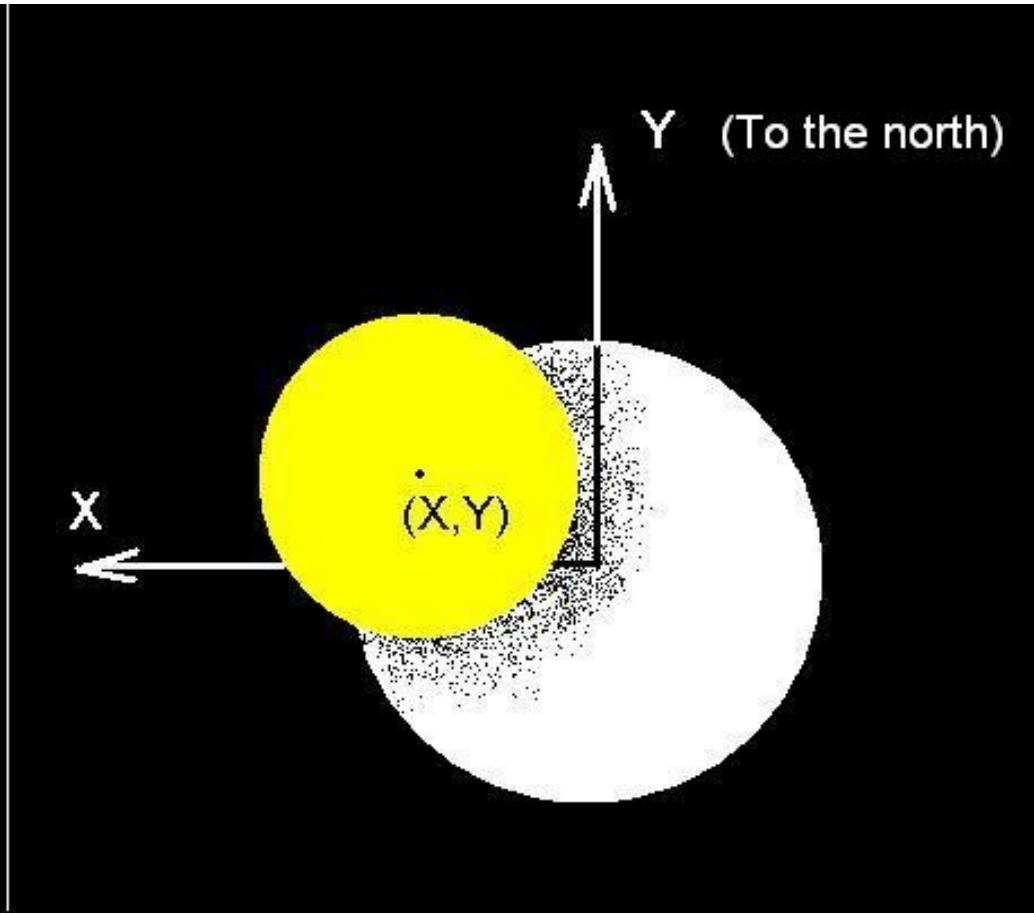
Loi de réflexion-diffusion



diffusion dans le milieu

Relative coordinate system (X, Y)

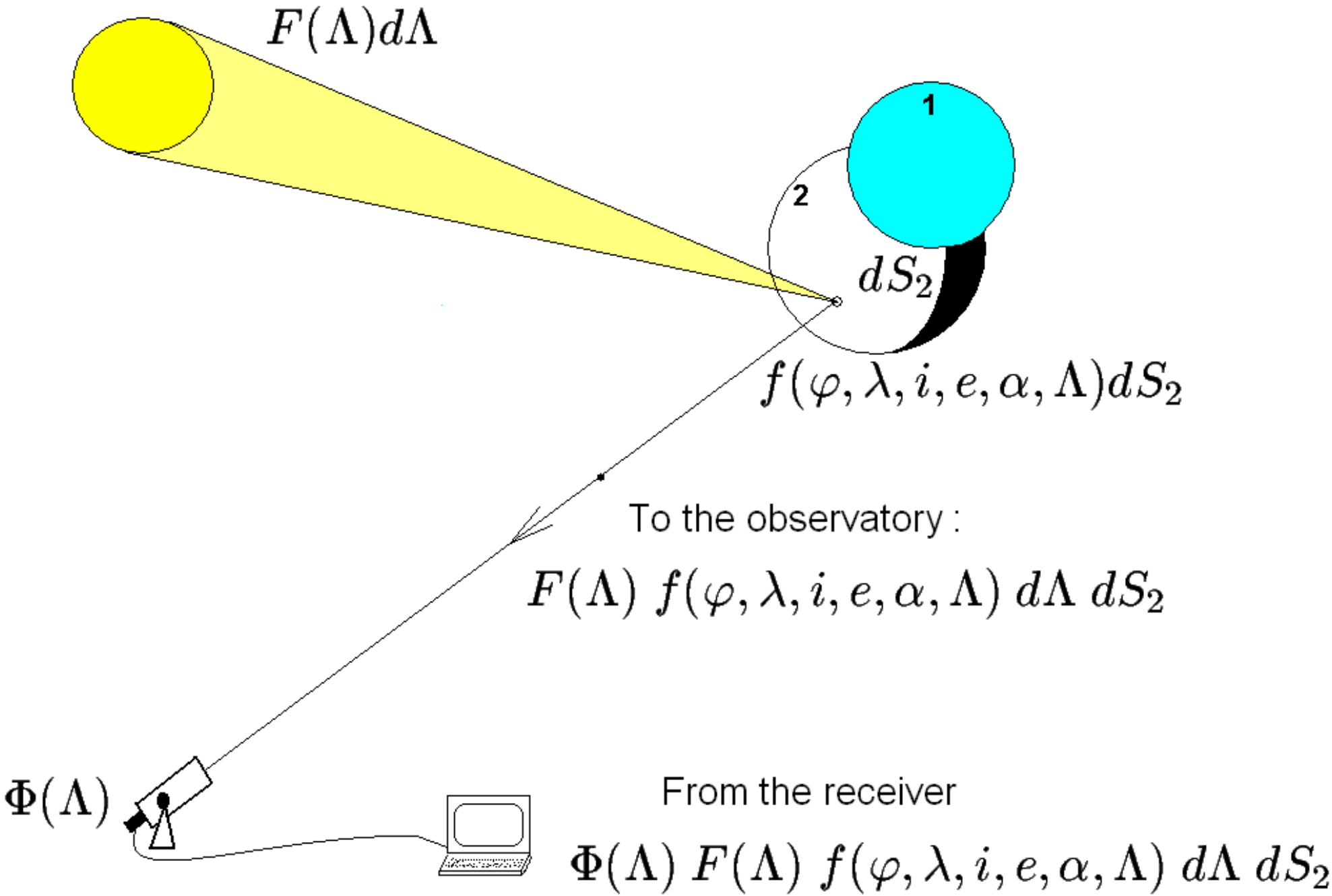


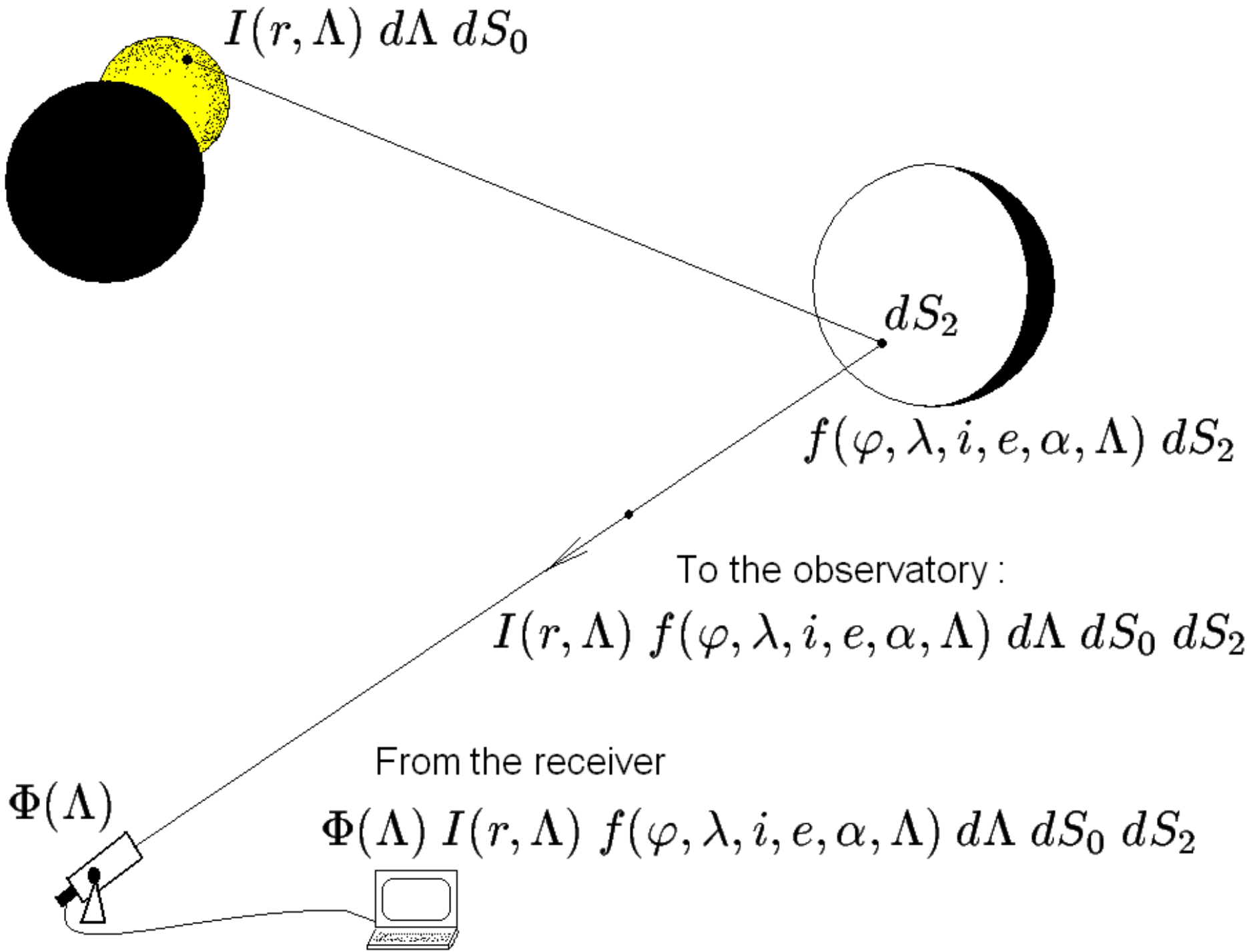


View from the Earth (mutual occultation)

View from the Sun (mutual eclipse)

$$X = \Delta\alpha \cos(\delta), \quad Y = \Delta\delta$$


$F(\Lambda)d\Lambda$
1
2
dS_2
$f(\varphi, \lambda, i, e, \alpha, \Lambda)dS_2$
To the observatory :
$F(\Lambda)\ f(\varphi, \lambda, i, e, \alpha, \Lambda)\ d\Lambda\ dS_2$
$\Phi(\Lambda)$
From the receiver
$\Phi(\Lambda)\ F(\Lambda)\ f(\varphi, \lambda, i, e, \alpha, \Lambda)\ d\Lambda\ dS_2$

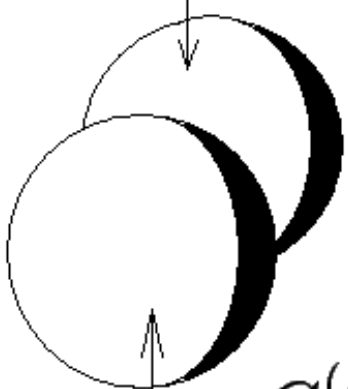

$I(r,\Lambda)\ d\Lambda\ dS_0$
dS_2
$f(\varphi,\lambda,i,e,\alpha,\Lambda)\ dS_2$
To the observatory :
$I(r,\Lambda)\ f(\varphi,\lambda,i,e,\alpha,\Lambda)\ d\Lambda\ dS_0\ dS_2$
From the receiver
$\Phi(\Lambda)$
$\Phi(\Lambda)\ I(r,\Lambda)\ f(\varphi,\lambda,i,e,\alpha,\Lambda)\ d\Lambda\ dS_0\ dS_2$

Mutual occultation

$G_{\underline{\underline{b}}}^{(p)}$ outside of the event

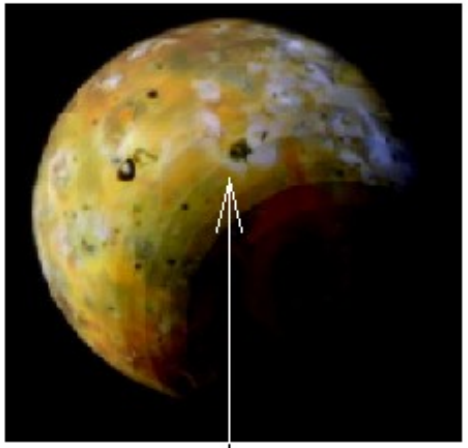
$$S = \frac{G_b^{(a)} + G^{(p)}}{G_b^{(a)} + G_b^{(p)}} = \frac{1 + \frac{G^{(p)}}{G_b^{(a)}}}{1 + \frac{G_b^{(p)}}{G_b^{(a)}}}$$

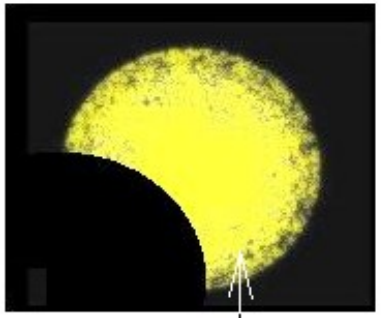
$$G^{(p)} = \int_{S_2} \int_{\Lambda_1}^{\Lambda_2} \Phi(\Lambda)\, F(\Lambda)\, f_2(\varphi, \lambda, i, e, \alpha, \Lambda)\, d\Lambda\, dS_2$$



$$G^{(a)} = \int_{S_1} \int_{\Lambda_1}^{\Lambda_2} \Phi(\Lambda)\, F(\Lambda)\, f_1(\varphi, \lambda, i, e, \alpha, \Lambda)\, d\Lambda\, dS_1$$

Mutual eclipse





$$G^{(p)} = \int_{S_2} \int_{\Lambda_1}^{\Lambda_2} \Phi(\Lambda)\, f(\varphi, \lambda, i, e, \alpha, \Lambda) \int_{S_0} I(r, \Lambda)\, dS_0\, d\Lambda\, dS_2$$

$G_{\underline{\underline{b}}}^{(p)}$ outside of the event $\Rightarrow$

$$S = \frac{G^{(p)}}{G_b^{(p)}}$$

Photometric function

$$f(\varphi, \lambda, i, e, \alpha, \Lambda) = R(\alpha, i\ , e\ , \Lambda)\ A(\theta, \Lambda)$$

$\Downarrow$

θ - rotation angle

Groundbased photometry

Morrison, D., Morrison, N. D., 1977.

Photometric function:

1. Lommel-Seeliger's law + albedo(α, Λ)
2. Hapke's reflectance function
   + Hapke's parameters $\longrightarrow$ McEven et al. (1988) for Io
   Domingue and Verbicer (1997)
   (V and B bands only)
   for another satellites

α - phase angle
i - incidence angle
e - reflectance angle
φ, λ - cartographic coordinates
Λ - wavelength

Two methods

Vasundhara (2003): $\cdot\, A(\varphi, \lambda, \Lambda)$

$\Downarrow$

satellite surface mapping

http://jupiter.berkeley.edu/maps/

Emelianov (2008): $A(\theta, \Lambda)$

$\downarrow$ θ - rotation angle

Groundbased photometry

Morrison, D., Morrison, N. D., 1977.

