Project1

February 21, 2016

In [4]:
```
from QTClock import QTClock
from ECGFigure import ECGFigure
from HRDerivClock import HRDerivClock
from ECGClock import ECGClock
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
%matplotlib inline
import pandas as pd
from scipy import signal
import numpy as np
import math
```

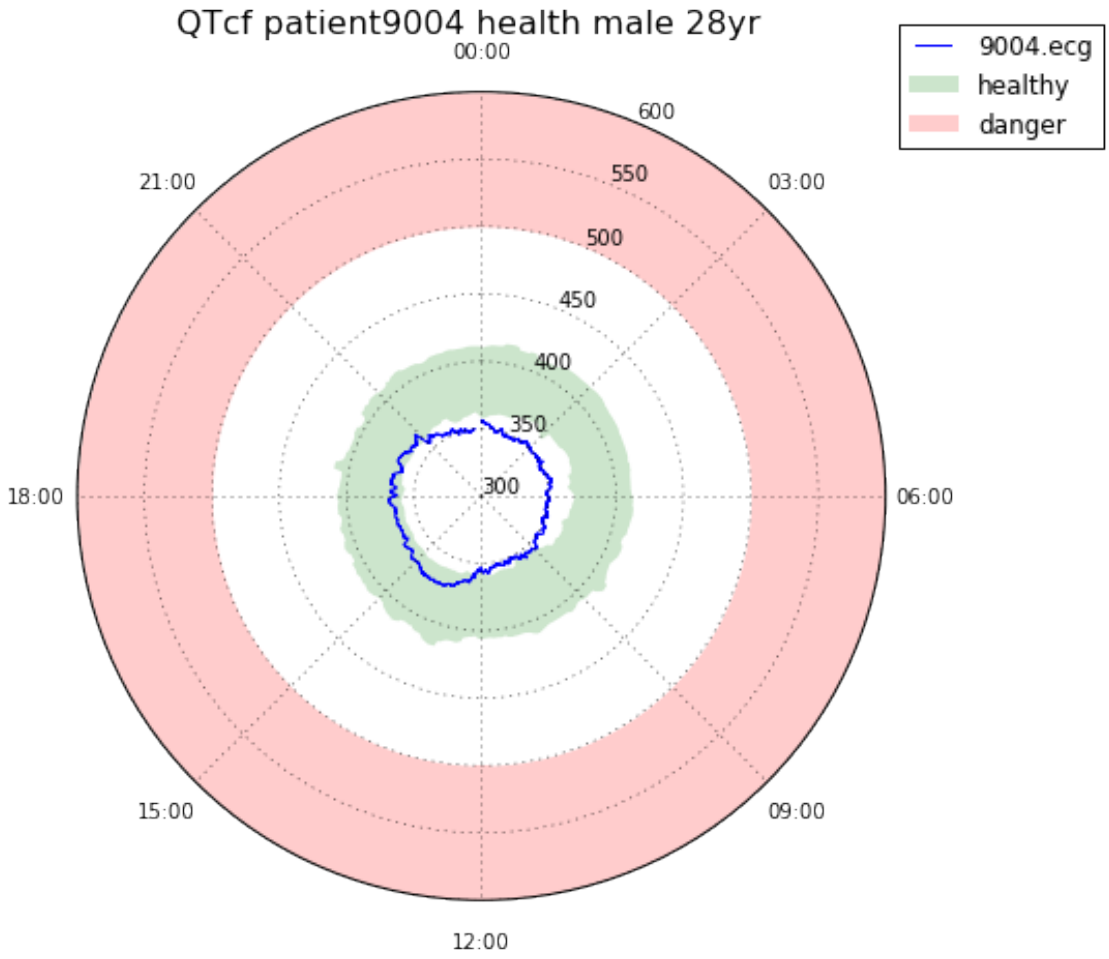
In [5]:
```
def smoothhr(inputdata,outputdata,cut = 10,shifttime=0,filtering = 10):
    th =pd.read_csv(inputdata, sep=',')


    #leads = len(th['lead'].unique())
    th = th[th.heartrate >= 40] #throw heartrate smaller than 40 or bigger than 160
    th = th[th.heartrate <= 160]


    #th['HeartRate1']= pd.rolling_median(th['HeartRate'], window=9, center=True).fillna(method=
    total = len(th['heartrate'])

    time = th.Time.tolist()

    h = []
    t = []
    for i in range(0,total-filtering,filtering):
        strt = i
        end = (i+filtering)

        ti= time[strt]
        hi = th['heartrate'][strt:end].median()

        t.append(ti)
        h.append(hi)

    t = pd.to_datetime(t, dayfirst=True)
    t = t + pd.DateOffset(hours=shifttime)

    result = pd.DataFrame(h,t)

    result = result.ix[cut:]
```

```
        result = result.ix[:-cut]

        result.to_csv(outputdata,header = False) #remove the first one

    def cuberoot(x):
        return math.pow(x,1/3)

    def smoothqtcf(inputdata,outputdata,cut = 10,shifttime=0,filtering = 10):
        th =pd.read_csv(inputdata, sep=',')

        th = th[th.heartrate >= 40] #throw heartrate smaller than 40 or bigger than 160
        th = th[th.heartrate <= 160]
        th = th[th.qti >= 210] #throw sqti smaller than 700 or bigger than 210
        th = th[th.qti <= 700]

        total = len(th['qti'])

        th['rri'] = th['rri'].astype('float64')
        th['qti'] = th['qti'].astype('float64')

        #th['rri_s'] = th['rri'].apply(np.sqrt)
        th['rri_s3'] = th['rri'].apply(cuberoot)
        th['qtcF'] = th['qti']/th['rri_s3']

        time = th.Time.tolist()

        f = []
        t = []
        for i in range(0,total-filtering,filtering):
            strt = i
            end = (i+filtering)
            ti = time[strt]
            fi = th['qtcF'][strt:end].median()

            t.append(ti)
            f.append(fi)

        t = pd.to_datetime(t, dayfirst=True)
        t = t + pd.DateOffset(hours=shifttime)

        #f = th.qtcF.tolist()
        resultf = pd.DataFrame(f,t)

        resultf = resultf.ix[cut:]
        resultf = resultf.ix[:-cut]

        resultf.to_csv(outputdata,header = False)
```

In [3]:
```
smoothqtcf('RRQT/9004_rrqt.csv','qtcf/9004_qtcf.csv')
```

In [4]:
```
my_clock = QTClock('QTcf patient9004 health male 28yr')

my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_male.csv',
                              lower=7, upper=93, color='g', alpha=0.2, label='healthy')
```

