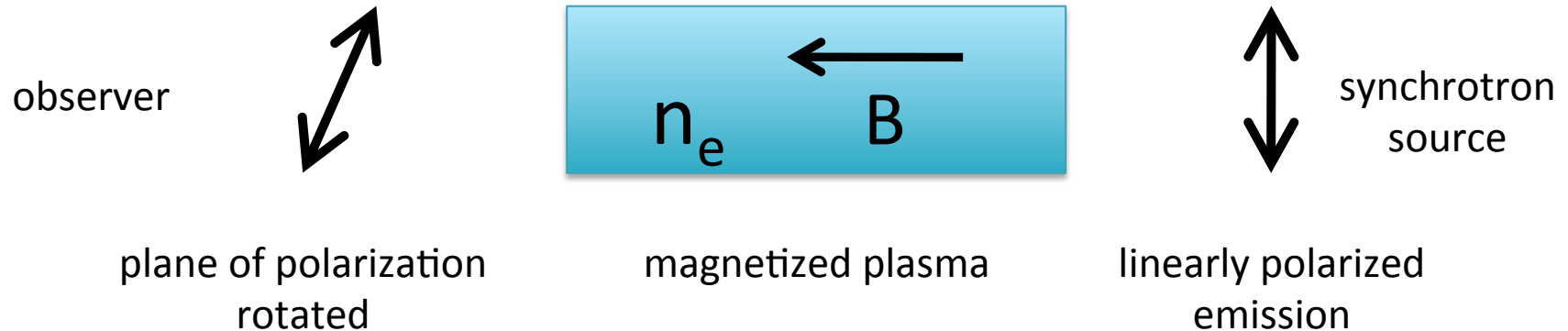


detection of Faraday rotation  
( $RM \sim 10^6 \text{ rad m}^{-2}$ ) toward 3c84  
(in NGC 1275, in the Perseus cluster)

Plambeck, Marrone, Bower, Hull,  
Fish, Doeleman, et al.

# Faraday rotation



- plane of polarization rotates as linearly polarized wave travels through a magnetized plasma
- $PA = PA_0 + RM \lambda^2$

## rotation measure

$$\text{RM} = 812 \int_0^L n_e \mathbf{B} \cdot d\mathbf{l} \text{ radians m}^{-2}$$

(  $n_e$  in  $\text{cm}^{-3}$ ,  $B$  in  $\mu\text{Gauss}$ ,  $dl$  in  $\text{kpc}$  )

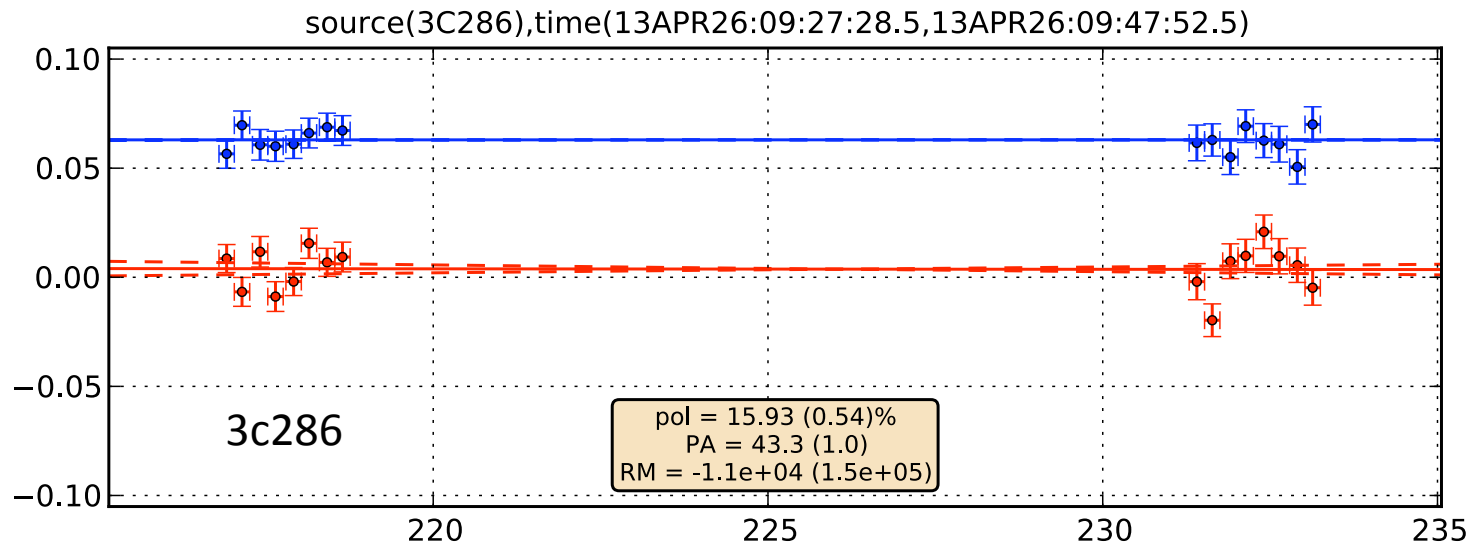
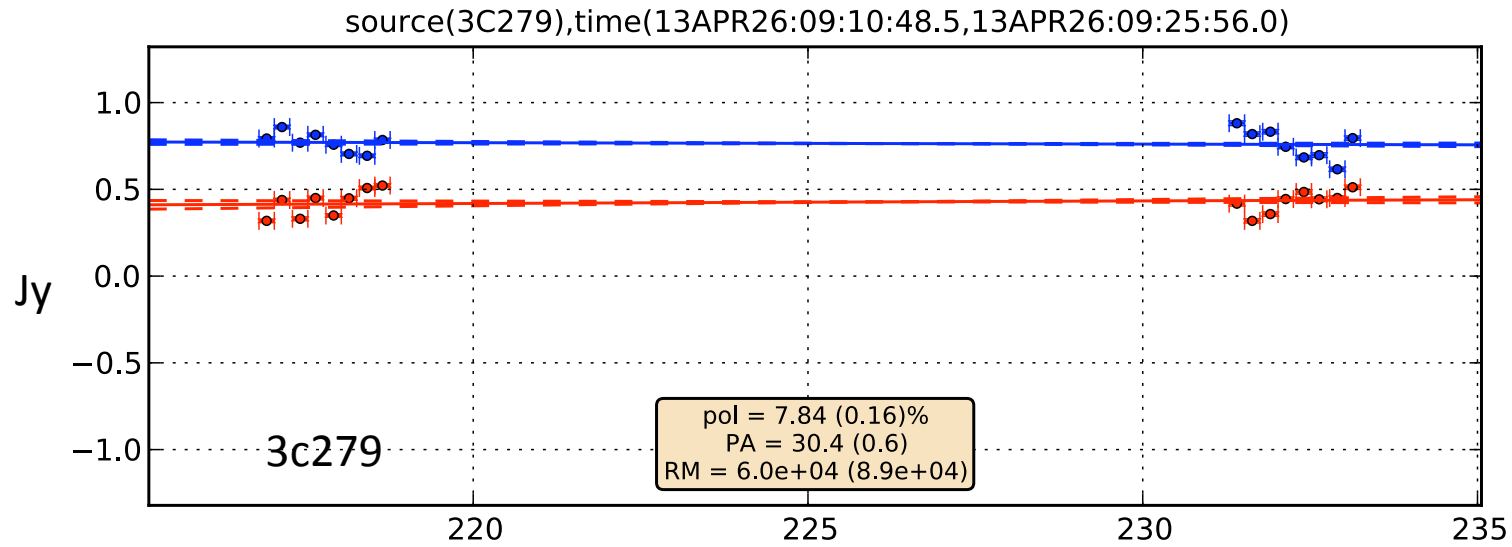
- typical galactic value 10-300  $\text{rad m}^{-2}$
- RM of 1000:  $\text{PA}(215 \text{ GHz}) - \text{PA}(230 \text{ GHz}) = .014^\circ$
- but, toward SgrA\*,  $\text{RM} \approx -5 \times 10^5 \text{ rad m}^{-2}$   
(Geoff Bower's talk)

large RM hard to detect at cm wavelengths

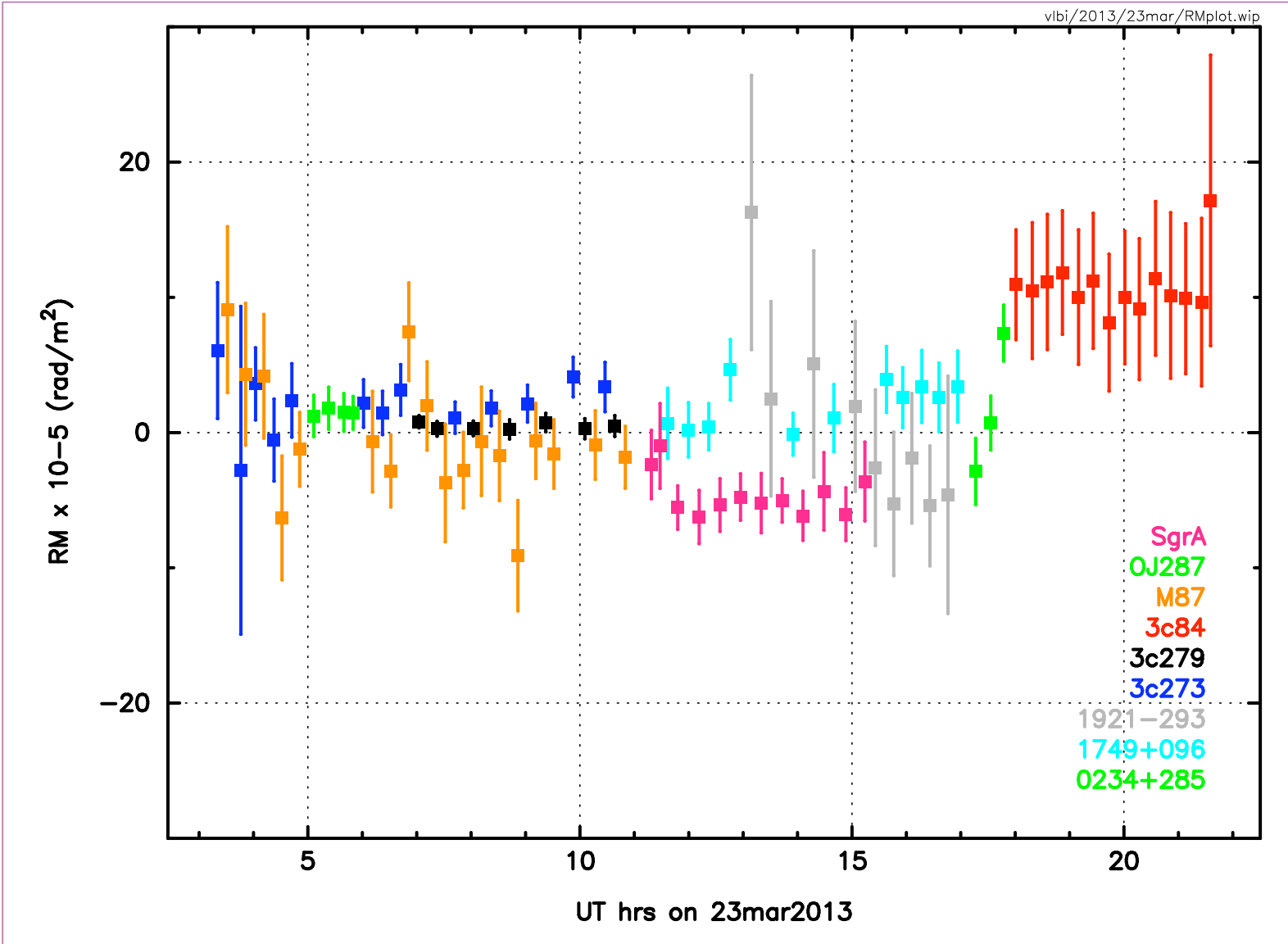
1. PA wraps through many times within passband – source appears unpolarized
2. slight variations in RM across the source smear out the polarization

# examples of fits to CARMA data

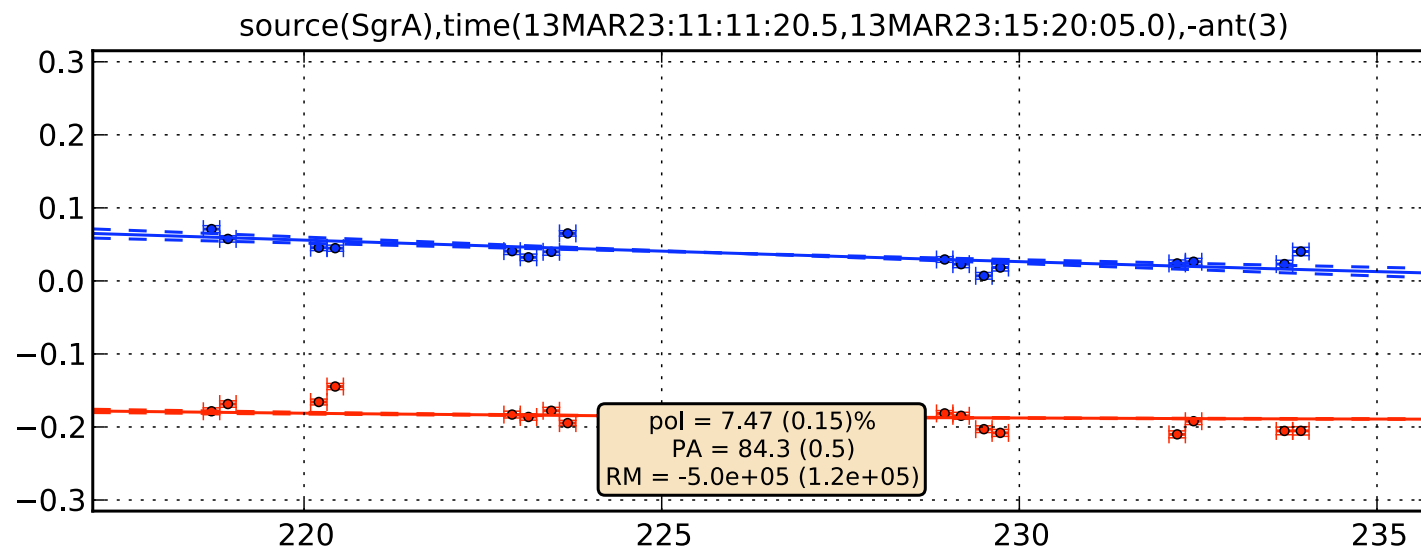
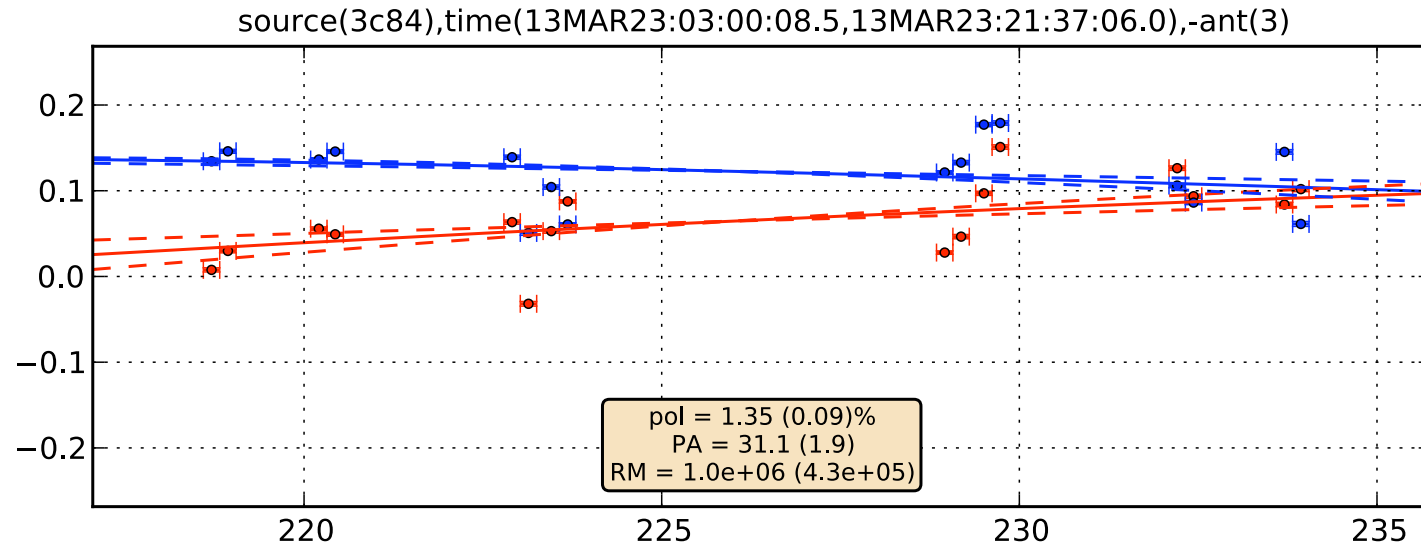
(Stokes Q = red, Stokes U = blue)



# RM for VLBI sources 23mar2013



# fits to 3c84 and SgrA data



# some worries...

Mon. Not. R. Astron. Soc. **425**, 1192–1198 (2012)

doi:10.1111/j.1365-2966.2012.21492.x

## **A search for linear polarization in the active galactic nucleus 3C 84 at 239 and 348 GHz<sup>★</sup>**

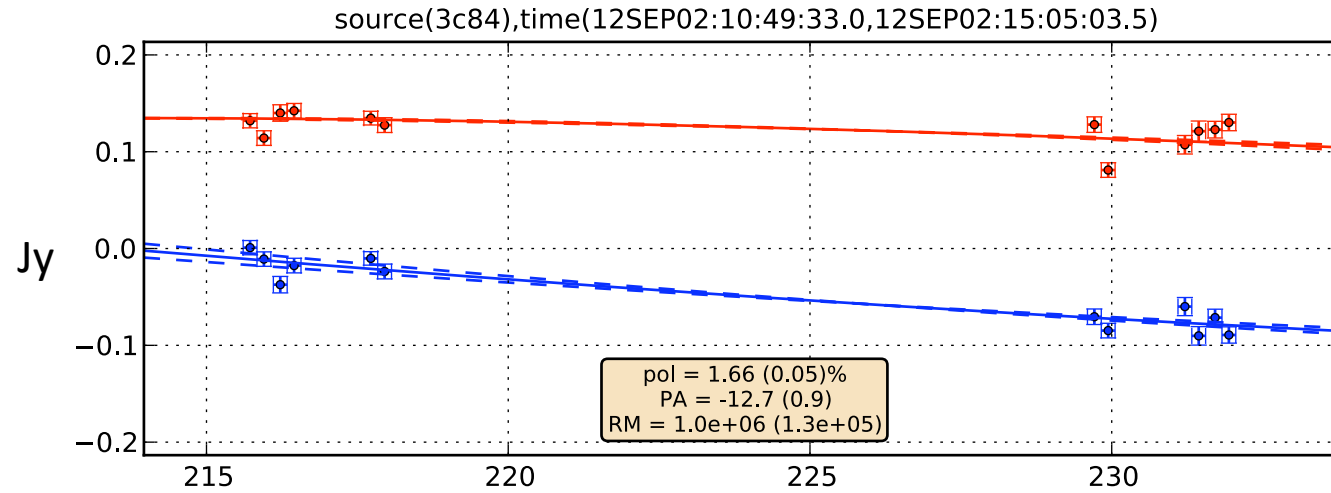
S. Trippe,<sup>1†</sup> M. Bremer,<sup>2</sup> T. P. Krichbaum,<sup>3</sup> M. Krips,<sup>2</sup> R. Neri,<sup>2</sup> V. Piétu<sup>2</sup>  
and J. M. Winters<sup>2</sup>

We report a search for linear polarization in the active galactic nucleus (AGN) 3C 84 (NGC 1275) at observed frequencies of 239 and 348 GHz, corresponding to rest-frame frequencies of 243 and 354 GHz. We collected polarization data with the IRAM Plateau de Bure Interferometer via Earth rotation polarimetry. We do not detect linear polarization. Our analysis finds  $3\sigma$  upper limits on the degree of polarization of 0.5 and 1.9 per cent at 239 and 348 GHz,

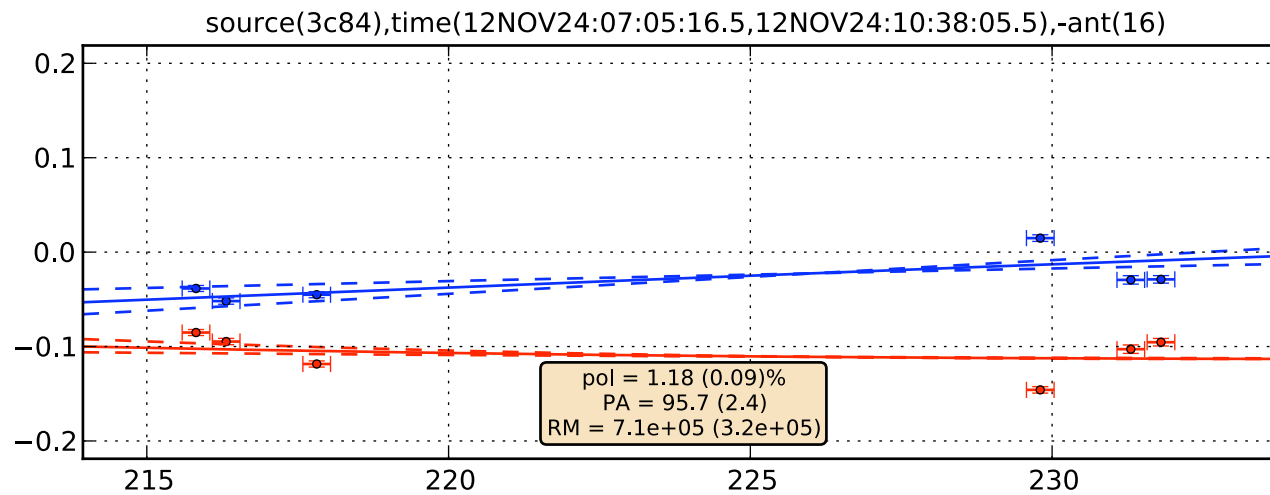
observations done March 2011



