

BiSON Pockels-Cell List

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BiSON

Birmingham
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TECHNICAL REPORT NO. 328

BiSON Pockels-Cell List

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The University of Birmingham, Edgbaston, Birmingham B15 2TT

2009 September 15

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OF BIRMINGHAM**

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Abstract

The Birmingham Solar-Oscillations Network Group has owned, and destroyed, many Pockels cells over the years.

1 Introduction

In the early days we purchased and used 5-mm thick Pockels cells. Unfortunately, no records were kept so very little information remains about these cells, however none of them are presently in use in solar instruments. Later, a large batch of 3-mm Pockels cells were purchased. Hugh Williams assigned each cell a single-letter serial number and kept track of their deployment.

2 Contacts

Our first purchases of Pockels cells were from Gsänger Optoelektronik GmbH in Germany.

Gsänger Optoelektronik GmbH
Robert-Koch-Strasse 1a
W-8033 Planegg 1
Germany
+49-89-8 59 56 21
+49-89-8 59 56 22
+49-89-8 59 78 75 (fax)

However, our contacts were Shaun Coles and Roger Traynor at Burleigh Instruments, Limited:

Burleigh Instruments, Limited
11 Hatfield Road
St. Albans, Hertfordshire AL1 3RR
United Kingdom

We have recently found a new supplier for Pockels cells, our contact is Dr. John Ley.

Leysop
17 Repton Court
Repton Close
Burntmills
Basildon, Essex SS13 1LN
United Kingdom

3 Purchases

Fifteen large-aperture cells, 3 mm thick, as per quote 1156/280, were ordered from Burleigh Instruments, Ltd., on 1992 March 17 at an estimated cost of £10,575. Fourteen of them were designated with the letters *A* to *P* skipping *I* and *O*.

One double-crystal cell (L0) incorporating a half-wave plate was obtained from Leysop, installed in Jabba in Carnarvon on 1997 October [1] and returned to Birmingham in 1998 August [2].

Two more cells were obtained from Leysop later. One was a single-crystal cell (L1) and one was a double-crystal cell (L2) incorporating a polarization rotator. These two cells were tested in Birmingham [3] and were then sent abroad. Cell L1 went to Carnarvon [2] and cell L2 went to Narrabri [4].

Twelve double-crystal cells were ordered from Leysop in 1998 September. The first (L3) arrived 1999 March 9. L4 and L5 arrived on 1999 May 11.

4 Pockels Cells

- A 3-mm, received 1992 July 21, mounted 1992 July 29, sent to Narrabri, failed (resistance) 1992 September 4, returned to Gsänger for recoating, tested by Phil Pavelin in 1993 October [5].
- B 3-mm, received 1992 July 21, mounted 1992 July 30, sent to Narrabri, failed (resistance) 1992 September 4, returned to Gsänger for recoating, tested by Phil Pavelin in 1993 October [5].
- C 3-mm, received 1992 July 21, mounted 1992 July 30, taken to Las Campanas by Sarah Wheeler to run at half voltage in 1992 July, returned to Birmingham without mount in 1993 October by Brek Miller [6].
- D 3-mm, received 1993 March 28, returned to Gsänger for recoating, sent to Sutherland, installed in 2-D 1993 September 29, removed from 2-D 1999 November 28 [7], and stored in a crate.
- E 3-mm, received 1993 March 30, taken by Richard Lines to Carnarvon and installed as the only Pockels cell in Jabba and left running at reduced voltage in 1994 October [8], removed by Brek Miller and George Isaak in 1995 April because of adhesive deterioration and returned to Birmingham leaving no Pockels cells in Jabba [9], returned to Gsänger for recoating. This cell was then possibly made into a liquid-filled Pockels cells and sent back to Sutherland on 1998 January 27 and installed in Fred by Piet Fourie. Then removed from Fred [7] by George Isaak on 1999 November 28 and taken back to Birmingham [10] by Brek Miller on 2000 May 9
- F 3-mm, received 1993 April 8, mounted in the old mount for cell A, returned to Gsänger for recoating, tested by Brek Miller (first one received with newer, thicker electrodes) on 1993 August 27 [11], installed in Birmingham spectrometer (Ivan), which was sent to Las Campanas in 1994 November [12].