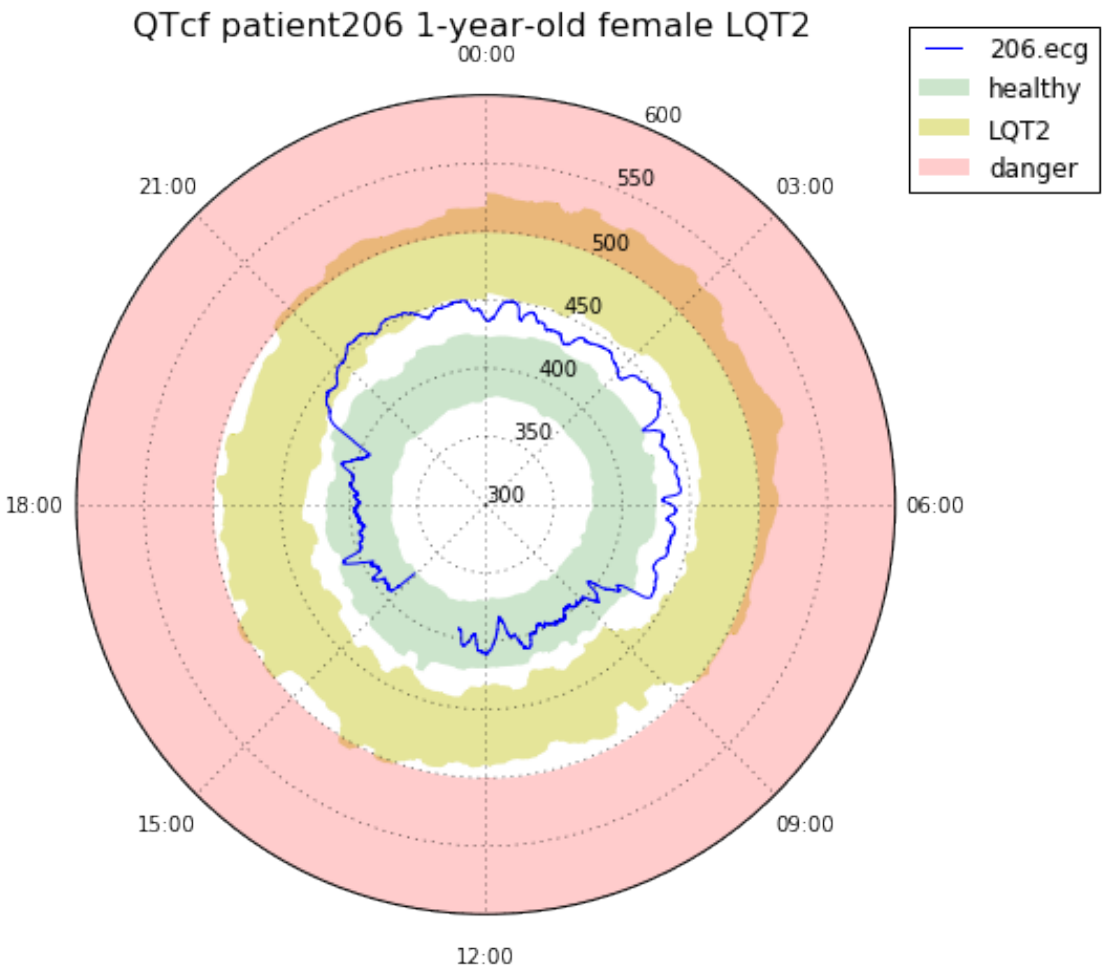
```
my_clock.add_recording('qtcf/9004_qtcf.csv', label='9004.ecg', filtering = 10)

# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('photos/9004_qtcf.png')
```



In [5]:
```
#figure 1
smoothqtcf('RRQT/206_rrqt.csv','qtcf/206_qtcf.csv',cut = 10,shifttime=15,filtering = 10)
```

In [6]:
```
#figure 1

my_clock = QTClock('QTcf patient206 1-year-old female LQT2')

my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_female.csv',
                              lower=7, upper=93, color='g', alpha=0.2, label='healthy')

#my_clock.add_percentile_range('./normal_ranges/QTcF_LQT1_female.csv', color='b', alpha=0.4, la
```

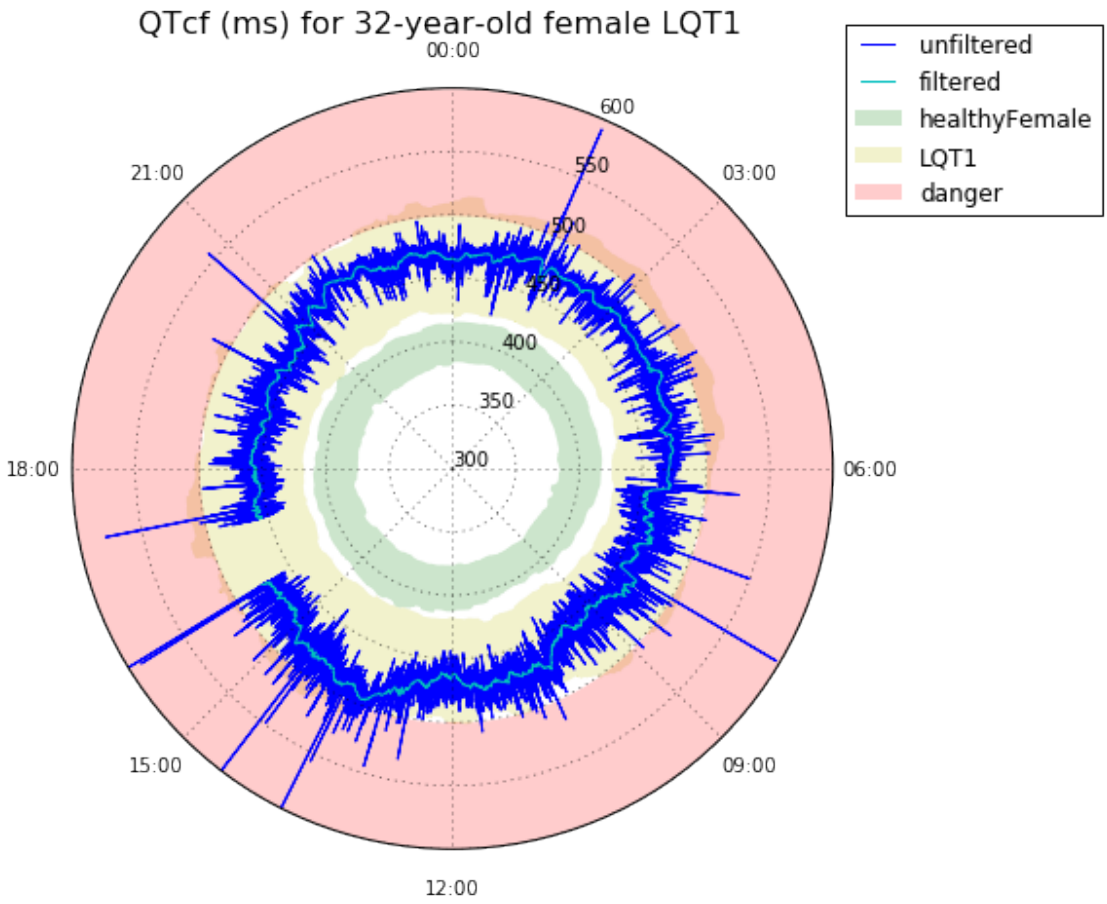
```
my_clock.add_percentile_range('./normal_ranges/QTcF_LQT2_female.csv', color='y', alpha=0.4, lab

my_clock.add_recording('qtcf/206_qtcf.csv', label='206.ecg', filtering = 10)

# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('photos/206_qtcf_inpaper.png')
```



