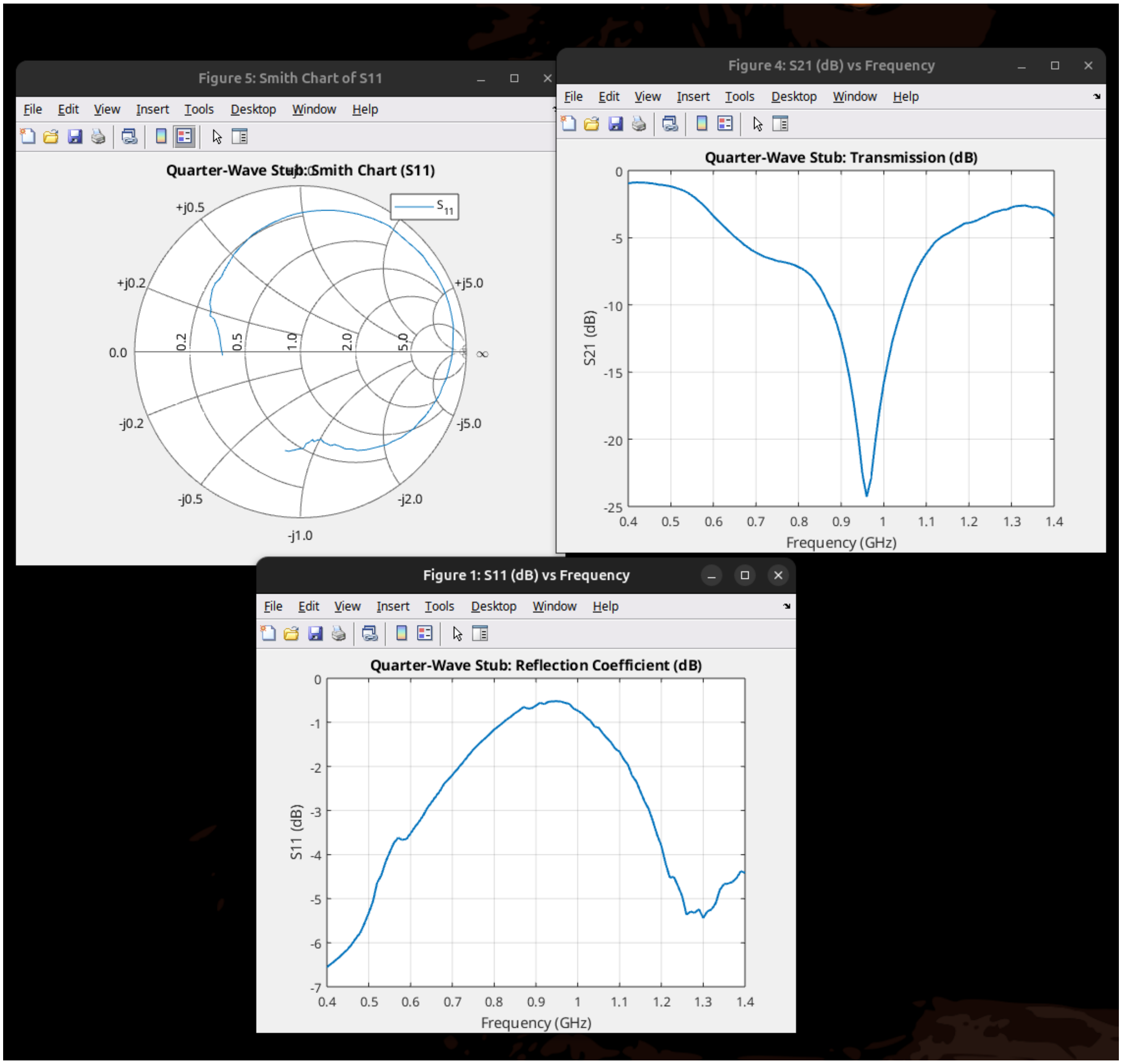
Lab 2:

1. **See the simulation results on the previous slide. How do these results relate to the absorbed and/or reflected power?**
   At 1ghz the quarter wavelength stub behavior is exactly lambda/4, for the open circuited stub this means that Zin=Z0^2/ZL, since ZL is infinite due to being open circuit, impedance becomes **zero**. (short circuit at main line). **Max current flow reflected power minimized**. So max power transfer.

   At 500Mhz the stub length is not quarter of wavelength its lambda/8. Does not transform impedance desired, result is **higher reflection** and less current flow (poor matching).

- 500 MHz → Poor impedance transformation → More reflected power (higher S11) → Less current in the stub.
- 1 GHz → Ideal impedance transformation (short-circuit behavior) → Minimal reflected power (low S11) → High current in the stub.