- G 3-mm, returned to Gsänger for recoating, received 1993 July 28, installed in Narrabri in 1993 August as velocity Pockels cell by Sarah Wheeler [13], slowly deteriorated (adhesive problem) over the next five years, removed from service by Roger New in 1998 August [4] then returned to Birmingham by Brek Miller in 2000 March [14].
- H 3-mm, returned to Gsänger for recoating, received 1993 July 28, installed in Narrabri in 1993 August as magnetic Pockels cell by Sarah Wheeler [13], failed shortly before a visit by Brek Miller and Phil Pavelin in 1994 March and returned to Birmingham at that time [15].
- J 3-mm, returned to Gsänger for recoating, received 1993 October 13, tested unmounted by Phil Pavelin on 1993 October [5], taken to Las Campanas in 1993 October unmounted by Brek Miller [6].
- K 3-mm, returned to Gsänger for recoating, received 1993 October 13, tested unmounted by Phil Pavelin on 1993 October [5], taken to Las Campanas in 1993 October unmounted by Brek Miller [6].
- L 3-mm, received 1994 April 21, sent to Carnarvon and installed in Jabba, failed (shattered) on 1994 September 21 and returned to Birmingham by Richard Lines [8].
- M 3-mm, received 1994 April 21, sent to Carnarvon and installed in Jabba, failed (shattered) on 1994 September 21 and returned to Birmingham by Richard Lines [8].
- N 3-mm, received 1993 March 17, installed in Narrabri as magnetic Pockels cell by Sarah Wheeler in 1993 August [13], failed (shattered) in 1994 March, replaced by Brek Miller and Phil Pavelin on 1994 March 17 [15].
- P 3-mm, received 1994 November 10, taken to Carnarvon and installed in Jabba by Darren Lewis and Brek Miller, failed (first day) on 1994 November 18.
- L0 Two-element KD*P modulator with two intermediate multi-order half-wave plates. Installed in Carnarvon (Jabba) by George Isaak in 1997 October [1], replaced by cell L1 by Brek Miller in 1998 August [2]. Now in Birmingham being tested by Hugh Williams.
- L1 Single-element KD*P modulator. Tested by Brek Miller and Hugh Williams in 1998 July [3], taken to Carnarvon by Brek Miller in 1998 August and installed in Jabba [2]. Removed from Jabba by George Isaak (unreported) in 1999 December to make room for L9 and L11 and left in Carnarvon. Returned to Birmingham by Brek Miller [16, 17] on 2000 November 15.
- L2 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Tested by Brek Miller and Hugh Williams in 1998 July [3], taken to Carnarvon and tested in Jabba in 1998 August by Brek Miller [2], then sent to Narrabri and installed by Roger New [4]. Removed on 2002 July 22 by Roger New and George Isaak to make room for two new Pockels cell [18] but left in Narrabri. Taken back to Birmingham [19] by Brek Miller on 2004 July 9.
- L3 Two-element KD*P modulator with two intermediate zero-order half-wave plates mounted with their fast axes 45° apart. Tested in 1999 March by Brek Miller [20]. The results were not good.
- L4 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 May 11 (purchase order number 125676). Tested in 1999 May by Brek Miller [21]. There were problems with the electrical connections. Returned to Leysop on 1999 June 3. Leysop returned it to us without modification. It was received again on 1999 July 2. We looked at it some more and sent it back to Leysop in late July. It was returned to us on 1999 August 19

along with L6 and now has one protruding window. It was tested again in 1999 September by Brek Miller [22] and this time found to be working. This Pockels cell is called “QR2” by John Ley and has “QR” and “2” scratched into the Leysop label. Taken to Sutherland [7] and installed in Fred as the magnetic Pockels cell by George Isaak on 1999 November 28. Moved to the velocity position by Brek Miller and Guy Davies [23] on 2008 May 26 because L6 failed.

