TFSR-03-07

Investigation of IEC 15 mm Bayonet cap/holder systems

Search for Substitute solutions (focus on PY21W with fit system BAU15s)

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LUMILEDS

Mechanical Keying (Cap/holder) 15 mm Bayonet family for LED Substitute

B15d/s, BA15d/s, BA15d/s-3(100°/130°) BAU 15d/s, BAWd/s, BAX15d/s, BAY15d/s, BAZ15d/s

The cap/holder family **B(A)(AU)(AW)(AX)(AY)(AZ)15d/s** , exists in the following combinations:
(categories for automotive **and** lamps for general lighting):

B15d	General lighting services
BA15d	= equal to B15d / not used in Automotive
BA15s	P21W (6V, 12V & 24V)
	R5W (6V, 12V & 24V)
	R10W (6V, 12V & 24V)
BAX15d	S4 (6V & 12V)
BAX15s	(reserved)
BAY15d	P21/5W (6V, 12V & 24V)
BAY15s	(reserved)
BAZ15d	P21/4W (6V, 12V & 24V)
BAZ15s	(reserved)
BAU15d	PR21/4W (12V & 24V)
BAU15s	PY21W (12V & 24V)
	RY10W (6V, 12V & 24V)
BA15d/s-3(100°/130°)	PY21/5W (12V)
BAW15d	PR21/5 (12V & 24V)
BAW15s	PR21W (12V & 24V)
	RR10W (6V, 12V & 24V)
	RR5W (6V, 12V & 24V)

Investigations “Physical Keys” dedicated for LED light sources

Options investigated for the 15 mm Bayonet cap/holder family

1) Extra pin
   a) on axial reference position (reference key) at 70°, 80°, 90°, 100° and 110°
   b) on elevated axial position (as used in BAW, BAY and BAZ caps) at 70°, 80°, 90°, 100° and 110°
   c) on axial position 3,2mm at angular position -30°
   d) on extra elevated position at angular position 0°

2) New extra contact dedicated to LED-Sources

Conclusions for PY21W5-case (cap / holder BAU15s)

The options related to an extra key-pin on the cap shell:

1. The BAU15s fit can have an extra key-pin:
   a) Between 90°and 110° (axial pin position at 3,2mm from reference),
   b) Between 100° and 110° (pin position at axial reference),
   c) At -30° (pin position 3.2mm from reference)
2. New 3rd axial position >5mm above the reference pin with additional holder conditions.

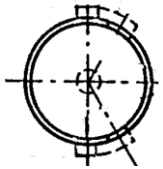
Option related to an extra contact for LED-operation

1. Creating a 2nd contact based on BAU15s is considered **impossible** due to distance between the contacts.

15 mm Bayonet Fit family *(Main key daimensions)*

(dimensions: cap ∅15,175mm ± 0,125; holder ∅ 15,40 ± 0,07

Fit (IEC 60061)	Cap Sheet (7004-..)	Holder Sheet (7005-..)	Ref pin Axial position	2nd (/ 3rd) pin Angle *(clockwise)*	2nd (3rd) pin (delta) Axial position	1st / 2nd pin Lengths
B15d	11	16	0° / 0 mm	+180°	0,0 ±0,1 mm	1,0 ±0,1
BA15d/s	11A	13	0° / 0 mm	+180°	0,0 ±0,1 mm	1,0 ±0,1
BA15d/s-3(100°/130°)	11D		0° / +3,2 mm	+130° / -130°	0,0 ±0,1 mm	1,0 ±0,1
BAU15d/s	19	13(d) / 19(s)	0° / 0 mm	-150°	0,0 ±0,1 mm	1,0 ±0,1
BAW15d/s	11E	13	0° / 0 mm	+150°	+3,2 ±0,1 mm	1,0 ±0,1
BAX15d(/s)	18	-	0° / 0 mm	+180°	0,0 ±0,1 mm	2,00 ±0,15 0,78 ±0,08
BAY15d(/s)	11B	13	0° / 0 mm	180°	+3,2 ±0,1 mm	1,0 ±0,1
BAZ15d(/s)	11C	13	0° / 0 mm	-150°	+3,2 ±0,1 mm	1,0 ±0,1

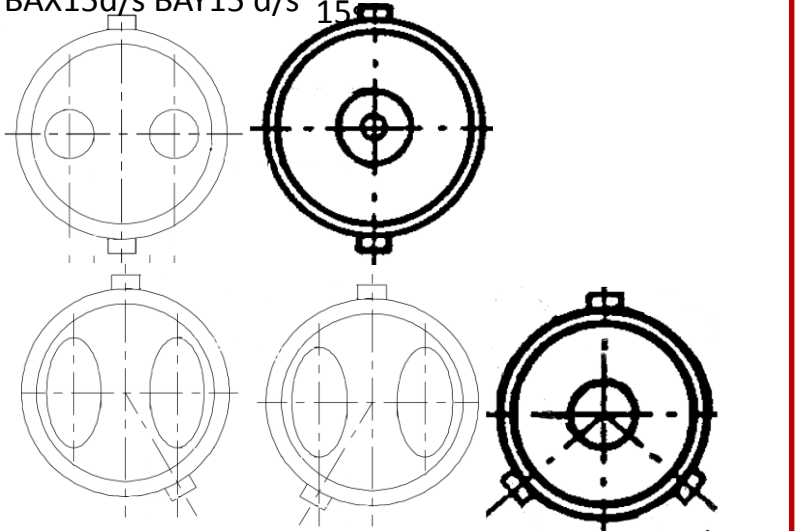


The Bayonet 15 mm fit system visualized (IEC 60061)

Caps (bottom view)

B15d & BA15d
BAX15d/s BAY15 d/s

B15s & BA 15s



BAZ15 / BAU15

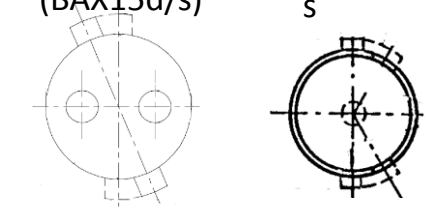
BAW15

BA15s-3(100°/130°)

Holders (top & side view)

B15d & BA15d (BAX15d/s)

BAU15 s



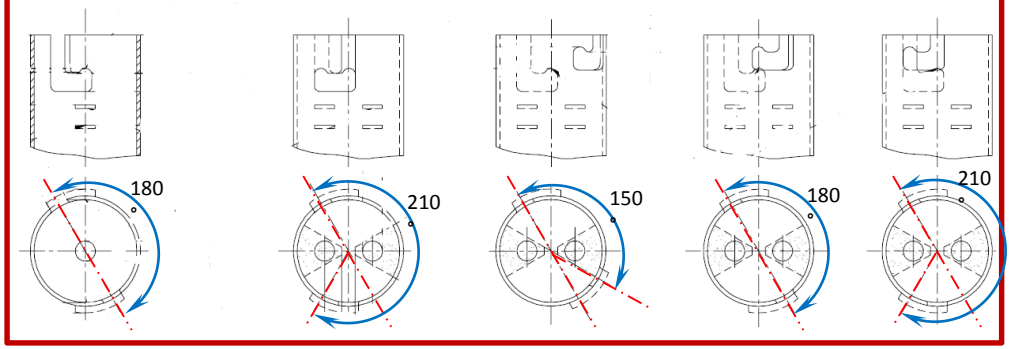
BA15s*

BAU15d**

BAW15d**

BAY15d**

BAZ15d**

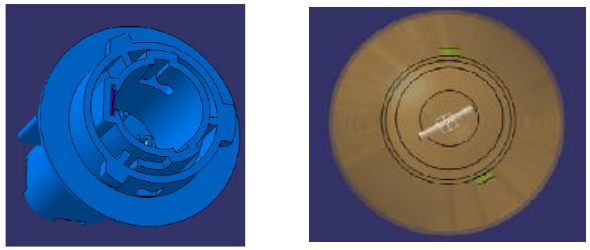


Family of key functions:

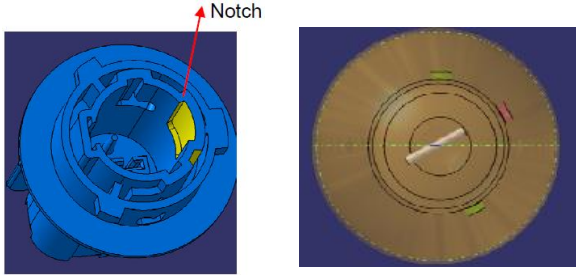
- Single contact / double contact
- 2nd pin on 180° (B15, BA15, BAX 15)
- 2nd pin on +150° (BAZ 15)
- 2nd pin on -150° (BAW15)
- 2nd pin on +130° **&** 3rd pin on -130° (BA15s-3…)
- BAX 15d has deviating pin-lengths; holder not defined in IEC

Evaluation proposal Valeo (reference TFSR-01-10)

Existing PY21W
Bulb holder BAU15s



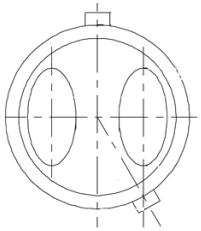
Proposed PY21/LED
bulb holder BAU15*s



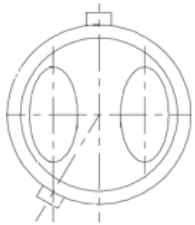
BAU15*s

Extending the 3rd pin option for Existing cap BAW15d/s in a similar direction as proposed doe the BAU15s cap result in two options:

(view "b" holder-top)

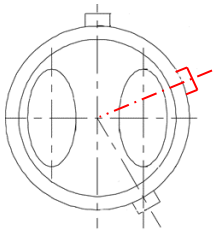


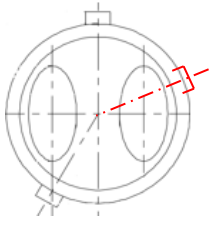
BAU15d

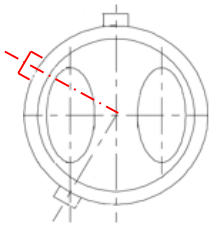


BAW15

3rd pin for also for BAU15, and BAW 15?







BAU15*d/s ---- BAW15*d/s ---- BAW15*d/s (alternative)

AS PROPOSED ---- copied as proposed for 3rd pin in BAY15 ---- mirrored as proposed ---- for 3rd pin in BAY15

Examination Valeo Proposal:

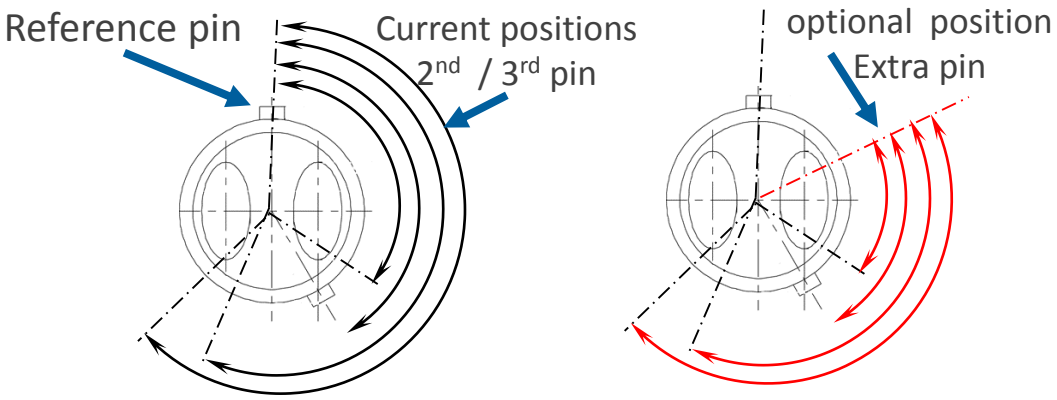
- Angular offset from Reference pin (estimated from input:)
  - A slot at +70°, 80°, 90° 100° or 110° clockwise holder top-view (see next slide)
- All* current Automotive 15 mm Bayonet fits with this extra pin added,
- All* “Non-LED” automotive fit-types to be checked:
  - “reference” Cap-pin in “new Holder-Slot”
  - “non-reference” Cap-pin in “new Holder-Slot”

- close fit need to be prevented:
  Due to tolerances in the fit system, the basic difference in “angular step” for the pins in this system should be 20° or more to enable a clear discrimination in the fit-system

* the BAX system is not taken into account for it’s different pin lengths is not a real discriminator in the BA15; it just fit’s and there is no adequate holder definition in IEC

Alternative angles (potential options)

verification 20° offset requirement



New position – conditions:

- Discrimination to existing systems >10° (20° preferred to cover tolerances and effective discrimination)

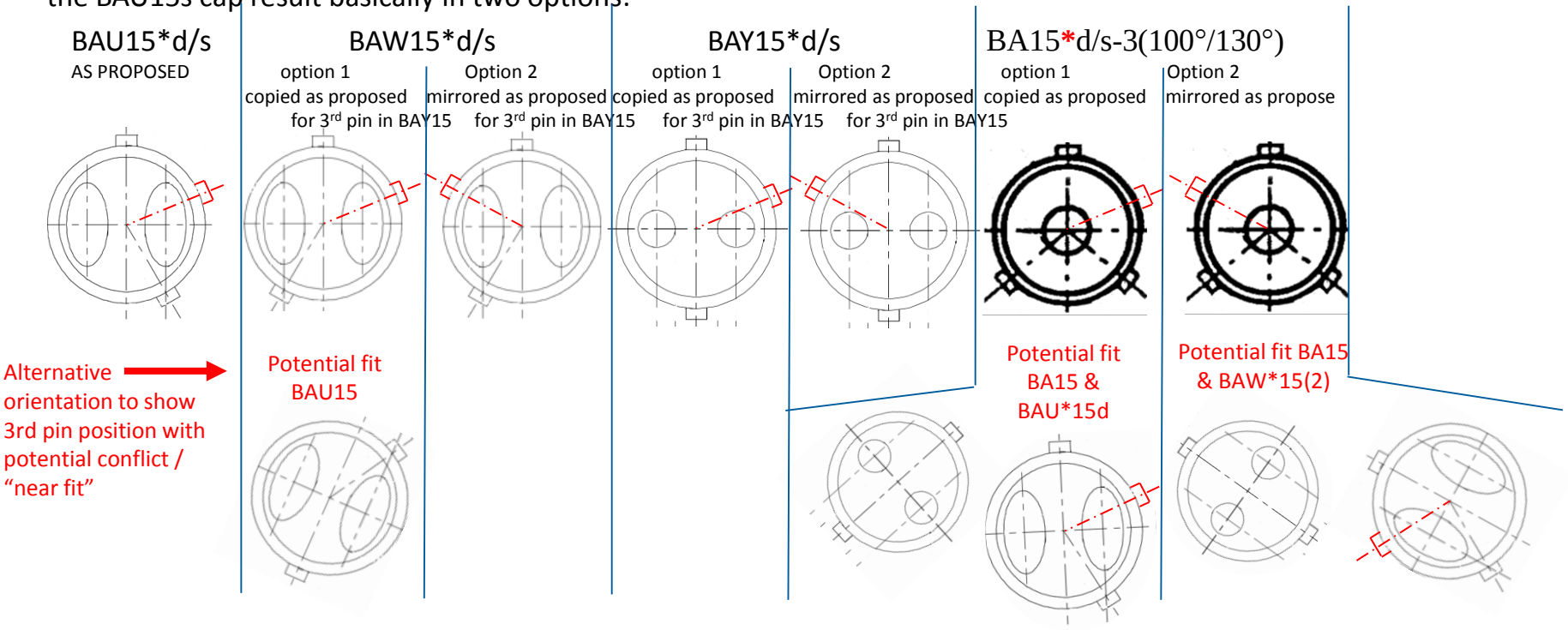
→ From reference: 70° to 110° solution seems possible in first instance and is examined in detail.

current positions	Optional New positions (Delta angle)								
	40°	50°	60°	70°	80°	90°	100°	110°	120°
130°	90°	80°	70°	60°	50°	40°	30°	20°	10°
150°	110°	100°	90°	80°	70°	60°	50°	40°	30°
180°	140°	130°	120°	110°	100°	90°	80°	70°	60°
210°	170°	160°	150°	140°	130°	120°	110°	100°	90°

Evaluation (based on proposal Valeo reference TFSR-01-10)

2D-Review angular positions between the pins for a 3rd slot between 70° or 80°

Extending the 3rd pin option for Existing cap BA15s, BAW15d/s, BAY15d and in a similar direction as proposed for the BAU15s cap result basically in two options:



Conditions to facilitate the Full 15 mm bayonet Family,

1) All automotive fits need a substitute option!

