A BRIEF PATTERN FOR WRITING A PAPER IN LaTeX2E CORRECTLY, COMFORTABLY AND ELEGANTLY

KVETOSLAVA DVOŘÁKOVÁ* AND FLORA SCHÖN**

ABSTRACT. A brief abstract without bibliography marks [.]: Having an MV-algebra, we can restrict its binary operation addition only to the pairs of orthogonal elements. The resulting structure is known as an effect algebra, precisely distributive lattice effect algebra. Basic algebras were introduced as a generalization of MV-algebras. Hence, there is a natural question what an effect-like algebra can be reached by the above mentioned construction if an MV-algebra is replaced by a basic algebra. This is answered in the paper and properties of these effect-like algebras are studied.

1. Options of setting environments for theorems, definitions, etc. and their counters

Remark 1.
1. formula. *Subordinate counting*:

`\newtheorem{new counter}{text}[existing counter]`

new counter: a name of the new (just setting) counter and environment
text: a text which appears in the output
existing counter: a name of the existing counter to which the new counter will be subordinate

2. formula. *Joint counting:*

`\newtheorem{new counter}[existing counter]{text}`

new counter: a name of the new (just setting) counter and environment
existing counter: a name of the existing counter which the new counter joins
text: a text which appears in the output

3. formula. *Independent counting:*

`\newtheorem{new counter}{text}`

new counter: a name of the new (just setting) counter and environment
text: a text which appears in the output

4. formula. *No counting:*

`\newtheorem*{new counter}{text}`

new counter: a name of the new (just setting) counter and environment
text: a text which appears in the output

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2. Examples of some environments: definitions, theorems, . . . , and itemization

Effect algebras were introduced by D. J. Foulis and M. K. Bennett [2]. An effect algebra is a partial algebra which serves as a generalization of the set of Hilbert-space effects, i.e. self-adjoint operators on a Hilbert space (see e.g. [1] for the motivation in full details). For reader's convenience, we recall the definition of effect algebra.

Theorem 2.1. *Let $\mathcal{A} = (A; \oplus, \neg, 0)$ be a basic algebra. The induced lattice weak effect algebra $\mathcal{E}(A) = (A; +, 0, 1)$ is commutative if and only if $\mathcal{A}$ is quasi-commutative.*

Proof. Assume that $a + b$ is defined. Then $a \leq b'$, i.e. $a \leq \neg b$ and $b \leq \neg a$ in $\mathcal{A}$ and, due to quasi-commutativity of $\mathcal{A}$ we have

$$a + b = (\neg a)^b = (\neg b)^a = b + a.$$

Conversely, if $\mathcal{E}(A)$ is commutative, $x, y \in A$ and $y \leq x$, then $\neg x \leq \neg y$ thus $y + x'$, $x' + y$ are defined and $(\neg y)^{(\neg x)} = (\neg y \vee \neg x)^{(\neg x)} = y \oplus \neg x = y + x' = x' + y = \neg x \oplus y = x^y$ thus $\mathcal{A}$ is quasi-commutative. □

Due to the mutual one-to-one correspondence mentioned in Remark 3, we can conclude:

Corollary 2.1.1. *A lattice weak effect algebra $\mathcal{E}$ is commutative if and only if the induced basic algebra $\mathcal{A}(E)$ is quasi-commutative.*

Example of using the environment "itemize".

Definition 1. An *effect algebra* is a partial algebra $\mathcal{E} = (E; +, 0, 1)$ of type $(2, 0, 0)$ satisfying the axioms

- (EA1) if $x + y$ is defined, then $y + x$ is defined and $x + y = y + x$;
- (EA2) if $x + y$ and $(x + y) + z$ are defined, then $y + z$ and $x + (y + z)$ are defined and $x + (y + z) = (x + y) + z$;
- (EA3) for each $a \in E$ there exists a unique $b \in E$ such that $a + b = 1$; let us denote this b by a';
- (EA4) if $1 + a$ is defined, then $a = 0$.

