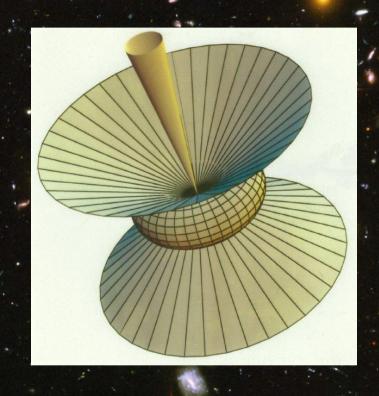
ADVENTURES IN AGN-LAND



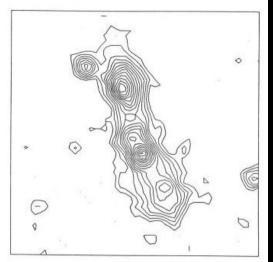
The nature of radio-loud AGN – where our roads have crossed ...



You - May 23, 2011



Me, chairing a Dutch funding agency committee





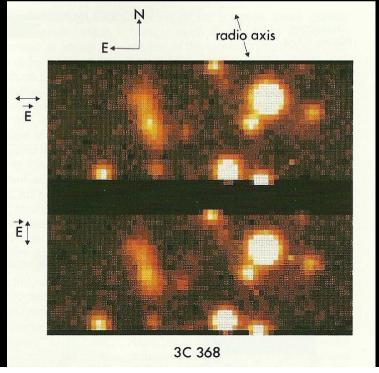
Chapter 1- Crossroads

We shared an interest in the nature of the extended emission line regions of radio galaxies: you et al. showed that a significant part of the radiation was scattered nuclear radiation – which I liked ...

3C368 @CFHT (LeFevre et al.)

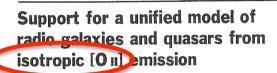
imaging

3C368 @ESO3.6/EFOSC polarimetry (Fosbury et al.)





We supervised PhD student Ronald Hes, and were able to show that [OII] emission qualifies as orientationinvariant



R. Hes*, P. D. Barthel* & R. A. E. Fosbury†

* Kapteyn Astronomical Institute, P.O. Box 800, 9700 AV Groningen, The Netherlands

† Space Telescope–European Coordinating Facility, European Southern Observatory, Karl-Schwarzschild-Strasse 2, 8046 Garching bei München, Germany

UNIFIED models¹⁻³ of radio-loud quasars and powerful radio galaxies suggest that they are intrinsically similar objects observed from different angles. This can be tested by comparing the isotropically emitted radiation from the spatially extended nebulae surrounding the nuclei; the unified models predict that the intensities of these emissions should be comparable for the two classes of object. But when this prediction was examined⁴ for the [O III] 5,007-Å emission line, it was found that quasar [O III] luminosities significantly exceed those of otherwise similar radio galaxies. We have measured the spatially integrated [O II] 3,727-Å emission-line luminosities for a number of quasars and radio galaxies taken from the 3C catalogue. Supplementing our data with values from the literature, we find no systematic difference in the [O II]

luminosities. We argue that this emission is indeed isotropic, and that our results are consistent with the unification hypothesis; the [O III] line, on the other hand, may still have a significant component from the nuclear region, and thus be subject to pronounced anisotropic obscuration.

The striking similarity in the radio properties and cosmological evolution of powerful radio galaxies (PRG) and radio-loud quasars (QSR) has stimulated a debate on the relationship between these classes. The objects might be related in an evolutionary sense, with the bright quasar being a phase in the life of every luminous radio galaxy, or otherwise be more directly connected. In the latter case the question arises of why the QSR are much brighter at optical wavelengths and exhibit broad permitted emission lines with full-width at half-maximum (FWHM) up to $10^4 \, \mathrm{km \, s^{-1}}$ in their spectra, whereas the permitted lines are narrow (FWHM $\lesssim 10^3 \, \mathrm{km \, s^{-1}}$) in PRG.

