Well Intercept

ISCWSA #60 - New Orleans, Louisiana, USA
Active Magnetic Ranging from Bottom Hole Assembly

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Outline

- AMR basics
- Tool build
- Test site
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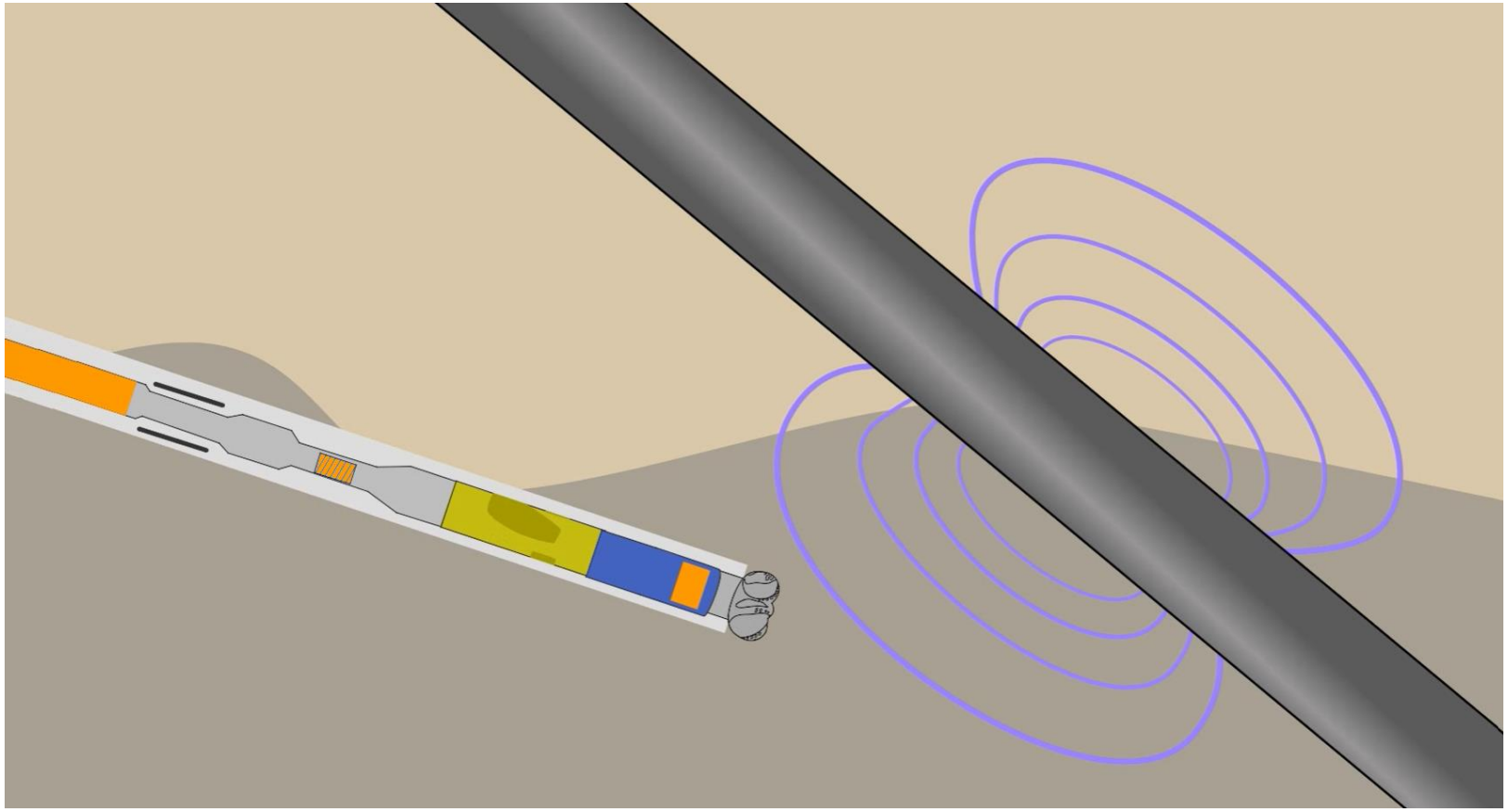
