# MICROSCOPE Specifications

**Instrument**
ID
Name
AnnotationRef

**MicroscopeBody**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
EyepieceFieldNumber
AnnotationRef

**MicroscopeTable**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
TableWidth
TableDepth

**IntensityCalibrationTool**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Description
AnnotationRef

**SampleHolder**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
MovementAxes
XTravelRange
YTravelRange
ZTravelRange
MaxVelocity
RotationAngle
AnnotationRef

Children Entities (choose one)

**ObjectiveTurret**

**MechanicalStage**

**PiezoElectricStage**

**PiezoElectricObjective**

**Focusing-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
MovementAxes
XTravelRange
YTravelRange
ZTravelRange
MaxVelocity
Resolution
PositionLinearityError
SettlingTime
Repetability
AnnotationRef

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**AutoFocus**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Description
AnnotationRef

**Lens**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Geometry
Construction
Magnification
AttenuationCoefficient
RadiusOfCurvature
FocalDistanceToObject
FocalDistanceToImage
FocalLenght
MaterialName
GlassCode
RefractiveIndex
AbbeNumber
Density
Diameter
AnnotationRef

**Prism**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Geometry
WavelengthRange
Reflectance
PrismAngle
IncidenceAngle
DeviationAngle
MaterialName
GlassCode
RefractiveIndex
AbbeNumber
Density
AnnotationRef

**Prism WavelengthRange**
CutIn
CutOut
WavelenghtProfileFile

**PolarizationOptics**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Description
AnnotationRef

**Polarizer WavelengthRange**
CutIn
CutOut
WavelenghtProfileFile

**LightSource-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Power
AnnotationRef

IS-A

Children Entities (choose one)

**Laser**
Type
LaserMedium
Wavelength
FrequencyMultiplication
Tuneable
Pulse
PockelCell
RepetitionRate

**Pump**
ID (LightSourceID)

**Filament**
Type

**Arc**
Type

**LightEmittingDiode**
Type
PeakWavelenght
WavelenghtProfile
LumenPower
ProjectionAngle

**GenericExcitationSource**
(The GenericExcitationSource element is used to represent a source as a collection of key/value pairs, stored in a Map. The other lightsource objects should always be used in preference to this if possible)

**LightSource WavelengthRange**
CutIn
CutOut

**LightSourceCoupling-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
CouplingLensRef
Transmittance
AnnotationRef

IS-A

Children Entities (choose one)

**LightGuide**
Type
Geometry
MaterialName
PeakWavelength
WavelengthRange
SingleMode
WaveguideMode
RefractiveIndex
NumericalAperture
AcceptanceAngle
Diameter
FerruleMaterial

**Direct**
Mount
Type

**LightGuide WavelengthRange**
CutIn
CutOut
WavelenghtProfileFile

**Optovar**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
LensType

**Objective**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Correction
NominalMagnification
CalibratedMagnification
LensNA
NominalImmersionMedium
Infinity
CoverslipTickness
WorkingDistance
Iris
ObjectiveFieldNumber
ParfocalizingDistance
BackFocalPlanePosition
AnnotationRef

**ExcitationFilterRef**
ID (FilterID)

**DichroicRef**
ID (MirrorID)

**EmissionFilterRef**
ID (FilterID)

**FilterSet**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
AnnotationRef

Children Entities (choose one)

**ExcitationFilter**

**EmissionFilter**

**AdditionalFilter**

**Filter**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
ReflectionCoating
FilterWheel
TransmittanceProfileRef
AnnotationRef

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**TransmittanceRange**
CutIn
CutOut
Transmittance

Children Entities (choose one)

**Reflector**

**Beamsplitter**
Transmittance
TranmissionAngle

**Dichroic**
TrasmissionType
Single
AttenuationMethod
Technology
HardSputtered
AttenuationLevel
Polarization
FilterWheel
TransmittanceProfileRef
ReflectanceProfileRef

**TransmittanceRange**
CutIn
CutOut
Transmittance

**ReflectanceRange**
CutIn
CutOut

**Mirror-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Type
Geometry
Reflectance
ReflectionAngle
RadiusOfCurvature
MaterialName
GlassCode
AnnotationRef

IS-A

**Detector-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Mount
RelayLensRef
ReadNoise
NoiseModel
DarkCurrentRate
PeakWavelength
QuantumEfficiencyatPeakWavelength
WavelengthRange
AmbientOperatingTemperature
AbientOperatingHumidity
AnnotationRef

IS-A

**Detector WavelengthRange**
CutIn
CutOut
WavelenghtProfileFile

Children Entities (choose one)

**PhotoMultiplier**
Type (PMT, Photodiode, APD)
RadiantSensitivity

**Camera-APE**
Illumination
ArrayWidth
ArrayHeight
PixelWidth
PixelHeight
ImageWidth
ImageHeight
PixelWellCapacity
RegisterWellCapacity
VerticalClockSpeed
MaximumFrameRate
MaximumReadoutRate

**GenericDetector**
(The GenericDetector element is used to represent a source as a collection of key/value pairs, stored in a Map. The other lightsource objects should always be used in preference to this if possible.)

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Children Entities (choose one)

**CCD**
Type (Conventional, EMCCD, Interline)

**IntensifiedCCD**
Type (Conventional, EBCCD)

**AnalogVideo**

**CMOS**
Type (Conventional, Scientific)
ReadOutMode

| Notes |
|---|
| Units are omitted for simplicity sake.<br>APE, Abstract Parent Entity<br><br>AnnotationRef: This element always refers to a Comment/ Annotation element as described for Channel. However for simplicity sake most Comment/Annotation elements have been omitted and the AnnotationRef has been inserted in the referring element as an attribute.<br><br>For questions or comments please contact:<br>caterina.strambio@umassmed.edu |

| Legend |
|---|
| This is a graphical representation of a possible extension of the OME data model developed by members of the Imaging Working Group of the 4D Nucleome consortium. The graph utilizes the Entity-Relationship formalism. In this formalism information about a real world situation/thing (in our case a Microscope and an image acquired using that instrument) are represented by three types of model elements:<br>1) Entities = Boxes; 2) Relationships = lines connecting boxes; 3) Attributes = fields within boxes<br>When describing a real life situation/thing:<br>1)ENTITIES corresponds to NOUNS = the things we want to collect information about.<br>2) RELATIONSHIPS corresponds to VERBS = actions/state/occurrence that connect Entities with each other<br>3) ATTRIBUTES corresponds to ADJECTIVES = the actual information about each Entity we want to collect<br>In order to read the schema please start from INSTRUMENT and from and IMAGE for the Specifications and Settings section respectively. Then follow the lines to the connected boxes and think something like: 1) An Instrument has a Microscope_Body, might rest on a Microscope_Table, and has a Light_Source etc.; 2) An Image was produced as part of a specific Experiment, was collected in a specific Imaging_Environment, was collected using specific Microscope_Settings etc. |

# IMAGE ACQUISITION Settings

**ImagingEnvironment**
Temperature
AirPressure
Humidity
CO2Percent

**MicroscopeSettings**
ID (MicroscopeID)
FieldOfView
OptovarMagnification
TotalEffectiveMagnification

**TIRFSettings**
ID
ThroughLens
Angle
Geometry
AnnotationRef

**Description**
A description for the TIRFsettings [plain-text multi-line string]

**ObjectiveSettings**
ID (ObjectiveID
CorrectionCollar
ImmersiumMedium
ImmersionRefractiveIndex
MeasuredRefractiveIndex
Temperature

**Description**
A description for the Microbeam Manipulation [plain-text multi-line string]

**MicrobeamManipulation**
ID
Type
ExperimenterRef
ROIRef

**LightSourceSettings**
ID (LightSourceID)
Attenuation
Wavelenght
WavelengthUnit
OutputPower
PowerAtSample

**Image Data**

TiffData
IFD
FirstZ
FirstT
FirstC
PlaneCount
UUID

**Description**
A description for the experiment [plain-text multi-line string]

**Image**
Name
AcquisitionDate
SizeX
SizeY
SizeZ
SizeC
SizeT
PhysicalSizeX
PhysicalSizeY
PhysicalSizeZ
TimeIncrement
DimensionOrder
ChannelOrder
PixelType
SignificantBit
Interleaved
BigEndian
___
Image/Description
InstrumentRef
ExperimenterRef
ExperimentGroupRef
ROIRef
MicroBeamManipulationRef
AnnotationRef

**Experiment**
ID
Name
Type
LabellingMethod
ExperimenterRef

Ref.

**Sample**
ID
Name
MountingMedium
MountingMediumRefractiveIndex
AnnotationRef

Planes

Plane
TheZ
TheT
TheC
Timestamp
ExposureTime
HashSHA1
AnnotationRef

**SamplePosition**
ID
Name
SamplePositionX
SamplePositionY
SamplePositionZ
SampleHolderRef

**FocalPosition**
ID
Name
StagePositionZ
FocusingRef
AutoFocusRef

**LightSourceCouplingRef**
ID (CouplingID)

**FilterSetRef**
ID (FilterSetID)

**ExcitationFilterRef**
ID (FilterID)

**DichroicRef**
ID (MirrorID)

**EmissionFilterRef**
ID (FilterID)

**AdditionalOptics**
ID
Name
AnotationRef

**AdditionalLensRef**
ID (LensID)

**PrismRef**
ID (PrismID)

**PolarizationOpticsRef**
ID (PolarizationOpticsID)

**AdditionalFilterRef**
ID (FilterID)

**AdditionalMirrorRef**
ID (MirrorID)
ActualMountedAngle

**OpticalCalibration ImageRef**
ID (ImageID)

**Optical CalibrationReportRef**
ID (FileURI)
OpticalCalibrationSoftware

**OpticalCalibration**
ID
Date
MedianSpotSize_FWHM
MedianTheoretical_FWHM
MinSpotSize_FWHM
MinTheoretical_FWHM
MaxSpotSize_FWHM
MaxTheoretical_FWHM
ZSpotSize_FWHM
ZTheoretical_FWHM
Planarity
Asymmetry
LateralChromaticShift
AxialChromaticShift
Description
AnnotationRef

Children entities (choose one)

**ColoredBeadsSlide**
BeadSize
BeadsConcentration
BeadVolume
BeadEmissionWavelenght
Type

**CalibrationSlide**
Type
CalibratedMeasure

**DNAOrigami**
Type

IS-A

**OpticalStandard-APE**
Manufacturer
Model
SerialNumber
LotNumber
SpecsFile
___
ID
Name
Description
AnnotationRef

Channels

Channel
ID
Name
SamplesPerPixel
IlluminationType
PinholeSize
AcquistionMode
ContrastMethod
ExcitationWavelenght
EmissionWavelength
Fluorophore
NDFilter
PockelCellSetting
Color

**LightSourceSettings**
ID (LightSourceID)
Attenuation
WavelengthUnit
OutputPower
PowerAtSample

**LightPath**
ID
Name
AnnotationRef

**DetectorSettings-APE**
ID (DetectorID)
EffectiveOffset
Integration
CameraFieldOfView

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Children Entities (choose one)

**CameraSettings**
Binning
AnalogToDigitalConverter
EMGain
ReadoutRate
FrameRate
OperatingTemperature

**PhotoMultiplierSettings**
PMTGain
PMTVoltage
EffectiveZoom

**AnnotationRef**
ID (AnnotationID)

**FlatFieldImageRef**
ID (ImageID)

Ref

**FieldCalibration**
ID
Date
Description
AnnotationRef

Children Entities (choose one)

**ExcitationCalibration**
ObservedExcitationWavelength
ObservedExcitationPower
Observed ExcitationVariance

**DetectorCalibration**
Method

IS-A

**Intensity Calibration-APE**
ID
Date
Description
IntensityCalibrationToolRef
AnnotationRef

**CalibrationMap**
MetricType
IlluminationIntensity
NrOfImages

**Row**
RowNr

**Cell**
CellNr
CellValue

**CommentAnnotation**
ID
Namespace
Annotator (ExperimenterID)

**Description**
A description for the annotation. [plain-text multi-line string]

**AnnotationRef**
ID (AnnotationID)

**Value**
[string]