Unified models have been developed in attempts to explain the differences between several classes of low luminosity active galactic nuclei (such as Seyfert 1 and Seyfert 2 galaxies¹), through the effects of axis orientation with anisotropic obscuration. Based on these, a radio-loud unified model has been proposed in which narrow-line PRG and QSR are the same objects seen at decreasing angles between the radio axis and the line of sight².³. To explain the difference between the optical continua and the emission line widths, an obscuring torus of dust is postulated: this surrounds the inner region where the broad lines are formed. The PRG are oriented so that this broad

NATURE · VOL 362 · 25 MARCH 1993

Anisotropic [OIII] emission in radio loud AGN*

S. di Serego Alighieri¹, A. Cimatti¹, R.A.E. Fosbury^{2,3}, and R. Hes^{4,5}

- Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50125 Firenze, Italy (sdiserego@arcetri.astro.it, acimatti@arcetri.astro.it)
- Space Telescope-European Coordinating Facility, Karl-Schwarzschild Str.2, D-85748 Garching bei München, Germany (rfosbury@eso.org)
- ³ Affiliated to the Astrophysics Division of the Space Science Dept., European Space Agency
- Dunsink Observatory, School of Cosmic Physics, Castleknock, Dublin 15, Ireland
- ⁵ Present address: Faculty of Systems Engineering, Group of Information and Communication Technology, Delft Univ. of Technology, P.O. Box 5015, 2600 GA Delft, The Netherlands (rhes@sepa.tudelft.nl)

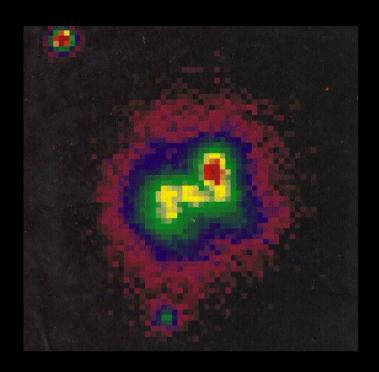
Received 22 May 1997 / Accepted 29 July 1997

Abstract. We present the results of spectropolarimetry of a sample of 7 powerful radio galaxies and 2 quasars with 0.07 < z < 0.35 obtained to detect possible anisotropies in the [OIII] line emission, which could explain the higher [OIII] luminosity of quasars than that of radio galaxies within the framework of the Unified Model of radio-loud AGN. We detect polarized [OIII] in 4 radio galaxies, consistent with the possibility that a considerable fraction ($\sim 20\%$) of the observed [OIII] emission is scattered in a similar way to the hidden nuclear continuum. However, small but detectable rotation between the polarization direction of the line and of the continuum in two radio galaxies shows that the geometry of the emitting regions can be different.

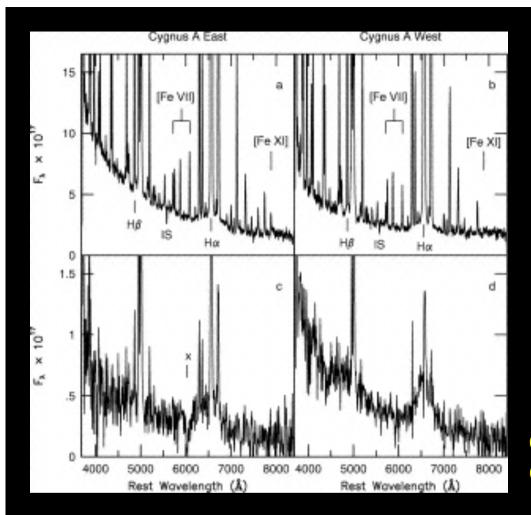
Key words: line: formation – scattering – techniques: polarimetric – galaxies: active – radio continuum: galaxies

type 2 objects for a sample of IRAS Seyfert galaxies selected for their warm far infrared colours. This difference in [OIII] luminosity between RQ and RG has been regarded as a failure of the Unified Model for radio-loud AGN, since it was thought that this forbidden line would be emitted only from regions at a large enough distance from the nucleus to be unobscured by the material causing the anisotropy in the featureless nuclear continuum and in the permitted broad lines, and that therefore its luminosity should be the same for RQ and RG, if they are parent populations, as discussed in Antonucci (1993). More recently, however, Hes et al. (1993, hereafter HBF93) have found that the [OII] 3727Å line luminosity is the same for matched samples of RG and RQ in a redshift range similar to that of JB90 (0.2 < z < 0.8), consistent with the prediction of the Unified Model.