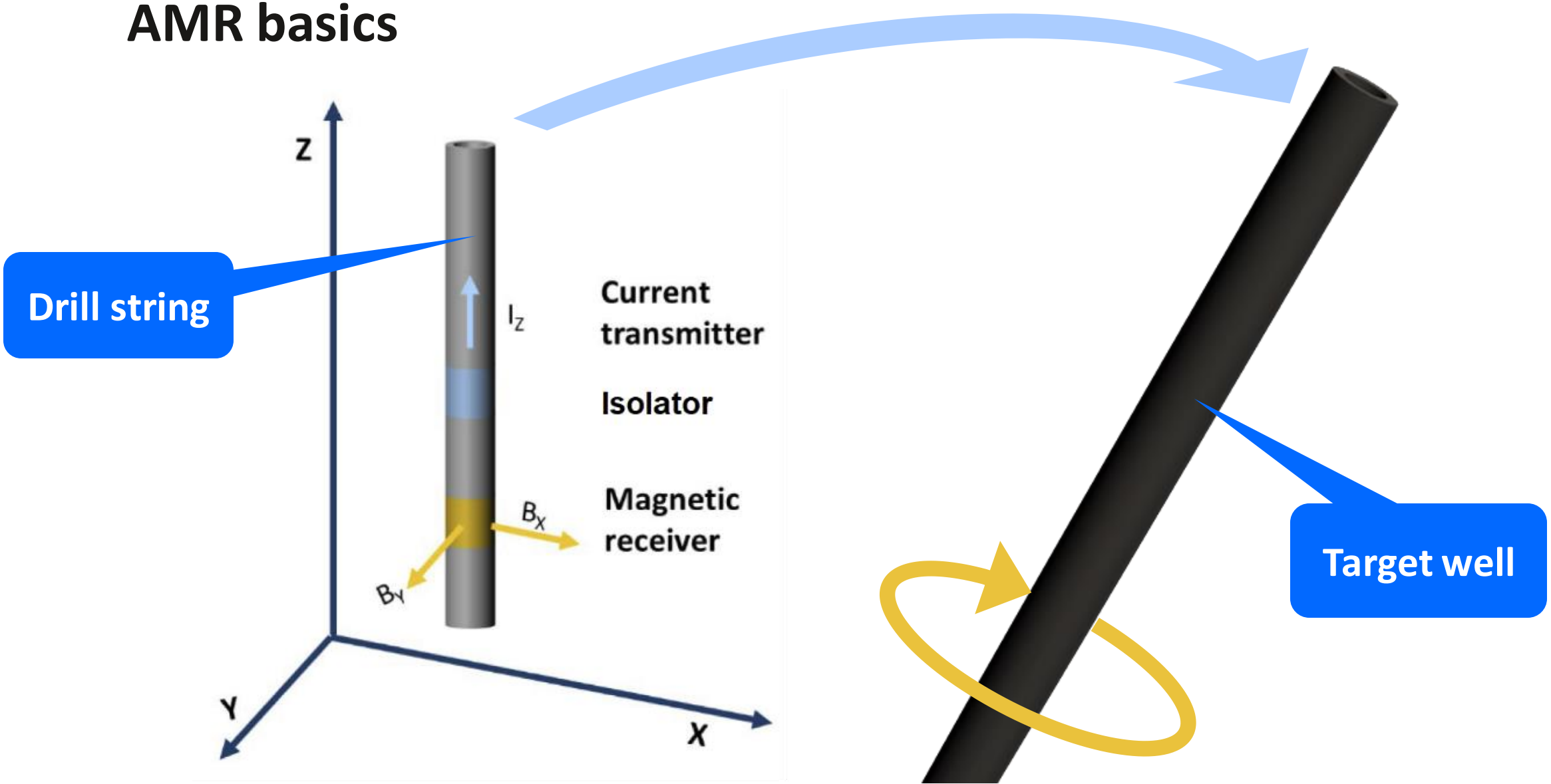
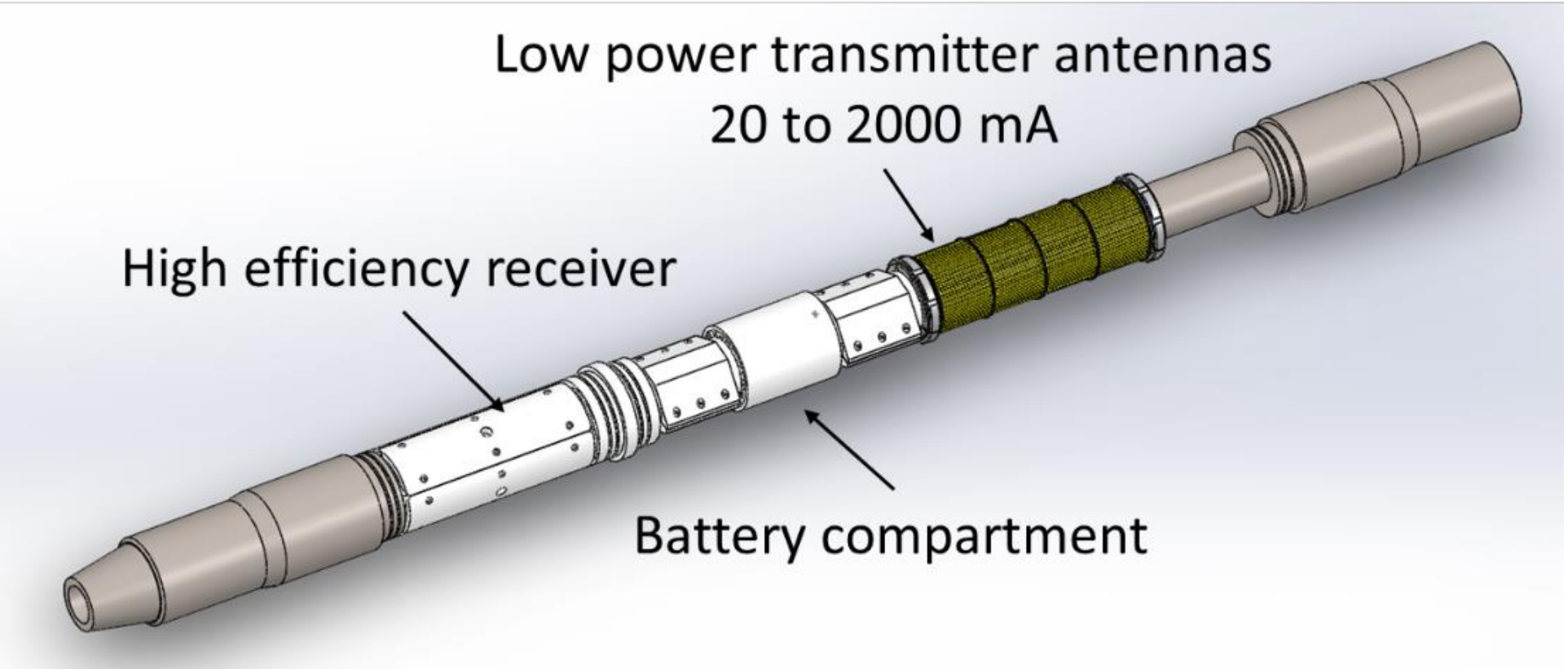
- Tool performance
- Receiver noise level
- Tool improvements
- Conclusion



