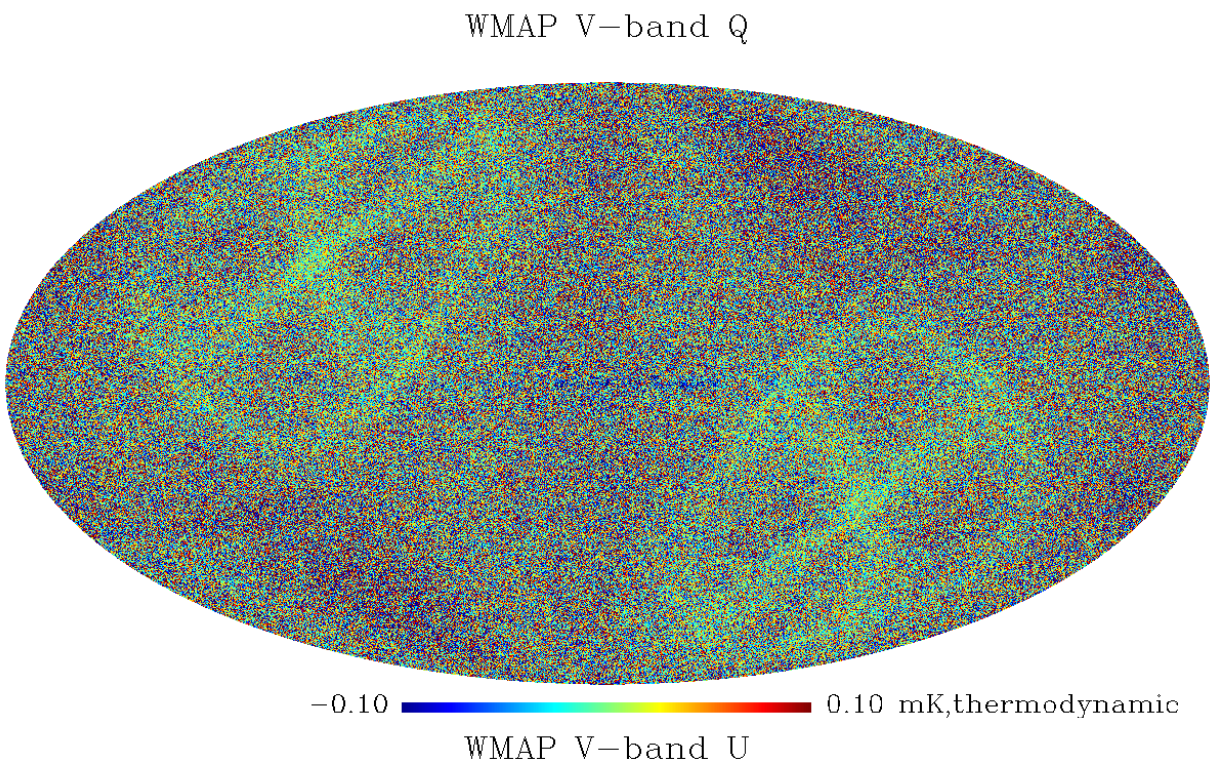
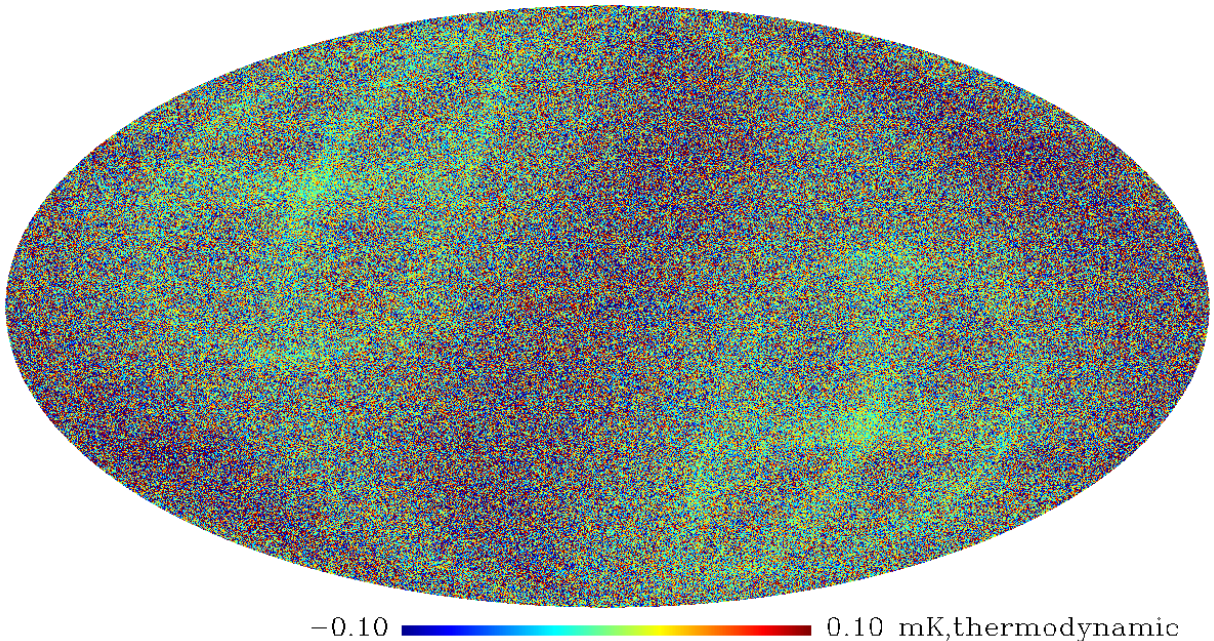
K.M. Gorski

Scanning considerations for PROBE





WMAP9 Q/U maps in V-band

Galactic coordinates

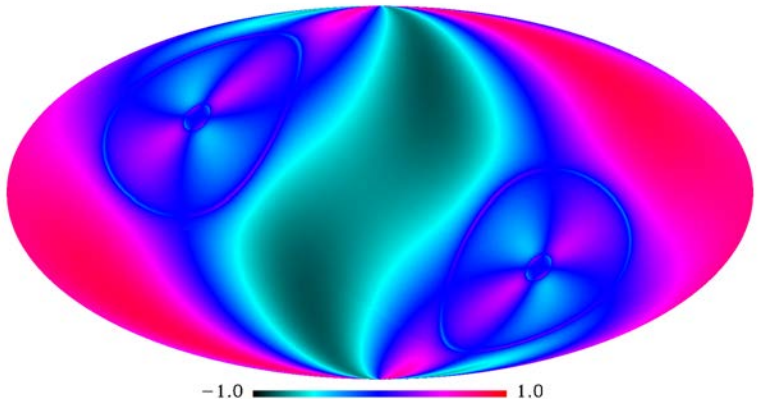
Foreground reduced

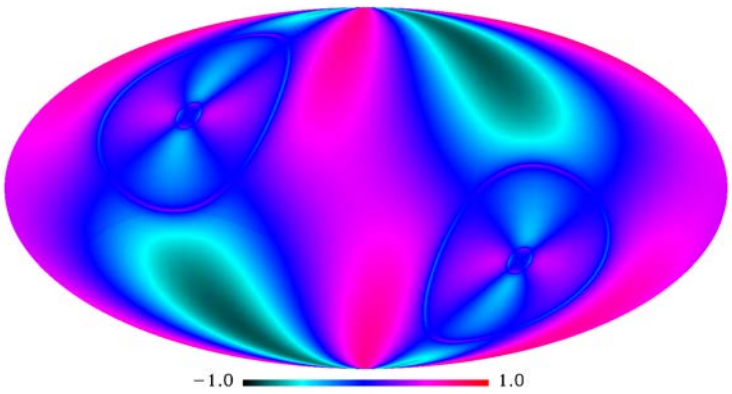
Noise dominated

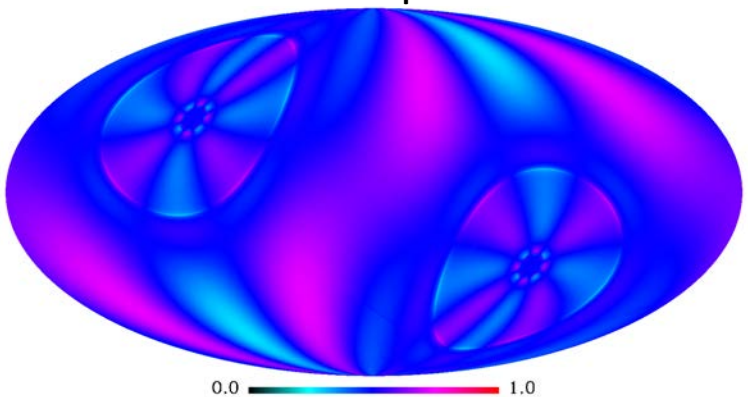
Structures seen around ecliptic poles are imprinted by scanning strategy, specifically, mostly by the values of **α** and **β**;
β – bore angle (center of the focal plane w.r.t. spin axis
α – opening angle of the precession cone