# 2012 TADPOL data: $RM \sim 10^6 \text{ rad m}^{-2}$

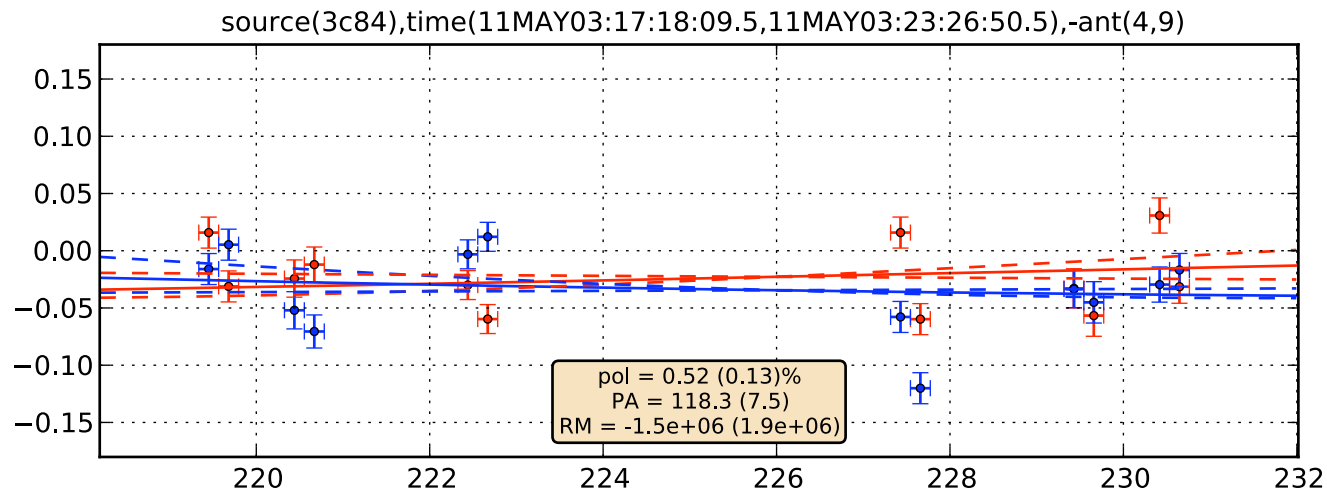


12 Sep 2012



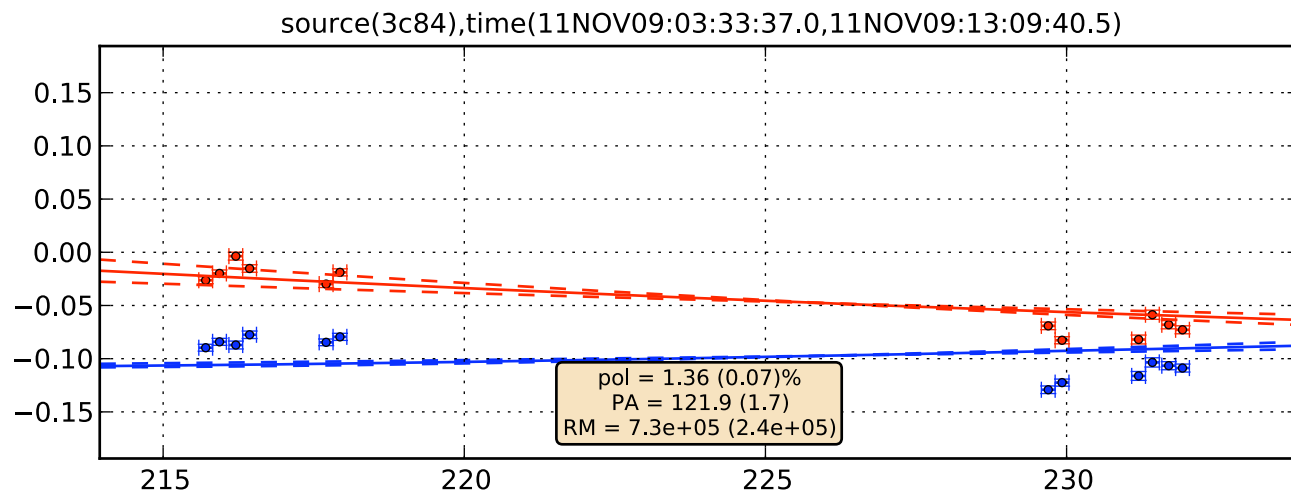
24 Nov 2012

# no polarization detected in May 2011, but RM of $7 \times 10^5$ in Nov 2011



03 May 2011

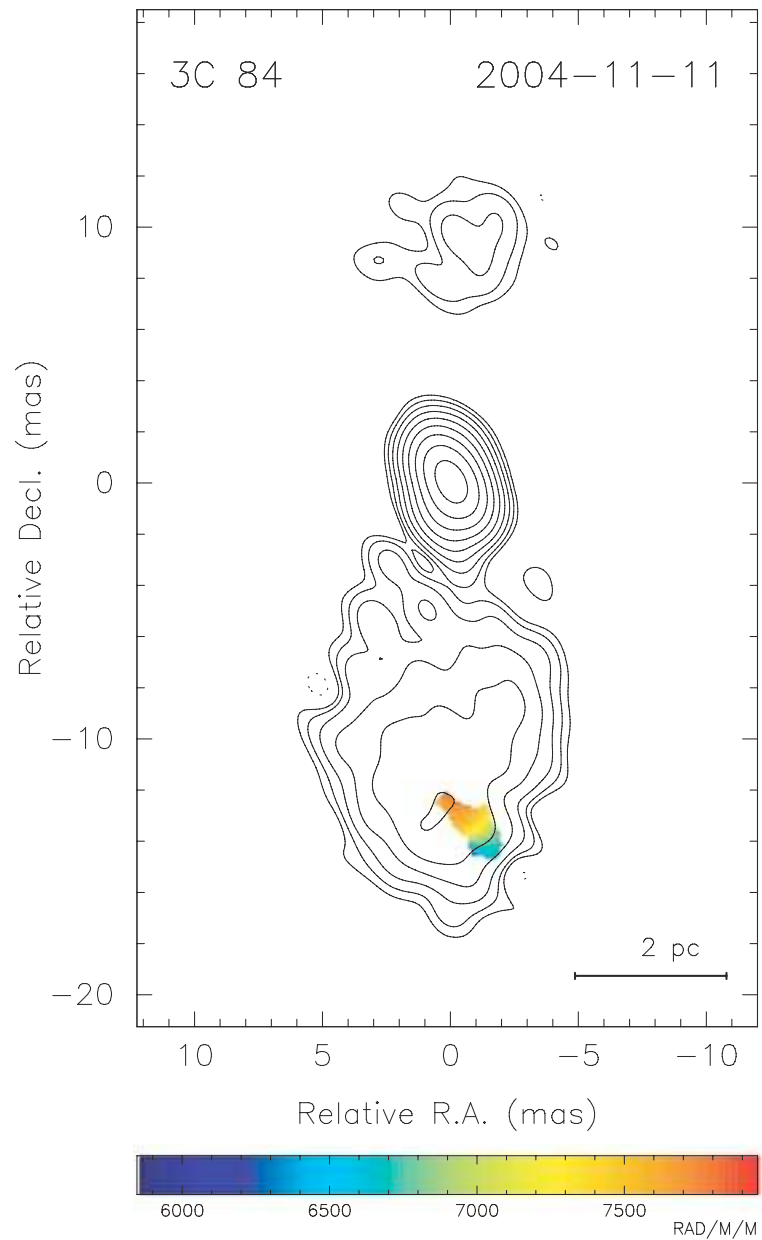
consistent with  
IRAM non-  
detection in  
March 2011



09 Nov 2011

## what plasma is producing the RM?

- cooling flow, 10 - 100 kpc scales?
  - $n_e \sim .1$  to  $.01 \text{ cm}^{-3}$   $\rightarrow B \sim 1 \text{ mG}$  UNLIKELY
- dense filaments, 1 kpc scales?
- gas close to the AGN or base of jet, 1 pc scales?



## VLBA image, 8.4 GHz 1.5 milliarcsec resolution (Taylor et al 2006)

- RMs of  $7000 \text{ rad m}^{-2}$  detected at tip of jet at cm wavelengths
- probably we see higher RM toward core or base of jet at 1mm
- a probe of  $n_e$  and  $B$  in accretion region

## what next?

- confirm with SMA ✓
  - Dan also measured RM of  $\sim 10^6$  radians  $\text{m}^{-2}$  at 230 GHz  
7/6/2013
- determine RM more precisely by measuring over a wider freq range (e.g., 210 – 270 GHz)
- time variations? so far, looks like RM is constant, but PA and polarized flux vary (much like SgrA)
- other sources?