... whereas partly obscured [OIII] does not! – cf. our expectations

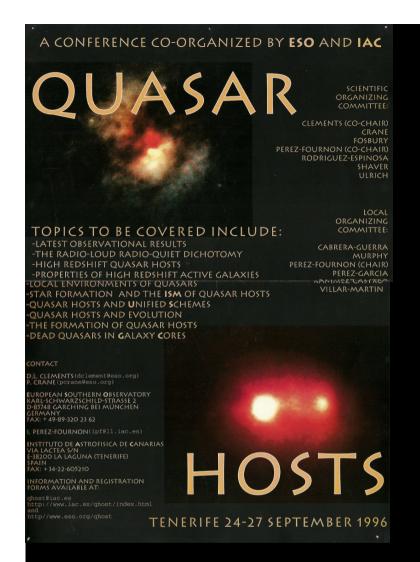


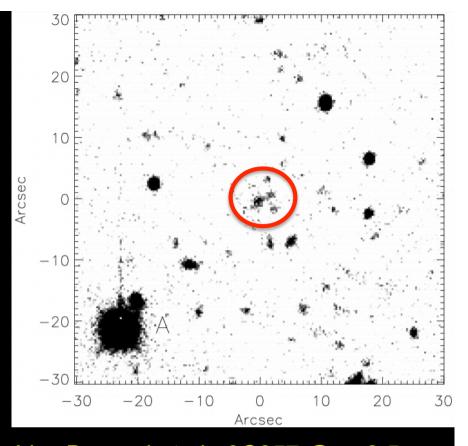
Using the NOT in 1992, Marianne
Vestergaard and I made 0.6arcsec
images of the Cygnus A host —
which you et al. later dramatically improved
using HST, and which were of crucial importance
in our understanding of FR2 radio galaxies



Ogle, Cohen, Miller, Tran, Fosbury & Goodrich: Keck spectropolarimetry

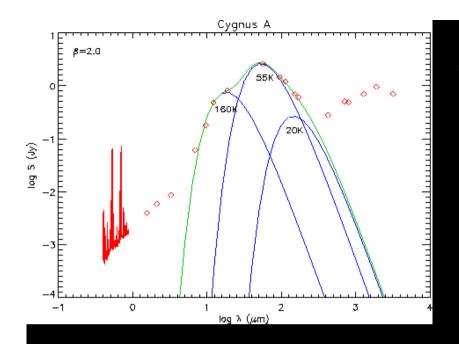
... leading to the ultimate looking-around-thecorner observation of its BLR in 1996





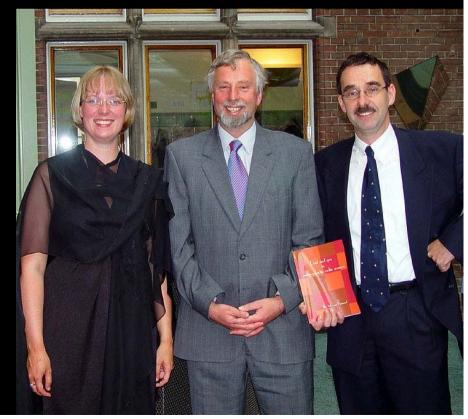
Van Breugel et al.: 3C257 @ z=2.5 (R-band image)

Knowing what FR2 radio galaxy hosts look like we knew that John Bahcall was wrong with his idea of naked quasar hosts – I recall our debate with him in 1996 at the Tenerife meeting



We supervised PhD student Ilse van Bemmel. She and I looked into the pro's and con's of FIR emission as orientation-invariant

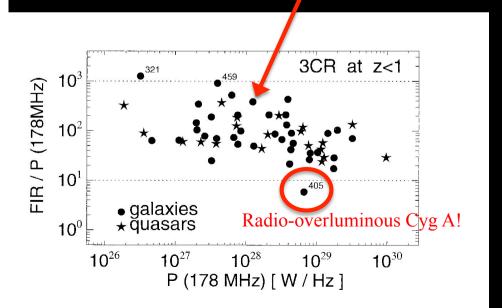
... and she worked with you and the Caltech group on the spectropolarimetry