2. **Measure the reflection coefficient. What do you expect? Do the simulations on the previous slide agree with measurements? If not, what can be the cause of that? Look at both the Smith chart and the LOGMAG plot.**



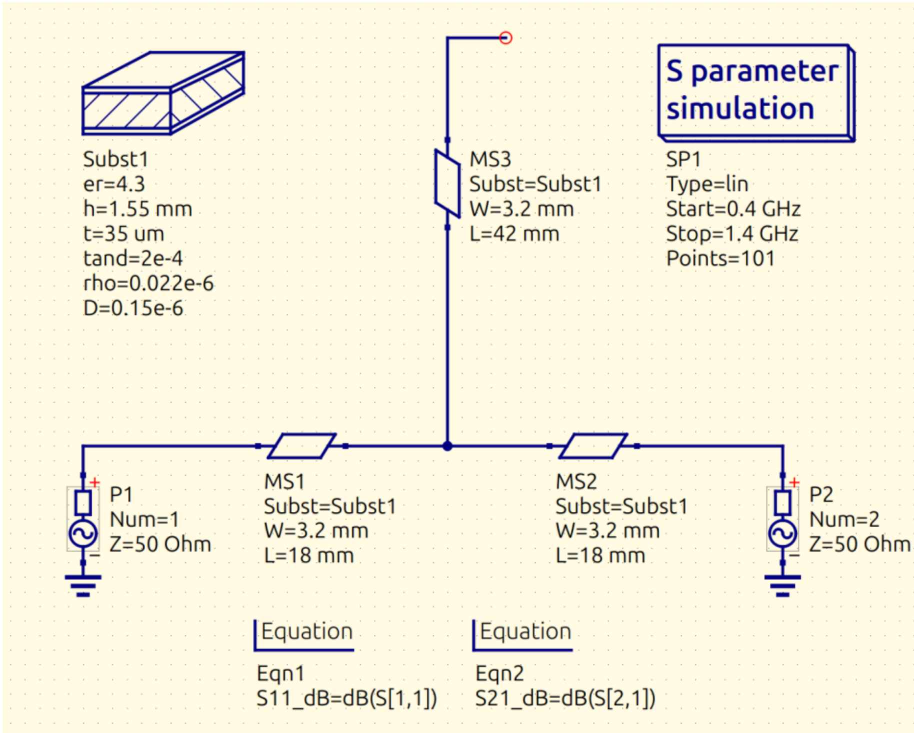
The smith chart seems weird on the slides, does not seem like it was made for the same stub, but the reflection and transmission coefficients match pretty well. As expected, the reflections being lower but still there the dip in transmission around 1Ghz is similar, and the smith chart showcases the impedance transformation.

3. **What kind of transmission line type is used for this stub (e.g. coax, stripline, coplanar waveguide, Microstrip etc.)**
   It's a coplanar waveguide.
4. **Determine the characteristic impedance Z0 of the stub. Explain how you get to your answer**

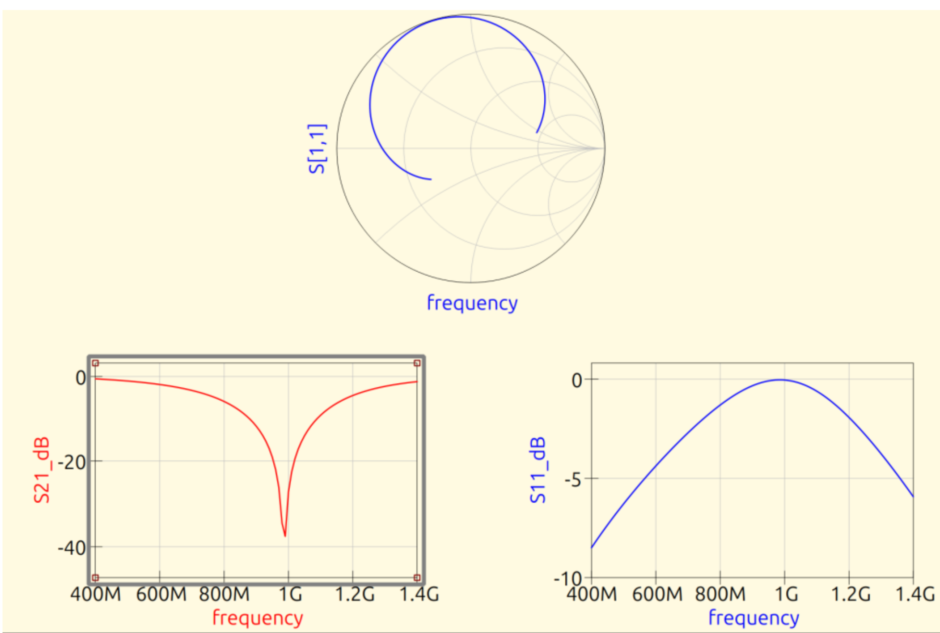
Through calculation it can be shown that the characteristic impedance is 50 Ohms also stated during lab.