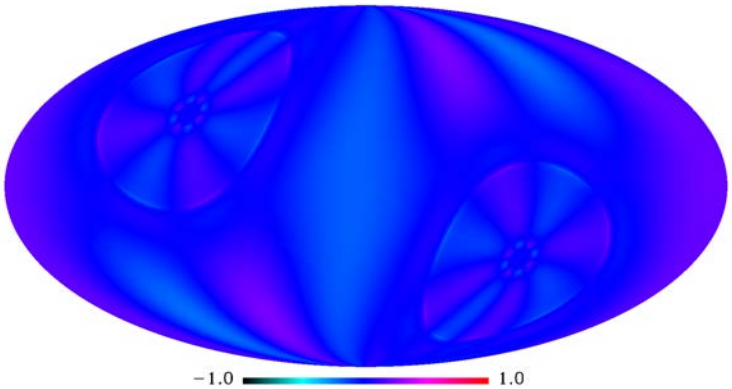
Large scale scanning effects

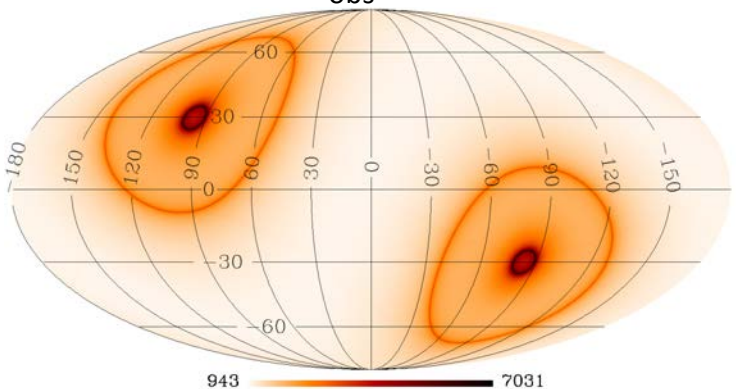
- As we agreed previously, I rerun the scanning case using spin period of 60 sec
- A range of precession periods is shown in the following plots, from 3 hrs, to 6 months; as illustrated later, I would suggest limiting a reasonable range of precession period to < ~10 hrs
- It is remarkable how gross large scale features are mostly dictated by the values of scan angles β and α (up until very slow precession, of period > ~1day, starts breaking the ecliptic-longitudinal smoothness of sky coverage
- Other scanning angle combinations can be included for comparison, if desired

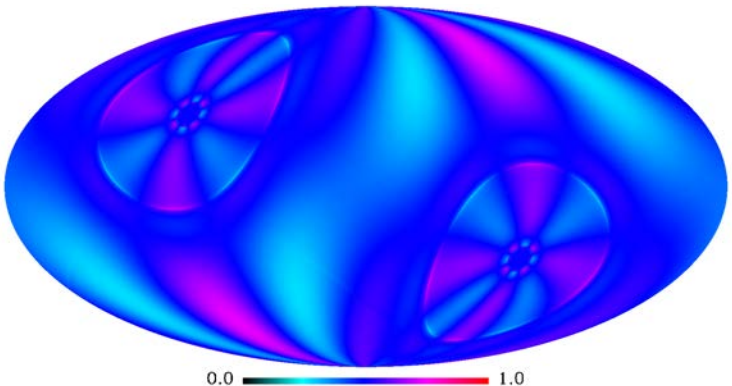












Example 1:

fast spin
&
fast precession

α = 22 deg
β = 73 deg

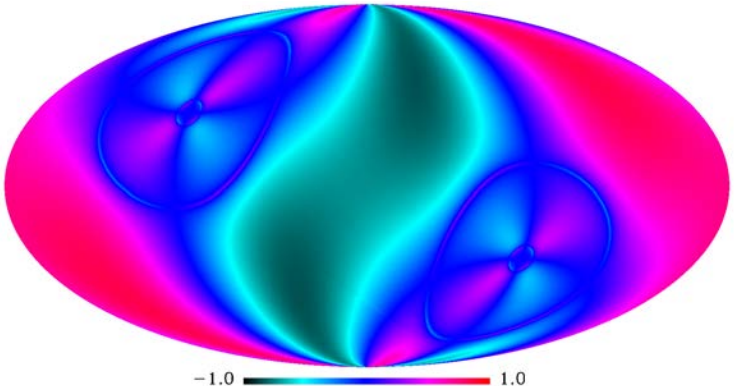
T_{spin} = 60 sec

$T_{precession}$ = 3 hrs

1 year scan

Reduced resolution:
10 arcmin sampling
on the sky

<cos 2ψ>



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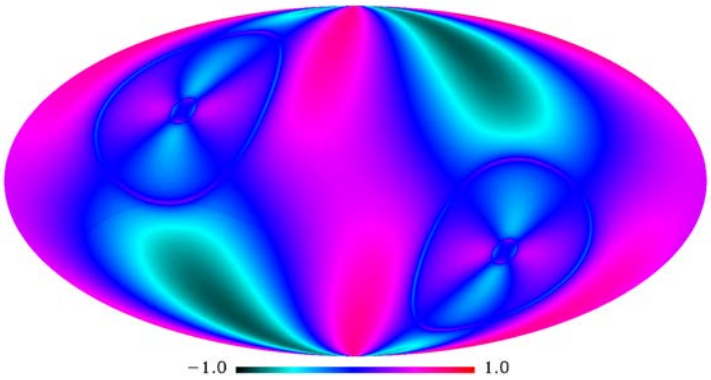
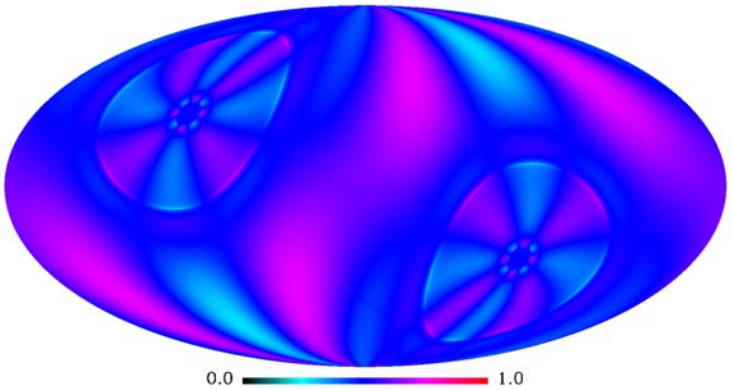


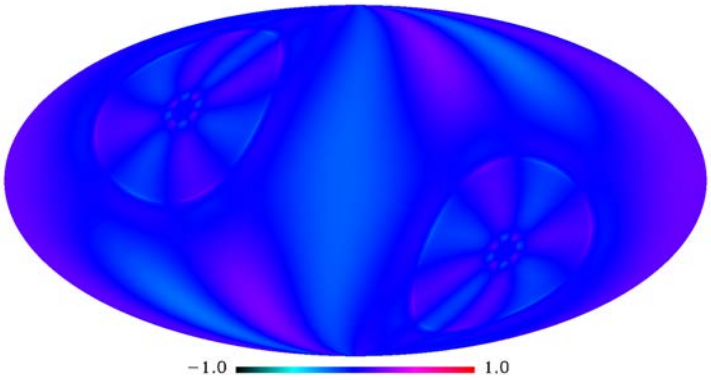
Example 2:

fast spin
&
fast precession

<cos^2 ψ>



<cos ψ * sin ψ>

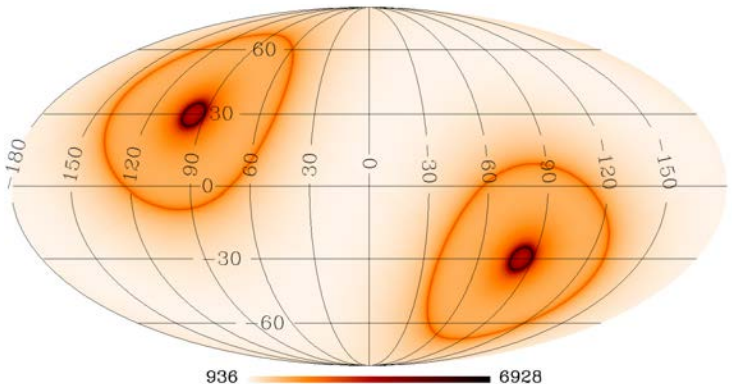


α = 22 deg
β = 73 deg

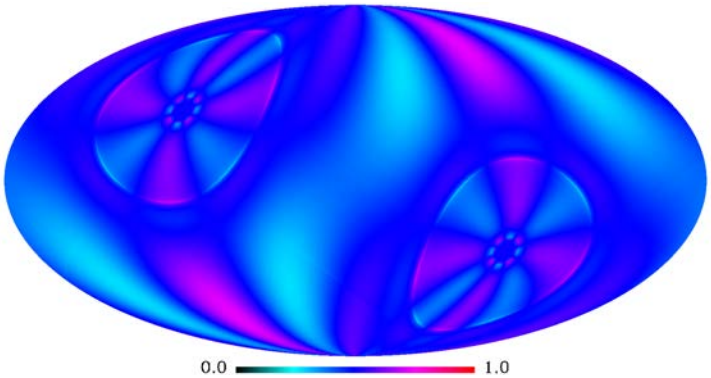
T_{spin} = 60 sec

$T_{precession}$ = 6 hrs

N_{obs}



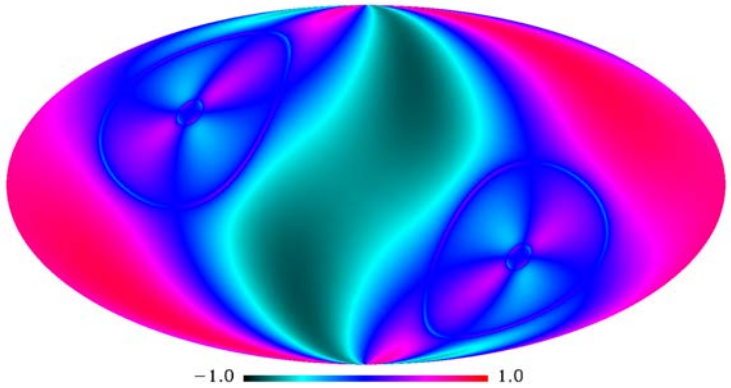
<sin^2 ψ>



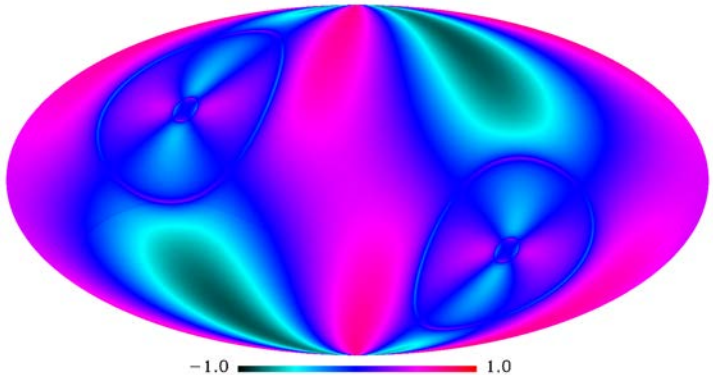
1 year scan

Reduced resolution:
10 arcmin sampling
on the sky

<cos 2ψ>



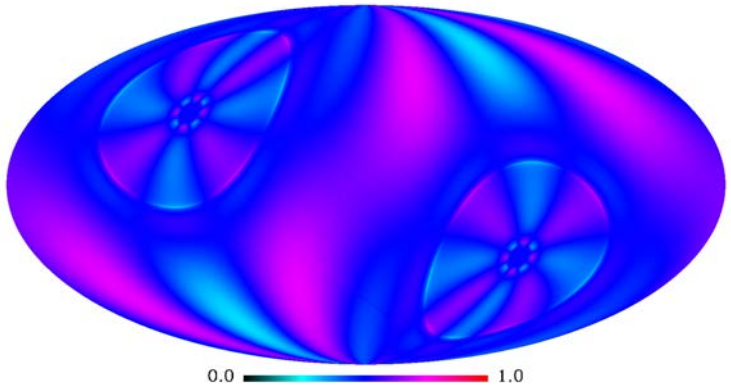
<sin 2ψ>



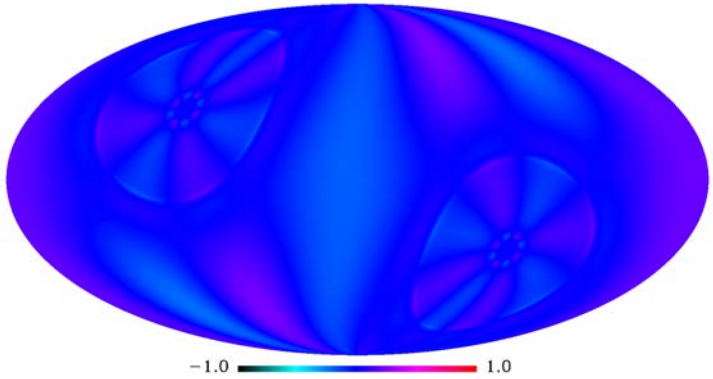
Example 3:

fast spin
&
fast precession

<cos^2 ψ>



<cos ψ * sin ψ>

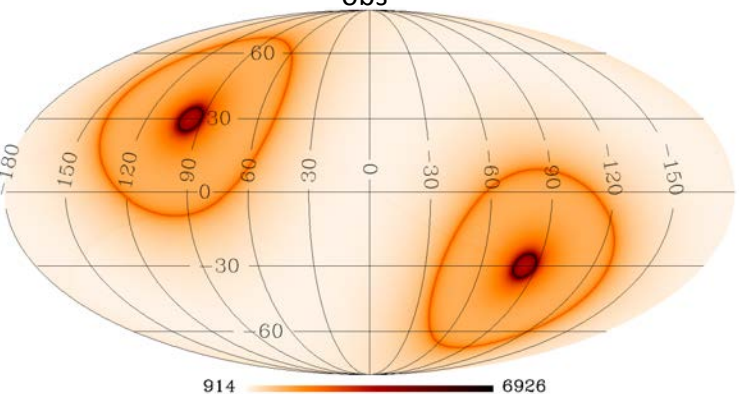


α = 22 deg
β = 73 deg

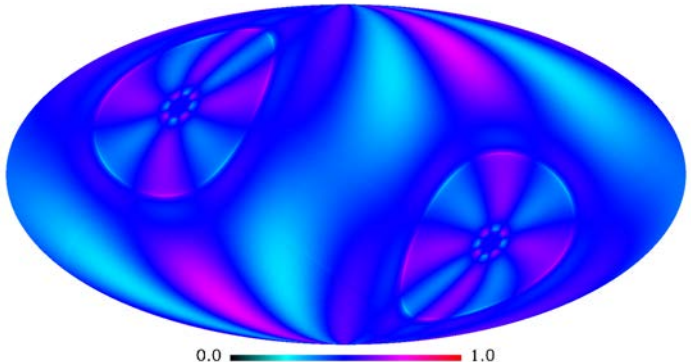
T_{spin} = 60 sec

$T_{precession}$ = 12 hrs

N_{obs}

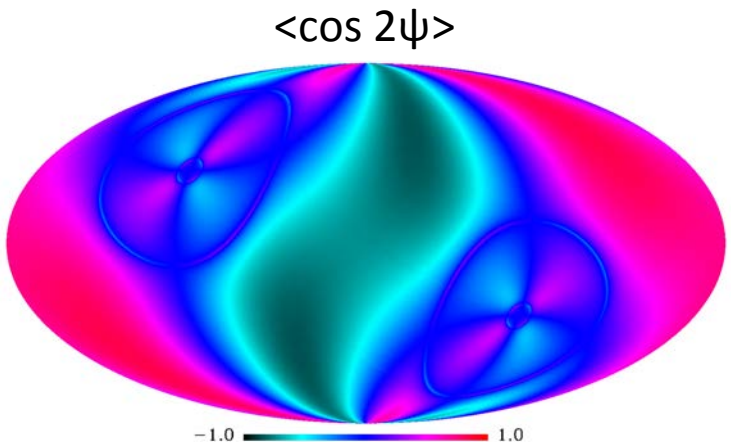


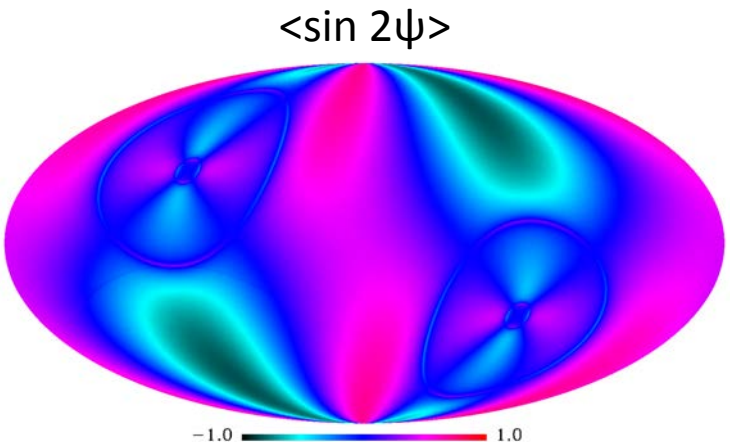
<sin^2 ψ>

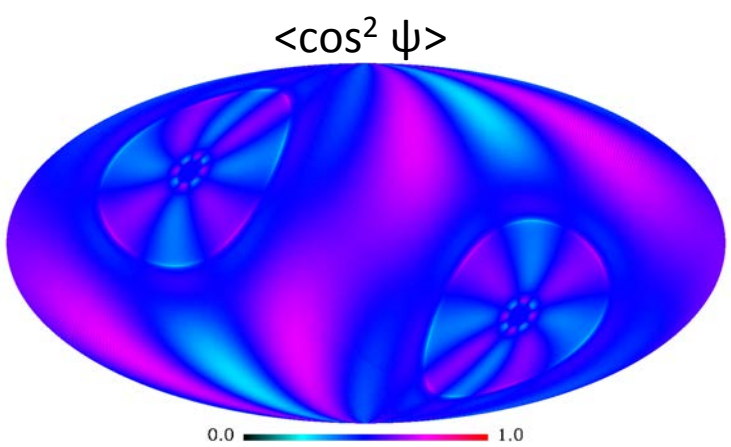


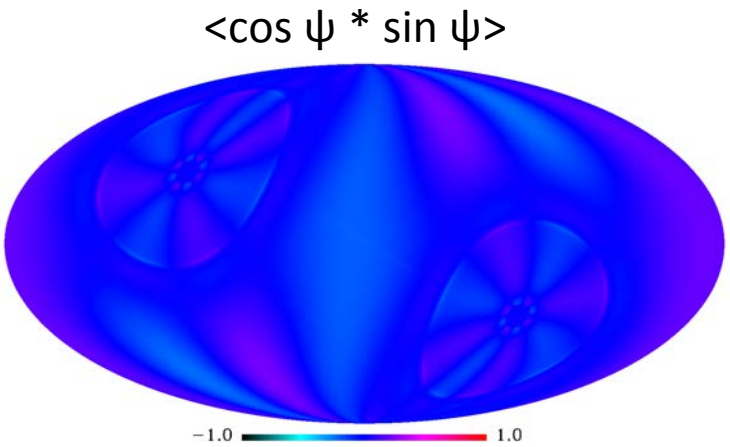
1 year scan

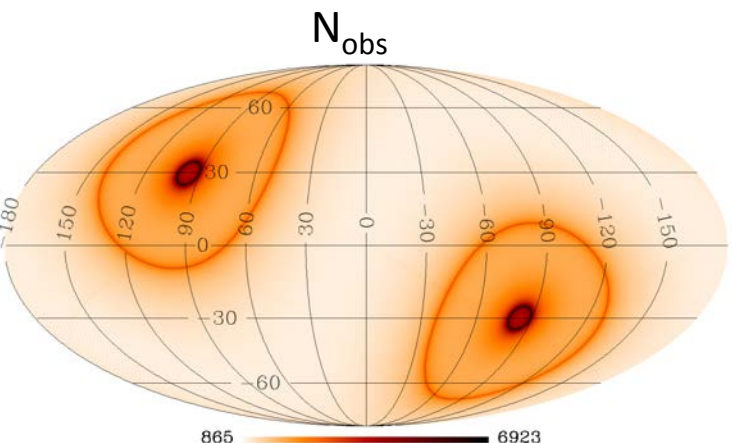
Reduced resolution:
10 arcmin sampling
on the sky

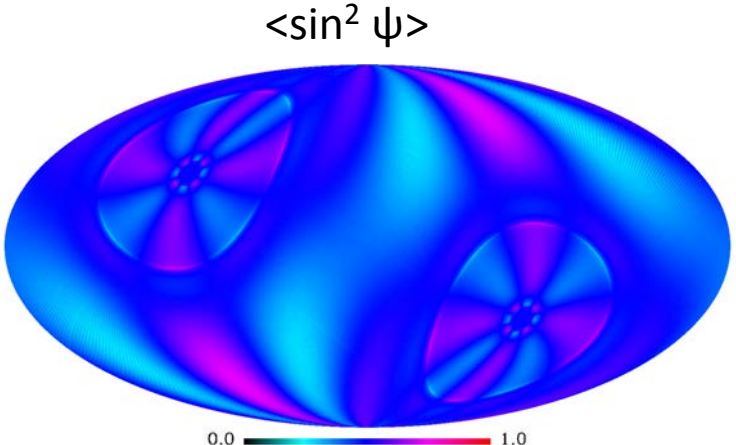












Example 4:

fast spin
&
fast precession

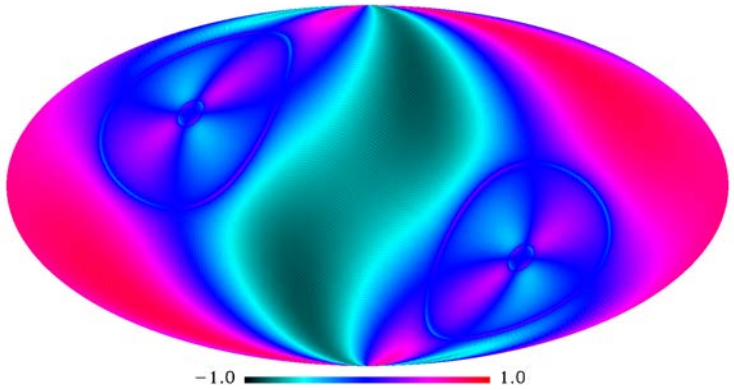
α = 22 deg
β = 73 deg

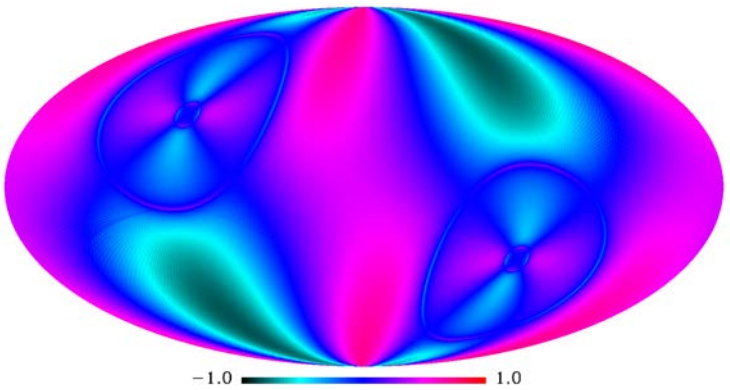
T_{spin} = 60 sec

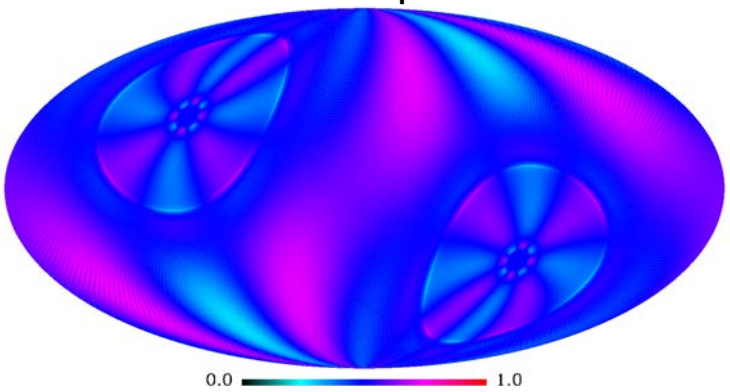
$T_{precession}$ = 24 hrs

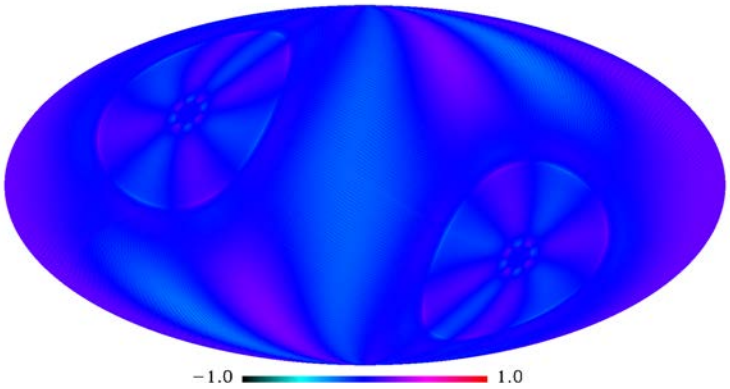
1 year scan

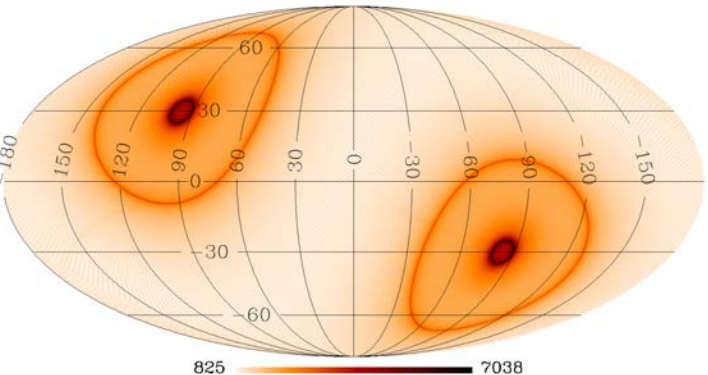
Reduced resolution:
10 arcmin sampling
on the sky

