

# W3USR Amateur Radio Station Equipment and Capabilities

**University of Scranton Amateur Radio Station Location:** Loyola Science Center, Room 596

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## Station Overview

W3USR is a fully-equipped amateur radio station capable of communications across multiple bands and modes, from HF worldwide communications to VHF/UHF satellite operations. The station features professional-grade equipment and antenna systems installed on the Loyola Science Center roof.

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## Antenna Systems

### 1. Satellite Antenna System

**Location:** Southwestern corner, western roof section of LSC

**Capabilities:** - VHF (2 meter) and UHF (70 centimeter) satellite operation - Terrestrial weak-signal communications when oriented at horizon - Full azimuth/elevation computer-controlled tracking

**Equipment:** - **VHF Antenna:** M2 2MCP22 circularly-polarized antenna (2m) - **UHF Antenna:** M2 436CP42UG circularly-polarized antenna (70cm) - **Rotator:** Yaesu G-5500DC azimuth/elevation rotator with fiberglass crossboom - **Controller:** Green Heron RT-21Aazel digital controller with computer interface - **Preamplifiers:** Low-noise DC-switched outdoor preamps (VHF and UHF) - **Mounting:** Non-penetrating roof mount with 2-3/8" x 12' mast and 850 lbs ballast

### 2. VHF/UHF Omnidirectional Antenna System

**Location:** Southeastern corner, western roof section of LSC

**Capabilities:** - 6 meter band (52 MHz) - 2 meter band (144-148 MHz) - 70 centimeter band (440-450 MHz) - 23 centimeter band (1.2 GHz) - GPS reception

**Equipment:** - **6m Antenna:** Kreco CP-40A (52 MHz, 2.1 dB gain) - **2m Antenna:** RFS BA1312 (144-148 MHz, 5.1 dBi gain) - **70cm Antenna:** Commander 1150-5N (440-450 MHz, 7.1 dBi gain) - **23cm Antenna:** Newtronics HS10-12430 (1.2 GHz, 14.1 dBi gain) - **GPS Antenna:** Abracan AEAGMK148060-S1575 multiband GPS antenna - **Mounting:** Non-penetrating frame with four 2-3/8" x 8' masts and 1,400 lbs ballast

### 3. HF Antenna System

**Location:** East-center and west-central sections of LSC roof

**Capabilities:** - 80 meter band - 40 meter band - 20 meter band - 15 meter band - 10 meter band

**Equipment:** - **Tower:** Custom 40' bracketed/self-supporting Rohn 45G tower - **Yagi Antenna:** DX Engineering DXE-3X10 (10m/15m/20m) on 20' chromoly 2" mast - **Rotator:** Yaesu G-1000DXA with top thrust bearing - **Wire Antenna:** Custom fan dipole for 40m/80m with rigging - **Support Masts:** Two 2-3/8" x 20' galvanized masts for dipole end supports

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## Radio Equipment

### HF Transceiver

- **Radio:** Icom IC-7610 HF all-mode transceiver
- **Radio Coverage:** 1.8-29.7 MHz (160m-10m amateur bands)
- **Station Antenna Coverage:** 3.5-29.7 MHz (80m-10m, limited by installed antennas)
- **Amplifier:** ACOM 1010 HF amplifier (~600W output)
- **Accessories:** SP-38 speaker, SM-50 microphone
- **Modes:** SSB, CW, AM, FM, RTTY, PSK31, and other digital modes

### 6m Transceiver

- **Radio:** Icom IC-7300 HF/6m all-mode transceiver (dedicated to 6m)
- **Radio Coverage:** 1.8-54 MHz (160m-6m amateur bands)
- **Station Configuration:** Dedicated to 6m operation (50-54 MHz)
- **Modes:** SSB, CW, AM, FM, RTTY, PSK31, and other digital modes

### VHF/UHF/23cm Transceiver

- **Radio:** Icom IC-9700 2m/70cm/23cm all-mode transceiver
- **Accessories:** SP-41 speaker, SM-50 microphone
- **Modes:** SSB, CW, FM, digital modes, satellite operations
- **Coverage:** 144-148 MHz, 430-450 MHz, 1240-1300 MHz

### VHF/UHF FM/Digital Voice

- **Radio:** Yaesu FTM-400XDR FM/C4FM transceiver
- **Modes:** FM analog voice, C4FM digital voice (System Fusion)
- **Coverage:** 2m/70cm
- **Accessories:** External speaker

### UHF DMR Radio

- **Radio:** Motorola XPR-5550 70cm FM/DMR transceiver
- **Modes:** FM analog voice, DMR (Digital Mobile Radio)
- **Accessories:** Programming software, programming cable, external speaker
- **Coverage:** 70cm band

### CW (Morse Code) Equipment

- **Iambic Paddles:** Vibroplex iambic paddles
- **Keyer:** microHAM Winkey CW keyer with cables
- **Straight Key:** Vibroplex straight key with cable

