Overview of ISIS Moderators

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ISIS Target Design Group
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Overview

• ISIS First Target Station (TS1)
  • Two ambient water moderators
  • Two cryogenic moderators
    • One liquid methane at ~110K
    • One liquid hydrogen at ~20K

• ISIS Second Target Station (TS2)
  • Two cryogenic moderators
    • One solid methane at ~40K
    • One liquid hydrogen at ~17K
  • Combined with two ambient water pre-moderators
ISIS First Target Station

- In operation for 28 years

View of the ISIS TS1
Target
Reflector
And
Moderators.
Schematic view of the ISIS TS1 Target Reflector and Moderators.
View of target and moderators with reflector removed

- Ambient water moderators
- Liquid methane moderator
- Liquid hydrogen moderator
Ambient water moderators

- Typical heat load with 180μA beam 380W
- Typical demin water flow rate of 25 litres/min (6 litres/min at moderator?)
Moderator bodies fabricated from 5000 series Al alloy. Usual stst to al alloy friction welded joints.
Moderator depth defined by Al clad Gd poisoning layer. One moderator has a single Gd layer and the other has a double Gd foil layer.
Liquid methane moderator

- Typical heat load with 180μA beam ~200W
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- No tertiary containment layer
- Cold head volume ~0.5litre
Moderator head fabricated from 5083 Al alloy. Design to spirit of PD5500, allowable stress in Al alloy 83N/mm². Stst to al alloy friction welded joints where head is joined to body and bayonet.
• Change liquid methane charge once every 24 hours as liquid forms a mousse like emulsion.

• Change moderator head every 3 to 4 cycles due to blocking by formation of carbon products.
Liquid hydrogen Moderator

- Typical heat load with 180\(\mu\)A beam ~200W
- Cold head volume ~1 litre
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer filled with helium.
Moderator head fabricated from 5083 Al alloy. Design to spirit of PD5500, allowable stress in Al alloy 83N/mm$^2$. Stst to Al alloy friction welded joints where head is joined to body.
ISIS Second Target Station

• In operation for ~5 years

View of the ISIS TS2 Target Reflector And Moderators with the edge cooled beryllium reflector partially open to reveal the target and cryogenic moderators.
The ISIS TS2 TRAM with the reflector open in maintenance mode and the target and cryogenic moderators revealed.
Decoupled Solid Methane Moderator

- Typical heat load with 40μA beam ~120W (currently no poisoning)
- Designed to spirit of PD5500, allowable stress in Al alloy 83N/mm²
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer too
Decoupled Moderator

Solid methane moderator
Decoupled Moderator

Solid methane moderator
Decoupled Moderator

E type Thermocouples

Helium heat exchanger

Methane fill and return pipes

Line heaters
High purity al foam to boost thermal Conductivity.

Original moderator volume of ~1 litre
Current methane volume of $\sim \frac{1}{2}$ litre

Strain gauges to monitor strain on charge change, typically equiv to 35bar after 17 hours of beam.
Coupled Grooved Moderator

- Typical heat load with 40μA beam ~100W (currently only hydrogen)
- Designed to spirit of PD5500, allowable stress in Al alloy 83N/mm²
- Inner cold head and outer vacuum containment
- Cryogenic bayonet connection to transfer line
- Outer tertiary containment layer too
Coupled Grooved Moderator

Solid methane 
& liquid hydrogen 
moderator
Coupled Grooved Moderator

Solid methane
& liquid hydrogen moderator
Coupled Grooved Moderator

- Flexible ‘Kapton’ heaters
- Methane fill tube
- Methane return tube with ‘swan neck’
Decoupled pre-mod heat load ~100W
Coupled pre-mod heat load ~300W