In [7]:
```
#figure 2
smoothqtcf('RRQT/288_rrqt.csv','qtcf/qtcf_288.csv',shifttime=17)
```

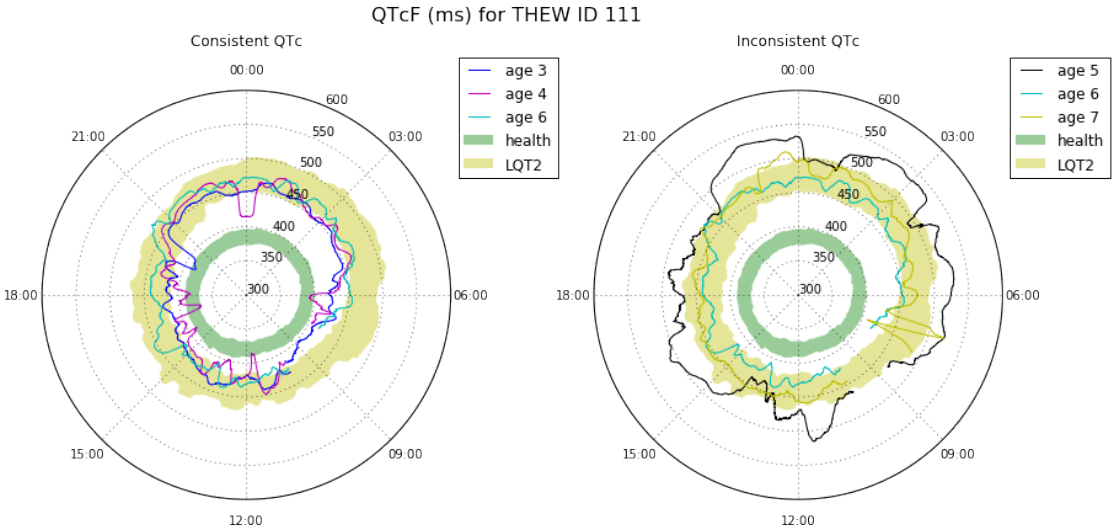
In [8]:
```
#figure 2
#smoothqtcf('RRQT/288_rrqt.csv','qtcf/qtcf_288.csv',shifttime=17)

my_clock = QTClock('QTcf (ms) for 32-year-old female LQT1',color_cycle = ['b','c'])
```

```
# Add two recordings to the plot.  Filtering is disabled because this data was
# already filtered.

# Show two 'tiers' of healthy QTc ranges: IQR in darker green, and a wider
# percentile range in lighter green around it.  IQR is darker because the
# regions overlap.  We only label one of them, because we don't want redundant
# entries in the legend.
my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_female.csv',
                              lower=16, upper=84, color='g', alpha=0.2, label='healthyFemale')


my_clock.add_percentile_range('./normal_ranges/QTcF_LQT1_female.csv',
                              lower=16, upper=84, color='y', alpha=0.2, label='LQT1')



my_clock.add_recording('qtcf/qtcf_288.csv', label='unfiltered')
my_clock.add_recording('qtcf/qtcf_288.csv', label='filtered', filtering = 10)


# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('qtcf/qtcf_288_inpaper.png')
```



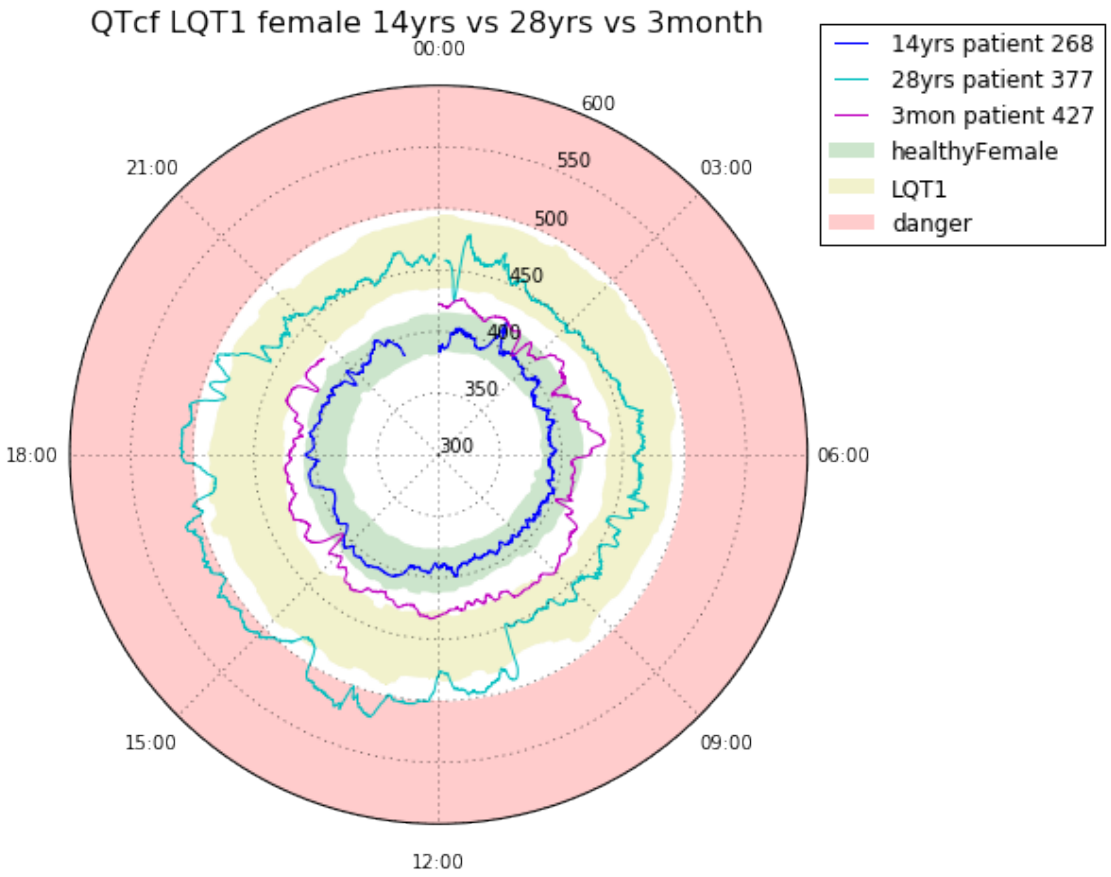

```
In [9]: smoothqtcf('RRQT/109_rrqt.csv','qtcf/109_qtcf.csv',shifttime=10,filtering = 10)
        smoothqtcf('RRQT/10_rrqt.csv','qtcf/10_qtcf.csv',shifttime=10,filtering = 10)
        smoothqtcf('RRQT/8_rrqt.csv','qtcf/8_qtcf.csv',shifttime=10,filtering = 10)
        smoothqtcf('RRQT/7_rrqt.csv','qtcf/7_qtcf.csv',shifttime=10,filtering = 10)
        smoothqtcf('RRQT/9_rrqt.csv','qtcf/9_qtcf.csv',shifttime=10,filtering = 10)

In [10]: #figure 4

         my_fig = ECGFigure(title='QTcF (ms) for THEW ID 111',ncols=2)

         left_clock = QTClock('Consistent QTc', parent_figure = my_fig,subplot=1)
         right_clock= QTClock('Inconsistent QTc',parent_figure = my_fig, subplot =2)


         left_clock.add_percentile_range('./normal_ranges/QTcF_healthy_male.csv',color='g', alpha=0.4, l

         right_clock.add_percentile_range('./normal_ranges/QTcF_healthy_male.csv', color='g', alpha=0.4

         left_clock.add_percentile_range('./normal_ranges/QTcF_LQT2_male.csv', color='y', alpha=0.4, lab

         right_clock.add_percentile_range('./normal_ranges/QTcF_LQT2_male.csv', color='y', alpha=0.4, la
```

```
left_clock.add_recording('qtcf/109_qtcf.csv', label='age 3', filtering = 20, color = 'b')
left_clock.add_recording('qtcf/10_qtcf.csv', label='age 4', filtering = 20, color = 'm')
left_clock.add_recording('qtcf/8_qtcf.csv', label='age 6', filtering = 20, color = 'c')

right_clock.add_recording('qtcf/7_qtcf.csv',label='age 5',filtering=20, color='k')
right_clock.add_recording('qtcf/8_qtcf.csv',label='age 6',filtering=20, color='c')
right_clock.add_recording('qtcf/9_qtcf.csv',label='age 7',filtering=20, color='y')


left_clock.add_legend()
right_clock.add_legend()

my_fig.save('photos/qtcf_figure4_inpaper.png')
```



