

# EW II Synapse Guide for Beginners

## General Tips

- The best view to start your synapse search is the xy view.
- Synapses are best visible when scrolling back and forth through 5-10 slices to grasp multiple slides at once. Click on the xp panel and scroll with the wheel of your mouse if the ',' and '.' keys.
- The xz and yz view become relevant for synapses that are oriented other than horizontal - typical synapse shape might become visible in other views (more about this below).
- 3D view shows the global shape of the synapse - can help to determine the direction of a synapse and distinguish them from mere contacts. This is more useful for conventional synapses than for ribbons though.

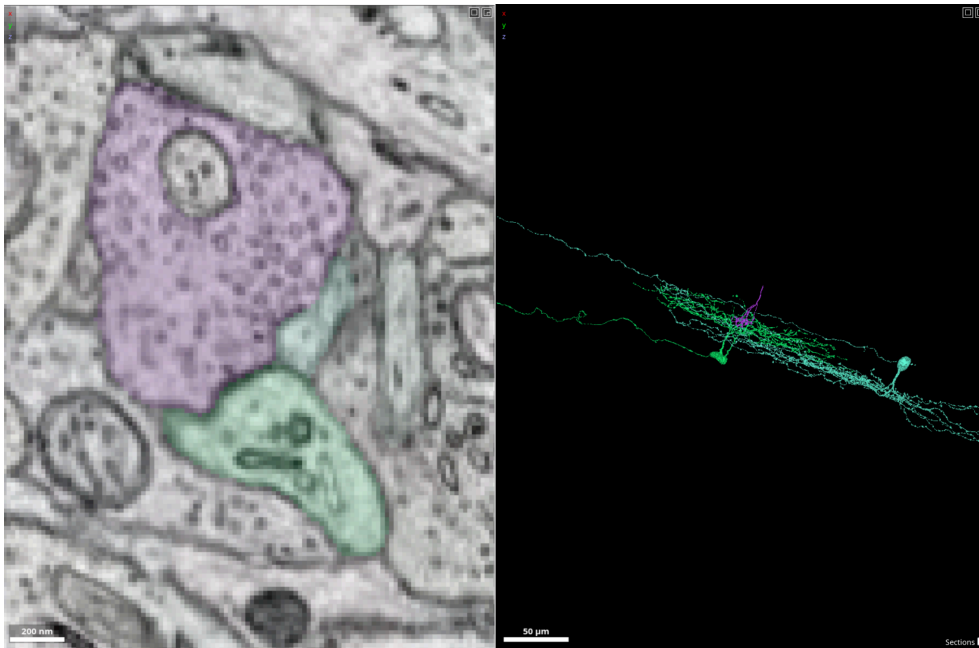
## How to detect Ribbons

- Main marker of ribbons: light grey circle/oval close to a membrane



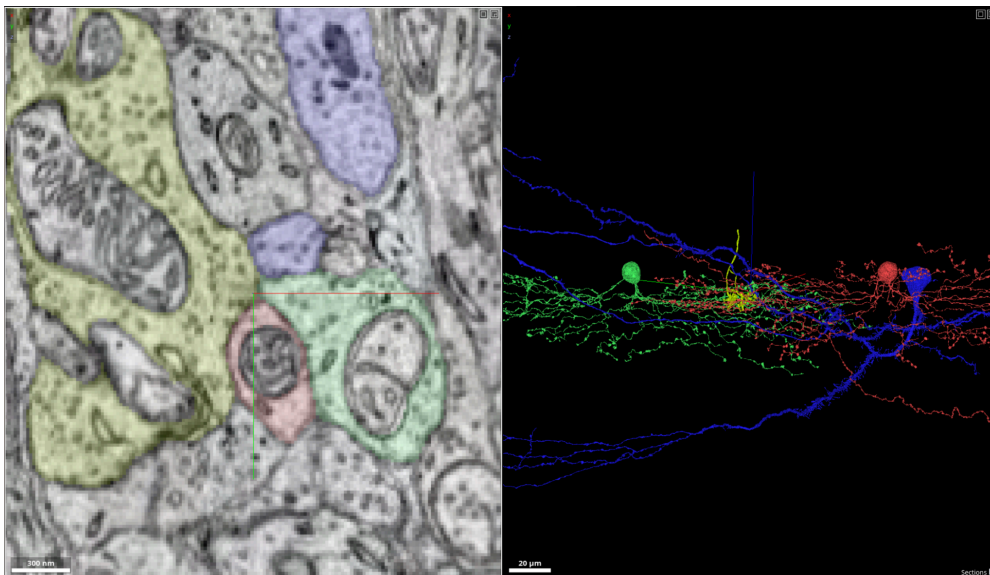
- Ribbons are inside bipolar terminals, which are bigger than most amacrine terminals. With a bit of training you can distinguish them to know where to look for ribbons - the 3D view also helps a lot here!
- Ribbon synapses can come in different shapes: Dyad synapses with two postsynaptic partners are the most common ones, triad and monad ribbons also exist. It is sometimes difficult to determine postsynaptic partners of a ribbon. Always look at multiple z-layers to make sure you don't miss one.

