Supporting information

Nine Orders of Magnitude Dynamic Range: Picomolar to Millimolar Concentration Measurement in Capillary Electrophoresis with Laser Induced Fluorescence Detection Employing Cascaded Avalanche Photodiode Photon Counters

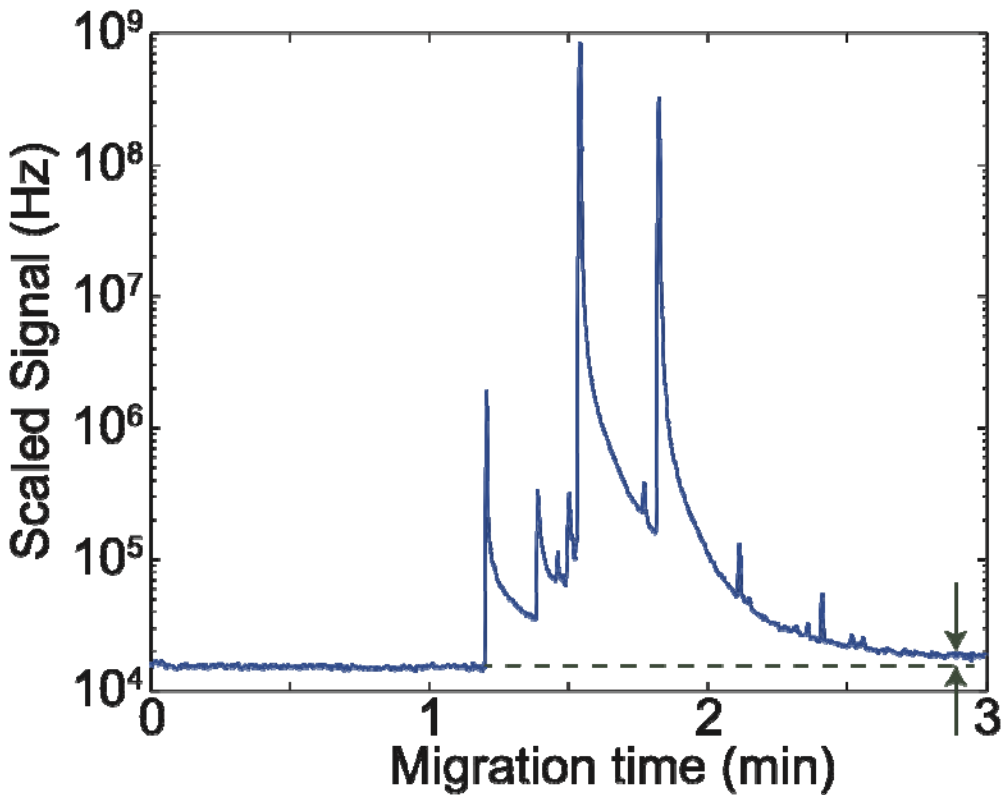

Figure S1. The same data as Figure 2 are presented with a logrithmatic Y axis.