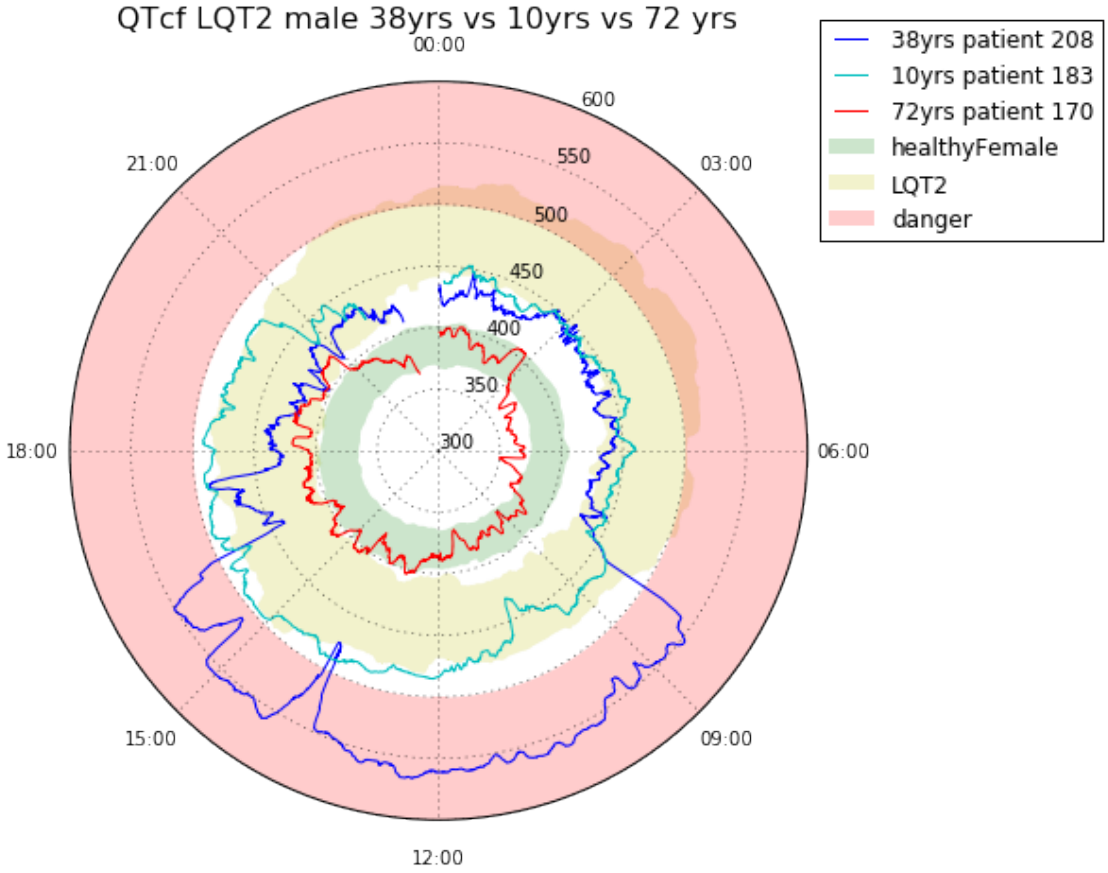

```
In [11]: smoothqtcf('RRQT/268_rrqt.csv','qtcf/268_qtcf.csv',filtering = 10)

In [12]: smoothqtcf('RRQT/377_rrqt.csv','qtcf/377_qtcf.csv',filtering = 10)

In [13]: smoothqtcf('RRQT/427_rrqt.csv','qtcf/427_qtcf.csv',filtering = 10)

In [14]: my_clock = QTClock('QTcf LQT1 female 14yrs vs 28yrs vs 3month',color_cycle = ['b','c','m'])

         my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_female.csv',
                                       lower=16, upper=84, color='g', alpha=0.2, label='healthyFemale')


         my_clock.add_percentile_range('./normal_ranges/QTcF_LQT1_female.csv',color='y', alpha=0.2, lab


         my_clock.add_recording('qtcf/268_qtcf.csv', label='14yrs patient 268', filtering = 10)
         my_clock.add_recording('qtcf/377_qtcf.csv', label='28yrs patient 377', filtering = 10)
         my_clock.add_recording('qtcf/427_qtcf.csv', label='3mon patient 427', filtering = 10)
```

```
# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('photos/268vs377vs427.png')
```




```
In [15]: smoothqtcf('RRQT/208_rrqt.csv','qtcf/208_qtcf.csv',filtering = 20)

In [16]: smoothqtcf('RRQT/183_rrqt.csv','qtcf/183_qtcf.csv',filtering = 20)

In [17]: smoothqtcf('RRQT/170_rrqt.csv','qtcf/170_qtcf.csv',filtering = 20)

In [18]: my_clock = QTClock('QTcf LQT2 male 38yrs vs 10yrs vs 72 yrs',color_cycle = ['b','c','r'])

         my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_male.csv',
                                       lower=16, upper=84, color='g', alpha=0.2, label='healthyFemale')


         my_clock.add_percentile_range('./normal_ranges/QTcF_LQT2_male.csv',
```

