

Optical circular polarization in quasars

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Introduction

Introduction

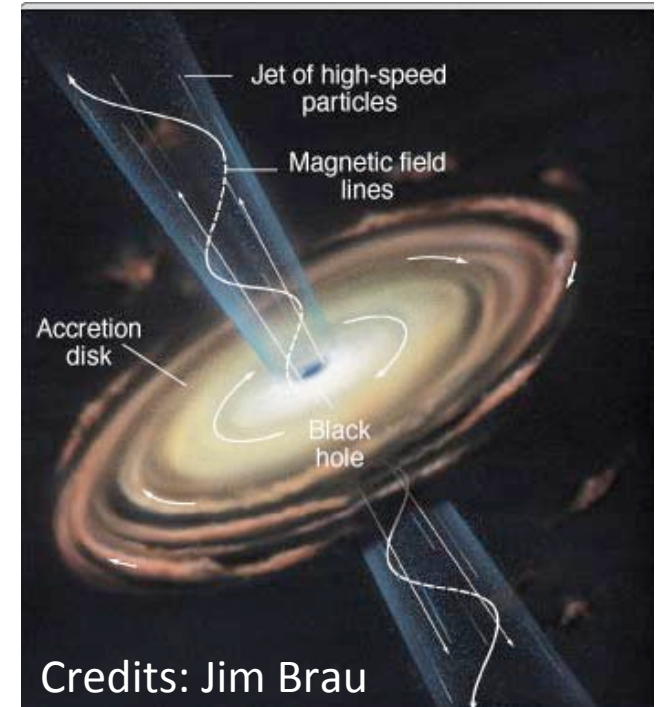
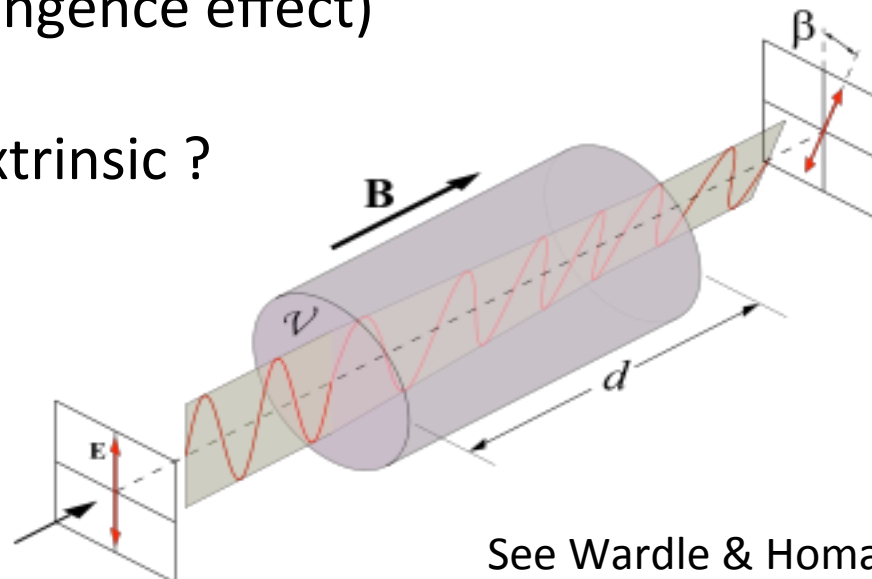
Data

Discussion

Conclusions

Mechanisms for CP in quasars:

- Intrinsic circular polarisation (CP) of relativistically beamed synchrotron radiation
- Faraday conversion of LP to CP (Faraday is a birefringence effect)
- Other / extrinsic ?



