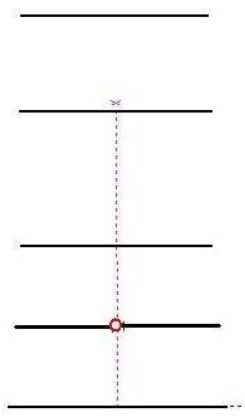
Cheap and light portable 2m Yagi

9 dB gain for less than 9 pounds

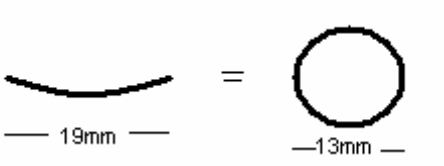
Build in March 2006 by Maik, M0RUN



In February 2006 I took part in my first ever foxhunt and there I had the idea to build this antenna. The foxhunting receiver (ROX-2A) we used had a simple 3 element Yagi with elements made of steel tape measure. The design is described by G3ZOI in [1] and it originates from a design by WB2HOL described in [2]. These antennas are optimised for front-to-back ratio. They have low gain, because their boom is relatively short. As a 2m-Dxer I thought it must be possible to build a simple and light Yagi with reasonable gain based on this principle.
So I went to B&Q where I spent about 9 quid for the following material:

- PVC installation tube (20mm diameter – 2m long)
- 8 space bar saddle clips (20mm)
- a 5m long tape measure (width 19mm)
- 25 M3 bolts with washers and nuts
- and about a meter of 75 Ohm TV coax cable

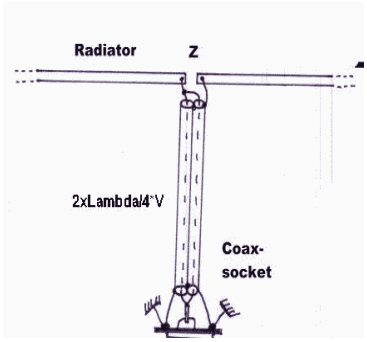
Looking at the stability of the 20mm PVC tube for the boom I quickly came to the conclusion that 2m is the maximum self-supporting length that is possible for this antenna. So I had to find an optimum design for this given length. Martin Steyer, DK7ZB describes a very simple 5 element high gain antenna in [4] which has exactly this boom length.



The major challenge was to transform the dimensions from round elements (used by DK7ZB) to slightly arced tape measure elements. Most antenna simulation programs used by radio amateurs allow only to enter circular elements. But the tape measure is far away from being circular. So with a little experimentation I found out that 19mm tape can be simulated as 13mm circular elements. Then I used MMANA [4] to re-model the DK7ZB Yagi for the elements made of my steel tape measure.

	Reflector	Dipole	Director 1	Director 2	Director 3
Total length (mm)	1030	958	898	904	882
Distance from Reflector (mm)	0	410	810	1500	1980

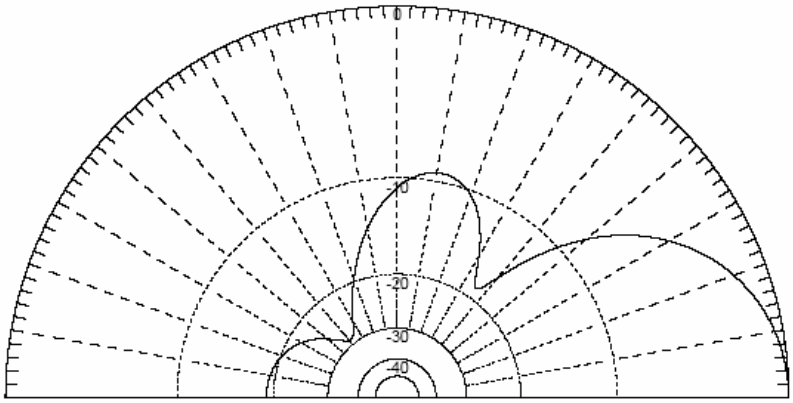
The dipole is made of 2 parts of tape measure with a distance of 1cm in the middle. The design of the Yagi antenna is calculated for a feedpoint impedance of 28 Ohm. This gives a reasonable compromise between gain and bandwidth and allows for some tolerances in the lengths of the elements. The impedance is matched to 50 Ohms by using two parallel λ/4-lenghts of 75 Ohm coax connected as shown at the right. Be careful, the physical length of the



coax is affected by the velocity factor which depends on the dielectric material. Foam Coax have about 0.8 while PE has 0.67 !
The elements are attached to the boom using the 5 saddle clips. Each element needs to be drilled very carefully with a 4mm drill to attach it to the clips. For the driven element an additional quarter section of PVC pipe (about 10cm long) is needed to give the element its arced shape. The Coax is attached to the steel tape with 2 solder lugs that make contact with the bare steel (scrape off the paint from the tape measure before). On the other end of the coax cable an N-type or any other RF Connector can be used. The 3 remaining saddle clips were used to build a simple mast clamp using a small plate of aluminium.

This antenna can easliy be lifted to a height of about 8-10m with a simple fiberglass mast (fishing pole) because it is very light. The driven element and the coax matching is not designed to be waterproof, so the antenna must not be used outside for a longer period of time. The antenna has one big enemy- wind – speeds of more than 5m/s will cause the tape elements to fold and basically ruin the performance of the Yagi completely. So use it in good weather only !

Radiation pattern and key paramters of the MMANA simulation are shown below



Ga : 11.33 dBi = 0 dB (Horizontal polarization)
Gh : 9.18 dBd
F/B: 19.00 dB; Rear: Azim. 120 dg, Elev. 60 dg
Freq: 144.300 MHz
Z: 28.251 - j1.016 Ohm
SWR: 1.8 (50.0 Ohm), 21.2 (600 Ohm)
Elev: 0.0 dg (Free space)

Sources:

[1] ARDF resources from G3ZOI (http://www.open-circuit.co.uk/tape.php)
[2] Joe Leggio “Tape measure beam optimised for ARDF” Internet resource (http://home.att.net/~jleggio/projects/rdf/tape_bm.htm)
[3] Mmana 2.03 Antenna Analyser Software by JE3HHT, DL1PBD & DL2KQ (http://mmhamsoft.ham-radio.ch/mmana/)
[4] Martin Steyer,DK7ZB – 144MHZ Yagis (http://www.qsl.net/dk7zb/2m-short/5-ele.htm)
[5] Martin Steyer,DK7ZB – The DK7ZB match (http://www.qsl.net/dk7zb/dk7zb-match.htm)