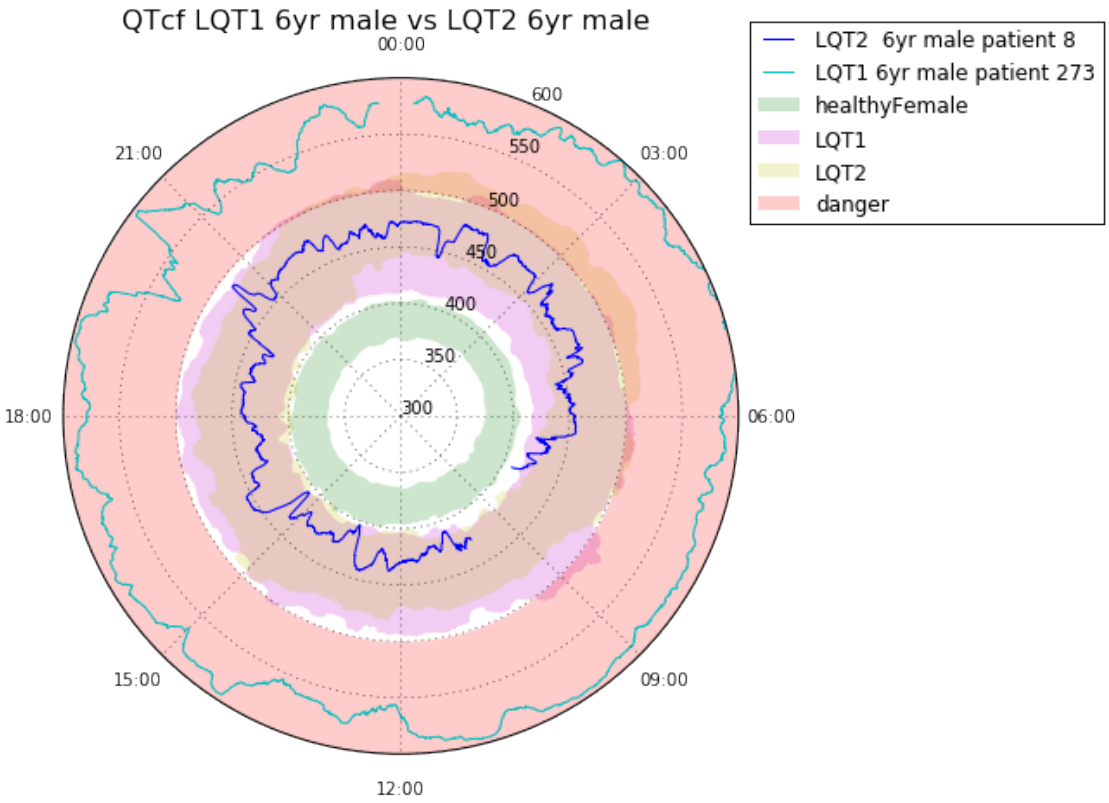
```
                                    lower=16, upper=84, color='y', alpha=0.2, label='LQT2')


my_clock.add_recording('qtcf/208_qtcf.csv', label='38yrs patient 208', filtering = 10)
my_clock.add_recording('qtcf/183_qtcf.csv', label='10yrs patient 183', filtering = 10)
my_clock.add_recording('qtcf/170_qtcf.csv', label='72yrs patient 170', filtering = 10)



# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('photos/208vs183vs170.png')
```



In [19]:
```
smoothqtcf('RRQT/273_rrqt.csv','qtcf/273_qtcf.csv',filtering = 20)
```

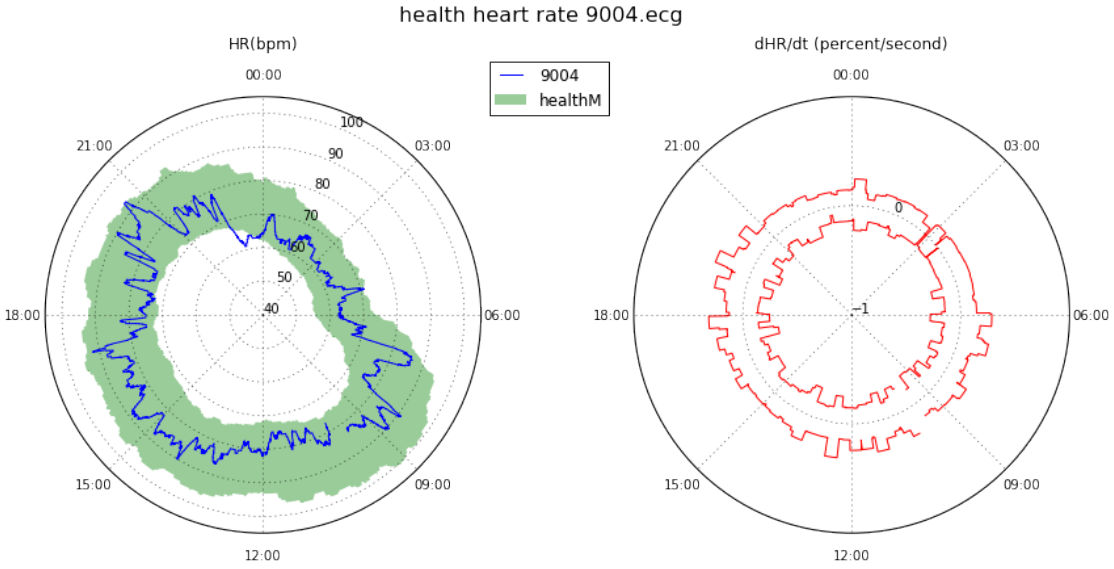
In [20]:
```
my_clock = QTClock('QTcf LQT1 6yr male vs LQT2 6yr male ',color_cycle = ['b','c'])

my_clock.add_percentile_range('./normal_ranges/QTcF_healthy_male.csv',
```

```
                                lower=16, upper=84, color='g', alpha=0.2, label='healthyFemale')

my_clock.add_percentile_range('./normal_ranges/QTcF_LQT1_male.csv',
                                lower=16, upper=84, color='m', alpha=0.2, label='LQT1')

my_clock.add_percentile_range('./normal_ranges/QTcF_LQT2_male.csv',
                                lower=16, upper=84, color='y', alpha=0.2, label='LQT2')



my_clock.add_recording('qtcf/8_qtcf.csv', label='LQT2  6yr male patient 8', filtering = 10)
my_clock.add_recording('qtcf/273_qtcf.csv', label='LQT1 6yr male patient 273', filtering = 10)



# >500ms will be highlighted red:
my_clock.add_danger_range(500)

my_clock.add_legend()

my_clock.save('photos/8vs273.png')
```