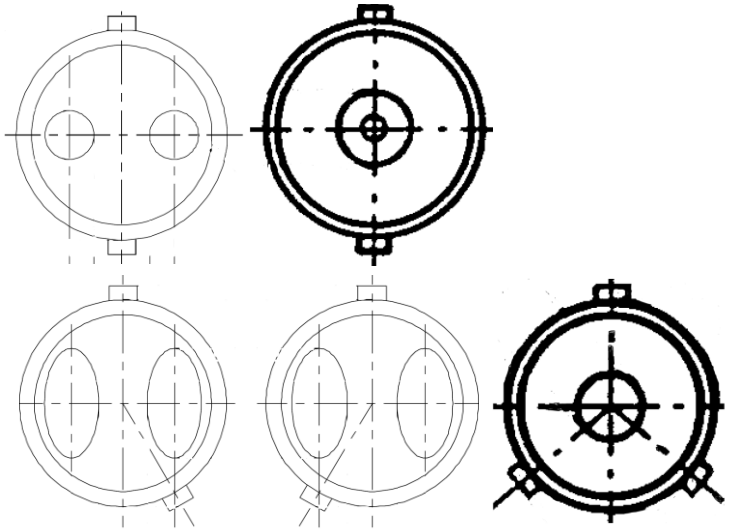
2) Only the Non-LED-source shall fit in the counterpart LED holder

Fit Substitute* (IEC "60061")	Ref pin Axial position	2nd (/ 3rd) pin Angle *(clockwise)*	2nd (3rd) pin (delta) Axial position	1st / 2nd pin Lengths	Extra pin Angle *(clockwise)*	Extra Pin Hight /Length?
B15*d	0° / 0 mm	+180°	0,0 ±0,1 mm	1,0 ±0,1	No need	No need 2)
BA15*d/s	0° / 0 mm	+180°	0,0 ±0,1 mm	1,0 ±0,1	+??° 1)	?
BA15*d/s-3(100°/130°)	0° / 0 mm	+130° / -130°	0,0 ±0,1 mm	1,0 ±0,1	+??° 1)	
BAU15*d/s *(Valeo proposal)*	0° / 0 mm	-150°	0,0 ±0,1 mm	1,0 ±0,1	~70° ?? 1)	Full height (open section in holder)
BAW15*d/s	0° / 0 mm	+150°	+3,2 ±0,1 mm	1,0 ±0,1	+??° 1)	
BAX15*d(/s)	0° / 0 mm	+180°	0,0 ±0,1 mm	2,00 ±0,15 0,78 ±0,08	+??° 1)	
BAY15*d(/s)	0° / 0 mm	180°	+3,2 ±0,1 mm	1,0 ±0,1	+??° 1)	
BAZ15*d(/s)	0° / 0 mm	-150°	+3,2 ±0,1 mm	1,0 ±0,1	+??° 1)	

1) The investigation should focus on a solution that could be applied on all fit systems with a clear key function to prevent unintended applications

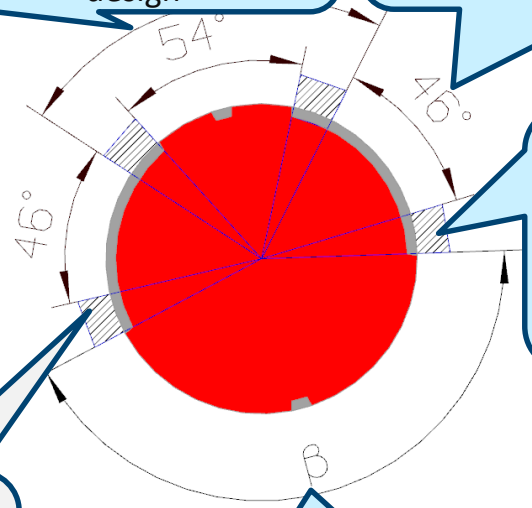
2) The B15d is not used in automotive applications.

The BA(…)15 Cap holder system;
Quick first 2D approach area used by the current family



54° is used by a single pin including the movement in the holder design

Remaining area 2 x 46° for an "extra pin" is to small: Minimum 54° is required for a single pin, including it's movement.



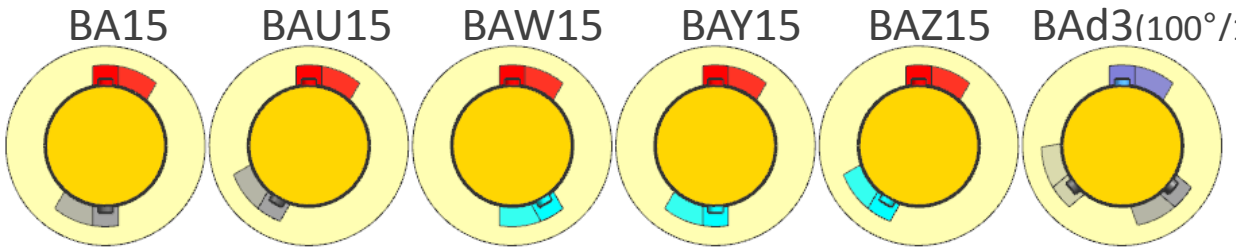
Hatched area's represent the holder material required for the holder construction (enabling movement stop position for the cap)

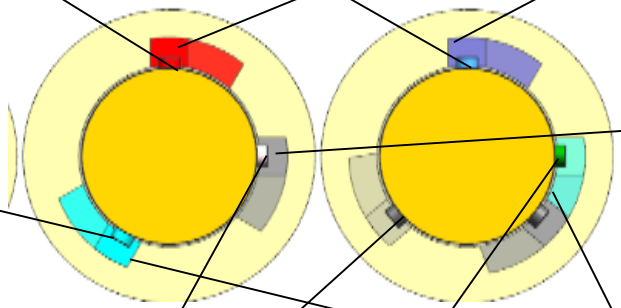
Family of key functions:
- Single contact / double contact
- 2nd pin on 180°
- 2nd pin on +150°
- 2nd pin on -150°
- 2nd pin on +130° **&** 3rd pin on -130°

Resulting occupied space in angular positions

β is occupied by bayonet15 mm family by:
- 2nd and 3rd pin
- movement of the pin in the holder design

Basic Family (pin-positions)
Explanation images





Cap

Red pin = Reference pin
(Blue Pin= Ref pin BA15d-3)

Cyan pin = Standard pin
(elevated level)

Grey Pin = Standard pin
(reference level)

White pin = Extra LED - pin (ref level)
Green pin = Extra LED - pin (elevated level)

Holder

Red Surface = plane reference Pin
(Blue Surface = Ref Plane BA15d3)

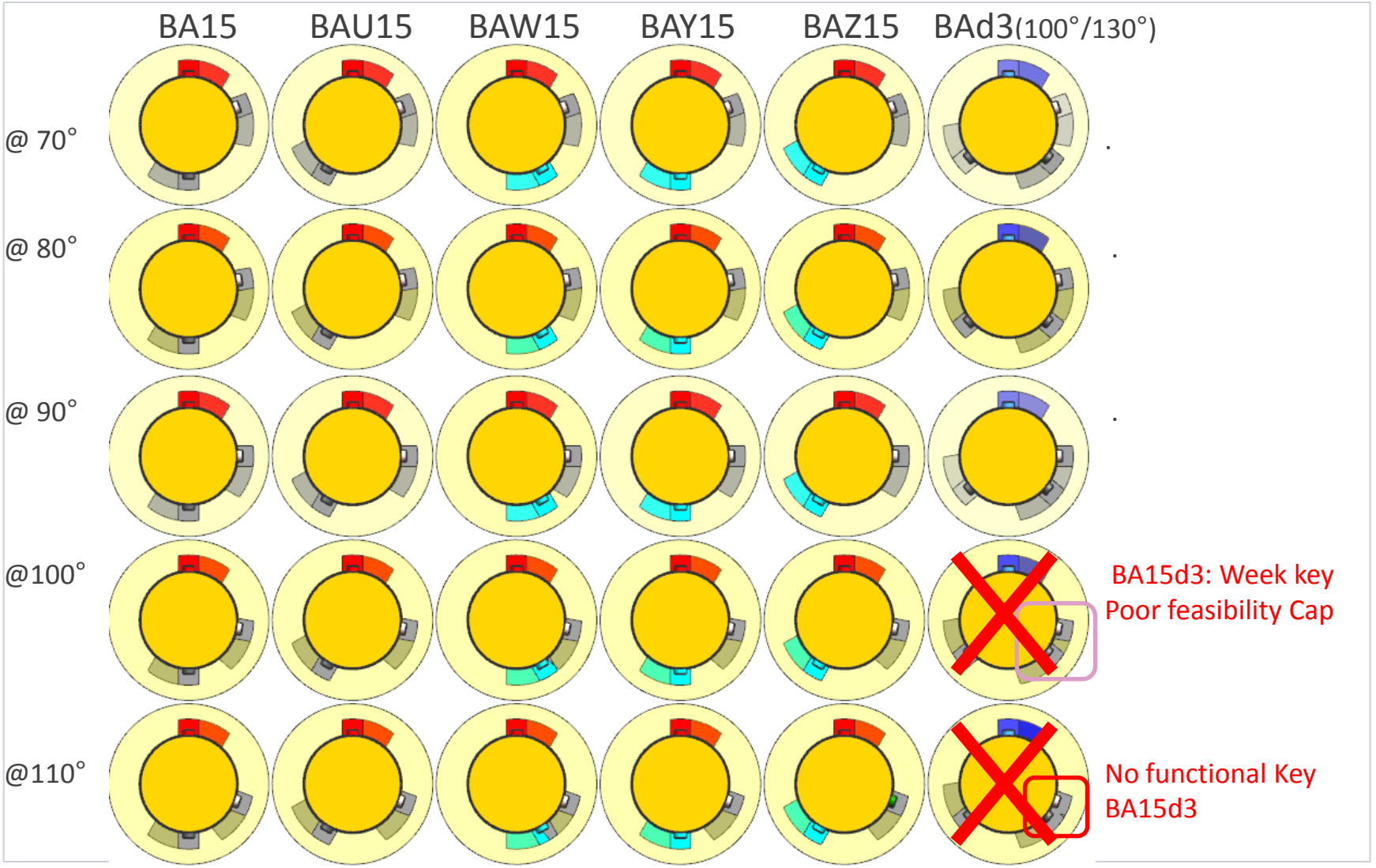
Grey surface = same level as Reference pin

Light Blue surface = elevated level for second pin

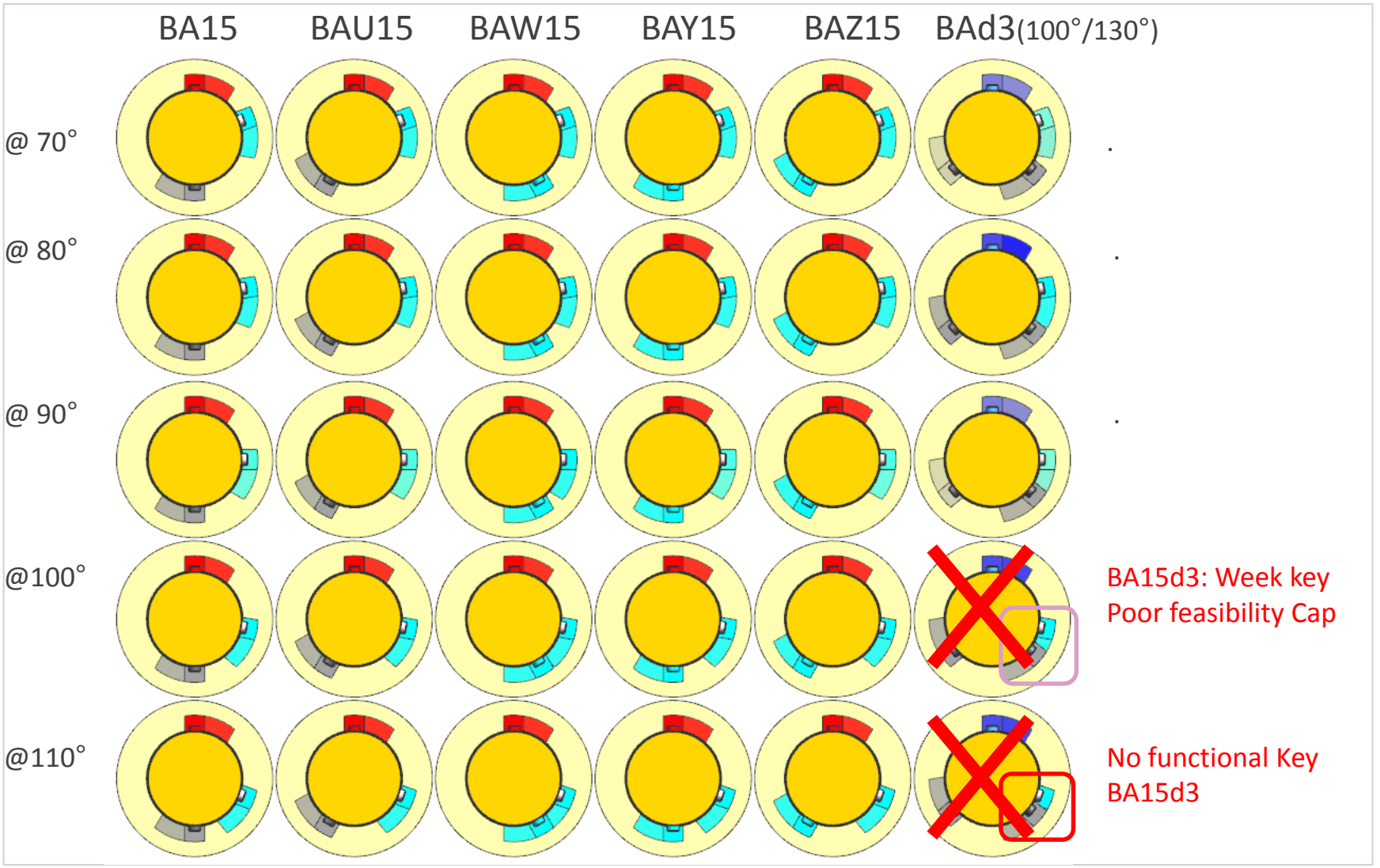
Notes:

1) *images build on Least Material Condition = maximum play acc. IEC 60061*
2) *Light colored areas are sections to provide axial positioning for the cap pin*

LED-Family Options (A): Extra-pin @ Reference Level



LED-Family Options (B): Extra-pin @ Elevated Level (@ 3.2mm)



Key verification (extra pin)

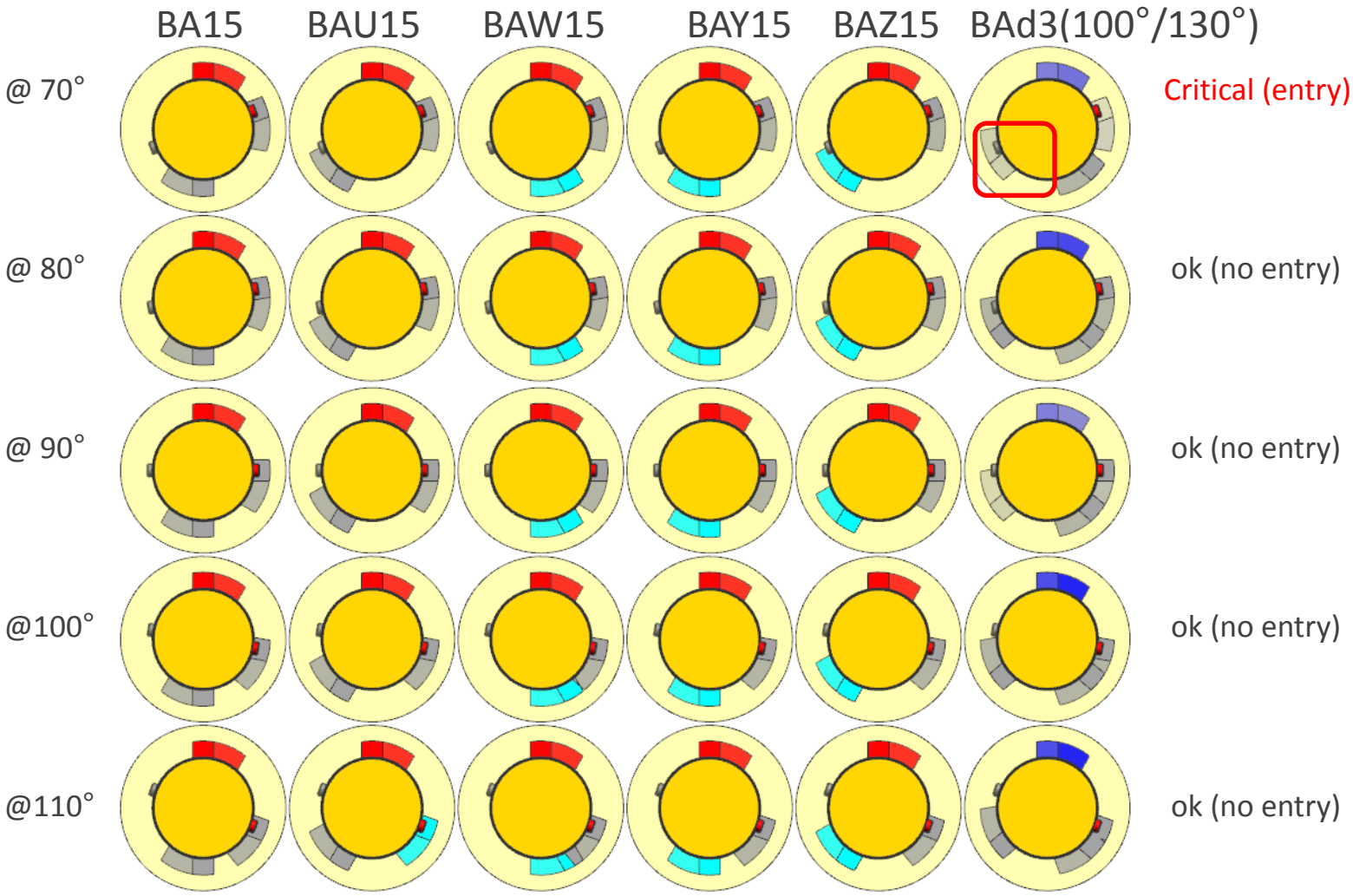
- Each non led cap shall be tested in a not-intended fit:
- i.e. a BA15 cap shall only fit in a BA-LED holder and shall not in one of the others LED holders
- The following pages show the tests for the non LED-caps:
  a) The Cap-Reference pin in the LED-holder at new slot position (A1)
  b) The Cap-Non-Reference pin (and third) in the LED-holder at new slot position (A2)
  c) The Cap-Reference pin in the LED-holder at new slot position (B1)
  d) The Cap-Non-Reference pin (and third) in the LED-holder at new slot position (B2)

Notes:

1) The other positions are by the system already keyed-out
2) Error (or critical) positions marked
3) Possible positions marked: insertion & no-rotation resulting is a positive option is marked
3) No further evaluation for week key in BA15d-3(100°/130°) holder @ 110° position

