# Magnetism and Spin

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#### Internal Faraday Rotation Measures





Lynden-Bell 2013



Blandford & Payne, Lovelace, Contopoulos, Begelman, Li...





Bogovalov

'Battery'!





Lynden-Bell 2013



### Christodoulou et al. 2015 (in prep.)



FIG. 8.— Average rotation measures in bins. Red circles (blue squares) represent positive (negative) RMs. The color intensity reflects the absolute magnitude. *Top*: NVSS data. *Bottom*: best fit model.

Pshirkov et al. 2012





Marscher 2002



Algaba et al. 2013

Arc seconds

### 5C4.114







"The largest electric current in the Universe" flows away from the origin of the jet (Kronberg et al. 13)

### Gabuzda, Contopoulos, Kazanas, Christodoulou

## kpc-scale Faraday RM

- 10 monotonic transverse Faraday RM
- All gradients Counter ClockWise (CCW)!
- Electric current flows AWAY from core

0333+321



Gabuzda, Reichstein, O'Neill 2014

### 'Battery'?



"There are currently 27 reports of

Gabuzda and collaborators



### Christodoulou et al. 2015 (in prep.)

## pc-scale Faraday RM

- 27 (36) monotonic transverse Faraday RM
- 20 (26) CW 7 (10) CCW ~1% (0.5%)

## pc-scale Faraday RM

- 4 (5) pc deca-pc scale:
  - Inner: CW
  - Outer: CCW

## A Cosmic Battery



Contopoulos & Kazanas 1998

### A Cosmic Battery



Figure 3. Evolution of the magnetic flux  $\Psi$  accumulated on the central object (in units of  $\Psi_{acc}$ ) for various values of the magnetic Prandtl number (from top to bottom:  $\mathcal{P}_m = 0.2, 0.4, 1, 10, 100$ , and 100 with finite optical depth in the disk). Time in units of  $t_{acc}$ 

#### Contopoulos, Nathanail & Katsanikas 2015



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### A Cosmic Battery



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# Magnetism along Spin: evidence for a Cosmic Battery!



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