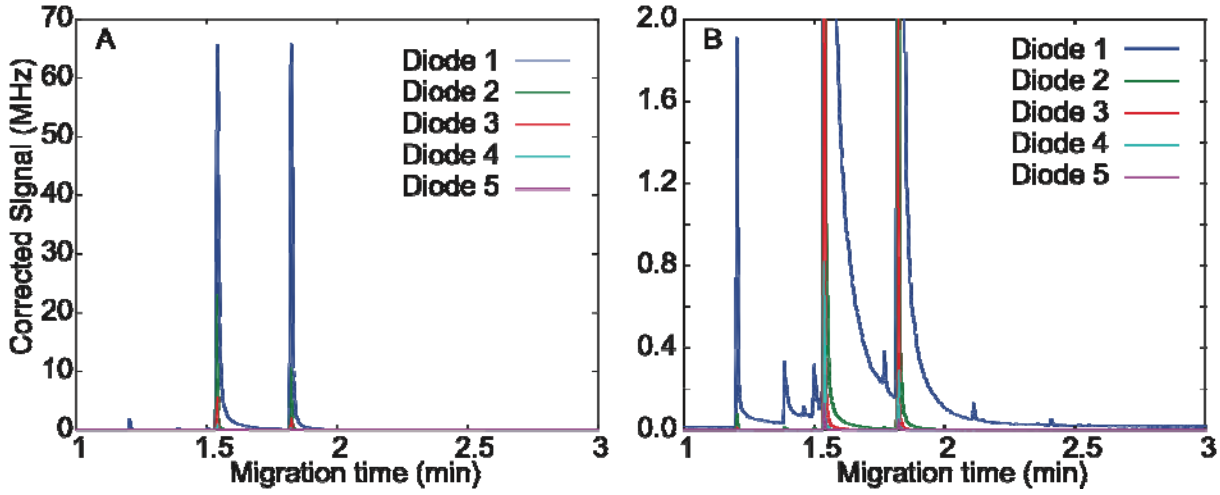

Figure S2. Capillary electrophoresis analysis of a 1 µM solution of TAMRA. The signal is recorded by the five-photodiode instrument of Figure 2 and corrected for detector dead time. Panel A – Data plotted at full scale for Diode 1, which records the least attenuated signal. The data for Diode 1 are severely saturated. Panel B – An expanded view of the data. The data generated by Diode 1 now highlight trace level components while the data from later diodes are within their linear range.

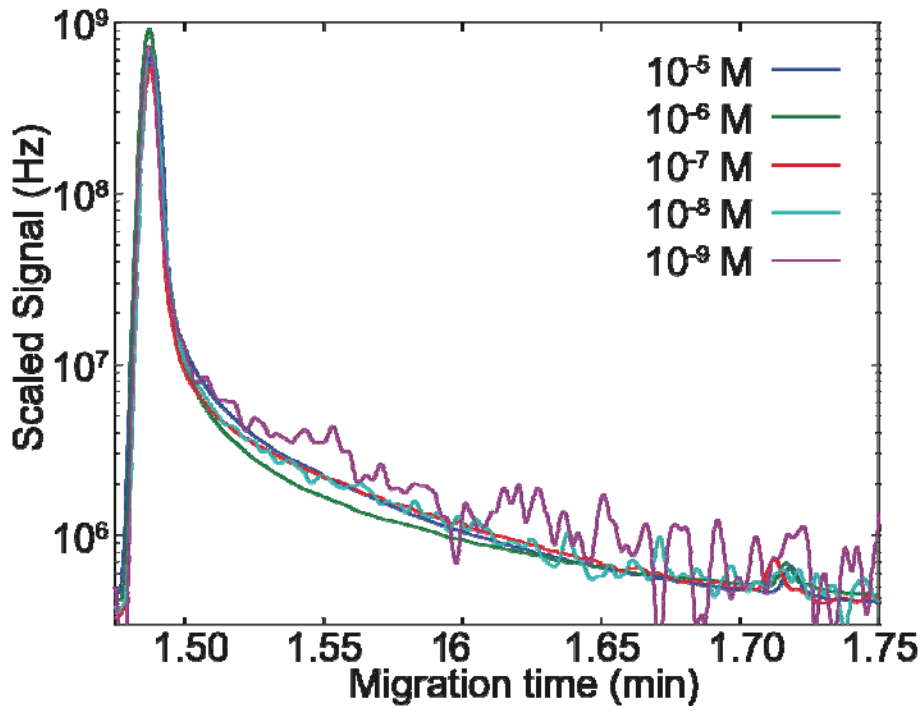

Figure S3. Comparison of the shape of the major peak from 10^{-9} to 10^{-5} M. Data are plotted on a logrithmic Y axis to highlight the long, but low amplitude, tail generated by the peak.

