QA0 QCD Macros

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Abstract

This memo describes all macro definitions for QCD.

1 `defs-spin.qa0` — SPIN OPERATIONS

File `defs-spin.qa0` contains the following definitions:

1.1 `project`

```
(macro project [const p/m] [const d] [reg res] [reg U] [reg psi])
```

Compute projection part of $(1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`U`	unused	
`psi`	in	register containing fermion to be projected

1.2 `project-U`

```
(macro project-U [const p/m] [const d] [reg res] [reg U] [reg psi])
```

Compute projection part of $U(1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`U`	in	gauge field register
`psi`	in	register containing a fermion to be projected

1.3 `project-U*`

```
(macro project-U* [const p/m] [const d] [reg res] [reg U] [reg psi])
```

Compute projection part of $U^\dagger(1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`U`	in	gauge field register
`psi`	in	register containing a fermion to be projected

1.4 `unproject`

```
(macro unproject [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $(1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`q`	unused	
`U`	unused	
`psi`	in	register containing projected fermion to be unprojected

1.5 `unproject-U`

```
(macro unproject-U [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $U(1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`q`	unused	
`U`	in	gauge field register
`psi`	in	register containing a projected fermion to be unprojected

1.6 `add-unproject`

```
(macro add-unproject [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $M[q] + (1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`q`	in	address for the fermion to be added to the unprojection
`U`	unused	
`psi`	in	register containing projected fermion to be unprojected

1.7 `sub-unproject`

```
(macro sub-unproject [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $M[q] - (1 \pm \gamma_d)\psi$.

`p/m`	in	either `'plus` or `'minus`
`d`	in	a number from 0 to `*dim*`-1 inclusive
`res`	out	result register
`q`	in	address for the fermion to be added to the unprojection
`U`	unused	
`psi`	in	register containing projected fermion to be unprojected

1.8 sub-unproject-U

```
(macro sub-unproject-U [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $M[q] - U(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*−1 inclusive
res	out	result register
q	in	address for the fermion to be added to the unprojection
U	in	gauge field register
psi	in	register containing a projected fermion to be unprojected

1.9 add-unproject-U

```
(macro add-unproject-U [const p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute unprojection part of $M[q] + U(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*−1 inclusive
res	out	result register
q	in	address for the fermion to be added to the unprojection
U	in	gauge field register
psi	in	register containing a projected fermion to be unprojected

1.10 one-x-gamma-U

```
(macro one-x-gamma-U [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $U(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*−1 inclusive
res	out	result register
q	unused	
U	in	gauge field register
psi	in	register containing a fermion

1.11 one-x-gamma-U*

```
(macro one-x-gamma-U* [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $U^\dagger(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*−1 inclusive
res	out	result register
q	unused	
U	in	gauge field register
psi	in	register containing a fermion

1.12 sub-one-x-gamma-U

```
(macro sub-one-x-gamma-U [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $M[q] - U(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*-1 inclusive
res	out	result register
q	in	address of the fermion to be added.
U	in	gauge field register
psi	in	register containing a fermion

1.13 add-one-x-gamma-U

```
(macro add-one-x-gamma-U [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $M[q] + U(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*-1 inclusive
res	out	result register
q	in	address of the fermion to be added.
U	in	gauge field register
psi	in	register containing a fermion

1.14 sub-one-x-gamma-U*

```
(macro sub-one-x-gamma-U* [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $M[q] - U^\dagger(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*-1 inclusive
res	out	result register
q	in	address of the fermion to be added.
U	in	gauge field register
psi	in	register containing a fermion

1.15 add-one-x-gamma-U*

```
(macro add-one-x-gamma-U* [const 'p/m] [const d] [reg res] [reg q] [reg U] [reg psi])
```

Compute $M[q] + U^\dagger(1 \pm \gamma_d)\psi$.

p/m	in	either 'plus or 'minus
d	in	a number from 0 to *dim*-1 inclusive
res	out	result register
q	in	address of the fermion to be added.
U	in	gauge field register
psi	in	register containing a fermion

2 `defs-A.qa0` — FLAVOR MATRICES

2.1 `S-compute-A`

```
(macro S-compute-A [reg r] [reg l-s] [reg s-1-size]
                   [reg t-plus] [reg t-minus] [reg x])
```

Compute $M[r] \leftarrow AM[x]$ at a flavor slice. Source `x` and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x`	in	address of the source fermion

2.2 `S-compute-A*`

```
(macro S-compute-A* [reg r] [reg l-s] [reg s-1-size]
                    [reg t-plus] [reg t-minus] [reg x])
```

Compute $M[r] \leftarrow A^{\dagger}M[x]$ at a flavor slice. Source `x` and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x`	in	address of the source fermion

2.3 `S-compute-add-A`

```
(macro S-compute-add-A [reg r] [reg l-s] [reg s-1-size]
                       [reg x-a] [reg t-upper] [reg t-lower] [reg x-b])
```

Compute $M[r] \leftarrow M[x_a] + AM[x_b]$ at a flavor slice. Sources `x-a` and `x-b`, and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`x-a`	in	address of the source fermion x_a
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x-b`	in	address of the source fermion x_b

2.4 `S-compute-add-A*`

```
(macro S-compute-add-A* [reg r] [reg l-s] [reg s-1-size]
                        [reg x-a] [reg t-upper] [reg t-lower] [reg x-b])
```

Compute $M[r] \leftarrow M[x_a] + A^{\dagger}M[x_b]$ at a flavor slice. Sources `x-a` and `x-b`, and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`x-a`	in	address of the source fermion x_a
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x-b`	in	address of the source fermion x_b

2.5 S-compute-sub-A

```
(macro S-compute-sub-A [reg r] [reg l-s] [reg s-1-size]
                       [reg x-a] [reg t-upper] [reg t-lower] [reg x-b])
```

Compute $M[r] \leftarrow M[x_a] - AM[x_b]$ at a flavor slice. Sources `x-a` and `x-b`, and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`x-a`	in	address of the source fermion x_a
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x-b`	in	address of the source fermion x_b

2.6 S-compute-sub-A*

```
(macro S-compute-sub-A* [reg r] [reg l-s] [reg s-1-size]
                        [reg x-a] [reg t-upper] [reg t-lower] [reg x-b])
```

Compute $M[r] \leftarrow M[x_a] - A^\dagger M[x_b]$ at a flavor slice. Sources `x-a` and `x-b`, and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`x-a`	in	address of the source fermion x_a
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x-b`	in	address of the source fermion x_b

2.7 S-compute-sub-A-norm

```
(macro S-compute-sub-A-norm [reg r] [reg norm] [reg l-s] [reg s-1-size]
                            [reg x-a] [reg t-upper] [reg t-lower] [reg x-b])
```

Compute $M[r] \leftarrow M[x_a] - A^\dagger M[x_b]$ and its contribution to $|r^2|$ at a flavor slice. Sources `x-a` and `x-b`, and destination `r` are *not* advanced and are allowed to coincide.

`r`	in	address of the result
`norm`	in/out	fermion norm accumulator
`l-s`	in	value of L_s
`s-1-size`	in	values of `(L_s-1)*sizeof(Fermion)`
`x-a`	in	address of the source fermion x_a
`t-upper`	in	address of `ABTable` for the upper part of A
`t-lower`	in	address of `ABTable` for the lower part of A
`x-b`	in	address of the source fermion x_b

2.8 S-compute-Ainv

```
(macro compute-Ainv [reg r] [reg l-s] [reg s-1-size]
                    [reg t-upper] [reg t-lower] [reg x])
```

Compute $M[r] \leftarrow A^{-1}M[x_a]$ at a flavor slice. Source `x` and destination `r` are *not* advanced and are allowed to coincide.

`r`	in/out	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	value of $(L_s - 1) * \texttt{sizeof}(\texttt{Fermion})$
`t-upper`	in	address of `AiTable` for A_+
`t-lower`	in	address of `AiTable` for A_-
`x`	in/out	address of the source fermion x

2.9 S-compute-A*inv

```
(macro compute-A*inv [reg r] [reg l-s] [reg s-1-size]
                     [reg t-upper] [reg t-lower] [reg x])
```

Compute $M[r] \leftarrow (A^\dagger)^{-1} M[x_a]$ at a flavor slice. Source `x` and destination `r` are *not* advanced and are allowed to coincide.

`r`	in/out	address of the result
`l-s`	in	value of L_s
`s-1-size`	in	value of $(L_s - 1) *$ `sizeof(Fermion)`
`t-upper`	in	address of `AiTable` for A_+
`t-lower`	in	address of `AiTable` for A_-
`x`	in/out	address of the source fermion x

3 `defs-F.qa0`—WILSON OPERATOR

3.1 S-compute-F

```
(macro S-compute-F [reg res] [reg l-s] [reg s-line] [reg nb]
                   [reg U] [reg src] [reg buf*])
```

Compute $\phi \leftarrow F\psi$, advance `res` and `nb`.

`res`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`U`	in	address of the gauge field
`src`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table

3.2 S-compute-F*

```
(macro S-compute-F* [reg res] [reg l-s] [reg s-line] [reg nb]
                    [reg U] [reg src] [reg buf*])
```

Compute $\phi \leftarrow F^\dagger\psi$, advance `res` and `nb`.

`res`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`U`	in	address of the gauge field
`src`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table

3.3 S-compute-add-F

```
(macro S-compute-add-F [reg phi] [reg l-s] [reg s-line] [reg nb]
                       [reg U] [reg src] [reg buf*])
```

Compute $\phi \leftarrow \phi + F\psi$, advance `phi` and `nb`.

`phi`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`U`	in	address of the gauge field
`src`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table

3.4 S-compute-add-F*

```
(macro S-compute-add-F* [reg phi] [reg l-s] [reg s-line] [reg nb]
                        [reg U] [reg src] [reg buf*])
```

Compute $\phi \leftarrow \phi + F^{\dagger}\psi$, advance `phi` and `nb`.

`phi`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`U`	in	address of the gauge field
`src`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table

3.5 S-compute-sub-F

```
(macro S-compute-sub-F [reg phi]
                       [reg l-s] [reg s-line] [reg nb]
                       [reg src-varphi] [reg U] [reg src-psi] [reg buf*])
```

Compute $\phi \leftarrow \varphi - F\psi$, advance `phi`, `src-varphi`, and `nb`.

`phi`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`src-varphi`	in/out	address of the local fermion field
`U`	in	address of the gauge field
`src-psi`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table

3.6 S-compute-sub-F*

```
(macro S-compute-sub-F* [reg phi]
                        [reg l-s] [reg s-line] [reg nb]
                        [reg src-varphi] [reg U] [reg src-psi] [reg buf*])
```

Compute $\phi \leftarrow \varphi - F^{\dagger}\psi$, advance `phi`, `src-varphi`, and `nb`.

`phi`	in/out	address of the result fermion
`l-s`	in	value of L_s
`s-line`	in	value of L_s`sizeof(Fermion)`
`nb`	in/out	address of be `neighbor` element
`src-varphi`	in/out	address of the local fermion field
`U`	in	address of the gauge field
`src-psi`	in	address of the local fermion field
`buf*`	in	address of the receive buffers table