Photometric function

$$f(\varphi, \lambda, i, e, \alpha, \Lambda) = R(\alpha, i\ , e\ , \Lambda) \cdot A(\varphi, \lambda, \Lambda)$$

$\Downarrow$

satellite surface mapping
http://jupiter.berkeley.edu/maps/

$\Downarrow$

Photometric function:

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   for another satellites

α - phase angle
i - incidence angle
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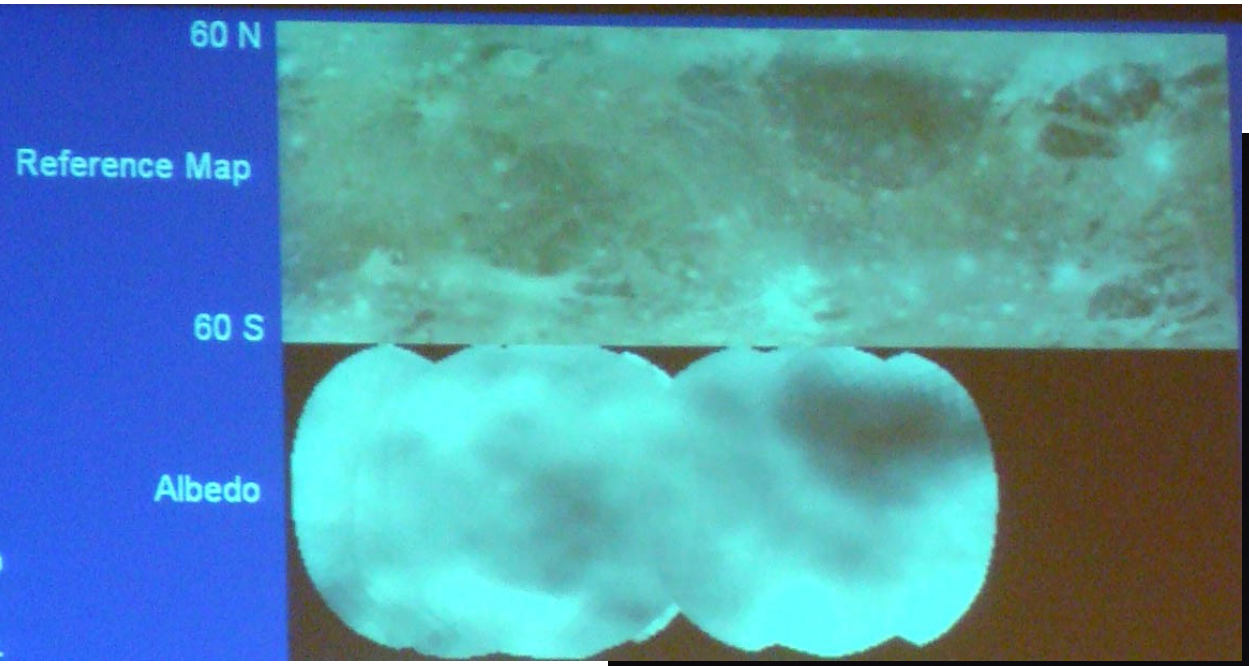
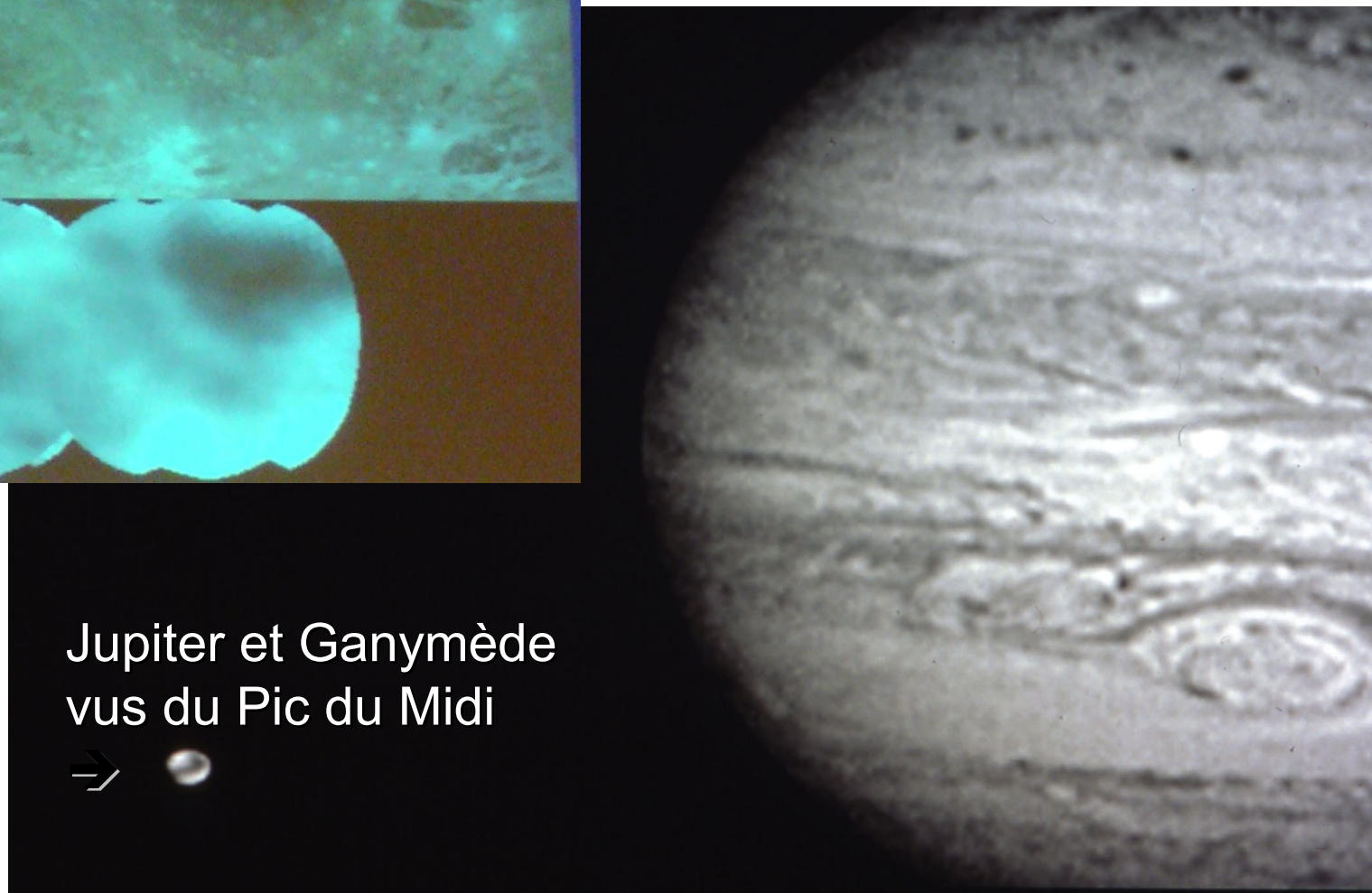
φ, λ - cartographic coordinates
Λ - wavelength

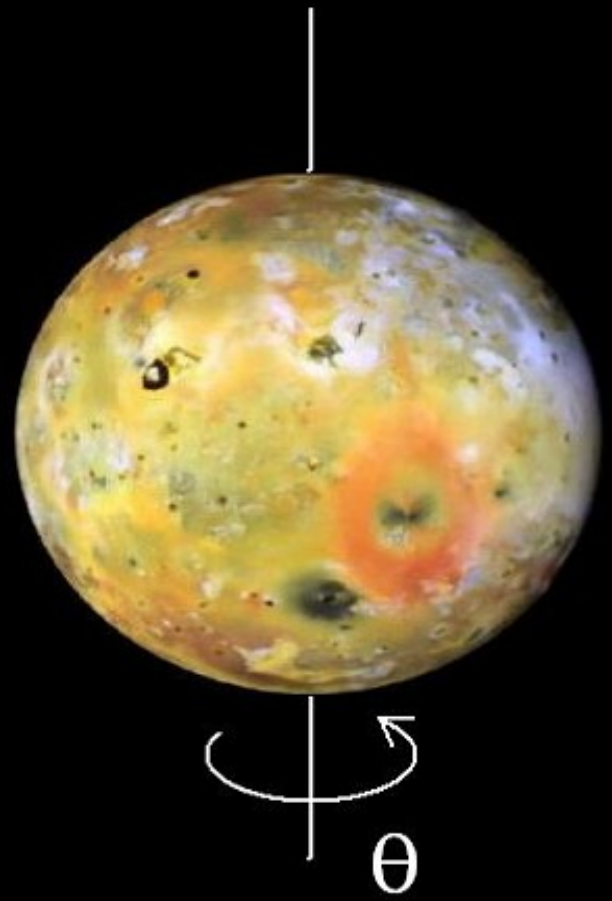
Augmenter la précision:
la surface des satellites n'est pas uniforme

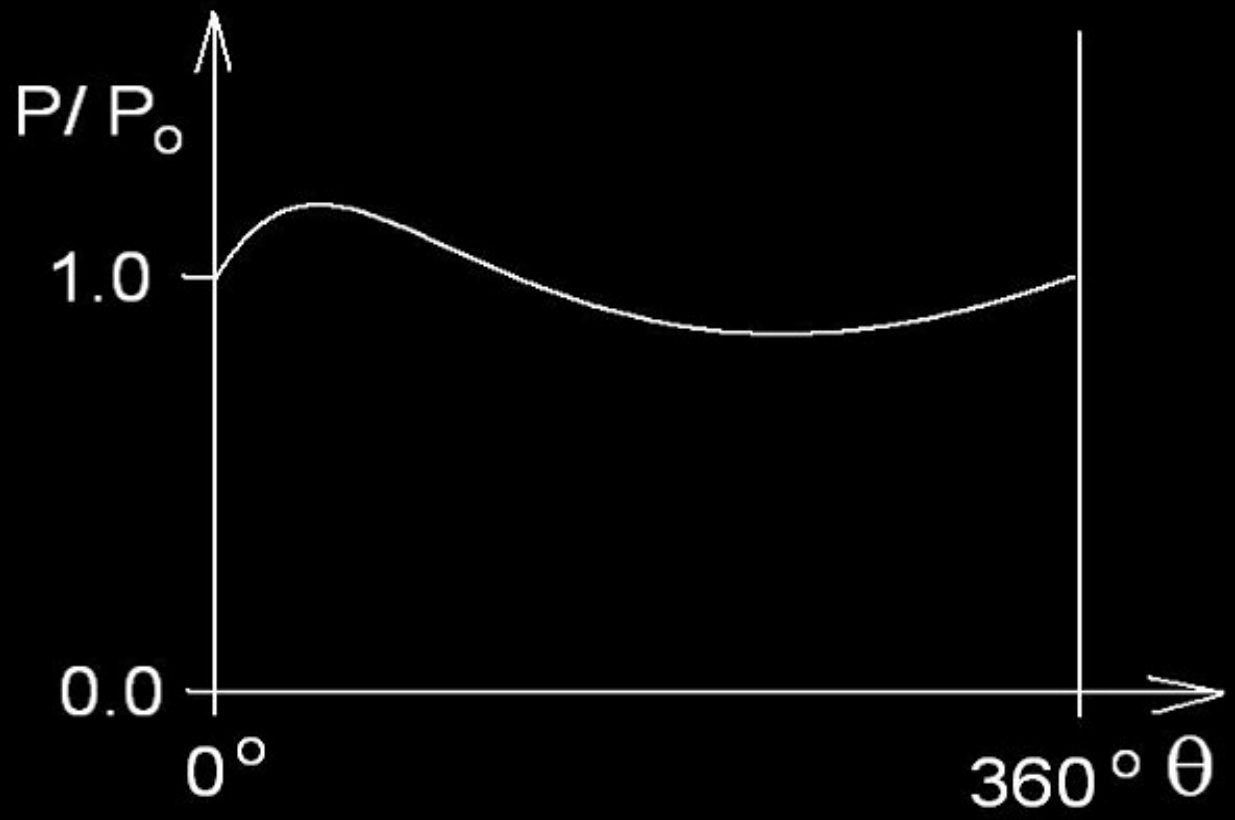
·Pour les objets « étendus » (de diamètre apparent supérieur à 0.5 arcsec), on peut améliorer la correction photocentre-centre de masse grâce à des cartes d'albédos et à une modélisation de la phase (60 mas maximum pour Ganymède)