### dyad example with partner



<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nglstate/api/v1/5251568017342464>

### triad example with partner

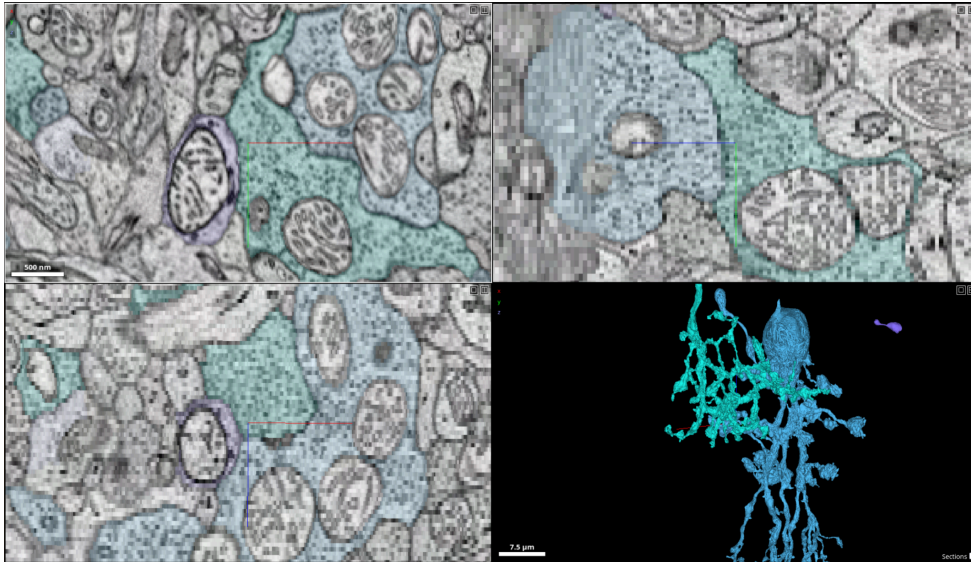


<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nglstate/api/v1/6194220661473280>

- Ribbons are often clearly visible in the horizontal view in xy as in the examples above. Detecting the postsynaptic partners can be more difficult though when the ribbon is

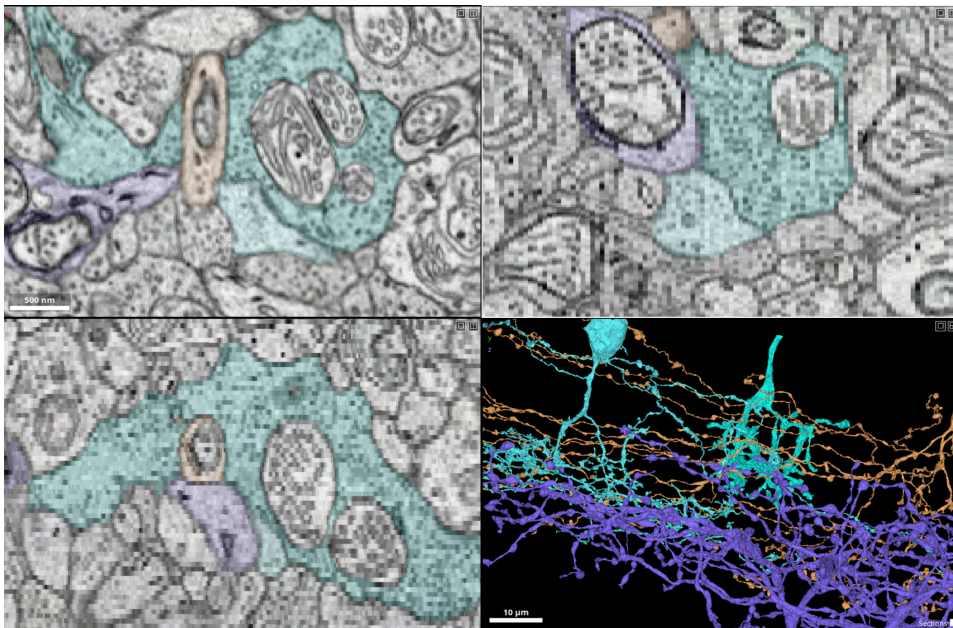
vertically or diagonally oriented. Here are some examples where the postsynaptic partners become clearer in other views.