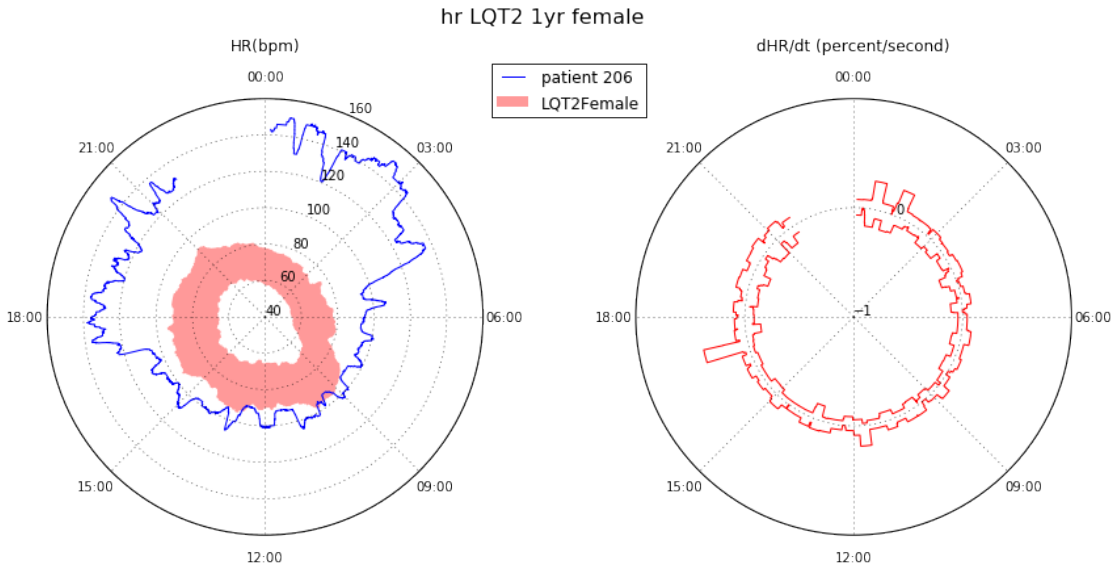

```
In [21]: smoothhr('RRQT/9004_rrqt.csv','hr/9004_hr.csv',filtering = 10,shifttime = 10)

In [22]: #change the title below
         my_fig = ECGFigure(nrows=1, ncols=2, title='health heart rate 9004.ecg')
```

```
hr_clock = ECGClock('HR(bpm)', parent_figure=my_fig, subplot=1,min_rad = 40,max_rad = 105)
hr_clock.add_recording('hr/9004_hr.csv',filtering = 10,label='9004')

#change the range for different type
hr_clock.add_percentile_range('./normal_ranges/HR_healthy_male.csv',color = 'g',
                              alpha = 0.4, label = "healthM")


dhr_clock = HRDerivClock('dHR/dt (percent/second)', parent_figure = my_fig, subplot =2,
                         min_rad = -1, max_rad = 1, tick_spacing = 1.0)
dhr_clock.add_recording('hr/9004_hr.csv',percent = True)
hr_clock.add_legend()
my_fig.save('photos/9004hr_inpaper.png')
```

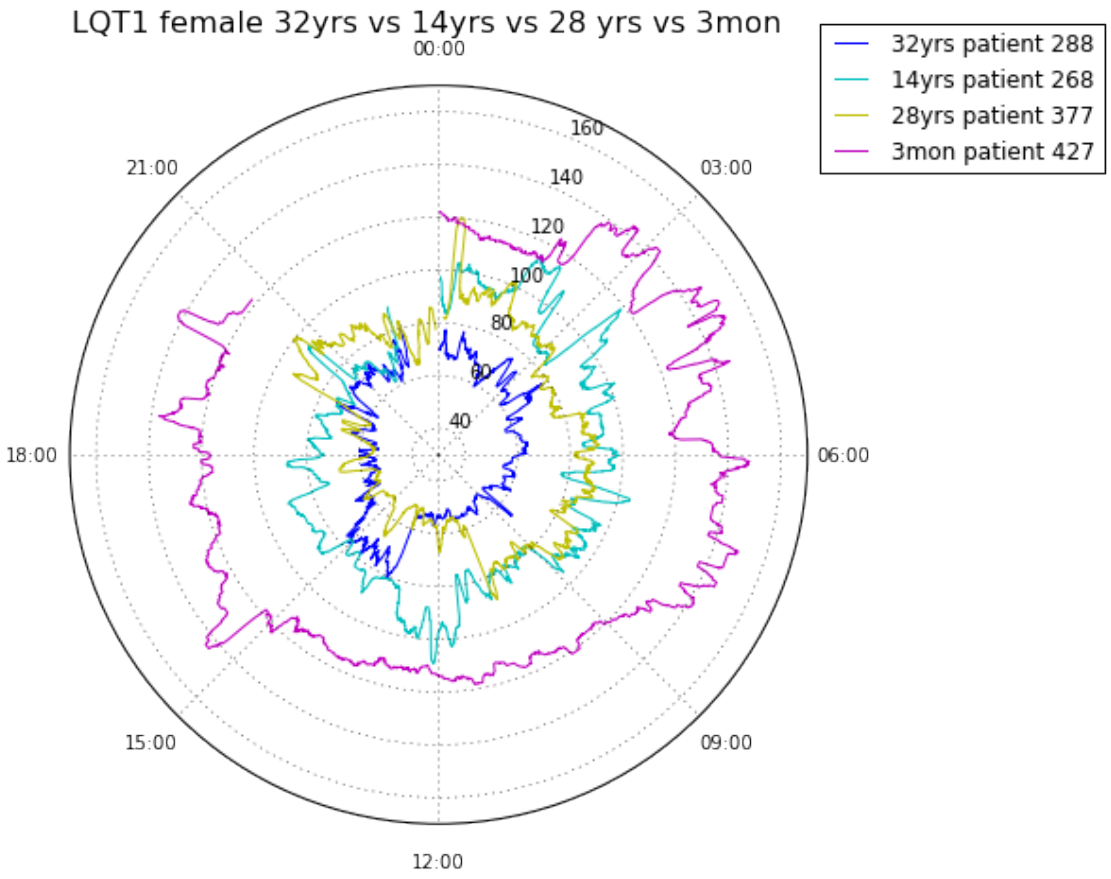


In [23]:
```
smoothhr('RRQT/206_rrqt.csv','hr/206_hr.csv',filtering = 20,shifttime = 0)
```

In [24]:
```
#change the title below
my_fig = ECGFigure(nrows=1, ncols=2, title='hr LQT2 1yr female')

hr_clock = ECGClock('HR(bpm)', parent_figure=my_fig, subplot=1,min_rad = 40,max_rad = 160)
hr_clock.add_recording('hr/206_hr.csv',filtering = 10,label='patient 206')

#change the range for different type

hr_clock.add_percentile_range('./normal_ranges/HR_LQT2_female.csv',color = 'r',
                              alpha = 0.4, label = "LQT2Female")

dhr_clock = HRDerivClock('dHR/dt (percent/second)', parent_figure = my_fig, subplot =2,
                         min_rad = -1, max_rad = 1, tick_spacing = 1.0)
dhr_clock.add_recording('hr/206_hr.csv',percent = True)
hr_clock.add_legend()
my_fig.save('photos/206hr.png')
```