Remark 2 (Upright marks of items in italic environments)**.** To avoid italic item marks in an italic environment, use the environment "itemize" instead of "enumerate" provided item marks are "hand-made". Or use (in the preamble)

```
\renewcommand{\labelenumi}{\textup{(\arabic{enumi})}}
or \roman \Roman \alph \Alph instead of \arabic
```

Illustration. *In an italic environment:*

- (EA1) *if $x + y$ is defined, then $y + x$ is defined and $x + y = y + x$;*
- (EA2) *if $x + y$ and $(x + y) + z$ are defined, then $y + z$ and $x + (y + z)$ are defined and $x + (y + z) = (x + y) + z$;*
- (EA3) *for each $a \in E$ there exists a unique $b \in E$ such that $a + b = 1$; let us denote this b by a';*
- (EA4) *if $1 + a$ is defined, then $a = 0$.*

Example of using the environment "eqlist".

Remark 3 (Long marks of items)**.** For long marks of items, you can use the package "eqlist" and subsequently the environment "eqlist" as in the following definition.

Definition 2. A partial algebra $\mathcal{E} = (E; +, 0, 1)$ of type $(2, 0, 0)$ is called a *weak effect algebra* if it satisfies the following conditions:

(WEA1) for each $a \in E$ there exists a unique $b \in E$, denoted as a', such that $a + b = 1 = b + a$;
(WEA2) if $a + 1$ or $1 + a$ is defined, then $a = 0$;
(WEA3) $a = x + a$ implies $x = 0$, $a = x + (y + a)$ implies $x = 0 = y$;
(WEA4) if $b = x + a$ and $c = y + b$, then there exists $z \in E$ with $c = z + a$;
(WEA5) if $b = x + a$, then there exists $y \in E$ with $a' = y + b'$;
(WEA6) if $b = x+a$ and $a+z$, $b+z$ are defined, then there exists $v \in E$ such that $b+z = v+(a+z)$;
(WEA7) if $a + b = c$, then $a' = c' + b$.

Remark 4 ("eqlist" in an italic environment)**.** In an italic environment use:

```
\begin{eqlist}[\def\makelabel #1{\textup{#1}}]
```

You can even use the following:

```
\begin{eqlist}[\def\makelabel #1{\textup{(WEA#1)}}]
\item[1]
\item[2]
 ...
\end{eqlist}
```

Illustration. *In an italic environment we can use:*

(WEA1) *for each $a \in E$ there exists a unique $b \in E$, denoted as a', such that $a + b = 1 = b + a$;*
(WEA2) *if $a + 1$ or $1 + a$ is defined, then $a = 0$;*
(WEA3) *$a = x + a$ implies $x = 0$, $a = x + (y + a)$ implies $x = 0 = y$;*
(WEA4) *if $b = x + a$ and $c = y + b$, then there exists $z \in E$ with $c = z + a$;*
(WEA5) *if $b = x + a$, then there exists $y \in E$ with $a' = y + b'$;*
(WEA6) *if $b = x+a$ and $a+z$, $b+z$ are defined, then there exists $v \in E$ such that $b+z = v+(a+z)$;*
(WEA7) *if $a + b = c$, then $a' = c' + b$.*

Remark 5. By using the environment "itemize" (or "enumerate") for long marks of items we have the following unsightly result.

Definition 3. A partial algebra $\mathcal{E} = (E; +, 0, 1)$ of type $(2, 0, 0)$ is called a *weak effect algebra* if it satisfies the following conditions:

(WEA1) for each $a \in E$ there exists a unique $b \in E$, denoted as a', such that $a + b = 1 = b + a$;
(WEA2) if $a + 1$ or $1 + a$ is defined, then $a = 0$;
(WEA3) $a = x + a$ implies $x = 0$, $a = x + (y + a)$ implies $x = 0 = y$;
(WEA4) if $b = x + a$ and $c = y + b$, then there exists $z \in E$ with $c = z + a$;
(WEA5) if $b = x + a$, then there exists $y \in E$ with $a' = y + b'$;
(WEA6) if $b = x+a$ and $a+z$, $b+z$ are defined, then there exists $v \in E$ such that $b+z = v+(a+z)$;
(WEA7) if $a + b = c$, then $a' = c' + b$.

Examples of using the environment "enumerate".