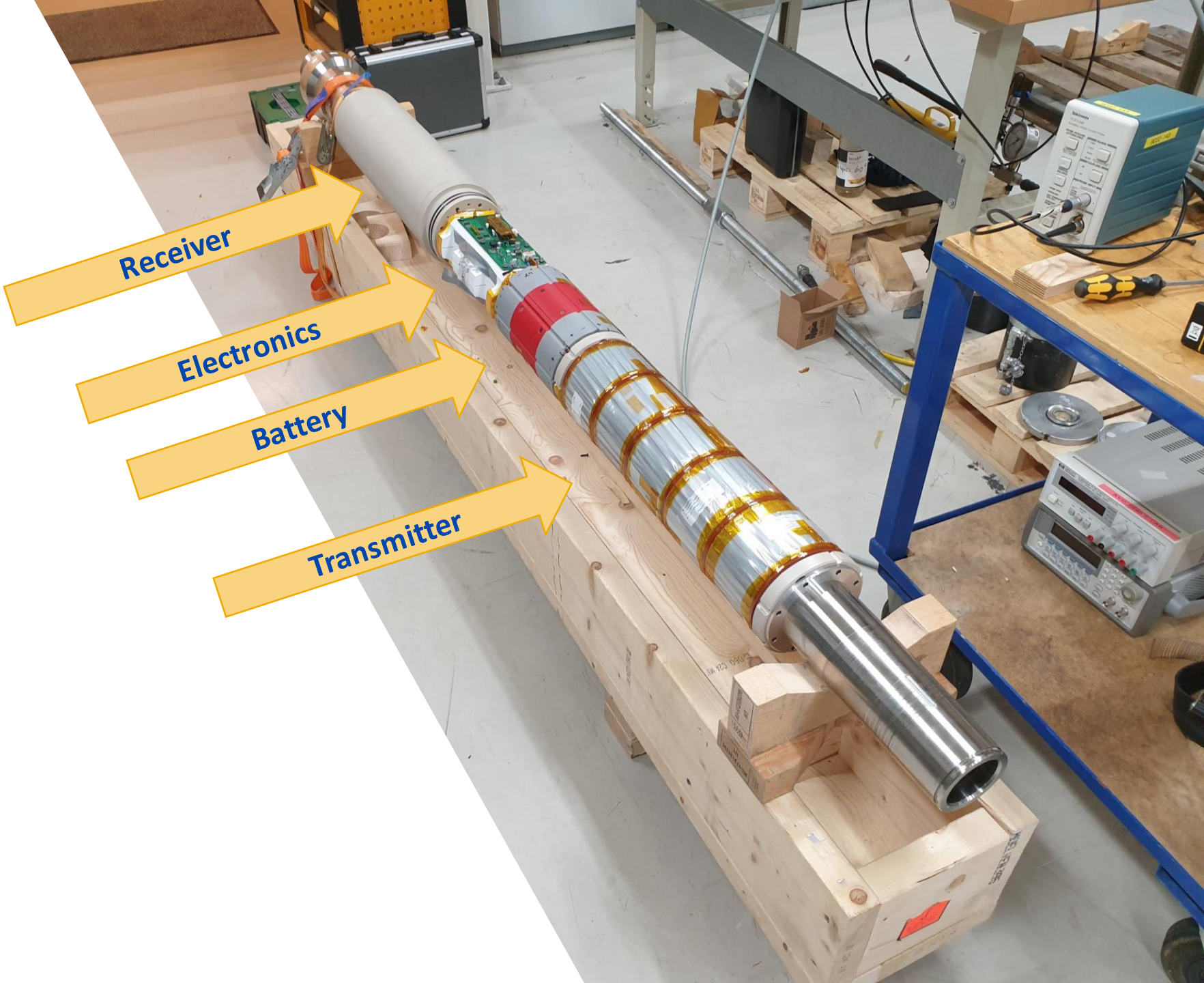
AMR basics


Drill string
Z
I_Z
Current transmitter
Isolator
B_X
Magnetic receiver
B_Y
Y
X
Target well

AMR tool prototype build
Transmitter TX and receiver RX closly positioned