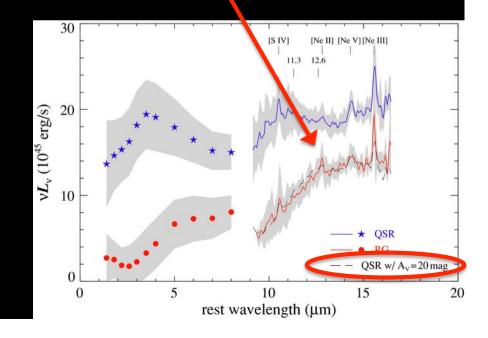




I continued to work on 3C @FIR with Belinda Wilkes, Martin Haas, Ski Antonucci, Christian Leipski, et al.

Using Spitzer we were able to show that indeed FIR is an orientation invariant; the MIR spectra incl. absorption/emission features can be understood



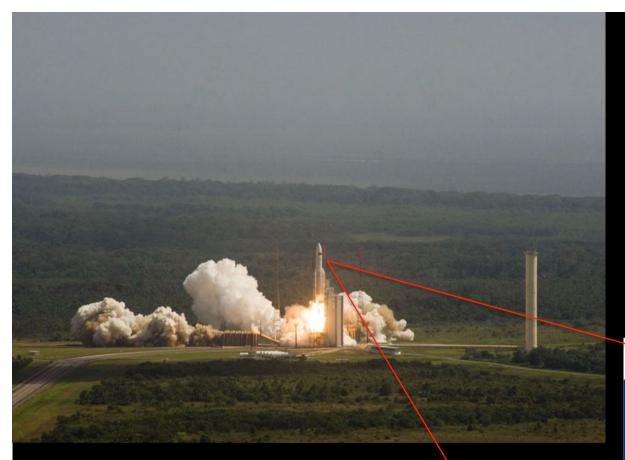


Chapter 2

HERSCHEL & 3C

Would you buy a car from these folks ...?





... launched with the IYA2009 logo!!

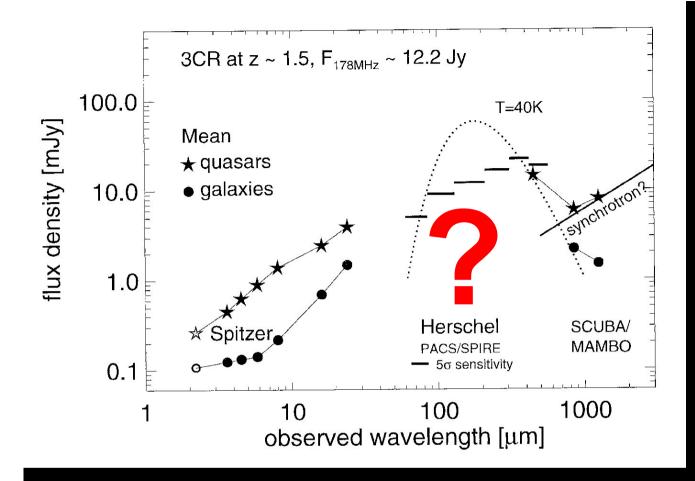


THE UNIVERSE YOURS TO DISCOVER





a logo which you, Bob, may well have invented



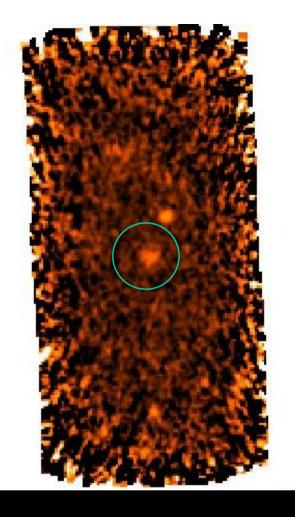
(Spitzer and SCUBA/MAMBO data are in hand)

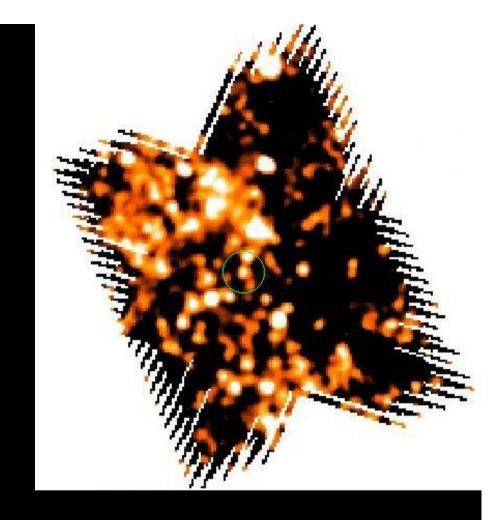
Goal of the Barthel, Haas, Wilkes et al. GT program using the PACS and SPIRE instruments: assess the FIR SED properties of all z > 1 3C objects plus a representative set of 2 < z < 3.5 4C objects re. the starburst-AGN symbiosis and as unification test

These GT observations, at 70, 160, 250, 350 and 500μ are ongoing; only very few objects have been looked at so far, using primitive tools/analysis.

Nevertheless, the initial, preliminary results are very interesting.

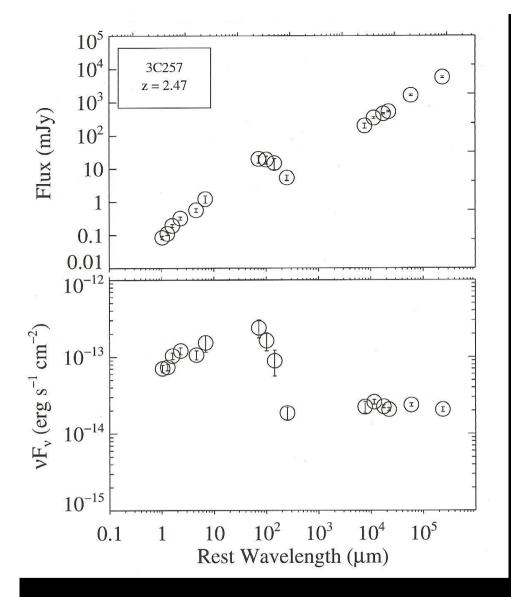
Let us have a look at old friends 3C368 and 3C257, at redshifts 1.1 and 2.5. 3C257 is the highest redshift 3C radio source.



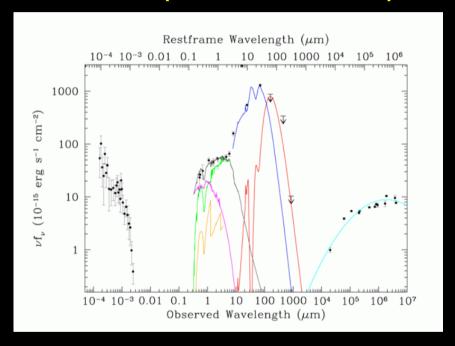


3C368 @ PACS 160 μ : 70mJy and slightly extended; combining with 29mJy at 70 μ (MIPS and PACS) its FIR luminosity must be in excess of 10¹³ L_o; awaiting the long wavelength SPIRE data

3C257 @ SPIRE 250 μ (and also 350 μ): 20mJy; combining with 5mJy at 850 μ (SCUBA) its FIR luminosity must also be in excess of 10¹³ L_o; awaiting the short wavelength PACS data



4C23.56 (De Breuck & Co.)

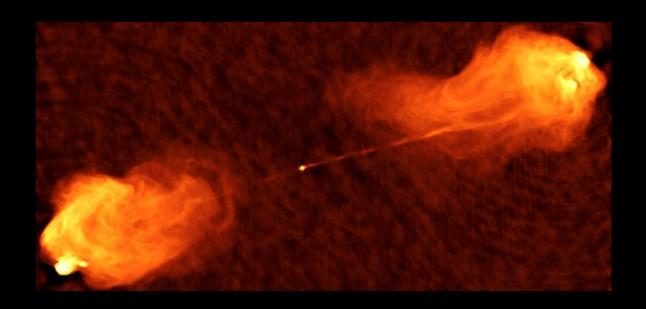


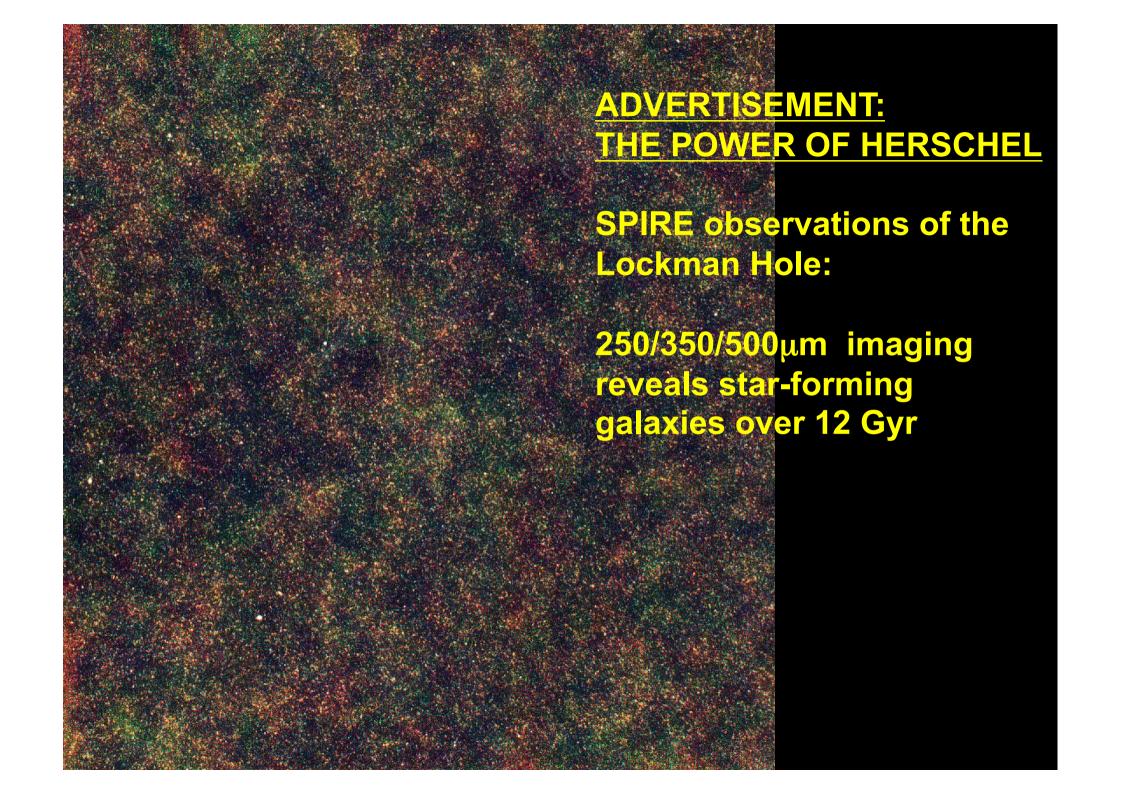
... we have not yet seen the SED peak in 3C257; the PACS data will tell us more but the object must be comparable to well-known 4C23.56 @ z = 2.483 (and 4C41.17 @ z = 3.8)

In the works:

Herschel 70, 160, 250, 350 and 500µ photometry, of:

- \triangleright all 3C QSRs and RGs having z > 1
- \triangleright representative 4C QSRs and RGs, up to z = 3.5
- \triangleright remaining 3C (after Spitzer) having 0.5 < z < 1 (Haas+)
- \triangleright representative 4C, 6C, MRC, .. RGs up to z = 5 (Seymour+)
- Cygnus A, incl. FIR spectroscopy (Edge+)





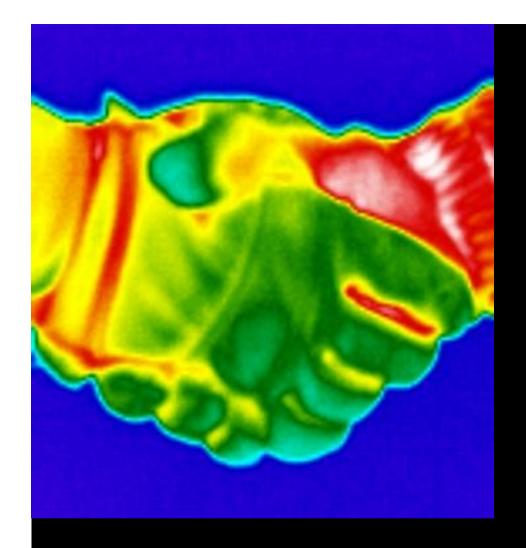




Let me conclude by expressing my admiration and gratitude for your Outreach efforts

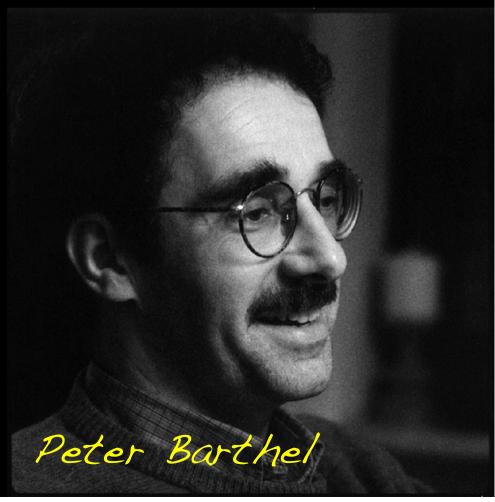


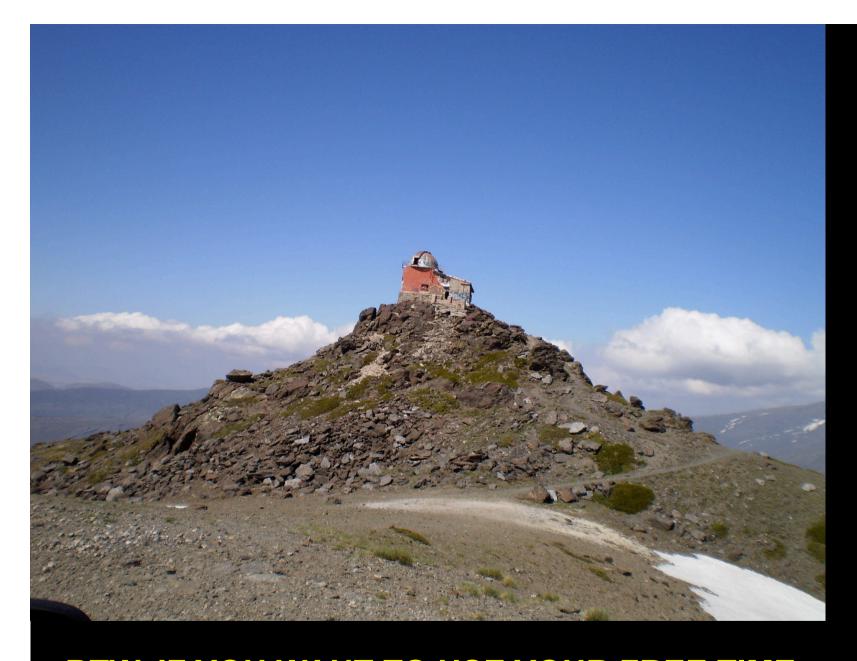
My Outreach now includes music: see Vol. 11 of the CAP-Journal, and do not hesitate to book me with the Grieg Piano duo at your 70th birthday party!!



Wishing you and yours many happy years!

FINAL QUESTION: YOUR COLLECTION OF ASTRONOMER PICTURES MUST BE HUGE – WHEN WILL THEY BE PUBLISHED OR APPEAR ON-LINE?





BTW, IF YOU WANT TO USE YOUR FREE TIME TO REMODEL AN OBSERVATORY, I KNOW ONE