The M-file used to scale data obtained from the cascade of photodetectors.

```
%scale peaks from the wide dynamic range experiment
%input - five diode data (data are assumed to be an N x 5 array)
%output - scaled data
%
%NJD - 2010 December 07
%

function [output] = ScaledRun(FiveDiodeData)

backgrounds=median(FiveDiodeData(1000:3000,:));%this portion of the
electropherogram is featureless
FiveDiodeData=FiveDiodeData-
ones(length(FiveDiodeData),1)*backgrounds;%subtract background before scaling


ScaleFactor = [1, 26, 150, 1e3, 6.5e3];
SeriousSaturationThreshold = 5e6;
ModestSaturationThreshold = 2e6;
SaturationRange= SeriousSaturationThreshold - ModestSaturationThreshold;


%now begin to generate scaled data
Dummy=FiveDiodeData(:,1);%lowest amplitude data from diode 1 will survive
procedure

%replace data when diode 1 is saturated
Peaks=find(FiveDiodeData(:,1)>SeriousSaturationThreshold);%identify data from
Diode 1 that are highly saturated
Dummy(Peaks)=FiveDiodeData(Peaks,2)*ScaleFactor(2);%scale data from Diode 2
for most saturated data
MediumPeaks=find(FiveDiodeData(:,1)<SeriousSaturationThreshold &
FiveDiodeData(:,1)>ModestSaturationThreshold);%identify data that are
moderately saturated
%For moderately saturated data, replace data with a smoothly varying
%combination of Diode 1 and scaled Diode 2
ScaledRatio=(FiveDiodeData(MediumPeaks,1)-
ModestSaturationThreshold)/SaturationRange;
Dummy(MediumPeaks)=FiveDiodeData(MediumPeaks,1).*(1-
ScaledRatio)+(ScaledRatio).*FiveDiodeData(MediumPeaks,2)*ScaleFactor(2);

%repeat when diode 2 is saturated
Peaks=find(FiveDiodeData(:,2)>SeriousSaturationThreshold);
Dummy(Peaks)=FiveDiodeData(Peaks,3)*ScaleFactor(3);
MediumPeaks=find(FiveDiodeData(:,2)<SeriousSaturationThreshold &
FiveDiodeData(:,2)>ModestSaturationThreshold);
ScaledRatio=(FiveDiodeData(MediumPeaks,2)-
ModestSaturationThreshold)/SaturationRange;
Dummy(MediumPeaks)=FiveDiodeData(MediumPeaks,2).*(1-
ScaledRatio)*ScaleFactor(2)+(ScaledRatio).*FiveDiodeData(MediumPeaks,3)*ScaleF
actor(3);

%repeat when diode 3 is saturated
Peaks=find(FiveDiodeData(:,3)>SeriousSaturationThreshold);
Dummy(Peaks)=FiveDiodeData(Peaks,4)*ScaleFactor(4);
MediumPeaks=find(FiveDiodeData(:,3)<SeriousSaturationThreshold &
FiveDiodeData(:,3)>ModestSaturationThreshold);
ScaledRatio=(FiveDiodeData(MediumPeaks,3)-
ModestSaturationThreshold)/SaturationRange;
Dummy(MediumPeaks)=FiveDiodeData(MediumPeaks,3).*(1-
ScaledRatio)*ScaleFactor(3)+(ScaledRatio).*FiveDiodeData(MediumPeaks,4)*ScaleF
```

```
actor(4);

%repeat when diode 4 is saturated
Peaks=find(FiveDiodeData(:,4)>SeriousSaturationThreshold);
Dummy(Peaks)=FiveDiodeData(Peaks,5)*ScaleFactor(5);
MediumPeaks=find(FiveDiodeData(:,4)<SeriousSaturationThreshold &
FiveDiodeData(:,4)>ModestSaturationThreshold);
ScaledRatio=(FiveDiodeData(MediumPeaks,4)-
ModestSaturationThreshold)/SaturationRange;
Dummy(MediumPeaks)=FiveDiodeData(MediumPeaks,4).*(1-
ScaledRatio)*ScaleFactor(4)+(ScaledRatio).*FiveDiodeData(MediumPeaks,5)*ScaleF
actor(5);

%add background back
Dummy=Dummy+backgrounds(1);
output = Dummy;
```