Actually we show that:

(1) up to isomorphism, every one-generated free $F_p(1)$ algebra is a relative MV-subalgebra of the cyclic free MV-algebra $F(1)$, for any p;
(2) up to isomorphism, the set of one-generated free $F_p(1)$ algebras, p varying in the set of all positive integers, forms a directed system in the category of relative MV-algebras;
(3) up to isomorphism, each one-generated free $F_p(1)$ algebra is a retractive subalgebra of $F(1)$, in the category of relative MV-algebras;

(4) there is a family $\mathcal{D} = \{D_p\}_{p\in\mathbb{N}}$ of finite sequences of elements of $Q \cap [0, 1]$ (sub-Farey sequences), such that each element $D_p \in \mathcal{D}$ allows us to cut out a relative MV-subalgebra of $F(1)$, which is isomorphic to $F_p(1)$.

We shall refer to [3] for any unexplained notion on MV-algebras and, for a better readability of the paper, we confine to Appendix the results, useful for our aims, which essentially concern with elementary properties of the integer numbers.

Example of using locally redefined environment "enumerate".

Proposition 2.2. *For $x, y \in [c, d]$ we have* (by using "enumerate")

(a) $x \dagger y = (x \oplus c^*y) \wedge d$;
(b) $\neg x = c \oplus x^*d$.

Or by using "itemize":

Proposition 2.3. *For $x, y \in [c, d]$ we have* (by using "itemize")

(a) $x \dagger y = (x \oplus c^*y) \wedge d$;
(b) $\neg x = c \oplus x^*d$.

Remark 6. Redefinitions of the environments "enumerate" and "itemize" placed in preambles "work" in the whole of a paper.

***Example* 1** (Options of redefining labels). `\renewcommand{\labelenumi}{\textup{(\alph{enumi})}}` `\renewcommand{\labelitemi}{(+)}`

Levels:

```
\labelenumi, \labelenumii, \labelenumiii, \labelenumiv
\labelitemi, \labelitemii, \labelitemiii, \labelitemiv
```

A typeface can be set by using one of the following commands:

```
\arabic, \roman, Roman, \alph, \Alph
for ``itemize'' only a common mark for a level
```

- $x \dagger y = (x \oplus c^*y) \wedge d$;
- $\neg x = c \oplus x^*d$.

⋆ $x \dagger y = (x \oplus c^*y) \wedge d$;
⋆ $\neg x = c \oplus x^*d$.

(+) $x \dagger y = (x \oplus c^*y) \wedge d$;
(+) $\neg x = c \oplus x^*d$.

Remark 7. In an "upshape" text we can use for item marks an "ordinary" expression:
If a weak effect algebra is commutative, then clearly (W7) implies (W5) thus the axiom system can be simplified.

In an italic text we are forced to provide the upright script in the following way:

```
\thetag{W7},  or  \textup{(W7)},  or  \emph{(W7)},
```

see the following corollary.

Corollary 2.3.1. *A partial algebra $\mathcal{E} = (E; +, 0, 1)$ is a commutative weak effect algebra if and only if it satisfies the axioms* (W1)–(W4), (W6), (W7) *and*

$$x + y = y + x.$$

3. Display structures, tagging and aligning multi-line structures

Let $b(\cdot,\cdot,\cdot)$ be the continuous trilinear form on $V_{1,q}$ defined by

$$b(u,v,w)=\sum_{i,j=1}^{n}\int_\Omega u_i\frac{\partial v_j}{\partial x_i}w_j\,\mathrm{d}x \qquad \text{for all} \quad u,v,w\in V_{1,q}.$$

Let $T\in\mathbb{R}$, $T>0$, be fixed and $t\in[0,T]$. Let Ω be a bounded, open domain in $\mathbb{R}^n$, $n=2,3$, whose boundary $\Gamma=\partial\Omega$ is Lipschitz continuity. For the functional setting of the problem (1)–(2) we take a Banach space $L^q(\Omega)$ and a Sobolev space

$$W_0^{1,q}(\Omega)=\big\{u\in L^q(\Omega):\ \partial_i u\in L^q(\Omega),\ \ u/_\Gamma=0\big\}. \tag{3.1}$$

We define the next spaces, where H and V are Hilbert spaces and $V_{1,q}$ is a Banach space.

The environments "align", "align*" and "aligned".