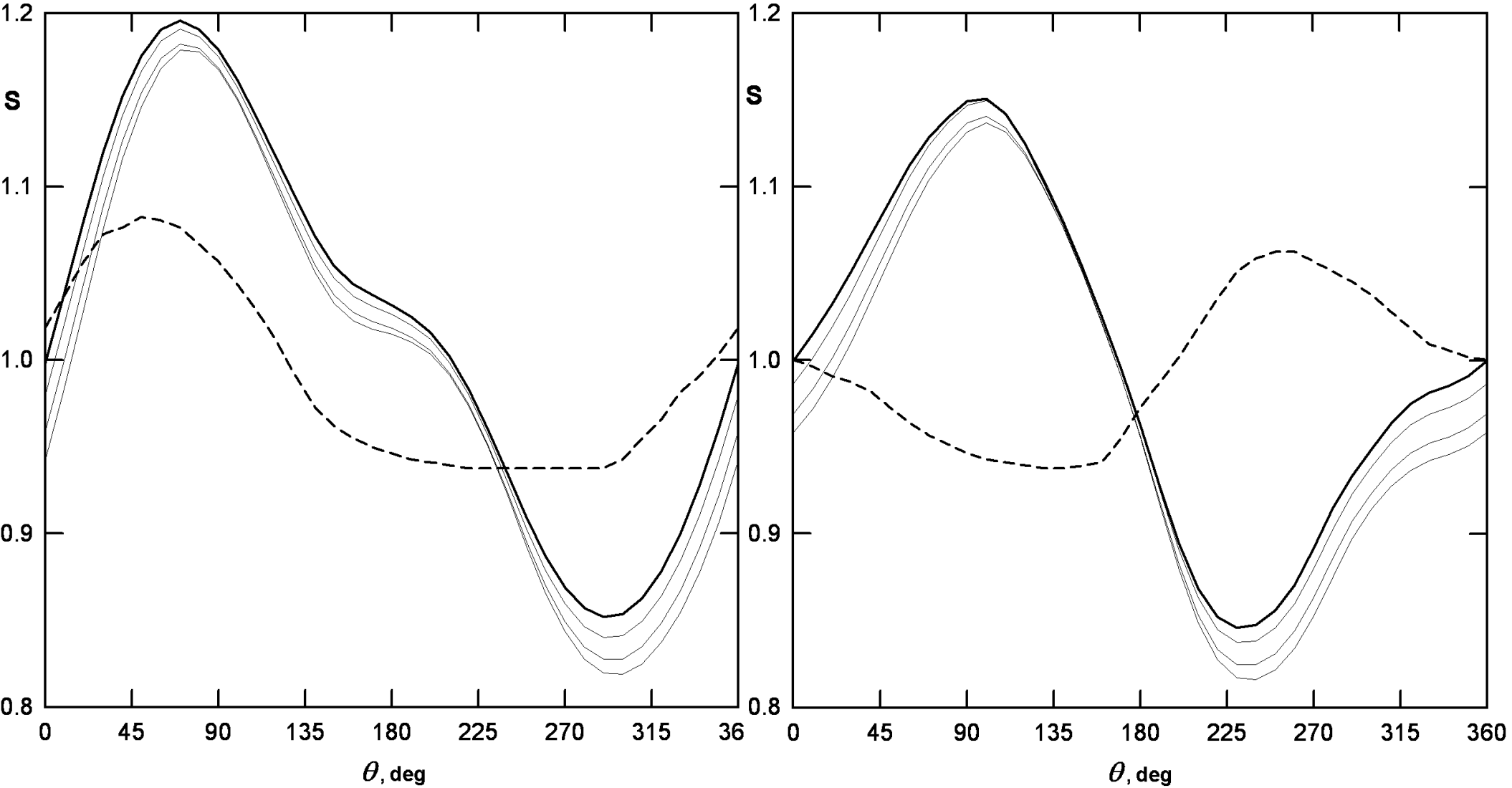


La fonction photométrique



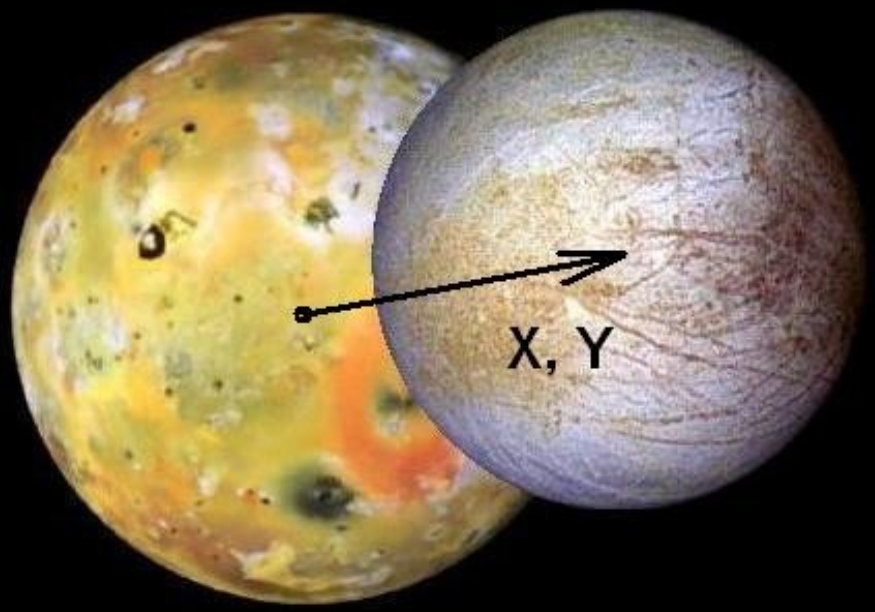


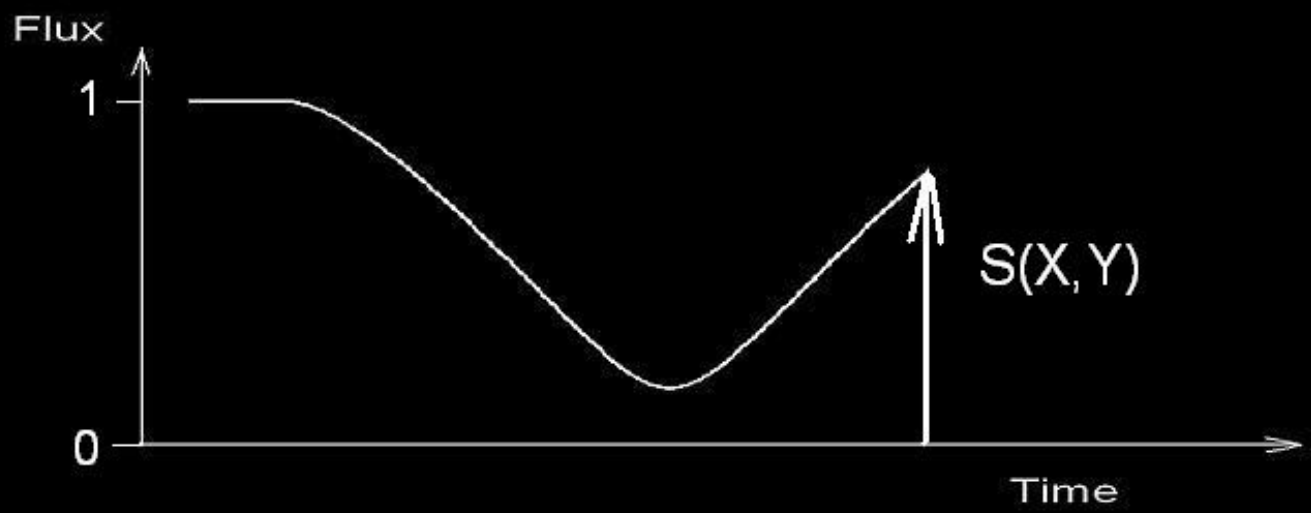
P(**θ**) - the integrated albedo of the satellite



The integrated brightness of the satellite Ganymede (at left) and Callisto (at right) as a function of the angle of rotation based on the surface maps (lines for different phase angles) and the results of ground-based photometry (dashed line).

Morrison, D., Morrison, N. D., 1977. Photometry of the Gallilean satellites, in Planetary satellites. Tucson, University of Arizona Press. 363.


X, Y


Flux
1
0
S(X,Y)
Time

Méthode de réduction

Réaction du recepteur

$$E(t) = K \cdot S(X(t), Y(t))$$

Intensivité de la lumière:
- de deux satellites (occultation)
- du satellite eclipsé (eclipse)

$S = 1$ hors du phénomène

Option: $$E(t) = K \cdot S(X(t), Y(t)) + P$$

Méthode de réduction

$$X(t) = X^{th}(t) + D_x(t) \ ,$$

$$Y(t) = Y^{th}(t) + D_y(t) \ .$$

$$\boxed{\begin{aligned} X(t) &= X^{th}(t) + \overline{D}_x \ , \\ Y(t) &= Y^{th}(t) + \overline{D}_y \ . \end{aligned}}$$

$$\boxed{E(t) = K \cdot S(X^{th}(t) + \overline{D}_x, \ Y^{th}(t) + \overline{D}_y) + P}$$

Les équations de condition (par rapport à $K, P, \overline{D}_x, \overline{D}_y$):

$E(t_i) = K \cdot S(X^{th}(t_i) + \overline{D}_x, \ Y^{th}(t_i) + \overline{D}_y) + P$

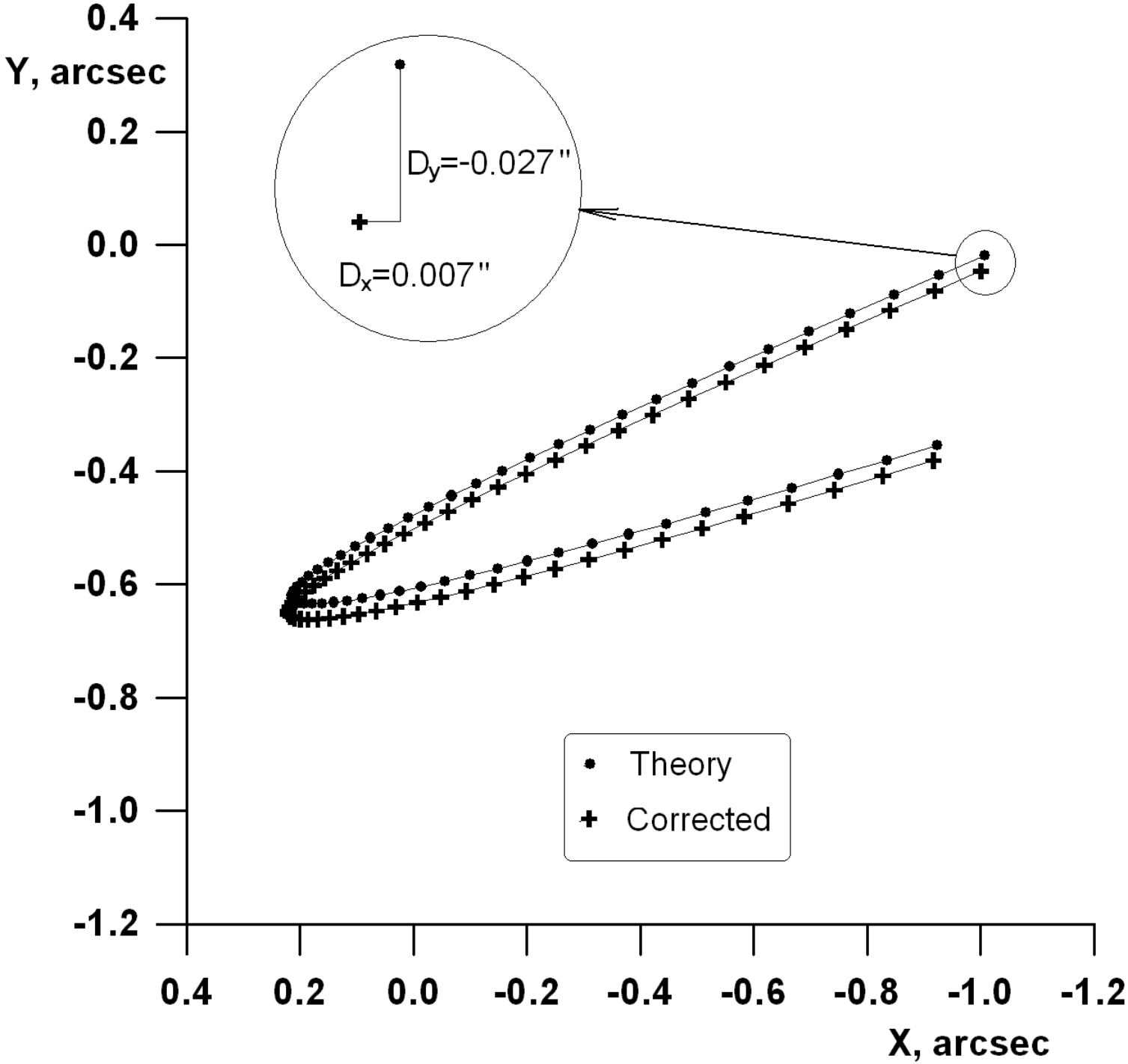
$(i = 1, 2, ..., m)$

Une fois resolues, on a le resultat astrométrique:

$X(t^*) = X^{th}(t^*) + \overline{D}_x, \quad Y(t^*) = Y^{th}(t^*) + \overline{D}_y$

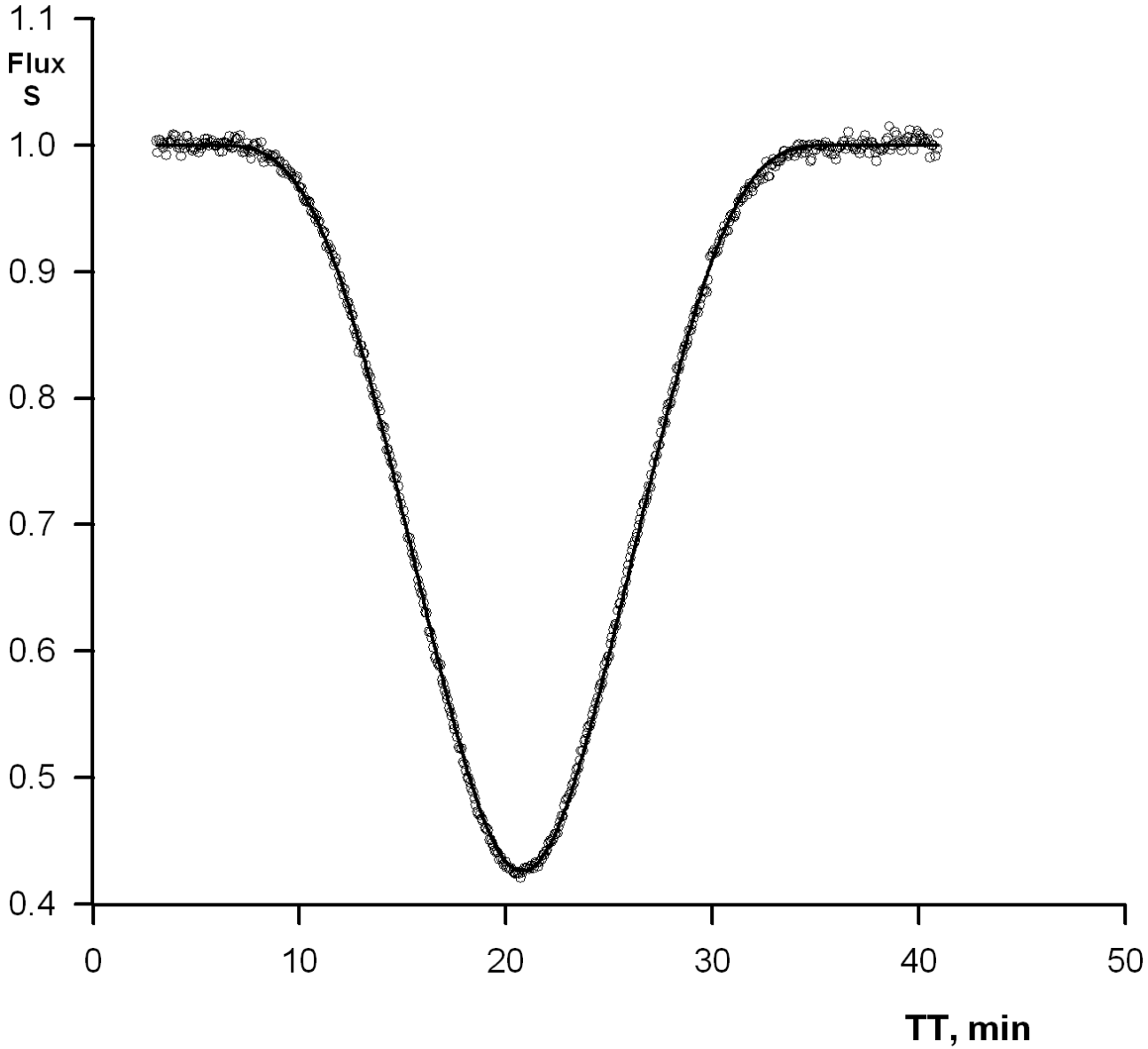
t^* **- arbitraire**

$\sigma_x = \sigma[D_x] = \sigma[X(t^*)] \quad \sigma_y = \sigma[D_y] = \sigma[Y(t^*)]$



Corrected apparent motion of Europa relative to Io

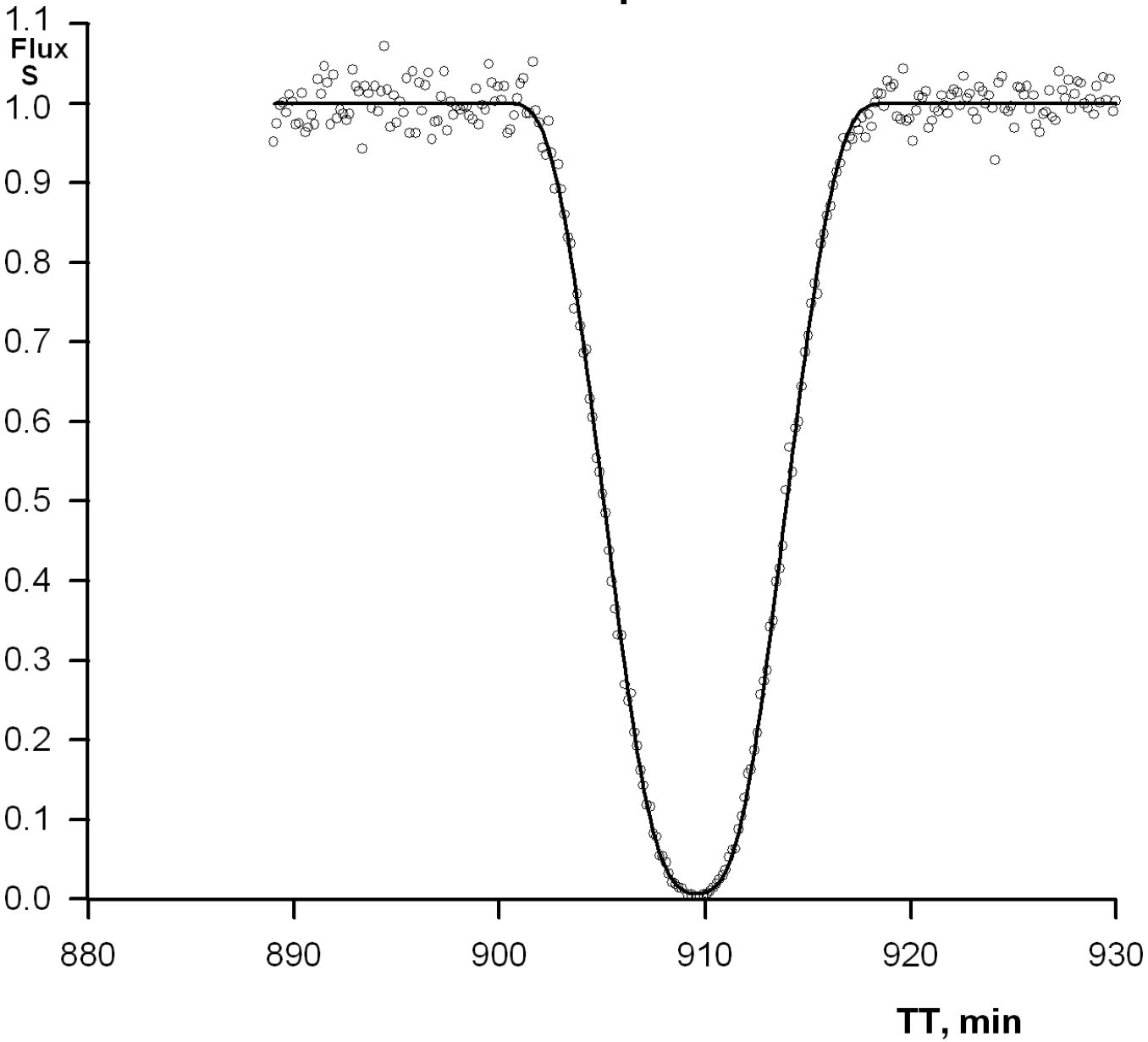
Exemples



1997.08.01 4e3 Tenerife σ_x = 0.0005" σ_y = 0.0006"