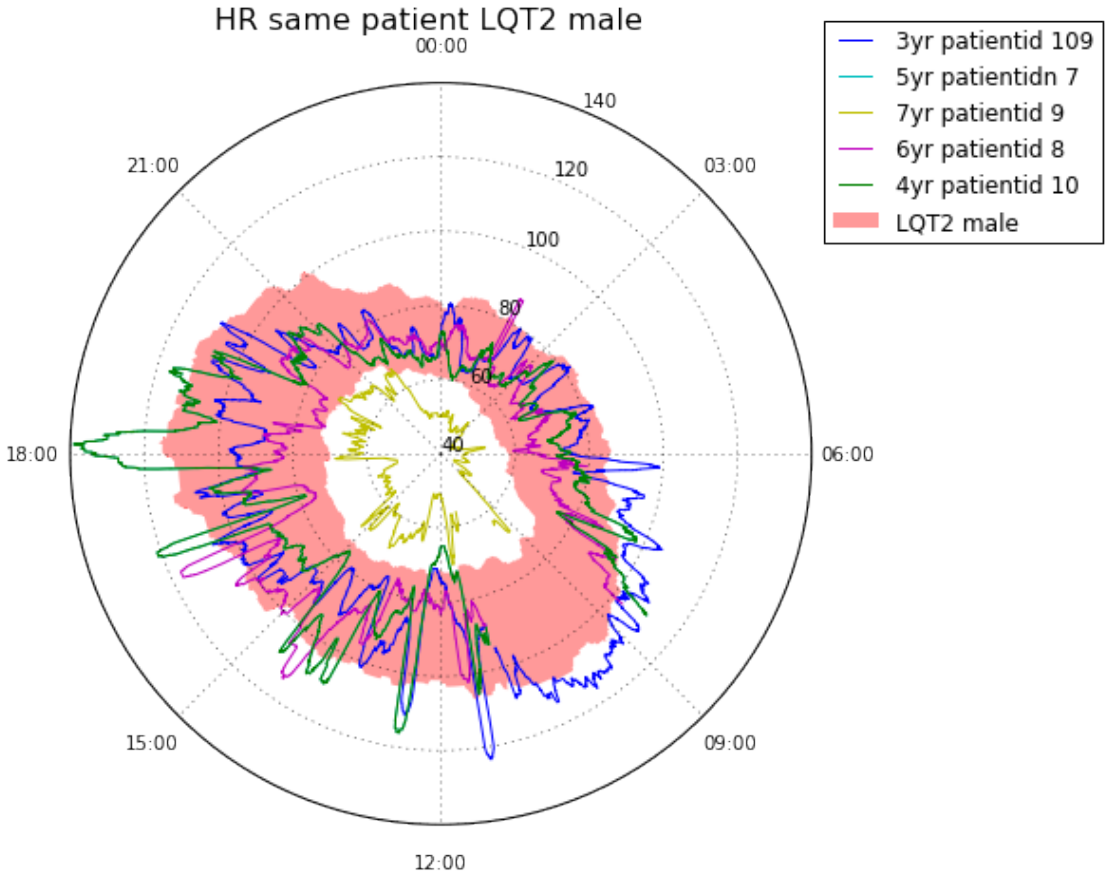



```
In [25]: smoothhr('RRQT/288_rrqt.csv','hr/288_hr.csv',filtering = 20,shifttime = 0)

In [26]: smoothhr('RRQT/268_rrqt.csv','hr/268_hr.csv',filtering = 20,shifttime = 0)

In [27]: smoothhr('RRQT/377_rrqt.csv','hr/377_hr.csv',filtering = 20,shifttime = 0)

In [28]: smoothhr('RRQT/427_rrqt.csv','hr/427_hr.csv',filtering = 20,shifttime = 0)

In [7]: hr_clock = ECGClock('LQT1 female 32yrs vs 14yrs vs 28 yrs vs 3mon', min_rad = 30,max_rad = 170)
        hr_clock.add_recording('hr/288_hr.csv',filtering = 10,label='32yrs patient 288',color = 'b')
        hr_clock.add_recording('hr/268_hr.csv',filtering = 10,label='14yrs patient 268',color = 'c')

        hr_clock.add_recording('hr/377_hr.csv',filtering = 10,label='28yrs patient 377',color = 'y')

        hr_clock.add_recording('hr/427_hr.csv',filtering = 10,label='3mon patient 427',color = 'm')


        #change the range for different type
        hr_clock.add_legend()

        hr_clock.save('photos/hr_LQT1_female.png')
```



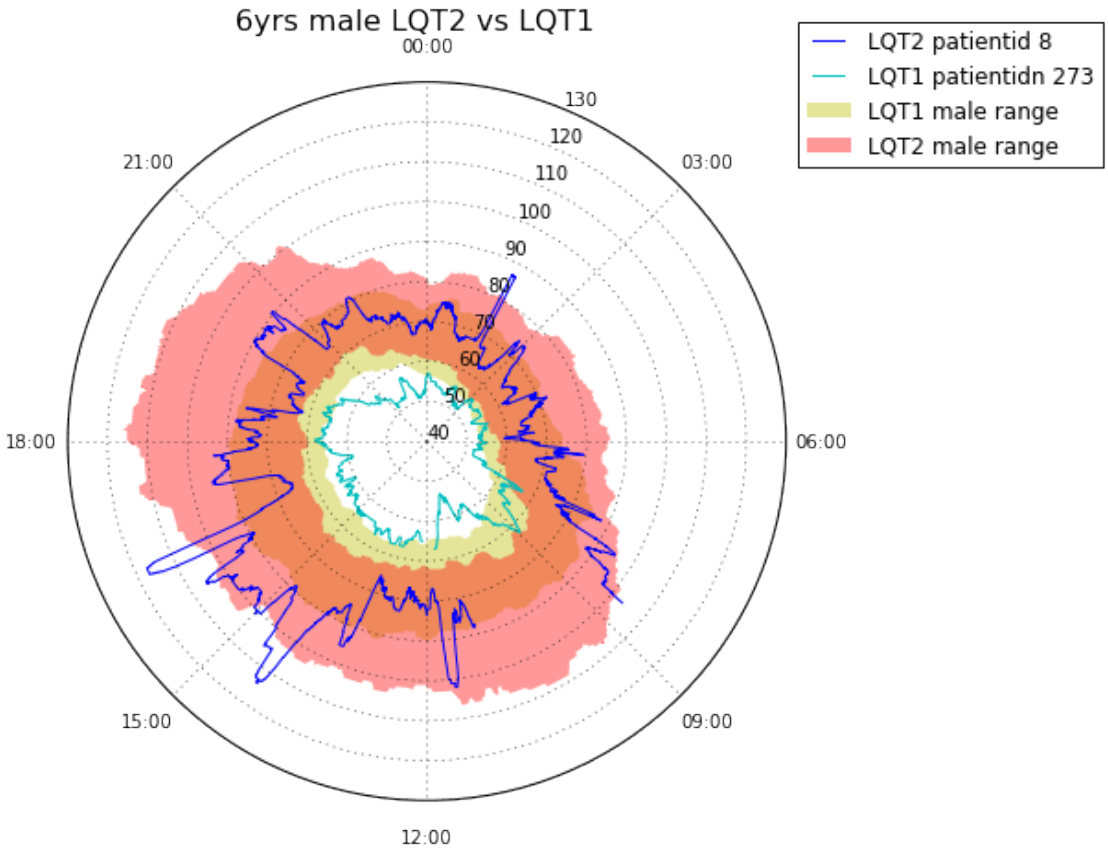

```
In [30]: smoothhr('RRQT/109_rrqt.csv','hr/109_hr.csv',filtering = 20,shifttime = 11)

In [31]: smoothhr('RRQT/10_rrqt.csv','hr/10_hr.csv',filtering = 20,shifttime = 11)

In [32]: smoothhr('RRQT/7_rrqt.csv','hr/7_hr.csv',filtering = 20,shifttime = 11)

In [33]: smoothhr('RRQT/8_rrqt.csv','hr/8_hr.csv',filtering = 20,shifttime = 11)

In [34]: smoothhr('RRQT/9_rrqt.csv','hr/9_hr.csv',filtering = 20,shifttime = 11)

In [35]: hr_clock = ECGClock('HR same patient LQT2 male', min_rad = 40,max_rad = 140)
         hr_clock.add_recording('hr/109_hr.csv',filtering = 10,label='3yr patientid 109',color = 'b')
         hr_clock.add_recording('hr/10_hr.csv',filtering = 10,label='5yr patientidn 7',color = 'c')

         hr_clock.add_recording('hr/7_hr.csv',filtering = 10,label='7yr patientid 9',color = 'y')

         hr_clock.add_recording('hr/8_hr.csv',filtering = 10,label='6yr patientid 8',color = 'm')

         hr_clock.add_recording('hr/10_hr.csv',filtering = 10,label='4yr patientid 10',color = 'g')

         hr_clock.add_percentile_range('./normal_ranges/HR_LQT2_male.csv',color = 'r',
                                       alpha = 0.4, label = "LQT2 male")
         #change the range for different type
         hr_clock.add_legend()
```

```
hr_clock.save('photos/hr_LQT2_male_samepatient.png')
```