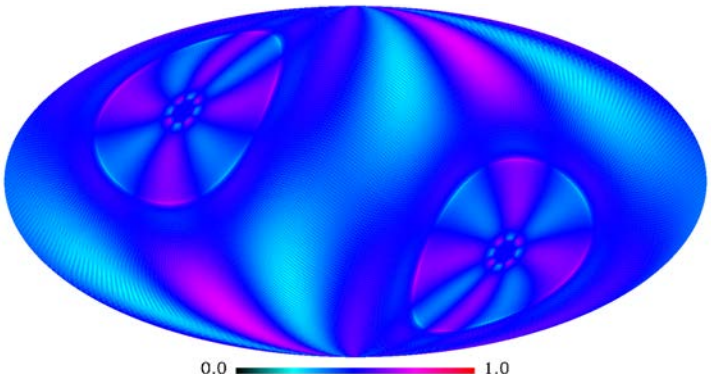












Example 5:

fast spin
&
slower
precession

α = 22 deg
β = 73 deg

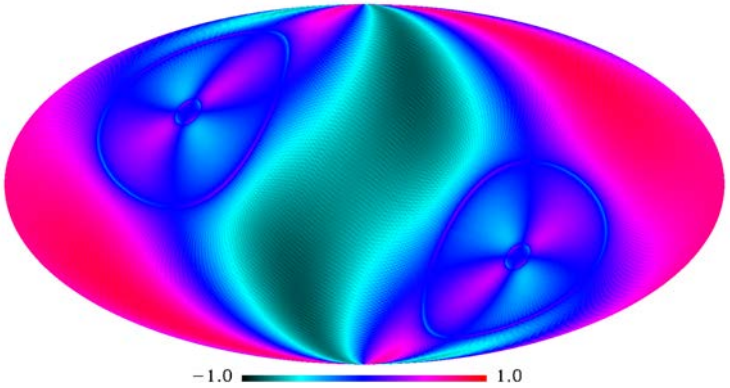
T_{spin} = 60 sec

$T_{precession}$ = 36 hrs

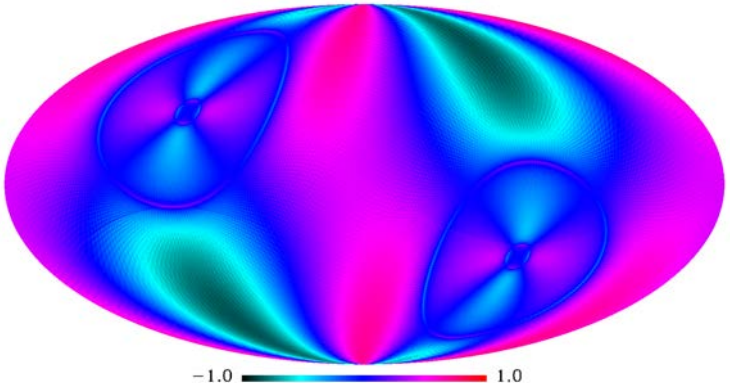
1 year scan

Reduced resolution:
10 arcmin sampling
on the sky

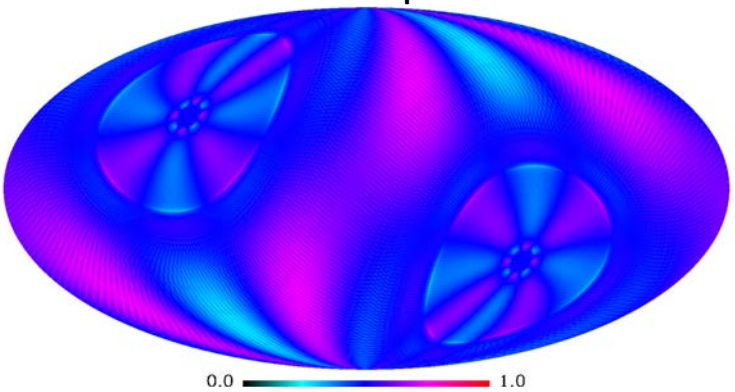
<cos 2ψ>



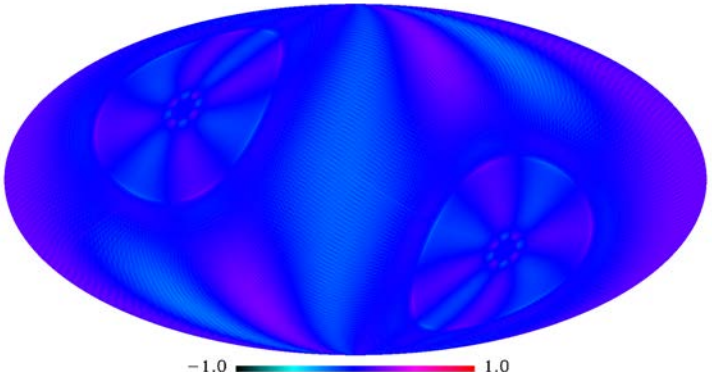
<sin 2ψ>



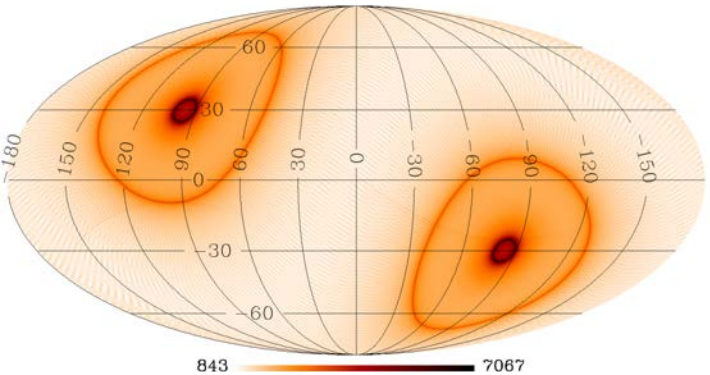
<cos^2 ψ>



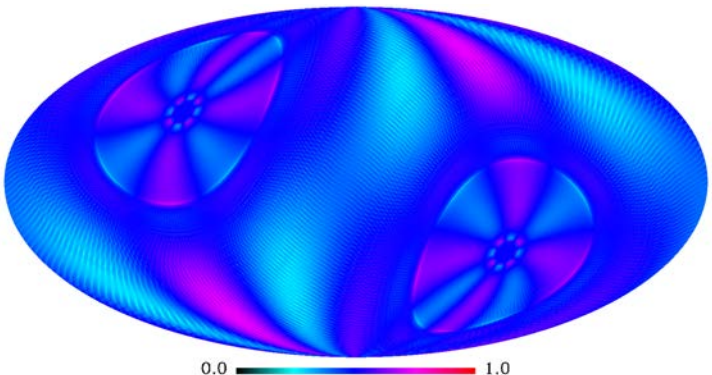
<cos ψ * sin ψ>



N_{obs}



<sin^2 ψ>



Example 6:

fast spin
&
slower
precession

α = 22 deg
β = 73 deg

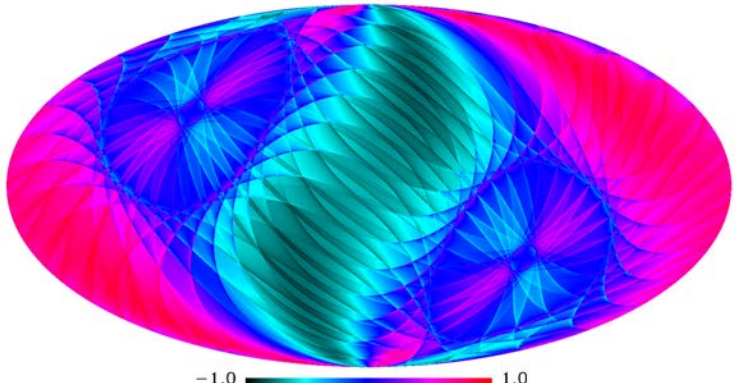
T_{spin} = 60 sec

$T_{precession}$ = 48 hrs

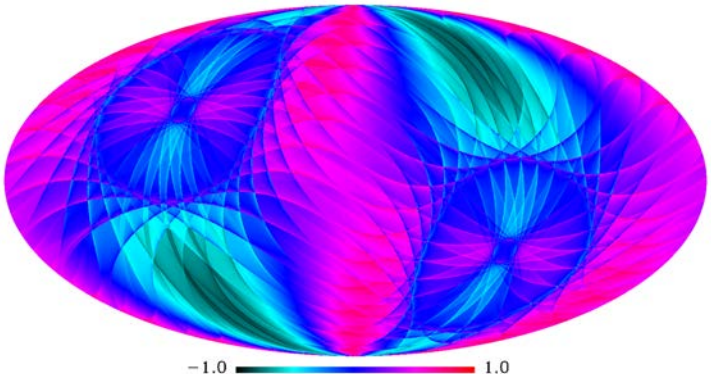
1 year scan

Reduced resolution:
10 arcmin sampling
on the sky

<cos 2ψ>



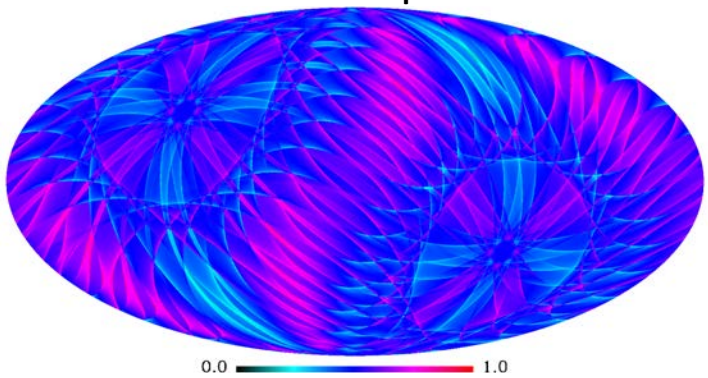
<sin 2ψ>



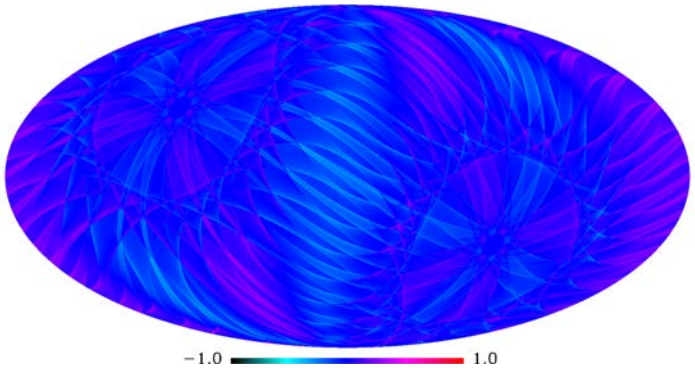
Example 7:

fast spin
&
slow precession

<cos^2 ψ>



<cos ψ * sin ψ>

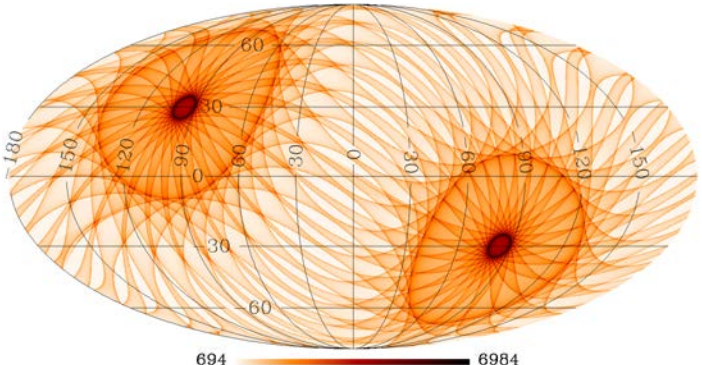


α = 22 deg
β = 73 deg

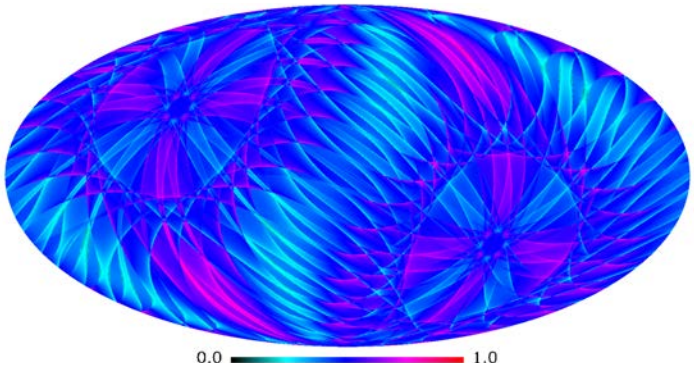
T_{spin} = 60 sec

$T_{precession}$ = 2 weeks

N_{obs}



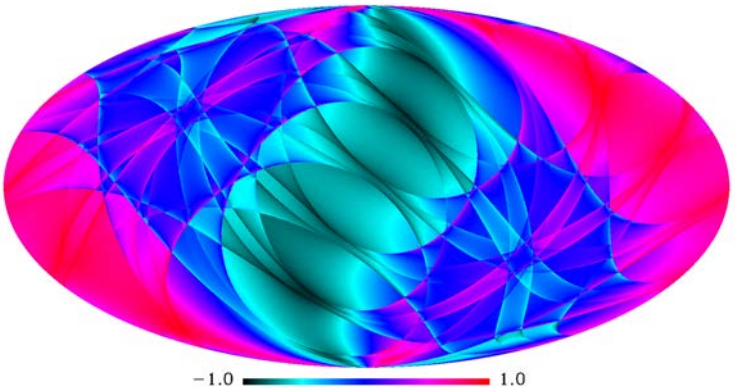
<sin^2 ψ>



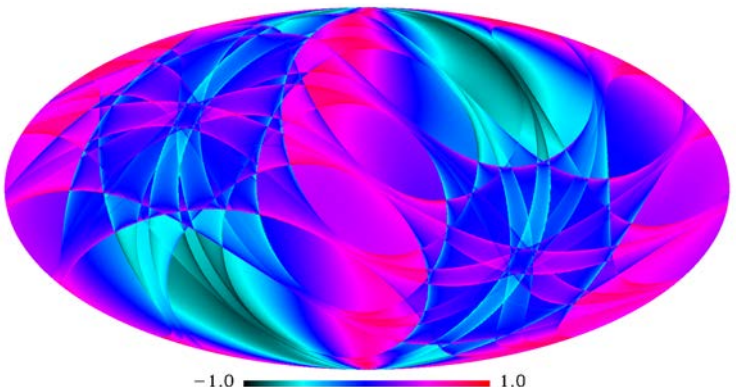
1 year scan

Reduced resolution:
10 arcmin sampling
on the sky

<cos 2ψ>



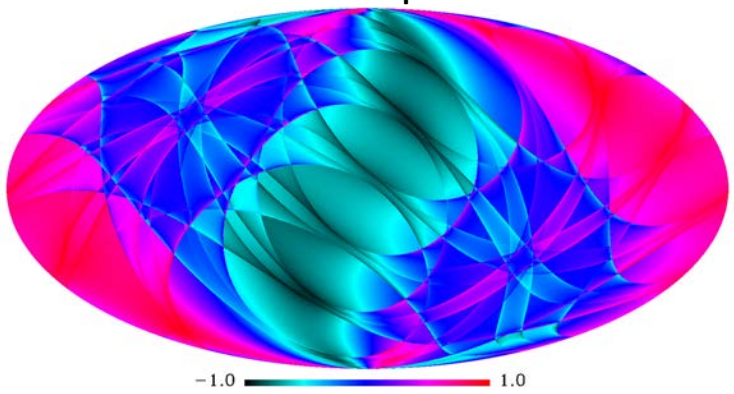
<sin 2ψ>



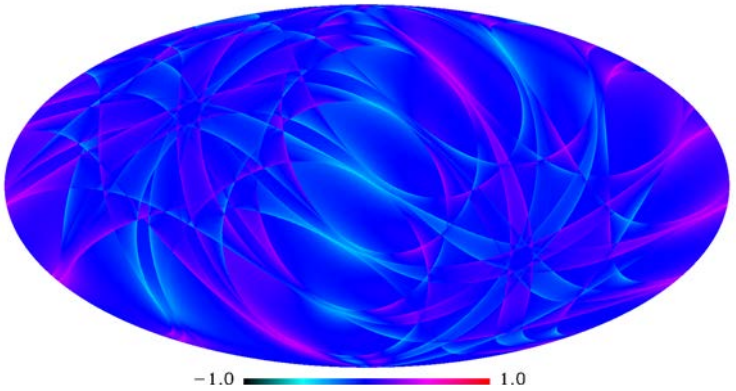
Example 8:

fast spin
&
slow precession

<cos^2 ψ>



<cos ψ * sin ψ>

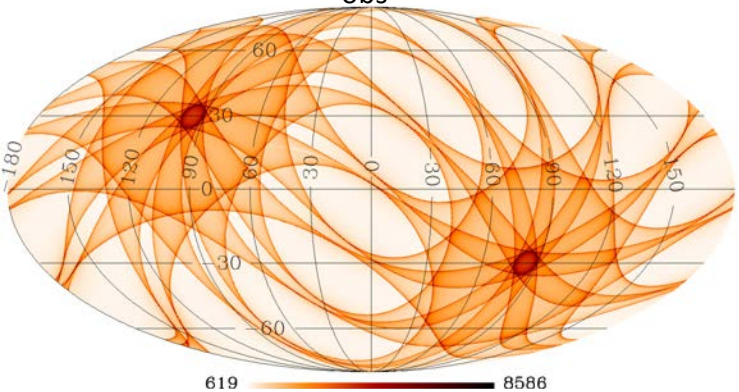


α = 22 deg
β = 73 deg

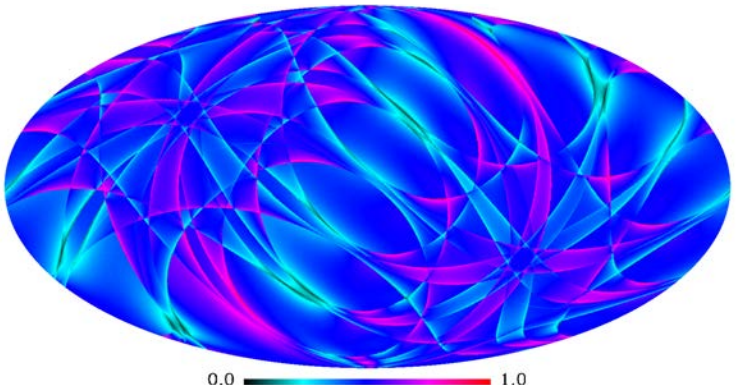
T_{spin} = 60 sec

$T_{precession}$ = 1 month

N_{obs}

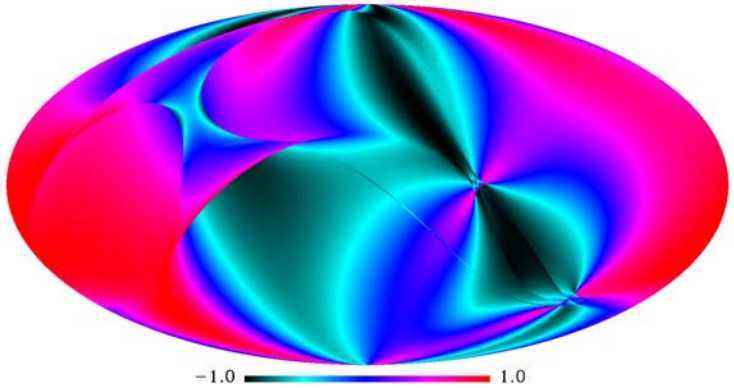


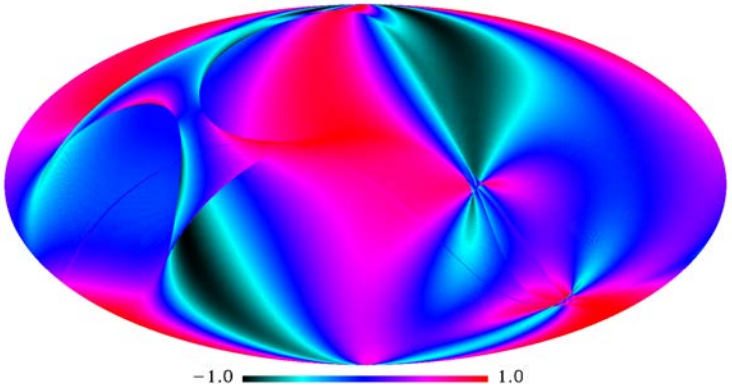
<sin^2 ψ>

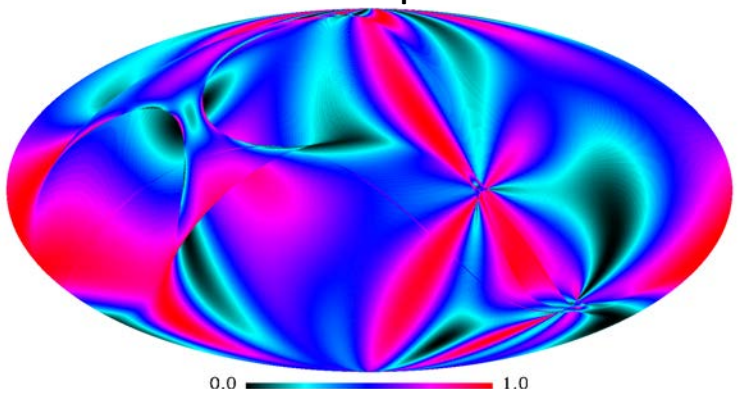


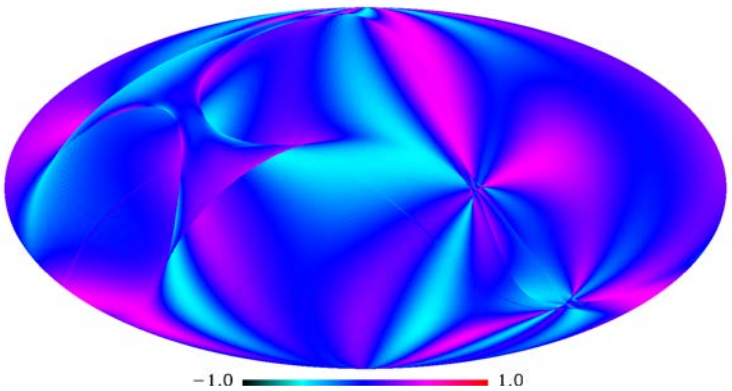
1 year scan

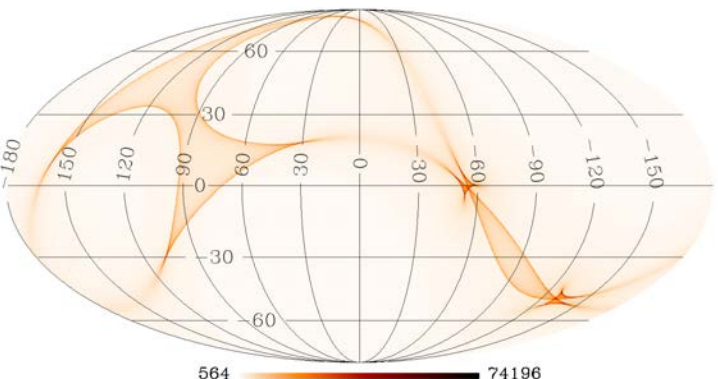
Reduced resolution:
10 arcmin sampling
on the sky

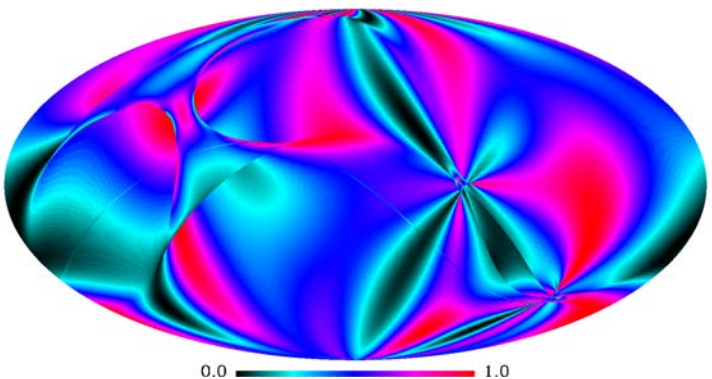












Example 9:

fast spin
&
slow precession

α = 22 deg
β = 73 deg

T_{spin} = 60 sec

$T_{precession}$ = 6 months

1 year scan

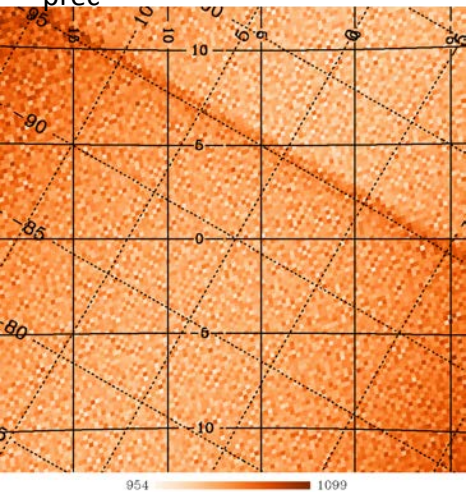
Reduced resolution:
10 arcmin sampling
on the sky

What precession rate makes sense

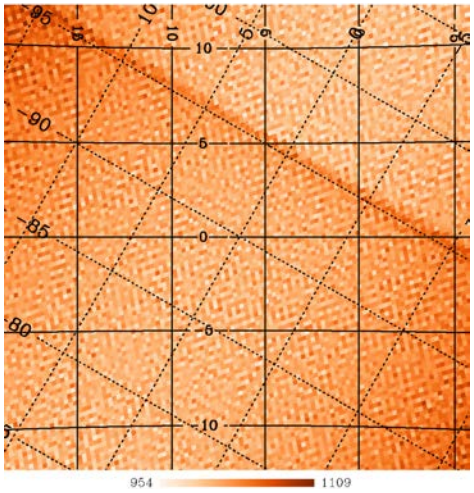
- Previous larges scale plots appear OK up to about precession period of ~2 days, but they should be inspected at smaller scales
- Next page shows a zoom at ~25degx25deg area of N_obs near the crossing of the Ecliptic and the galactic equator(plotted in galactic frame); it is clear that (ecliptic) longitudinal inhomogeneity of N_obs sets in already below ~12 hrs of precession period; I think that more refined inspection will reveal that a reasonable range is for precession periods < ~10hrs.

All: T_{spin} = 1 min, β = 73 deg, α = 22 deg, 1 year scan, det_angle = 45 deg, N_{side} = 256

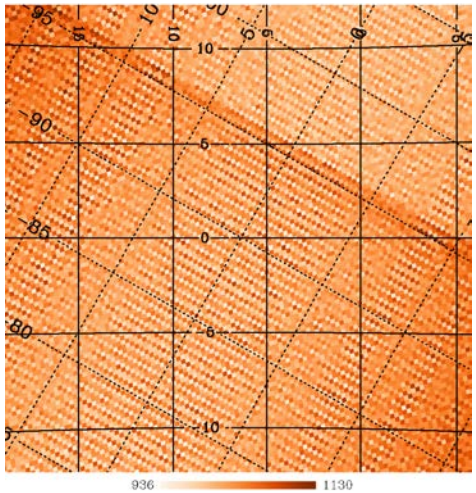
T_{prec} = 3 hrs



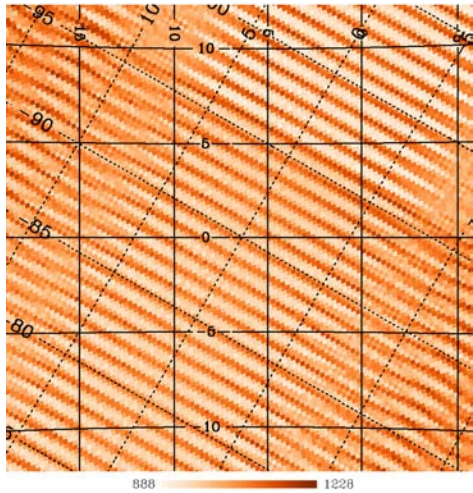
6 hrs



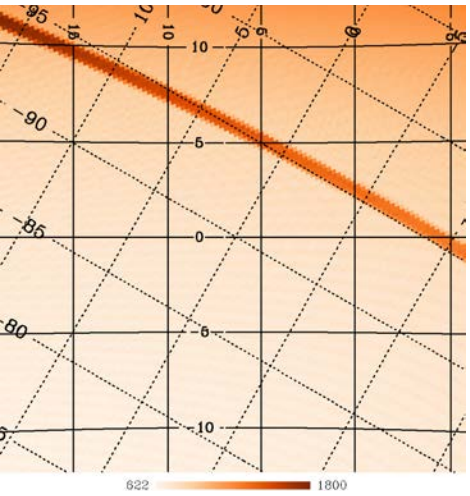
12 hrs



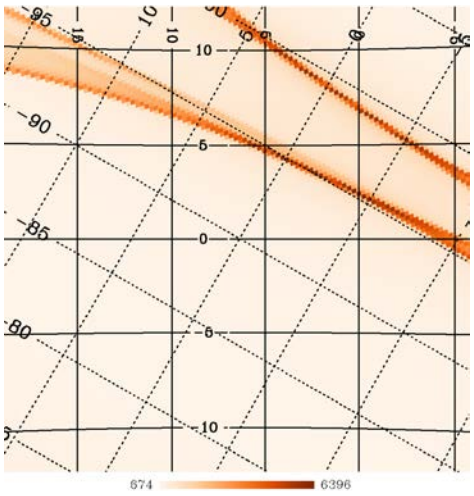
24 hrs



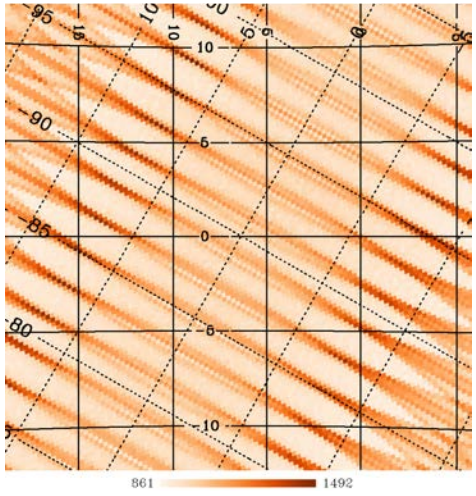
T_{prec} = 6 months



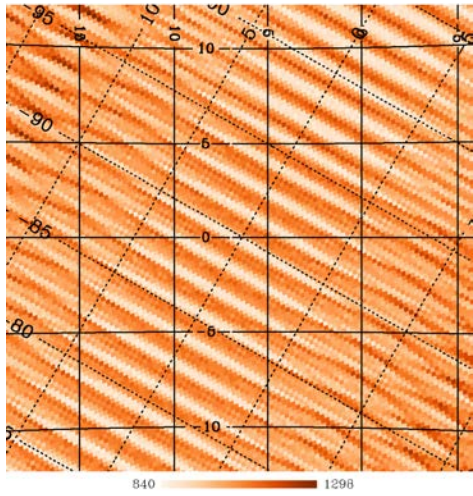
1 month



48 hrs



36 hrs



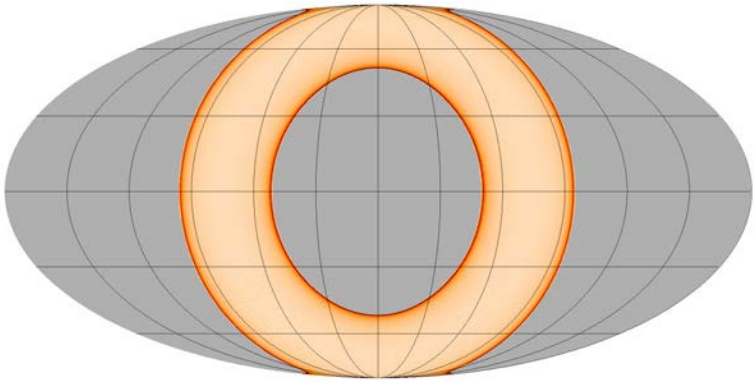
Short scans

how much sky gets observed
before full sky is seen in ~6months

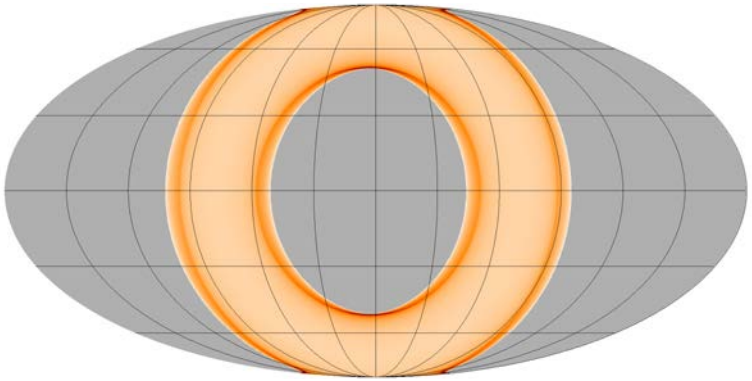
Essentially a repeat of WMAP given these scanning parameters

β=73deg, α=22deg, spin=60sec, precession~3hrs

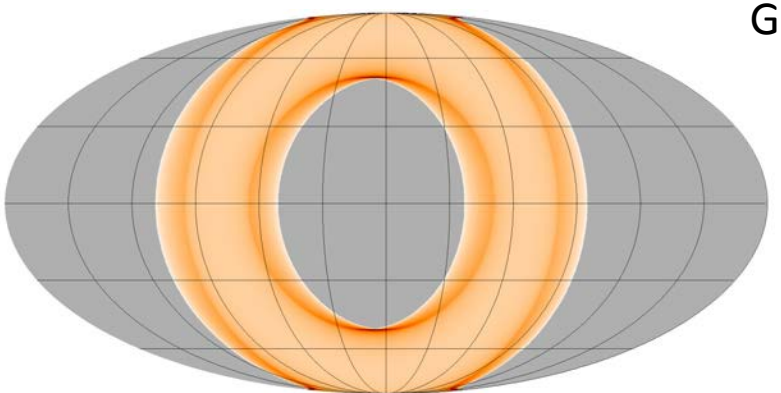
Scan 1day



7 days

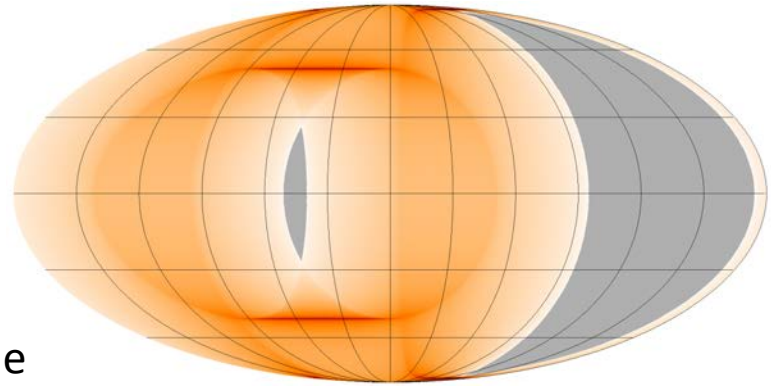


14 days



Plots in ecliptic frame
East->left,
Graticule 30x30 deg

3 months



1 month