Automatic tagging.

$$\begin{align} H&=\big\{u\in L^2(\Omega):\ \nabla\cdot u=0,\ \ u/_\Gamma=0\big\}, \tag{3.2}\\ V&=\big\{u\in H_0^1(\Omega):\ \nabla\cdot u=0\big\}, \notag\\ V_{1,q}&=\big\{u\in W_0^{1,q}(\Omega):\ \nabla\cdot u=0\big\}, \tag{3.3}\end{align}$$

Author's tagging.

$$\begin{align} H&=\big\{u\in L^2(\Omega):\ \nabla\cdot u=0,\ \ u/_\Gamma=0\big\}, \notag\\ V&=\big\{u\in H_0^1(\Omega):\ \nabla\cdot u=0\big\}, \tag{α}\\ V_{1,q}&=\big\{u\in W_0^{1,q}(\Omega):\ \nabla\cdot u=0\big\}, \tag{A}\end{align}$$

Mixed tagging.

$$\begin{align} H&=\big\{u\in L^2(\Omega):\ \nabla\cdot u=0,\ \ u/_\Gamma=0\big\}, \notag\\ V&=\big\{u\in H_0^1(\Omega):\ \nabla\cdot u=0\big\}, \tag{$*$}\\ V_{1,q}&=\big\{u\in W_0^{1,q}(\Omega):\ \nabla\cdot u=0\big\}, \tag{3.4}\end{align}$$

No tagging.

$$\begin{align*} H&=\big\{u\in L^2(\Omega):\ \nabla\cdot u=0,\ \ u/_\Gamma=0\big\},\\ V&=\big\{u\in H_0^1(\Omega):\ \nabla\cdot u=0\big\},\\ V_{1,q}&=\big\{u\in W_0^{1,q}(\Omega):\ \nabla\cdot u=0\big\},\end{align*}$$

One tag by using the construction "aligned" within "equation".

Automatic:

$$\begin{aligned} H&=\big\{u\in L^2(\Omega):\ \nabla\cdot u=0,\ \ u/_\Gamma=0\big\},\\ V&=\big\{u\in H_0^1(\Omega):\ \nabla\cdot u=0\big\},\\ V_{1,q}&=\big\{u\in W_0^{1,q}(\Omega):\ \nabla\cdot u=0\big\},\end{aligned} \tag{3.5}$$

Author's:

$$
\begin{aligned}
H &= \big\{u \in L^2(\Omega) :\ \nabla \cdot u = 0,\ \ u/_\Gamma = 0\big\},\\
V &= \big\{u \in H_0^1(\Omega) :\ \nabla \cdot u = 0\big\},\\
V_{1,q} &= \big\{u \in W_0^{1,q}(\Omega) :\ \nabla \cdot u = 0\big\},
\end{aligned}
\tag{A}
$$

Remark 8. The command

`\numberwithin{equation}{name of existing counter}`

subordinates the counter "equation" to the existing counter which name is within the 2nd braces. Usually, it is the counter "section".

The environments "alignat", "alignat*" and "alignedat".

Now, our optimal control problem, in the coefficient of kinematic viscosity $a = a\,(|\nabla u|)$ in the modification of Navier-Stokes equations, is:

$$\inf_{a\in Q}\Big\{J(a) :\ J(a) = \textstyle\int_0^T |u(a)(t) - z(t)|^2_{L^2(\Omega)}\,\mathrm{d}t\Big\}^1 \tag{$\mathcal{P}$}$$

subject to

$$
\begin{alignedat}{3}
\frac{\partial u}{\partial t} - \nu_0 \triangle u - \nu_1 \nabla \cdot \big(a\,(|\nabla u|)\,\nabla u\big) + \sum_{i=1}^n u_i D_i u + \nabla p &= 0 &\qquad &\text{in} &\quad &\Omega \times (0,T),\\
\operatorname{div} u &= 0 && \text{in} && \Omega \times (0,T),\\
u &= 0 && \text{on} && \Gamma \times (0,T),\\
u(x,0) &= u_0 && \text{in} && \Omega,
\end{alignedat}
$$

where $u(x,t) = \big(u_1(x,t),\dots,u_n(x,t)\big)$ is velocity, $p = p(x,t)$ is pressure, $u_0 = u_0(x)$ is initial velocity.

Remark 9. For more (*number*) aligned blocks we can use the environment "alignat" which has the following construction.

```
\begin{alignat}{number}
  ...
\end{alignat}
```

odd &'s align parts of lines within a given block in this marked place,
even &'s separate blocks.

