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Importance of **Perpendicular Projections** for Guidewire Manipulation

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Katoh

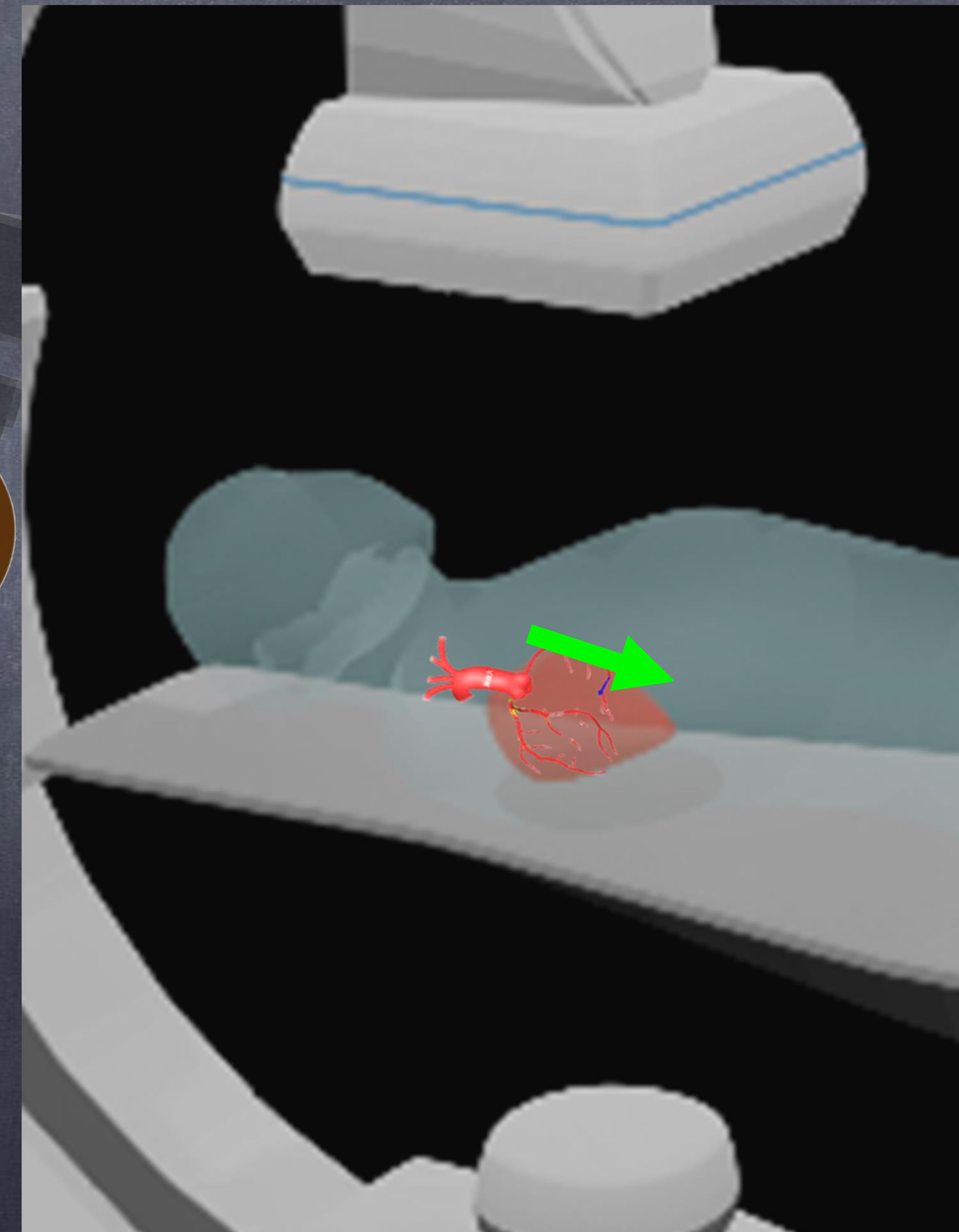
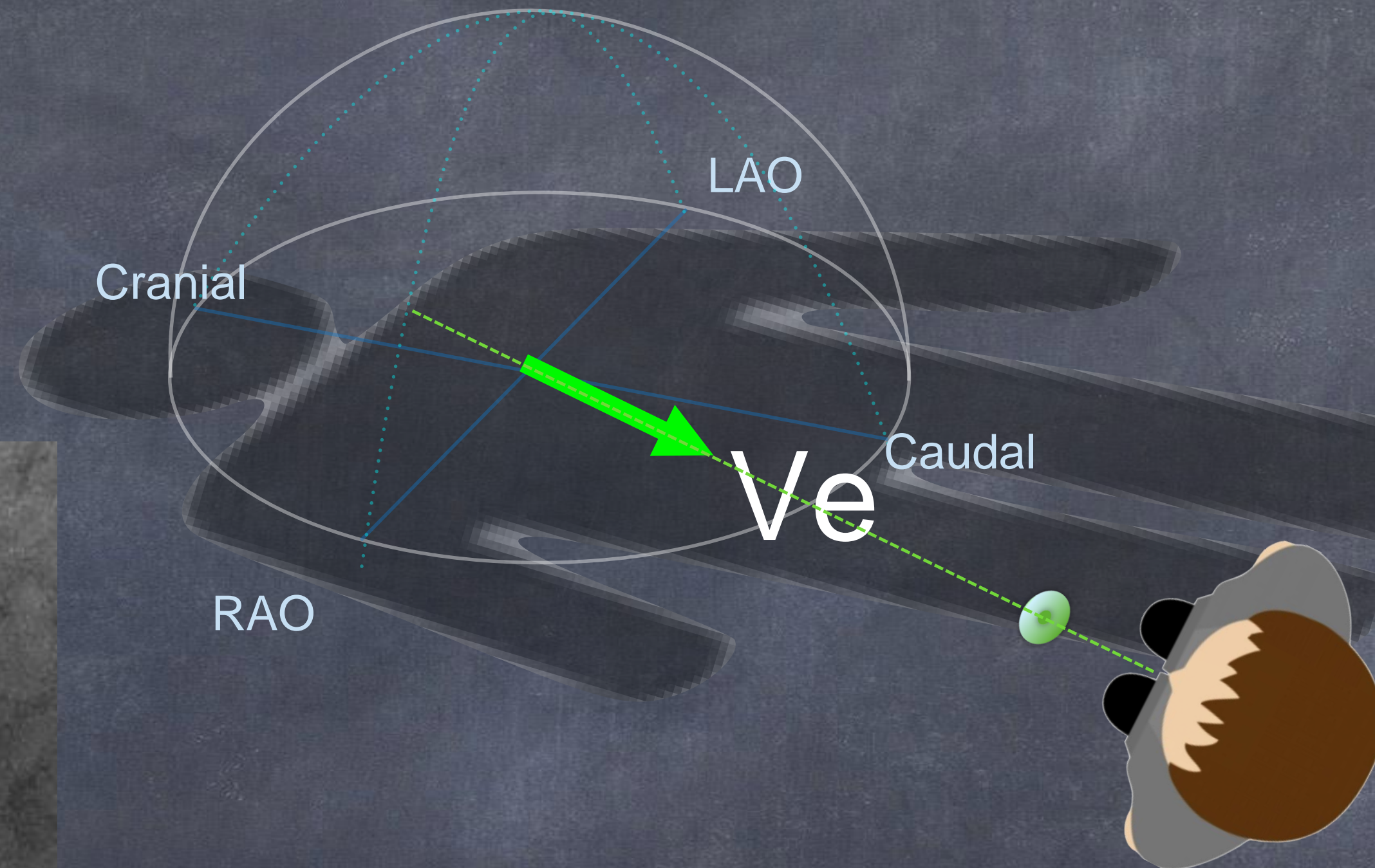
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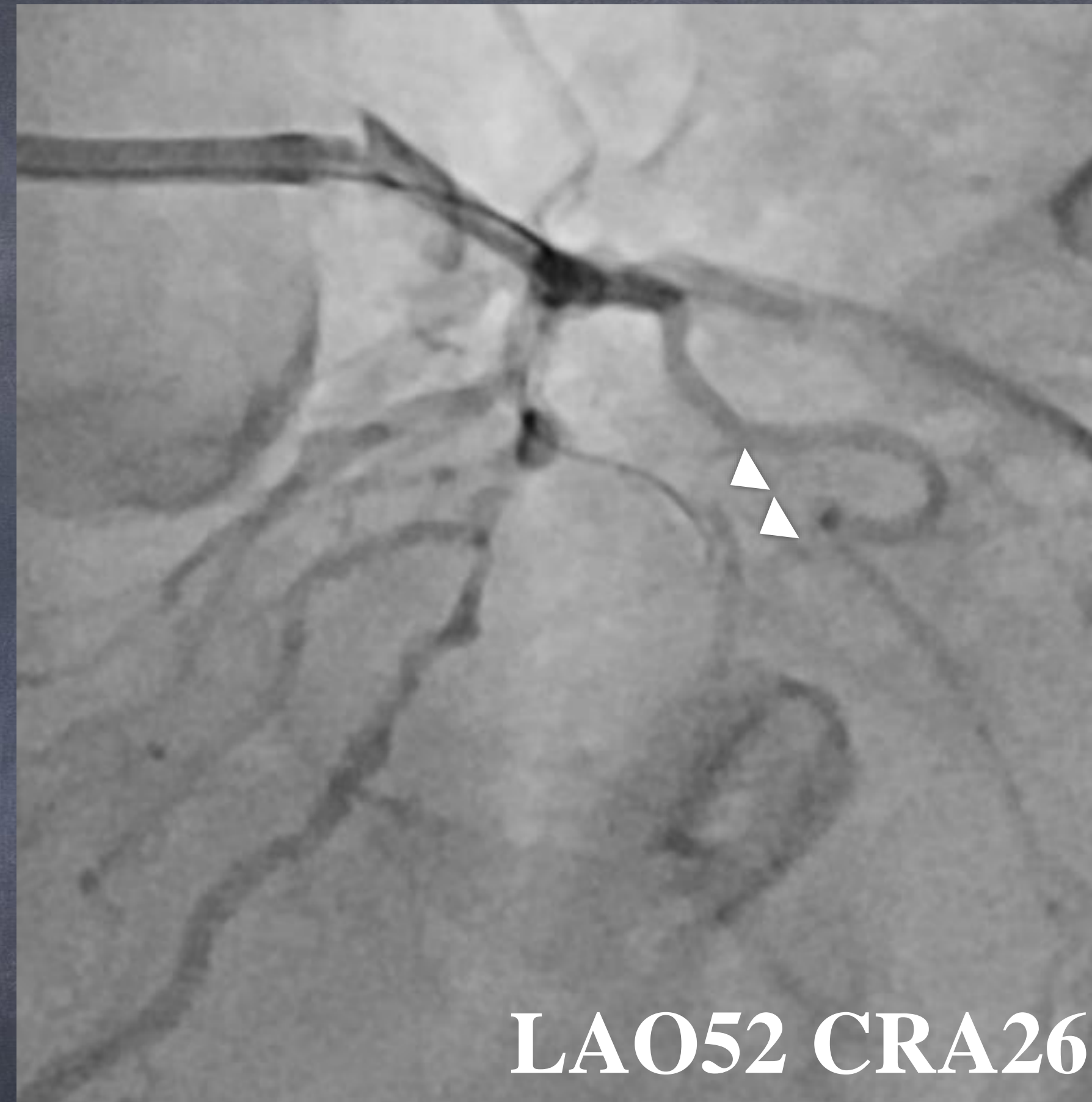
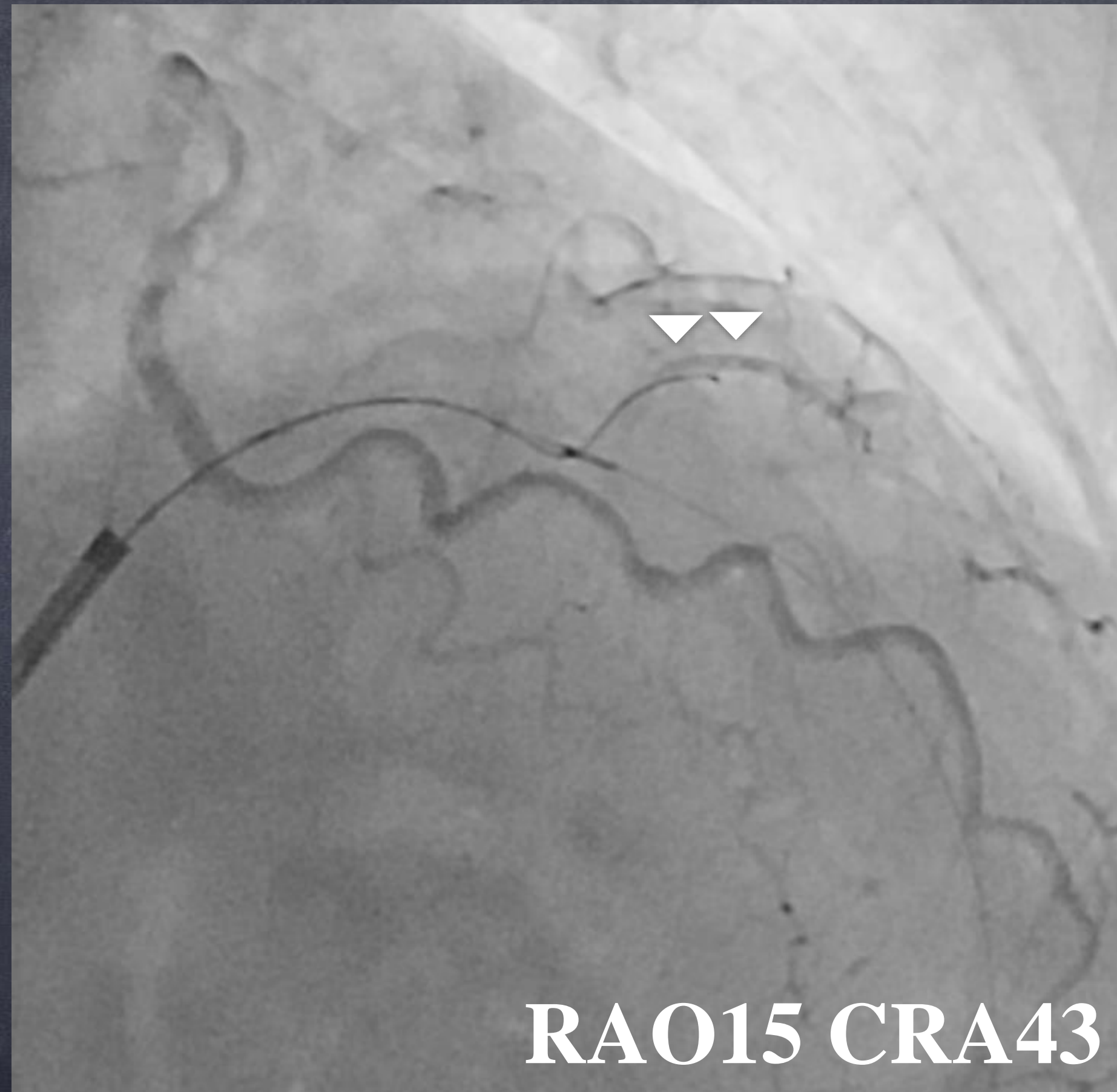
Background

- ✓ During PCI procedure, understanding of the **optimal working angle** is important.
- ✓ Especially in CTO wiring, accurate information about **perpendicular projection** is a key to success.
- ✓ However, the concept of perpendicular projections has been commonly misunderstood.

Ve; vector of the vessel axis

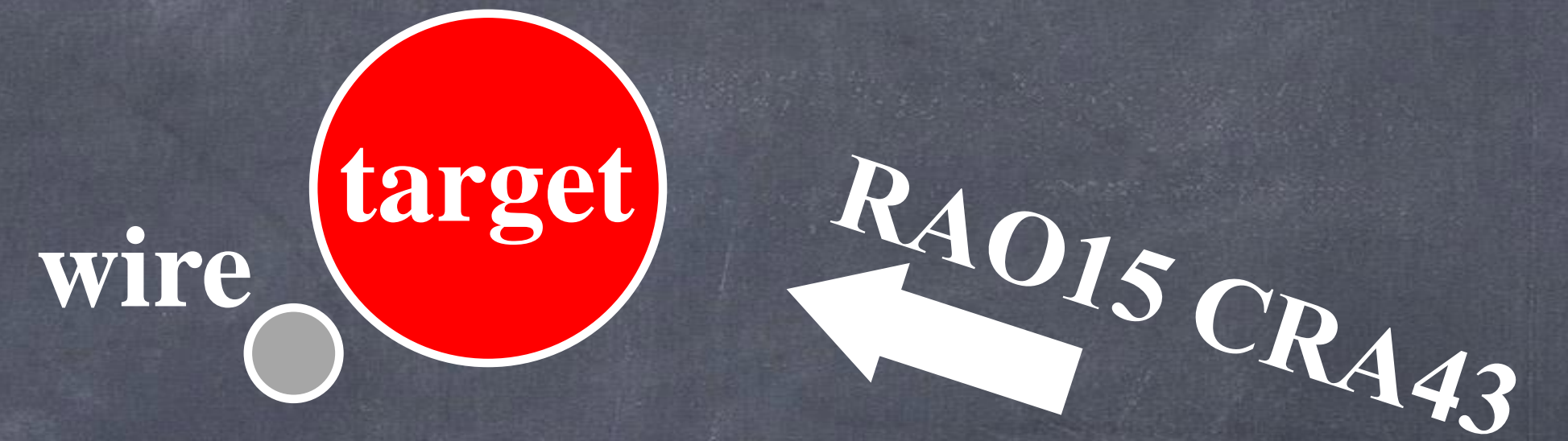
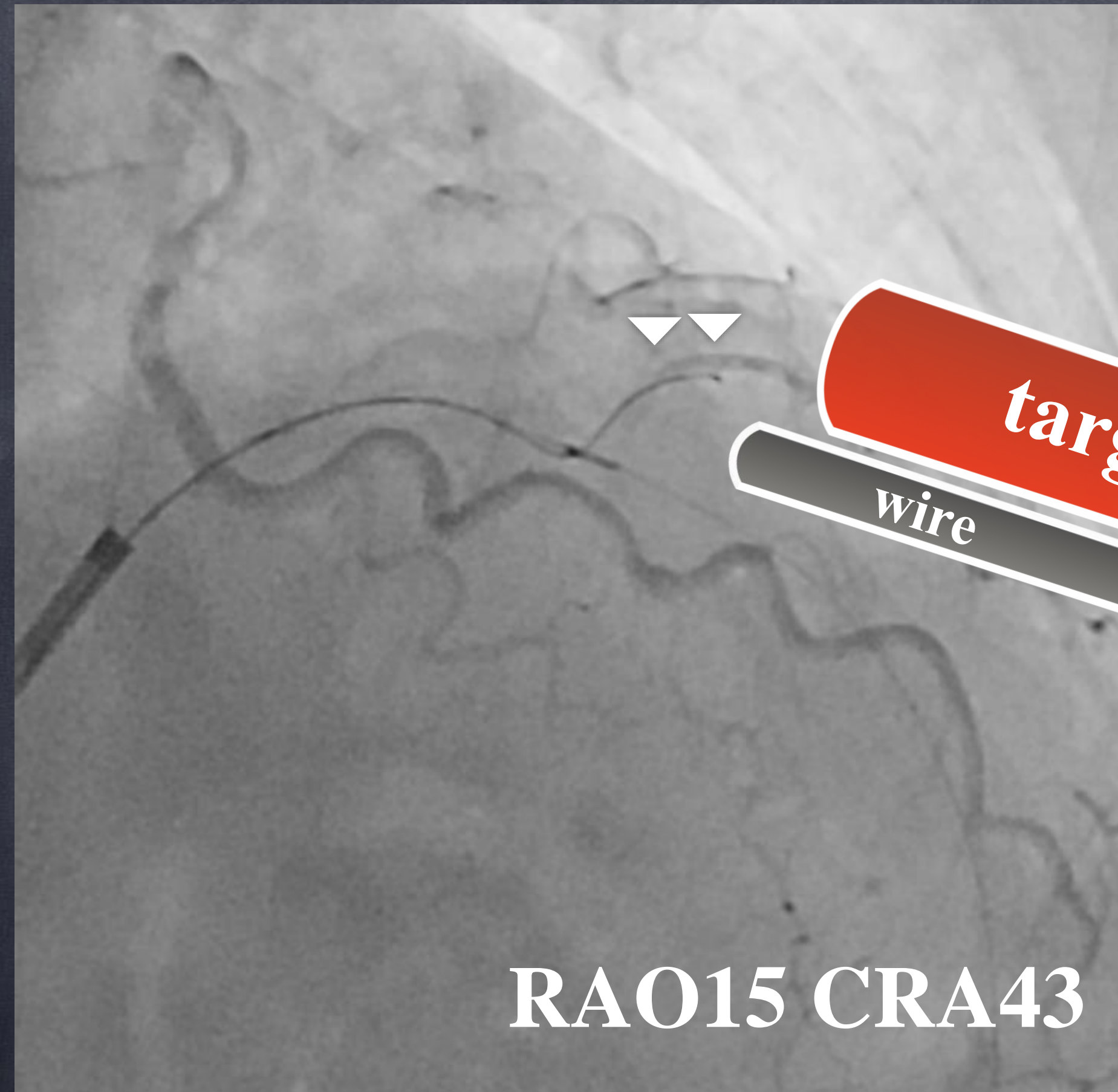


Are these bilateral coronary angiograms optimal ?

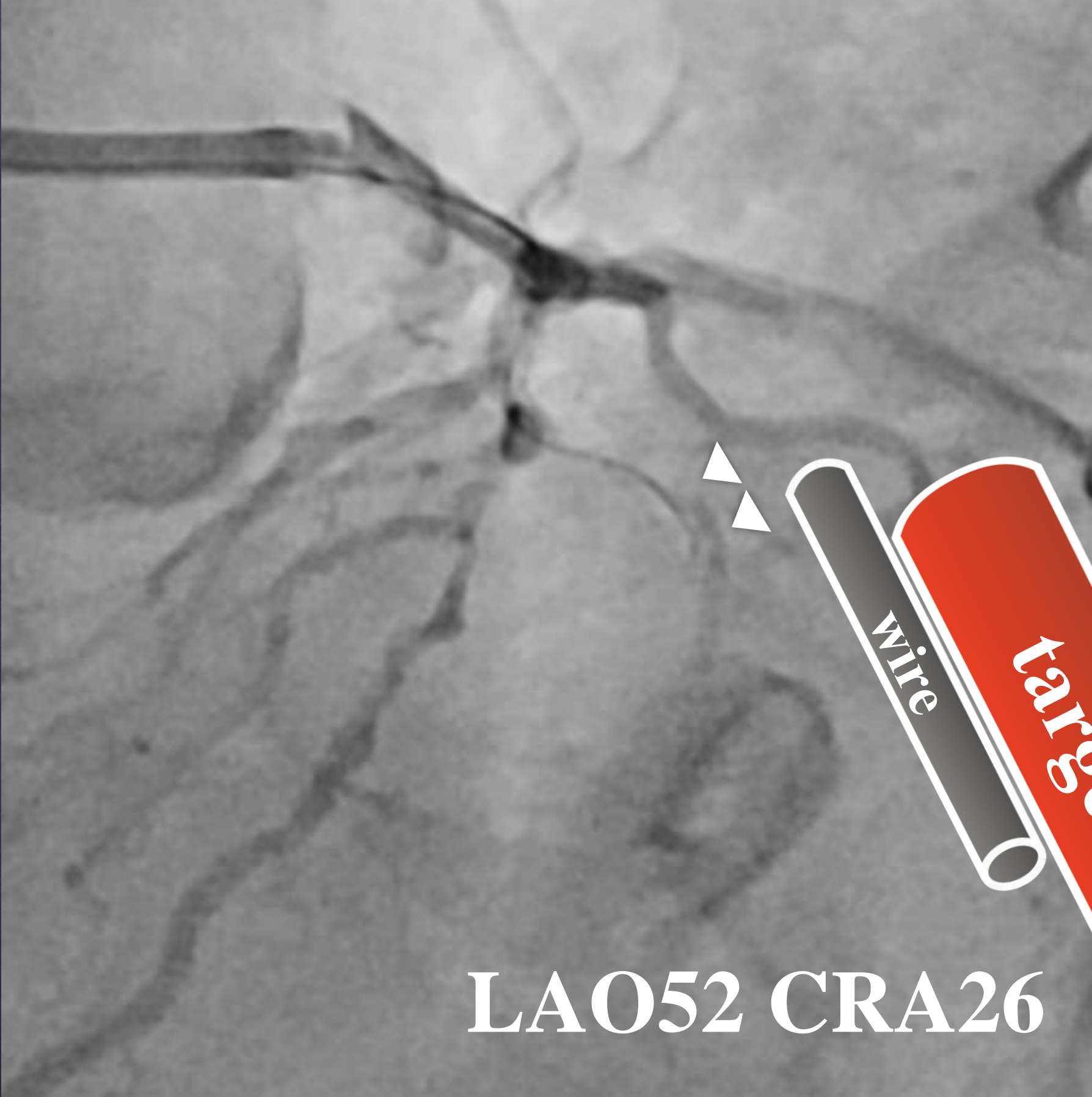


- **Bilateral coronary angiograms do not necessarily provide optimal images helpful for accurate comprehension of wire position and target direction.**

Projection correspond to RAO15 CRA43 (Ve view)



Projection correspond to LAO52 CRA26 (Ve view)

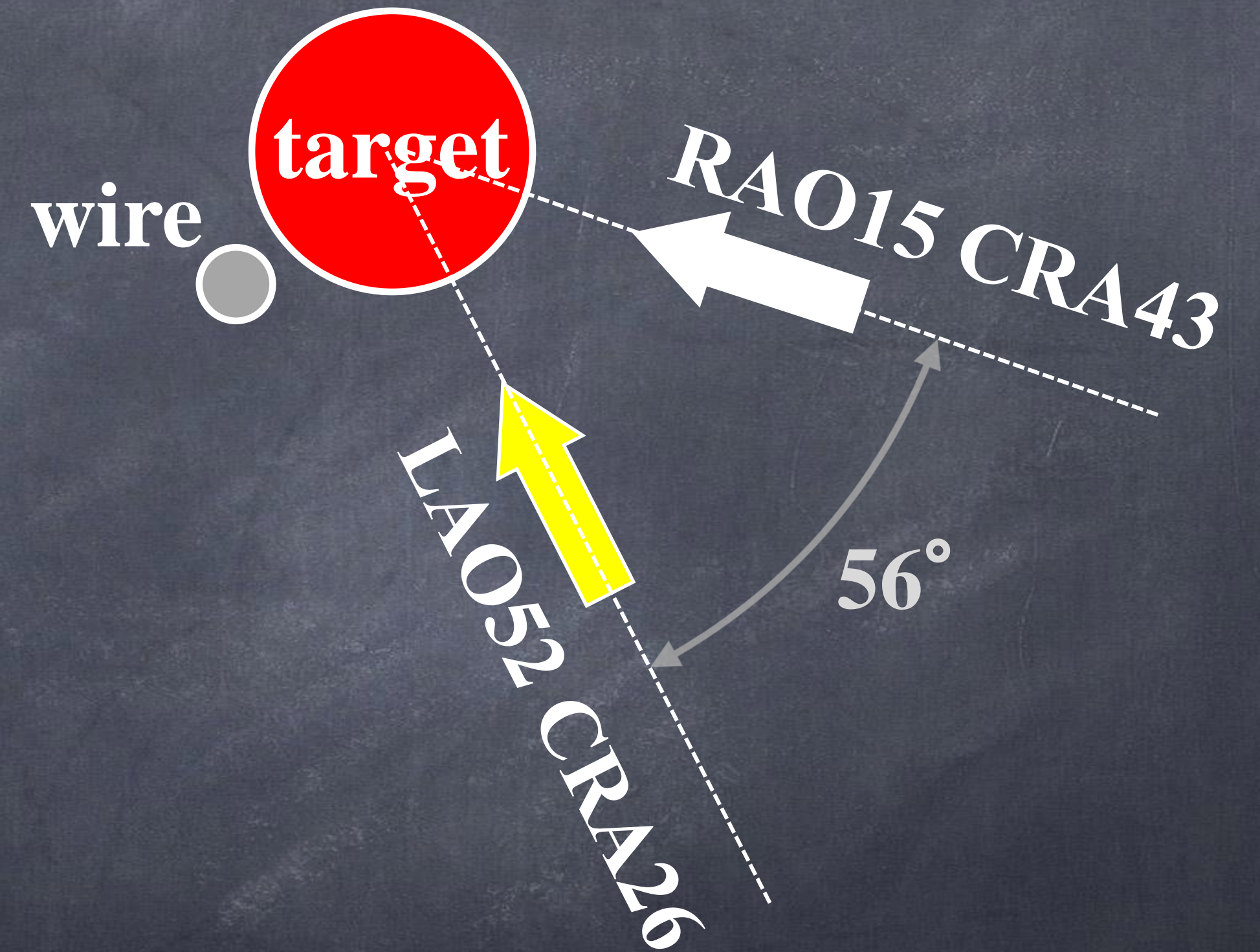
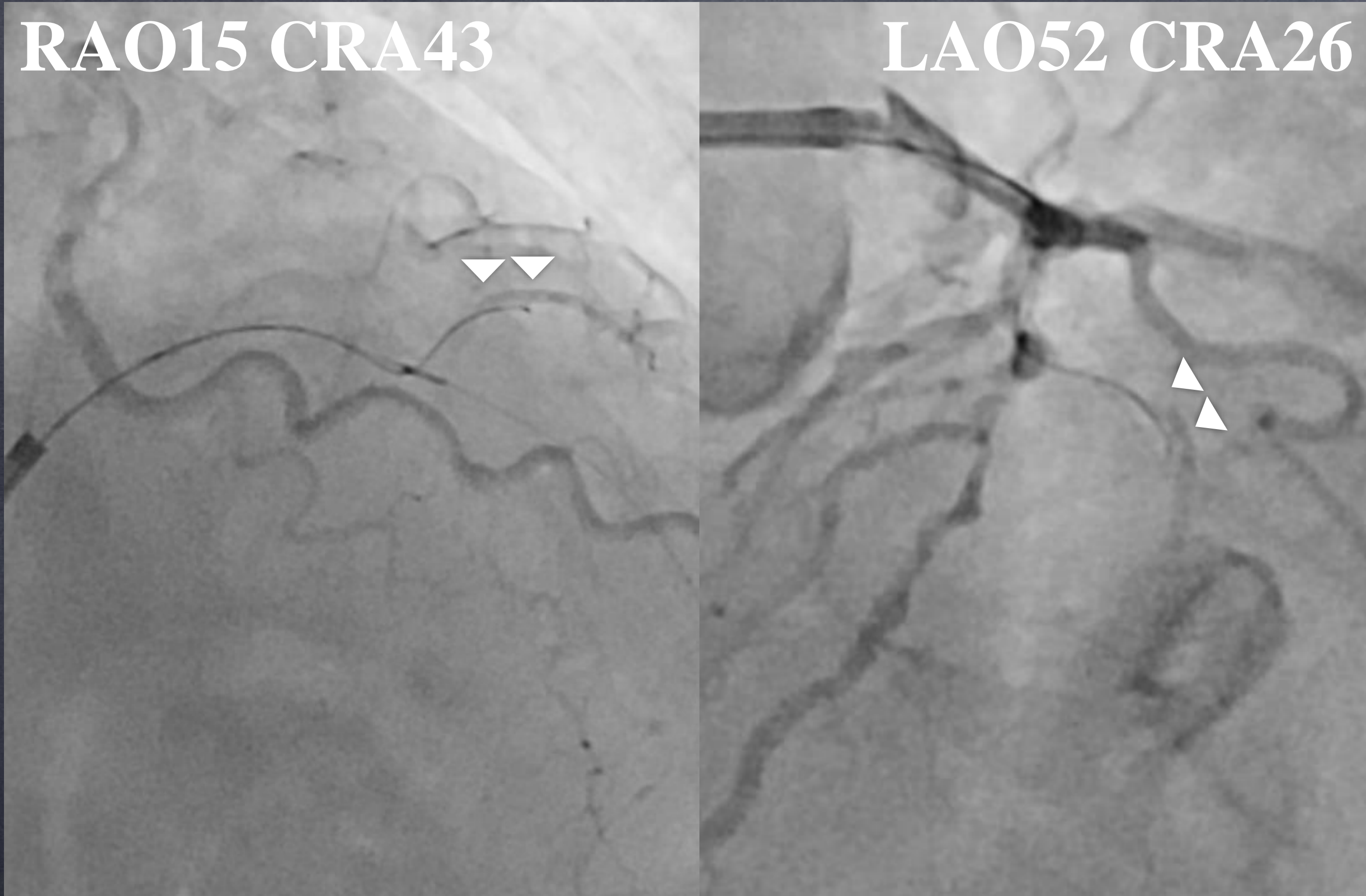


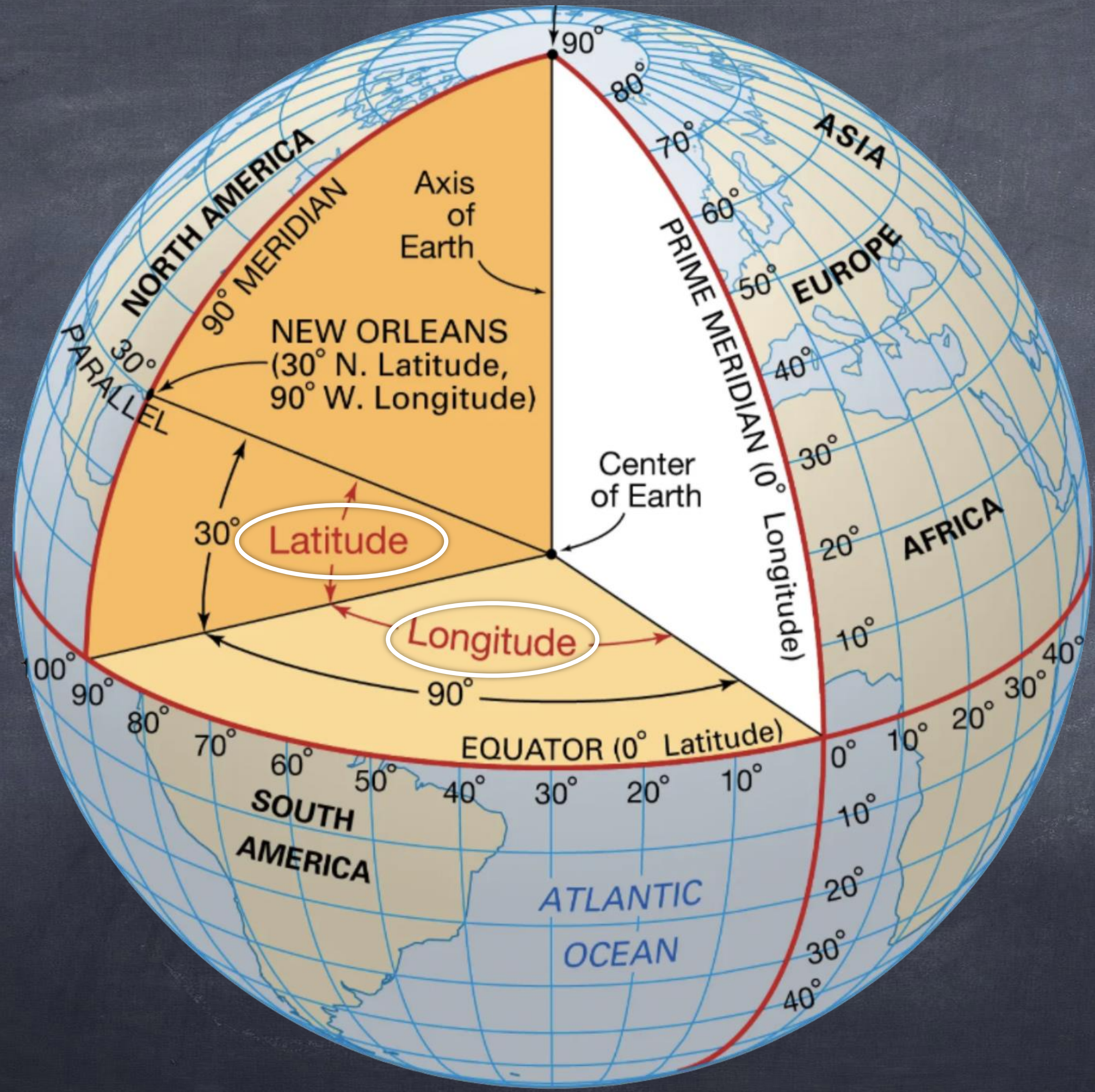
LAO52 CRA26

A yellow arrow pointing upwards and to the left, with the text 'LAO52 CRA26' written vertically along its shaft.

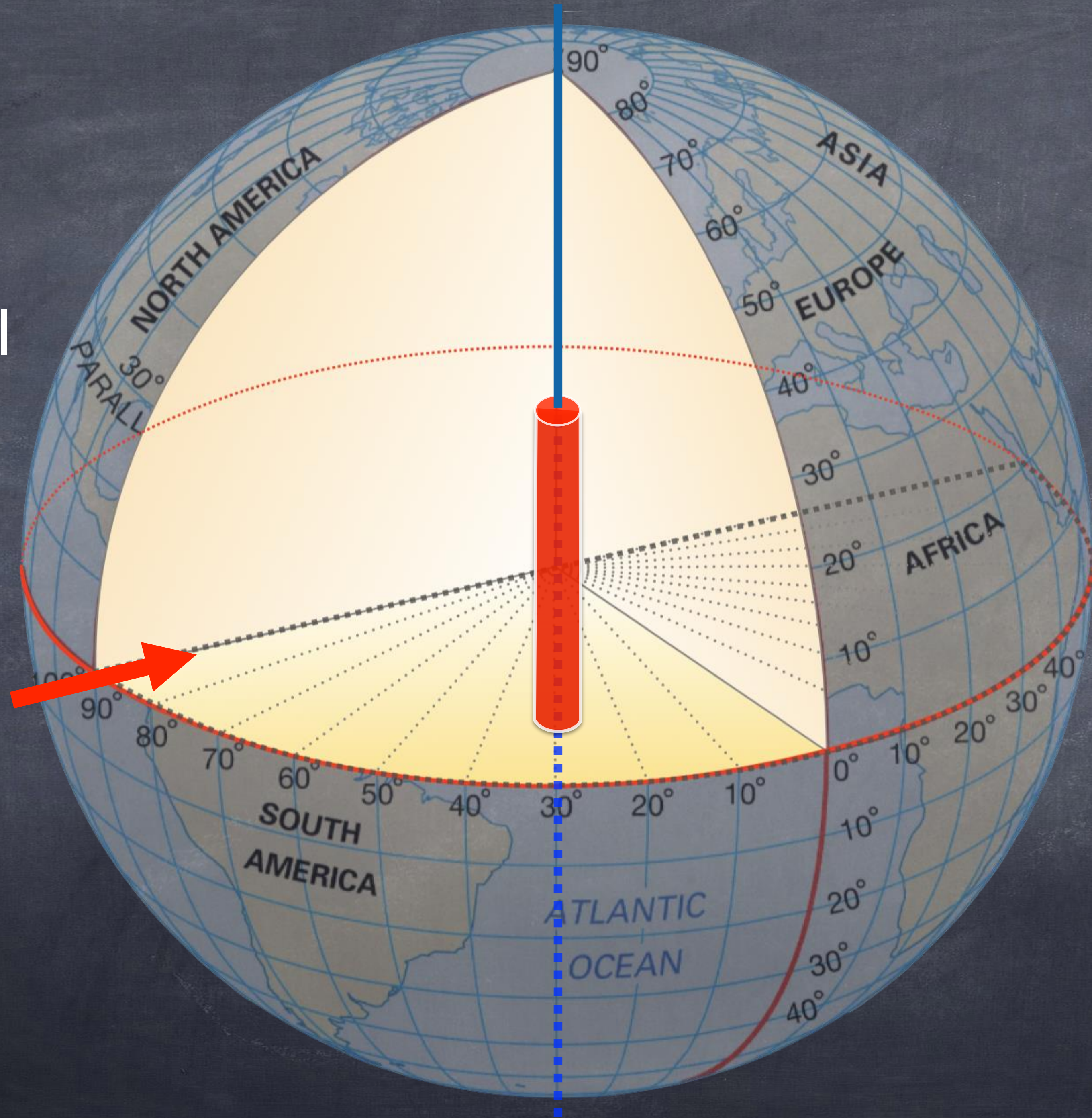


These bilateral coronary angiograms are not optimal.

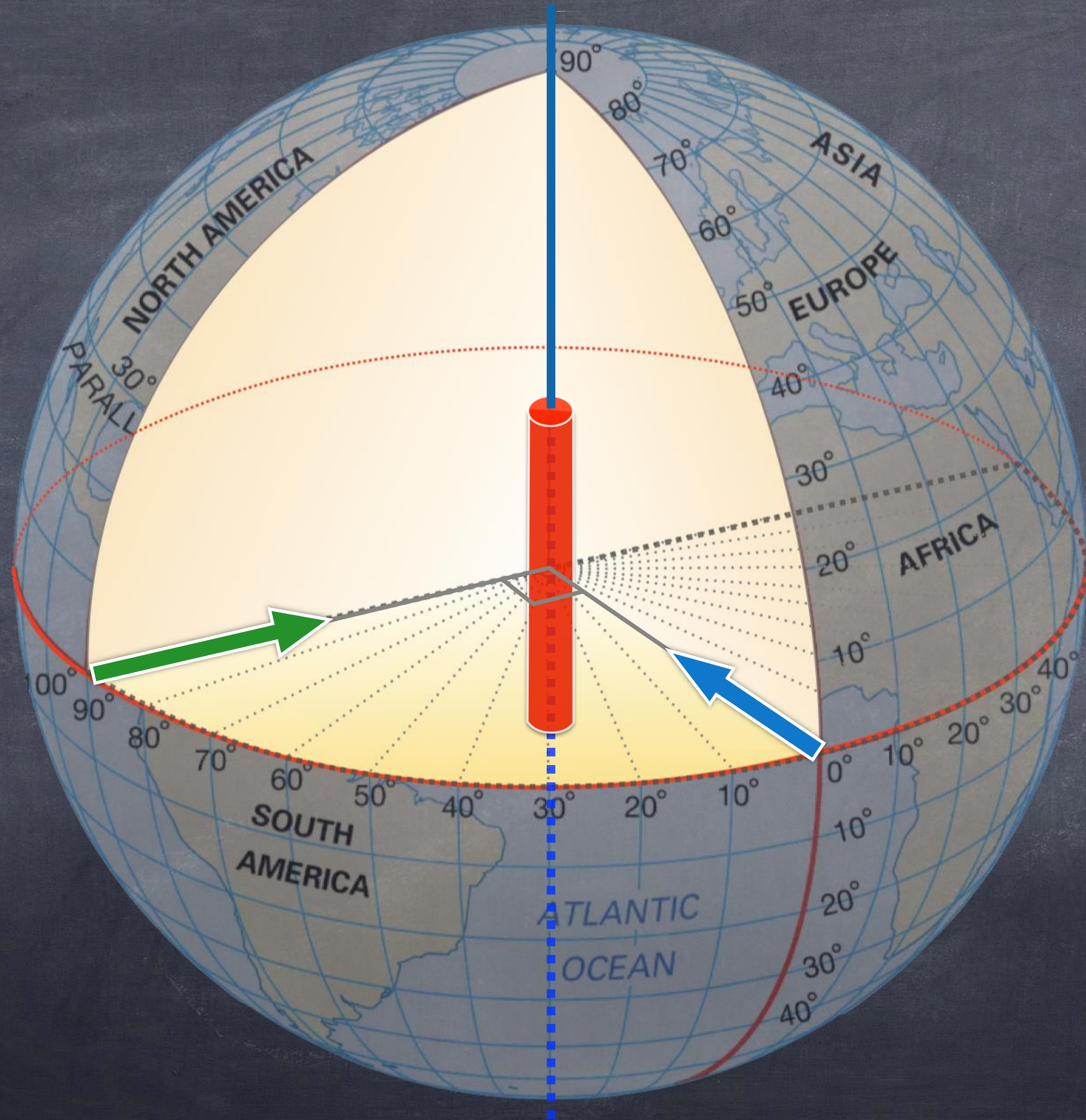


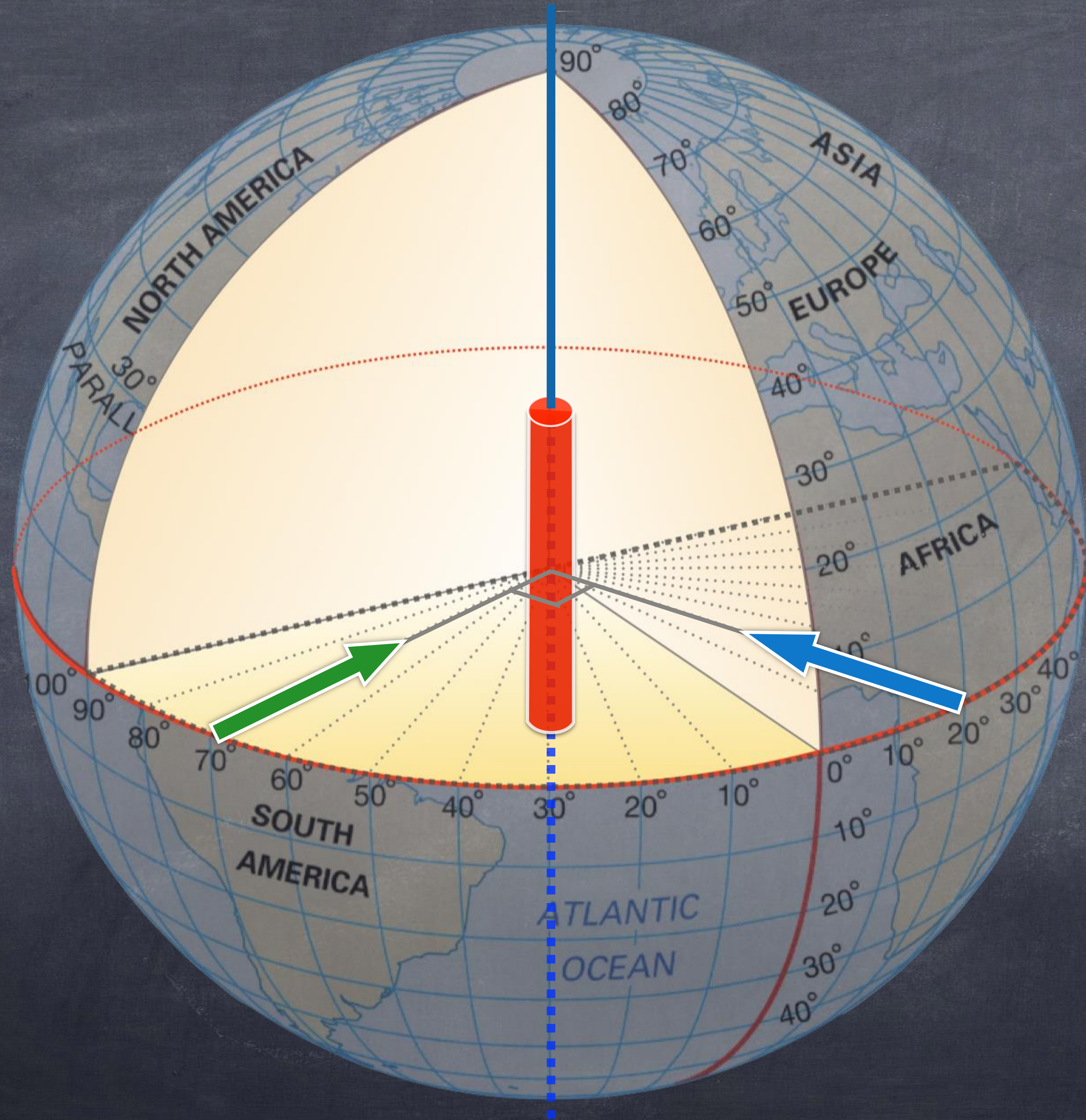


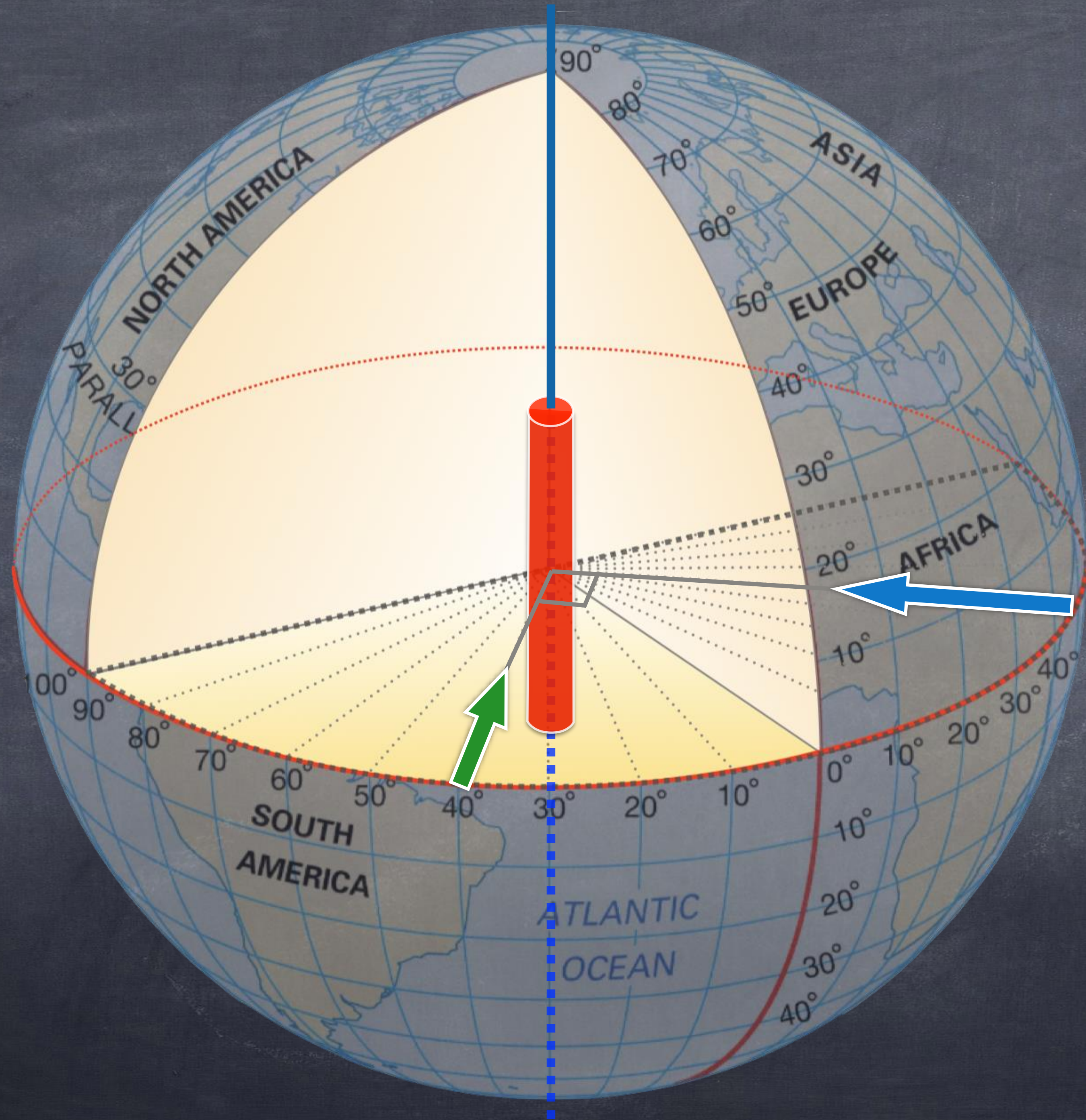
Earth's axis
||
Target vessel

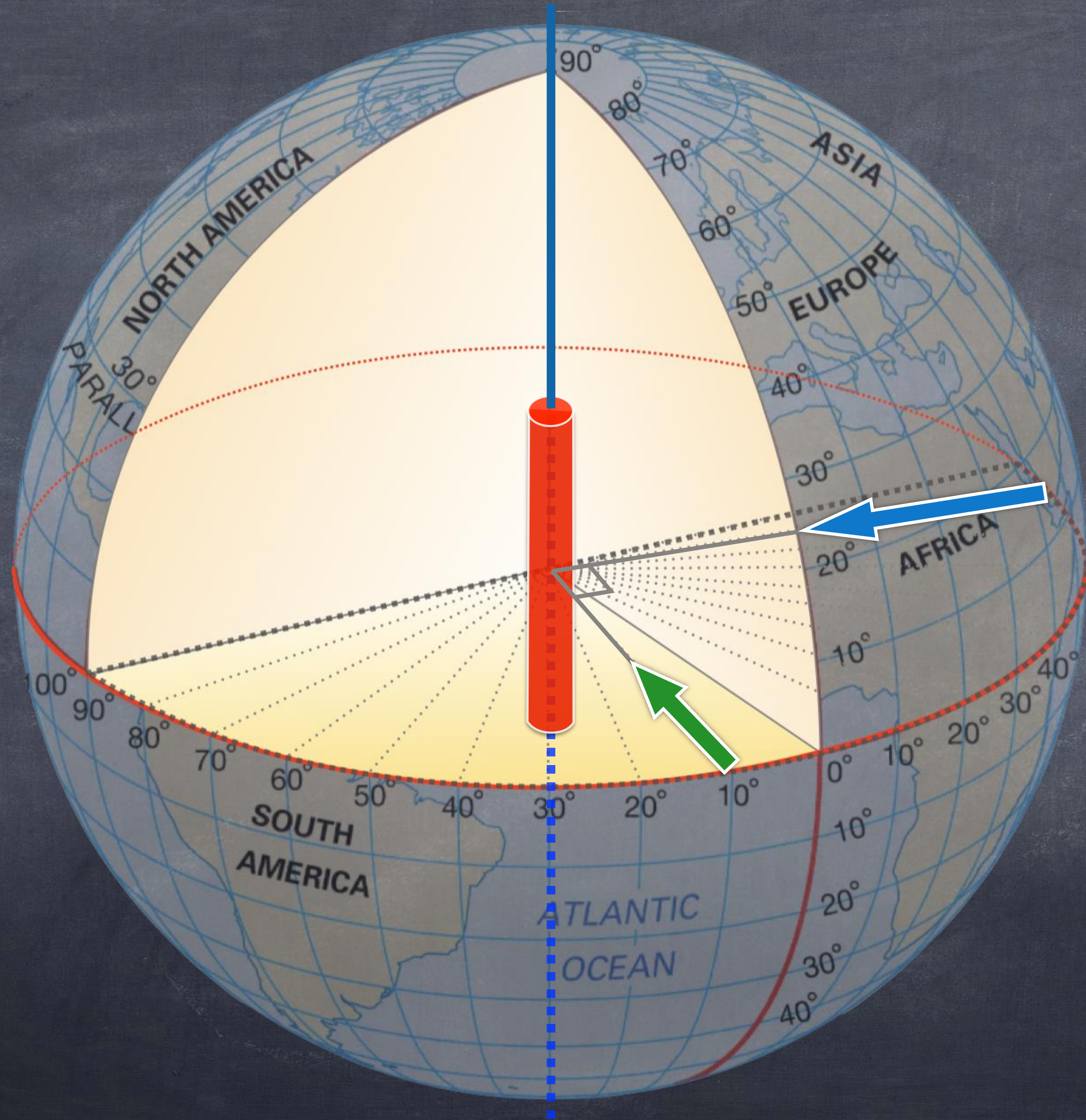


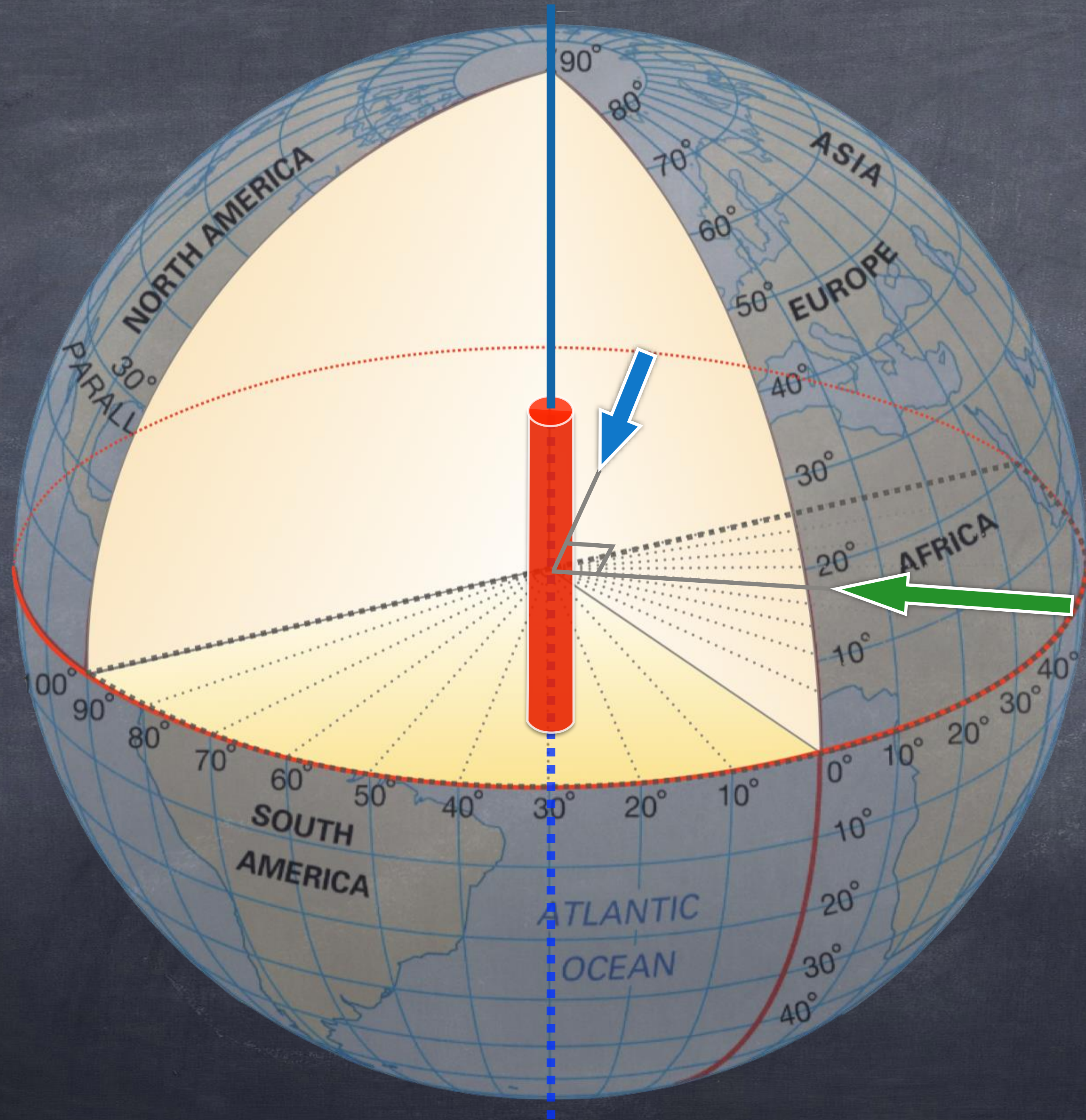
Equator
(0° latitude)

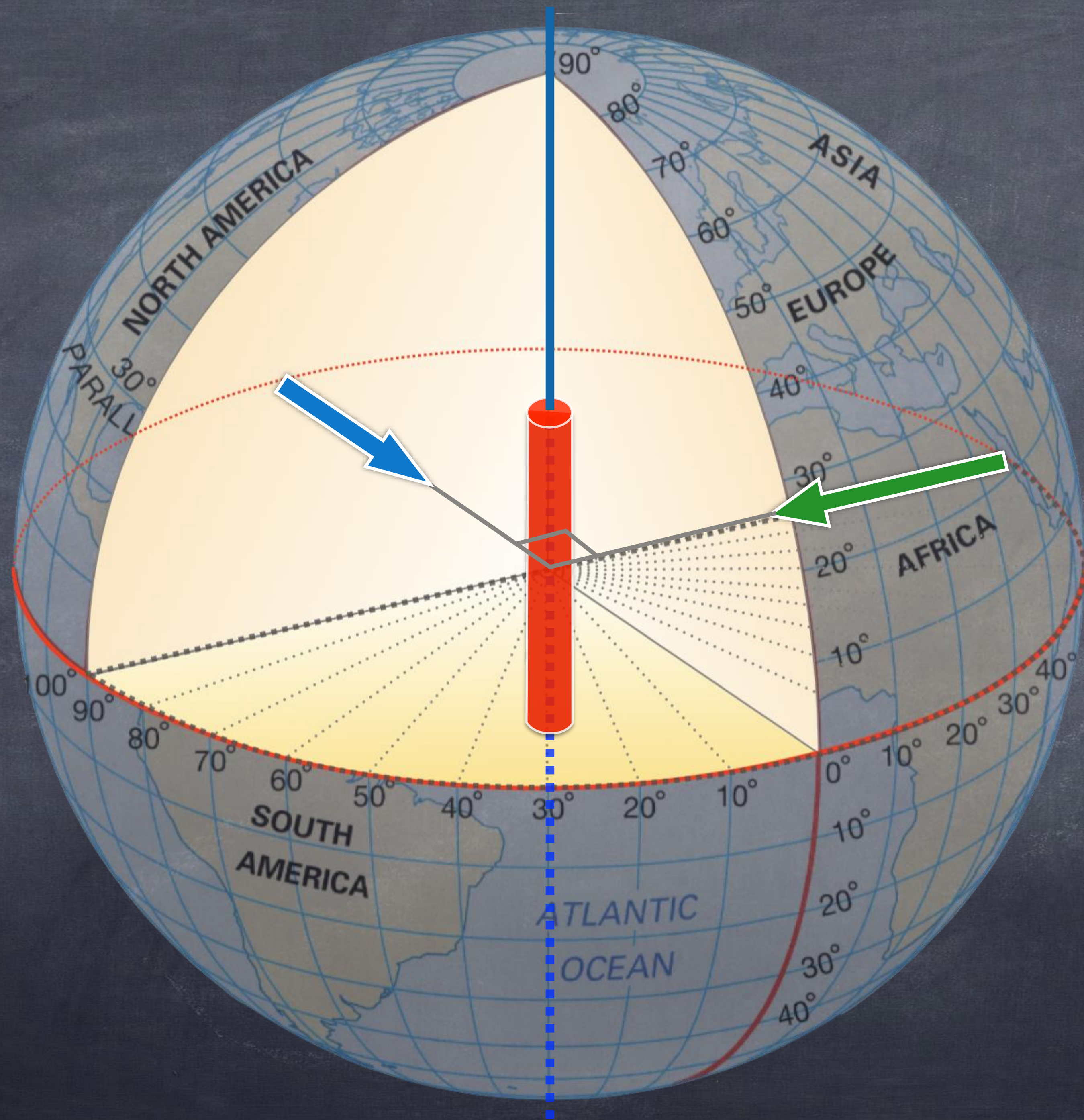


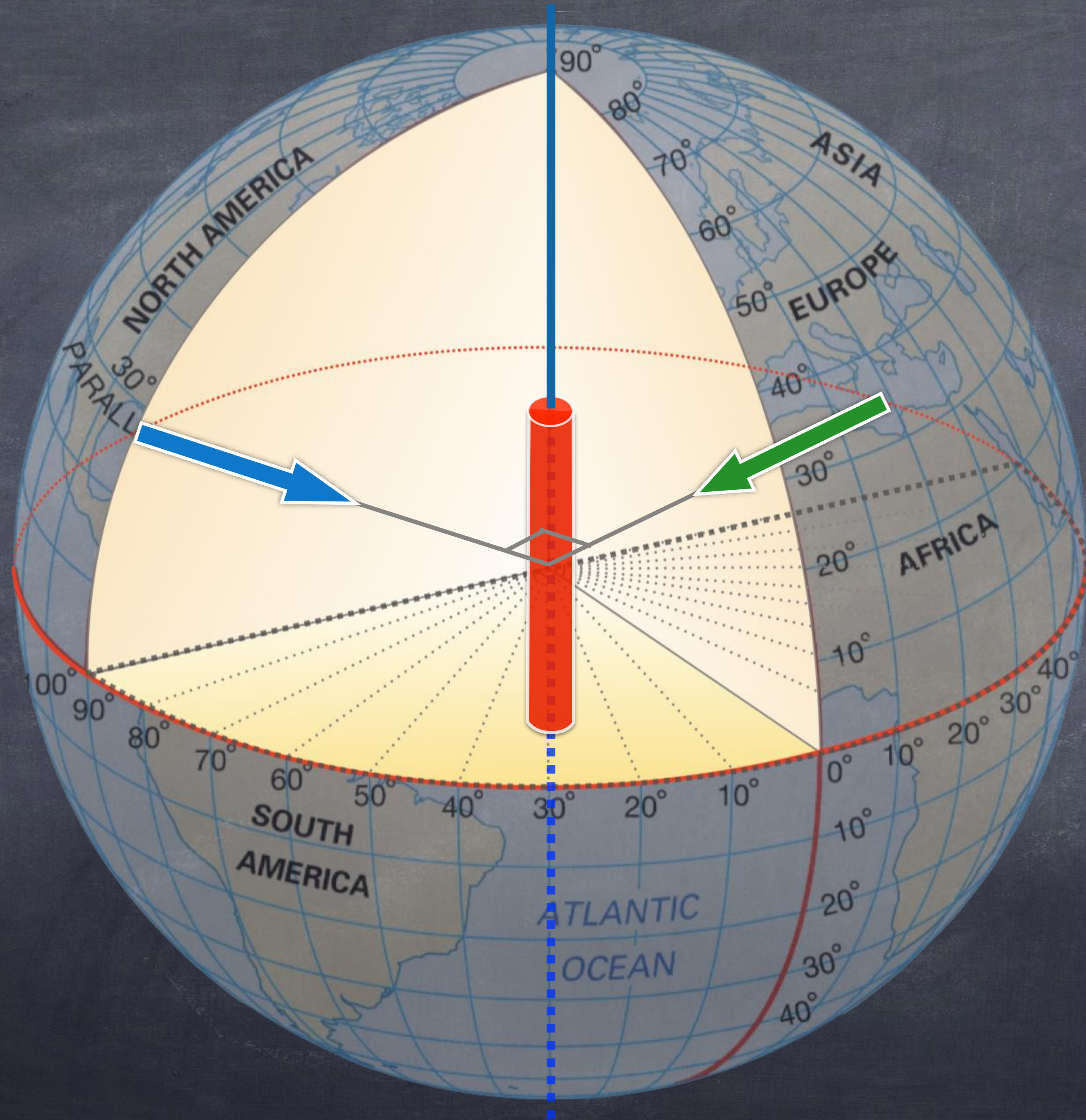


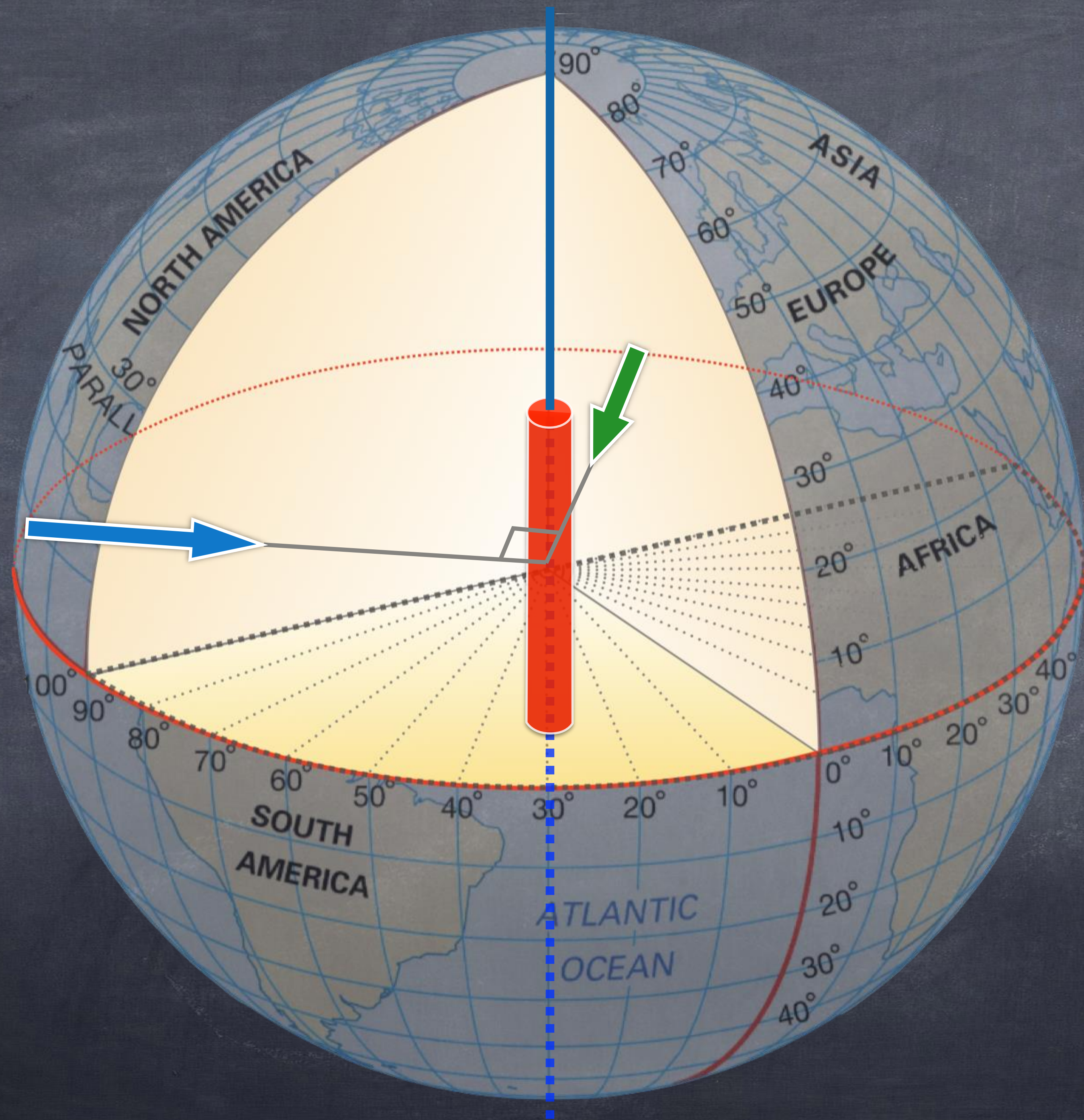


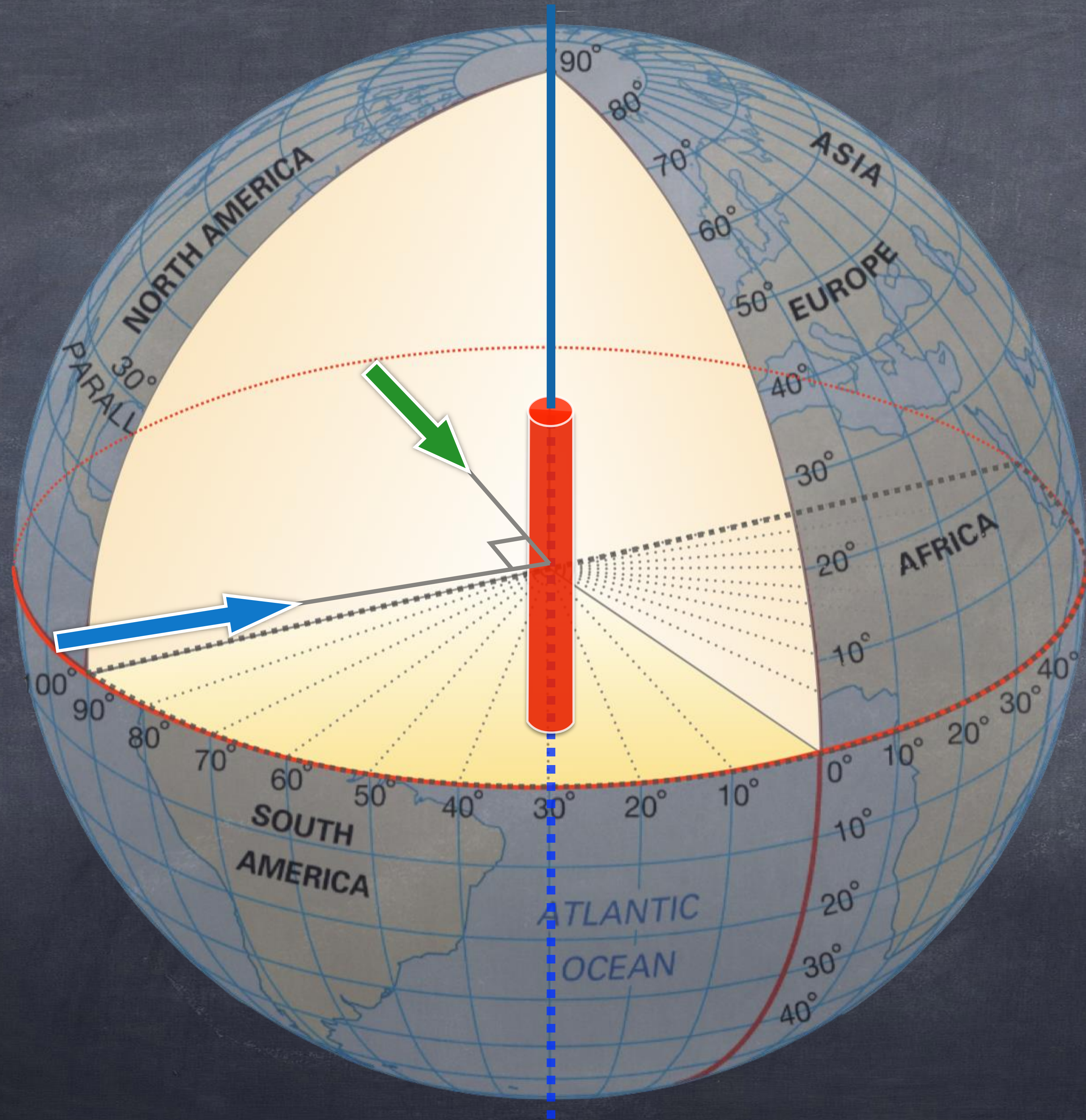


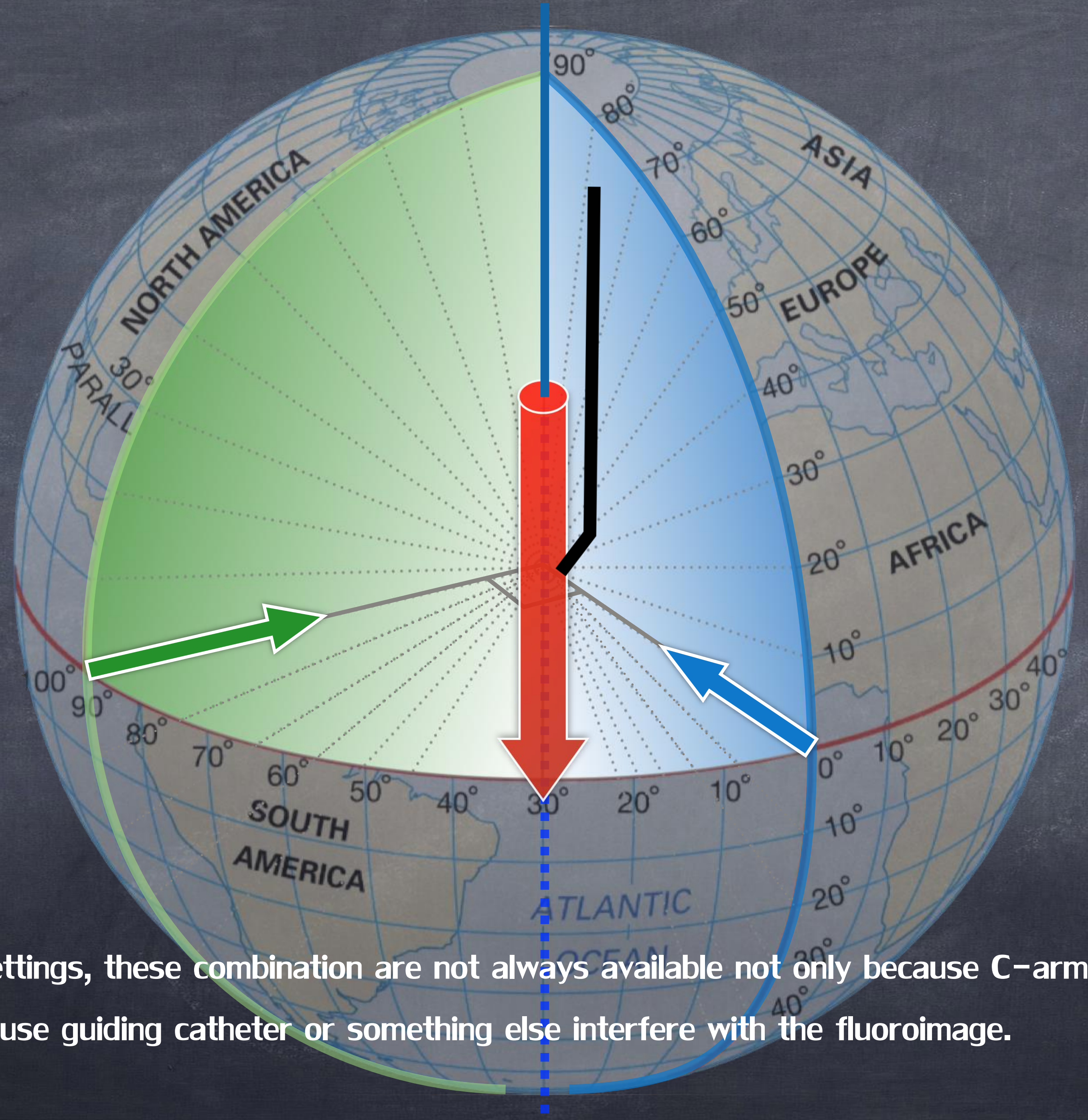




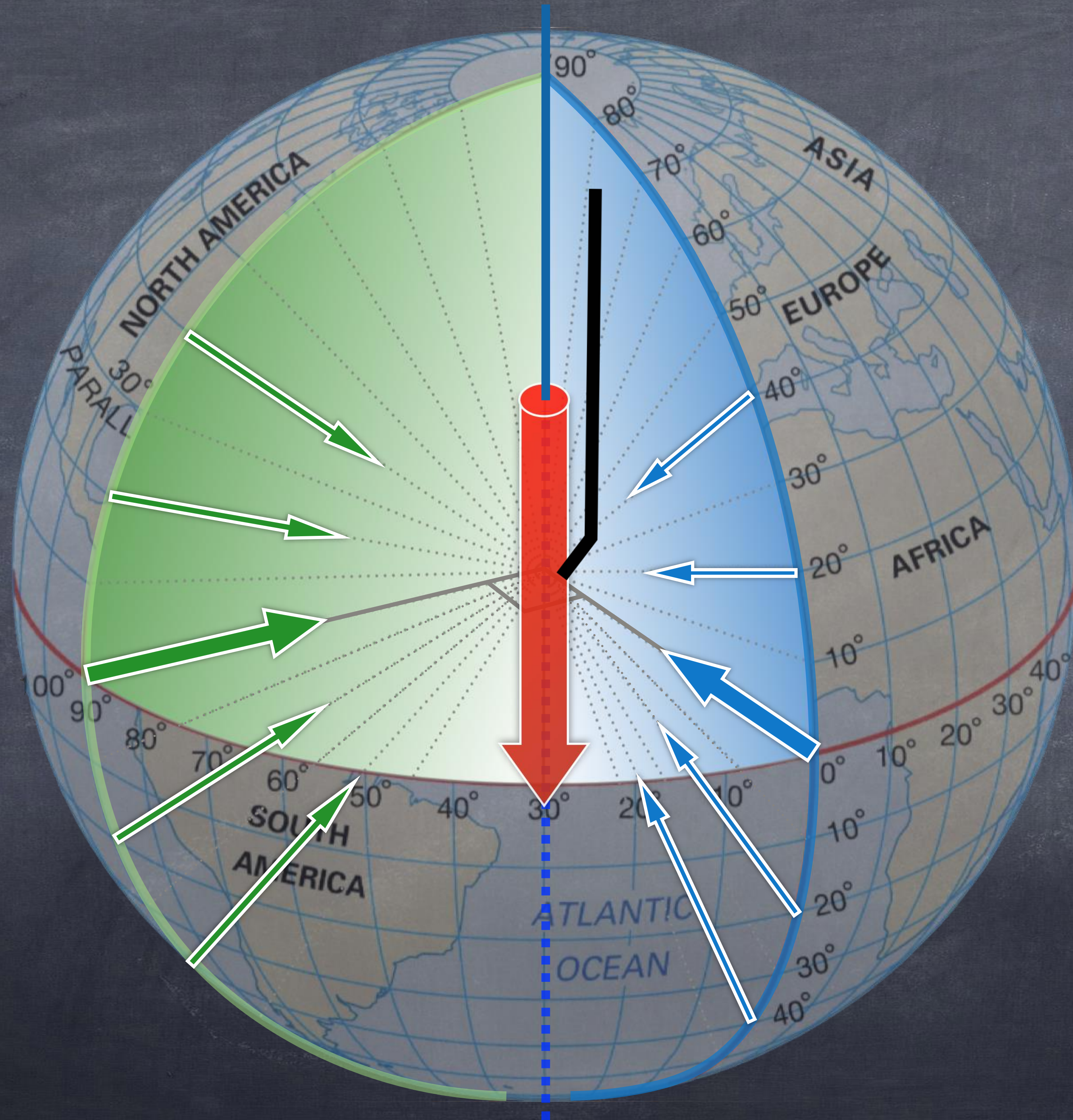






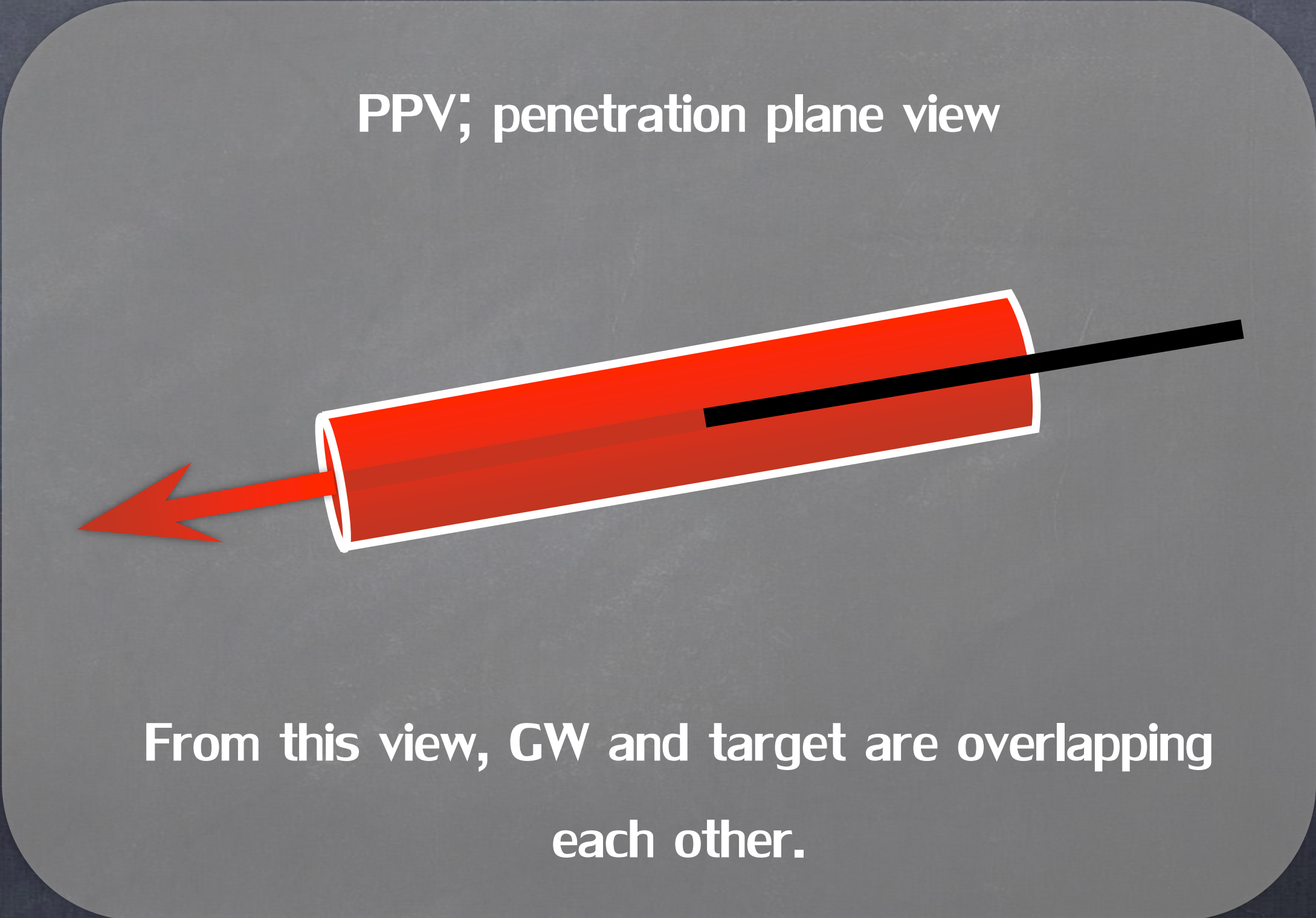
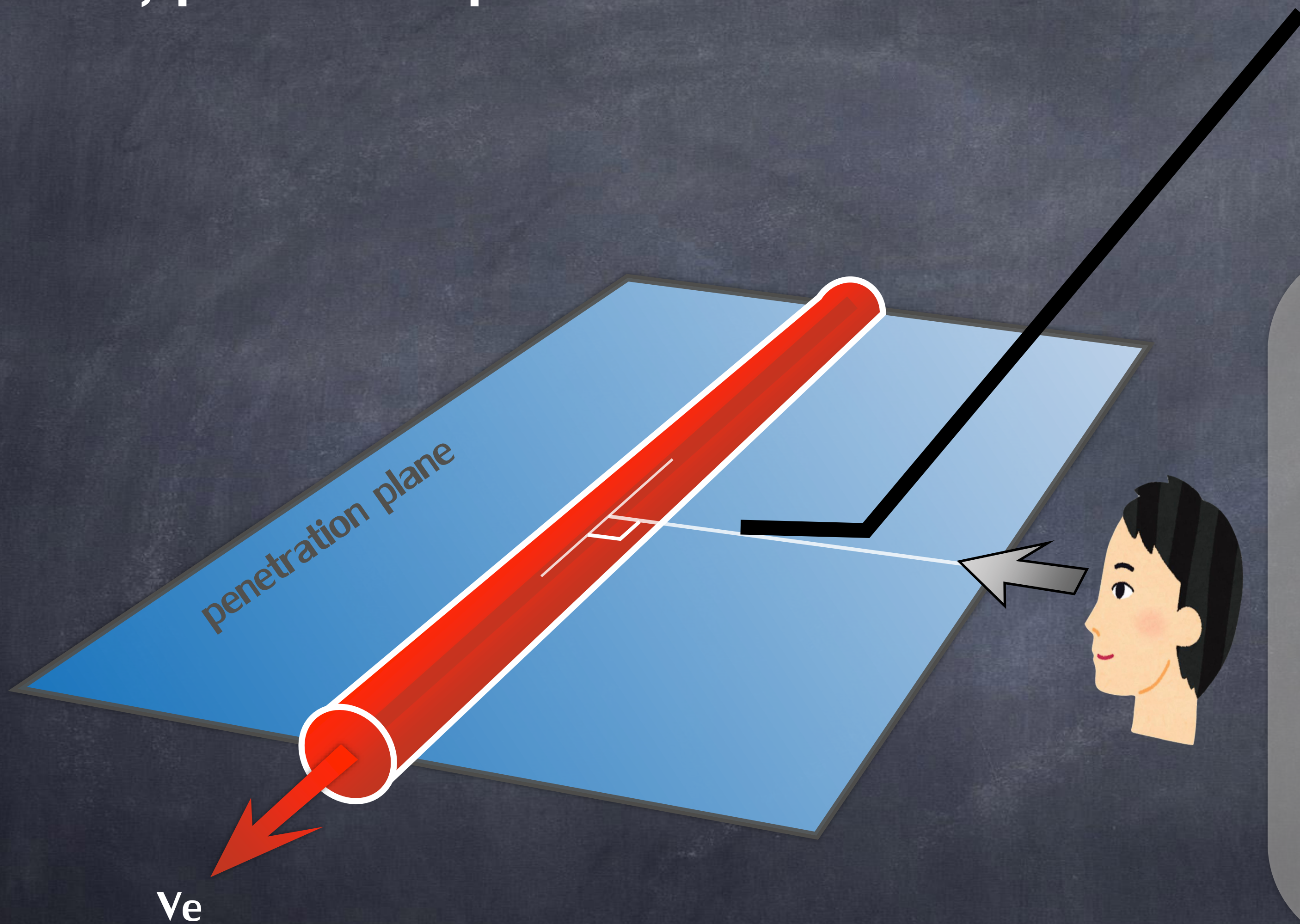


In the clinical settings, these combination are not always available not only because C-arm cannot cover all the direction, but also because guiding catheter or something else interfere with the fluoroimage.



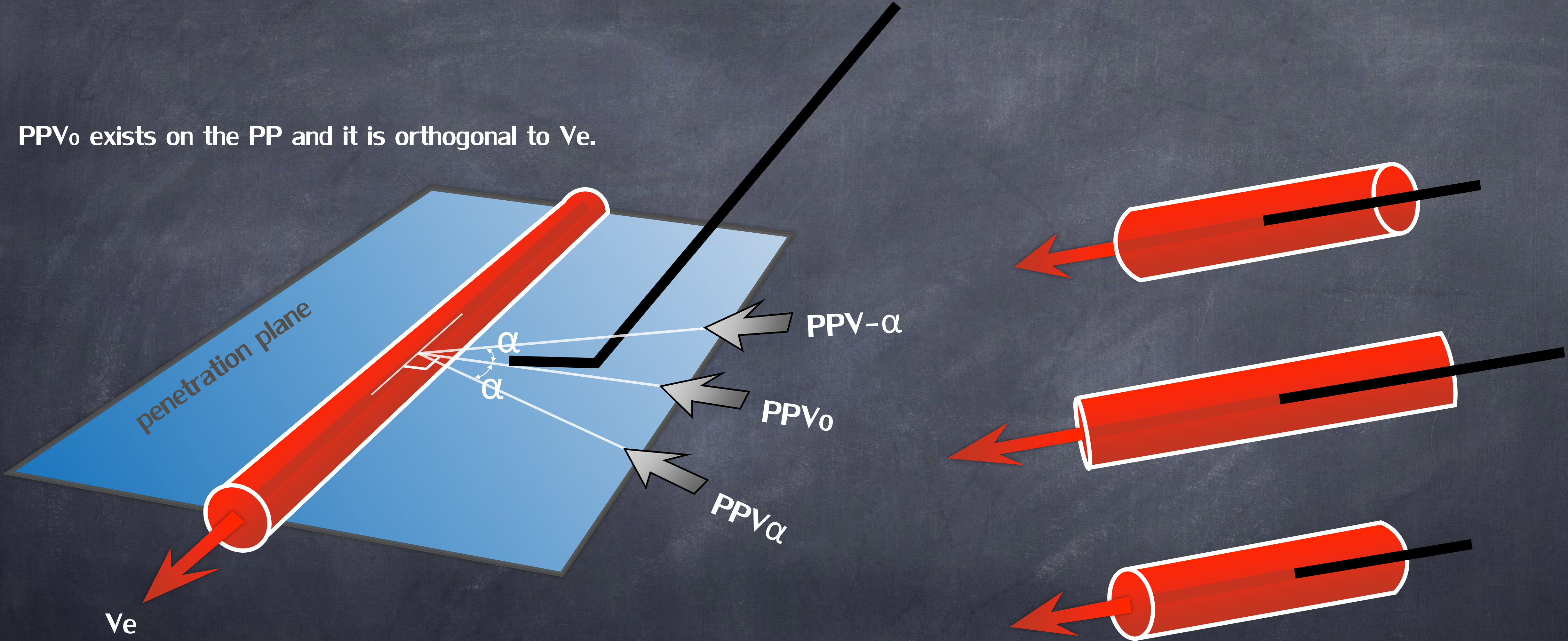
Oblique views work.

PPV; penetration plane view

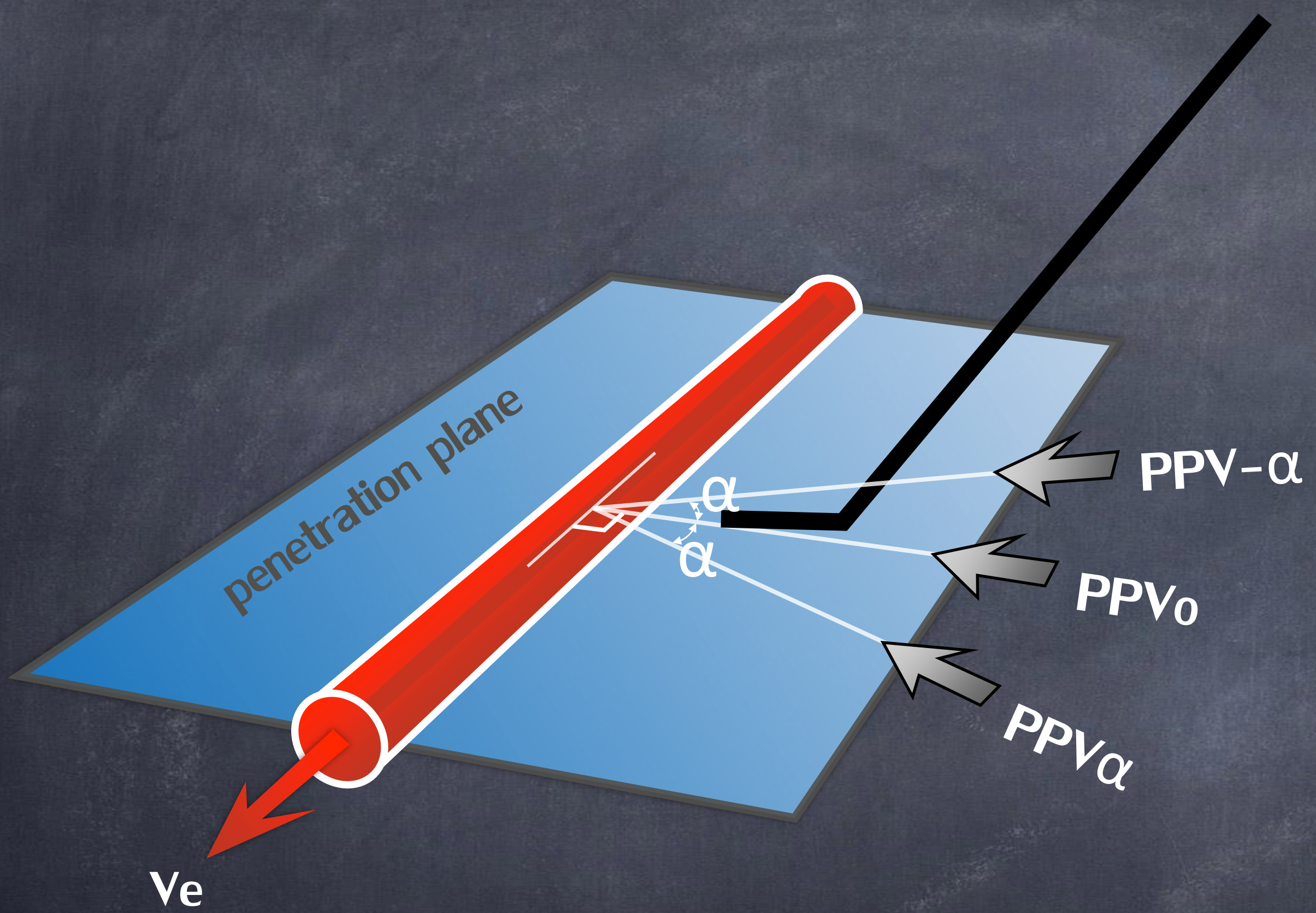


PPV α ; oblique penetration plane view

PPV₀ exists on the PP and it is orthogonal to V_e.



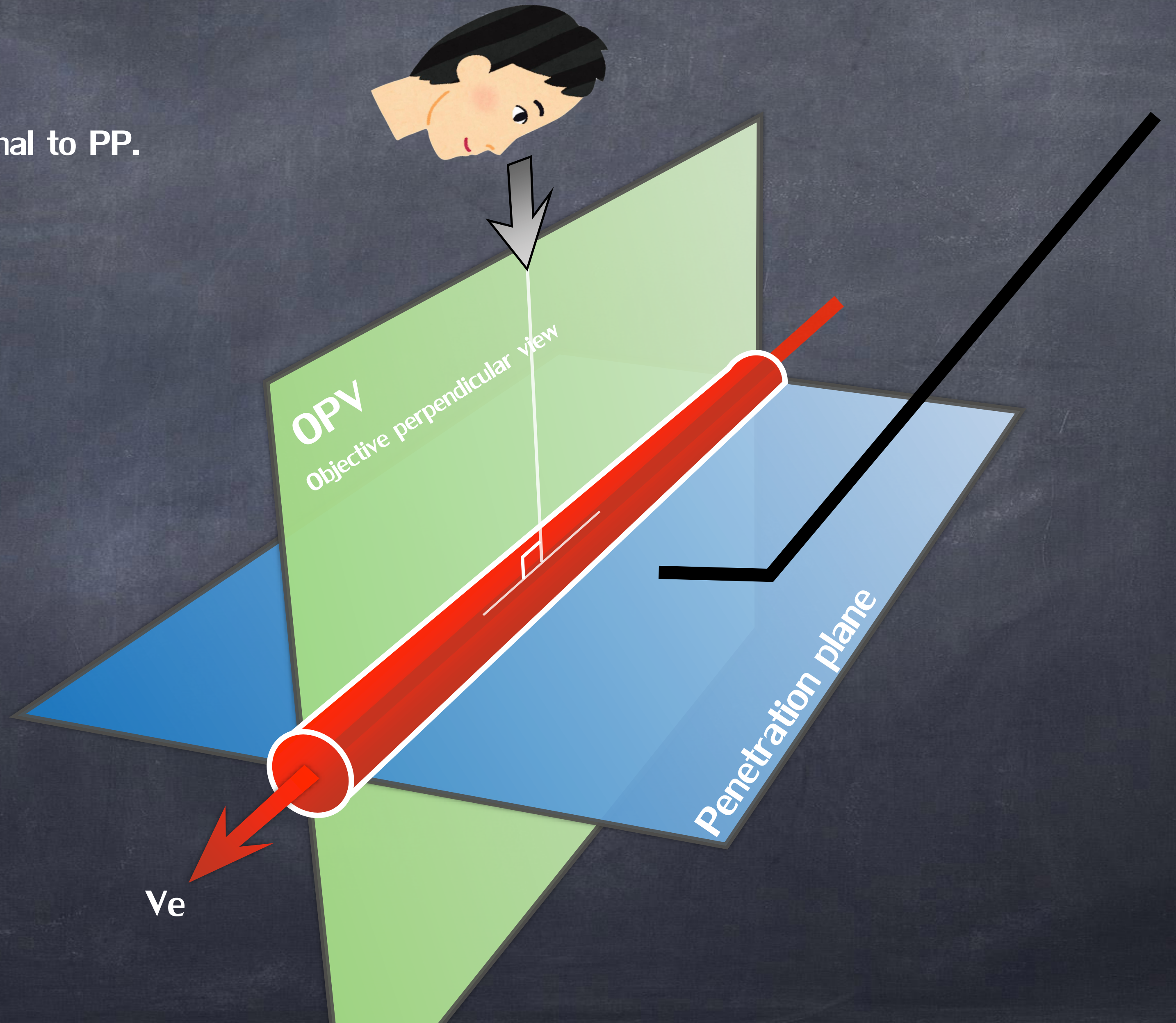
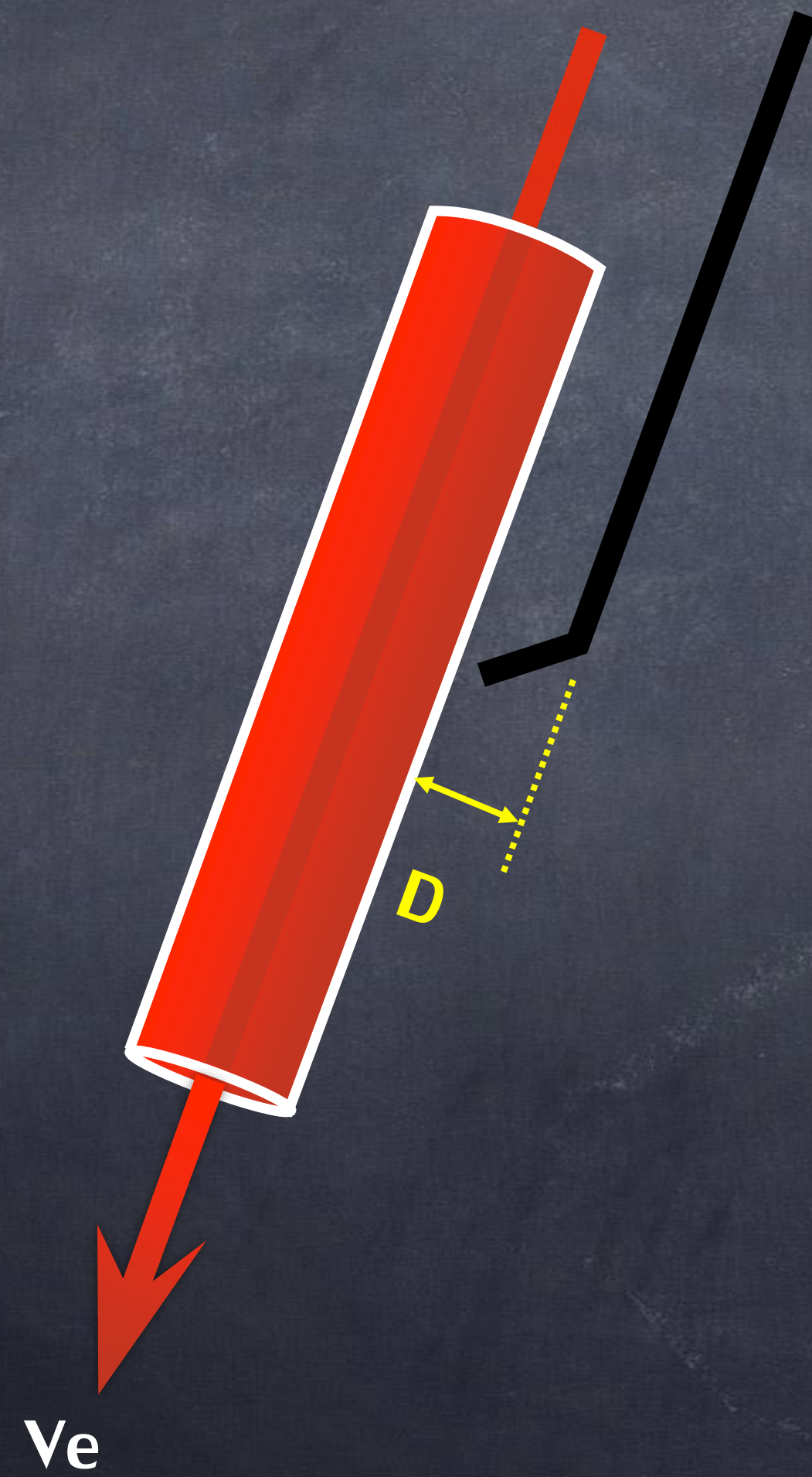
GW and the target are overlapping each other as long as each vector of projection is on the penetration plane.



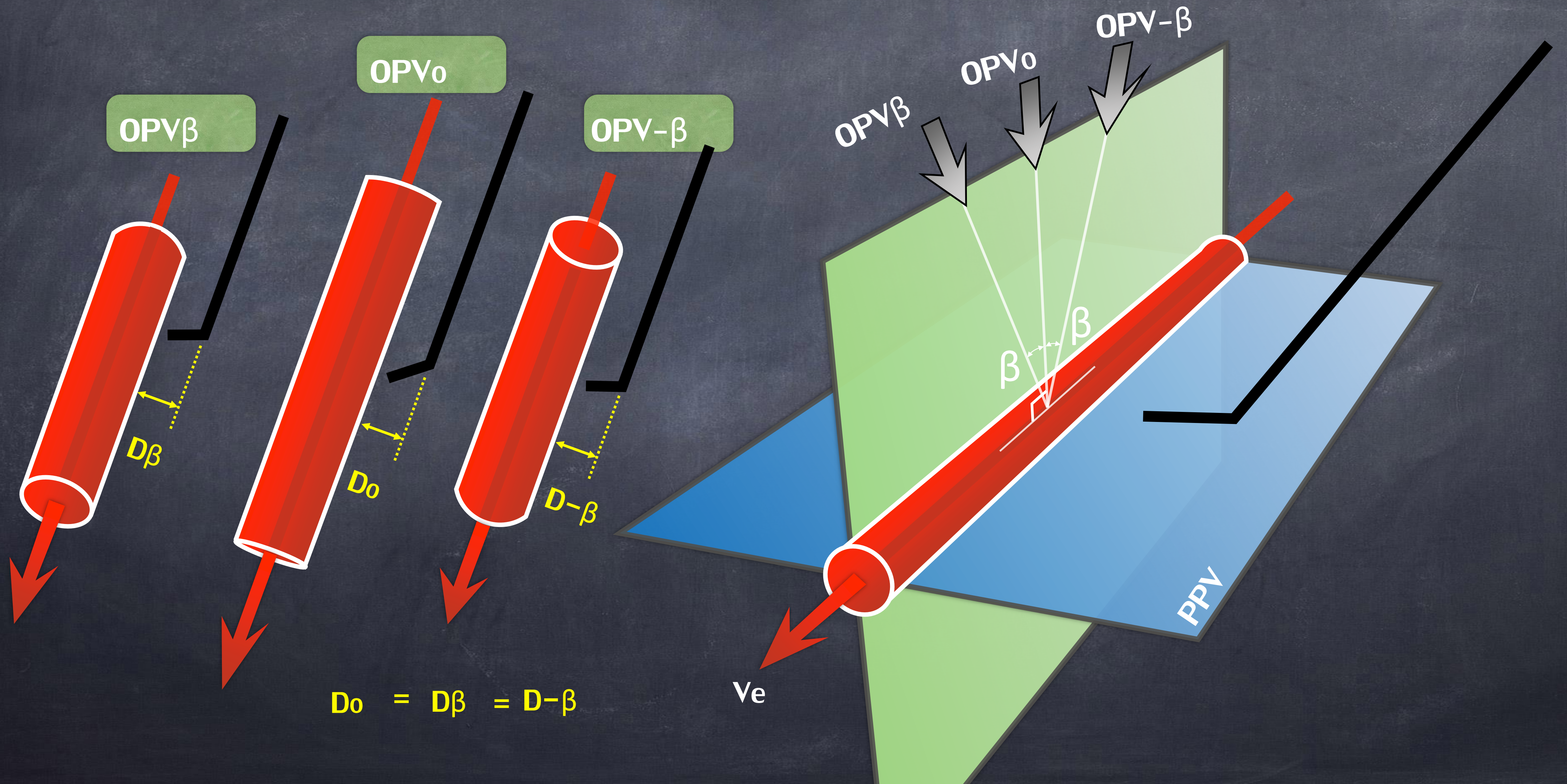
Ve and GW keep overlapping each other
 during C-arm motion (PPV₀→PPV α 、PPV₀→PPV- α).

OPV; objective perpendicular view

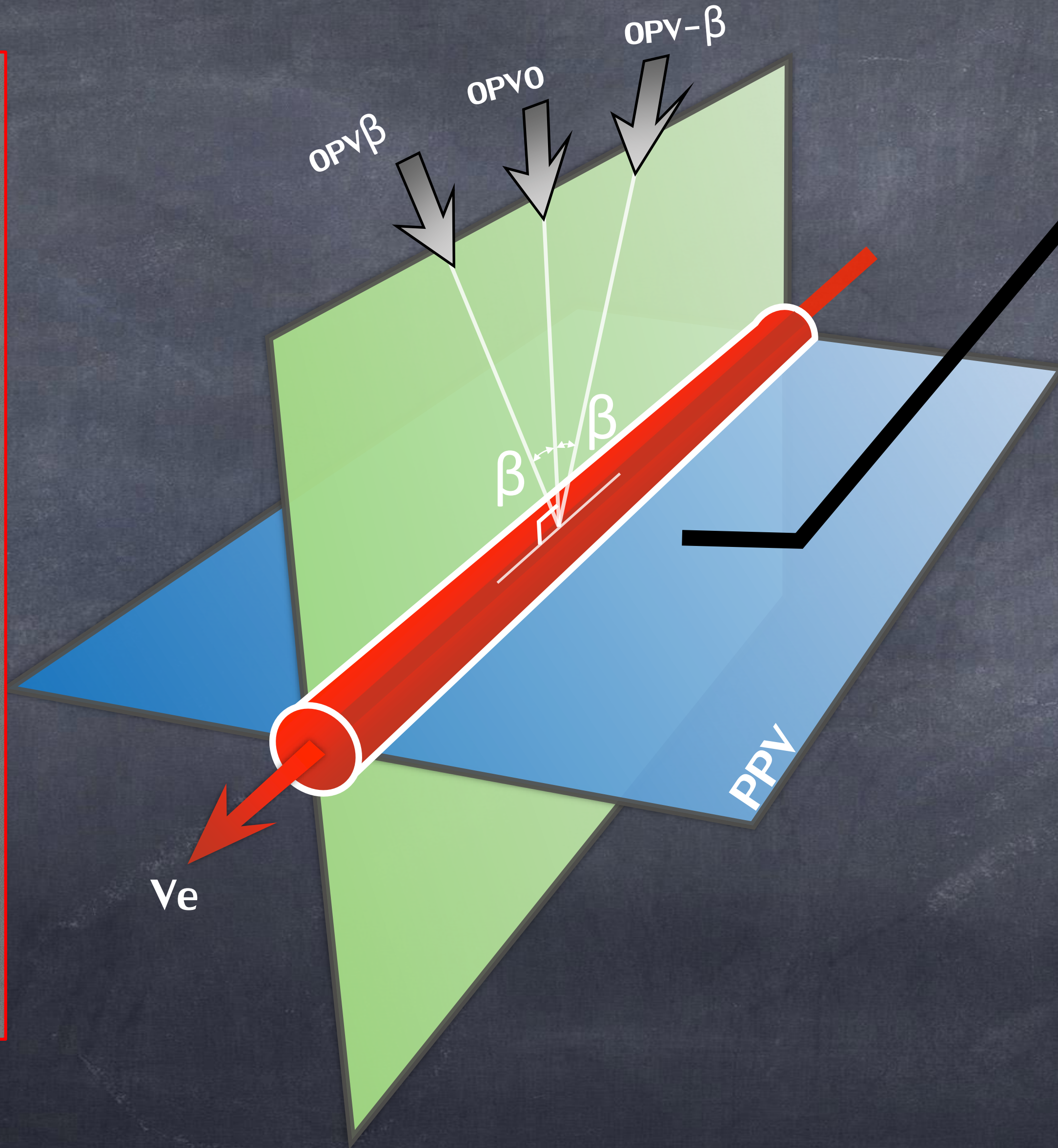
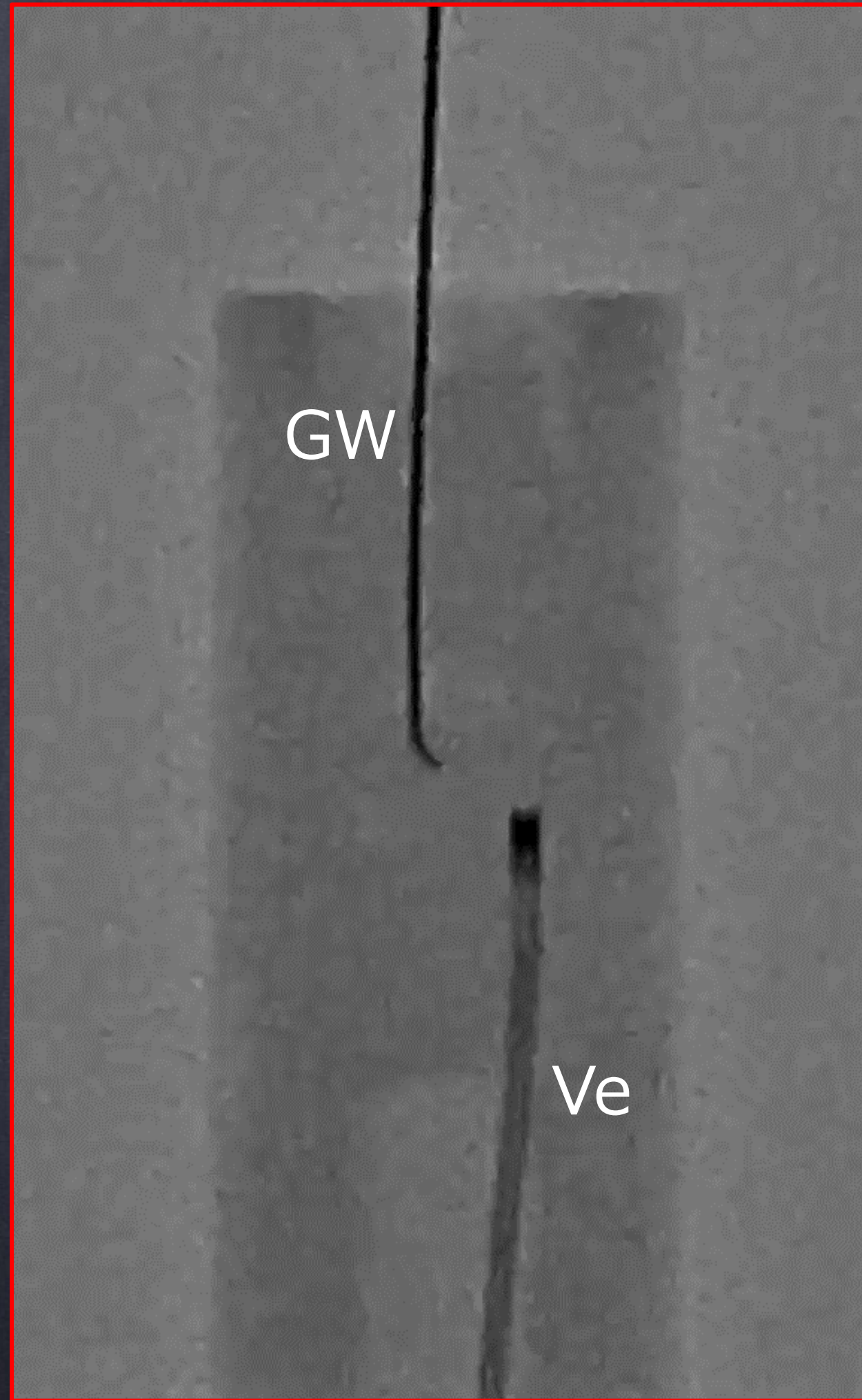
Ve exists on OPV, and OPV is orthogonal to PP.



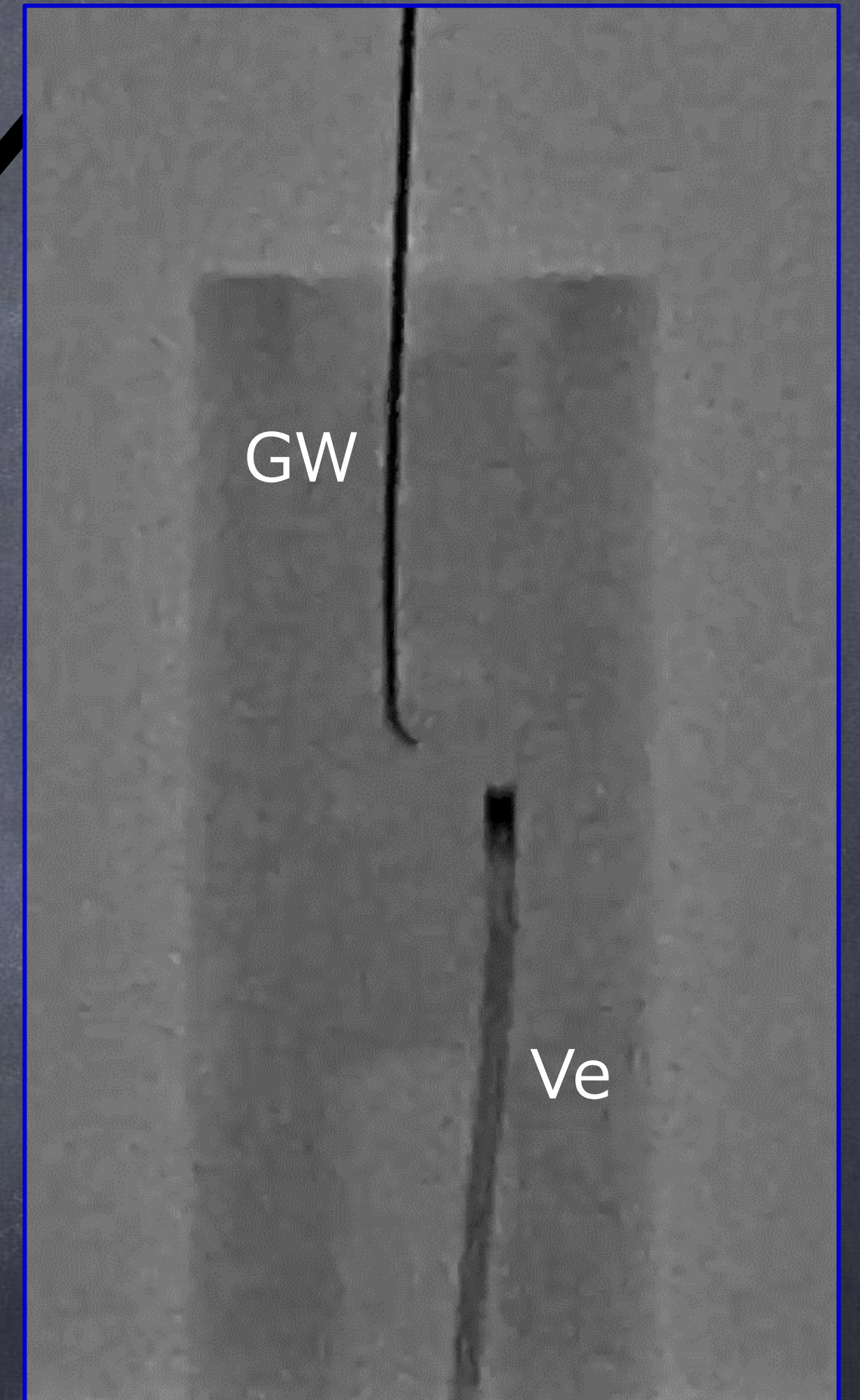
OPV β ; deflected objective perpendicular view



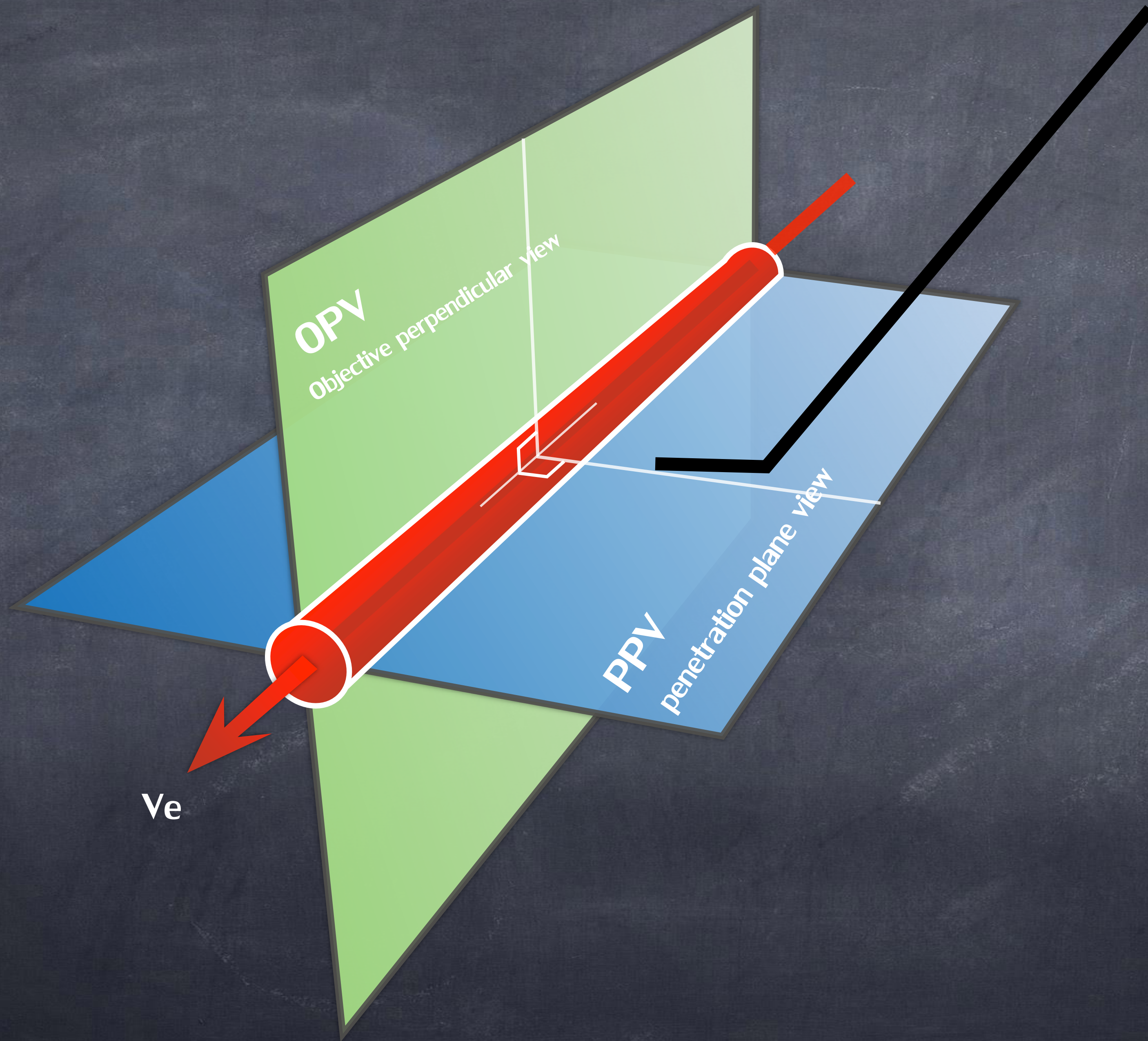
OPV0→OPV β

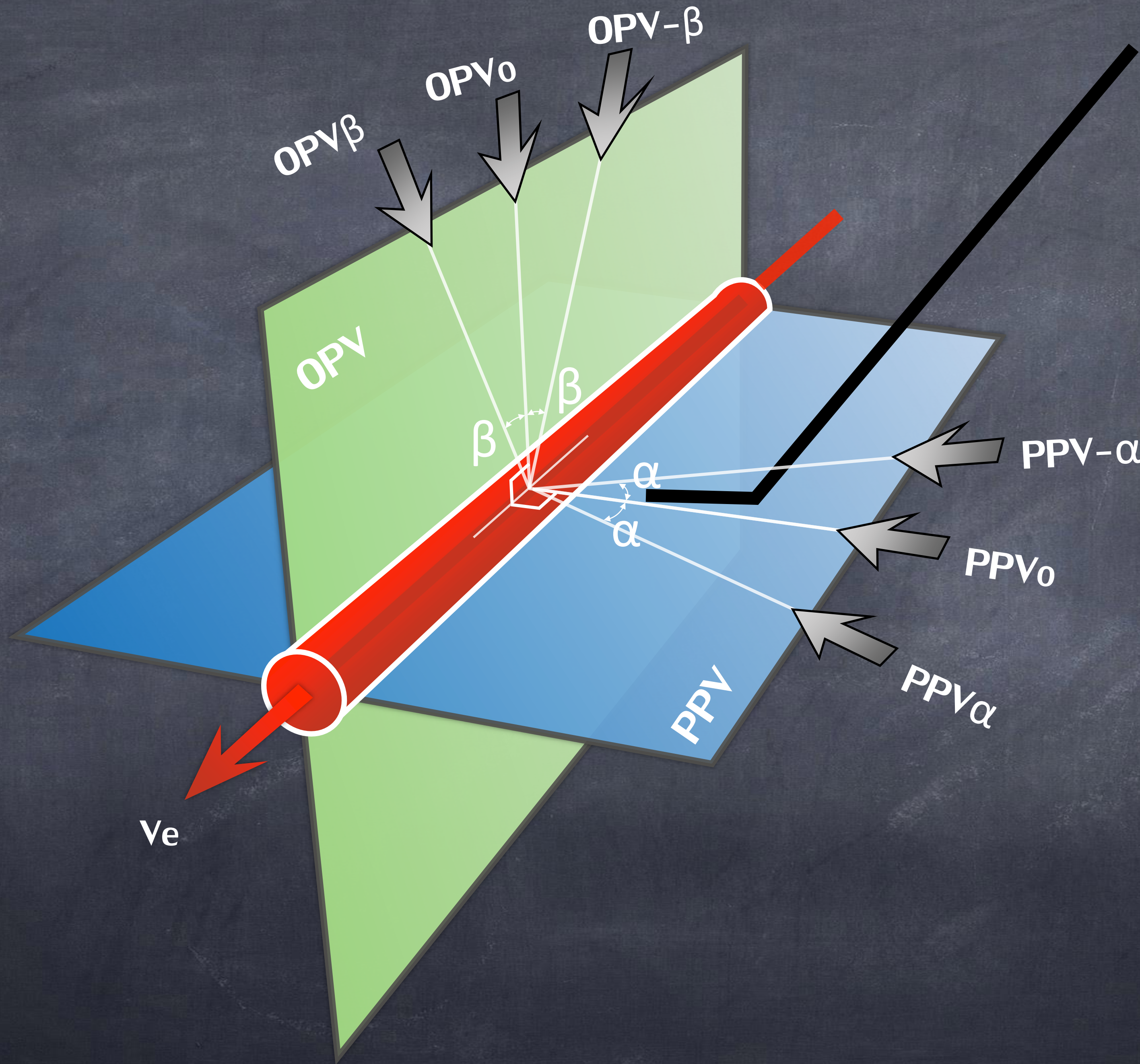


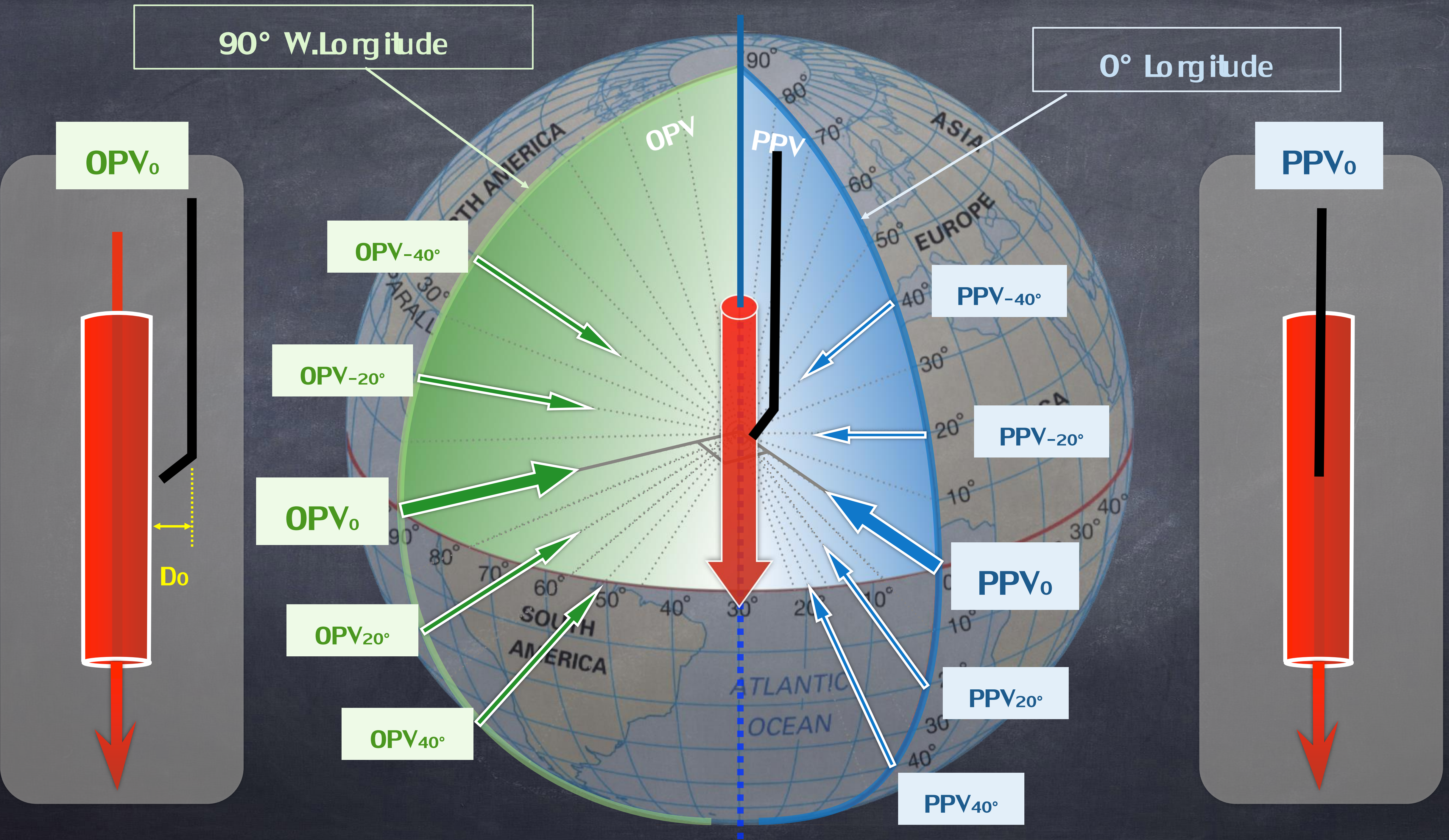
OPV0→OPV- β

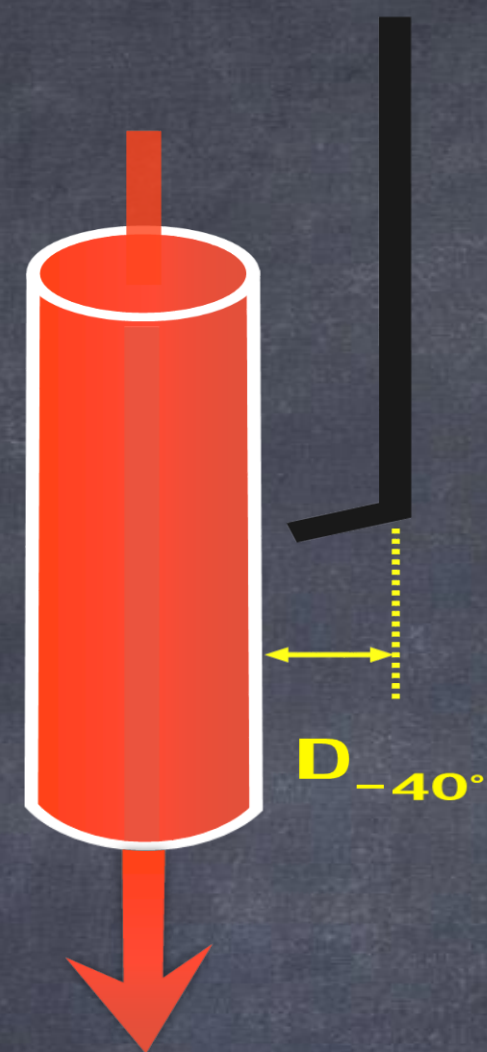


The distance between GW and target does not change during C-arm motion.

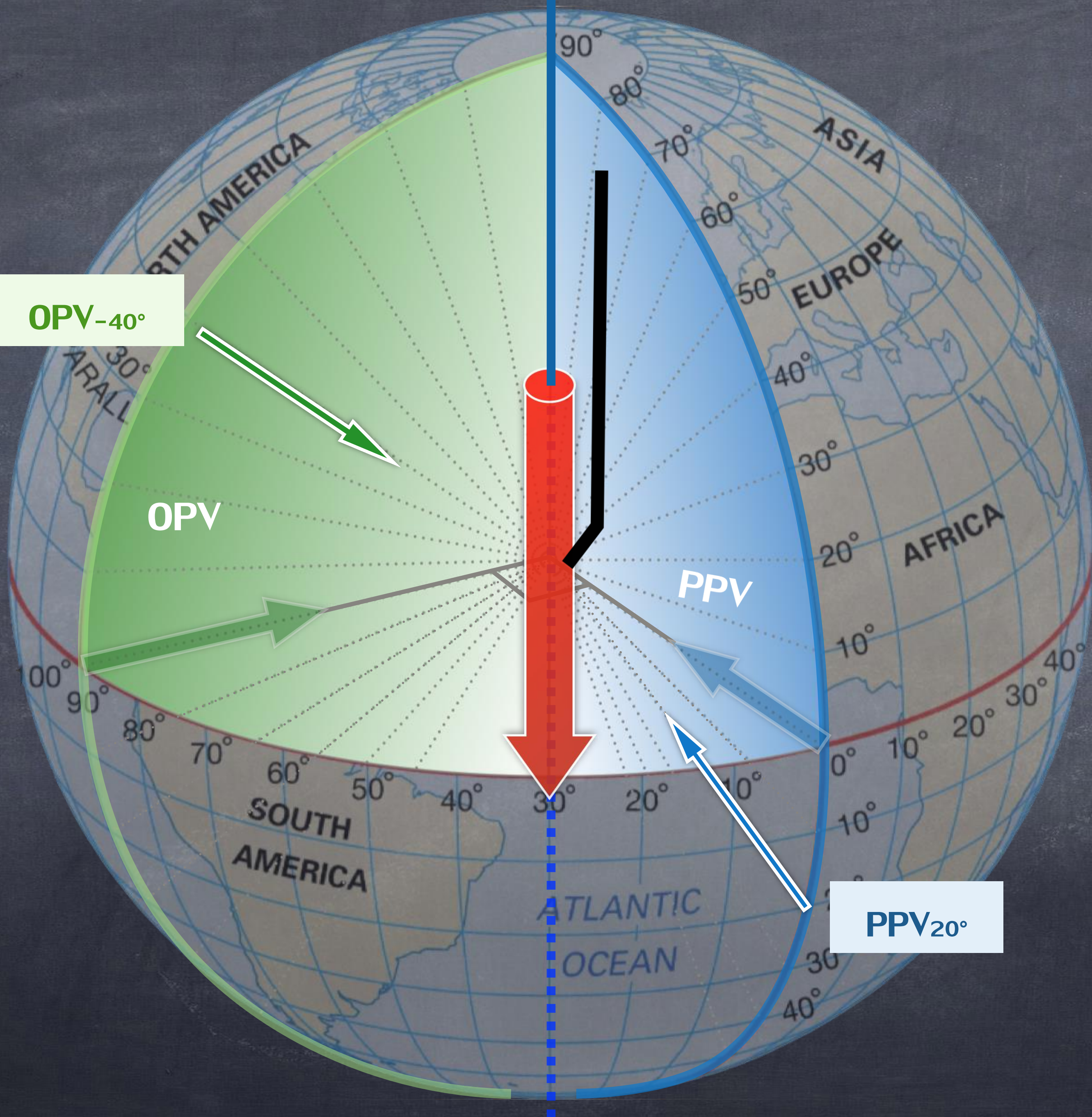




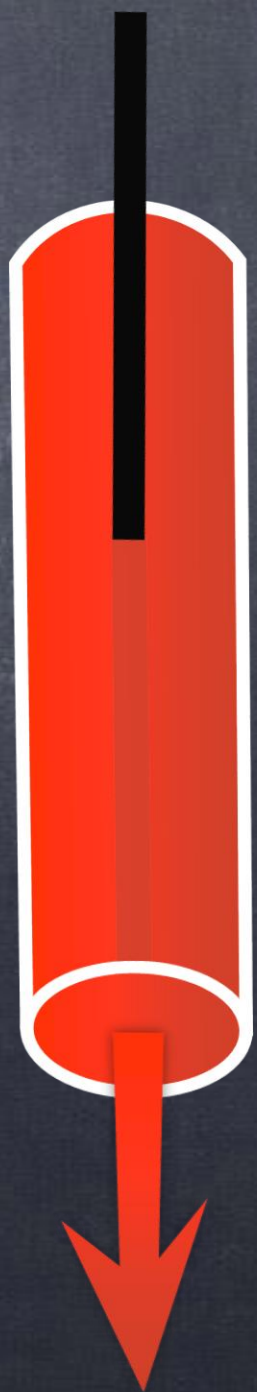




OPV_{-40°}



PPV_{20°}



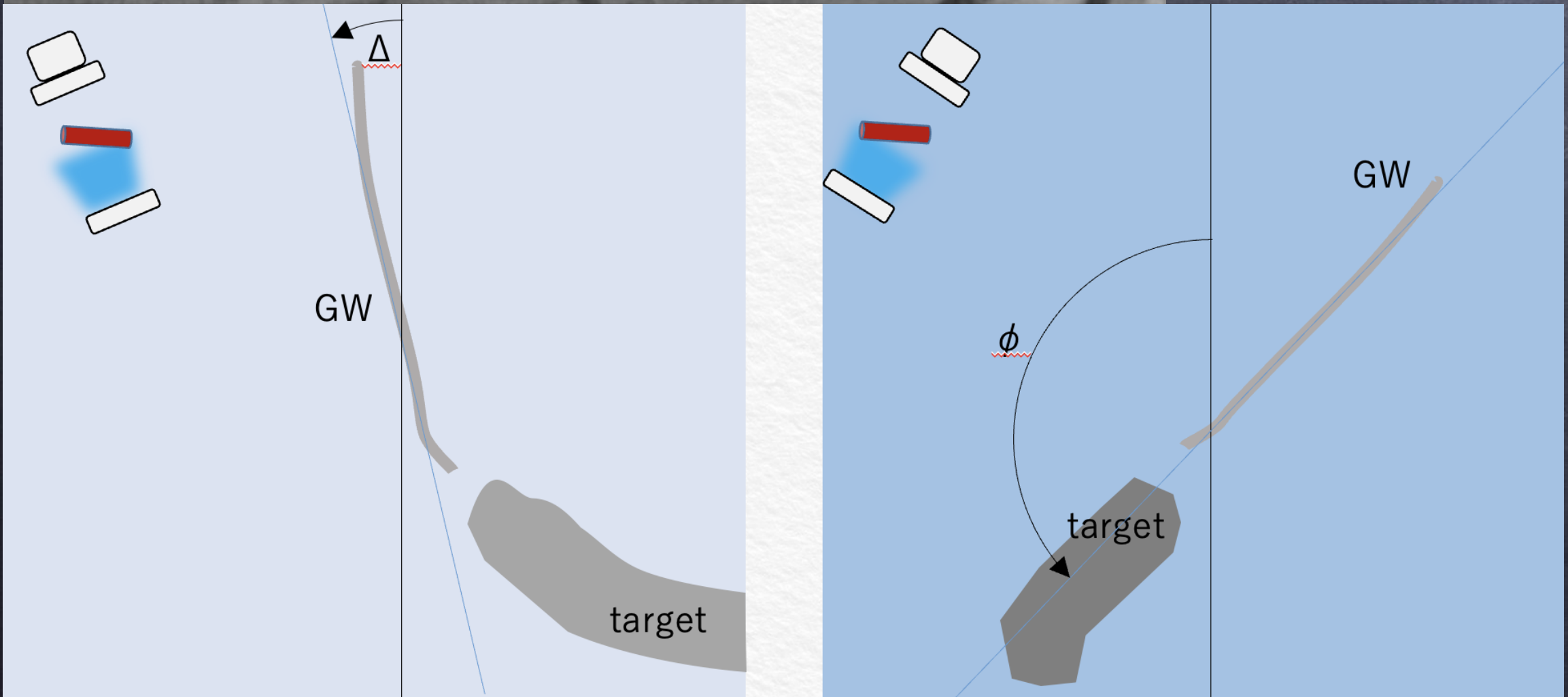
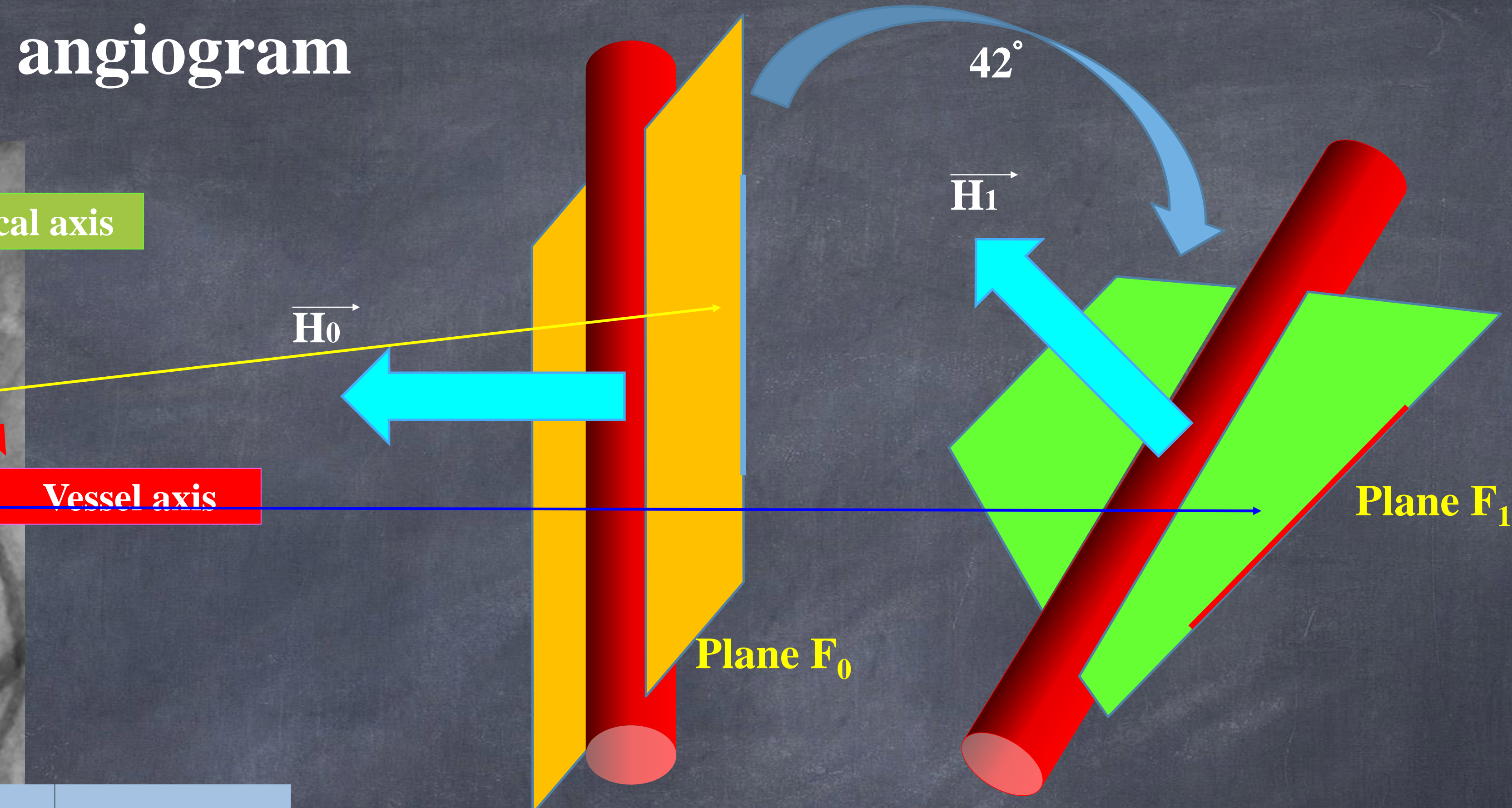
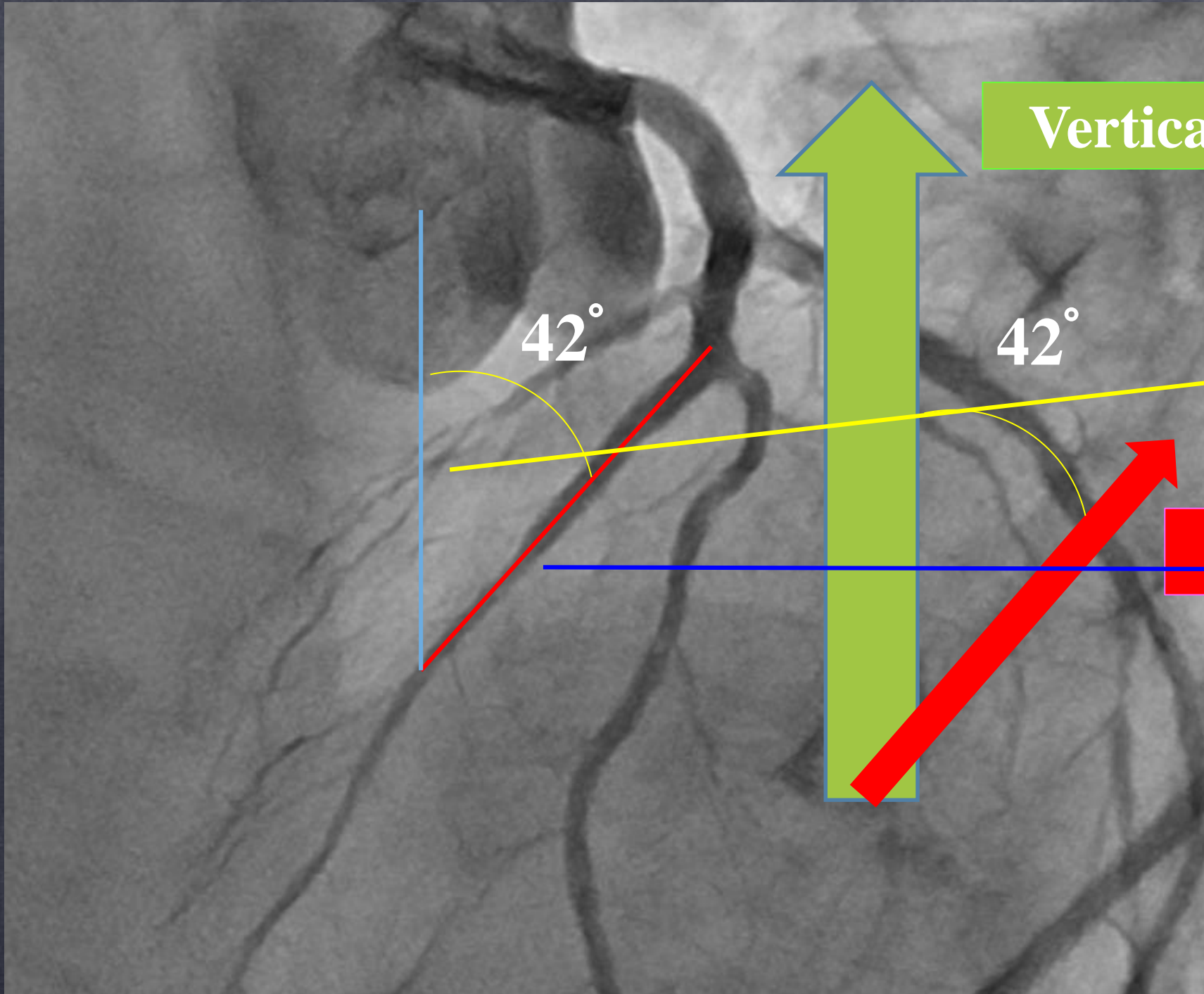
Limitations and problems

(1) Information about V_e and perpendicular projection is obtained from CT angiogram. However, there is some discrepancy between the data from CT image and those from angiogram.

(2) Cardiac motion and the movement of diaphragm have a certain influence on vessel axis and perpendicular projection.

(3) To confirm the perpendicular projection is one thing, and to navigate a guidewire intentionally toward the target is quite another. In order to reach the target, wire-advancing brand-new apparatus is needed.

Identification of Ve from angiogram



- Plane F₀ includes vertical axis.
- Plane F₁ includes vertical axis.
- Plane F₁ is calculated by Δ rad rotation of plane F₀
- \vec{H}_0 is a normal vector of Plane F₀
- \vec{H}_1 is a normal vector of Plane F₁
- In rectangular coordinate system, $\vec{H}_1 = R_n(\Delta) \cdot \vec{H}_0$ by Rodrigues' rotation formula

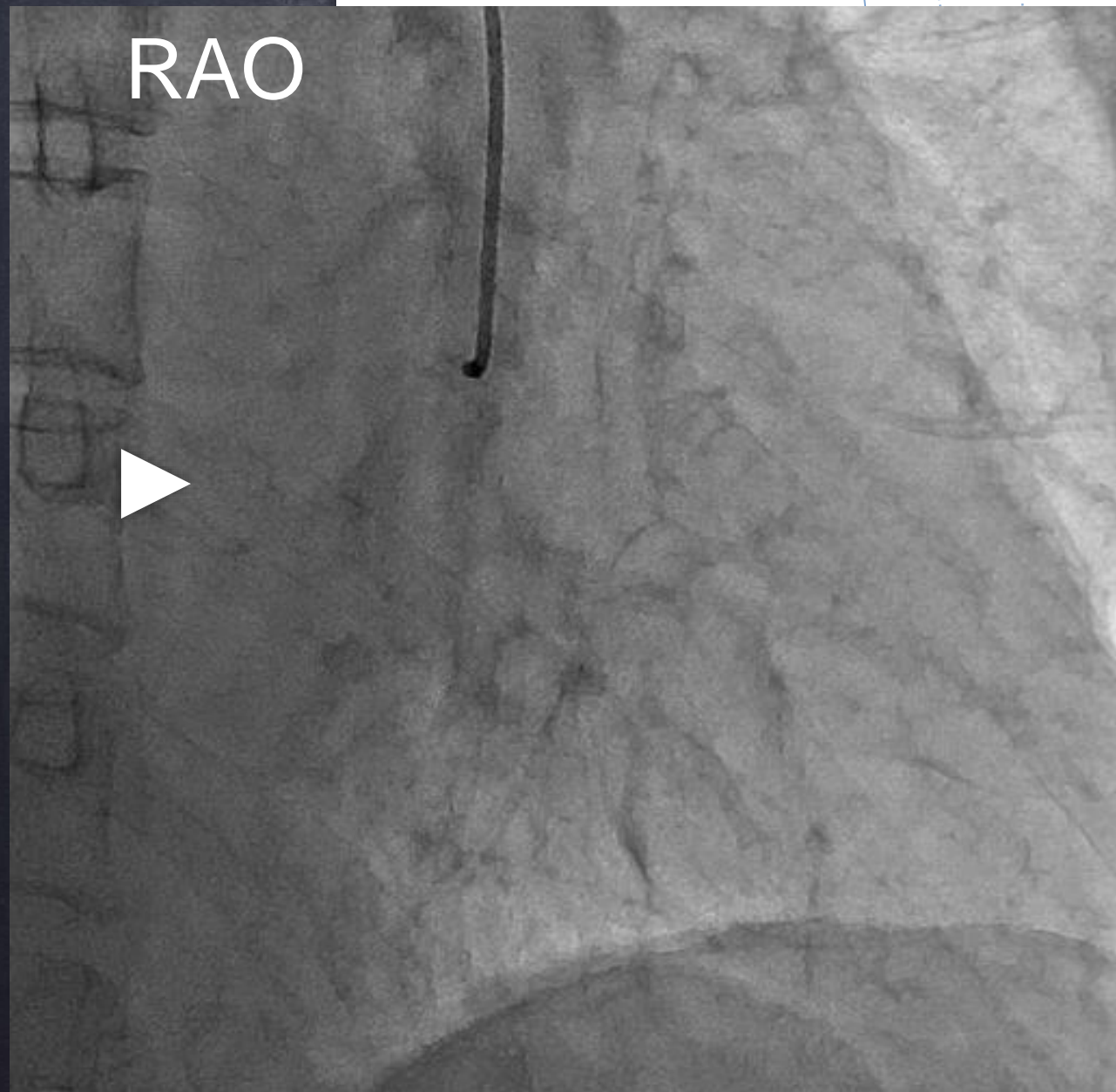
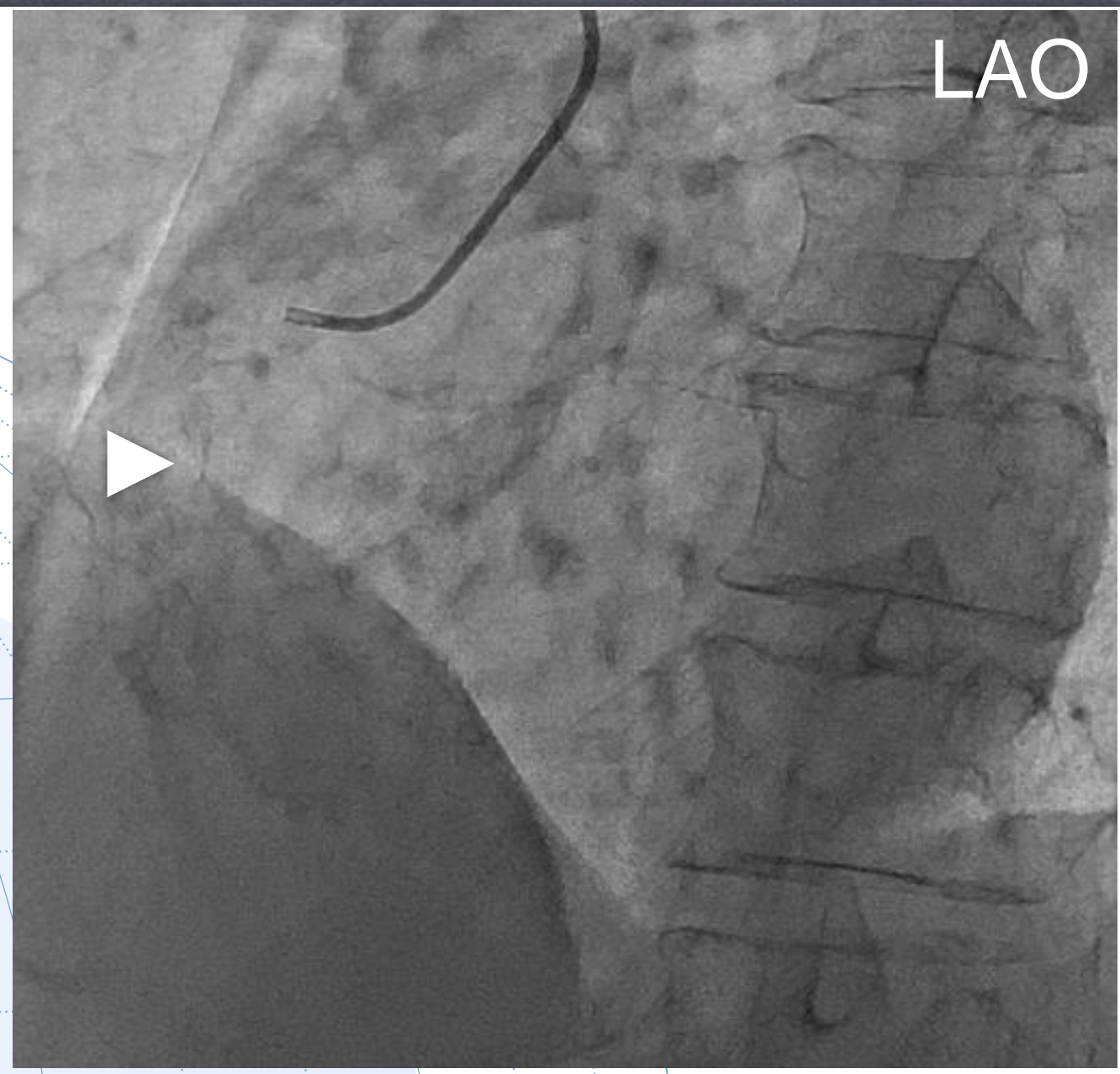
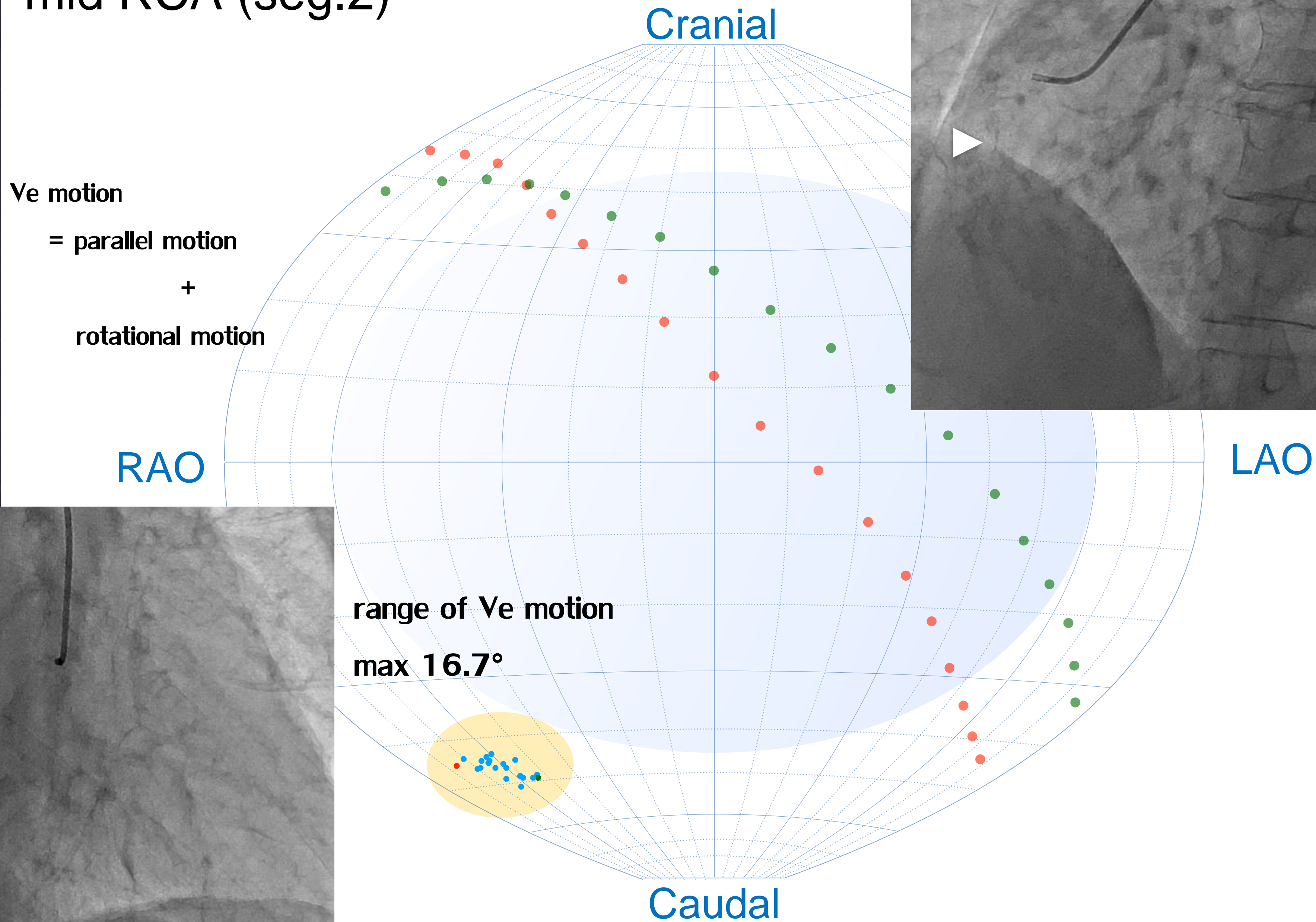
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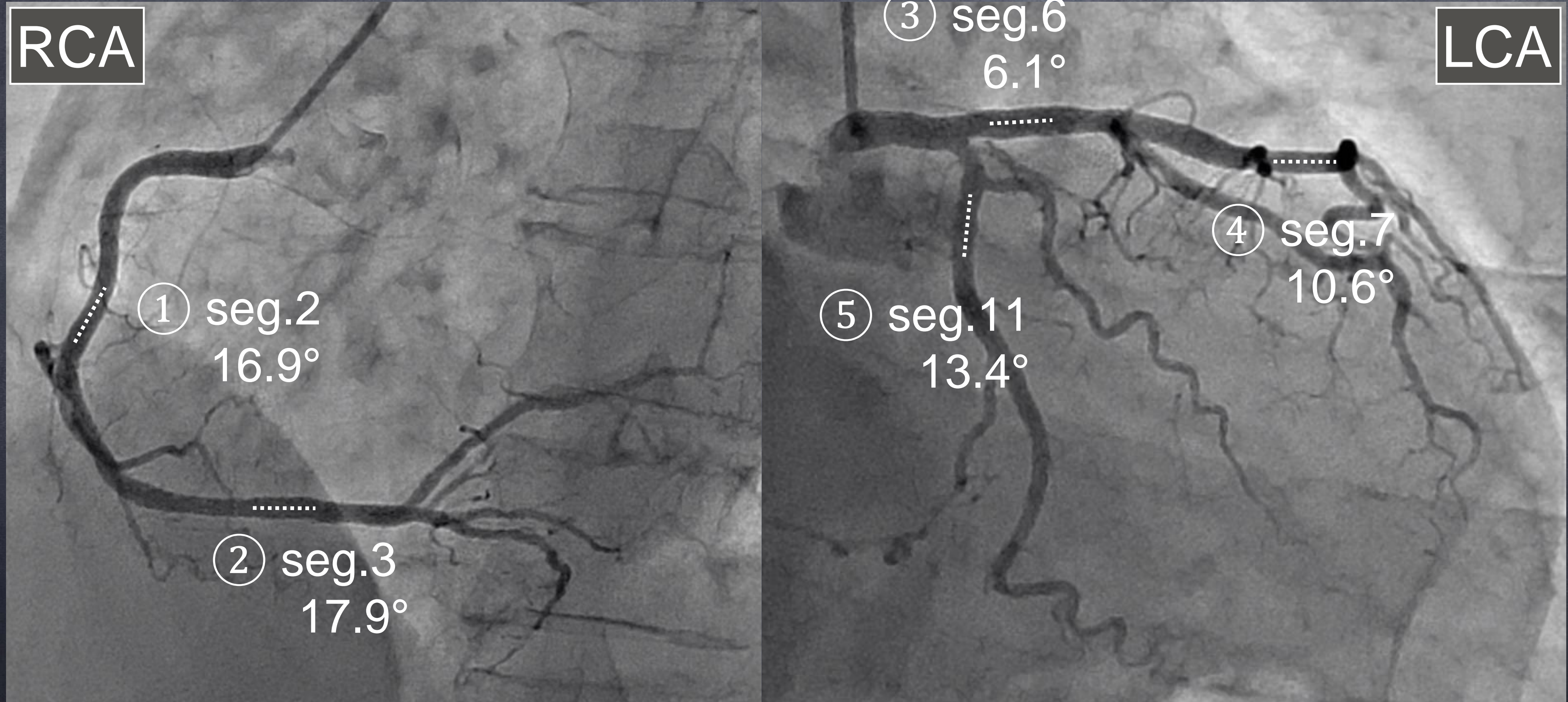
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mid RCA (seg.2)



	L-R	CRA
0%	-70	-47
5%	-69	-46
10%	-71	-43
15%	-62	-44
20%	-59	-46
25%	-52	-48
30%	-60	-43
35%	-54	-45
40%	-53	-49
45%	-62	-52
50%	-56	-49
55%	-62	-44
60%	-59	-48
65%	-65	-46
70%	-65	-48
75%	-63	-46
80%	-60	-46
85%	-64	-45
90%	-59	-49
95%	-77	-45

Ve motion at each segment



Stabilizing the angiographic image is needed for optimal wire manipulation.

Limitations and problems

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Thank you for your kind attention.