- L5 Two-element KD*P modulator with intermediate 10-mm, z-cut, MgF_2 compensator. Dr. John M. Ley decided to try again with the MgF_2 device, having found a supply of better optical quality material. Received 1999 May 11 (purchase order number 125676). Tested in 1999 May by Brek Miller [21]. This Pockels cell has “MF” scratched into the Leysop label.
- L6 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 August 19 (purchase order number 125676). One of the two windows protrudes. It was tested in 1999 September by Brek Miller [22]. This Pockels cell is called “QR3” by John Ley and has “QR” and “3” scratched into the Leysop label. Taken to Sutherland [7] and installed in Fred as the velocity Pockels cell by George Isaak on 1999 November 28. It partially failed [23] overnight between 2008 March 11 and March 12. On 2008 May 26, Brek Miller and Guy Davies removed it from Fred and returned it to Birmingham.
- L7 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 October 20 and tested shortly thereafter by Brek Miller [24]. This should be the final design. Shortly after this Pockels cell was tested, we gave Leysop the go-ahead to produce the rest of the cells. Taken to Narrabri [18] and installed as the velocity Pockels cell on 2003 July 22 by George Isaak and Roger New. Removed and taken back to Birmingham [19] by Brek Miller on 2004 July 9. Taken to Sutherland [25] and installed as the magnetic Pockels cell on 2008 November 17.
- L8 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 November 10 and tested shortly thereafter by Brek Miller [26]. This Pockels cell is called “QR5” by John Ley and has the number “5” punched into its side. Pockels cells L8, L9, L10, and L11 were all delivered together. The delivery note (number 2753) mentions purchase order number 125676 and quotes the price as £2,050 each. Taken to Sutherland [7] and installed in the 2-D instrument by Adam Bray on 1999 September 28. Removed from the 2-D instrument when it was decommissioned [27] by Brek Miller and Ian Barnes on 2006 July 9 and then returned to Birmingham.
- L9 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 November 10 and tested shortly thereafter by Brek Miller [26]. This Pockels cell is called “QR6” by John Ley and has the number “6” punched into its side. Taken to Carnarvon and installed in Jabba by George Isaak (unreported) in 1999 December. Removed from Jabba and returned to Birmingham [28] by Brek Miller and Ian Barnes on 2006 November 21 as Jabba was sent home.
- L10 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 November 10 and tested shortly thereafter by Brek Miller [26]. This Pockels cell is called “QR7” by John Ley and has the number “7” punched into its side. Taken to Sutherland in 1999 November by Adam Bray [7] with the intention of installing it in the 2-D instrument, however it did not fit. It wasn’t seen after that until 2005 November 21 when Brek Miller found it in George Isaak’s garage.
- L11 Two-element KD*P modulator with intermediate 7-mm quartz rotator. Received on 1999 November 10 and tested shortly thereafter by Brek Miller [26]. This Pockels cell is called

“QR8” by John Ley and has the number “8” punched into its side. There are two bolts missing. Taken to Carnarvon and supposedly installed in Jabba by George Isaak (unreported) in 1999 December. On 2000 November 15 Brek Miller and Richard Bryan discover that it is not in Jabba and no where in the Carnarvon dome. This Pockels cell is now missing.

- L12 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “9” by John Ley and has the number “9” scribed onto one of its faces. Taken to Narrabri [18] with the intention of installing it as the magnetic Pockels cell on 2003 July 22 by George Isaak and Roger New. However, Pockels-cell driver problems prevented this. It was left in Narrabri. Taken back to Birmingham [19] by Brek Miller on 2004 July 9.
- L13 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “10” by John Ley and has the number “10” scribed onto one of its faces. Taken to Carnarvon [29] by George Isaak on 2004 March 12. Returned to Birmingham [28] by Ian Barnes and Brek Miller on 2006 November 21. Taken back to Carnarvon [30] and put in the magnetic position of Jabba but left unpowered by Ian Barnes and Brek Miller on 2009 July 10.
- L14 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “11” by John Ley and has the number “11” scribed onto one of its faces. Taken to Carnarvon [29] by George Isaak on 2004 March 12. Returned to Birmingham [28] by Ian Barnes and Brek Miller on 2006 November 21. Taken back to Carnarvon [30] and put in the velocity position of Jabba by Ian Barnes and Brek Miller on 2009 July 10.
- L15 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “12” by John Ley and has the number “12” scribed onto one of its faces.
- L16 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “13” by John Ley and has the number “13” scribed onto one of its faces.
- L17 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “14” by John Ley and has the number “14” scribed onto one of its faces. Taken to Narrabri [19] on 2004 July 9 by Brek Miller and Barry Jackson and installed as the magnetic Pockels cell.
- L18 Two-element KD*P modulator. Received on 2000 April 18. The delivery note (number 2852) mentions order number 125676 and quotes the price as £2,050 each. The delivery

note also says that these cells contain zero-order half-wave plates, though we thought we were getting cells with 7-mm quartz rotators. This Pockels cell is called “17” by John Ley and has the number “17” scribed onto one of its faces. This Pockels cell was received in the same shipment as cells L12–L17. Those Pockels cells had consecutive Leysop serial numbers, however serial numbers 15 and 16 have been skipped. Taken to Narrabri [19] on 2004 July 9 by Brek Miller and Barry Jackson and installed as the velocity Pockels cell.

5 Station Chronologies

5.1 Mount Wilson

1996 July Klaus is installed in Mount Wilson with a liquid-filled Pockels cell built by Hugh Williams.

5.2 Las Campanas

1991 October Sarah Wheeler reports [31] that there is a 5-mm Pockels cell in Las Campanas.

1992 July Cell C and another taken to Las Campanas by Sarah Wheeler.

1993 February Sarah Wheeler and Brek Miller visit Las Campanas [32] but do not change the Pockels cells.

1993 October Brek Miller reports that there are two 3-mm Pockels cells in Las Campanas each running at half voltage [6]. Both of these cells are returned to Birmingham and two recoated 3-mm Pockels cells (J and K) are left in Las Campanas to run at full voltage.

1994 November Ivan is installed in Las Campanas containing one 3-mm Pockels cell by Chris Underhill, Pete Monks, and George Isaak [12], this is possibly cell F.

1998 January Brek Miller reports that there are three working Pockels cells in Las Campanas, two in Spectrometer H and one in Ivan [33].

2007 April 13 Patricio Pinto turns off the magnetic Pockels-cell driver, at our request, and then turns it back on again on June 26.

5.3 Sutherland

1990 The original instrument, Fred, is installed in Sutherland with a 5-mm cell.

1992 Andy Dumbill installs two 3-mm cells.

1993 September 29 Cell D is installed in the 2-D instrument.

1998 January 27 The velocity Pockels cell stops working. Piet Fourie swaps the magnetic and velocity Pockels cells. It is discovered that the magnetic Pockels cell had stopped working some time before. Richard Lines sends out a liquid-filled Pockels cell (perhaps cell E) and Piet installs it.

- 1999 November 28 George Isaak installs Pockels cells L4 (magnetic) and L6 (velocity) in Fred while Adam Bray installs L8 in the 2-D instrument. L10 was taken to Sutherland to be installed in the 2-D instrument, but it did not fit [7]. L10 was later found on 2005 November 21 in George Isaak's garage.
- 2000 May 9 Brek Miller takes the two old, broken, 3-mm Pockels cells and the liquid-filled Pockels cell (possibly cell E) back to Birmingham [10].
- 2006 July 9 Brek Miller and Ian Barnes remove the 2-D instrument from the mount [27]. Pockels Cell L8 is removed from the 2-D instrument and carried back to Birmingham. They accidentally leave the magnetic Pockels cell off.
- 2007 August 21 Ian Barnes turned [34] the magnetic Pockels cell back on and increased the amplitude on the velocity Pockels cell.
- 2008 March 11 Pockels cell L6 (velocity) partially fails.
- 2008 May 26 Brek Miller and Guy Davies found Pockels cell L6 (velocity) damaged [23]. They moved Pockels cell L4 (magnetic) into the velocity position. They also found that Pockels cell L6 had been mounted incorrectly. The fast axis for both L4 and L6 is 45° away from the SHV marked with red paint [22]. L4 as mounted with the red SHV at 0° , which is correct. But L6 was mounted with the non-red SHV at 0° . The polarizer had been rotated to 60° to compensate. But this means that the Pockels cell L4 (magnetic) was not aligned with the polarizer correctly. Pockels cell L6 was returned to Birmingham.
- 2008 November 17 Brek Miller installed Pockels Cell L7 as the magnetic Pockels cell [25].

5.4 Carnarvon

- 1994 July Jabba is installed in Carnarvon with Pockels cells L and M by Darren Lewis and George Isaak [35].
- 1994 September 21 Richard Lines found that both Pockels cells L and M in Jabba in Carnarvon had shattered [8]. He put in a replacement (cell E).
- 1994 November 18 Darren Lewis and Brek Miller test Pockels cell P in Jabba, but it fails on the first day.
- 1995 April Cell E is removed from Jabba because of adhesive deterioration and is returned to Birmingham by Brek Miller and George Isaak leaving no Pockels cells [9].
- 1996 George Isaak takes liquid-filled Pockels cell to Carnarvon, but must return it to Birmingham because of leakage.
- 1997 October Pockels cell L0 is installed in Jabba by George Isaak [1].
- 1998 August Pockels cell L0 is removed from Jabba and returned to Birmingham by Brek Miller [2]. Cells L1 and L2 are tested. Cell L1 is left in Carnarvon, cell L2 is sent to Narrabri.
- 1999 December George Isaak claims to install Pockels cells L9 and L11 in Jabba (unreported). Cell L1 is removed.

- 2000 November 15 Brek Miller and Richard Bryan discover [16, 17] that Pockels cell L9 is the velocity Pockels cell in Jabba, but there is no magnetic Pockels cell. Cell L1 is found in the dome and returned to Birmingham by Brek; however, there is no trace of cell L11.
- 2004 March 17 George Isaak claims to install [29] Pockels cells L13 and L14 in Jabba.
- 2005 July 28 Roger New and Steve Hale found [36] Pockels cells L13 and L14 in the crate in Carnarvon. They left them there.
- 2006 November 23 Ian Barnes and Brek Miller remove [28] Pockels cell L9 from Jabba before sending Jabba back to Birmingham. They also recover Pockels cells L13 and L14 from the crate. All three Pockels cells are returned to Birmingham.
- 2009 July 10 Ian Barnes and Brek Miller reinstall [30] Jabba in Carnarvon. It now has Pockels cell L14 in the velocity position and L13 in the magnetic position. However, they are one SHV connector short and so the magnetic Pockels-cell is left unpowered.
- 2009 September 15 Les Schultz connects the magnetic Pockels cell.

5.5 Narrabri

- 1992 September Narrabri is commissioned with an old 5-mm Pockels cell.
- 1992 September 4 Roger New and Brek Miller install cells A and B. They both fail (resistively) almost immediately.
- 1993 August Sarah Wheeler removes the original velocity Pockels cell from Narrabri and returns it to Birmingham. She also installs two new Pockels cells (magnetic G, velocity H) [13].
- 1994 March 17 The magnetic Pockels cell G fails shortly before Brek Miller and Phil Pavelin arrive. They install new magnetic Pockels cell N [15].
- 1995 February 4 The magnetic Pockels cell N fails. It is removed from the spectrometer by Ben Reddall and Roman Novak. We run with only a velocity Pockels cell after that. In 1995 December the broken Pockels cell is returned to Birmingham by Brek Miller [37].
- 1998 August Roger New removes the old, deteriorating Pockels cell H and replaces it with cell L2 [4].
- 2003 July 22 Roger New and George Isaak remove Pockels cell L2 and replace it with Pockels cell L7 [18]. Cell L12 was taken to Narrabri at the same time, but Pockels-cell driver problems prevented it being installed as the magnetic Pockels cell. Pockels cells L2 and L12 were left in Narrabri.
- 2004 July 9 Brek Miller removes [19] Pockels cell L7 and installs L17 in the magnetic position and L18 in the velocity position. Brek also dismantles the two, old, Malcom Andrews Pockels-cell drivers and installs a Richard Lines driver instead. Pockels cells L2, L7, and L12 are taken back to Birmingham.
- 2007 March 8 Brek Miller changes [38] the gate cabling so that the magnetic Pockels cell runs at 78 Hz and the velocity Pockels cell runs at 156 Hz. Previously, they were the other way around.

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