**diad example, best visible in xz**



<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nqlstate/api/v1/5995444676067328>

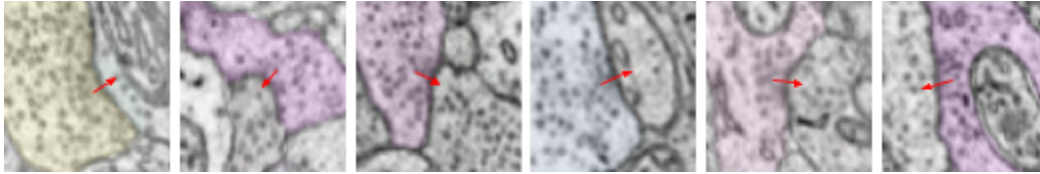
**triad example, best visible in yz and xz**



<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nqlstate/api/v1/5986587698528256>

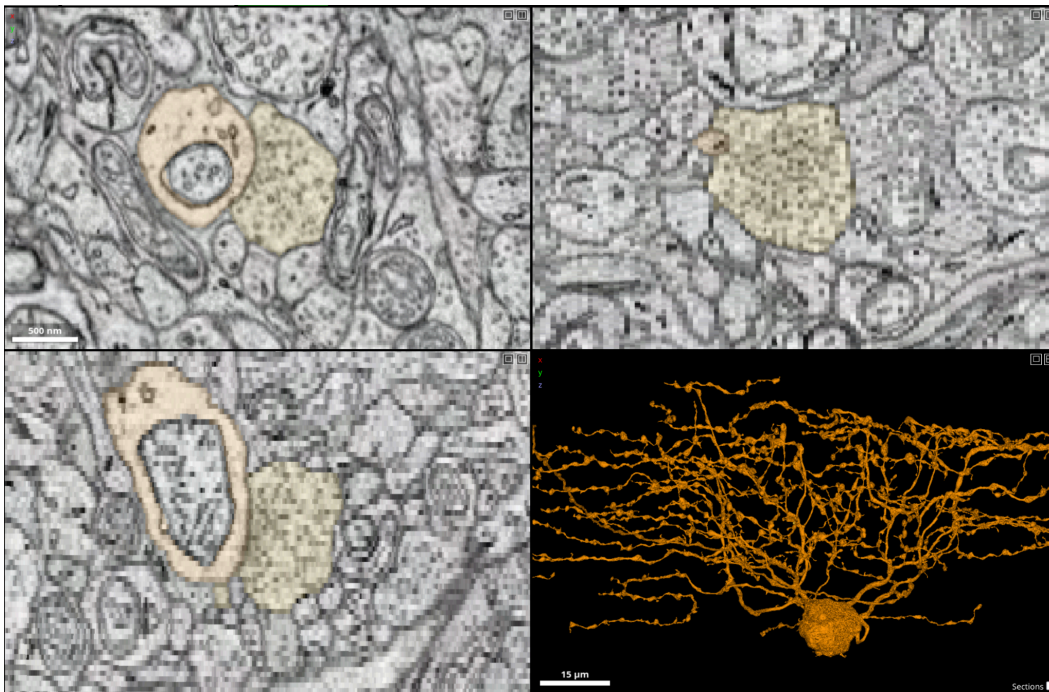
# How to detect Conventional Synapses

- main markers: vesicle clouds, associated with a membrane region between the two cells that may appear darker than elsewhere. Often with a concave shape.