5. **Determine the magnitude and phase of the reflection coefficient of the component at 1 GHz. Import these results into Matlab!**
   Magnitude: 0.9188 (linear) or -0.74 dB and Phase: 1.47°
6. **What is the impedance seen from port 1?**
   Input Impedance (Zin) : 1083.14 + j326.86 Ohms. Consistent with an open-circuited stub behavior at this frequency (high impedance transformation).
7. **What kind of application can this passive component be used for?**
   Impedance matching network for example, by transforming a specific load impedance to match the transmission line. Or for antenna feed networks, as antenna matching circuit to match the impedance to feed lines at specific frequencies.

8. **Draw the quarter-wave stub in QUCS (see figure)**

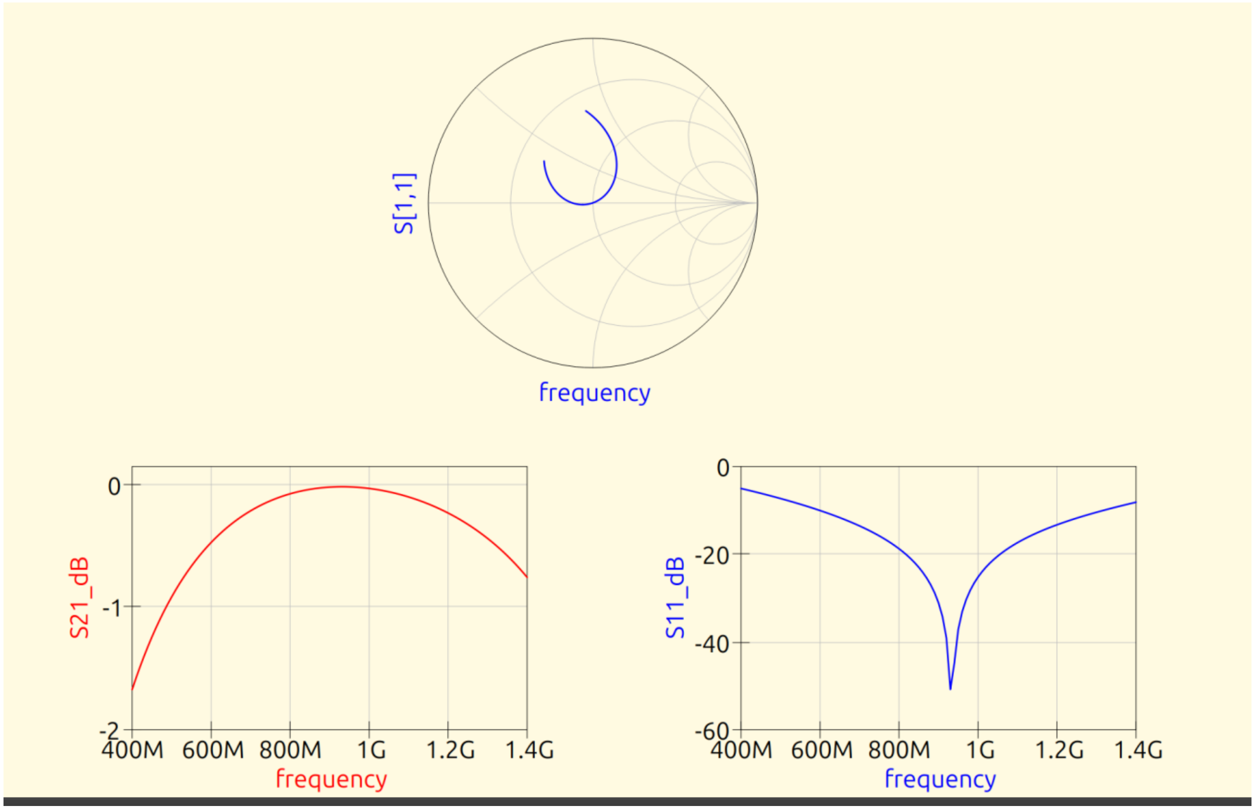


9. **Do the simulations agree with the S- parameters of your measurement? If not, what could be the cause of that?**



Yes, once again the transformation and reflection coefficient are relatively like what is shown on slides and what was generated from VNA/Matlab.

10. **What happens if your stub is a short- circuited stub? Explain what happens with your S11 and S21.**



In the short-circuited stub, at 1 GHz the stub transforms to an open circuit, resulting in minimal reflection and maximum transmission. This is observed as a deep dip in **S11** to around **-50 dB** (excellent matching) and a peak in **S21** at 1 GHz. Unlike the open-circuited case, where **S21** shows a notch and **S11** peaks, the short-circuited stub behaves as a bandpass filter, allowing signal transmission with minimal reflection at the design frequency.

https://electronics.stackexchange.com/questions/699724/intuitive-explanation-of-shorted-stub-behaviour#:~:text=Open%20circuits%20reflect%20back%20in,then%20back%20to%20the%20source.