***Example* 2** ("alignat")**.**

$$
\begin{alignat}{3}
vs(n) &\ge 2^{\frac{3(n-4)}{4}} \cdot 12, \tag{W}\\
s(n) &\ge 2^{\frac{3n}{4}-2} \cdot 31 &\qquad &\text{if}\quad n \equiv 0 \pmod 4, \tag{3.6}\\
s(n) &\ge 2^{\frac{3(n-1)}{4}-2} \cdot 3 && \text{if}\quad n \equiv 1 \pmod 4.
\end{alignat}
$$

$$\Delta^i z_n > 0 \qquad \text{for} \quad n \ge n_0, \qquad 0 \le i \le p, \tag{3.7}$$

and

$$(-1)^{p+i}\Delta^i z_n > 0, \qquad \text{for} \quad n \ge 1, \quad p+1 \le i \le m-1 \tag{3.8}$$

---

[1]In set notations we use the textstyle size for big operators.

***Example* 3** ("alignat*").

$$\begin{alignedat}{3}
&\mathbf{r}_l = (0,\dots,0), \quad &&\mathbf{i}_l = (0,0) \qquad &&(1\le l\le L'),\\
&\mathbf{r}_l = \mathbf{r}^*_{l-L'}, &&\mathbf{i}_l = \mathbf{i}^*_{l-L'} &&(L'+1\le l\le L-3),\\
&\mathbf{r}_l = (0,\dots,0), &&\mathbf{i}_l = (q-1,0) &&(l=L-2),\\
&\mathbf{r}_l = (0,\dots,0), &&\mathbf{i}_l = (i_1,0) &&(l=L-1),\\
&\mathbf{r}_l = (0,\dots,0), &&\mathbf{i}_l = (0,0) &&(l=L),
\end{alignedat}$$

***Example* 4** ("alignedat" within "equation").

$$\begin{alignedat}{3}
N &\equiv 0 \pmod 9 &&\iff S(N) \equiv 0 \pmod 9 \qquad &&\text{if}\quad w_i = 1,\\
N &\equiv 0 \pmod{11} &&\iff S(N) \equiv 0 \pmod{11} &&\text{if}\quad w_i = (-1)^i,\\
N &\equiv 0 \pmod 7 &&\iff S(N) \equiv 0 \pmod 7 &&\text{if}\quad w_i \in \{1,3,2,-1,-3,-2\}.
\end{alignedat} \tag{3.9}$$

Functions with cases.

$$h^*(v) = \begin{cases} h(v), & v\in A,\\ h(b)+(i-1)2n, & v=b_i\in B_i,\\ h(c)+(x-i)2n, & v=c_i.\end{cases}$$

$$\Gamma_{u,\kappa} = \begin{cases} 0 & \text{if } h(u,\kappa) \text{ is odd},\\ 2^{\ell(u,\kappa)+1} & \text{otherwise}.\end{cases}$$

$$\bigl|t\bigl([0,x)\times[0,y)\bigr)\bigr| - xy = \begin{cases} x-xy & \text{for } (x,y)\in A_1,\\ y-(1/q)-xy & \text{for } (x,y)\in A_2,\\ y+x-1-xy & \text{for } (x,y)\in A_3.\end{cases} \tag{3.10}$$

$$Ax(t) = \begin{cases} Ax(T), & t\in[T_0,T],\\ p(t)x(t-\tau)+\frac{9(1-p)}{10}, & t\ge T.\end{cases} \tag{3.11}$$

$$Bx(t) = \begin{cases} Bx(T) & \text{for } t\in[T_0,T],\\ -\int_t^\infty \frac{1}{r(s)}\bigl(\int_s^\infty q(u)G\bigl(x(h(u))\bigr)\,\mathrm{d}u\bigr)\,\mathrm{d}s & \\ -\int_t^\infty \frac{F(S)}{r(s)}\,\mathrm{d}s, & \text{for } t\ge T.\end{cases} \tag{3.12}$$

4. About labels and refs

Remark 10. In this section, there are shown some possibilities to put labels into theorems, lemmas, …and equations and subsequently to refer to them in a text. These constructions are not obligatory.

As the nonlinear operator $\mathbf{A}$ is monotone and $z(0)=0$, we find

$$|z(t)|^2 + 2\nu_0\int_0^t \|z(s)\|^2\,\mathrm{d}s \le 2\int_0^t \bigl|b\bigl(z(s),u_1(s),z(s)\bigr)\bigr|\,\mathrm{d}s \tag{4.1}$$

We have also inequality

$$\|v\|_{L^3(\Omega)} \le |v|^{\frac12}\|v\|^{\frac12}_{L^6(\Omega)} \tag{4.2}$$

(see [4, pp. 86]). As a consequence of these two last relations we have

$$\begin{aligned} |b(z,u_1,z)| &\le \|u_1\|_{L^6(\Omega)}\|z\|\|z\|_{L^3(\Omega)} \\ &\le \|u_1\|_{L^6(\Omega)}\|z\||z|^{\frac{1}{2}}\|z\|^{\frac{1}{2}}_{L^6(\Omega)} \\ &\le \|u_1\|_{L^6(\Omega)}|z|^{\frac{1}{2}}\|z\|^{\frac{3}{2}} \\ &\le \varepsilon\|z\|^2 + C_\varepsilon|z|^2\|u_1\|^4_{L^6(\Omega)}. \end{aligned} \tag{4.3}$$

If we put $\varepsilon = 2\nu_0$ in the above inequality (4.3), then from (4.1), we shall have

$$|z(t)|^2 \le C_\varepsilon \int_0^t |z(s)|^2\|u_1\|^4_{L^6(\Omega)}.$$

In this paper, sufficient conditions are obtained, so that every solution of

$$\Delta^m(y_n - p_n y_{\tau(n)}) + q_n G(y_{\sigma(n)}) - u_n H(y_{\alpha(n)}) = f_n, \tag{4.4}$$

oscillates or tends to zero or $\pm\infty$ as $n \to \infty$, where Δ is the forward difference operator given by $\Delta x_n = x_{n+1} - x_n$, p_n, q_n, u_n and f_n are infinite sequences of real numbers with $q_n > 0$, $u_n \ge 0$, $G, H \in C(\mathbb{R},\mathbb{R})$.

The results in [6, 7] do not hold for a class of equations, where G is either linear or super linear, i.e., for example, when $G(u) = u$ or $G(u) = u^3$. Here in this paper an attempt is made to fill this existing gap in literature and obtain sufficient conditions for oscillation of solutions of a more general equation (4.4) under the weaker conditions (H4) or (H6). Moreover, we observe that the existing papers in the literature do not have much to offer when p_n satisfies (A4), (A6) or (A7). In this direction we find that the authors in [5] have obtained sufficient conditions for the oscillation of solutions of the equation

$$\Delta^m(y_n - p_n y_{n-k}) + q_n G(y_{n-r}) = 0 \tag{4.5}$$

with (A4) or (A7) and have the following results.

Theorem 4.1. ([5, Theorem 2.6]) *Let p_n satisfy* (A7). *If the condition*

$$\sum_{n=n_0}^{\infty} q_n = \infty \tag{4.6}$$

holds, then the following are valid statements.

(i) *Every solution of* (4.5) *oscillates, if m is even.*
(ii) *Every solution of* (4.5) *oscillates or* $\liminf_{n\to\infty} y_n = 0$ *if m is odd.*

Theorem 4.2. ([5, Theorem 2.7]) *Let p_n satisfy* (A4). *If* (4.6) *holds, then the following statements are true.*

(i) *Every solution of* (4.5) *oscillates for m even.*
(ii) *Every solution of* (4.5) *oscillates or tends to zero as $n \to \infty$ if m is odd.*

Theorems 4.1 and 4.2 are very useful for our next considerations.

Remark 11. We can refer not only to the environment "equation", but also to every particular line in align, which is tagged and labeled.

$$\begin{aligned} H &= \{u \in L^2(\Omega) : \ \nabla \cdot u = 0, \ \ u/_\Gamma = 0\}, \\ V &= \{u \in H^1_0(\Omega) : \ \nabla \cdot u = 0\}, \qquad (*) \\ V_{1,q} &= \{u \in W^{1,q}_0(\Omega) : \ \nabla \cdot u = 0\}, \qquad (4.7) \end{aligned}$$

The first line is not tagged, but the lines $(*)$ and (4.7) are tagged and labeled, that is why they can be referred to.

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* Mathematical Institute
Slovak Academy of Sciences
Štefánikova 49
SK–814 73 Bratislava
SLOVAKIA
E-mail address: `dvorak@mat.savba.sk`

** Department of Mathematics
Comenius University
Mlynská Dolina
SK–842 15 Bratislava
SLOVAKIA
E-mail address: `Flora.Schon@fmph.uniba.sk`