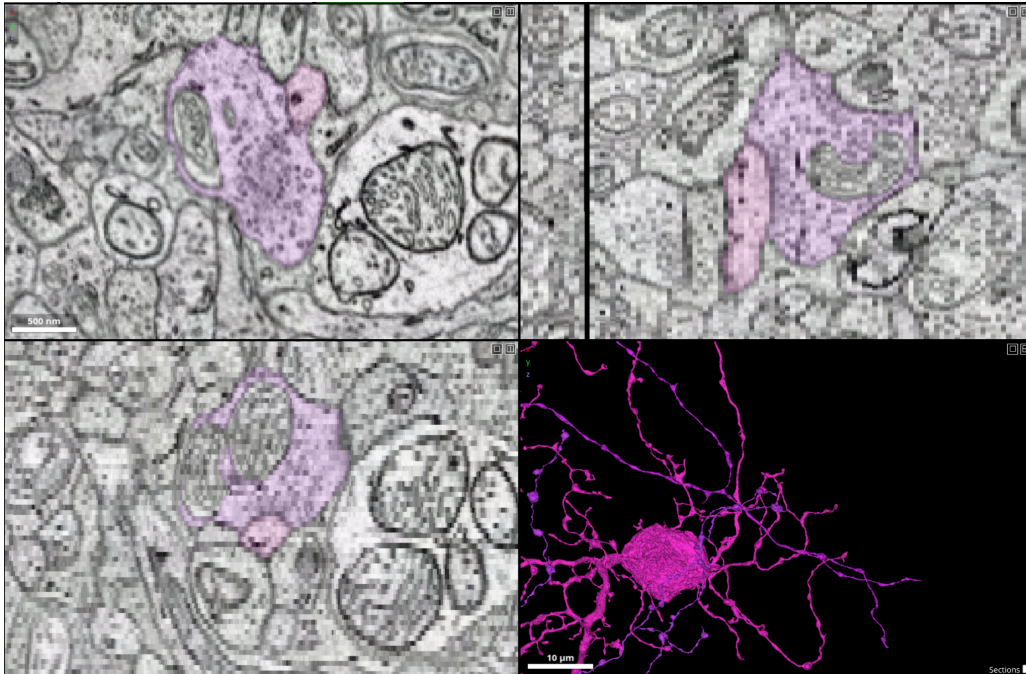
- As with ribbons, the orientation of a conventional synapse can also be horizontal or vertical or diagonal to the imaging plane.

## Horizontal view on synapse in xy



<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nglstate/api/v1/5412709418926080>

## xz and xy views helpful to detect other orientations



<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nqlstate/api/v1/5150419792691200>

- can look very different in different cells
  - GABAergic ACs have local vesicle clouds associated with their synapses and otherwise contain vesicles only sparsely. Most of the examples above likely show GABAergic synapses. Glycinergic amacrine cells often are filled with vesicles everywhere, synapses are more tricky to detect. Glycinergic terminals can look similar to bipolar terminals.
  - Wide field amacrine cells can form small synapses between each other with only a few vesicles. These can also be difficult to identify.

## Synapse Annotation Organization

- To label synapses, we recommend creating a new annotation layer and choosing the line annotation tool. Place the first point on the ribbon/presynaptic terminal and the second point on the postsynaptic partner. If you want to quantify both ribbon and conventional synapses, keeping both in separate layers will help to distinguish them later on.
- You can download your annotation points from a link for analysis via the [CAVEClient](#).

## Further examples

You can sweep through examples in the link below to get a better feeling for how synapses look. Select the annotation layer of your synapse type of interest. Right-click on the first annotation in the list to jump to its position in the view panels. Scroll through the annotations with the '[' and ']' keys.

<https://spelunker.cave-explorer.org/#!middleauth+https://global.daf-apis.com/nglstate/api/v1/6755207345078272>

Synapse example link: Courtesy of David Berson.