O-C_x = 0.0380" O-C_y= -0.0260"

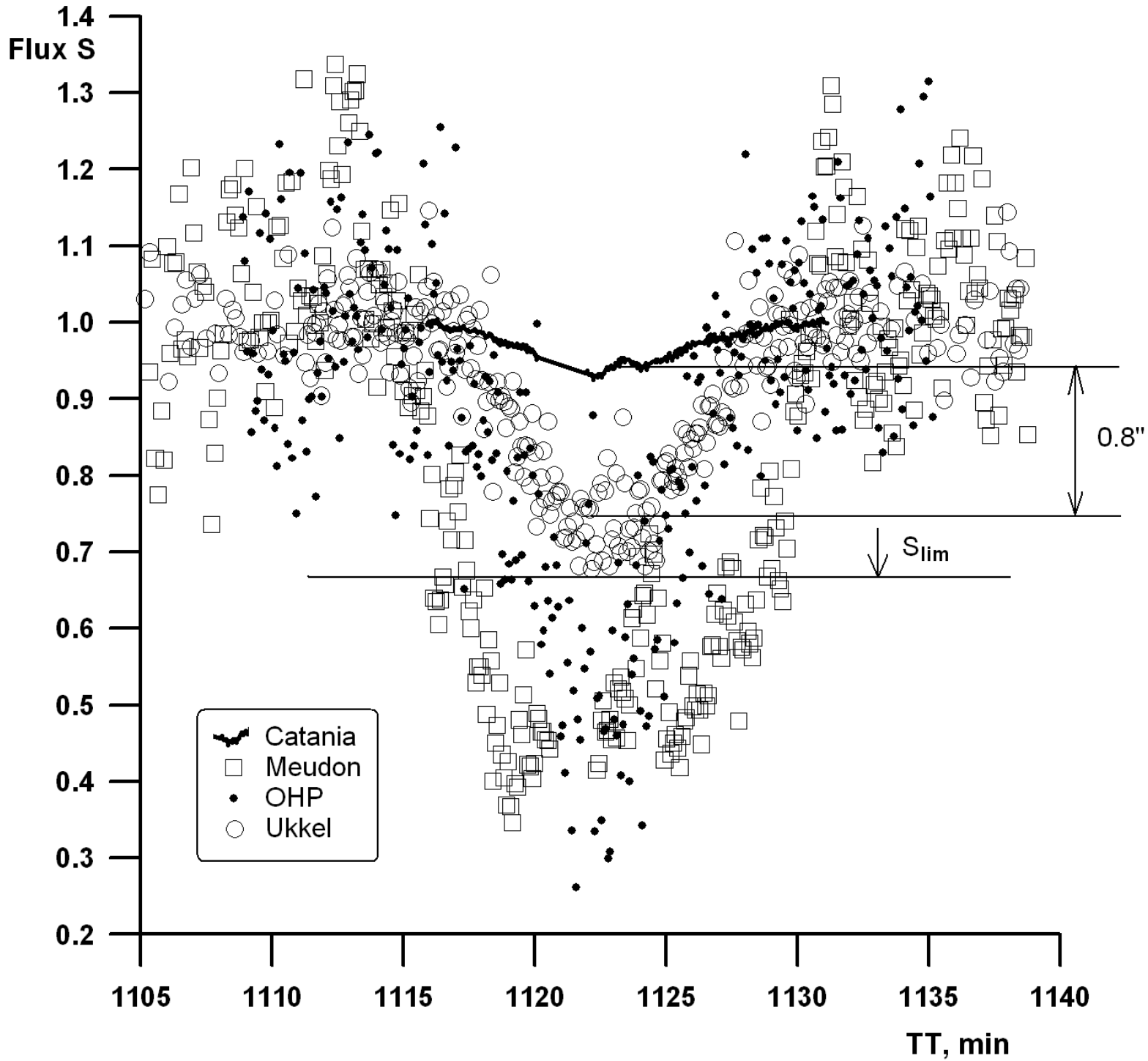
Exemples



1997.09.15 3e2 Alma-Ata σ_x = 0.0029" σ_y = 0.0054"

O-C_x =-0.0059" O-C_y= 0.0497"

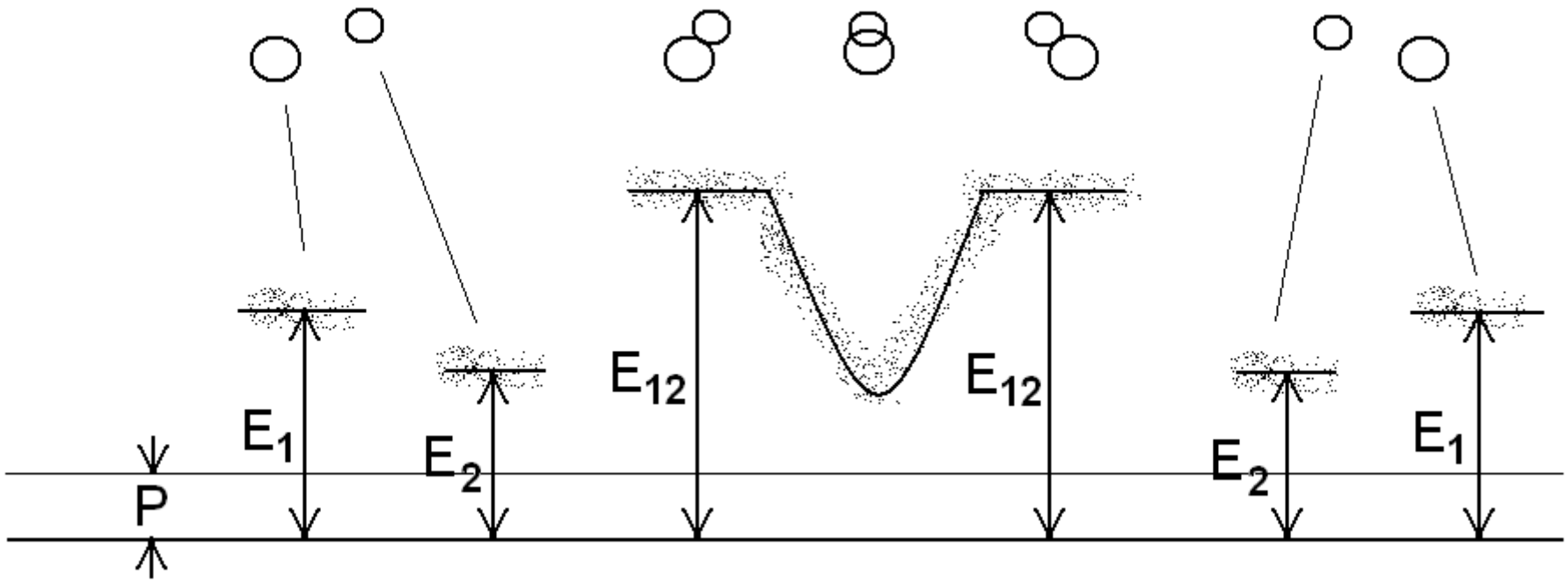
Exemples



1997.09.29 3o2

Les précautions à prendre lors de l’observation

La suppression des erreurs systématiques



$$E_1 = Rp_1r_1^2 + P, \quad E_2 = Rp_2r_2^2 + P, \quad E_{12} = R(p_1r_1^2 + p_2r_2^2) + P$$

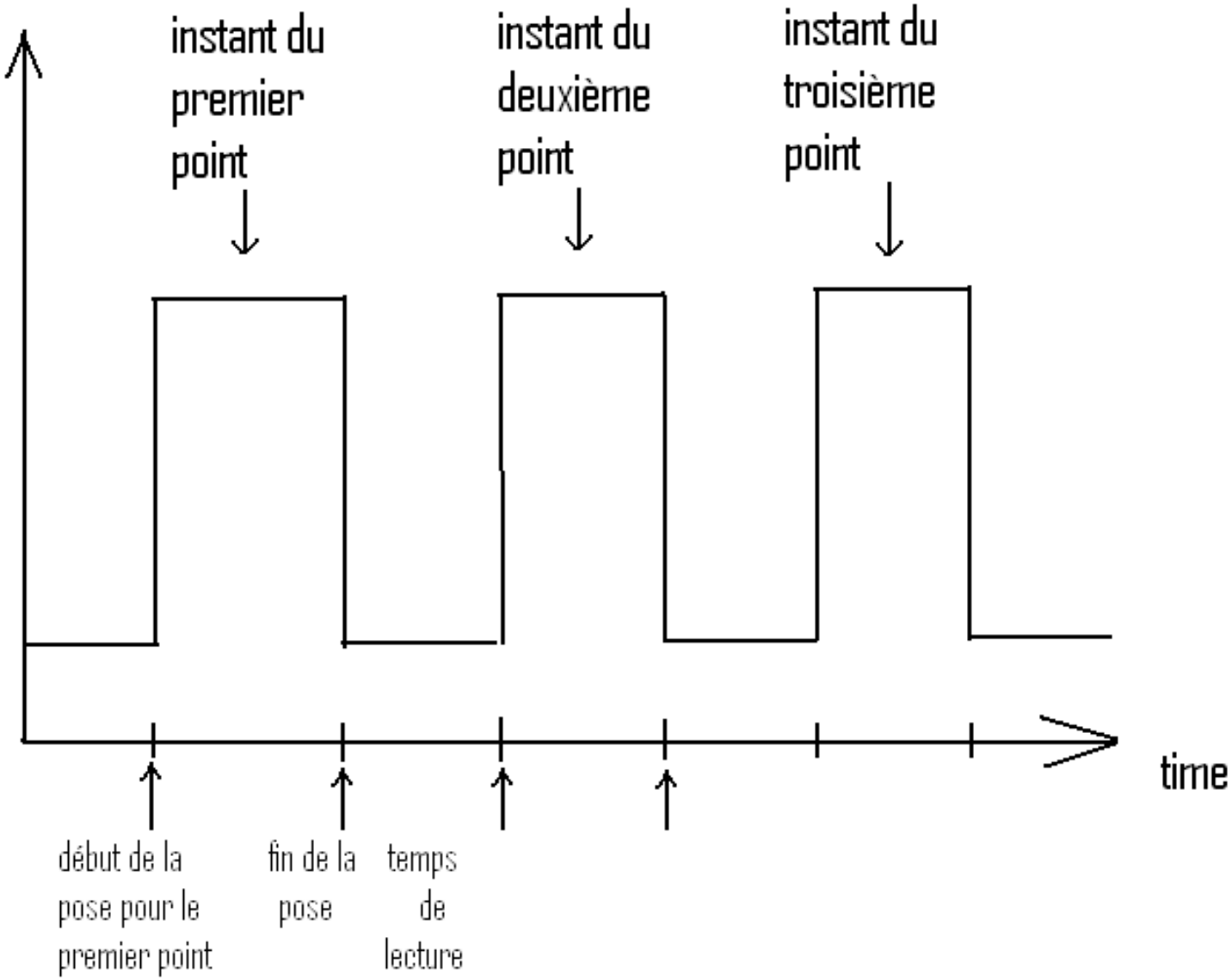
$$P = E_1 + E_2 - E_{12} \qquad \frac{p_2}{p_1} = \frac{r_1^2}{r_2^2}\,\frac{E_{12} - E_1}{E_{12} - E_2}.$$

Emelyanov (2008) Solar System Research

Temps d'intégration et échantillonage temporel de l'observation

- - le temps d'intégration ne doit pas être trop court (il faut avoir un bon rapport signal/bruit) ni trop long (les phénomènes sont courts et il faut un bon échantillonnage de la courbe de lumière enregistrée). L'expérience montre que le temps d'intégration peut varier, selon les récepteurs, de 0,1 à 2 seconde de temps.
- - l'échantillonage temporel de la courbe de lumière enregistrée va dépendre tout d'abord du temps d'intégration mais aussi du phénomène. Un phénomène court, durant seulement quelques minutes doit être échantillonné avec plusieurs points par seconde. Un phénomène long, durant plus d'une demi-heure peut être échantillonné avec un point toutes les 2 secondes.
- - ne pas oublier de tenir compte du temps de lecture et de stockage de l'observation, image ou flux.
- L'échantillonnage est la somme du temps d'intégration et du temps de lecture.

Dater son observation



Bien dater une succession rapide d'images

La saturation

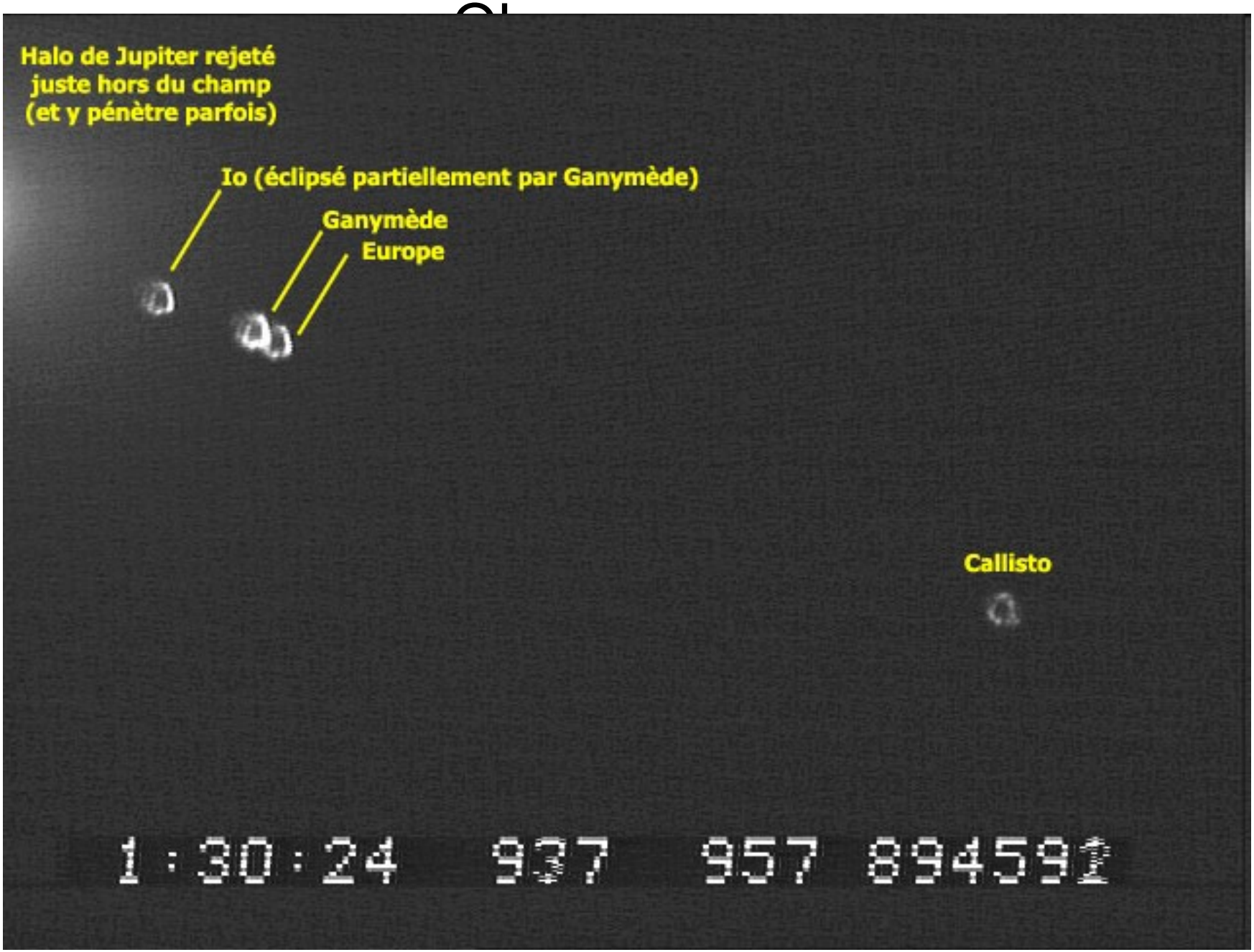
- Attention à éviter la saturation des images. Des photons perdus et l'observation photométrique devient fausse. Pour cela on peut:
- - diminuer le temps d'intégration de chacun des points (mais cela diminue le rapport signal/bruit)
- - diaphragmer l'ouverture du telescope
- - utliser un filtre de densité pour diminuer la lumière incidente
- - défocaliser les images pour étaler la lumière sur la cible.

Cette dernière solution est souvent indispensable en cas de mauvais seeing: les images sont très étalées et au moment du phénomène, les satellites sont confondus et la densité de lumière double entraînant une saturation.