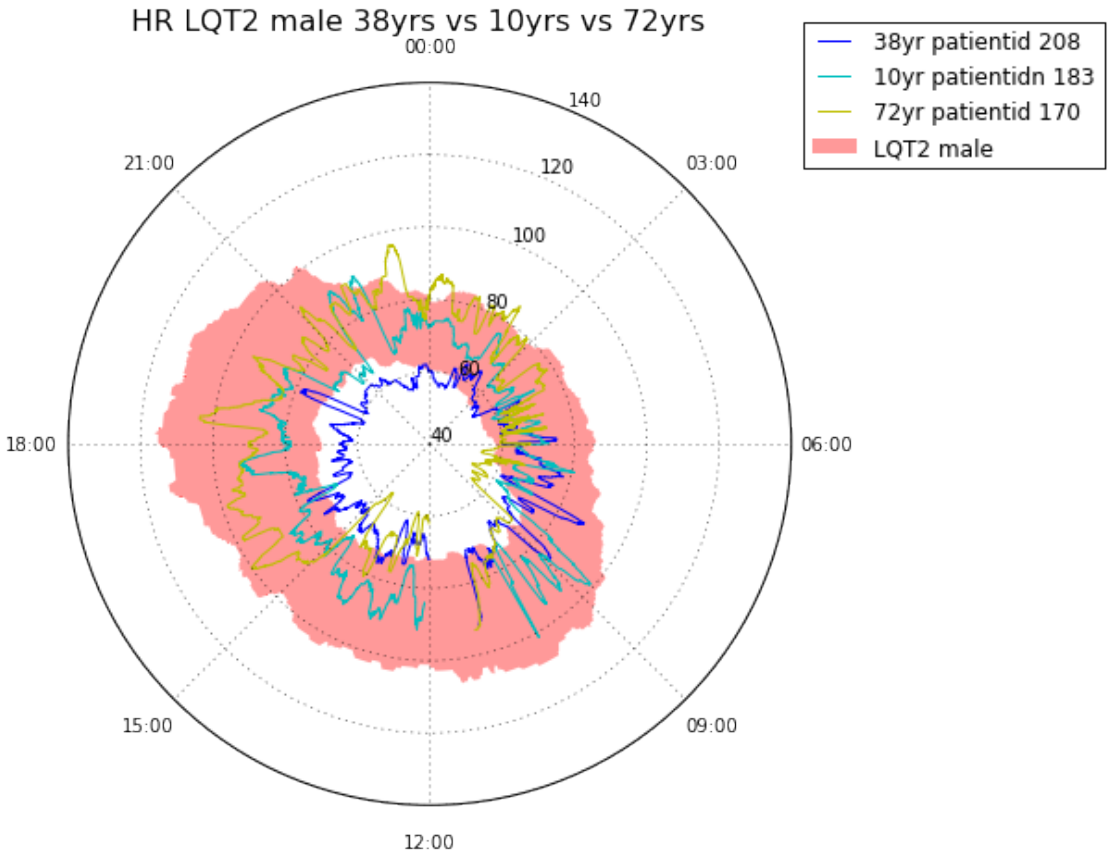



```
In [36]: smoothhr('RRQT/273_rrqt.csv','hr/273_hr.csv',filtering = 20,shifttime = 12)
```

```
In [9]: hr_clock = ECGClock('6yrs male LQT2 vs LQT1', min_rad = 40,max_rad = 130)
        hr_clock.add_recording('hr/8_hr.csv',filtering = 10,label='LQT2 patientid 8',color = 'b')
        hr_clock.add_recording('hr/273_hr.csv',filtering = 10,label='LQT1 patientidn 273',color = 'c')

        hr_clock.add_percentile_range('./normal_ranges/HR_LQT1_male.csv',color = 'y',
                                      alpha = 0.4, label = "LQT1 male range")
        hr_clock.add_percentile_range('./normal_ranges/HR_LQT2_male.csv',color = 'r',
                                      alpha = 0.4, label = "LQT2 male range")
        #change the range for different type
        hr_clock.add_legend()

        hr_clock.save('photos/hr_6yrs_male_LQT2_vs_LQT1.png')
```




```
In [38]: smoothhr('RRQT/208_rrqt.csv','hr/208_hr.csv',filtering = 20,shifttime = 12)

In [39]: smoothhr('RRQT/183_rrqt.csv','hr/183_hr.csv',filtering = 20,shifttime = 12)

In [40]: smoothhr('RRQT/170_rrqt.csv','hr/170_hr.csv',filtering = 20,shifttime = 12)

In [8]: hr_clock = ECGClock('HR LQT2 male 38yrs vs 10yrs vs 72yrs', min_rad = 40,max_rad = 140)
        hr_clock.add_recording('hr/208_hr.csv',filtering = 10,label='38yr patientid 208',color = 'b')
        hr_clock.add_recording('hr/183_hr.csv',filtering = 10,label='10yr patientidn 183',color = 'c')
        hr_clock.add_recording('hr/170_hr.csv',filtering = 10,label='72yr patientid 170',color = 'y')


        hr_clock.add_percentile_range('./normal_ranges/HR_LQT2_male.csv',color = 'r',
                                      alpha = 0.4, label = "LQT2 male")
        #change the range for different type
        hr_clock.add_legend()

        hr_clock.save('photos/hr_LQT2_male_differentages.png')
```


HR LQT2 male 38yrs vs 10yrs vs 72yrs
38yr patientid 208
10yr patientidn 183
72yr patientid 170
LQT2 male
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
140
120
100
80
60
40

In [ ]:

In [ ]: