

Improve type hint in quantum_info

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Improve UX of quantum_info in Qiskit-Terra

Background:

- Qiskit-Terra's quantum_info contains many useful classes without type hints.
- Providing more type hints would be a great help for coding

At start point of this project:

- Many classes of quantum_info have only docstrings
- Generating type hints from mechanically docstrings should provide better code completion...
- However not all type hints can be generated mechanically...
 - **Type hints by tools and manual work** (target of this time!)

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Brief review for Checkpoints 1&2:

- Develop a tool to generate type hints from docstrings as automatically as possible
 - Study Python's type hints
 - Study Qiskit Terra's docstrings
 - Develop a tool:
 - https://github.com/derwind/qamp-spring-23-tools/tree/main/auto_typehints
- Manually provide type hints to important classes
 - quantum_info.Statevector
 - quantum_info.DensityMatrix
- Created a draft PR

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Finally:

- Promoted a draft PR to a PR
 - Title: Provide type hints to quantum info
 - <https://github.com/Qiskit/qiskit-terra/pull/10110>
 - Status: Under review but will be merged soon
- All **54** classes of quantum_info are now provided type hints
 - quantum_info.Statevector
 - quantum_info.DensityMatrix
 - **quantum_info.StabilizerState**
 - **quantum_info.Kraus**
 - **quantum_info.SparsePauliOp** etc.

Show time!!

```
[1]: import numpy as np
      from qiskit import QuantumCircuit
      from qiskit.quantum_info import Pauli, PauliList, SparsePauliOp
      from qiskit.primitives import Estimator
```

```
• [2]: ansatz = QuantumCircuit(3)
      ansatz.ry(np.pi/5, 0)
      ansatz.ry(np.pi/4, 1)
      ansatz.ry(np.pi/3, 2)
      ansatz.cx(0, 1)
      ansatz.cx(1, 2)
      ansatz.cx(2, 0)
```

```
I = Pauli('I')
```

```
Z = Pauli('Z')
```

```
PauliList(Z.tensor(I).tensor
```

tensor qiskit.quantum_info.operat

_tensor

tensor(other: Pauli) -> Pauli

- You, quantum researchers and developers can check the types while completing the method by pressing the tab key.

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```

```
I = Pauli('I')
Z = Pauli('Z')
pauli_list = PauliList(Z, I)
observable = SparsePauliOp(pauli_list)
```

SparsePauliOp(data: PauliList | SparsePauliOp | Pauli | list | str, coeffs: np.ndarray | None=None, *, ignore_pauli_phase: bool=False, copy: bool=True)
Sparse N-qubit operator in a Pauli basis representation.

▶ 詳細

- Then you can see what arguments are accepted when they create class instances.


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      ansatz.cx(0, 1)
      ansatz.cx(1, 2)
      ansatz.cx(2, 0)

      I = Pauli('I')
      Z = Pauli('Z')
      pauli_list = PauliList(Z.tensor(I).tensor(I))

      observable = SparsePauliOp(pauli_list)
```

```
[3]: estimator = Estimator()
      job = estimator.run(ansatz, observable)
      print(job.result().values[0])
```

```
0.28603070140884224
```

- Basically, type hints reduce the number of times you have to refer to API documents, allowing you to focus on your research.

Usage

All you need to do is:

- To install `jupyterlab-lsp` to your jupyter env for better UX or simply use Visual Studio Code and/or other apps that are aware of type hints.

Thank you very much!