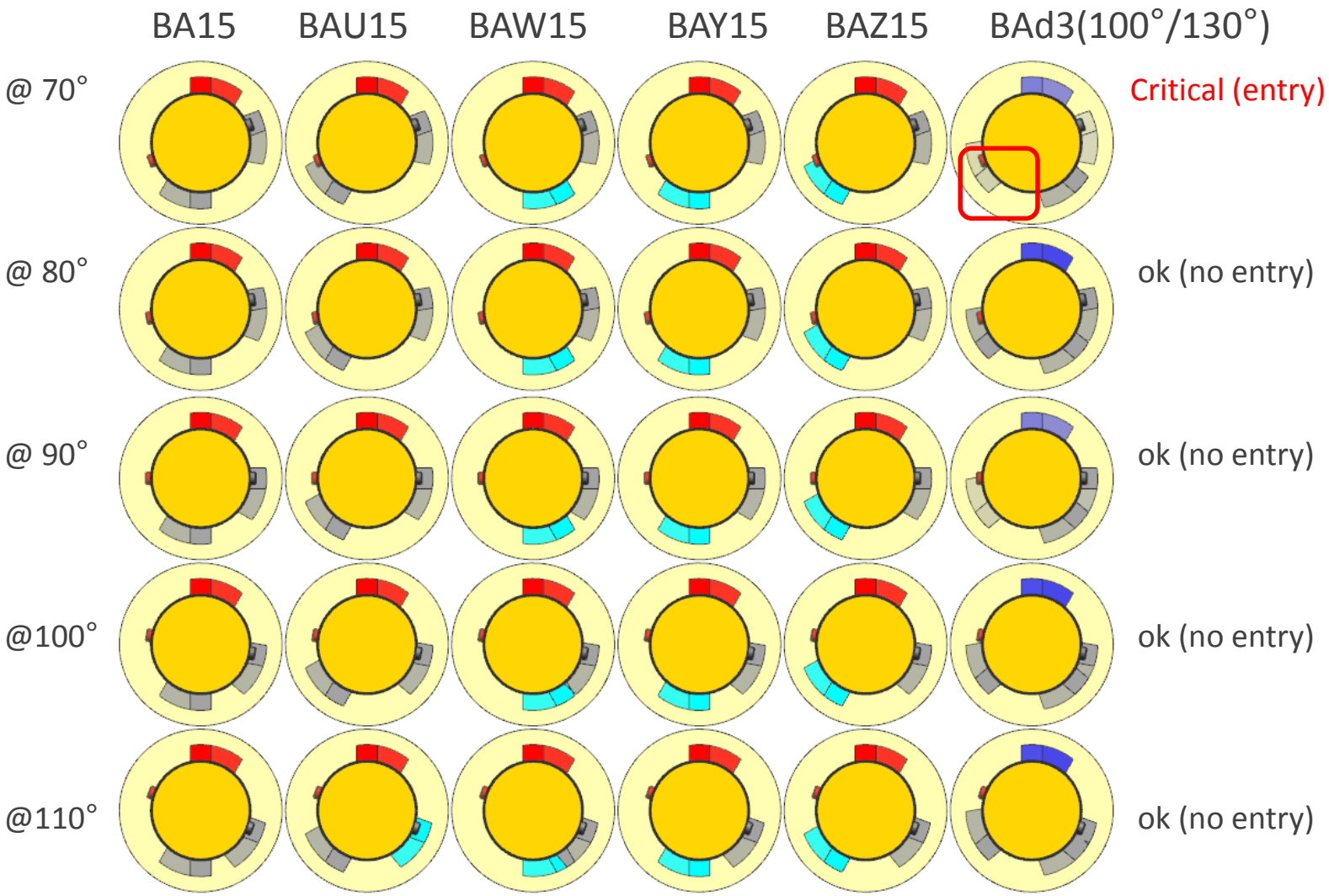
BA15 - non-LED cap in **LED-**Holders

Ref-pin-Cap in new slot (A)

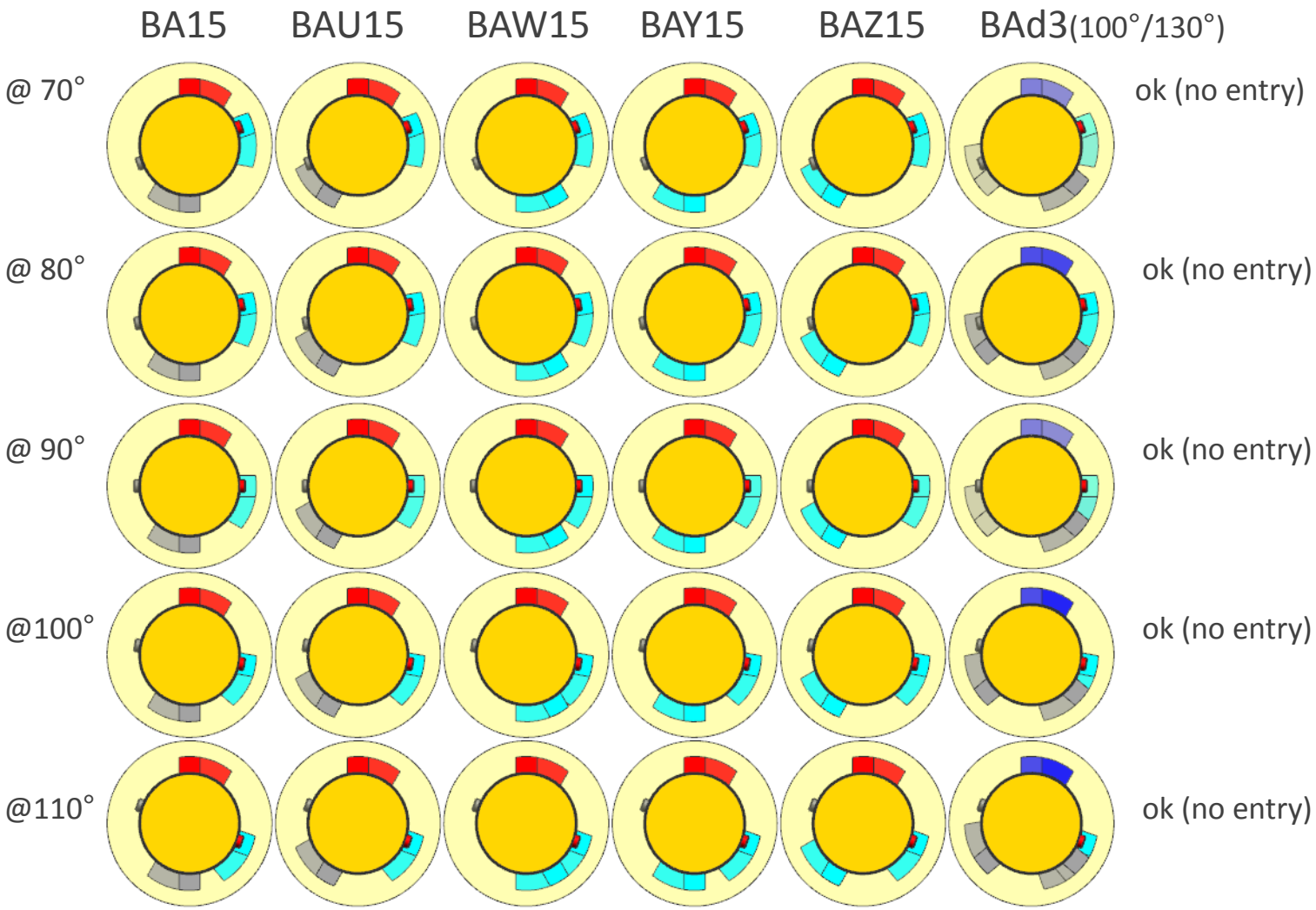


BA15 - non-LED cap in **LED-**Holders

Non-Ref-pin-Cap in new slot (A)

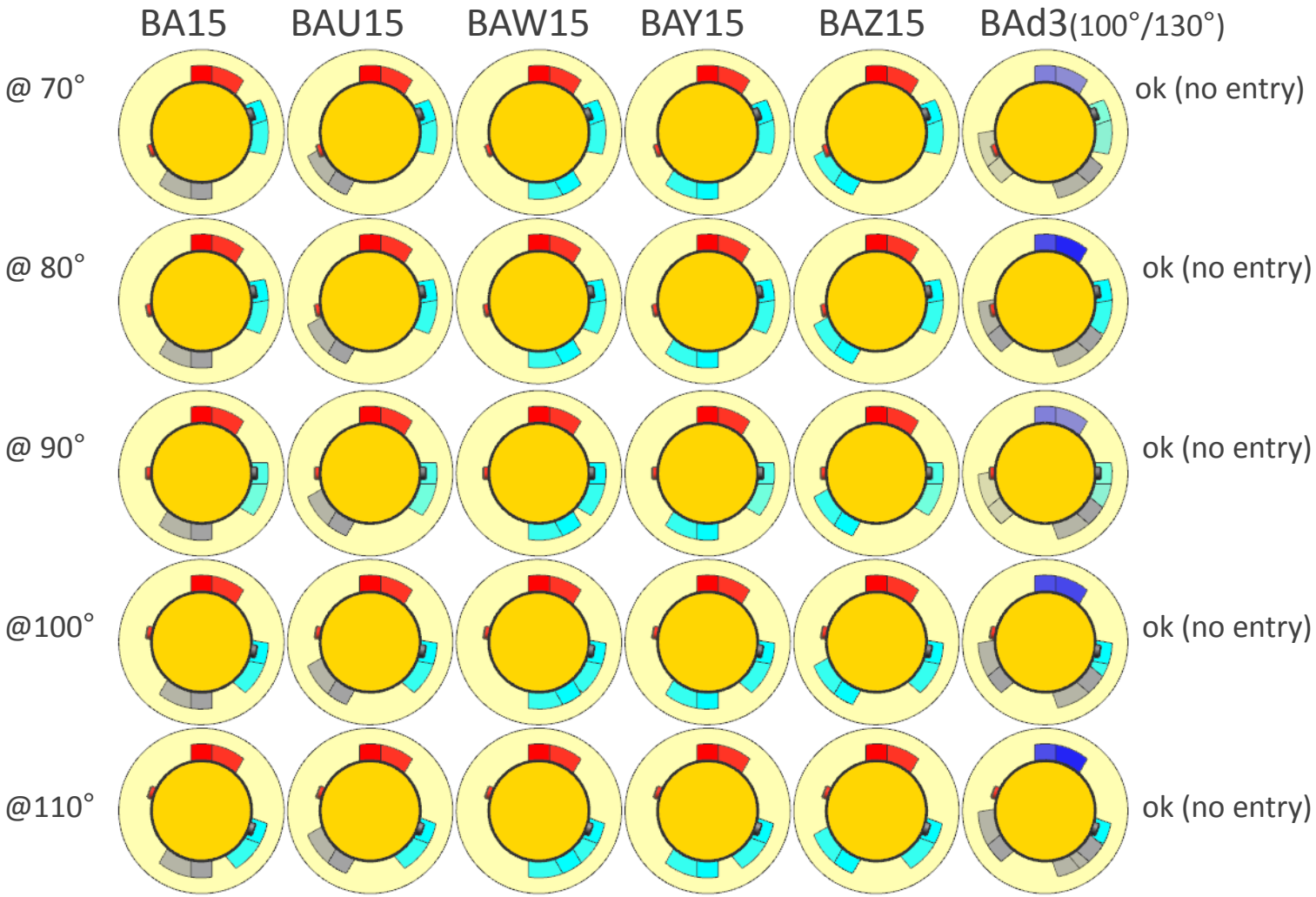


BA15 - non-LED cap in **LED-**Holders
Ref-pin-Cap in new slot (B)



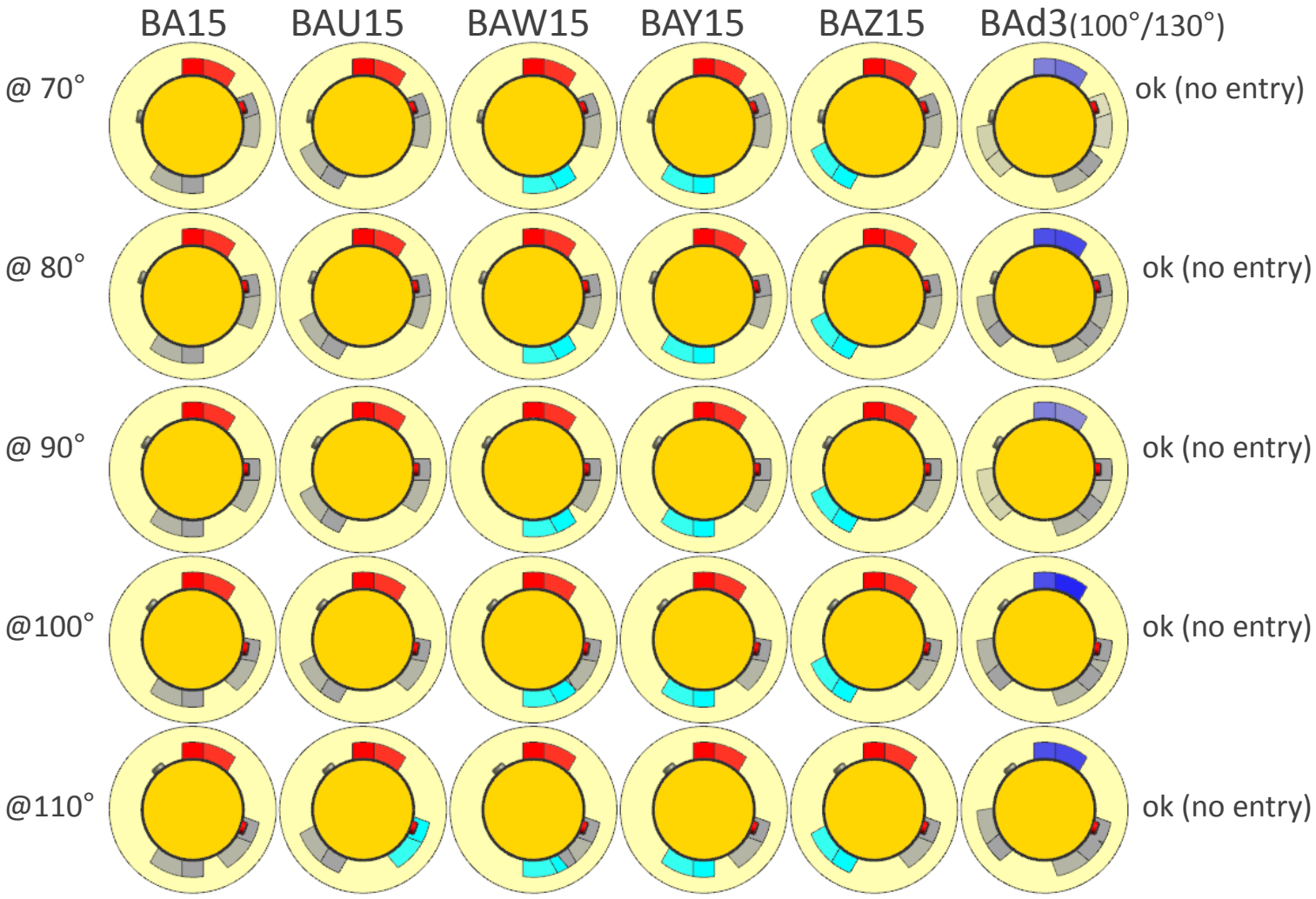
BA15 - non-LED cap in **LED-**Holders

Non-Ref-pin-Cap in new slot (B)



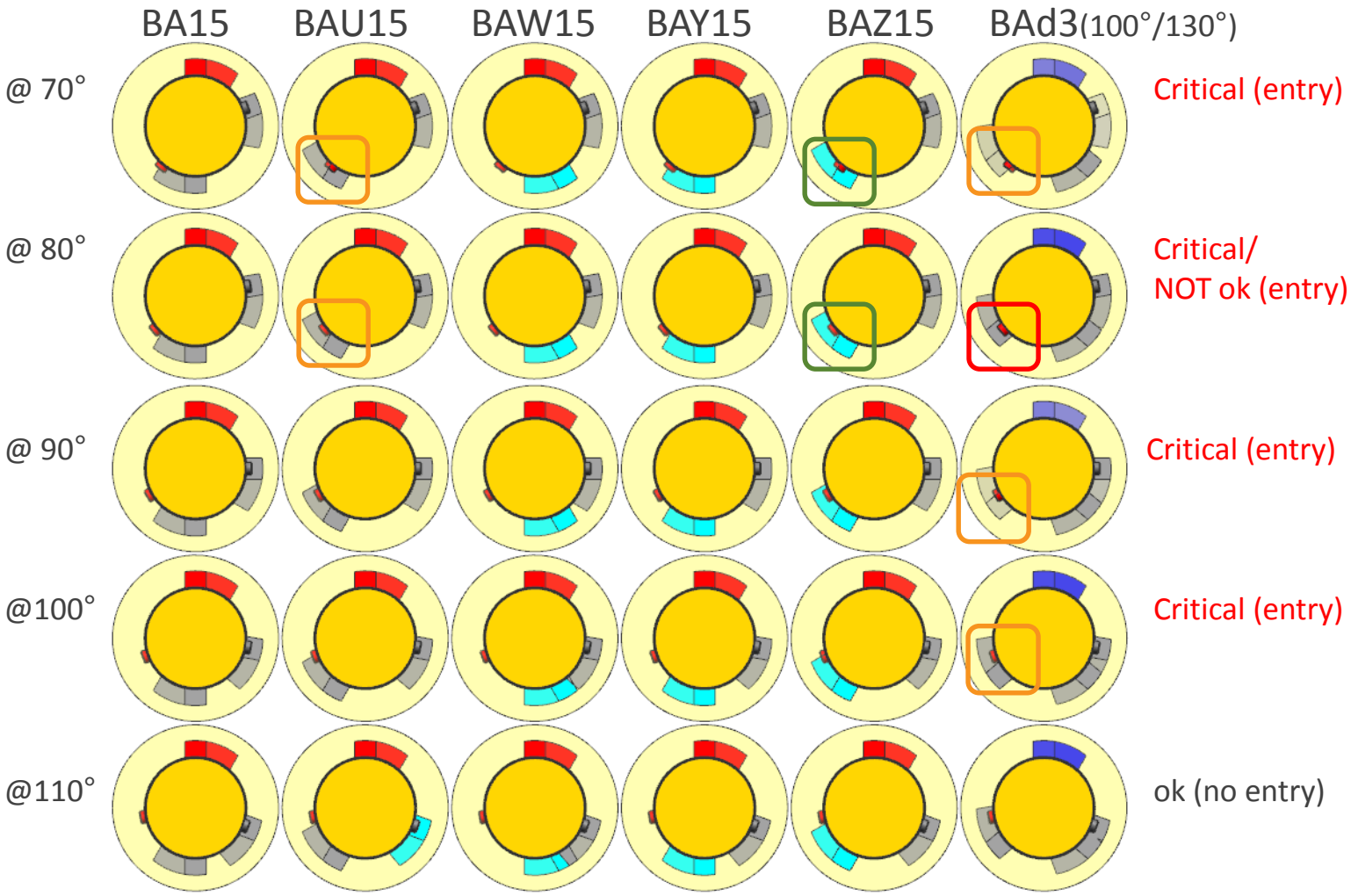
BAU15 - non-LED cap in **LED-**Holders

Ref-pin-Cap in new slot (A)