AMR tool prototype build



Test site
X-rig at Ålgård, Stavanger

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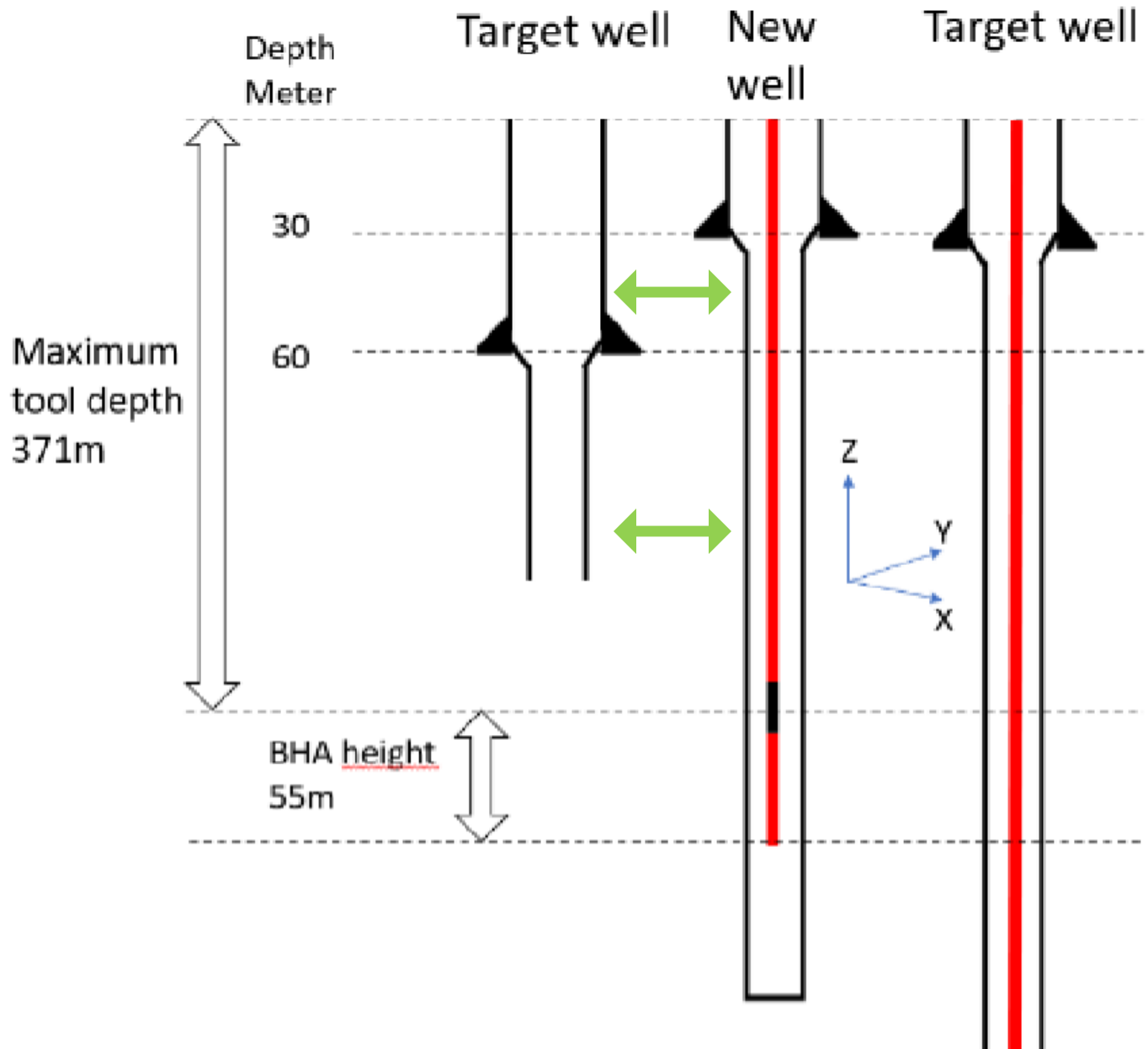
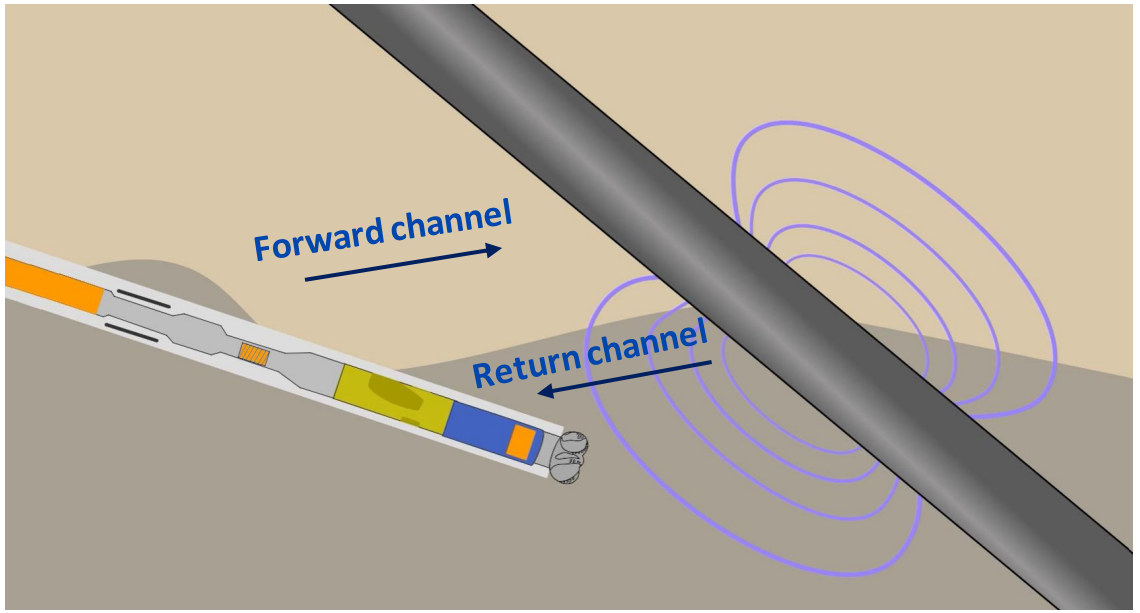


Tool performance
Range calculations

$$\underbrace{k_{fwd}(R_T)}_{\text{Forward channel}}\underbrace{k_{ret}\frac{R_0}{R_T}}_{\text{Return channel}}$$



$$R_T(n+1) \approx \frac{\Gamma_0}{\Gamma_T} R_0 k_{fwd}\big(R_T(n)\big) k_{ret}$$

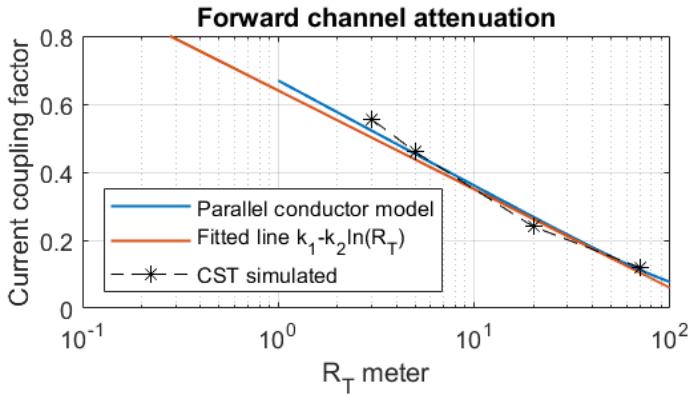
Reqursive equation for range

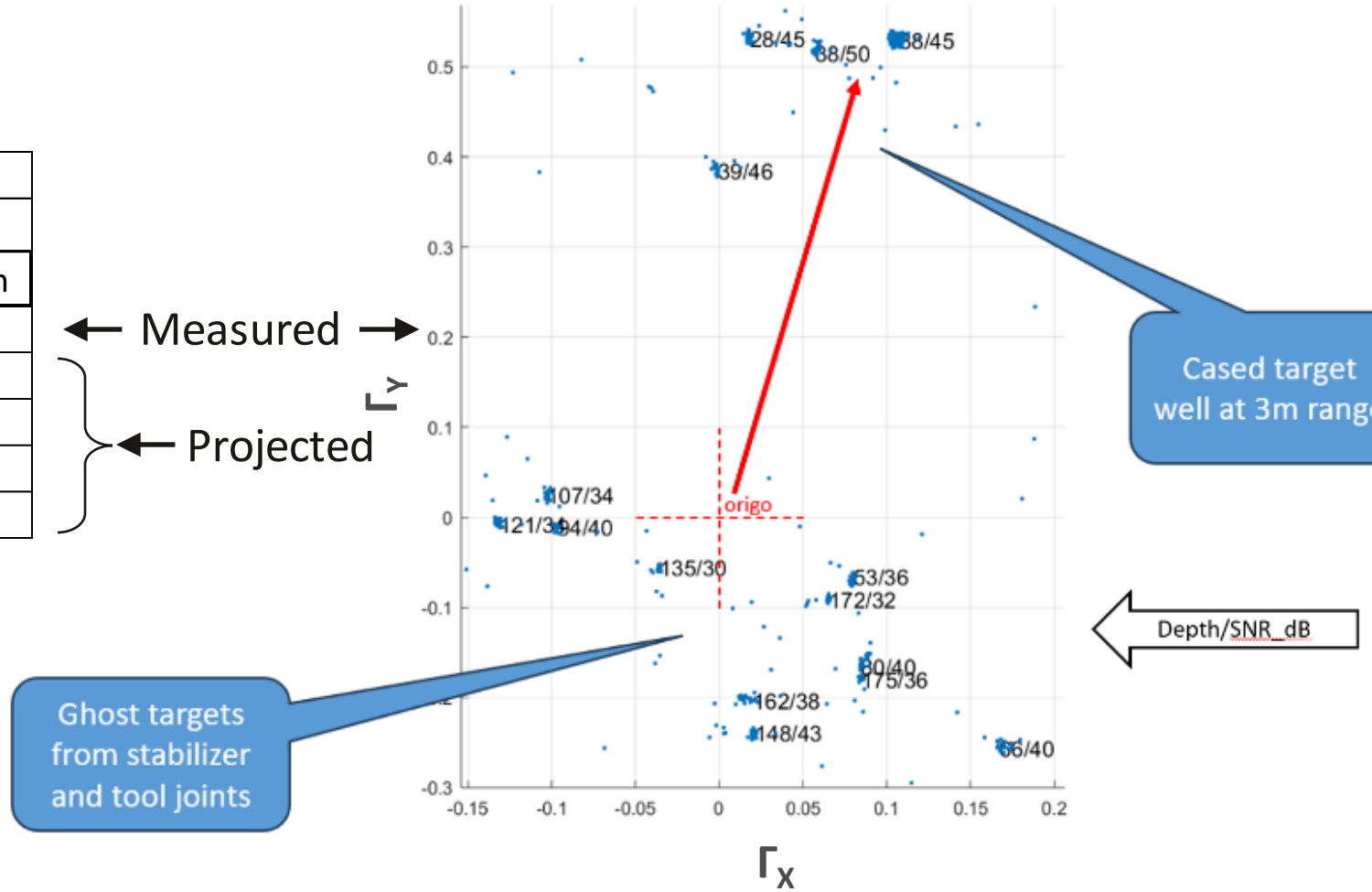
Tool performance at Ålgård, Stavanger

Transmitter	0,05	A @ X-Rig		
RX Noise	7,1E-06	A/m @ T_i = 3s		
SNR dB	k_{fwd}	Target A	RX A/m	Range m
47	0,6	0,030	1,59E-03	3
32	0,35	0,018	2,79E-04	10
17	0,2	0,010	5,31E-05	30
11	0,15	0,008	2,39E-05	50
4	0,1	0,005	1,14E-05	70

← Measured →

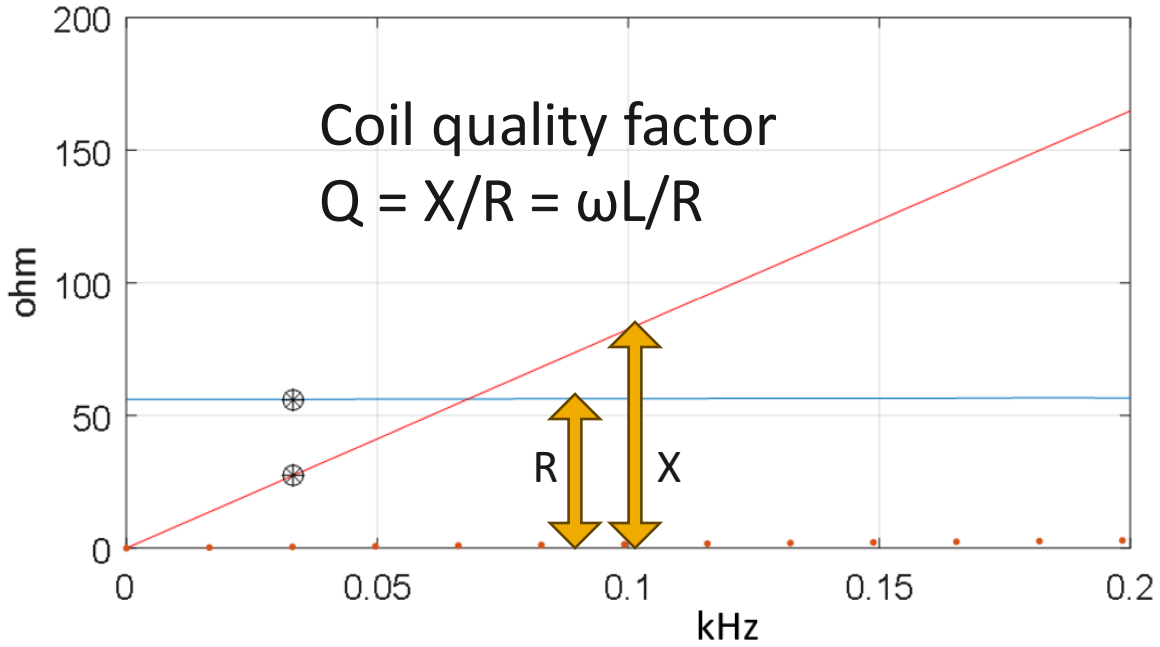
← Projected





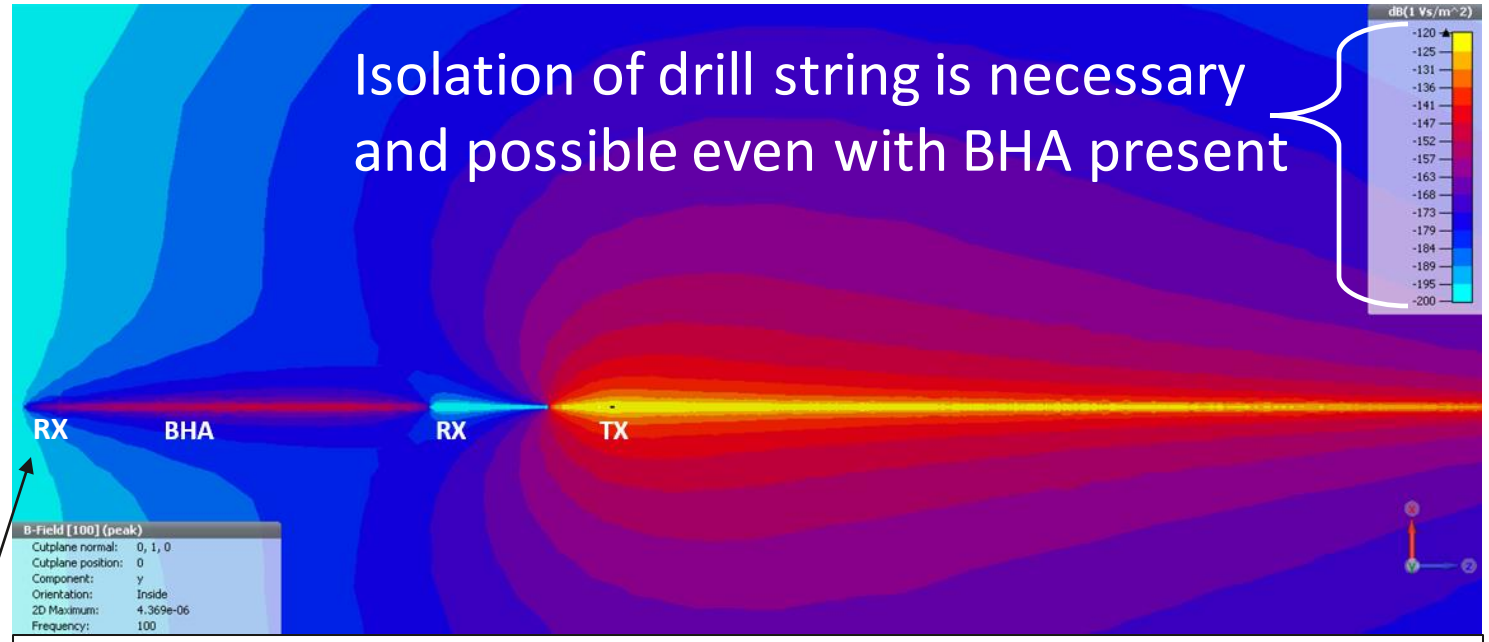
Receiver noise level

- High Q-factor receiver coils
  - A lot of copper
  - Large antenna aperture
- Low noise amplifiers
- Long integration time (3s)
- RMS receiver magnetic noise 7.1 µA/m i.e. 9pT



Neccesary tool improvements

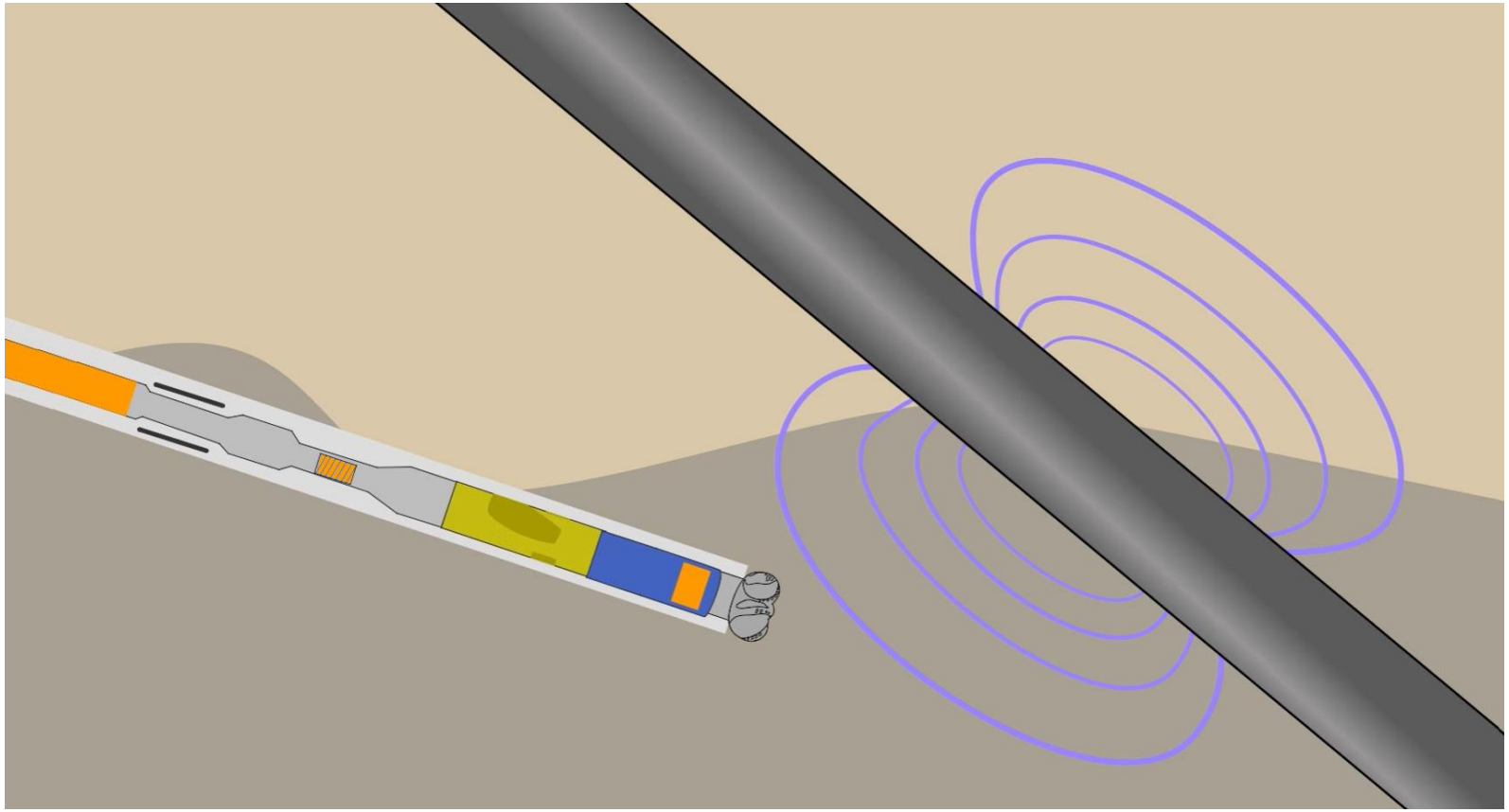
- Any strong EM field from transmitter TX can generate false targets if present at receiver RX position
- At least 40 dB noise suppression is needed in the vicinity of the RX position
- Even higher suppression is available when using multiple isolators on the drill string
- In this case Access-Independent AMR tools will performe equally well at pipes than at wireline
- Adequate suppression is also found for a receiver at the bit position



Magnetic field from transmitter TX without any target present

Conclusion

- Cost effective AMR on drill string is feasible
- Well intercept and collision avoidance from AMR tools on BHA can be compared to tools on wireline
- Inhomogeneous formation may limit the maximum ranging distance somewhat less than 70 m



Thank You for listening
Questions?

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