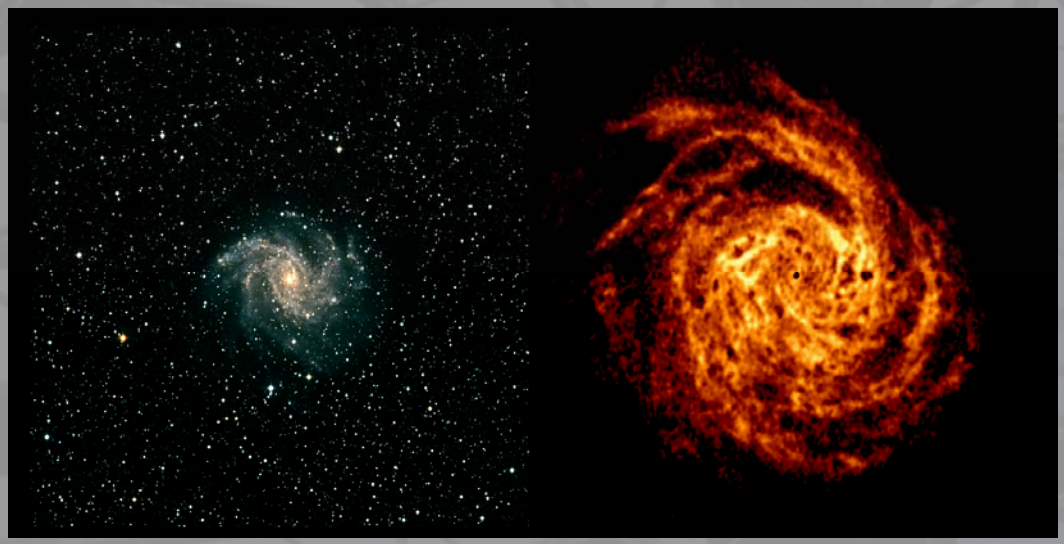
1. Image-plane effects in WSRT data (peeling)
2. WSRT-LFFE as prototype for Lofar

WSRT Peeling

For LFFE (& Lofar): need different calibration for different directions
→PSS (peeling)

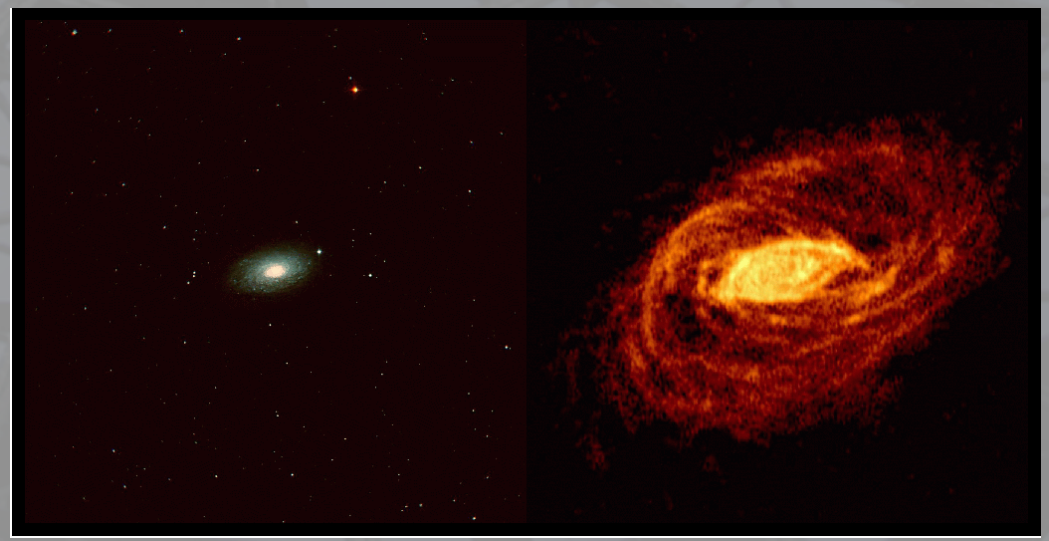
Also needed for WSRT at higher frequencies, even L band

WSRT can make nice images!



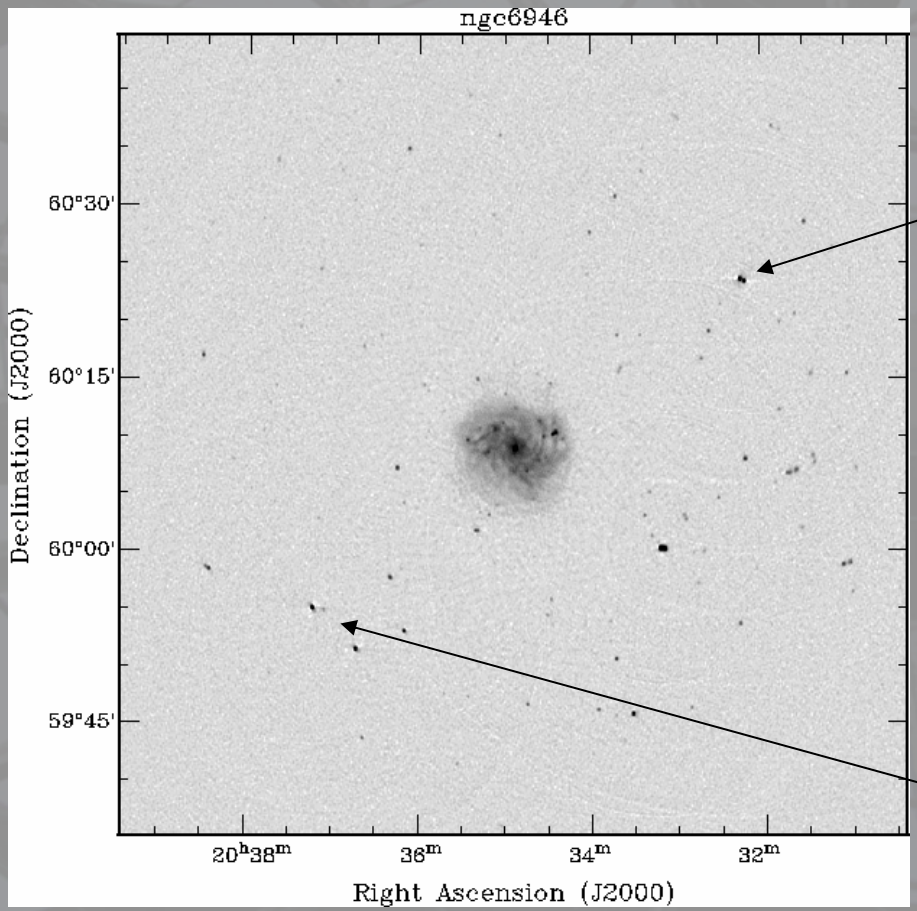
NGC 6946 H I; Boomsma et al.

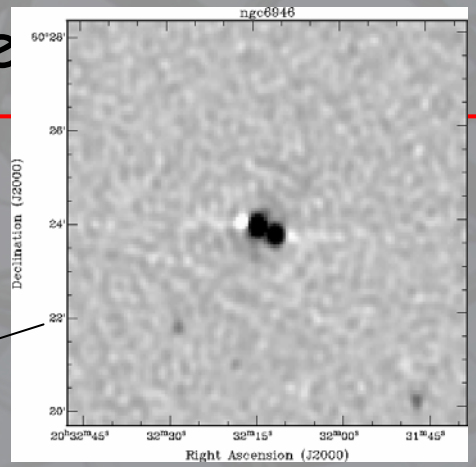
~ ½ degree

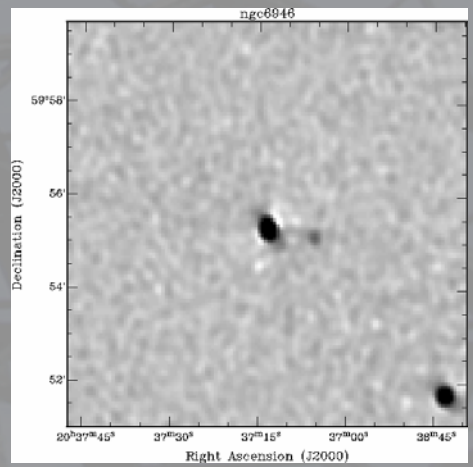


NGC 5055 H I; Battaglia et al.

WSRT can make fairly nice image



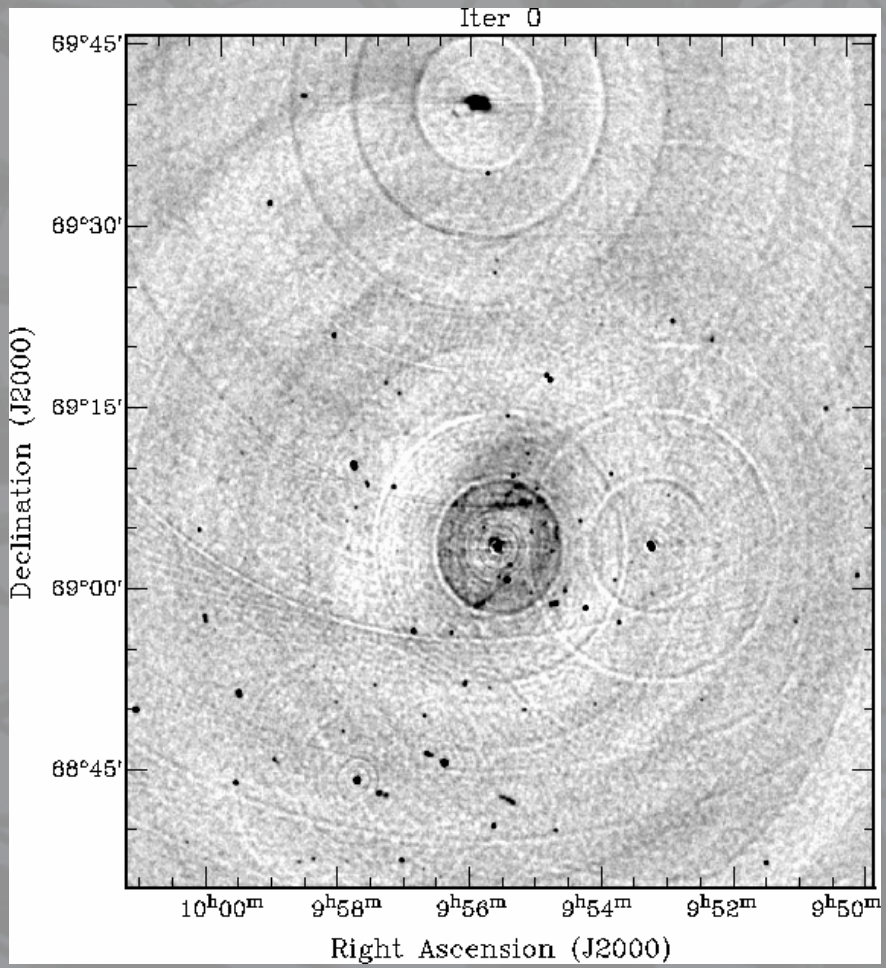




NGC 6946, L-band continuum

position dependent errors in image !!!!

WSRT can make very ugly images



~ 1 degree

M81 & M82, L-band continuum

Result of selfcal on entire field (this is a cleaned image!!!!)

- Position dependent errors
- Dynamic range ~50……

due to:

- pointing errors
- small differences between dishes
- different spectral response for off-axis sources (17 MHz ripple)
- …
- …

Peeling, the MIRIAD way

Normal assumption: 1 set of gains for entire field:

$$V_{1\text{-}2,\text{true}} = V_{1\text{-}2,\text{obs}} \cdot g_1 g_2^*$$
$$g = g(t,\nu) = a(t)\, b(\nu)$$

Clearly, this does not work for WSRT even at L band (let alone LFFE….)
Image plane effects forces use of patches:
separate calibration for different regions of the image

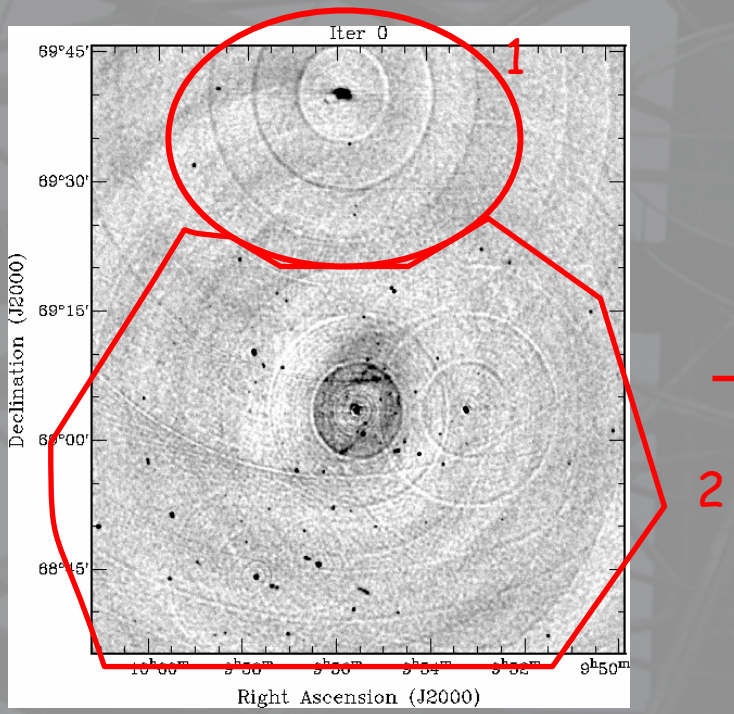
For <u>each patch:</u> $V_{1\text{-}2,\text{true}} = V_{1\text{-}2,\text{obs}} \cdot g_1 g_2^*$

so: $g = g(t,\nu|\text{patch}) = a(t|\text{patch})\, b(\nu|\text{patch})$

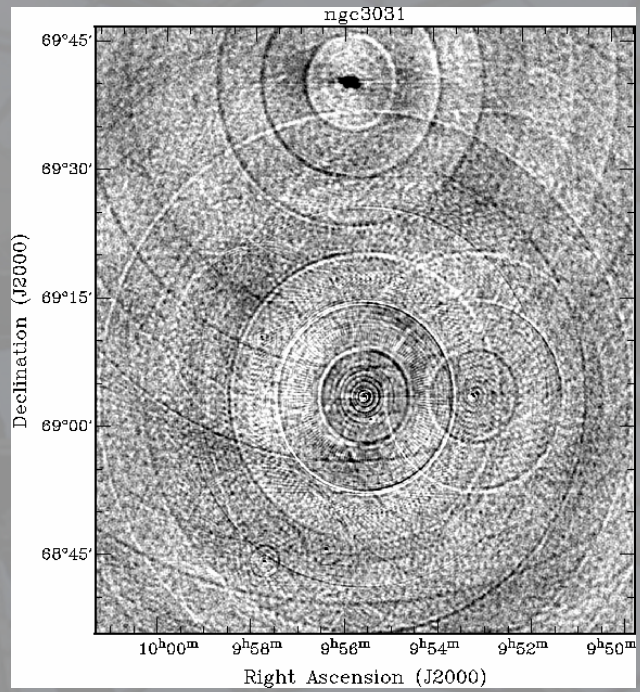
Time dependent gain *and* bandpass "position" dependent