Un phénomène mutuel défocalisé

-Les images des satellites ont été légèrement défocalisées pour éviter la saturation du récepteur

-Attention à la saturation lorsque les images se superposent

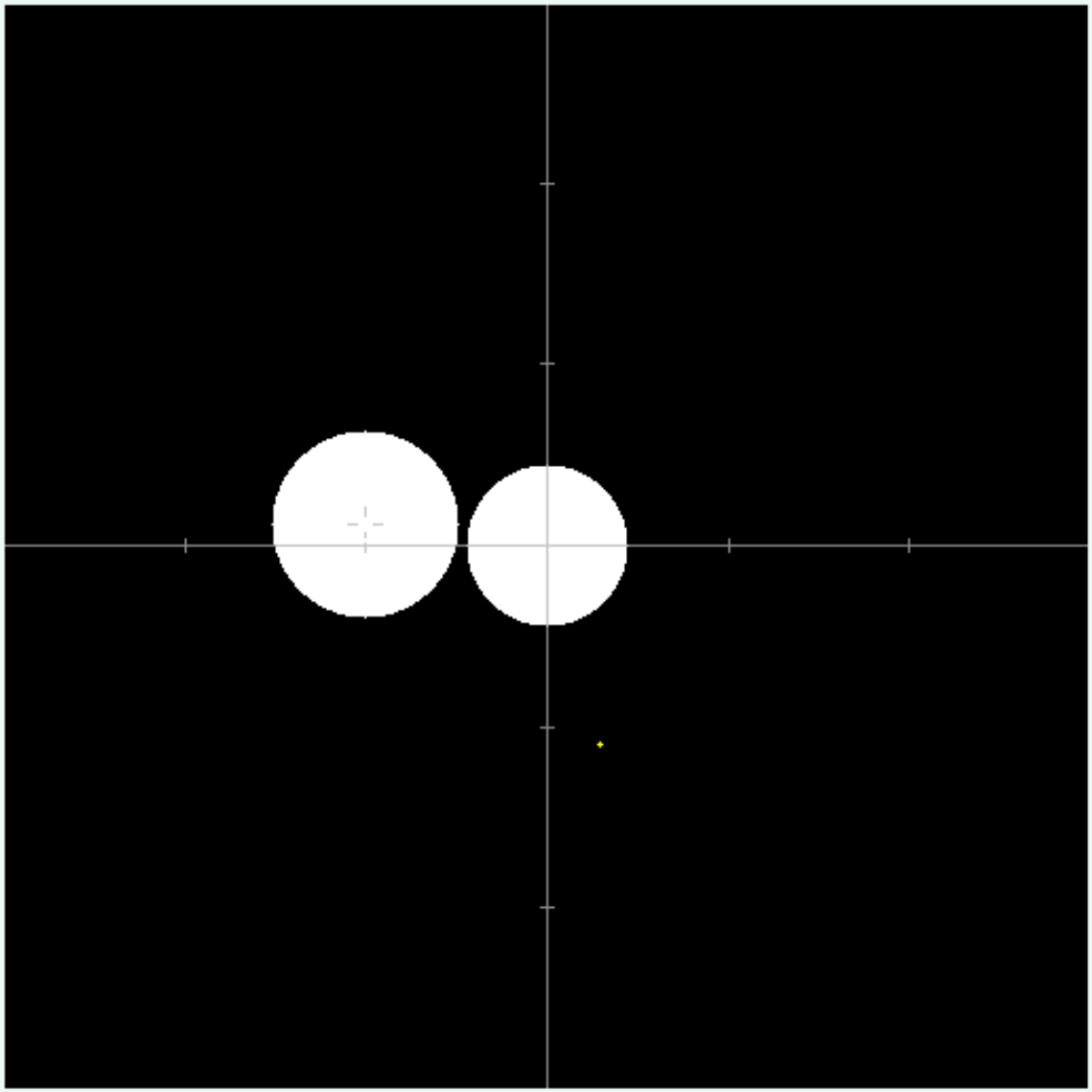

Halo de Jupiter rejeté
juste hors du champ
(et y pénètre parfois)
Io (éclipsé partiellement par Ganymède)
Ganymède
Europe
Callisto
1:30:24 937 957 894591

Phénomènes mutuels

- Durée typique: 5 à 10 minutes
- Phénomènes rasants courts et de faible chute en magnitude

- Quelques phénomènes longs:
- Le 12 décembre 2014 à 23h 12m 44s: J2 occulte J1 pendant 187 minutes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 12 23 12 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

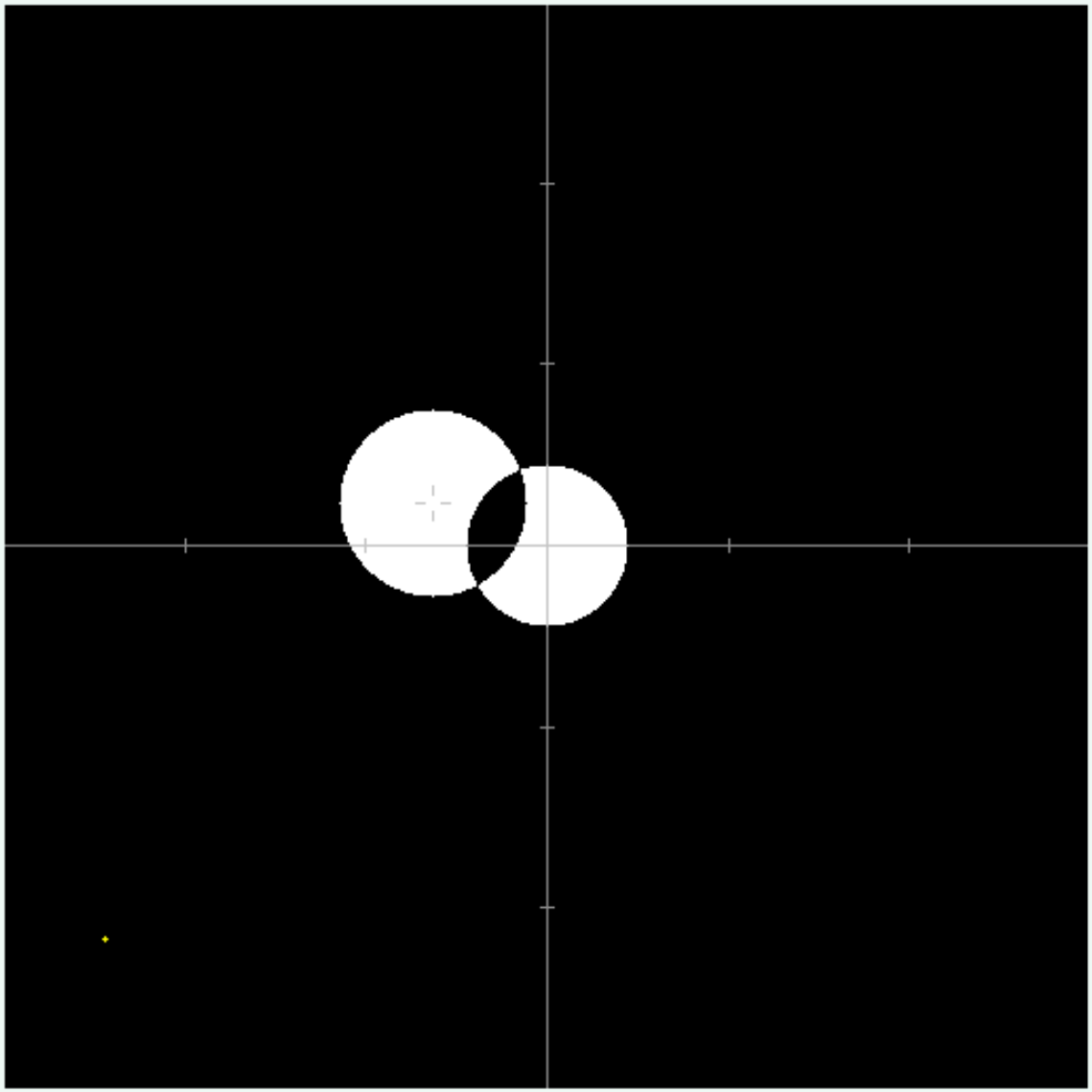
Marked satellite:
J1 Io

Center of the field:
α = 9h 39m 57.109s
δ = 14° 47' 37.79"

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 12 23 24 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

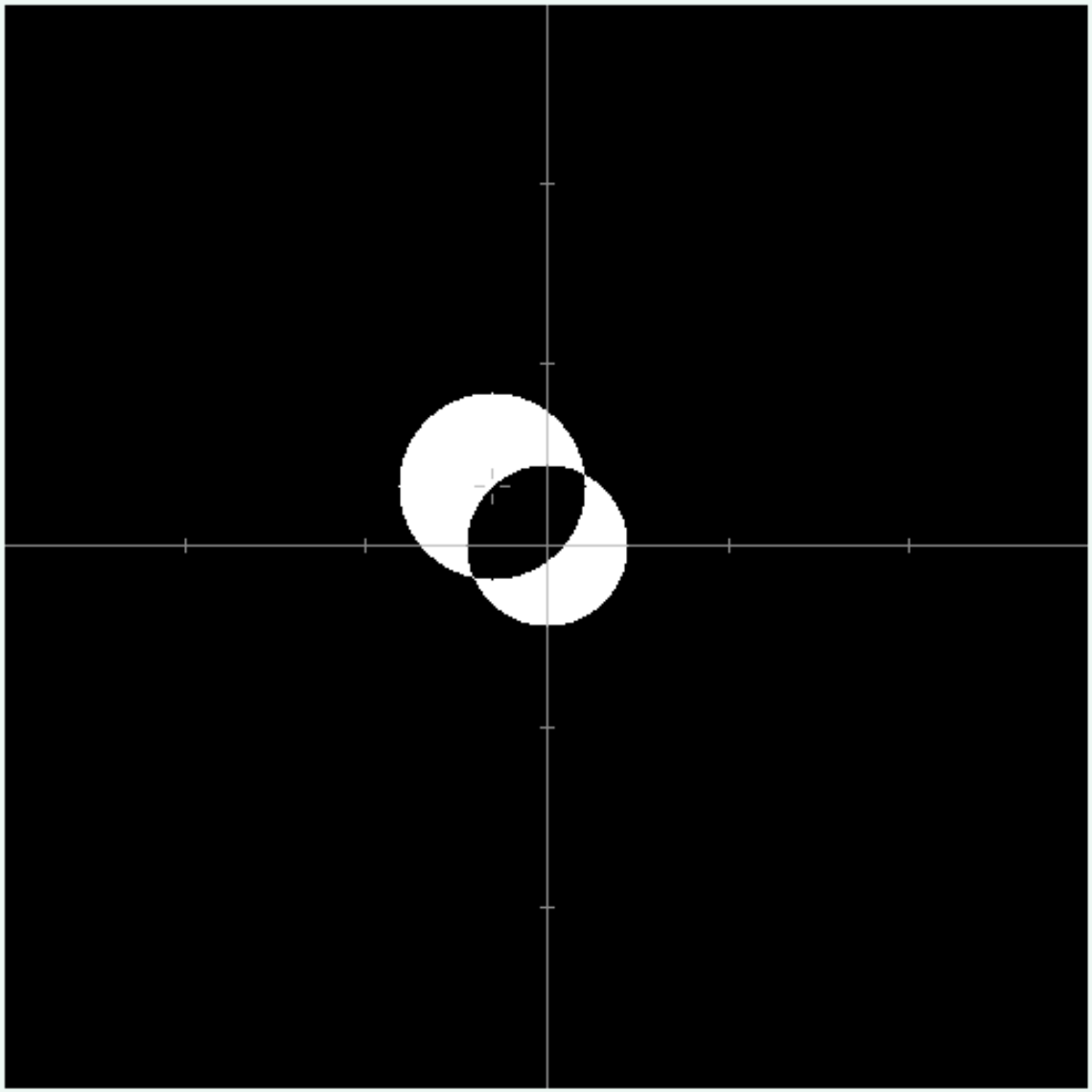
Marked satellite:
J1 Io

Center of the field:
α = 9h 39m 56.914s
δ = 14° 47' 39.02"

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 12 23 36 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

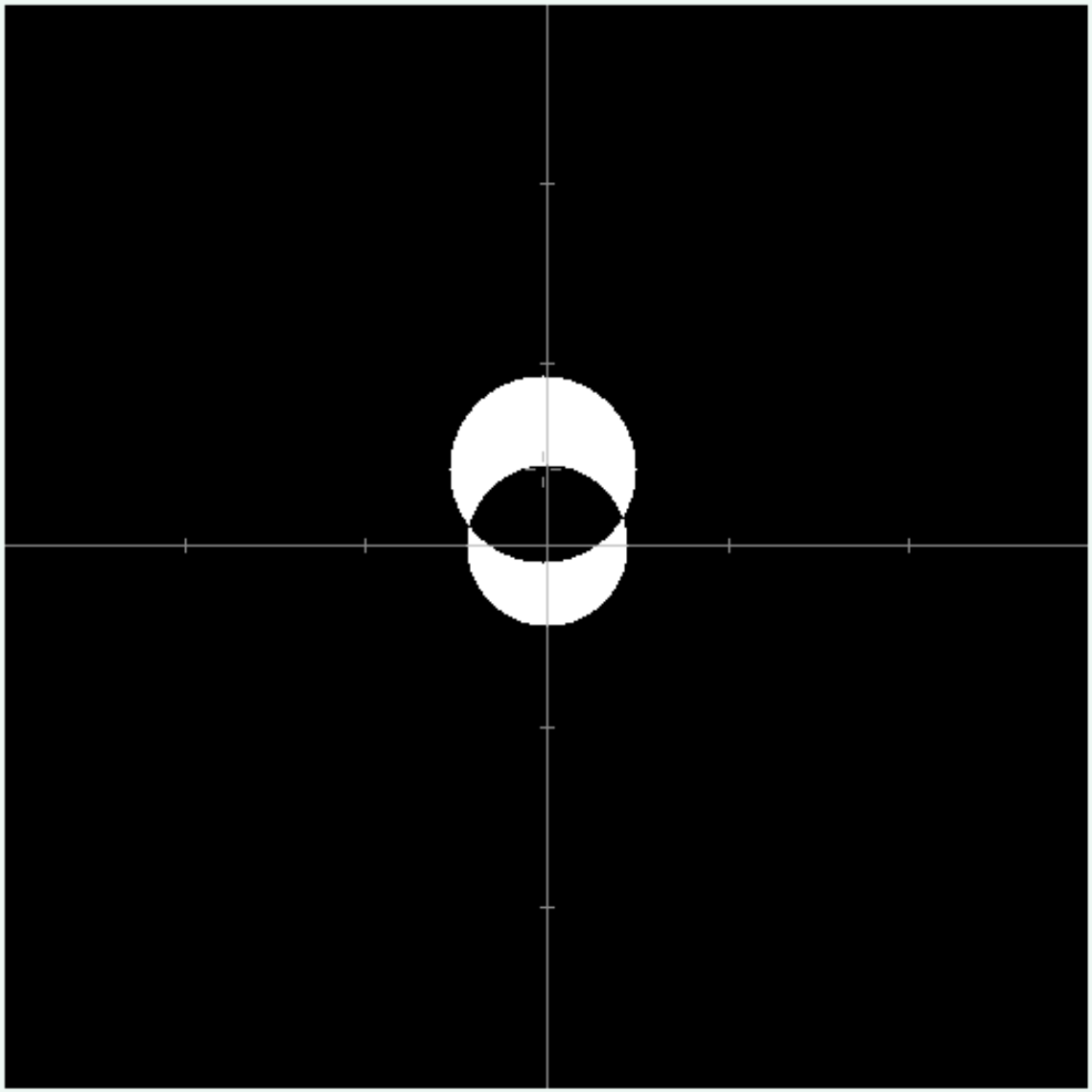
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 56.720^s$
$\delta = 14^\circ\ 47'\ 40.24''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 12 23 48 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

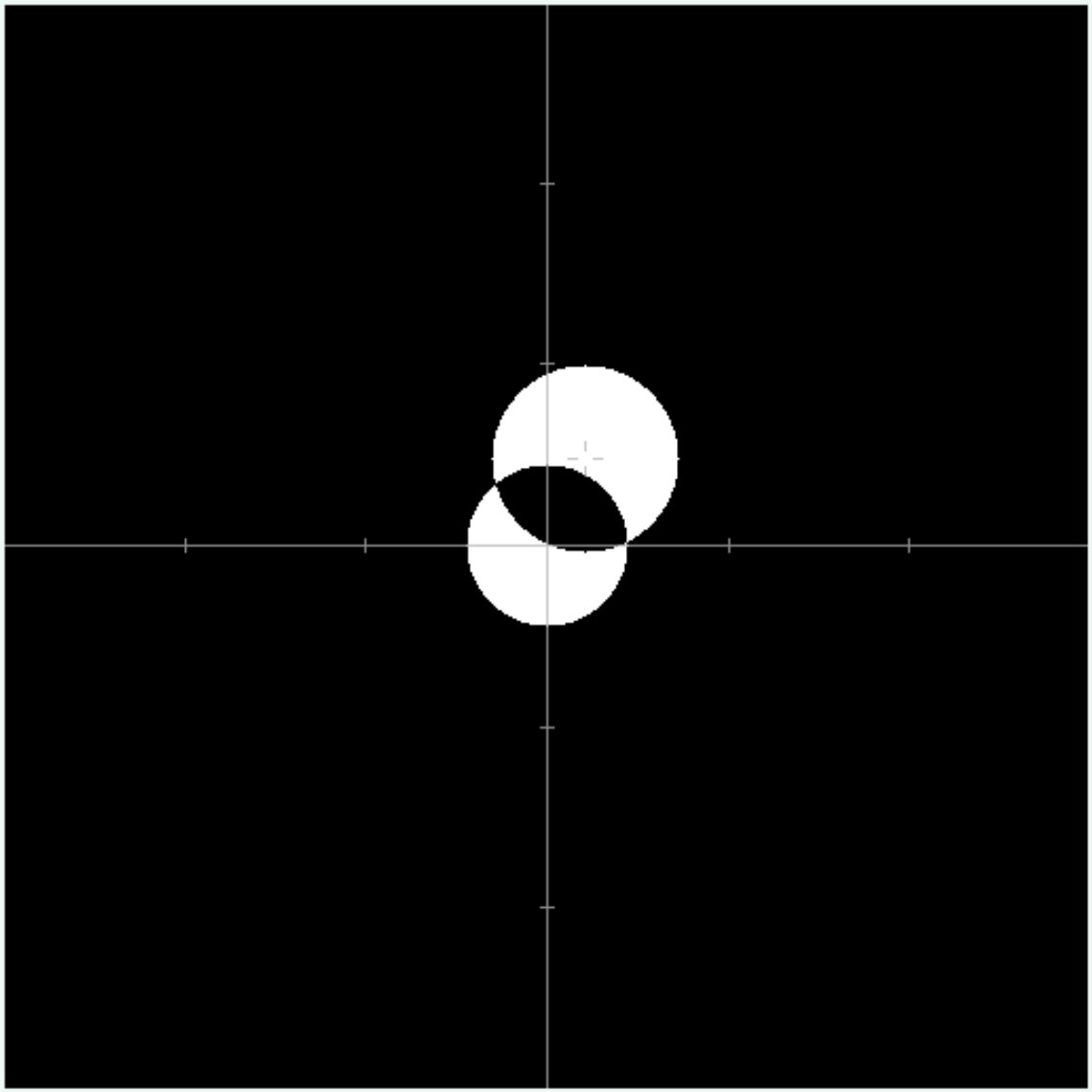
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 56.527^s$
$\delta = 14^\circ\ 47'\ 41.45''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 0 0 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

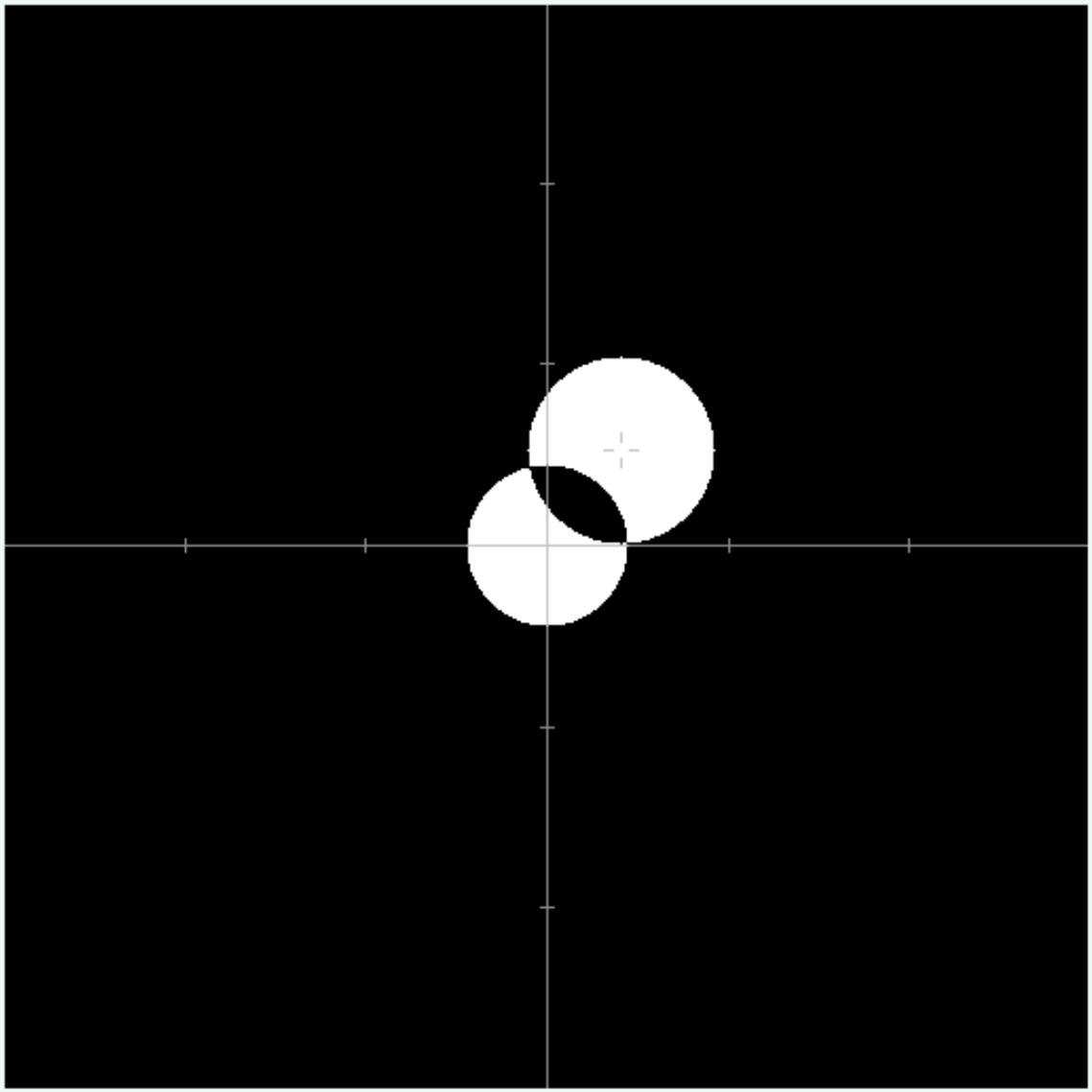
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 56.334^s$
$\delta = 14^\circ\ 47'\ 42.67''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 0 12 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

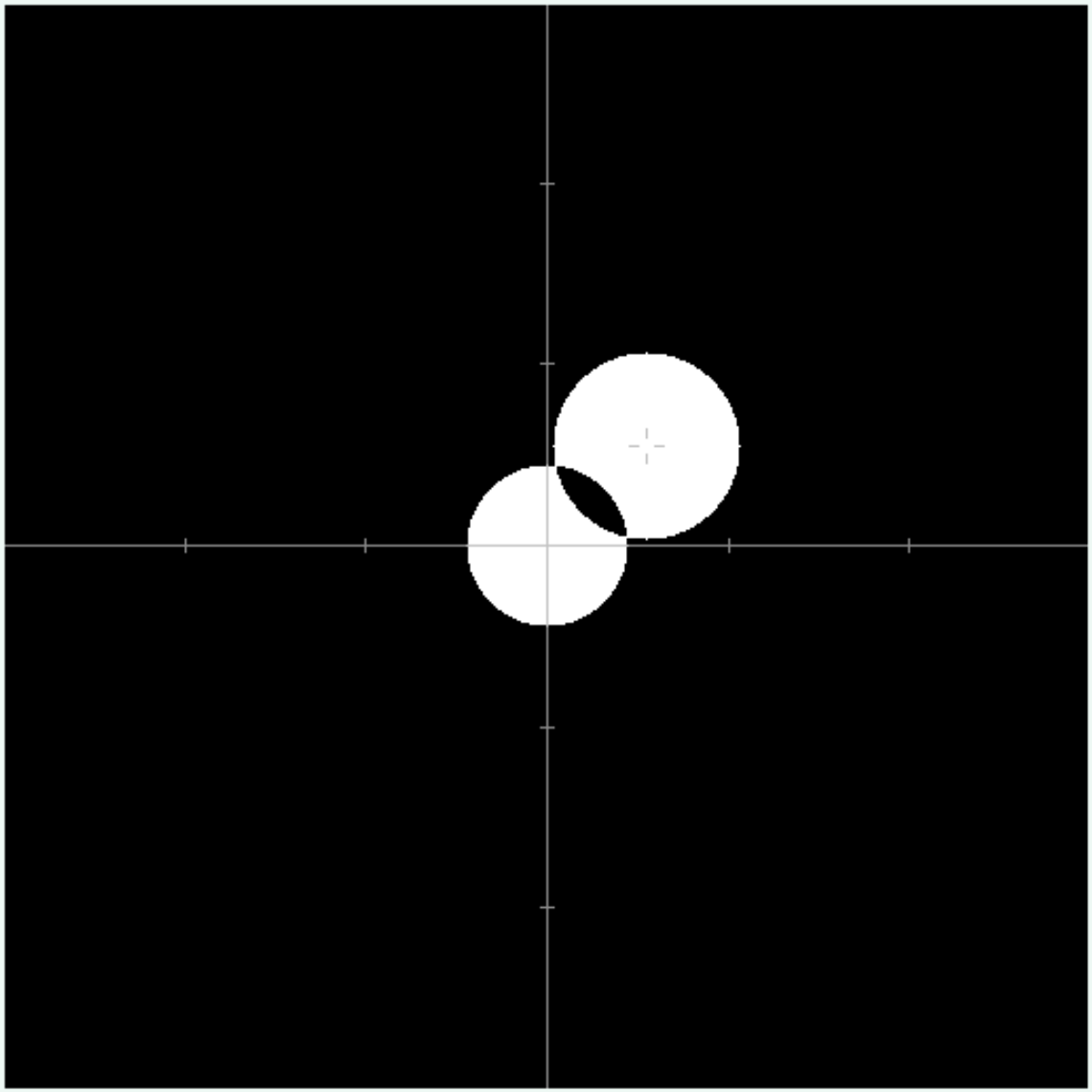
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 56.143^s$
$\delta = 14^\circ\ 47'\ 43.87''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 0 24 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

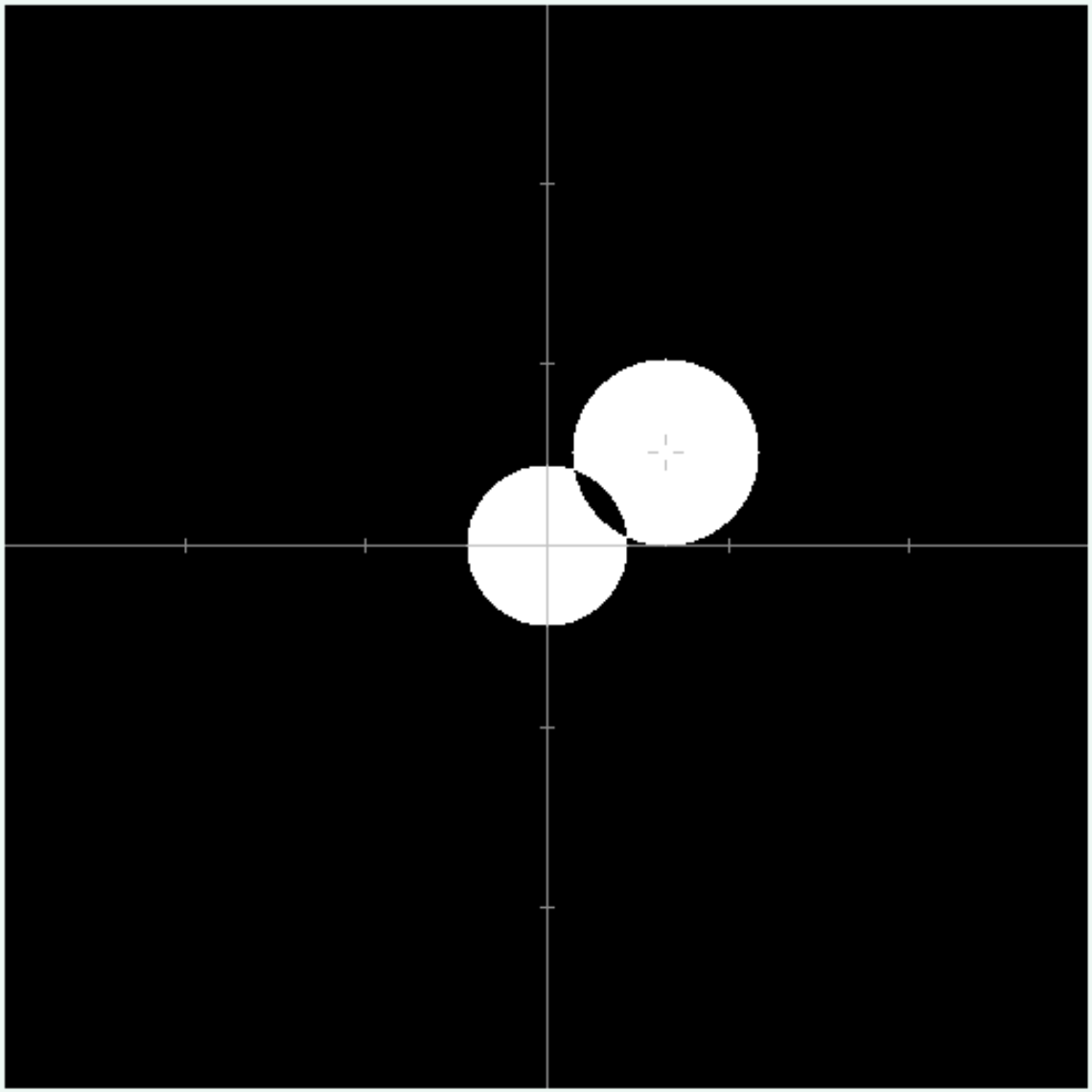
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 55.953^s$
$\delta = 14^\circ\ 47'\ 45.07''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 1 0 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

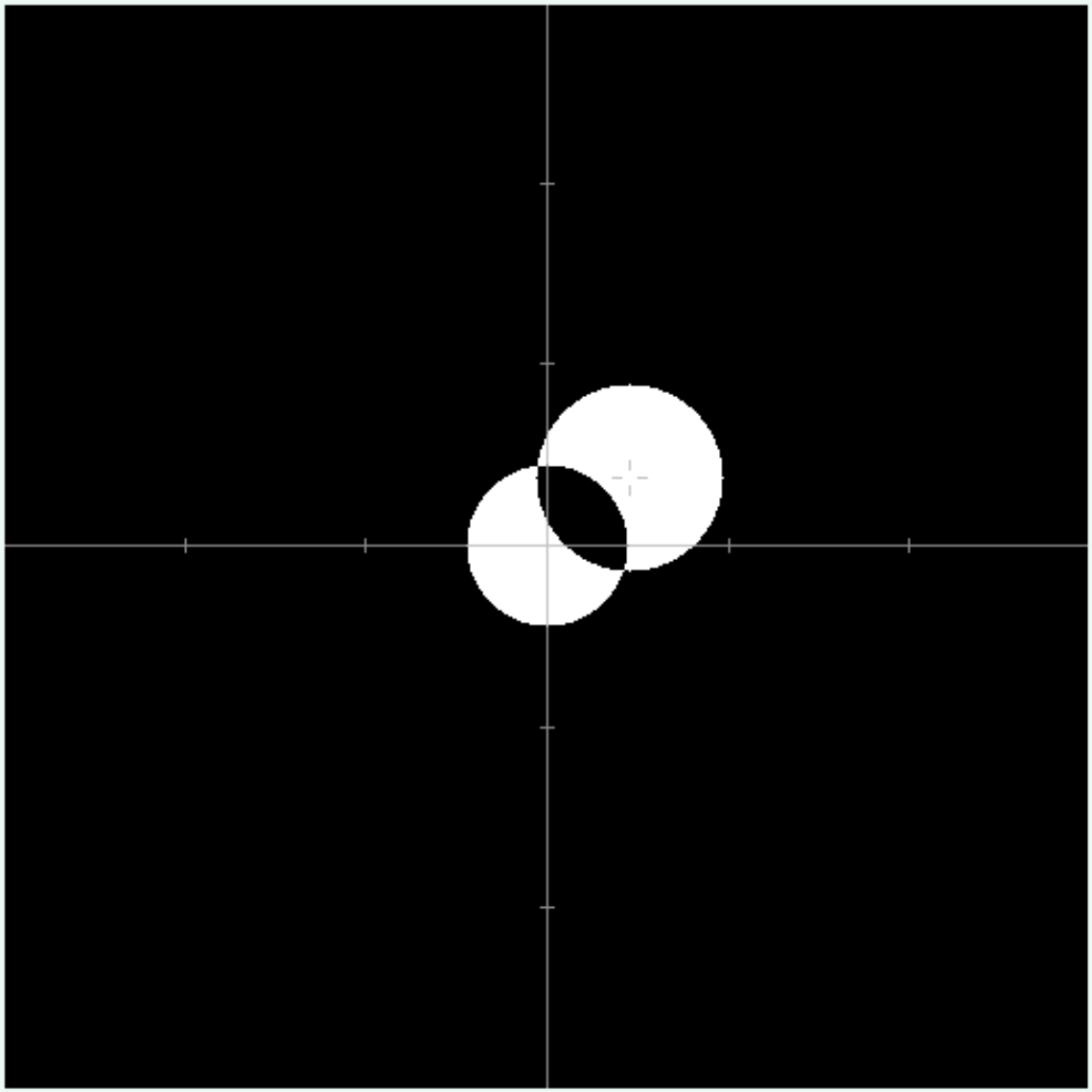
Marked satellite:
J1 Io

Center of the field:
α = 9^h 39^m 55.388^s
δ = 14° 47' 48.64"

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 1 24 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

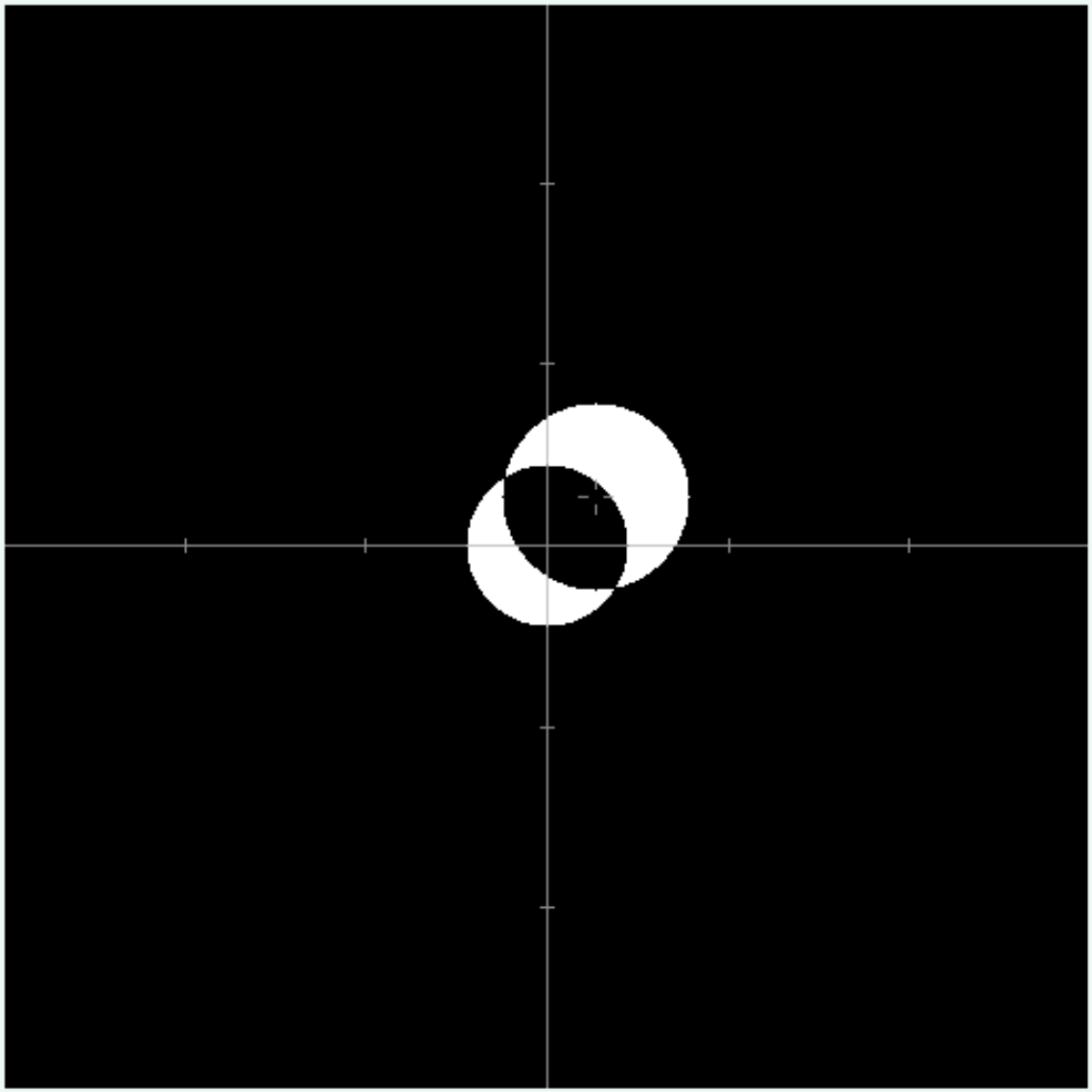
Marked satellite:
J1 Io

Center of the field:
α = 9h 39m 55.017s
δ = 14° 47' 50.98"

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 1 36 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

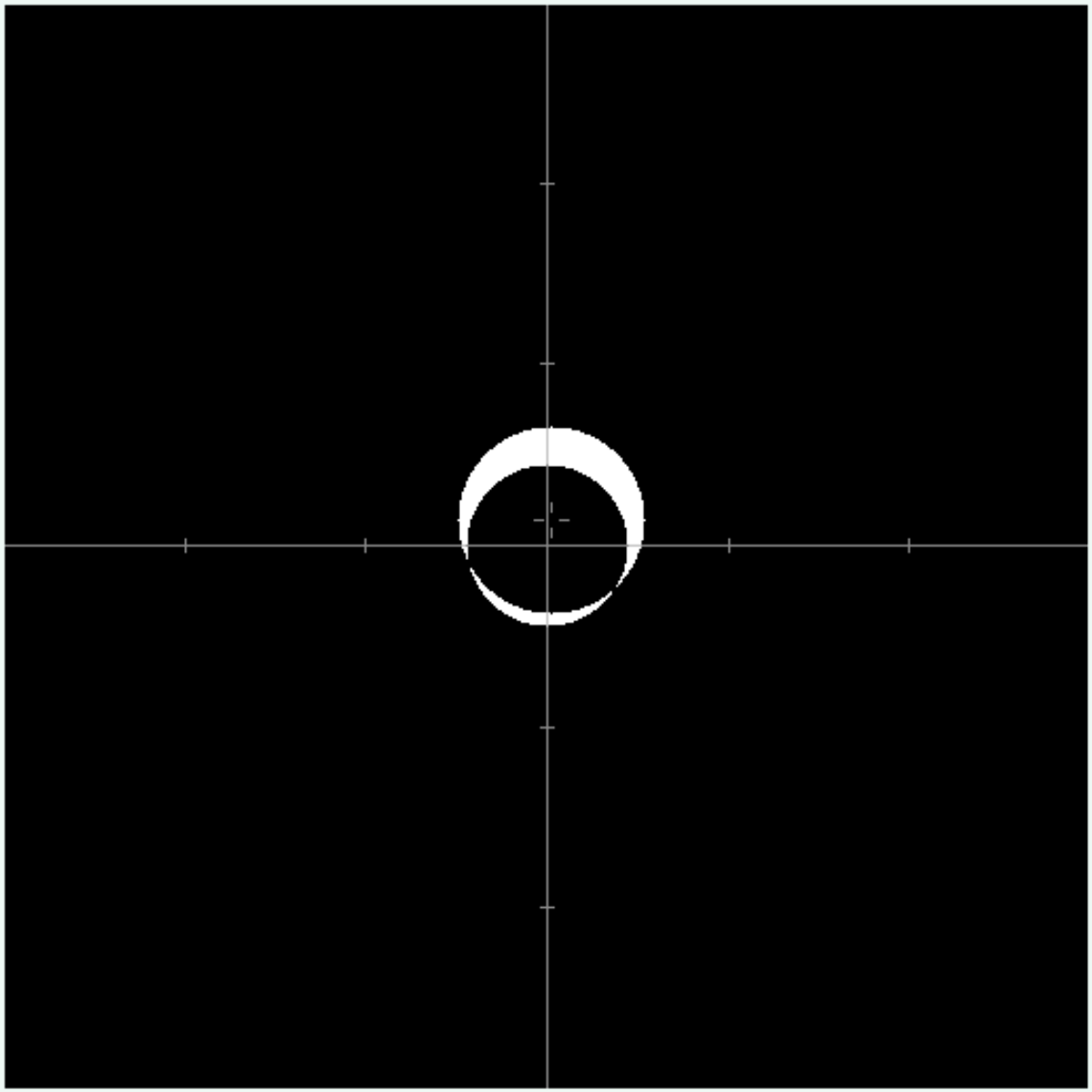
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 54.834^s$
$\delta = 14^\circ\ 47'\ 52.14''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 1 48 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

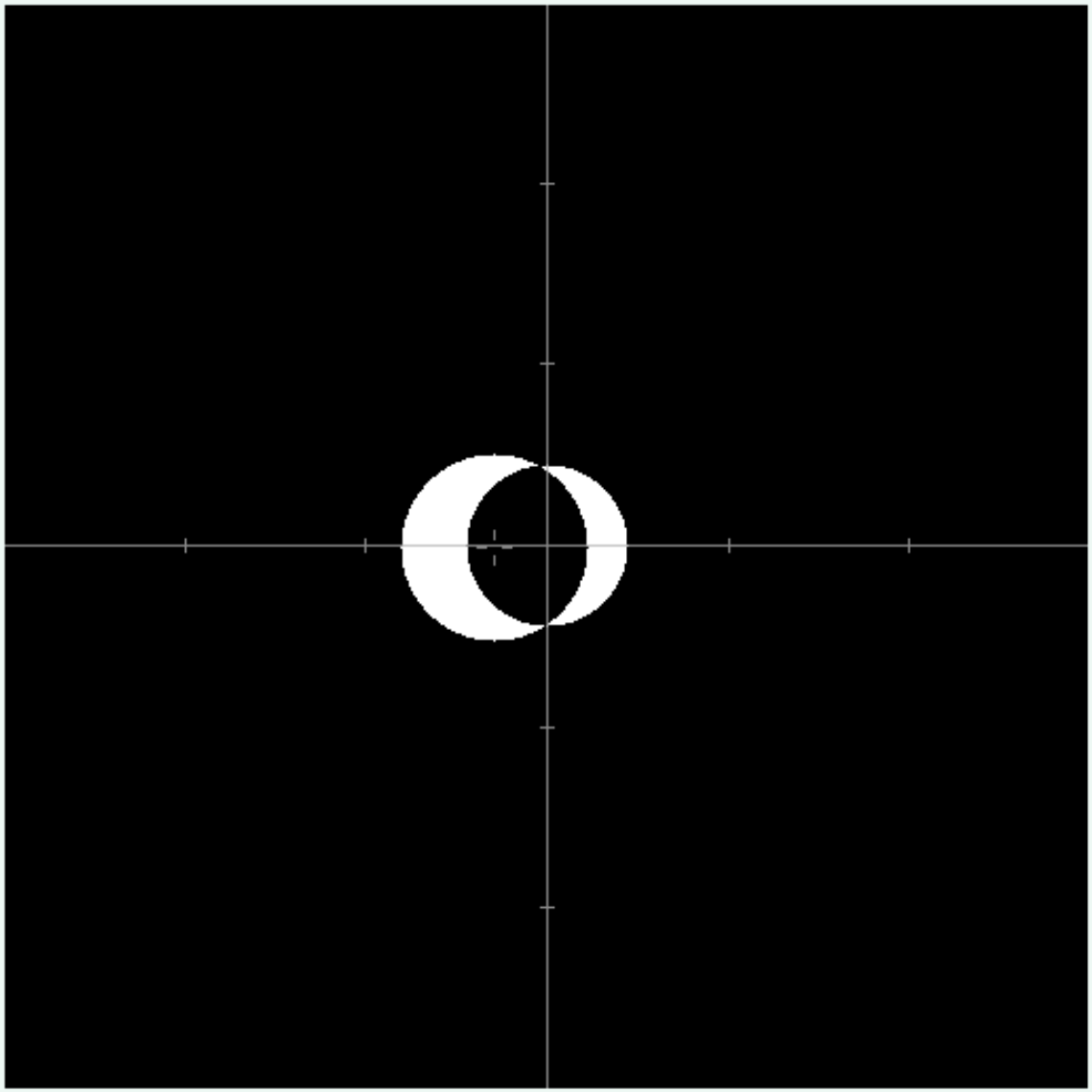
Marked satellite:
J1 Io

Center of the field:
α = 9^h 39^m 54.651^s
δ = 14° 47' 53.30"

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | IMCCE-SAI: Natural Satelli... | Elections municipales et co... | Club Eclipse - WETO 2014 | resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 2 0 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

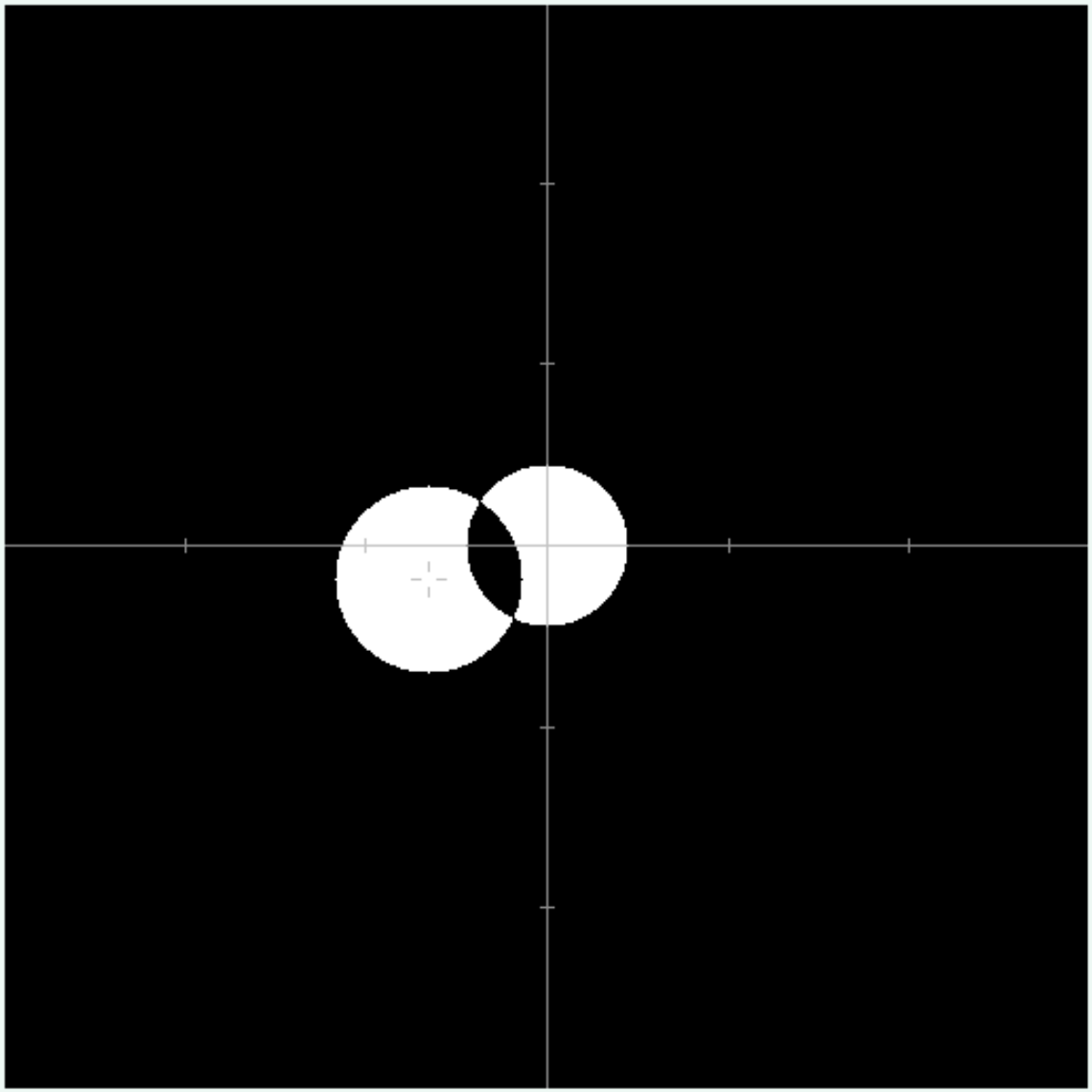
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 54.470^s$
$\delta = 14^\circ\ 47'\ 54.44''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 2 12 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