## **Audio Equipment**

- **Headset:** Heil ProSet PS-IC with footswitch

## **Power Supplies**

- **Two Astron RM-50M power supplies** with fused DC distribution panels
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## **Computer Systems**

### **Station Computers**

- **Two Windows 11 workstations** with:
  - Monitor
  - Speakers
  - Keyboard and mouse
  - Ham Radio Deluxe (HRD) software licenses

**Capabilities:** - Digital mode operations (RTTY, PSK31, FT8, WSPR, etc.) - Satellite tracking software - Logging and contest software - Radio control and remote operation

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## **Infrastructure**

### **Station Grounding**

- R56-compliant professional grounding system
- Copper bus bar with bond to building steel
- Coaxial cable ground kits on all antenna transmission lines
- #6 green THHN grounding conductor to equipment

### **Patch Panel System**

**Radio Station (LSC 596):** - 40-port rack-mount patch panel in Middle Atlantic MMR-1220 rack - 16 ports for antennas (4 UHF, 12 Type N) - 16 ports for radio equipment (4 UHF, 12 Type N) - 8 ports for intramural cables to research room - Custom-length coaxial cables to equipment - UHF and Type N patch cables

**Research Room:** - 8-port wall-mount rack panel (2 UHF, 6 Type N) - Intramural cabling (LMR400) from radio station

### **Surge Protection**

- Coaxial cable arrestors on all antenna feedlines
- Rotator cable arrestors
- Professional R56 grounding and lightning protection

### **Cable Infrastructure**

- Professional LMR-type low-loss coaxial cables

- 3" rigid conduit risers through roof with weatherheads
  - Proper cable management with hangers, strut, and raceways
  - All roof penetrations sealed by certified contractor
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## Operating Capabilities

### Communication Modes

1. **Voice:**
  - SSB (Single Sideband) - HF and VHF/UHF
  - FM (Frequency Modulation) - VHF/UHF
  - AM (Amplitude Modulation) - HF
2. **Digital Voice:**
  - C4FM (System Fusion)
  - DMR (Digital Mobile Radio)
3. **CW (Morse Code):**
  - Traditional straight key
  - Electronic iambic paddles with computer keyer
4. **Digital Data Modes:**
  - RTTY (Radioteletype)
  - PSK31, PSK63
  - FT8, FT4, WSPR
  - APRS (Automatic Packet Reporting System)
  - Other experimental modes

### Operating Scenarios

1. **Local Communications:**
  - VHF/UHF FM repeater operations (2m, 70cm)
  - Simplex communications
  - Digital voice networks (DMR, System Fusion)
2. **Weak-Signal VHF/UHF:**
  - SSB communications on 2m, 70cm, 23cm
  - CW operations
  - Digital modes (FT8, MSK144, etc.)
  - Tropo, meteor scatter, and sporadic-E propagation
3. **Satellite Communications:**
  - FM voice satellites
  - Linear transponder satellites (SSB/CW)
  - Digital satellites
  - Computer-controlled antenna tracking
4. **HF Worldwide Communications:**
  - DX (long distance) on 80m, 40m, 20m, 15m, 10m
  - SSB voice, CW, and digital modes
  - Propagation studies across different bands and times
  - Contests and special event operations
5. **Experimental and Research:**

- Propagation studies
  - Antenna pattern analysis
  - Digital mode development and testing
  - GPS timing applications
  - Software-defined radio experiments
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## Educational Applications

The W3USR station provides hands-on learning opportunities in:

- **Electromagnetic wave propagation** (HF, VHF, UHF, microwave)
  - **Antenna theory and design** (dipoles, yagis, vertical antennas, circular polarization)
  - **Modulation techniques** (AM, FM, SSB, digital modulation)
  - **Radio frequency transmission lines** and impedance matching
  - **Signal processing** (analog and digital)
  - **Satellite communications** and orbital mechanics
  - **Computer-controlled systems** (rotator control, satellite tracking)
  - **Receiver design concepts** (superheterodyne, direct conversion)
  - **Spectrum management** and frequency coordination
  - **Propagation phenomena** (ionospheric, tropospheric, line-of-sight)
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## Technical Specifications Summary

Parameter	Specification
<b>Frequency Coverage</b>	3.5 MHz - 1.3 GHz (80m through microwave, antenna-limited)
<b>Transmit Power</b>	Up to 600W on HF (with amplifier), 100W on VHF/UHF
<b>Antenna Gain</b>	2.1 dB (6m) to 14.1 dBi (23cm)
<b>Rotator Control</b>	Computer-controlled Az/El and azimuth-only
<b>Operating Modes</b>	SSB, CW, FM, AM, C4FM, DMR, and digital data
<b>Computer Integration</b>	Full logging, digital modes, satellite tracking
<b>Grounding</b>	Professional R56 standard

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*Document created from equipment proposal dated 01 Aug 2022 All proposed equipment assumed installed and operational*