Derive patch dependent gains

1: define patches



2: subtract model of patch 2 from patch 1



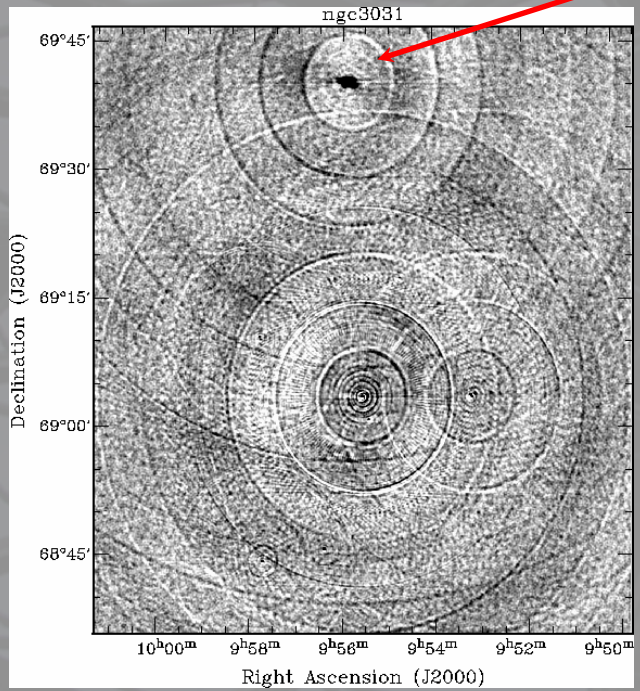
contains source + errors patch 1
+ errors patch 2
but not source patch 2

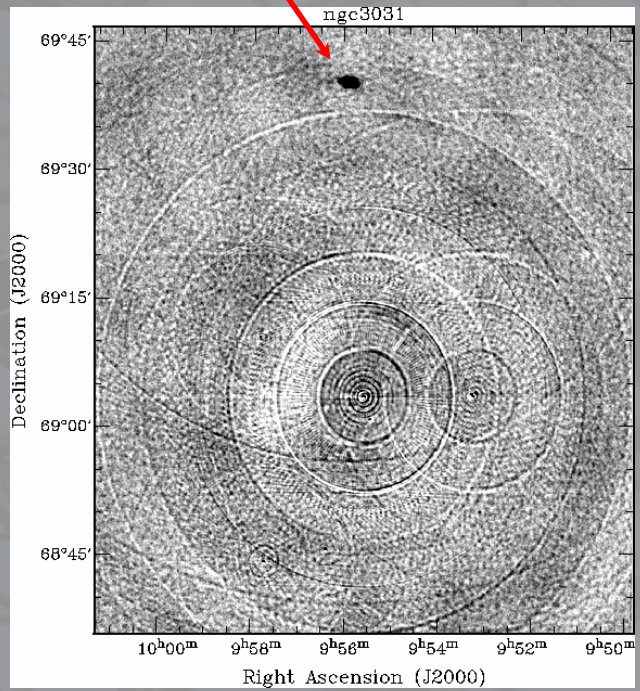
wide-band cleaned images!!!

Derive patch dependent gains

improvement for patch 1!!!!

3: selfcal patch 2
→extra gains for patch 2





contains source + errors patch 1
+ errors patch 2

contains source patch 1
+ errors patch 2

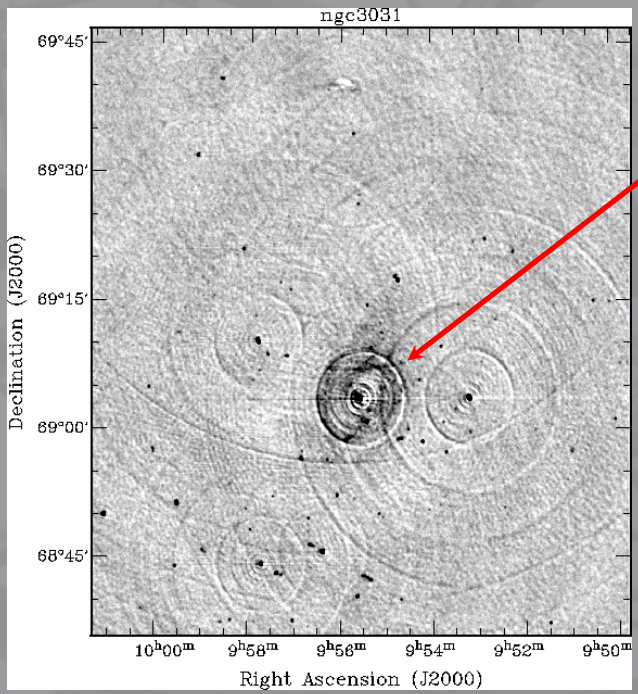
wide-band cleaned images!!!

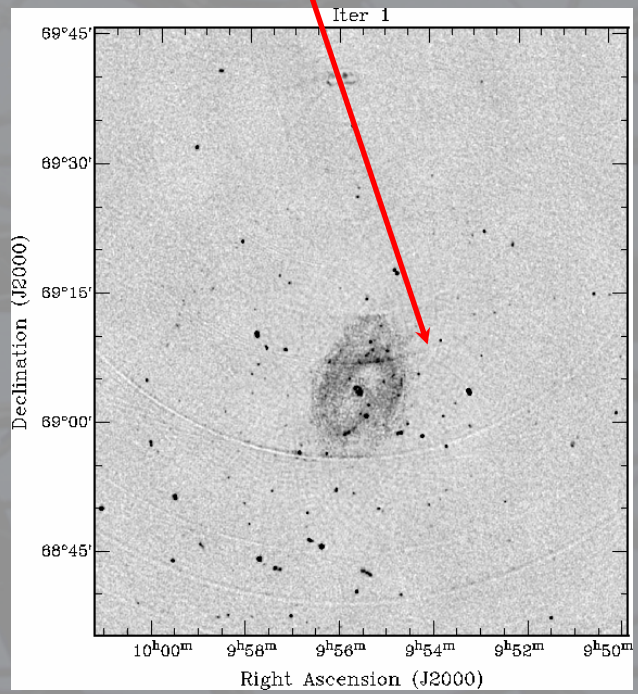
Derive patch dependent gains

improvement for patch 2!!!!

4: subtract better model of patch 1 from patch 2 (using extra gains)

5: selfcal patch 2



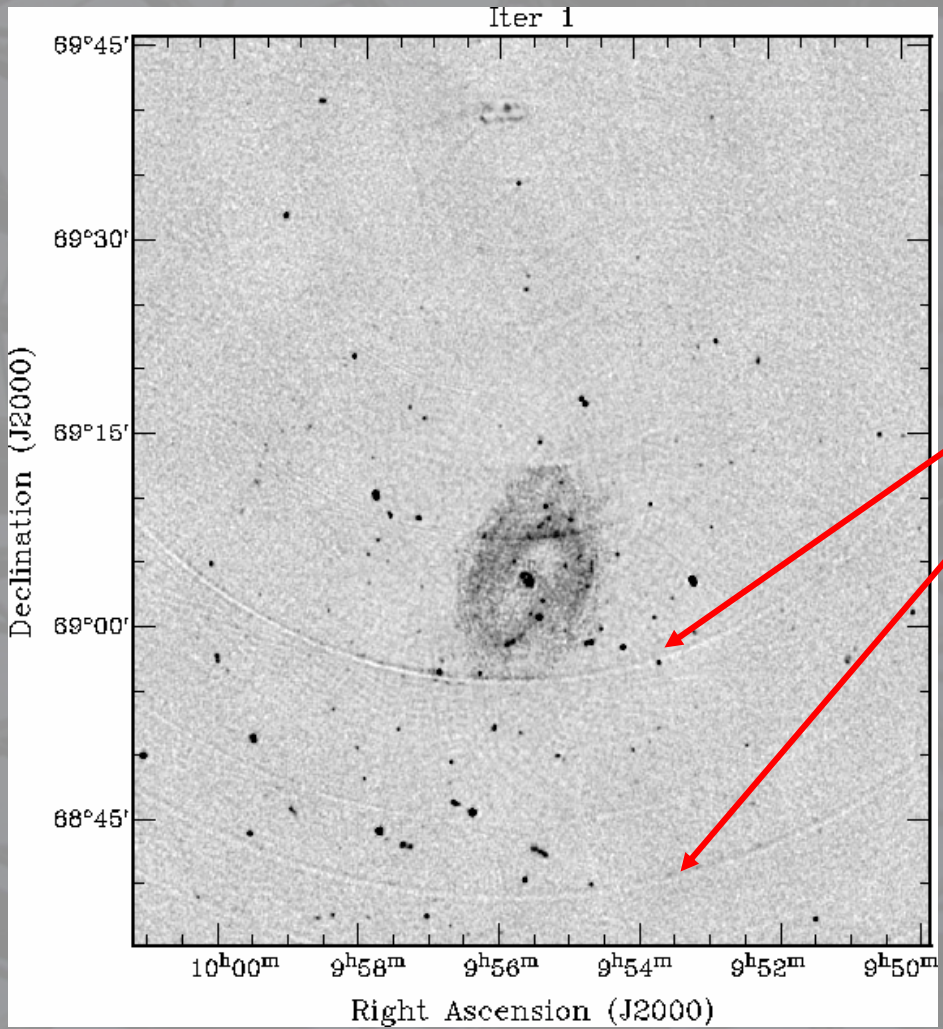


contains source patch 2
+ errors patch 2
patch 1 "completely" removed

contains source patch 2

wide-band cleaned images!!!

However…



Still rings in image

Have solved only for time part of gains

what remains are deconvolution errors due to difference in bandpass

For <u>each patch</u>: $V_{1\text{-}2,\text{true}} = V_{1\text{-}2,\text{obs}} \cdot g_1 g_2^*$

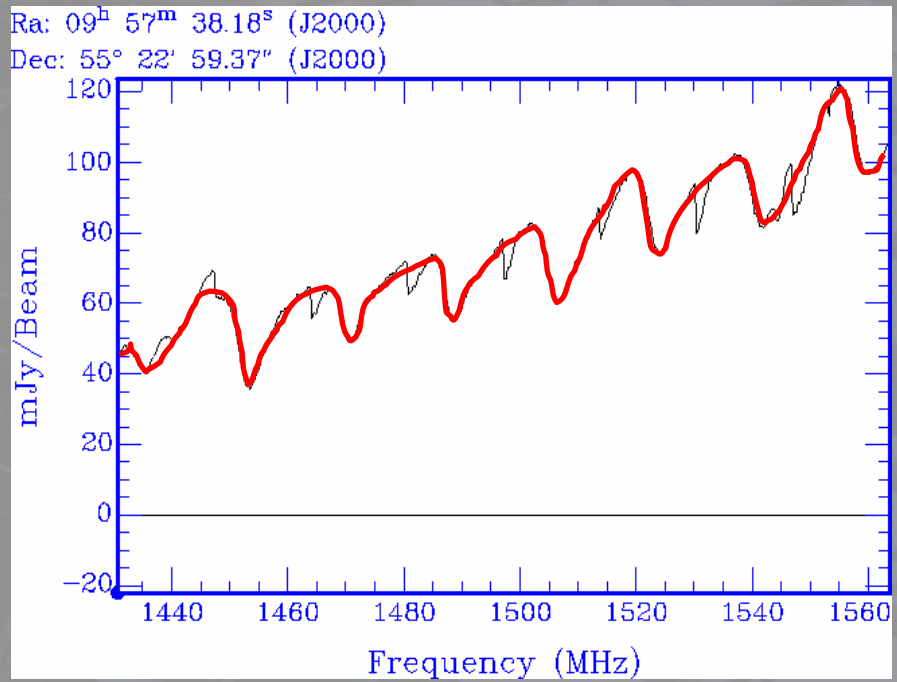
so: $g = g(t,\nu|\text{patch}) = a(t|\text{patch})\, b(\nu|\text{patch})$

The 17 MHz ripple….

Spectrum of off-axis source looks like

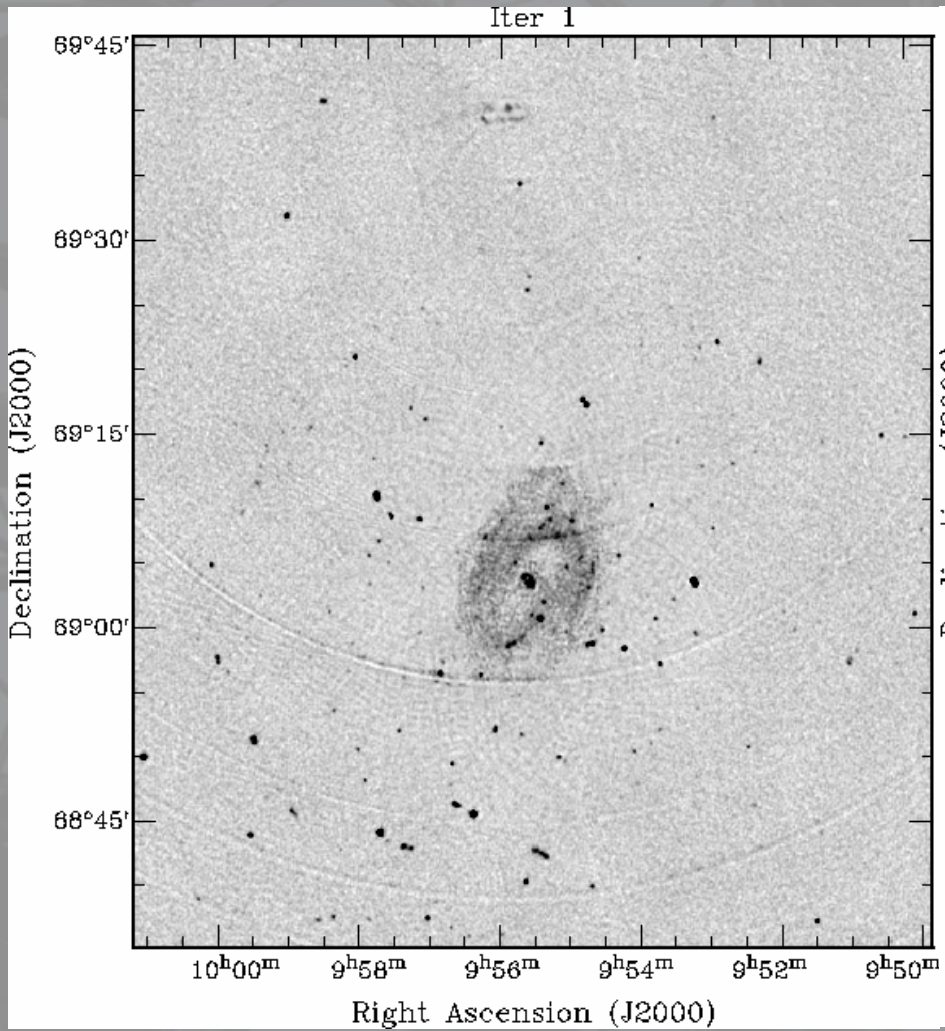
Even worse:
very different in X and Y

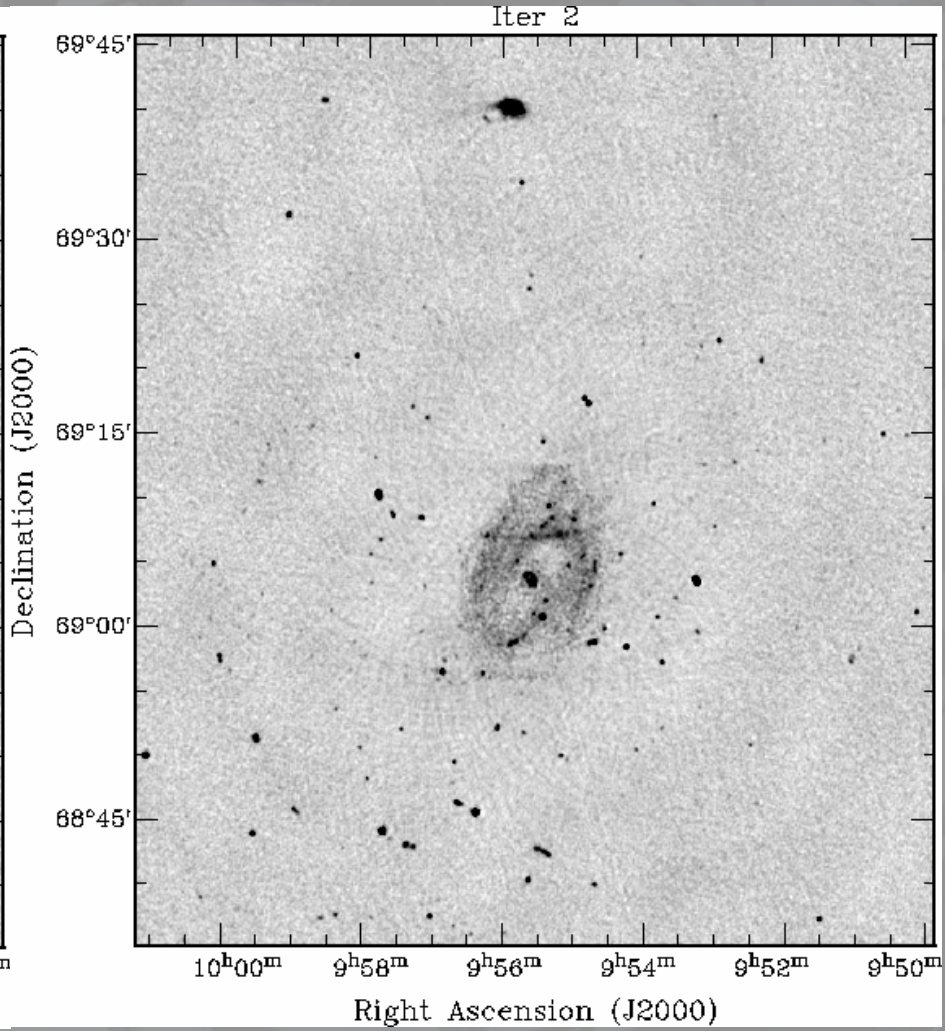
dark areas is where ripple is present



Large (30%!!!!) bumps in spectrum every 17 MHz.
Wide-band clean in Miriad assumes smooth spectrum (ν^{α})
→ leads to deconvolution errors

Also solve for extra bandpass for patch 1:

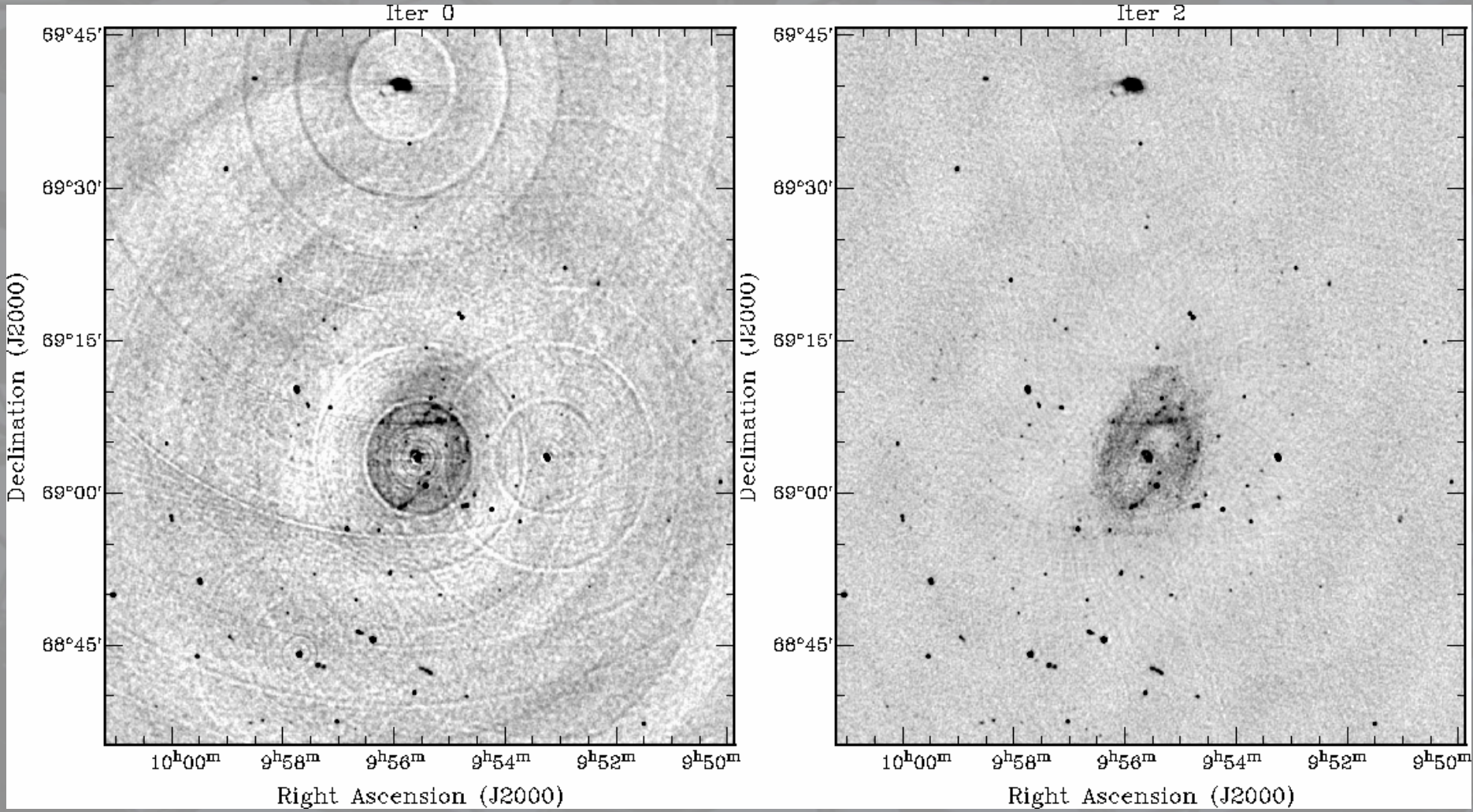




For <u>each patch:</u> $V_{1\text{-}2,\text{true}} = V_{1\text{-}2,\text{obs}} \cdot g_1 g_2^*$

so: $g = g(t,\nu|\text{patch}) = a(t|\text{patch})\, b(\nu|\text{patch})$

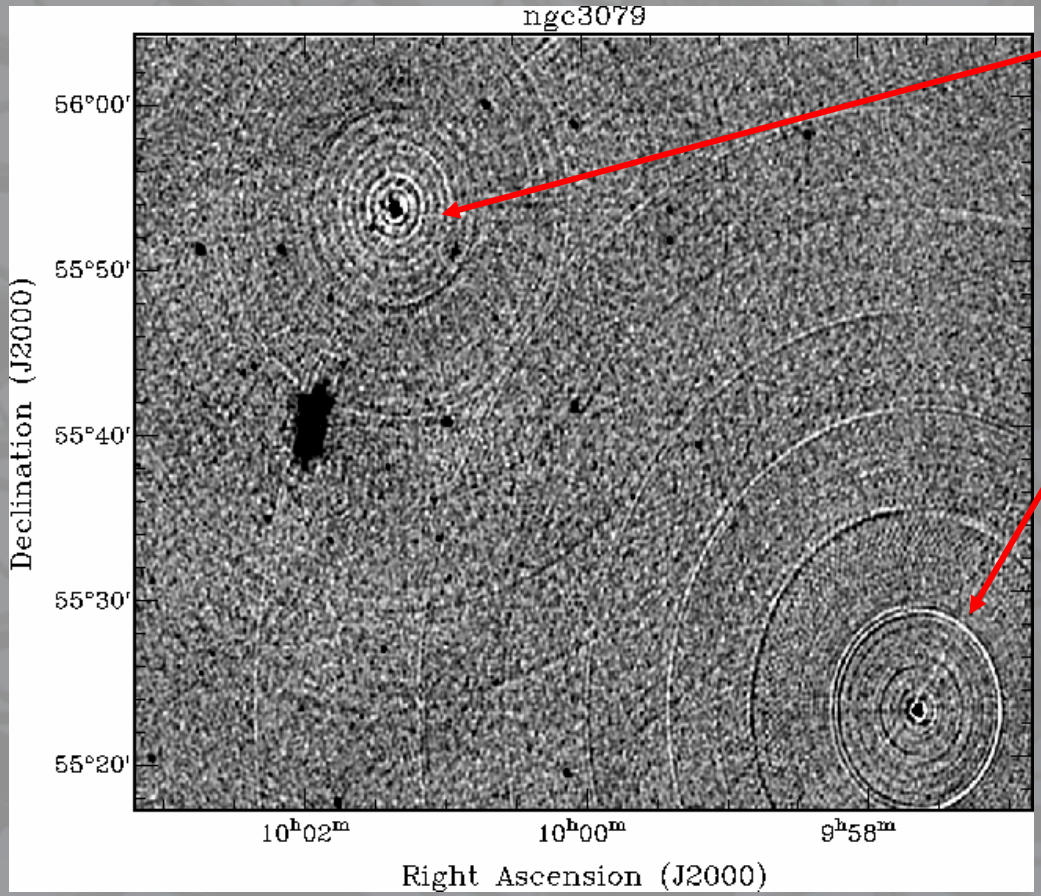
Peeling WSRT L-band data



standard selfcal entire field

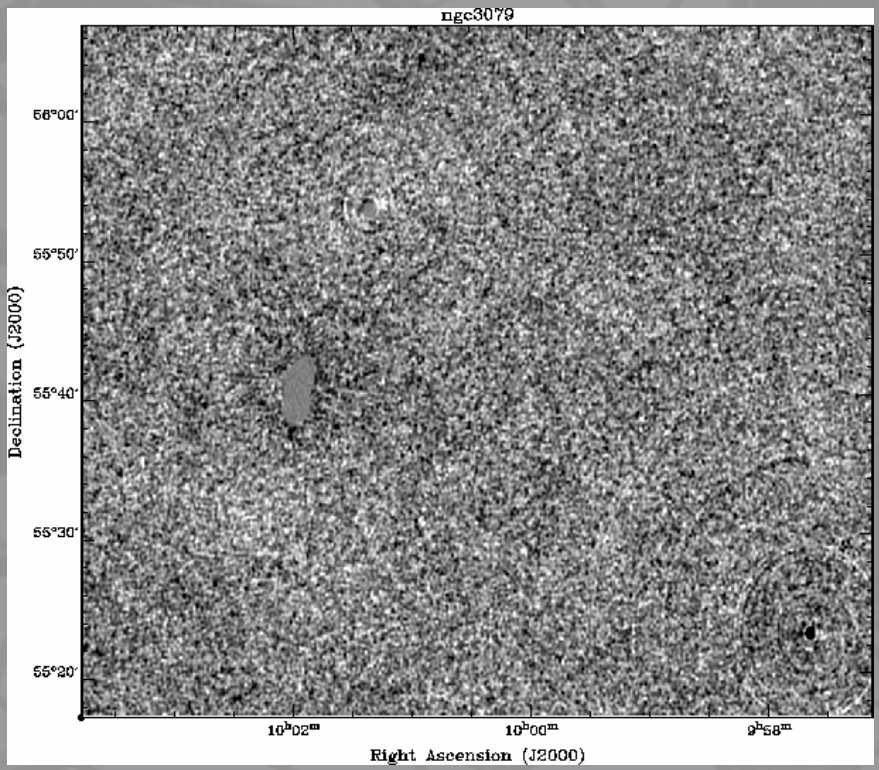
2-patch peeling (miriad)

other example: NGC 3079

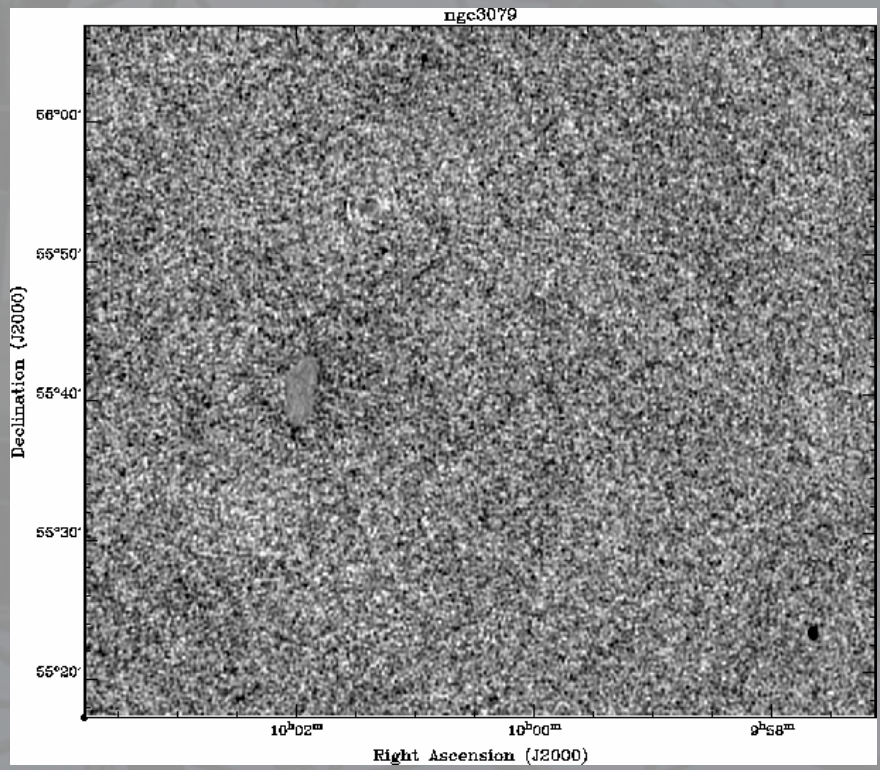


different errors around different sources

Need peeling!!!!

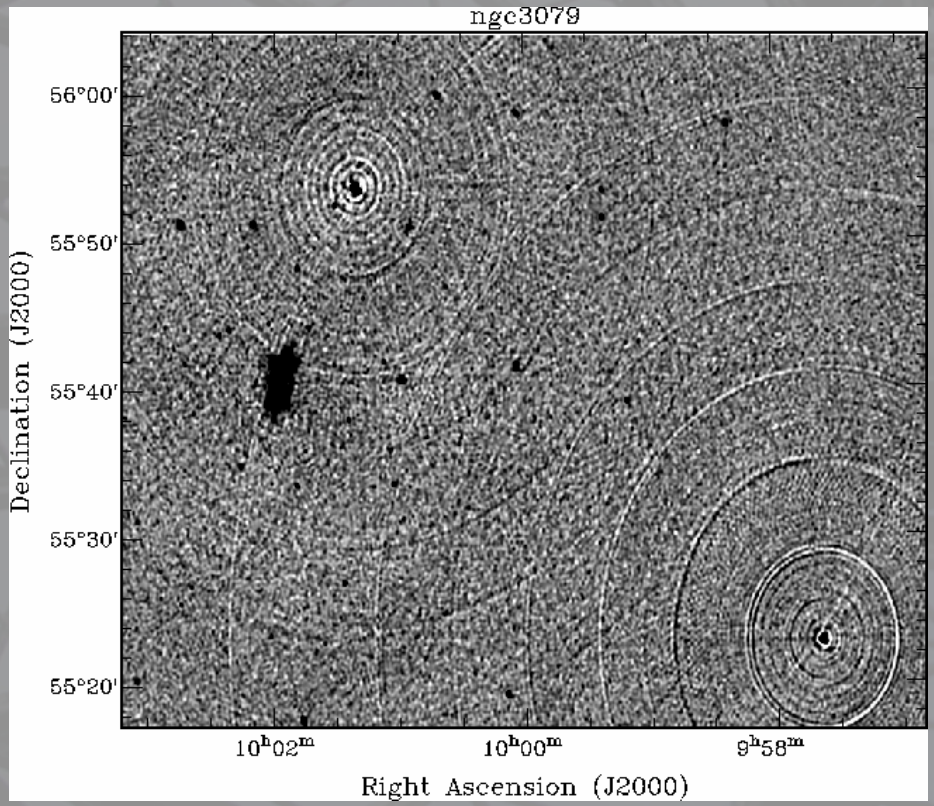


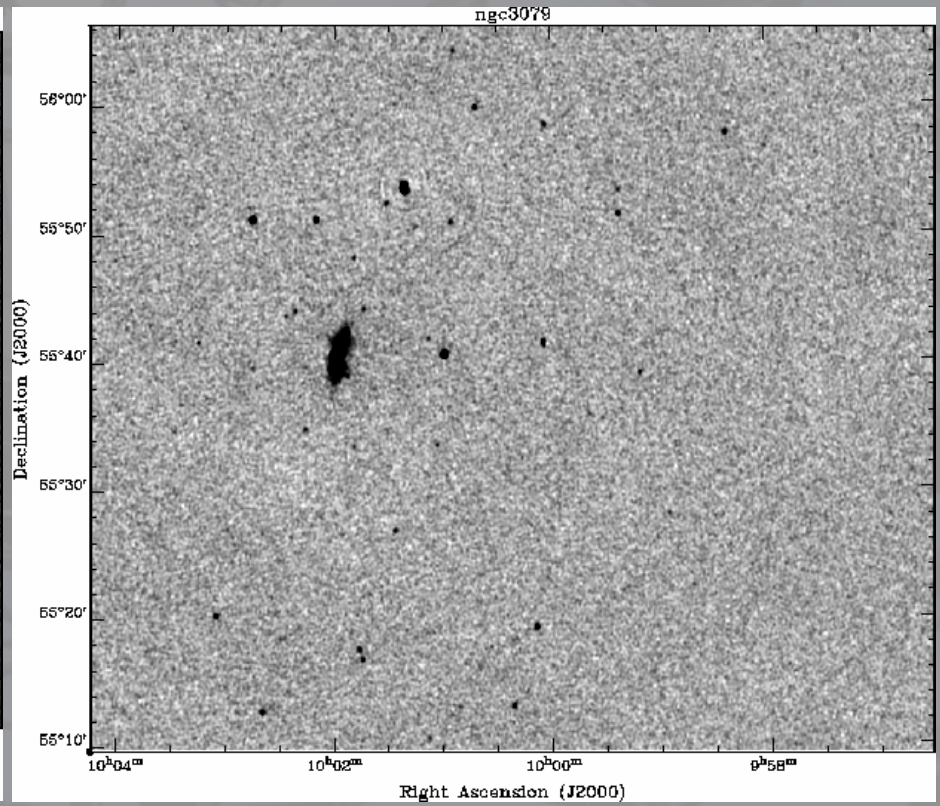
subtract model of all other patches



selfcal on patch alone

Problem solved





Peeling works OK in Miriad but

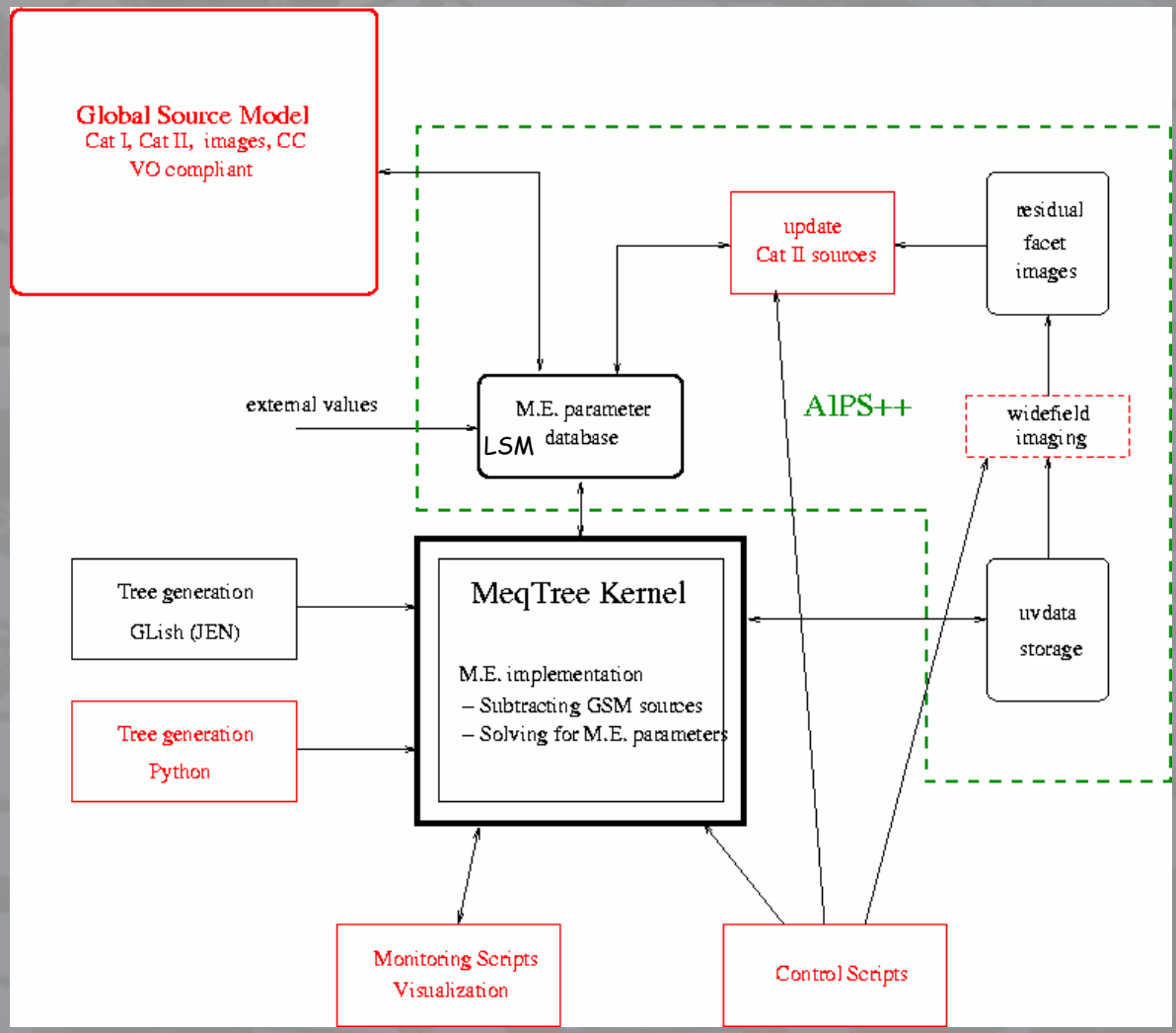
it is a lot of work!!!!

At L band doable (?) but for LFFE becomes unpractical
+ there are limitations →
need automated approach to patches and model subtraction

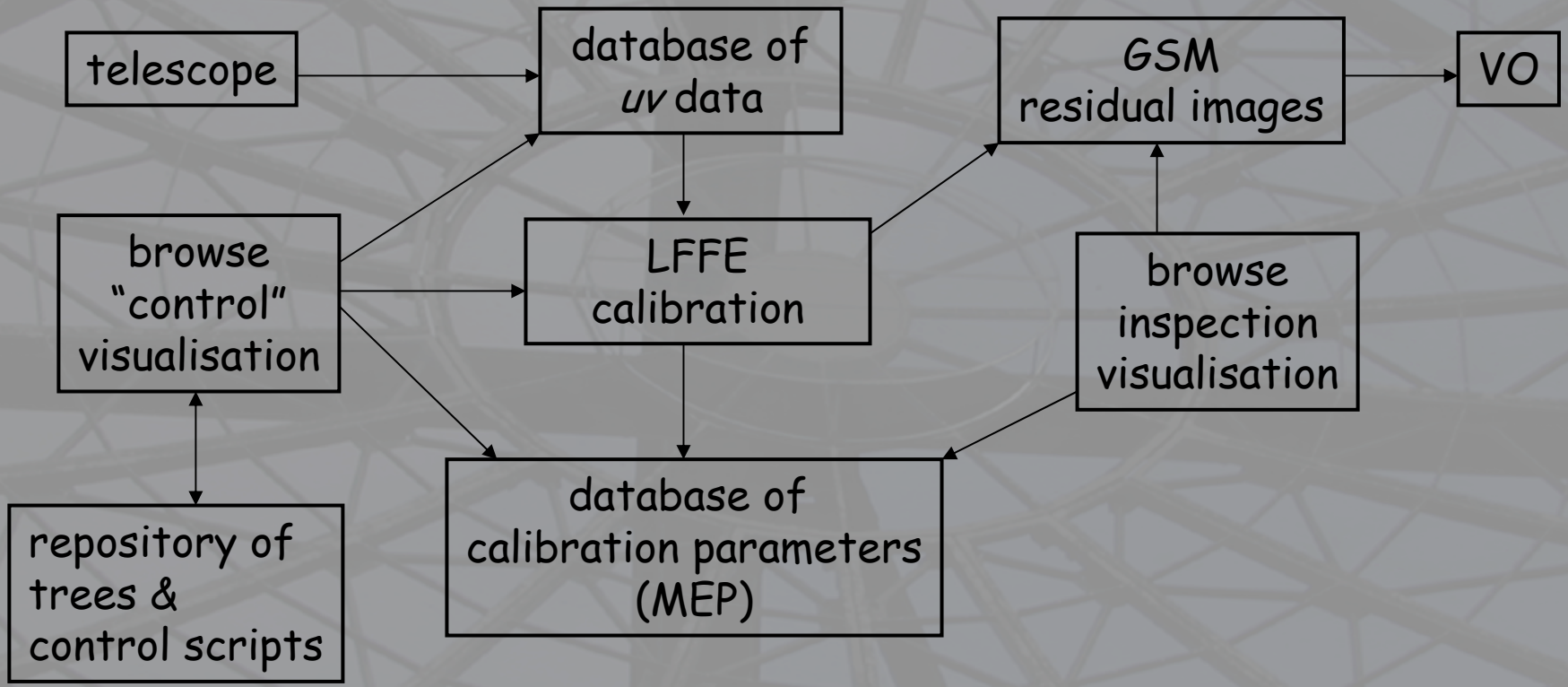
➔need PSS for WSRT
➔prototype Lofar "ideas" for LFFE

LFFE calibration

Heart of LFFE calibration



WSRT-LFFE dataflow: prototype Lofar ideas



Issues:

- how to offer calibration software to user?
- every LFFE observation is calibrated at observatory?
- provide user with calibration products (GSM + residual images)?
- provide user with trees & control scripts?
- browse not only archive of data but also archive of calibration parameters?
- offer GSM + residual images to Virtual Observatory?