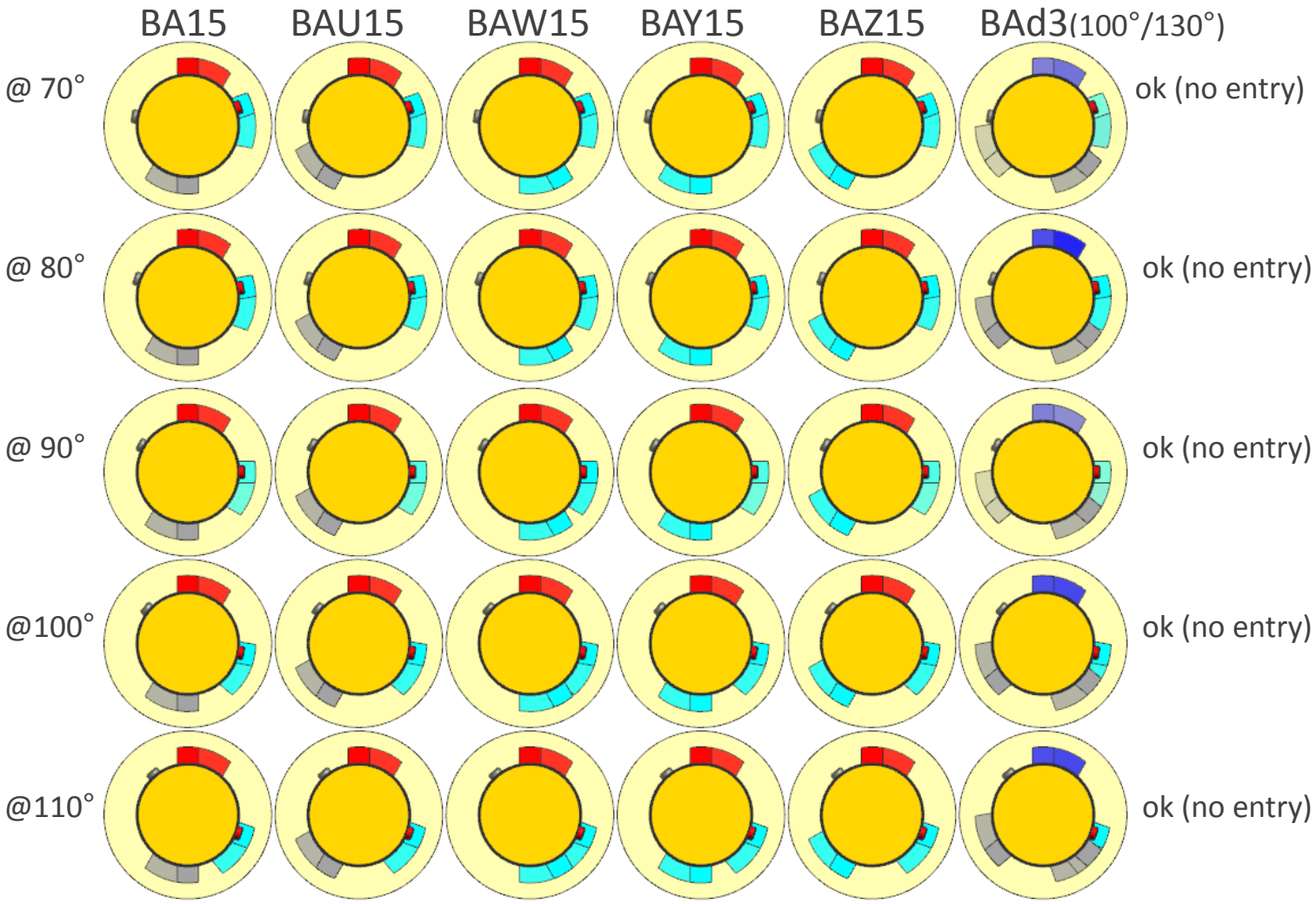
BAU15 - non-LED cap in **LED-**Holders

Non-Ref-pin-Cap in new slot (A)



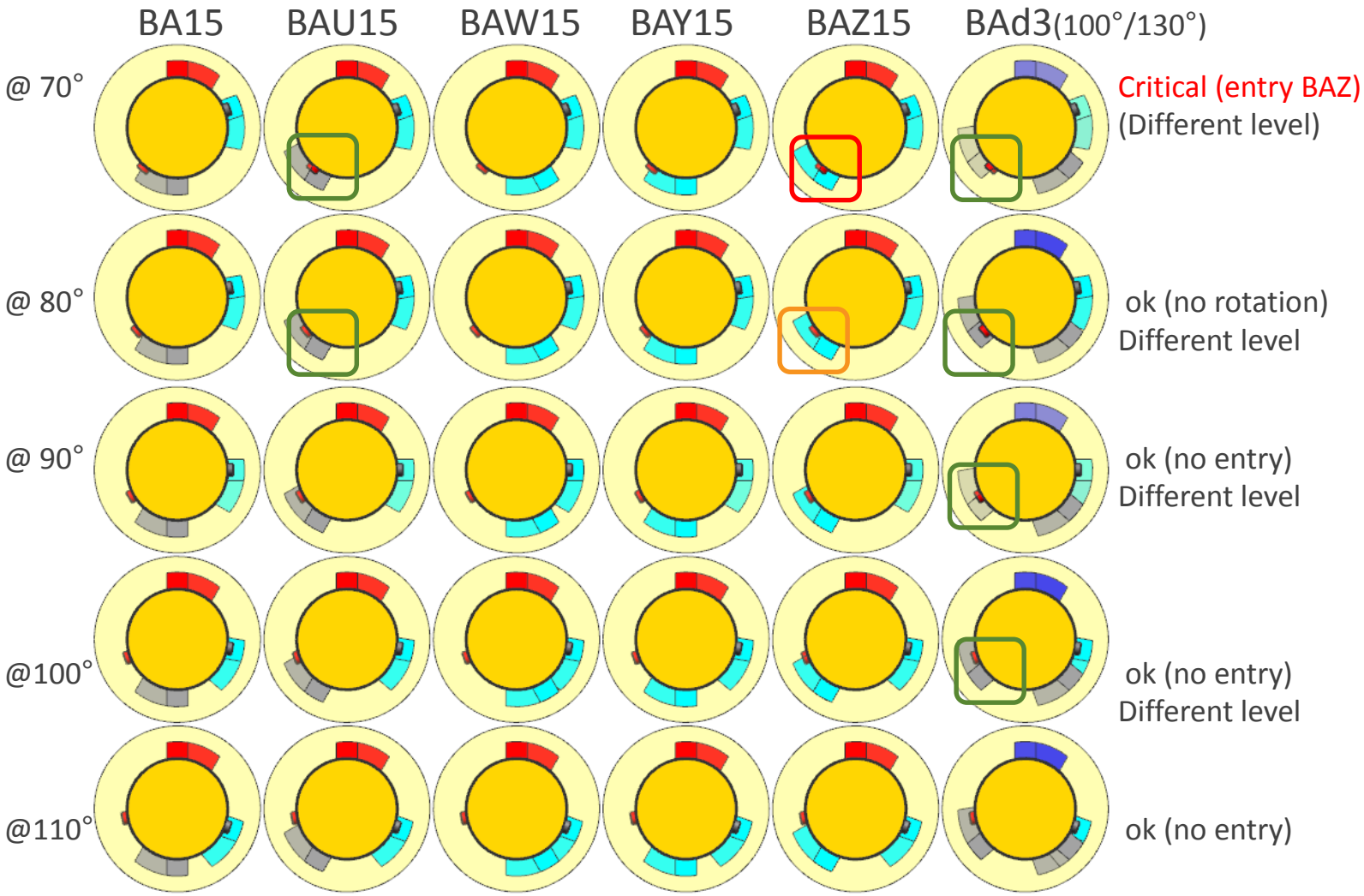
BAU15 - non-LED cap in **LED-**Holders

Ref-pin-Cap in new slot (B)



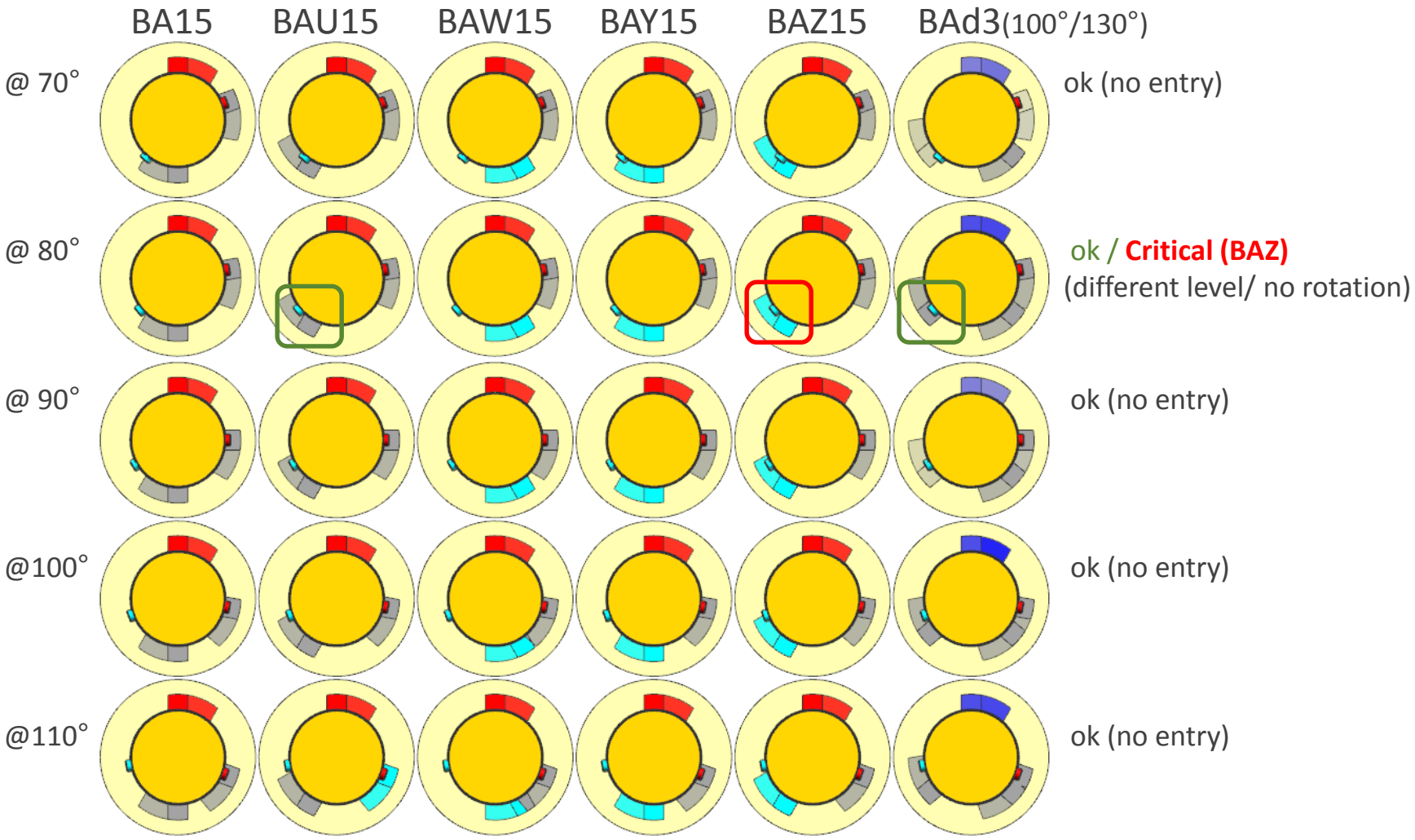
BAU15 - non-LED cap in **LED-**Holders

Non-Ref-pin-Cap in new slot (B)



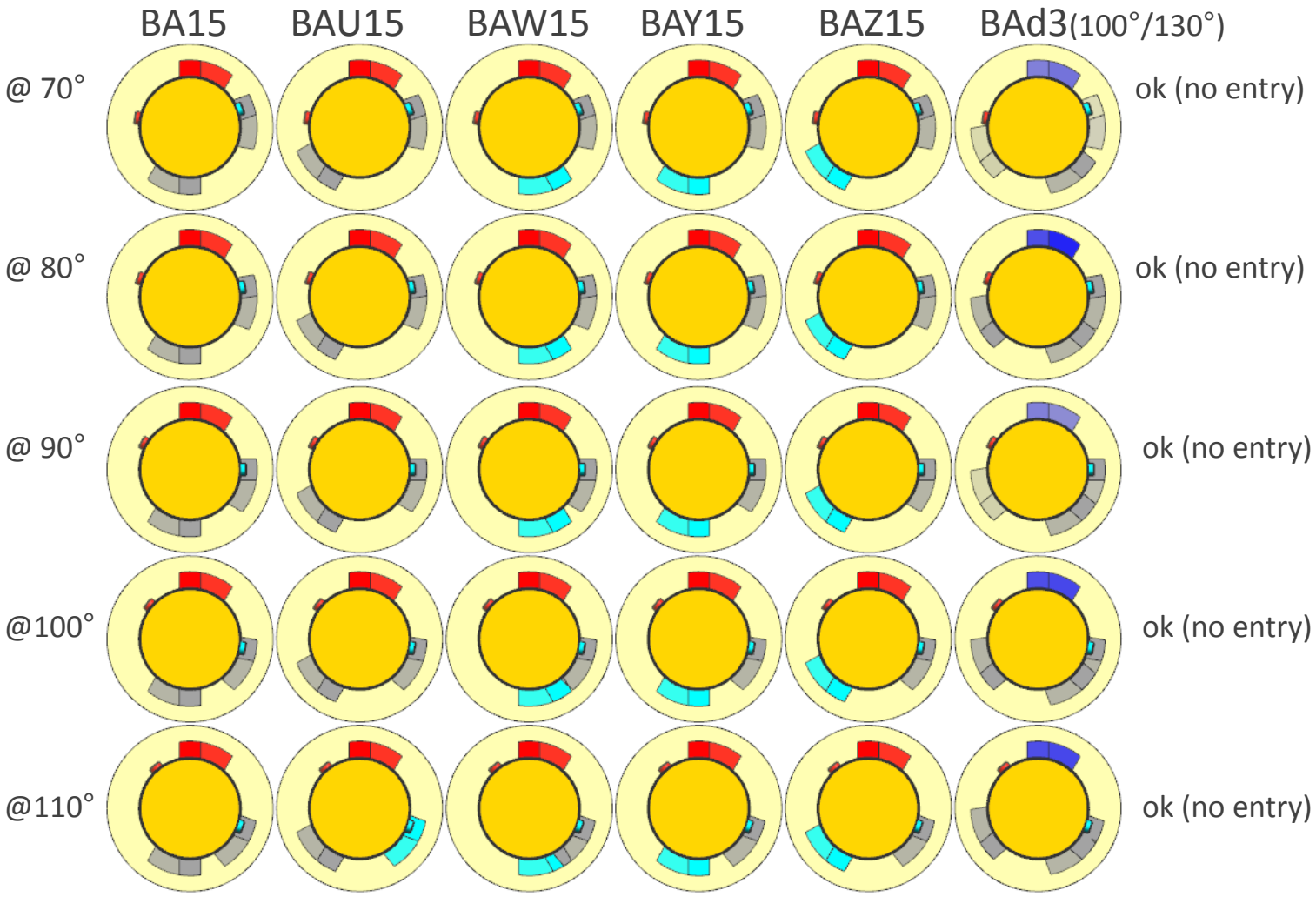
BAW15-LED-Holder v/s non-LED caps

Ref-pin-Cap in new slot (A)



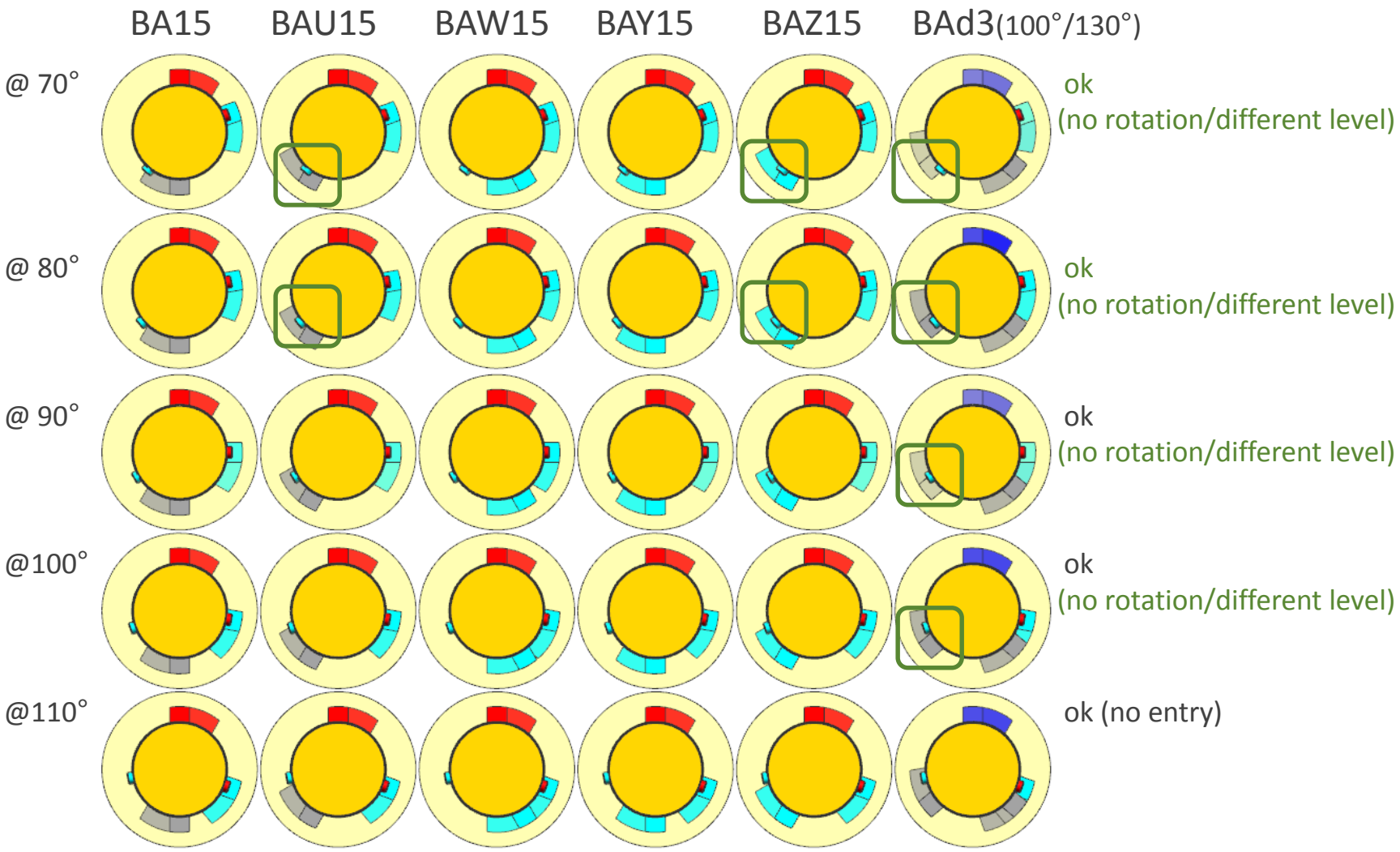
BAW15 - non-LED cap in **LED-**Holders

Non-Ref-pin-Cap in new slot (A)



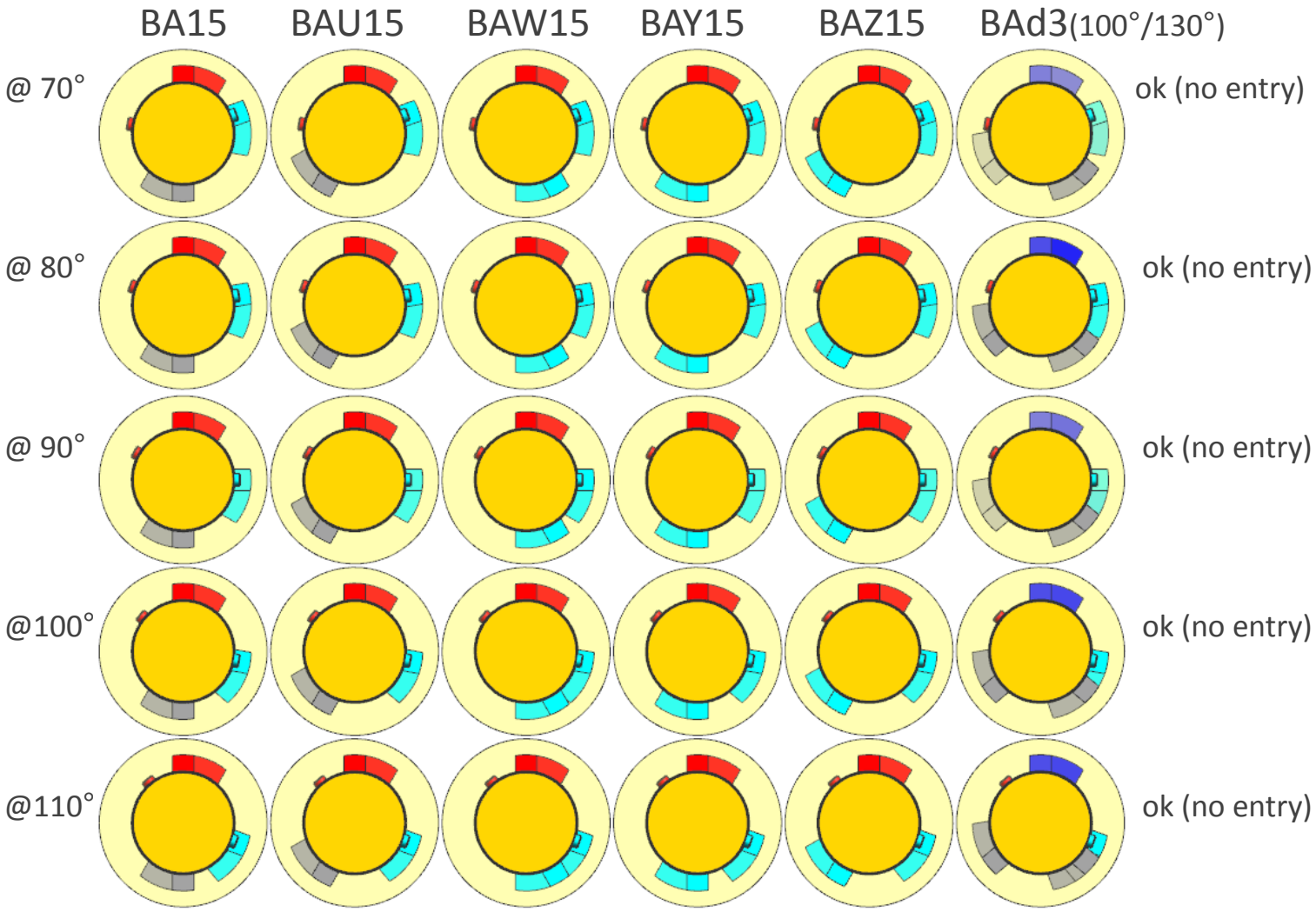
BAW15 - non-LED cap in **LED-**Holders

Ref-pin-Cap in new slot (B)



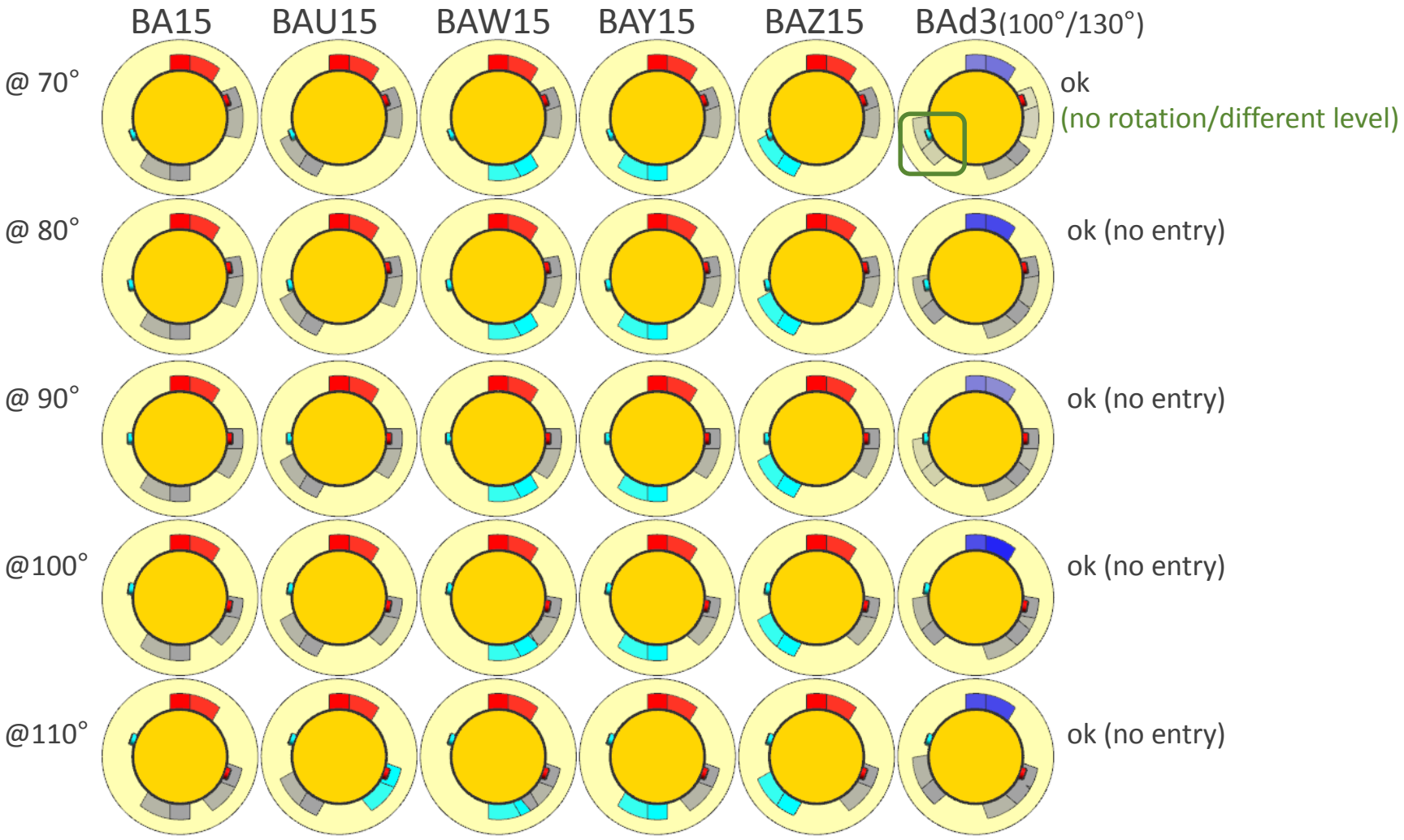
BAW15 - non-LED cap in LED-Holders

Non-Ref-pin-Cap in new slot (B)



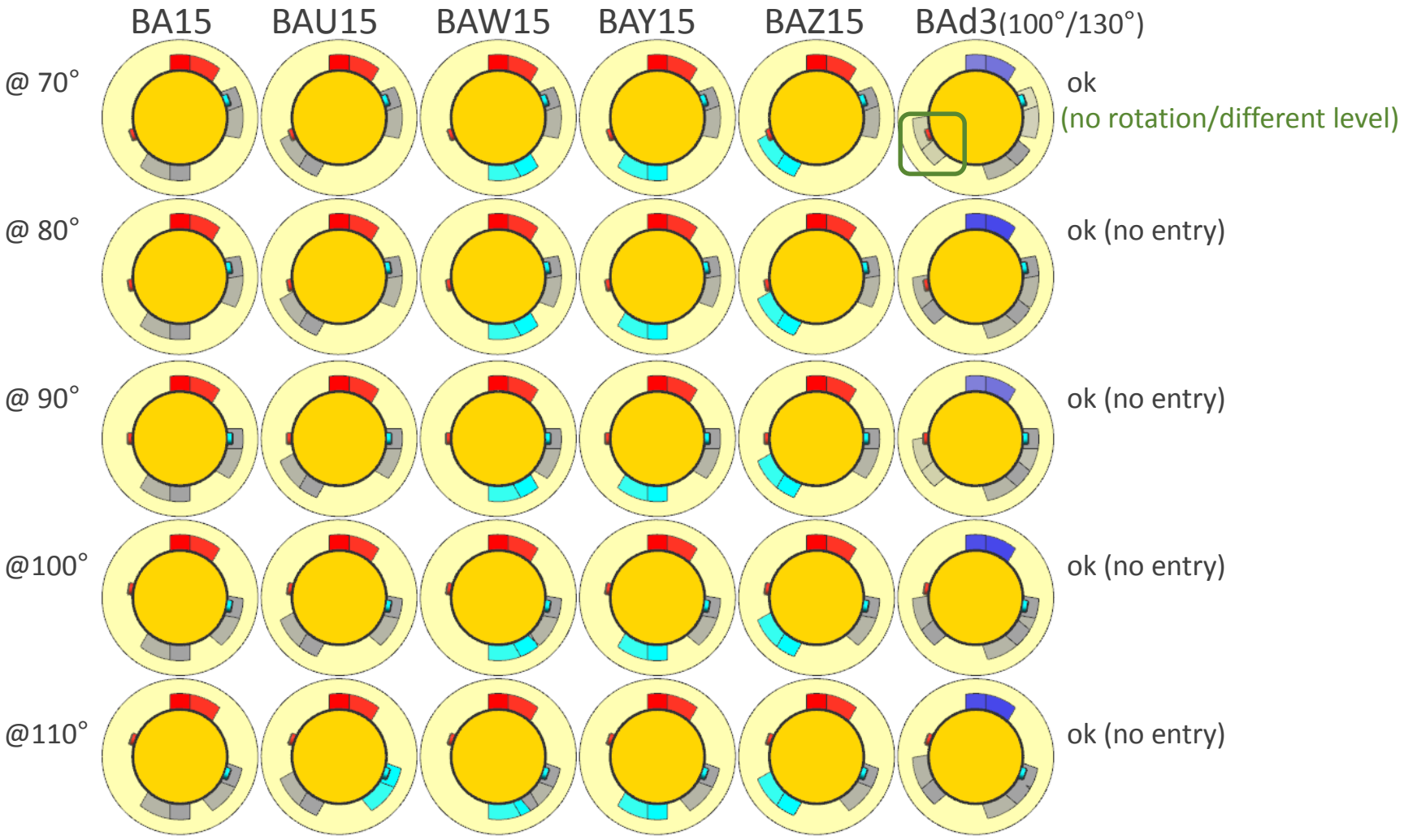
BAY15 - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (A)



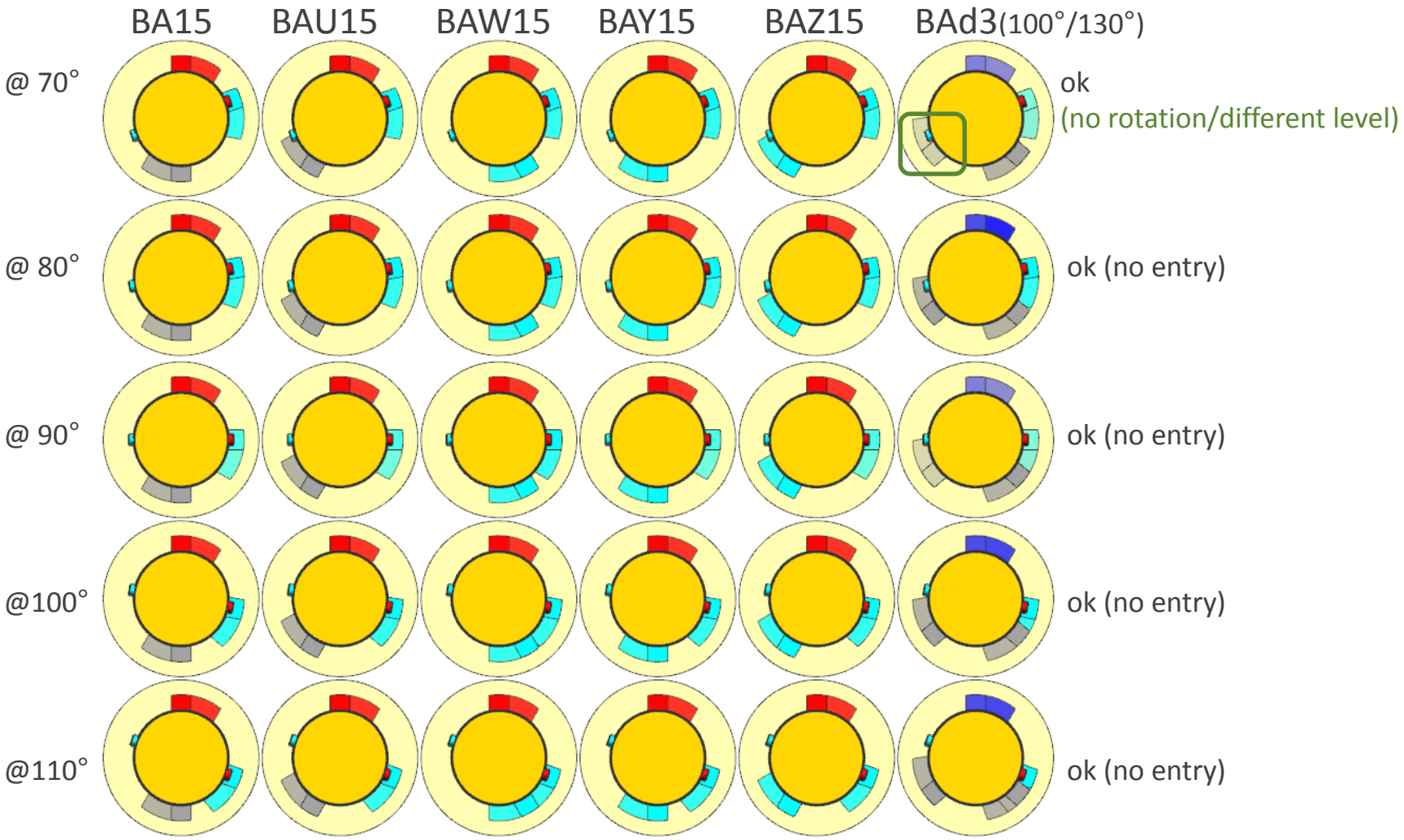
BAY15 - non-LED cap in LED-Holders

Non-Ref-pin-Cap in new slot (A)



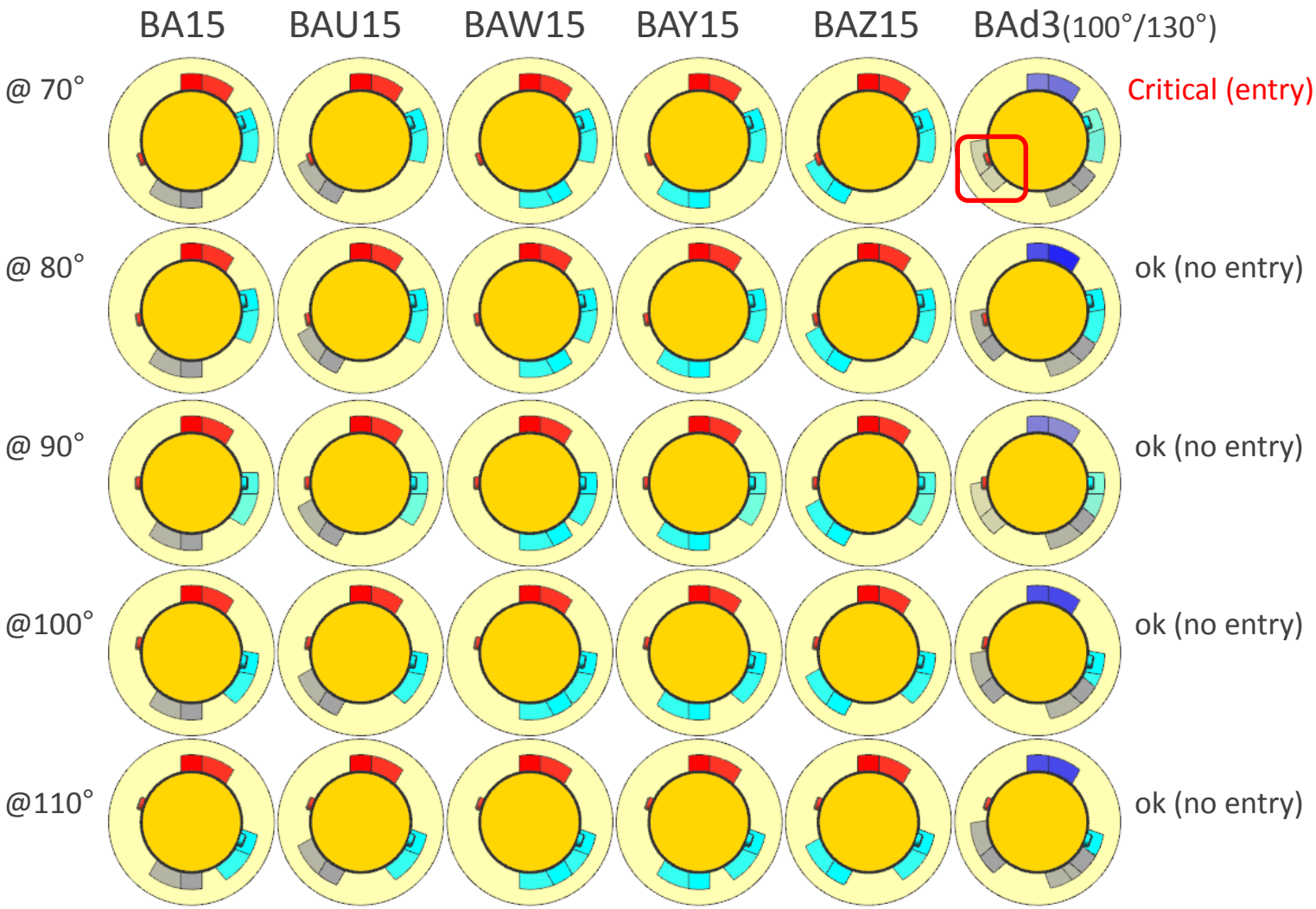
BAY15 - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (B)



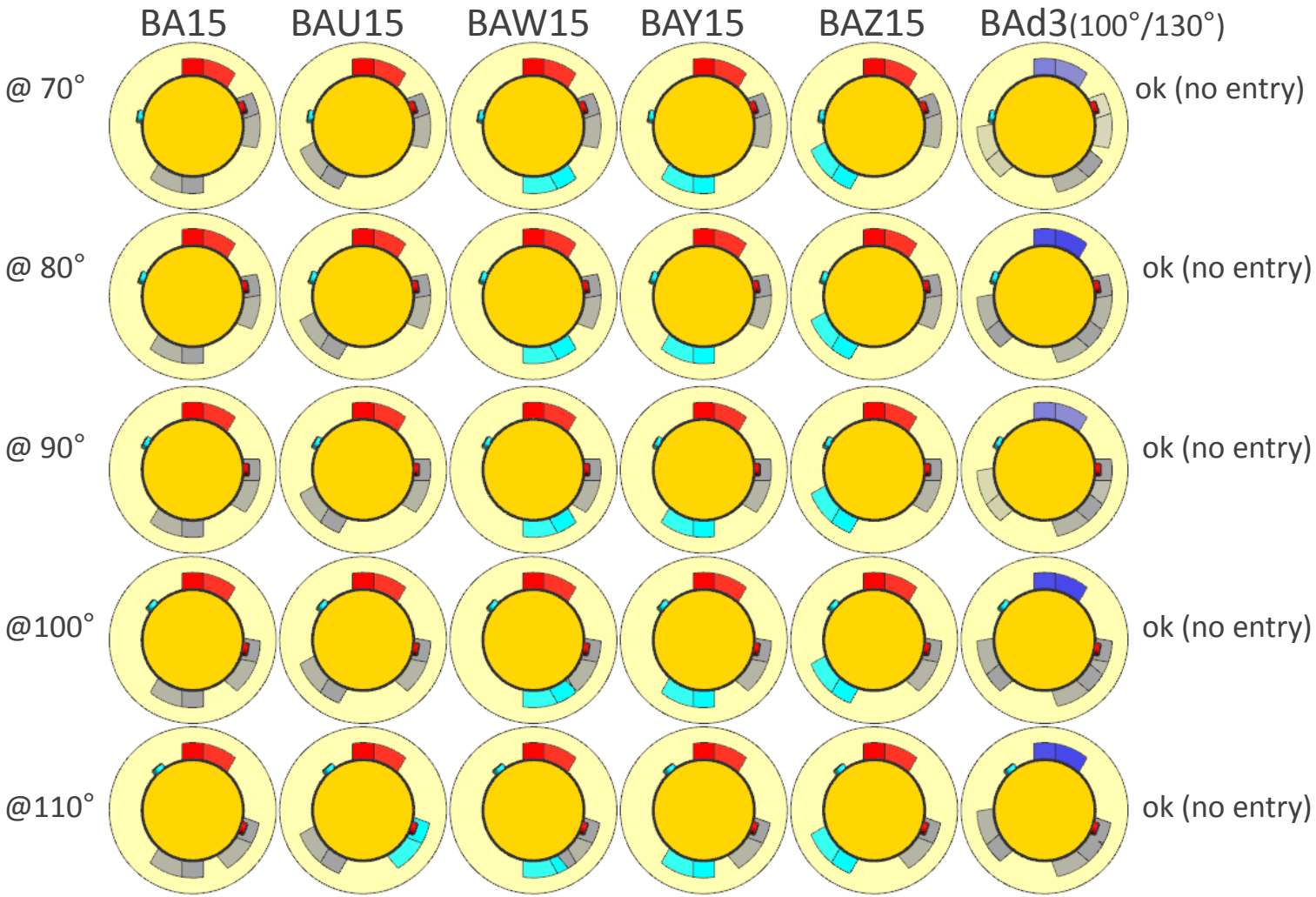
BAY15 - non-LED cap in LED-Holders

Non-Ref-pin-Cap in new slot (B)



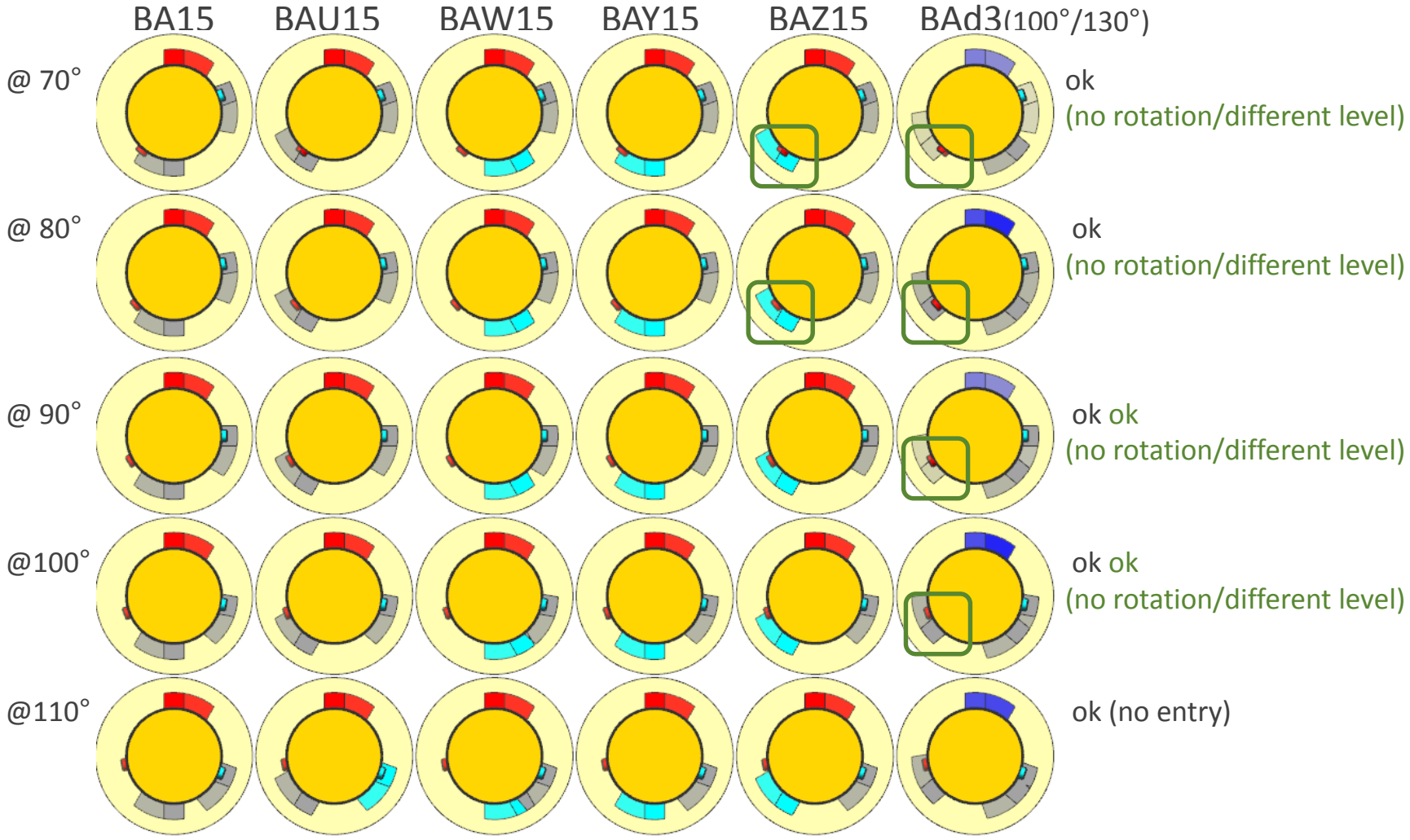
BAZ15 - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (A)



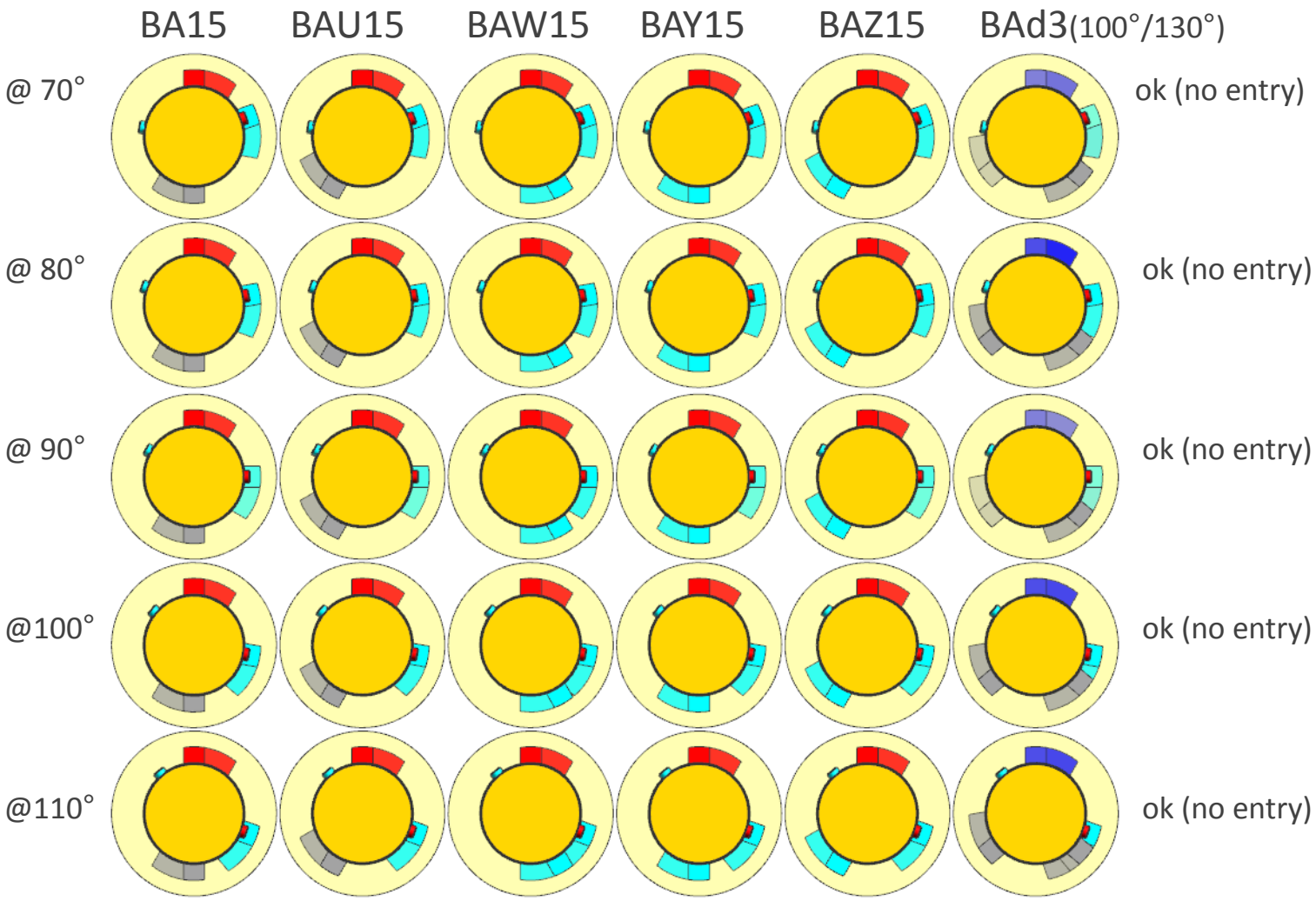
BAZ15 - non-LED cap in LED-Holders

Non-Ref-pin-Cap in new slot (A)



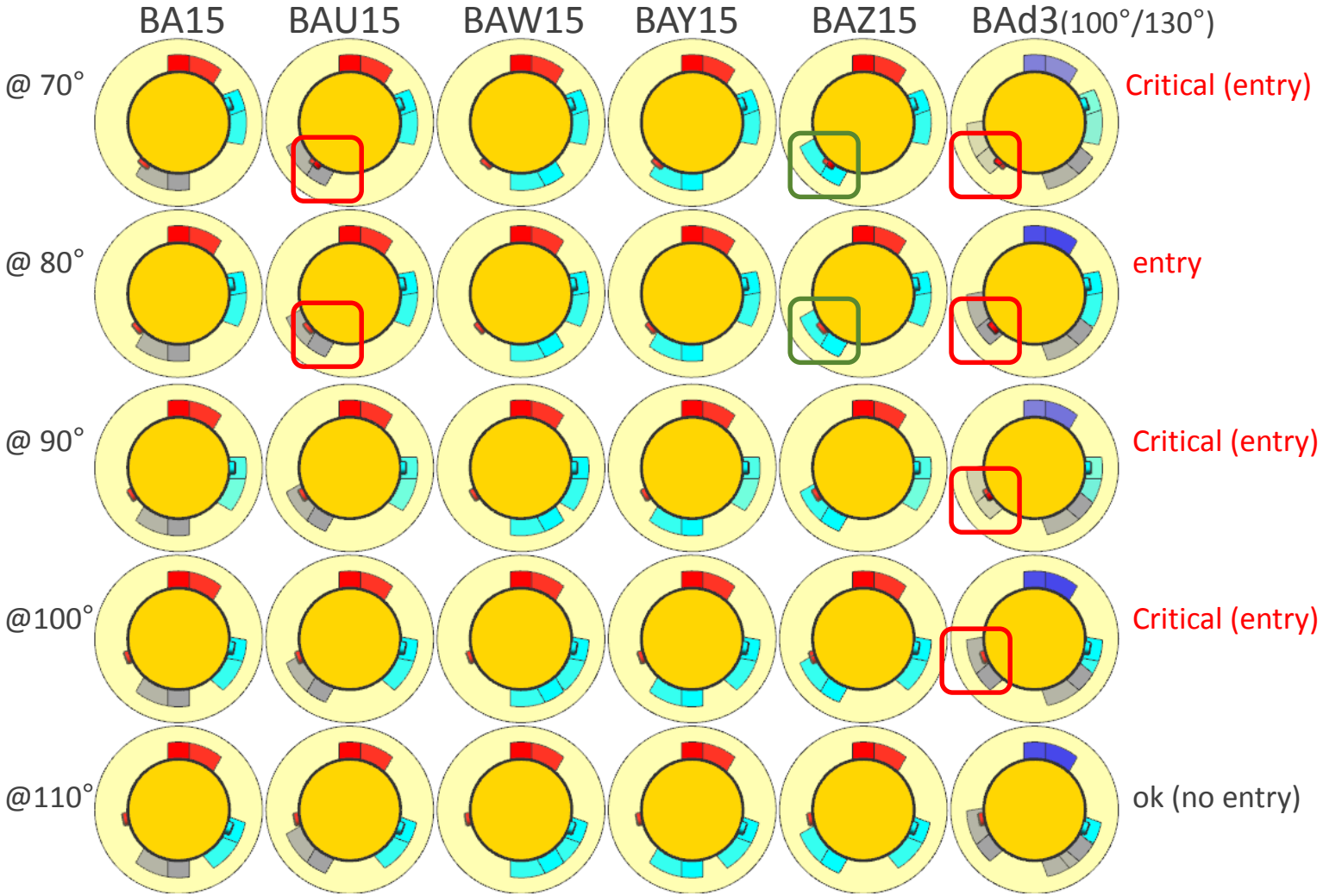
BAZ15 - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (B)



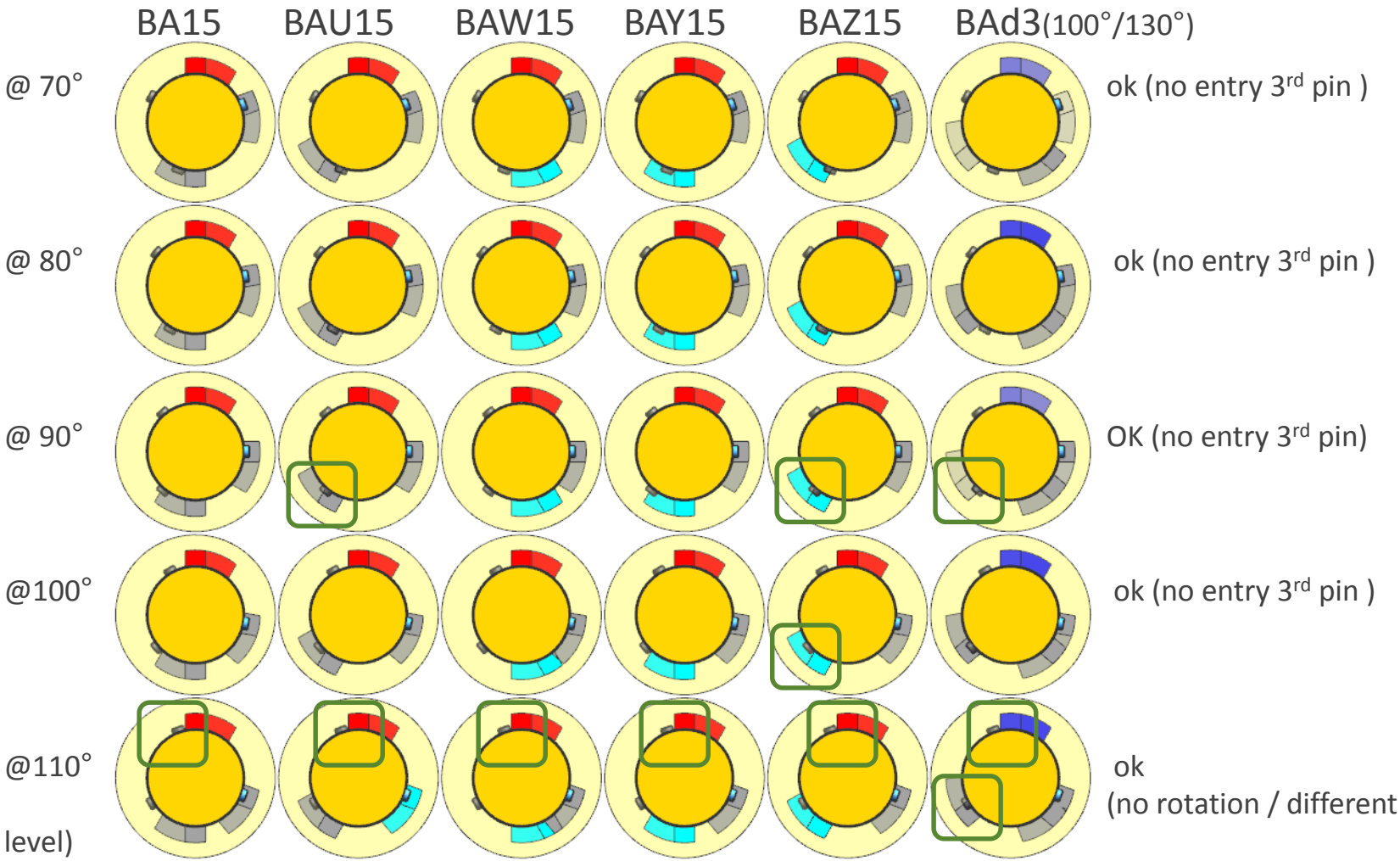
BAZ15 - non-LED cap in LED-Holders

Non-Ref-pin-Cap in new slot (B)



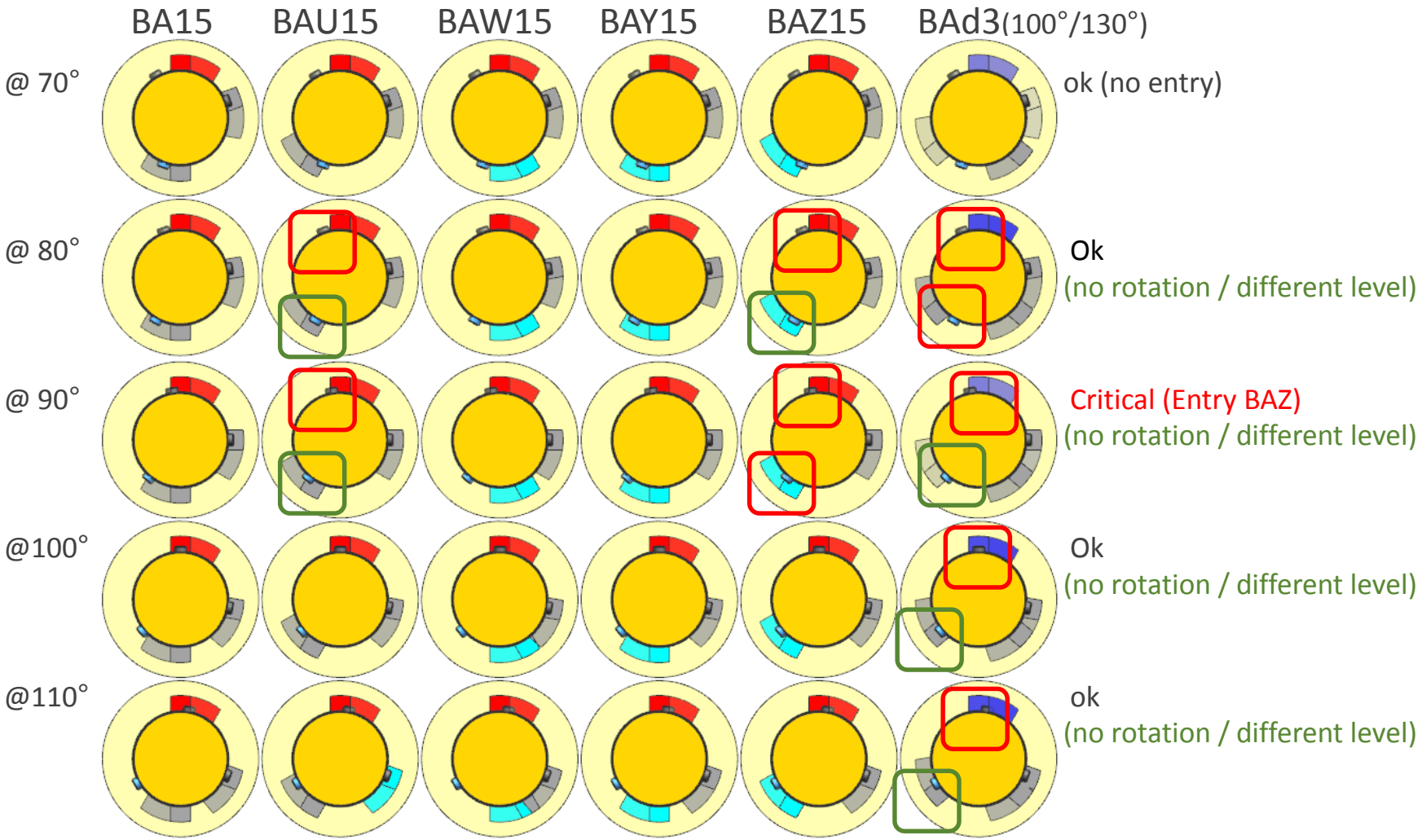
BA15d-3(100°/130°) - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (A)



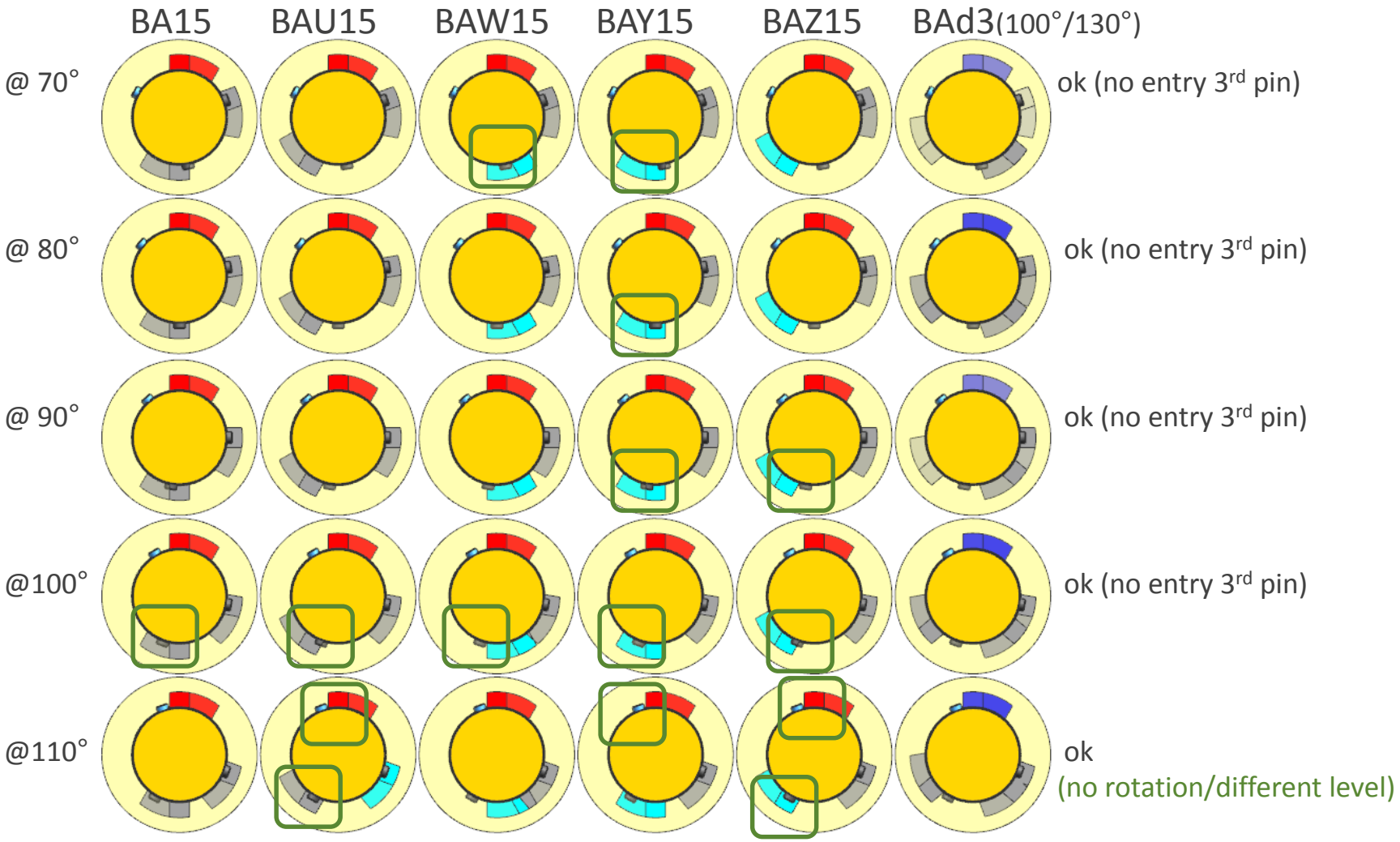
BA15d-3(100°/130°) - non-LED cap in LED-Holders

Non-Ref-pin(1)-Cap in new slot (A)



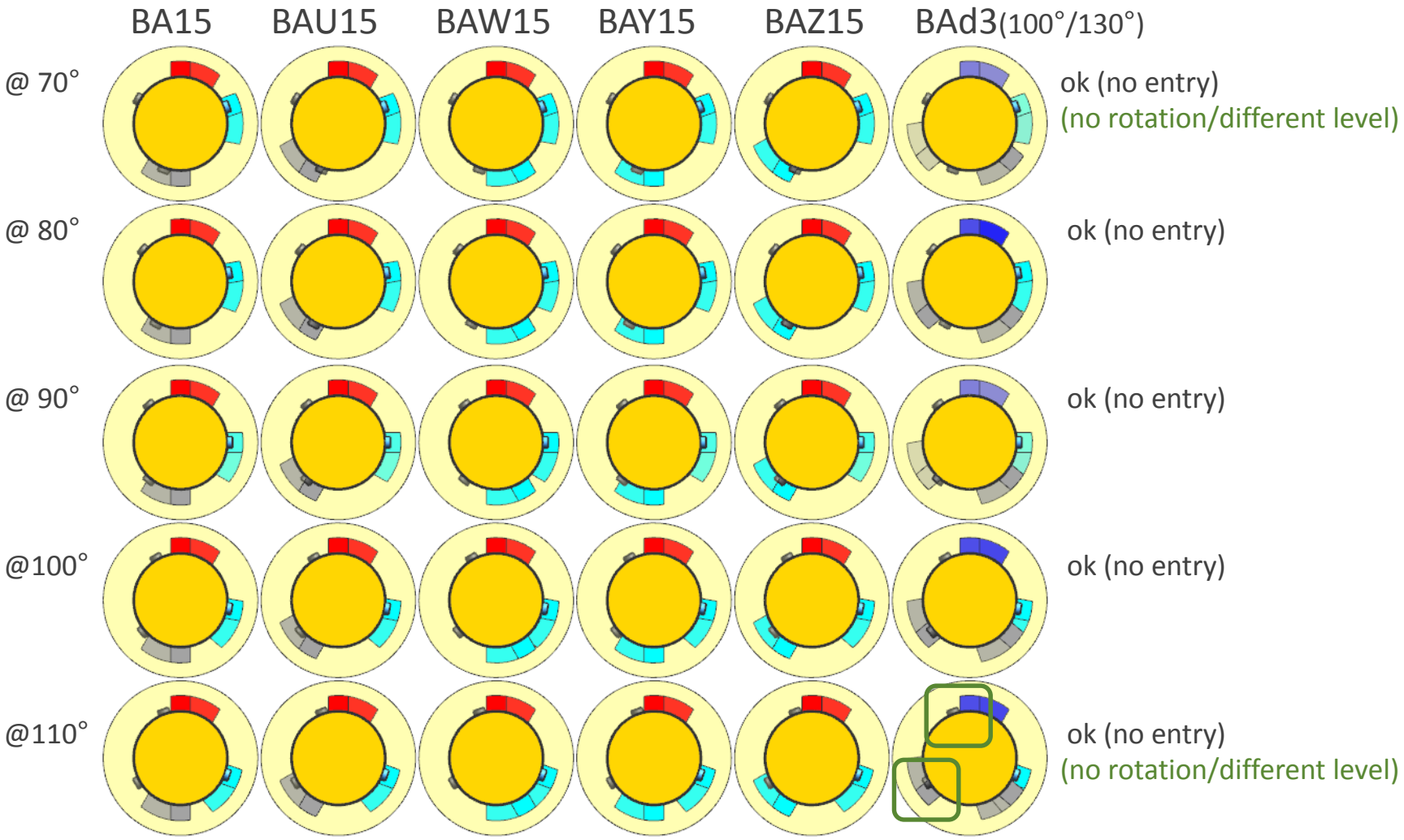
BA15d-3(100°/130°) - non-LED cap in LED-Holders

Non-Ref-pin(2)-Cap in new slot (A)



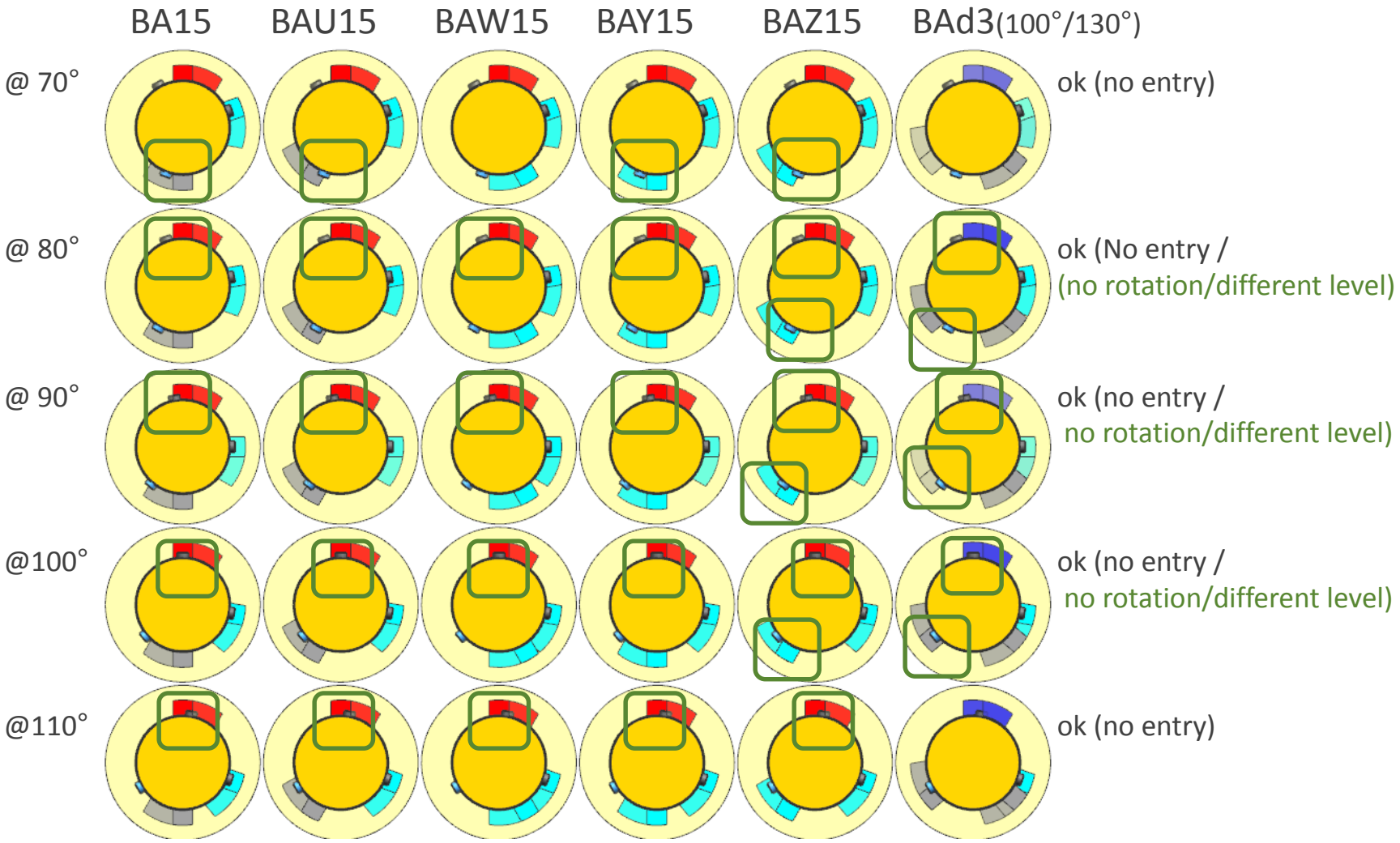
BA15d-3(100°/130°) - non-LED cap in LED-Holders

Ref-pin-Cap in new slot (B)



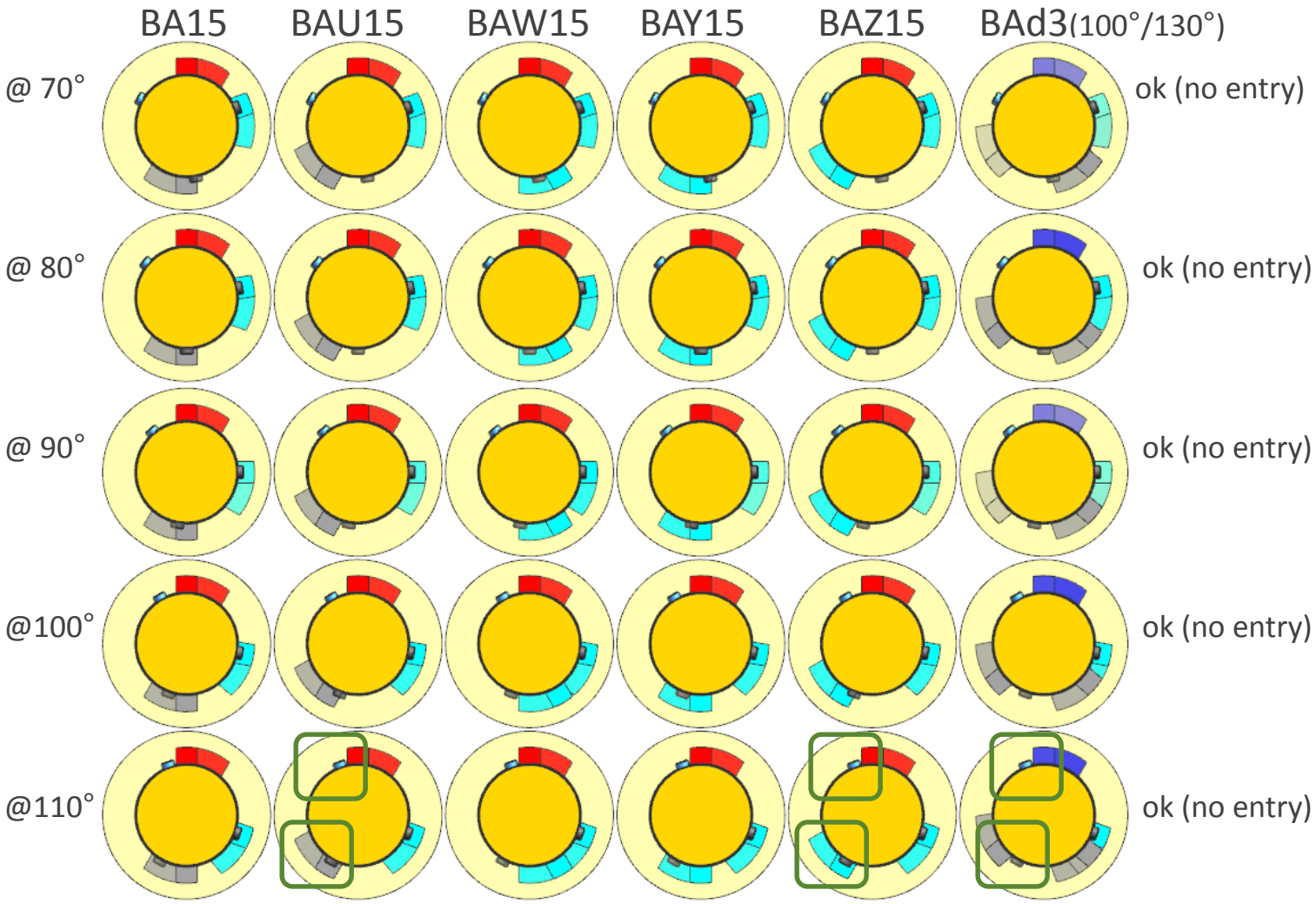
BA15d-3(100°/130°) - non-LED cap in LED-Holders

Non-Ref-pin(1)-Cap in new slot (B)



BA15d-3(100°/130°) - non-LED cap in LED-Holders

Non-Ref-pin(2)-Cap in new slot (B)



Compilation of result / preparing for conclusions

- On the following page a wrap up of the analyses showing:
  - If a single Non-LED-Source fits (or nearly fits) in a version of a not intended LED holder, the holder as such is deemed not suitable: This is marked in the table with a cross in the table 
  - This cross results in the exemption of a holder solution marked by a red column for the option in the holder (different in A position = pin at reference, and B position = pin at 3.2 axial position.

Summary evaluation: 70°, 80°, 90°, 100° and 110° extra key position

			Holders																										
			BA					BAU					BAW					BAY					BAZ					BA3				
			70°	80°	90°	100°	110°	70°	80°	90°	100°	110°	70°	80°	90°	100°	110°	70°	80°	90°	100°	110°	70°	80°	90°	100°	110°	70°	80°	90°	100°	110°
Caps (A)	BA15d/s	Pin Ref																										X				
		Pin No-Ref																										X				
	BAU15d/s	Pin Ref																														
		Pin No-Ref						X	X																			X	X	X	X	
	BAW15/d/s	Pin Ref																						X								
		Pin No-Ref																														
	BAY15d/s	Pin Ref																														
		Pin No-Ref																														
	BAZ15d/s	Pin Ref																														
		Pin No-Ref																														
	BA15d-3 (100°/130°)	Pin Ref																														
		Pin No-Ref 1																														
		Pin No-Ref 2																							X							
Caps (B)	BA15d/s	Pin Ref																														
		Pin No-Ref																														
	BAU15d/s	Pin Ref																														
		Pin No-Ref																					X	X								
	BAW15/d/s	Pin Ref																														
		Pin No-Ref																														
	BAY15d/s	Pin Ref																														
		Pin No-Ref																										X				
	BAZ15d/s	Pin Ref																														
		Pin No-Ref						X	X																			X	X	X		
	BA15d-3 (100°/130°)	Pin Ref																														
		Pin No-Ref 1																														
		Pin No-Ref 2																														

Conclusion1: Common 90° position for BA15, BAU15, BAW15 and BAY (on reference axial positions)
Conclusion2: Common 90° for BA15, BAU15, BAW15, and BAY and BAZ (on 2nd axial positions)
Conclusion 3: Common 100° position for BA15, BAU15, BAW15, BAY and BAZ (on both Axial positions)
Conclusion 4: No feasibility for BA15d-3

Alternative 1

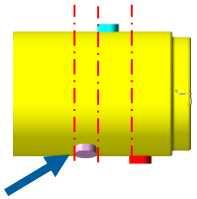
New pin above current level used for 2nd pin in BAY, BAZ and BAW system; within the 17 mm shell length

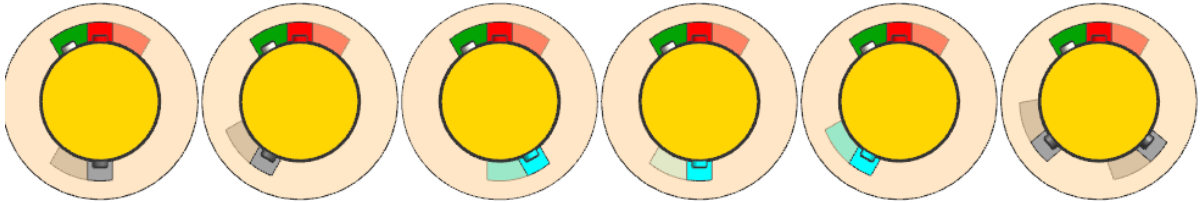
Requiring

→elevated holder

→Extended dimensional shell specification (increase of dimension “h” in the cap)

The option
A - New pin @-30°

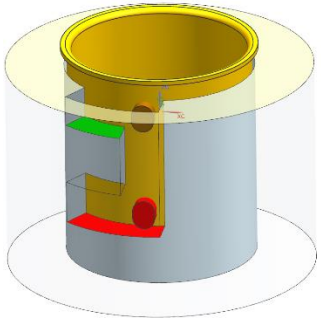




(seen not feasible for all combinations (see next pages)

- B - New Pin @ 0°

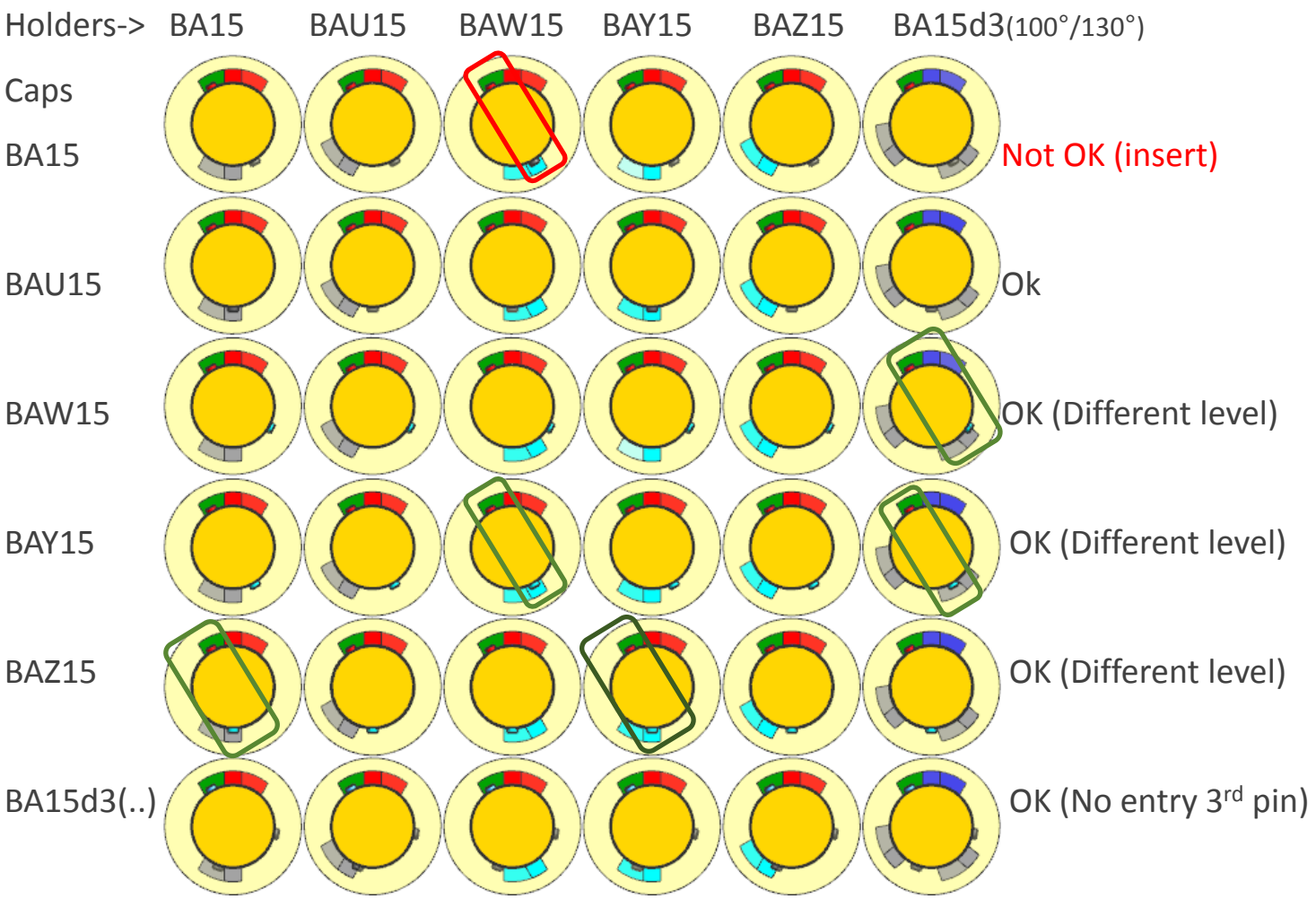
  This version “B” is to enable all versions:



- With an single new pin
- without conflicts of non intended insertions of non-LED sources

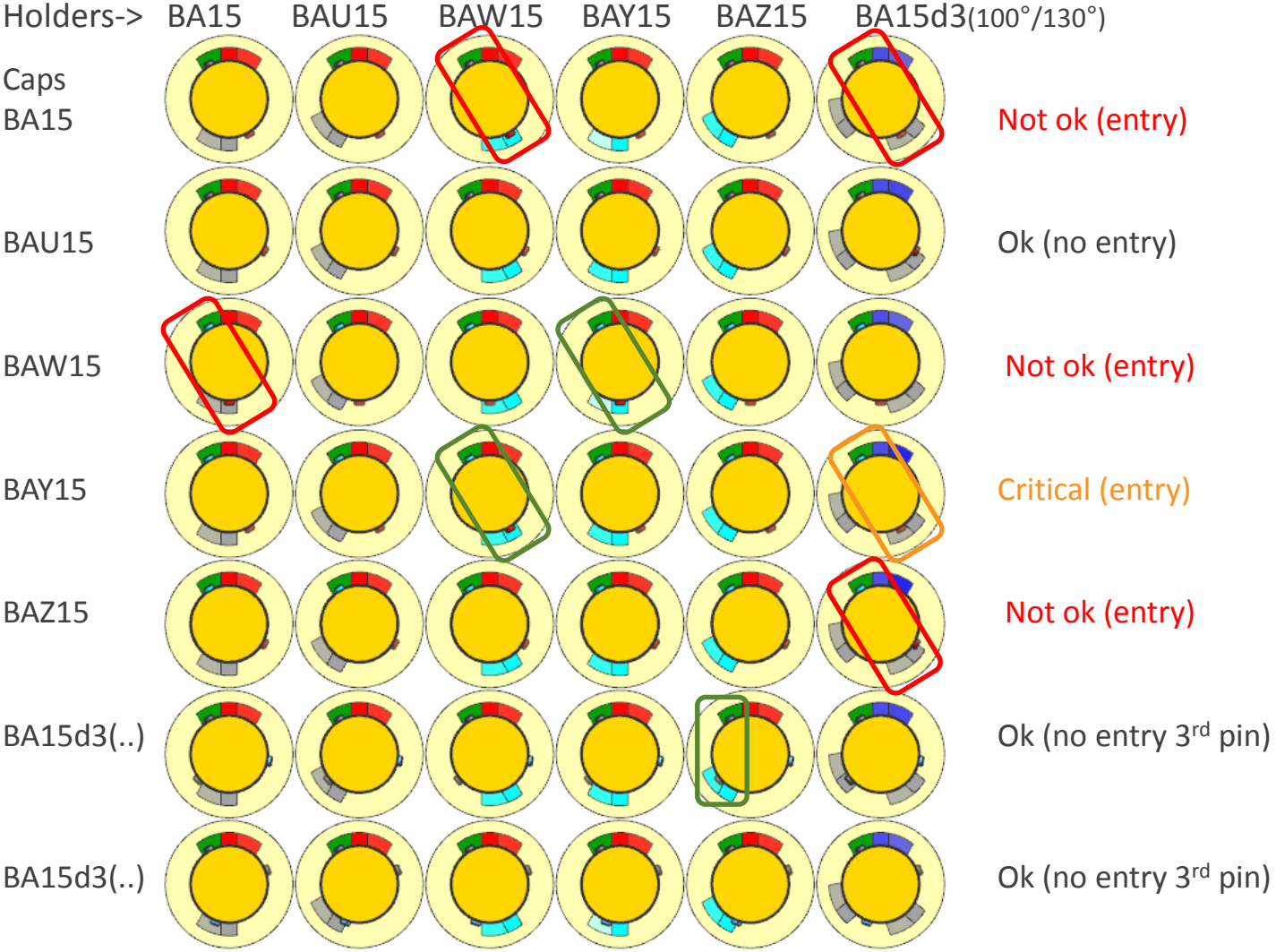
Alternative 1a (-30°) Evaluation Elevated holder rim

(ref-pin in at position -30°)



Alternative 1a (-30°) Evaluation Elevated holder rim

(non-ref-pin at position -30)



Conclusions for PY21W5-case (cap / holder BAU15s)

The options related to an extra key-pin on the cap shell:

1. The BAU15s fit can have an extra key-pin:
   a) Between 90°and 110° (axial pin position at 3,2mm from reference),
   b) Between 100° and 110° (pin position at axial reference),
   c) At -30° (pin position 3.2mm from reference)
2. New 3rd axial position >5mm above the reference pin with additional holder conditions.

Option related to an extra contact for LED-operation

1. Creating a 2nd contact based on BAU15s is considered **impossible** due to distance between the contacts.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