See Wardle & Homan 2003, Homan+2009 for review

Introduction / Motivation

Introduction

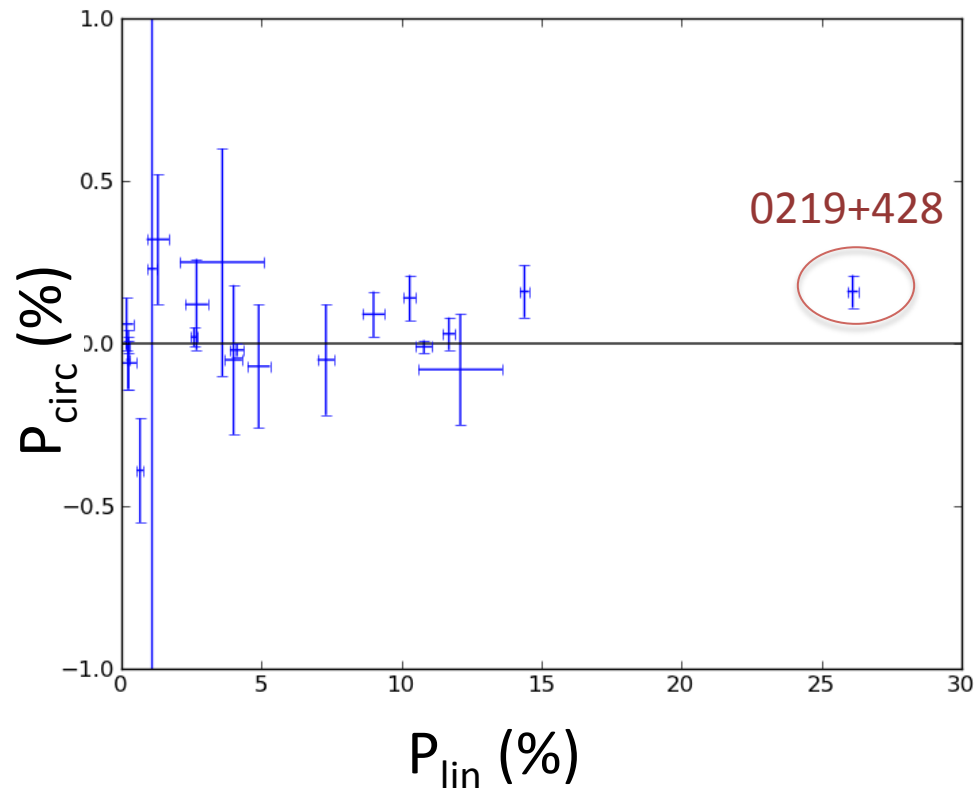
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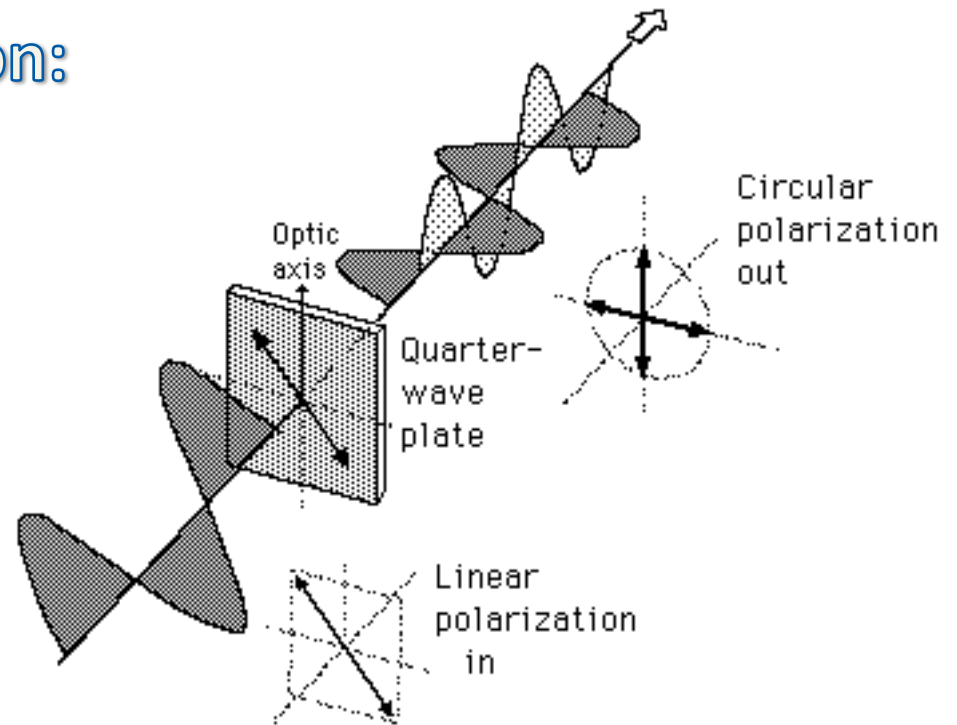
Optical circular polarization (prior to Hutsemékers+ 2010):

- **21** objects (including 9 BL Lacs) w. optical CP between 1972 and 2001
- **One** BL Lac (0219+428 = 3C66A) with positive detection (3σ) of CP (Takalo & Sillanpää 1993 + Tommasi+2001)



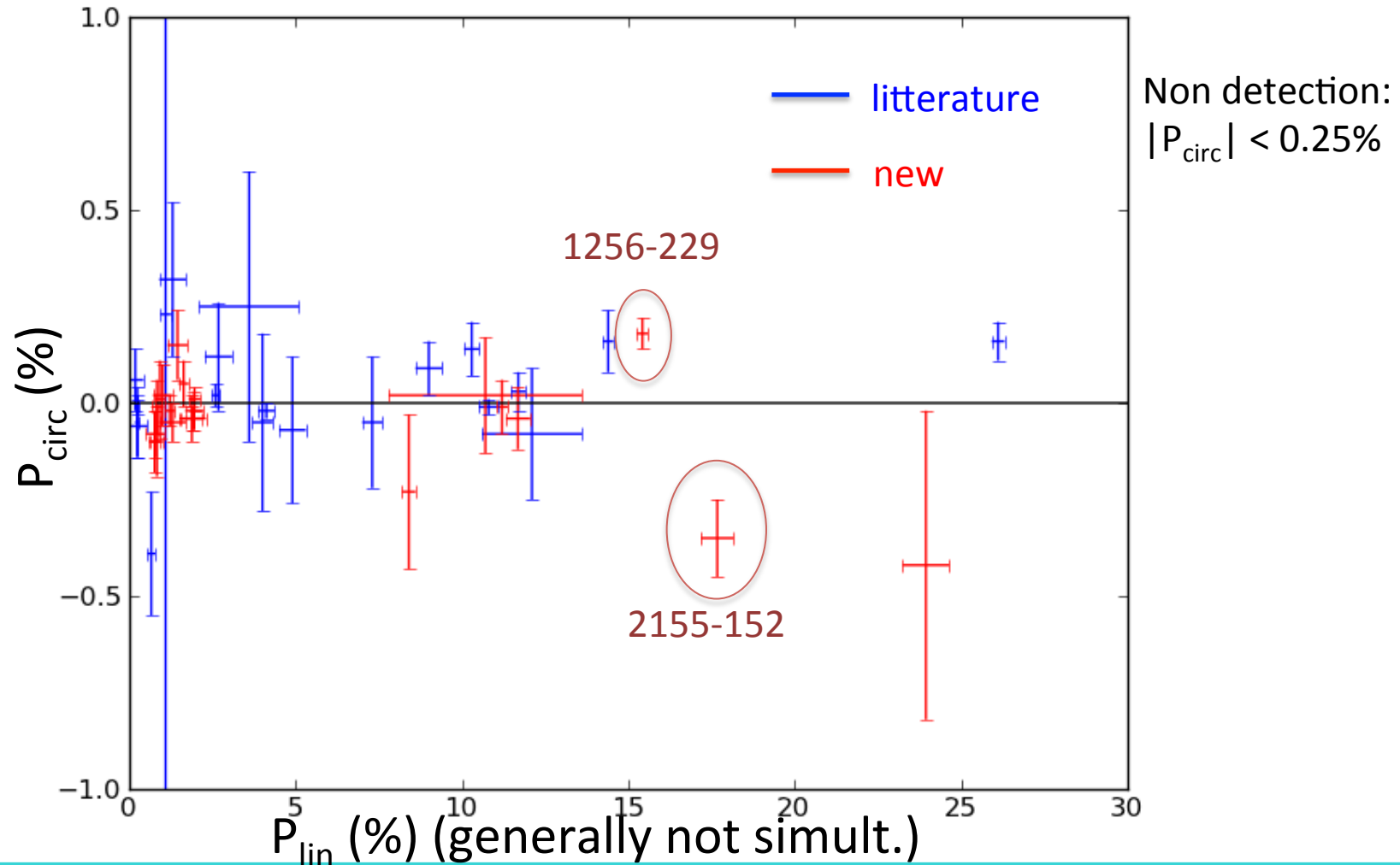
New optical circular polarization:

- EFOSC @ the 3.6 m ESO telescope
- QWP + Wollaston
- Two of the QWP: $+45^\circ$ and -45°
 $\rightarrow V/I = P_{\text{circ}}$
- 13 quasars measured in V-band
- 8 quasars measured in white light
- 3 polarized std stars $\rightarrow |P_{\text{circ}}/P_{\text{lin}}| \leq 0.0075$ (3σ limit)



Data

New optical circular polarization:



Implications

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Fact sheet:

- Existing detections are for HPQ or blazars (3 objects in total)
- P_{circ} has been detected in the radio for some blazars ($\approx 0.1\%$)
- Only upper limit on the *radio CP* of these 3 systems (i.e. no multi- λ)

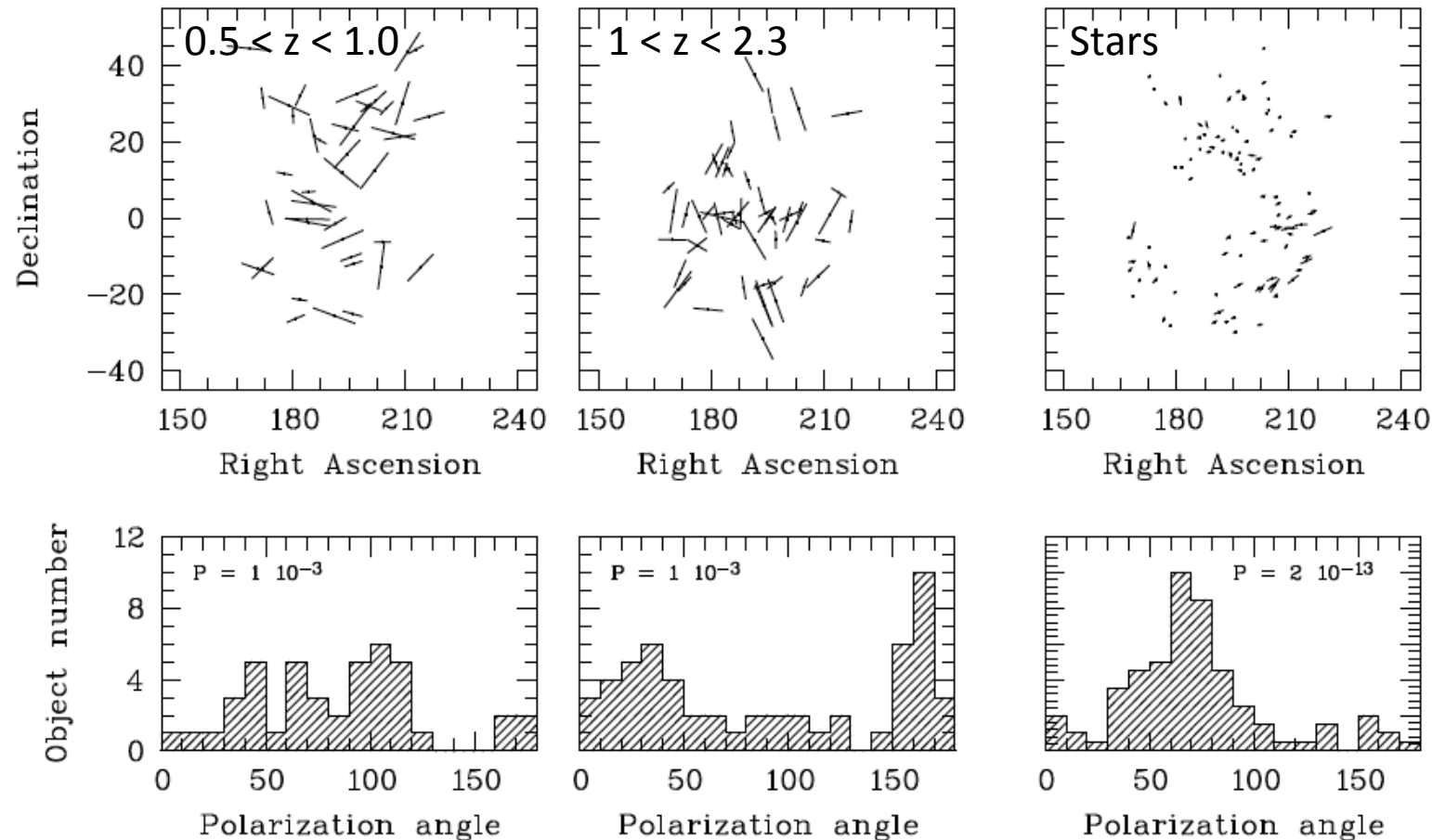
Implications:

- Faraday conversion is inefficient in the optical but we cannot exclude it plays a role for radio circular polarisation
- Intrinsic beamed synchrotron pola. can explain high LP and CP in optical and radio → Homogeneous **B** in the jet

Cosmological implications

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Large-scale alignment of quasar polarisation vectors:

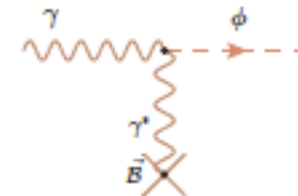


Such an alignment can be generated by adding $P \approx 0.5\%$ to random LP

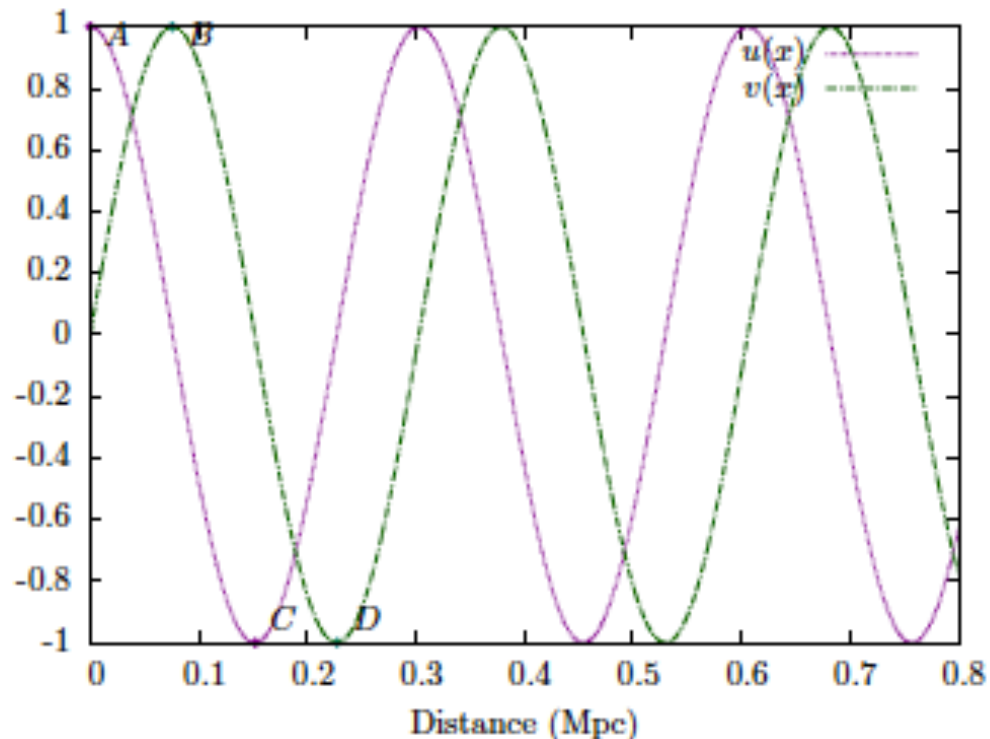
Hutsemékers 1998, Hutsemékers & Lamy 2001, Hutsemékers+ 2005, Payez+2010

Cosmological implications

Photon-pseudoscalar mixing:



Photons through a large scale \mathbf{B} can be converted into light pseudo-scalar particles (and vice-versa). P_{lin} and P_{circ} could be generated.



- Observed alignment \rightarrow
 $P_{\text{circ}} = |\Delta P_{\text{lin}}| \approx 0.5\%$
- Our data (13 QSOs in $1 < z < 2.3$)
 $\rightarrow \langle |P_{\text{circ}}| \rangle \leq 0.05\% (3\sigma)$

$\mathbf{B} = 0.1 \mu\text{G}$
 $\omega_p = 10^{-14} \text{eV}$

$m_\phi = 4.5 \cdot 10^{-14} \text{eV}$
 $g = 7 \cdot 10^{-12} \text{GeV}^{-1}$

Conclusions

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Conclusions

- Optical circular polarisation measurements are difficult and sparse (≈ 40 objects) and only **3 positive detections** ($|P_{\text{circ}}| \approx 0.2\%$) in **HPQ/BL Lacs** → Suggests that CP is due to intrinsic beamed synchrotron radiation
- **Multi-wavelengths** -radio to optical- (simultaneous + multi-epochs) observations are needed to further investigate the mechanisms producing CP. **Cross talk** has to be accurately estimated.
- Small CP of objects in the region of **large scale alignment** of polarisation vector of quasars does not support the **photon-pseudoscalar** mixing scenario to explain the alignment. Absence of CP and small LP constrain photon-pseudoscalar mixing.