- Back
- Non
- Forvard

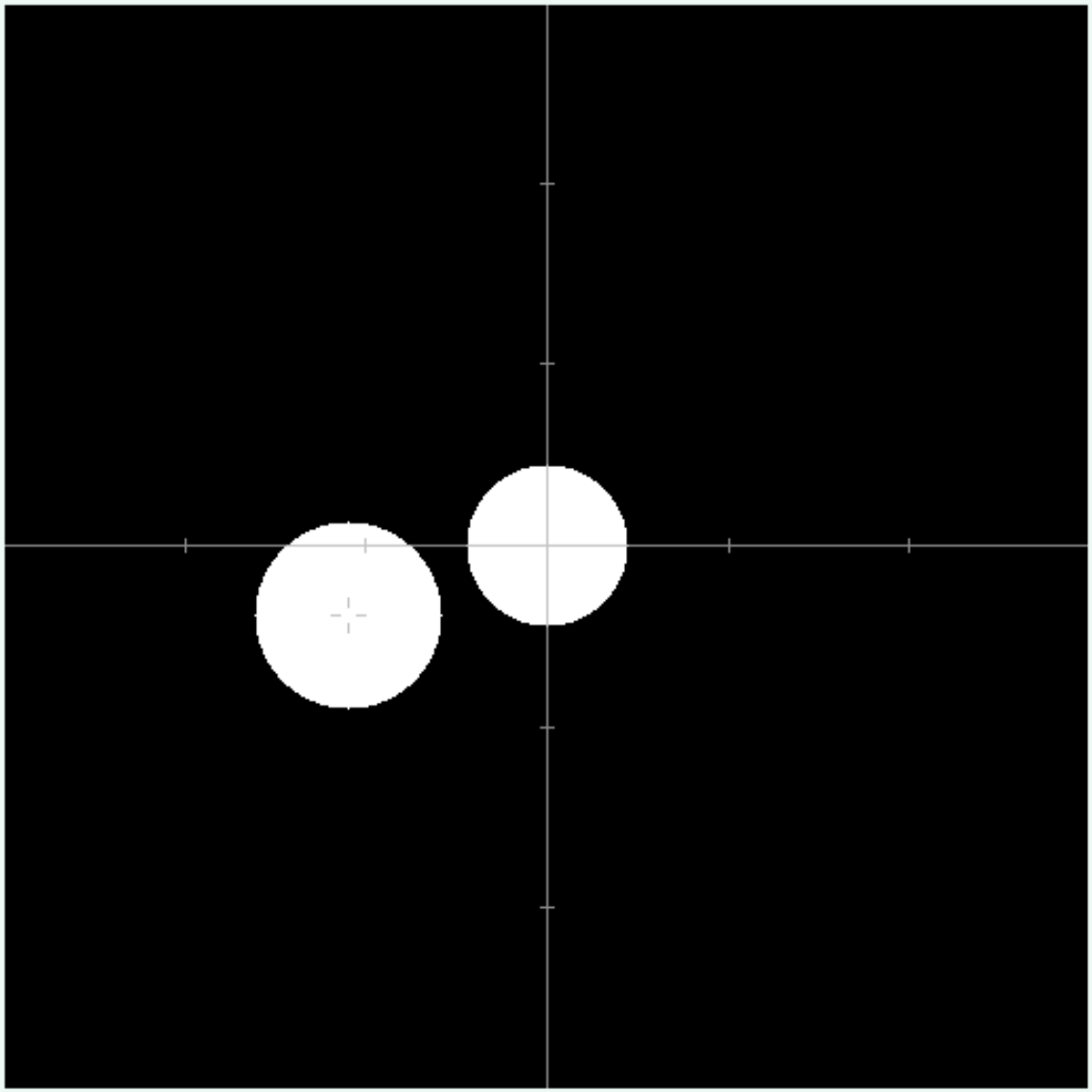
Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 54.291^s$
$\delta = 14^\circ\ 47'\ 55.58''$

N
E + W
S

Coordinates and magnitudes

Historique Marque-pages Outils ?
IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... IMCCE-SAI: Natural Satelli... Elections municipales et co... Club Eclipse - WETO 2014 resta
e.fr/cgi-bin/saimirror/nss-eph3.cgi
amalthée observation CC



Present field : **6" x 6"**
Time moment: **2014 12 13 2 24 0.00 (UTC)**
Observatory: **Geocenter**

IMCCE/SAI. Natural Satellites Ephemeride Server. MULTI-SAT.

Satellites of Jupiter

Reference body:
J2 Europe
Marked satellite:
J1 Io
Epoch of equator and equinox J2000
Differential coordinates

Refresh image

With 6" field scale

One time step of 0.2000 hours

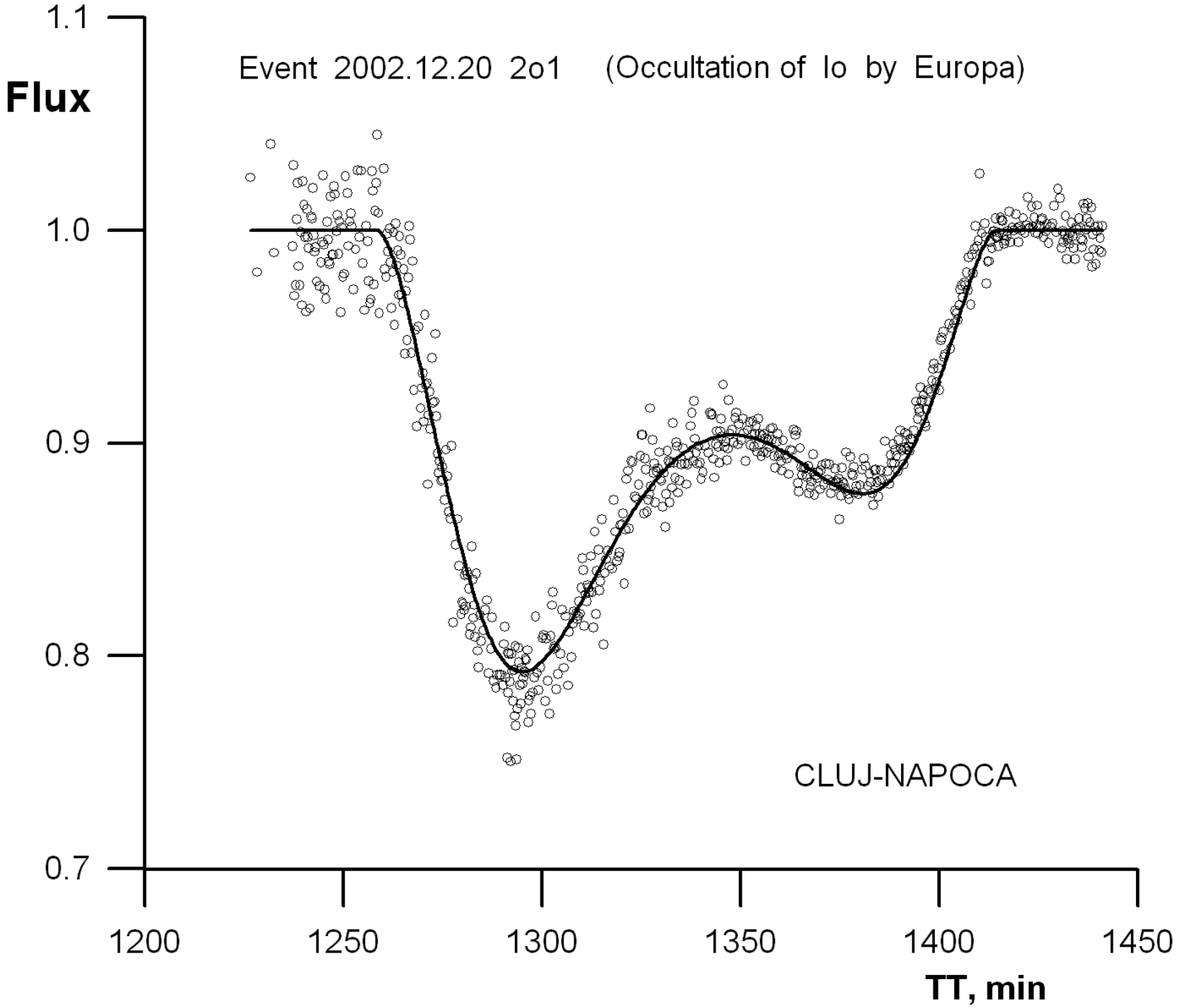
- Back
- Non
- Forvard

Marked satellite:
J1 Io

Center of the field:
$\alpha = 9^h\ 39^m\ 54.112^s$
$\delta = 14^\circ\ 47'\ 56.72''$

N
E + W
S

Coordinates and magnitudes


Event 2002.12.20 2o1 (Occultation of Io by Europa)
Flux
1.1
1.0
0.9
0.8
0.7
1200
1250
1300
1350
1400
1450
TT, min
CLUJ-NAPOCA

Natural Satellites Service.

Automatic input of the photometric observations of the mutual occultations and eclipses
of the galilean satellites of Jupiter in 2014-2015.

To start entering your data, send email to Dr. Arlot
arlot@imcce.fr
to obtain an unique operator ID.

To see your previously entered observation input operator ID [ ]
and code of one observation [ ] you want to see
Then press [Show]

To delete your previously entered observation from data base input operator ID [ ]
and code of one observation [ ] you want to delete.
Then press [Delete]

To input your results of observation of **one mutual phenomenon**
enter or choose the following information and press **Submit**.
You will **receive** on a separate page and by e-mail unique identification code of this **one observation.**
Remember this identification code for subsequent operations.

Input operator ID [ ]

Event identification

- Event midtime date:
  year [2009] month [01] day [01] hour [00]
- Event: [J1 - Io] [occults] [J1 - Io]
- Type of the photometric measurement:
  ◉ **occultation** ○ **eclipsed satellite only** ○ **eclipsed and eclipsing together**

La page de téléchargement de vos observations

Suite➔

Site identification

- Name or identifier of the **site of observation:** conventional_site_name
- Check this box ☐ to use previously entered parameters and description of the site with the given conventional site name.

  Otherwise input new parameters and description of the site.
  Note that previously entered parameters and description of the site will be replaced by new ones.

- **Parameters and description of the site of observation.**
  Disregard this section if you are using previously entered site parameters
  Observatory IAU code: XXX (put XXX if not available)
  Site geographic coordinates:
  Longitude = W 000 deg 0 min 0 sec
  Latitude = N 00 deg 0 min 0 sec
  Elevation 0 m Type of the telescope: reflector Designation: not obligatorily
  Diameter 100 cm Focal length: 1000 cm
  Description: not obligatorily

Observation condidtions

- Filter: V or check ☐ if no filter.
- Used receptor: CCD Designation: receptor type
  Receptor description: not obligatorily
- Observation conditions: not obligatorily

Observers identification

- **Enter observers names and affiliations.**
  For each observer input: surname, first name, affiliation (observers separator = ';').
- E-mail address for contacts: @
  Name of responsible person: responsible

Results of one observation (of one event)

- Choose format of the date JD with decimals
- Choose type of the photometric value
  relative flux (given with an arbitrary unknown multiplier)

In each line enter your observations (One date with photometric value per line. Max. 2000 lines)

Submit

Fiche d'observation à joindre à un envoi de fichier ➔

REPORT OF ONE OBSERVATION
(to be sent with the data after each observation to:
IMCCE, PHEMU09, 77 ave. Denfert-Rochereau, F-75014 PARIS, France)
or at phemu09@imcce.fr

OBSERVED EVENT :

DATE and HOUR:

Beginning and duration of the observation:

NAMES OF THE OBSERVERS:

INSTITUTION:
ADDRESS:

LOCATION OF THE OBSERVATION:
ADDRESS:

Geographic coordinates: (longitude: h m s; latitude: ° ' "; elevation= m).
IAU code:

METEOROLOGICAL CONDITIONS (fog, haze, light clouds?):

Quality of the sky (stable, transparent, photometric?):

Seeing:

Elevation of Jupiter above the horizon at the time of the observation:

Twilight? Moon?

USED TELESCOPE:
Refractor or reflector?

Aperture:

Focal length:

USED RECEPTOR:
CCD ?

Are the images put slightly out of focus?

Size of the field of the CCD:

FILTER used (if any):

SENT DATA:
file of light flux, magnitude drop or images?

TIME SCALE for dating each point
or each image:

relation to UTC:

Rappel de quelques erreurs fréquentes à éviter :

- .se tromper de satellite ! (confusions Nord-Sud, Est-Ouest; miroirs à 45°,...)
- .commencer l'observation trop tard (incidents d'enregistreurs,...) et imaginer qu'on va faire les calibrations et rattachements photométriques après le phénomène (il y a des surprises...) ;
- .sous-estimer la possibilité de faire des mesures valables à 10° de l'horizon et moins (mais attention aux dérives de réfraction !)
- . choisir un mauvais champ dans le cas d'un CCD;
- . croire que le déplacement mutuel est toujours linéaire uniforme ;
- . croire que l'on sait tout sur les satellites galiléens et que les magnitudes sont bien connues (elles varient d'ailleurs d'un point à l'autre de l'orbite) ;
- . ne pas être sûr de son échelle de temps: il faut absolument se rattacher à UTC.
- EN BREF : PREPARER SOIGNEUSEMENT CHAQUE OBSERVATION ET SUIVRE MINUTE PAR MINUTE UNE PROCEDURE REDIGEE A L'AVANCE.

Récapitulation des points importants à bien examiner

- 1 . être sûr que l'on a une **base de temps calée sur UTC** à mieux de 0,1 seconde ;
- 2 . vérifier que Jupiter ne se cachera pas **derrière un obstacle pendant l'observation** ;
- 3 . vérifier que chaque point de la courbe de lumière est **datée avec une précision meilleure que 0,1s**
- 4 . penser à utiliser le cas échéant **un filtre adapté** : 5000-5300 Å en site urbain, rouge dans le crépuscule ou près de la pleine lune, ... mais indiquez bien quel filtre vous avez utilisé ;
- 5 . **bien identifier les satellites** et se méfier des montages optiques qui retournent le champ ;
- 6 . **bien choisir le champ** à enregistrer avec un satellite de référence en plus des satellites en phénomène
- 7 . **prévoir les mouvements des satellites** pour le guidage et se méfier de l'augmentation de la réfraction lorsque l'on se rapproche de l'horizon ;
- 8 . **voir si la Lune ou la proximité de Jupiter risque de gêner** l'observation du fait de la lumière parasite et y remédier
- 9 . **faire des mesures photométriques individuelles de chaque satellite** avant et après le phénomène ;
- 10 . prendre des précautions particulières pour les **phénomènes ayant lieu au crépuscule** , mais ne pas hésiter à les observer en se préparant la veille dans les mêmes conditions.
- 11. **observer avant les phénomènes mutuels** une éclipse par Jupiter pour s'habituer au matériel et mettre en place la bonne procédure d'observation.

Conclusions

1. La précision des résultats astrométriques obtenus est supérieure à la précision des meilleurs observations astrometriques classiques.

2. La précision des resultats astrométriques est limitée par la <u>précision de la photométrie</u> et non pas par la exactitude de la méthode de réduction.

3. Il faut absolument <u>suivre un protocole d'observation strict</u> lors de l'observation pour ne pas risquer de faire une observation inutile..